PM

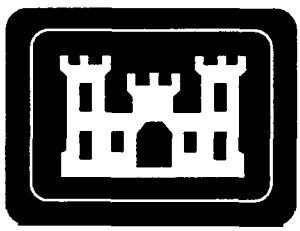
00-2640

FINAL

SLAPS IMPLEMENTATION REPORT

ST. LOUIS, MISSOURI

JUNE 2001



U.S. Army Corps of Engineers
St. Louis District Office
Formerly Utilized Sites Remedial Action Program

FINAL

SLAPS IMPLEMENTATION REPORT

ST. LOUIS, MISSOURI

JUNE 2001

prepared by

U.S. Army Corps of Engineers, St. Louis District Office, Formerly Utilized Sites Remedial Action Program

with assistance from

Science Applications International Corporation
under Contract No. DACW43-00-D-0515, Task Order 0001

TABLE OF CONTENTS

LIST OF APPENDICES
(Appendices are provided on the enclosed CD-ROM)

LIST OF FIGURES
(figures are located at the end of each section)

LIST OF FIGURES (CONT'D)

LIST OF FIGURES (CONT'D)

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AEC	Atomic Energy Commission
AQL	aquatic life
ASL	Any-Use Soil Level
ATV	all terrain vehicle
bgl	below grade level
bgs	below ground surface
cm	centimeter
CME	Central Mine Equipment
COC	contaminant of concern
CP	contiguous property
DCA	1,2-dichloroethane
DCE	1,2-dichloroethene
DOE	Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis Report
EM	Electromagnetic
FS	Feasibility Study
ft	feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
GC/MS	chromatography/mass spectrometry
GPR	ground-penetrating radar
ha	hectares
HISS	Hazelwood Interim Storage Site
HZ	hydrostratigraphic zone
IA	investigation area
IAL	investigative action level
IDW	investigation derived waste
in	inch(es)
IRA	interim remedial action
km	kilometers
LWW	livestock/wildlife watering
m	meters
MCL	maximum contaminant level
MDNR	Missouri Department of Natural Resources
MED	Manhattan Engineer District
mg/kg	milligram per kilogram
mi	miles
mm	millimeter
mM/m	millimhos per meter
MSL	above mean sea level
mV	millivolts
ng/L	nanogram/liter

ACRONYMS AND ABBREVIATIONS (CONT'D)

mg/L	milligrams per liter
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
nT	nanoTeslas
NTU	nephelometric turbidity unit
ohms/mRb	ohms per meterrubidium
OVA	organic vapor analyzer
PAH	polynuclear aromatic hydrocarbon
PAM	Potential Contaminant of Concern Assessment Memorandum
PCB	polychlorinated byphenols
pCi	picocurie
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOC	potential contaminant of concern
PI	Plasticity Index
PID	photoionization detector
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QCSR	Quality Control Summary Report
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
SLS	St. Louis Sites
SOR	sum of ratios
SSHP	Site Safety and Health Plan
SVOC	semi-volatile organic compound
TAL	target analyte list
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TCLP	Toxicity Character Leaching Procedure
TPP	Technical Project Planning
UCL	Upper Confidence Level
USACE	United States Army Corp of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
µ/m	micrometer
µg/L	micrograms per liter

SECTION 1.0

INTRODUCTION

1.0 INTRODUCTION

This document presents the results of implementation of the United States Army Corps of Engineers (USACE) Sampling and Analysis Plan (SAP) [USACE, 1998a] for sampling tasks conducted at the St. Louis Airport Site (SLAPS) property during the summer and fall of 1998 as part of the Formerly Utilized Site Remedial Action Program (FUSRAP). SLAPS and the SLAPS contiguous properties (CPs) are part of the St. Louis FUSRAP North County Site. SLAPS is located approximately 17 miles northwest of downtown St. Louis. The location of SLAPS is shown on Figure 1-1.

The primary focus of the SLAPS sampling work was to provide the necessary data to support ongoing remedial efforts, define the contaminants of concern (COCs) at SLAPS and CPs, and confirm site conditions and assumptions needed to prepare the Feasibility Study (FS) and develop a Record of Decision (ROD) for this site. The extent of the SLAPS investigation area, including CPs, is shown on Figure 1-2. The objectives for the SAP were developed as a result of an on-board Technical Project Planning (TPP) process (USACE, 1995) which included USACE, regulatory agencies [United States Environmental Protection Agency (USEPA) Region VII and Missouri Department of Natural Resources (MDNR)], and other stakeholders. After approval by USACE, SLAPS field activity commenced in April 1998 and proceeded until December 1998.

The purpose of this SLAPS Implementation Report is to provide the results of the investigations including the soil boring, well drilling, and geophysical surveys. The objectives identified in the SAP (USACE, 1998a) were:

1. Collection of data to support interim remedial actions (IRAs).

2. Collection of data to provide information on contaminant transport and limits of migration for contaminants.

3. Collection of data to support contaminant boundary determination in both the horizontal and vertical axes.

1.1 SITE HISTORY

Between 1946 and 1966, SLAPS was used to store Manhattan Engineer District (MED)/Atomic Energy Commission (AEC) residue material generated by uranium separation processes at the St. Louis Downtown Site (SLDS). This residue material included solids from the neutralization and filtration of ore raffinate, which was stored on the ground, and radium-bearing residues, which were stored in drums (Figure 1-3). Barium cake residue was also stored on the ground at the site. Other wastes brought to SLAPS included used dolomite liner and recycled magnesium fluoride liner; tailings from a process used to recover uranium from magnesium fluoride slag; 50,000 empty drums; 3,500 tons of radioactively contaminated metal scrap; 2,400 drums containing miscellaneous residues; uranium-containing sand; and radioactive scrap materials. Some of these materials were buried in pits dug on the site.

MED acquired SLAPS in 1946, and used the site to store uranium-bearing residues from SLDS from 1946 until 1966. In 1966, these residues were purchased by Continental Mining and Milling Company of Chicago. By 1967, the stored residues had been moved by Continental Mining and Milling from SLAPS to another site located at 9200 Latty Avenue in Hazelwood, Missouri, for subsequent shipment to Canon City, Colorado. Some barium sulfate material remaining at 9200 Latty Avenue was taken to a landfill in western St. Louis County. After most of the residuals had been removed from SLAPS, site structures were demolished and buried on the property along with approximately 60 truckloads of scrap metal and a vehicle that had become contaminated (USEPA, 1989). Clean fill material was spread over the disposal area from 0.3 to 1.0 meters (m) [1 to 3 feet (ft)] to achieve surface radioactivity levels acceptable at that time. In 1973, the United States Government and the City of St. Louis agreed to transfer ownership of SLAPS by quitclaim deed from AEC to the City of St. Louis Airport Authority. The City of St. Louis Airport Authority remains the owner of the property.

Several CPs beyond SLAPS were included in the investigation. These areas include the ballfields located immediately north of SLAPS across McDonnell Boulevard; Coldwater Creek and the original flood plain located along the northern side of the creek; a portion of the airport property and Banshee Road located just south of the railroad and SLAPS; The Norfolk and Western Railroad which runs along the southern boundary of SLAPS; McDonnell Boulevard which runs along the northern boundary of SLAPS; and a portion of the Boeing parking lot located across Coldwater Creek to the west of SLAPS. The CPs were investigated due to known or suspected contaminant migration pathways. These migration pathways include wind deposition, surface drainage and overland flow, flooding, ground-water movement, and spillage during waste transportation.

1.2 HISTORICAL AERIAL PHOTOGRAPHY

Aerial photography records were researched to provide photo documentation of site activities. Figure 1-4 through 1-14 provides a chronology of the site from 1937 to 1993. The photographs are registered to the current site features and have been manipulated to approximate orthogonal aerial photographs. Significant photographic distortion occurred while manipulating Figure 1-6.

1.3 PREVIOUS REPORT INVESTIGATIONS

Various documents and reports have been generated for the SLAPS and CPs. This investigation relied heavily on five major documents. Although also contained in the references section, they are listed below:

1. Remedial Investigation Report for St. Louis Site, DOE/OR/21949-280, BNI, January 1994.

2. Remedial Investigation Addendum Report for the St. Louis Site, St. Louis, Missouri, DOE/OR/21950-132, SAIC, September 1995.

3. Site Safety and Health Plan (SSHP) for Site Activities at the St. Louis Airport Site, USACE, January 2000.

4. Quality Assurance Project Plan (QAPP) for the St. Louis Site and Contiguous Properties, SAIC, June 1998.

5. Sampling and Analysis Plan (SAP) for the St. Louis Airport and Downtown Sites, USACE, June 1998.

1.4 CURRENT SITE CONDITIONS

SLAPS and the Lambert-St. Louis Airport are owned by the City of St. Louis. Planning and zoning for SLAPS are governed by the adjacent City of Berkeley. SLAPS is currently zoned "M-1" (Light Industrial). This category allows for the full range of light industrial uses, such as building material storage yards, utility substations, wholesale warehouses, and some manufacturing activities. Limited commercial uses include offices, financial institutions, and training academies (Zoning Code, City of Berkeley, Section 23.12.1). The south-central and eastern portions of the property are in the approach zones of runways 17 and 24, respectively, of the adjacent Lambert-St. Louis International Airport (BNI, 1994). This proximity to the airport imposes additional restrictions on SLAPS related to noise from aircraft and height restrictions in the approach zones. The portion of the site adjacent to Coldwater Creek is zoned "M-1/FP," which indicates that it is also located within the flood plain district.

More than two-thirds of the land within 0.8 kilometers (km) [0.5 miles (mi)] of SLAPS is used for transportation-related purposes, because of its proximity to the airport. The remaining land is used for commercial and industrial purposes. The nearest residential properties to SLAPS are located approximately 0.6 km (0.4 mi) to the northeast on Frost Avenue in the City of Berkeley. Information presented in the *Remedial Investigation Report for the St. Louis Site* (BNI, 1994) indicates that another population center (75 to 100 people) is located approximately 0.8 km (0.5 mi) west of the property. The next nearest is approximately 1.6 km (1 mi) northwest of SLAPS along Chapel Ridge Drive, with about 1,500 people. Most of the Hazelwood population is north of Interstate 270 (I-270), more than 2.4 km (1.5 mi) north of SLAPS.

Land in the immediate vicinity of SLAPS is not used for agricultural purposes, although some agricultural use was observed along Hazelwood Avenue. As shown on Figure 1-2, SLAPS is bounded on the north and east by McDonnell Boulevard. South of SLAPS is the Norfolk and Western Railroad, then Banshee Road, and the Lambert-St. Louis International Airport. West of SLAPS is Coldwater Creek and the Boeing property. Additional information on land use in the area is presented in the *Remedial Investigation Report for the St. Louis Site* (BNI, 1994) and the *Feasibility Study/Environmental Impact Statement for the St. Louis Site* (DOE, 1994).

SLAPS covers 8.8 hectares (ha) (22 acres) and is surrounded by chain link security fencing. A municipal water line runs along the northern boundary of SLAPS, and a gas line crosses the northwest corner and runs parallel to the property on the north side of McDonnell Boulevard. At the time of the fieldwork there were overhead utility lines on the western end of SLAPS.

The pre-remediation activity elevation at SLAPS varies from approximately 155 to 161 m (510 to 530 ft) from east to west, and the land surface ranges from 4.5 to 6 m (15 to 20 ft) above Coldwater Creek (BNI, 1994). Generally, the property surface is flat; however, because the fill placed over the property in the early 1970s was not spread evenly, compaction, differential settling, and erosion have created an irregular surface (BNI, 1994). The 100-year flood level at SLAPS is 159 m (522 ft) above mean sea level (MSL) (FEMA, 1983). The ballfields cover approximately 32 ha (80 acres) of an abandoned former recreational area. This area was constructed on former lowlands, which were filled with various fill materials.

Coldwater Creek flows for 153 m (500 ft) along the western border of SLAPS. The creek originates 5.8 km (3.6 mi) to the south of SLAPS and continues for 24 km (15 mi) in a northeasterly direction through Hazelwood, Florissant, and unincorporated areas of the county, and along the northern edge of the unincorporated community of Black Jack, until it discharges into the Missouri River. The creek, with the exception of the 1.2 mi it travels under the airport, is accessible to the public (SAIC, 1992).

Coldwater Creek is classified by the MDNR as a Class "C" waterway downstream of SLAPS. Class C waters are streams that may cease flow in dry periods but maintain permanent pools which support aquatic life. Flooding in Coldwater Creek occurs annually. Coldwater Creek is protected downstream of SLAPS from I-270 to its mouth for livestock/wildlife watering (designation LWW) and aquatic life (designation AQL) usage.

The water quality in Coldwater Creek is generally poor. Storm water runoff, primarily from industrial properties and SLAPS, flows into Coldwater Creek. Only one National Pollutant Discharge Elimination System (NPDES)-permitted discharge is known to enter the creek upstream of SLAPS. This discharge is from Lambert-St. Louis International Airport. The nearest known downstream NPDES-permitted discharge to the creek is from the Hazelwood Interim Storage Site (HISS).

Implementation of the SAP began in April 1998 with mowing of the SLAPS area within the security fencing and cutting of small saplings and heavy growth with hand tools. No earthmoving was performed as part of this work scope. Geophysical surveys were performed following the hand clearing, followed by soil sampling using hand tools, followed by mobilization of soil boring rigs. Field activity by Science Applications International Corporation (SAIC) was suspended in September 1998, awaiting completion of various construction activities being performed by others and resolution of access agreements for CPs.

USACE construction of a rail spur at SLAPS began in June 1998 and continued throughout the summer. Contractors also began construction of runoff control features at the north ditch, and east and west end of the site in late summer 1998. The primary catchment basin on the western edge of SLAPS is lined with an impermeable liner to limit infiltration and recharge of the shallow soils at SLAPS. Excavation and removal of impacted soils has occurred at the east end, along the north ditch, and in the area of the radium pits.

1.5 PROJECT OBJECTIVES

The following project objectives were stated for the SAP in the TPP meetings of February 1998:

1. Collection of data to support interim remedial actions;

2. Collection of data to support the SLAPS FS and ROD;

3. Collection of data to support a Potential Contaminant of Concern Assessment Memorandum (PAM); and

4. Collection of health and safety data.

Soil samples from SLAPS were collected and analyzed for radionuclides, and selected samples were analyzed for chemical parameters, including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, herbicides, polychlorinated byphenols (PCBs), and target analyte list (TAL) metals. Toxicity Character Leaching Procedure (TCLP) analyses were performed on selected soil samples to support disposal decisions. Additional information concerning the criteria used to select soil sampling locations is presented in Section 2.2.1.

1.6 SITE SOILS

The soils over the St. Louis North County Site are predominately silty deposits that originated from former glacial advances, historical Missouri and Mississippi River flooding, and more recent fill activities. The soil types mapped over SLAPS and adjacent areas by the Soil Survey of St. Louis County and St. Louis City, Missouri (USDA-SCS, 1982), are predominantly the Nevin silt loam, the Nevin-Urban land complex, and the Menfro silt loam. According to the Unified Soil Classification System (USCS), a silt loam texture would be considered an ML or CL classification, depending upon the amount of clay in the soil. A CL classified soil has higher clay content than an ML classification.

The Nevin silt loam is a nearly level, somewhat poorly drained soil located in moderately wide to wide depressional (formerly glacial lake) basins on uplands. This loam has formed in silty loess and lacustrine deposits. The Menfro silt loam is a gently to moderately sloping, well-drained soil located on ridge tops and side slopes of uplands and has formed in loess deposits in these adjacent upland areas. The Nevin-Urban land complex consists of intermingled areas of native Nevin soils and disturbed soils that have been developed and built upon. The complex may have had fill material placed to improve surface drainage.

The Nevin silt loam soils and undisturbed areas of Nevin soils within the Nevin-Urban land complex typically have a very dark gray to black surface layer of silt loam approximately 28 centimeters (cm) [11 inches (in)] thick. The first subsurface layer is a very dark gray to black silt loam about 33 cm (13 in) thick. The subsoil is a mottled dark grayish-brown and yellowish-brown, silty clay loam and silt loam about 53 cm (21 in) thick. The substratum (parent material) to

a depth of about 1.5 m (60 in) is light brownish-gray, mottled silt loam. The soil permeability is moderate, surface run-off is slow, and the available water capacity is very high. A seasonal high water table may be apparent at a depth of 0.6 to 1.2 m (2 to 4 ft) below the soil surface during winter and early spring if the soil is not frozen. The Menfro silt loam soils typically have a surface layer of brown silt loam about 18 cm (7 in) thick, a subsurface layer of brown silt loam about 15 cm (6 in) thick, and a subsoil of brown silty clay loam about 107 cm (42 in) thick. The substratum (parent material) to a depth of about 150 cm (60 in) is yellowish-brown silt loam. The soil permeability is moderate, and surface run-off is medium. This soil also has a very high available water capacity (USDA-SCS, 1982).

1.7 SITE GEOLOGY

SLAPS is situated on a modest upland area between the Missouri and Mississippi River flood plains in northern St. Louis County. The upland area surrounds a topographic depression known as the Florissant Basin. Pleistocene sediments and recent fill overlay shale and limestone bedrock. Faulting is not evident at the site, and bedrock at depth appears to be almost flat, dipping regionally at a rate of 11 m/km (60 ft/mi) to the north-northeast. Pleistocene sediments and recent fill overlie shale and limestone bedrock. An erosional buried valley system has been interpreted at the site. Illinoian glaciation formed an ice dam east of the Florissant Basin, effectively blocking flow of a paleo-creek and allowing accumulation of lacustrine and wind blown sediments in the subsequently formed paleo-lake.

The site stratigraphy at SLAPS and CPs (Figure 1-15) is divided into six units: a fill layer, three discontinuous units of soil materials ranging in thickness from 15.2 to 24.4 m (50 to 80 ft), and two bedrock units underlying the soils.

The top fill layer (Unit 1) consists of fill material with intermixed rebar, scrap metal, reinforced concrete, and slag within loose to compacted silt, sand, and gravel. The three units underlying Unit 1 represent loess, lake and glacial sediments. Boring logs identify each unit as having a thickness between 2 and 9 m (7 to 30 ft). The uppermost unit beneath the fill is loess (Unit 2). Accumulation of the loess is attributed to windborne sediment being deposited in a paleo-lake within the Florissant Basin. Beneath the Unit 2 loess is the clayey Unit 3, which is subdivided into top (3T), middle (3M), and bottom (3B) subunits.

Pleistocene loess and glacial lacustrine deposits underlie the fill (Units 2, 3, and 4). Unit 2 corresponds to wind deposited loess. Unit 3, which is subdivided into Subunits 3T, 3M, and 3B, consists primarily of clay and silt lacustrian (lakebed) deposits. Unit 4 consists of clayey gravel with increasing fine- to very-fine sand and sandy gravel near the bedrock contact. The coarse-grained nature of some of the sediments that make up Unit 4 suggests deposition was in a high-energy environment.

Subunit 3T directly overlies Subunit 3M. Beneath the SLAPS footprint, the 3T Subunit varies in thickness from 3 to 8 m (9 to 27 ft). The next unit is Subunit 3M, which is approximately 9 m (30 ft) thick on the western edge of the ball fields, and thins to the east, finally pinching out near the eastern edge of SLAPS. Subunit 3B directly underlies Subunit 3M. It is continuous beneath SLAPS and thickens towards the east. The various clayey subunits of Unit 3 are typical of

sediments deposited in lacustrine environments. The lowest unit (Unit 4) is clayey gravel with an increasing amount of fine- to very fine-grained sand and occasional sandy gravel at the contact with limestone bedrock. This unit is interpreted to be approximately 2 to 5 m (5 to 15 ft) thick and thins eastward, and is absent beneath the eastern part of SLAPS, where the 3T, 3M, and 3B drape, or onlap, onto the shale bedrock.

Bedrock at the site consists of Pennsylvanian sandstones, shales, and siltstones (Unit 5) or Mississippian limestone (Unit 6). Unit 5 is identified as a shale member of the Cherokee Group. Depth to bedrock ranges from 16.5 m (55 ft) on the eastern side of SLAPS to a maximum of 27 m (90 ft) near Coldwater Creek.

Two cross sections have been generated to show the relationships between the lithostratigraphic zones, the hydrostratigraphic zones (HZs) and the site surface features. Figure 1-16 depicts a west to east cross section (A-A') constructed parallel to Banshee Boulevard. The cross section utilizes litholgy information collected during installation of monitoring wells and soil sampling borings. This section illustrates the presence of the shale bedrock at the eastern third of the site, and the onlapping of the 3M and 3T Units onto the shale. The pinchout of Unit 4 is also projected in the vicinity of the shale limestone contact. Figure 1-17 illustrates a south to north cross section which intersects Coldwater Creek. This cross section illustrates the lateral persistence of the 2, 3T, 3M, and 3B lithostratigraphic units. Thickening and thinning of Unit 4 is also apparent.

1.8 SITE HYDROGEOLOGY

Five HZs have been identified beneath SLAPS on the basis of different ground-water flow and chemical characteristics. As would be expected, there is overlap between the HZs and the stratigraphic units. The differing lithologies described above impart different hydraulic properties to the stratigraphy. The HZs are: HZ-A which corresponds to stratigraphic Units 1, 2, and 3T; HZ-B which corresponds to stratigraphic Unit 3M; HZ-C which corresponds to stratigraphic Units 3B and 4; HZ-D which corresponds to shale Unit 5; and HZ-E which corresponds to limestone bedrock Unit 6. In general, HZ-A through C have low average vertical hydraulic conductivities ranging from 2.5×10^{-6} cm/s in HZ-A to 5.5×10^{-8} cm/s in HZ-B. The low hydraulic conductivities in these hydrostratigraphic units are regularly manifested by slow recharge rates in monitoring wells screened in them.

Forty-eight ground-water wells were installed from 1979 to 1992 at SLAPS and surrounding properties. Seven of these were decommissioned in 1997 and 1998. Four additional wells were installed in 1998. Four new wells were installed in 1999, two just south of SLAPS and two at the west end of SLAPS.

Thirty-two monitoring wells penetrated HZ-A. These wells penetrate stratigraphic Units 1 and 2, but do not penetrate the entire 3M Unit. Sixteen wells were completed beneath the 3M Unit. Fourteen are in the silty clay and clayey gravels of HZ-C (stratigraphic Units 3B and 4). Two were completed in HZ-D, the shale bedrock occurring beneath the eastern end of the site.

Potentiometric maps for zone HZ-A are presented for calendar years 1998, 1999, and 2000 in Figures 1-18 through 1-23. Assuming isotope media, the flow paths are interpreted to be

perpendicular to ground-water equipotential contours. The depth to ground water ranges between 1 and 7 m (3 to 23 ft) beneath the site. Ground-water flow in HZ-A is westerly to north westerly towards Coldwater Creek at a fairly uniform gradient, and ground-water of HZ-A is interpreted to discharge into Coldwater Creek.

Potentiometric surfaces maps for the deep ground-water zone (HZ-C, HZ-D, and HZ-E) have been created for calendar years 1998, 1999, and 2000 (Figures 1-24 through 1-29). The 1997 through 2000 maps only utilize wells screened within lithologic Unit 4. A review of the screened intervals in the deep borings indicated many screened intervals crossed several lithologic units and HZs. Wells with screened intervals entirely within Unit 4 were chosen as representative of the deep potentiometric surface. While this reduces the number of data points, it provides a higher confidence in the potentiometric surfaces. Flow paths are interpreted to be perpendicular to ground-water equipotential contours. The flow in HZ-C is north to northeasterly. The equipotential contours are not influenced by the Coldwater Creek drainage, implying that HZ-C is not contributing to flow of the creek. In the vicinity of Coldwater Creek, the equipotential contours of HZ-C are at elevations between 510 and 520 ft/msl, while the thalweg of Coldwater Creek is between 510 and 490 ft, further supporting the lack of contaminant migration from surface water and HZ-A to HZ-C in this area. Lithostratigraphic Unit 3B functions as a confining layer for HZ-C. The shallow ground water of HZ-A does not have direct connection with the aquifer HZ-E. HZ-C's Unit 4 gravel are recognized as the surrogate, recoverable water for the North County St. Louis Sites.

Recharge to the ground water occurs from precipitation, off-site inflow of ground water, and creek bed infiltration during high creek stage. Discharge may occur by seepage into Coldwater Creek during low creek stage (BNI, 1994). The vertical ground-water flow direction varies beneath the site and is influenced by stratigraphic heterogeneity and seasonal fluctuations in recharge and evapotranspiration. Based on the calendar year 2000 maps, the HZ-A ground-water surface tends to be higher in the spring and summer and lower in the fall and winter, ranging from 1 m to more than 5 m below existing grade.

In summary the two main conclusions can be drawn based on the geology and the hydrogeology:

- Lithologic data: a highly impermeable clay aquitard (Unit 3M) separates the upper ground-water system from the underlying ground-water zones. The geometric mean vertical hydraulic conductivity of the Unit 3M aquitard, based on laboratory tests, is 3.1×10^{-8} cm/s (BNI, 1994; USACE, 2000). The underlying silty clay layer Unit 3B (geometric mean vertical hydraulic conductivity $=3.1\times10^{-7}$ cm/s) provides an additional barrier to vertical contaminant migration. Most chemical species will sorb to some extent to the clay particles
- Ground-water modeling results indicate the peak contaminant concentrations reaching HZ-E are well below risk levels (BNI, 1996). The rate of vertical contaminant movement suggests times exceeding 1,000 years to reach the Limestone Aquifer. This arrival period assumes continued soils contamination. There are several reasons to suggest that the arrival periods for contaminants to reach HZ-E are longer than 1,000 years. Soil source-term removal would lengthen the arrival period and would reduce the concentrations reaching HZ-E.

SECTION 1.0

FIGURES

TABLE OF CONTENTS

(a brief description is included for Figures 1-4 through 1-14)

Figure 1-11. Oct. 10 1965 Aerial Photo
Description: Activities continue inside fenceline at SLAPS. Buildings still in place. Prominent scar in drainageway in central area of ballfields. A small building has been built on the Eva Road loadout area.

Figure 1-12. May 4 1971 Aerial Photo
Description: No buildings visible inside fenceline. Road network removed. Boundaries between work areas no longer sharp. Boundaries between light and dark scarring are irregular and uneven. Ballfield access road is built. Ballfields appear active. Meanders of Coldwater Creek downstream of bridge appear to be filled in and much vegetation has been cleared along drainageways. The McDonnell Boulevard north ditch is uniform in width, which implies some regrading has been performed.

Figure 1-13. Oct. 8 1980 Aerial Photo
Description: No activity within fenceline at SLAPS. Ballfields are active. Large scars at pistol range (northeast corner of ballfields). Pistol range structures in place. Regrading and clearing performed north of Coldwater Creek.

Figure 1-14. Oct. 22 1993 Aerial Photo
Description: No activity within fenceline at SLAPS. Ballfields are no longer active.

Figure 1-15. Generalized Stratigraphic Column for SLAPS

Figure 1-16. SLAPS Geologic Cross Section A-A'

Figure 1-17. SLAPS Geologic Cross Section B-B'

Figure 1-18. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1997

Figure 1-19. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1998

Figure 1-20. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1998

Figure 1-21. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1999

Figure 1-22. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1999

Figure 1-23. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 2000

Figure 1-24. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1997

Figure 1-25. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1998

Figure 1-26. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1998

Figure 1-27. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1999

Figure 1-28. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1999

Figure 1-29. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 2000

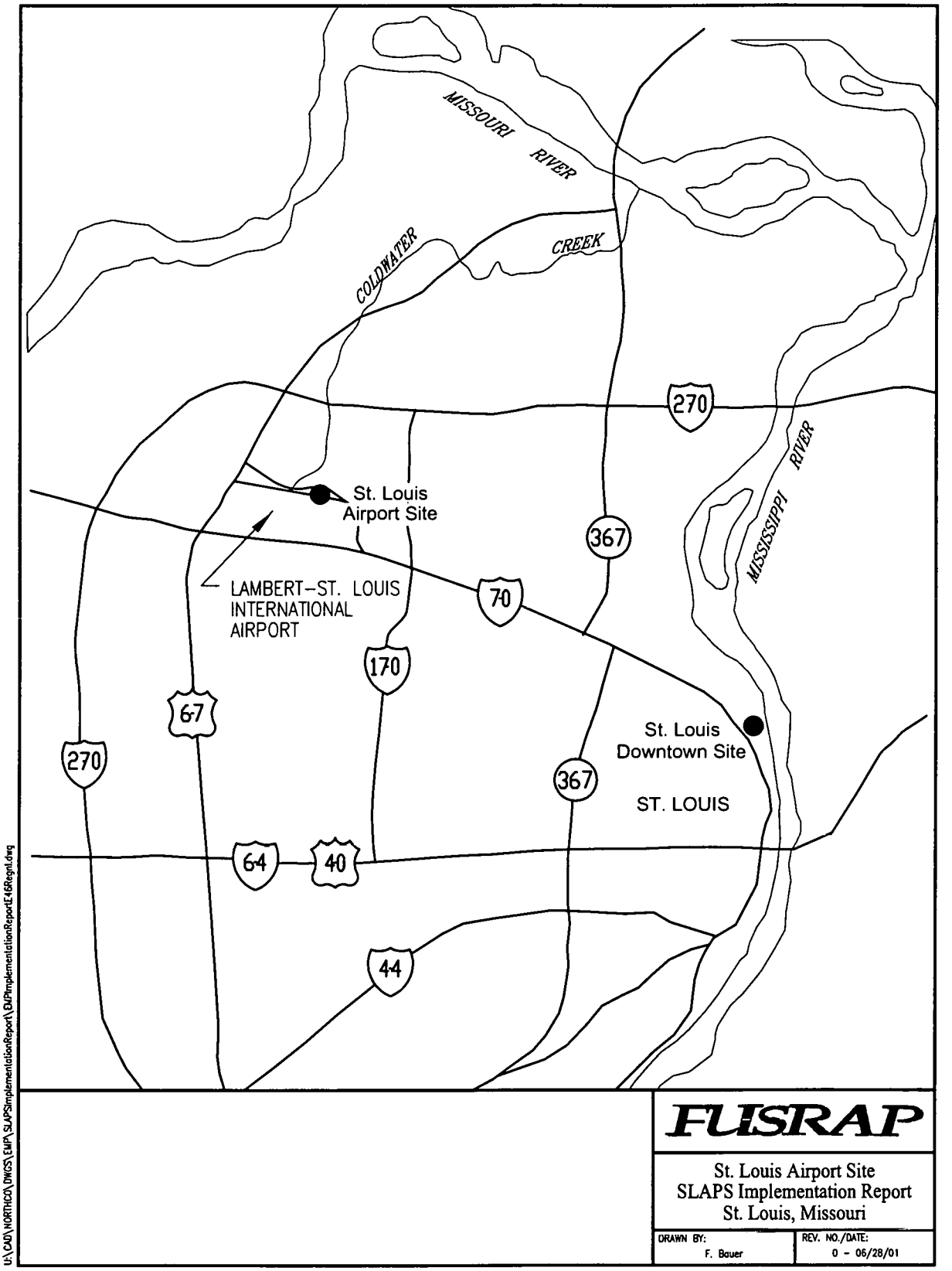


Figure 1-1. SLAPS Location Map

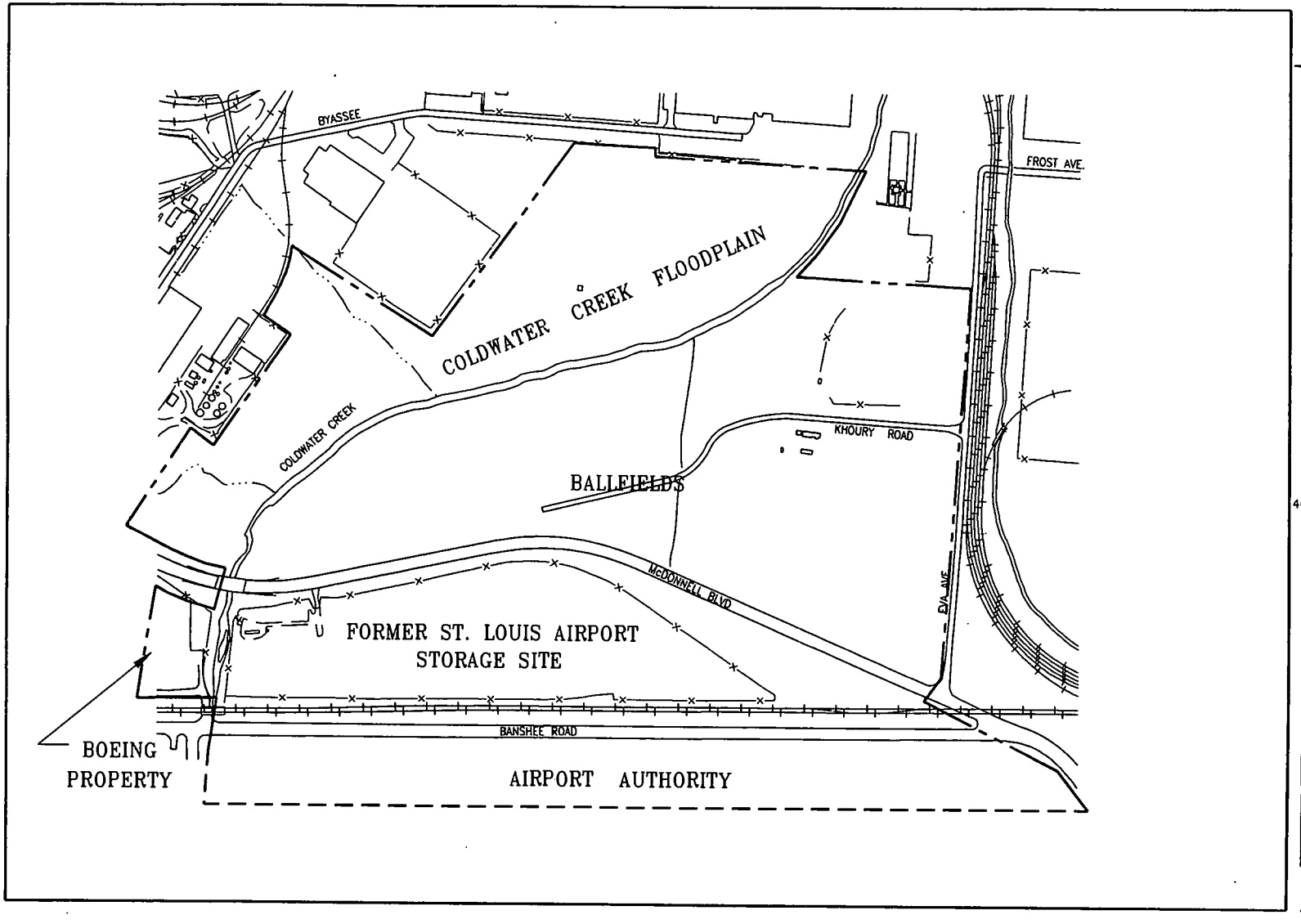


Figure 1-2
Extent of Investigation

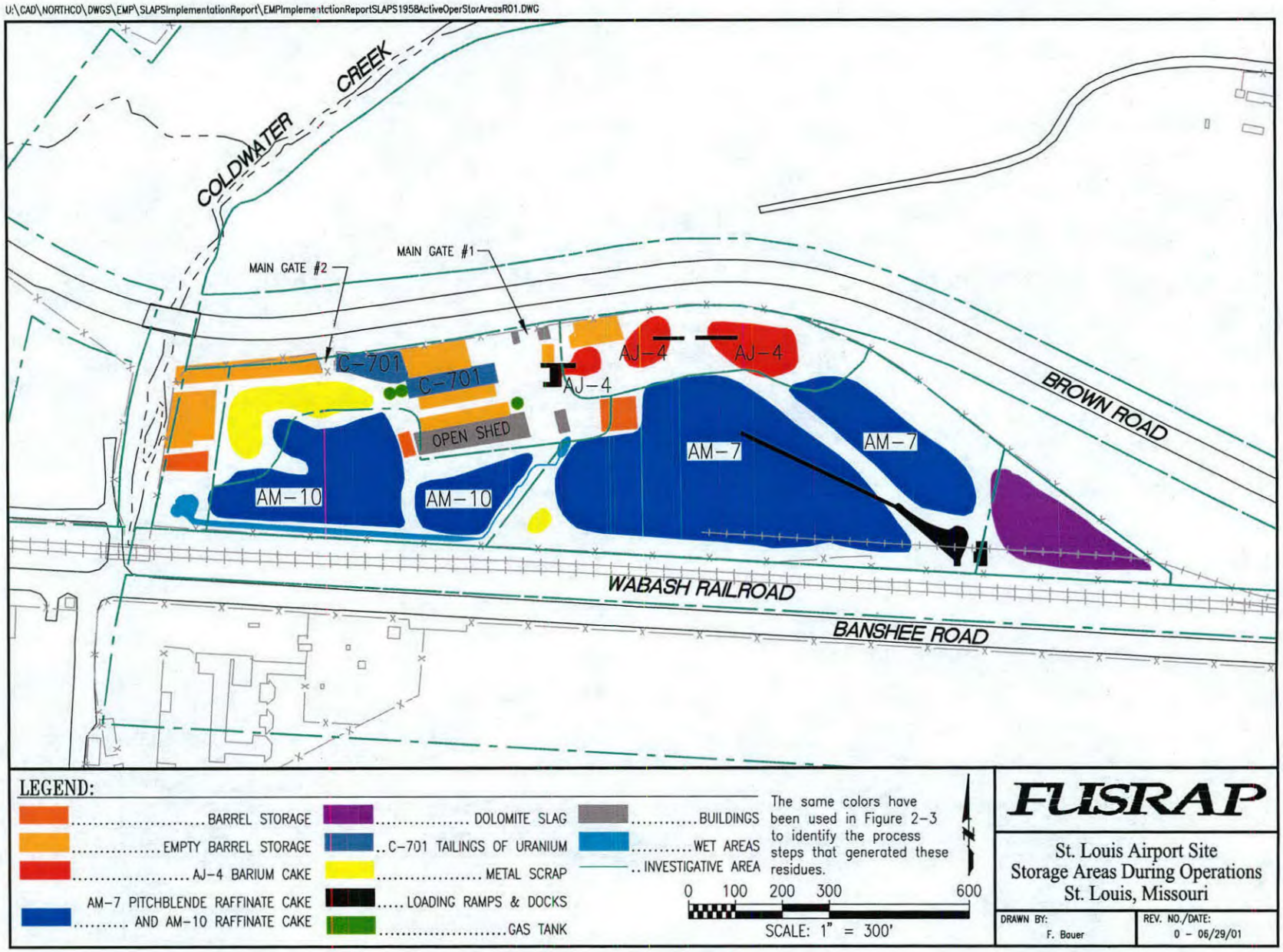


Figure 1-3. SLAPS Areas of Former Use

\\HELMSD\C:\STLOUIS\PROJECTS\AERIALPHOTO00.APR

Figure 1-4. Sept. 17 1937 Aerial Photo

Figure 1-5. July 29 1941 Aerial Photo

Figure 1-6. May 12 1951 Aerial Photo

\\HELMSD\C:\STLOUIS\PROJECTS\AERIALPHOTO00.APR

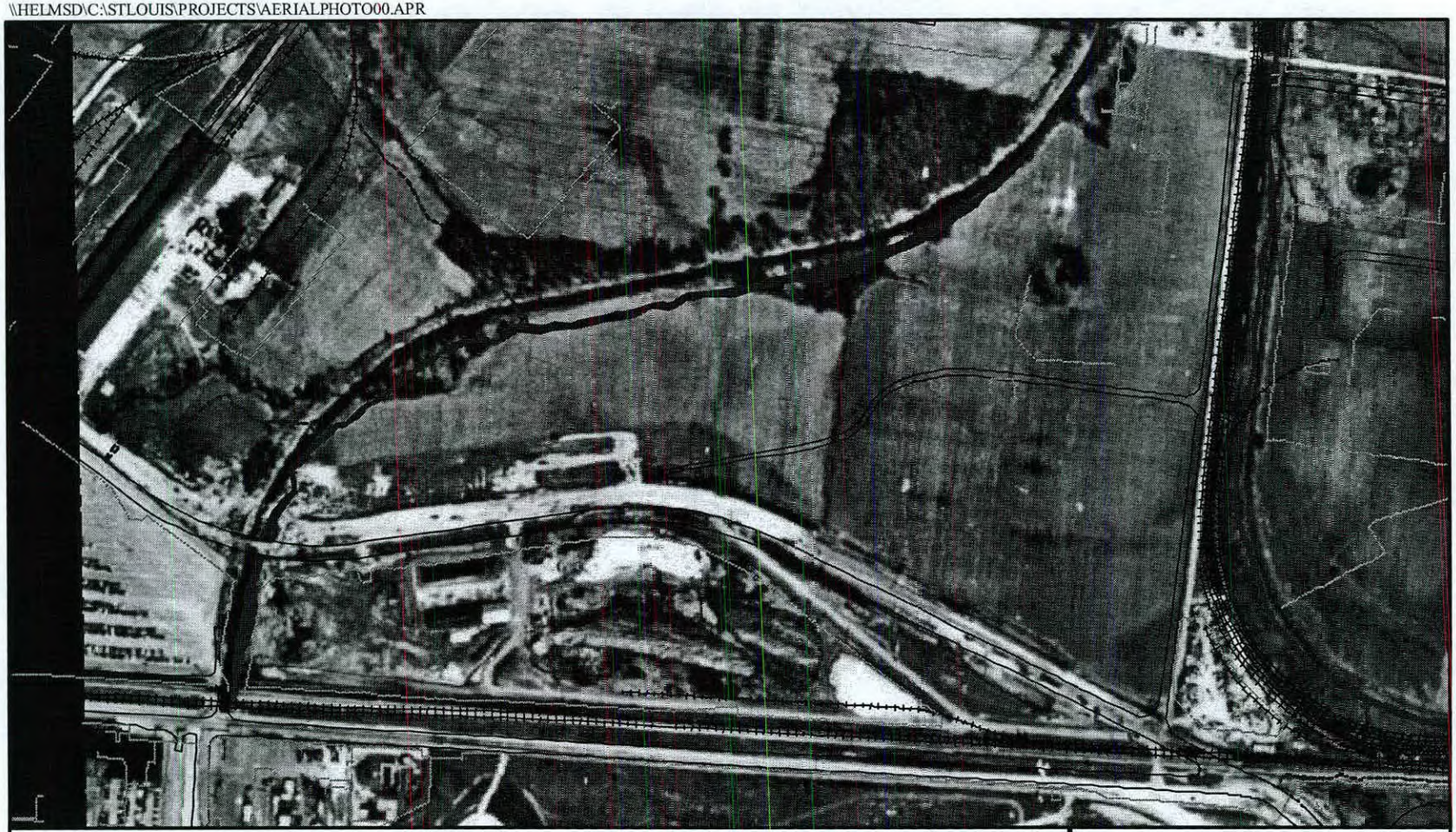


Figure 1-7. March 28 1952 Aerial Photo

\\HELMSD\C:\STLOUIS\PROJECTS\AERIALPHOTO00.APR

Legend:

Surface Features
- Fence
- Streams
- Railroad
- Primary Road

Creek

N

MO East State Plane NAD83 (Feet)

500 0 500 1000 Feet

Science Applications International Corporation

St. Louis Airport Site
Aerial Photos
St. Louis, Missouri

DRAWN BY:	REV. - DATE:	ARCVIEW PROJECT:
S. Kitchings	0 - 12/2/98	SEE NOTE

Figure 1-8. Jan. 27 1953 Aerial Photo

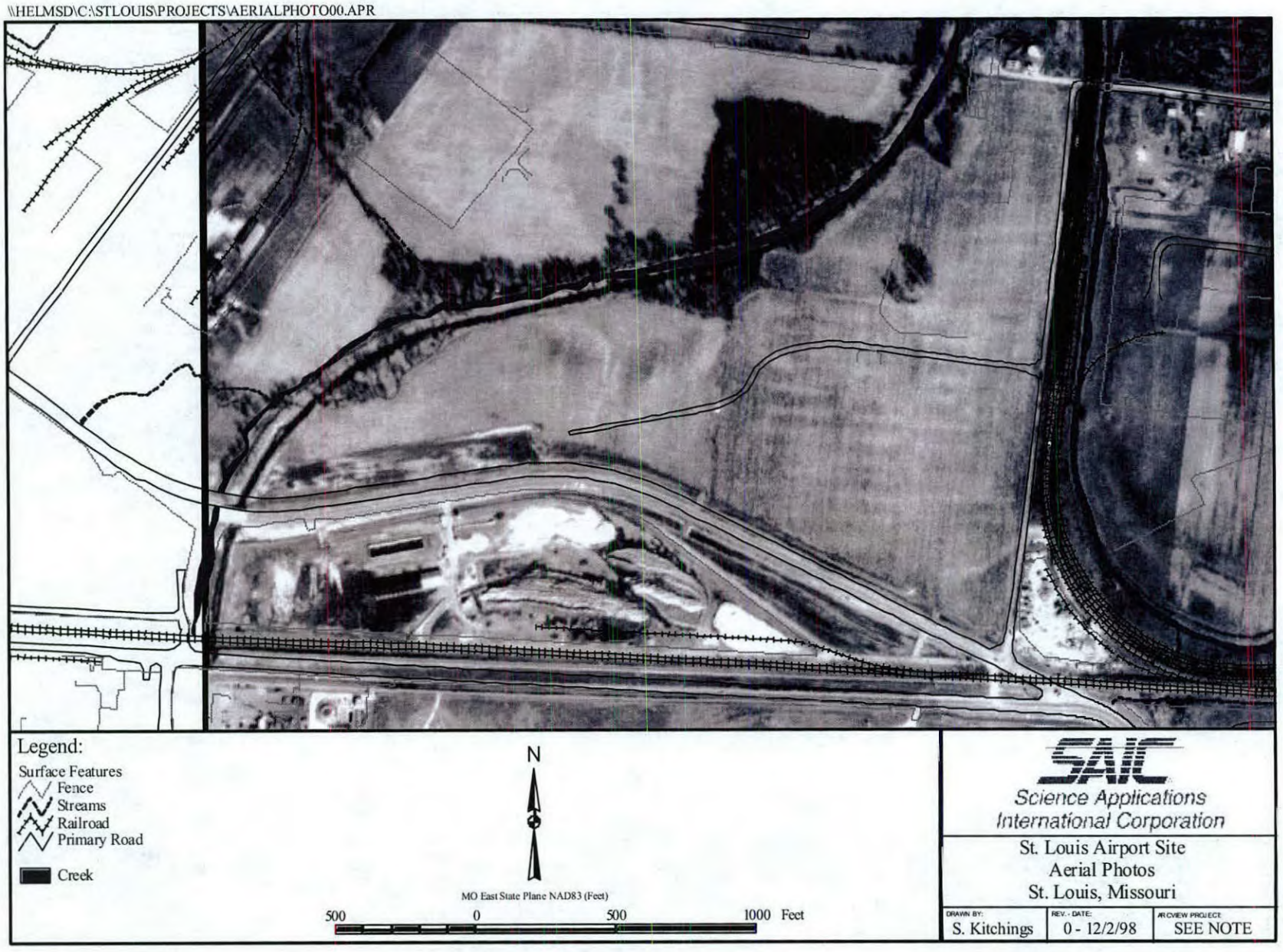


Figure 1-9. Feb. 20 1953 Aerial Photo

\\HELMSD\C:\STLOUIS\PROJECTS\AERIALPHOTO00.APR

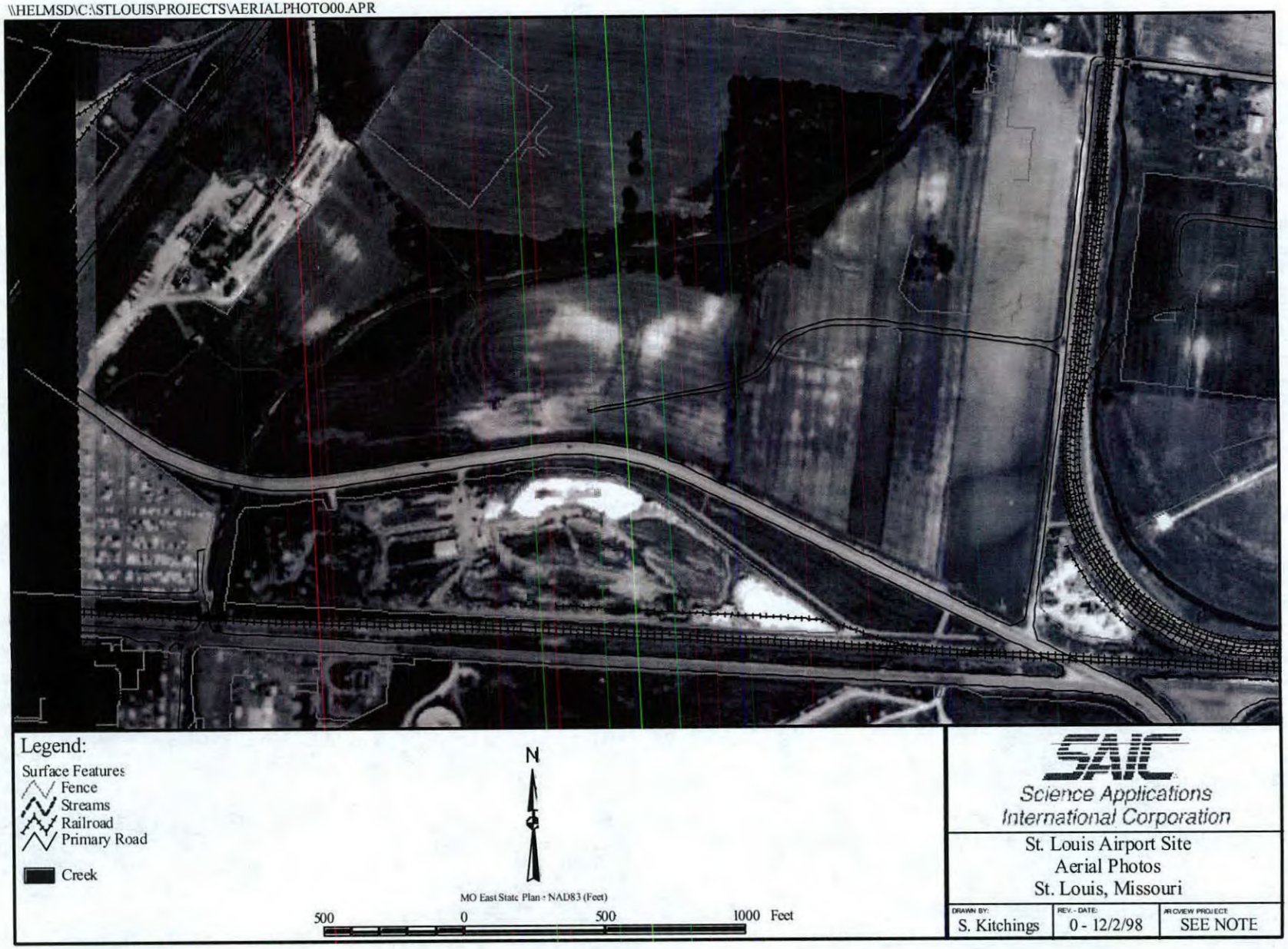


Figure 1-10. May 13 1958 Aerial Photo

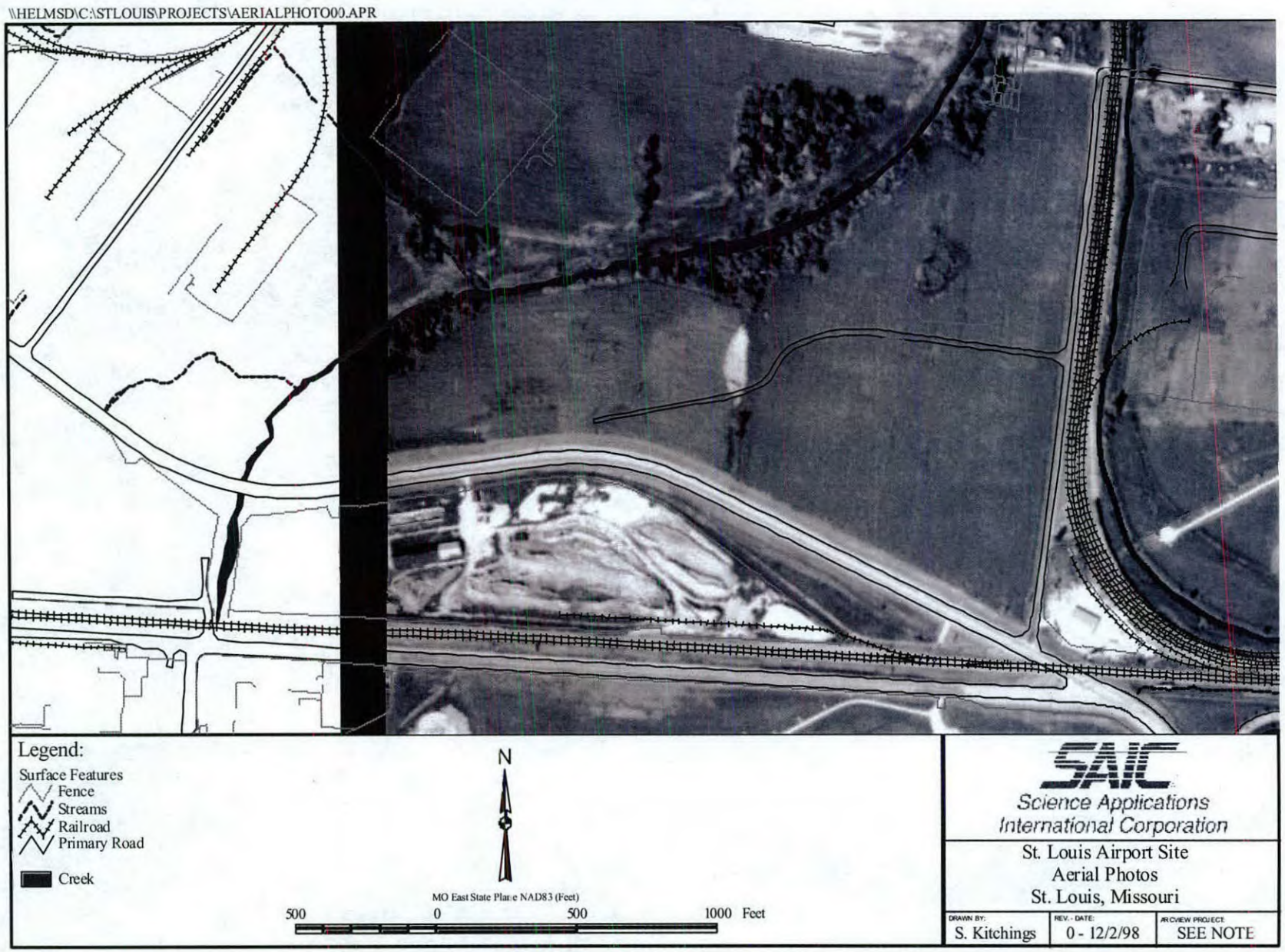


Figure 1-11. Oct. 10 1965 Aerial Photo

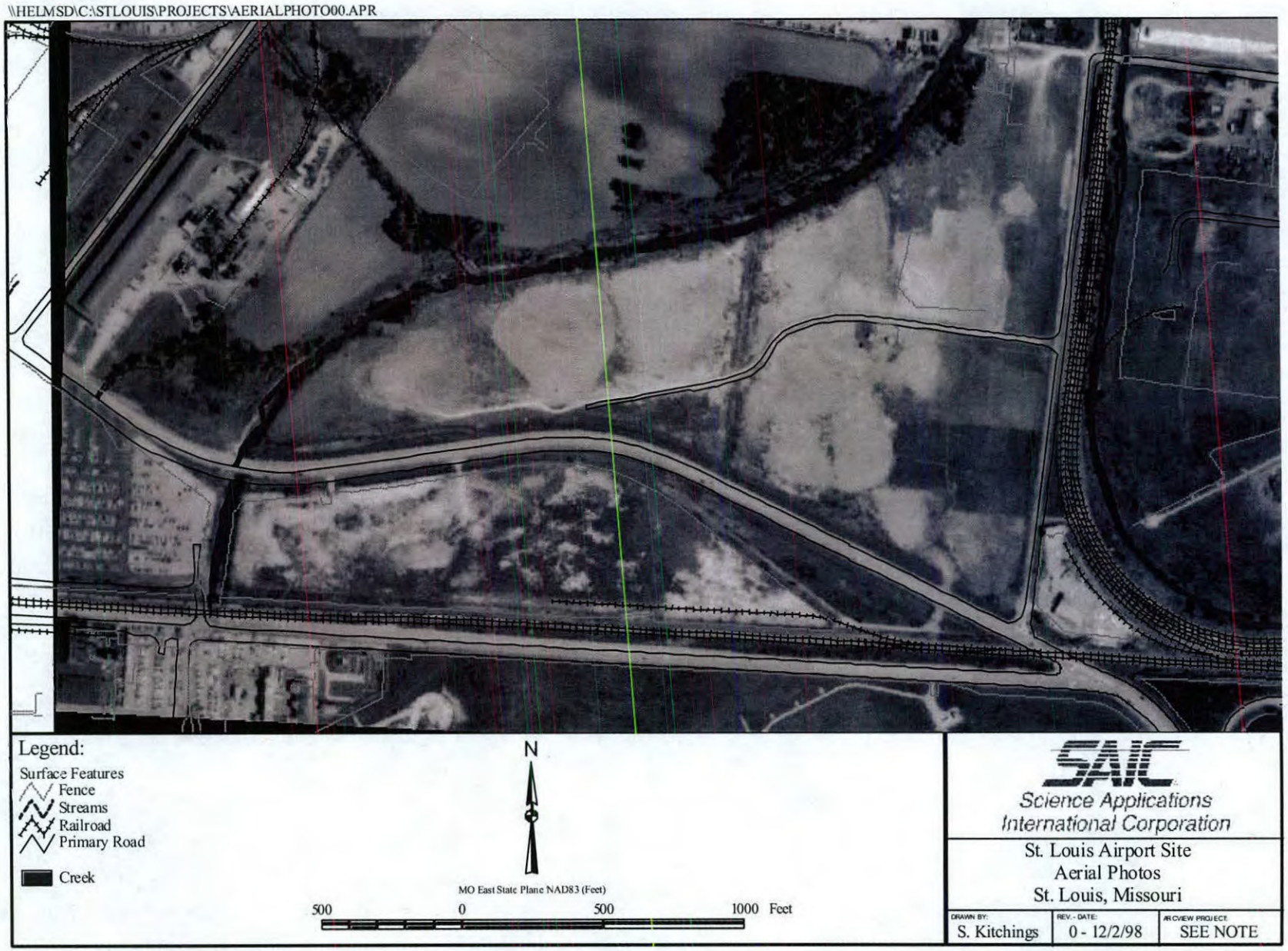


Figure 1-12. May 4 1971 Aerial Photo

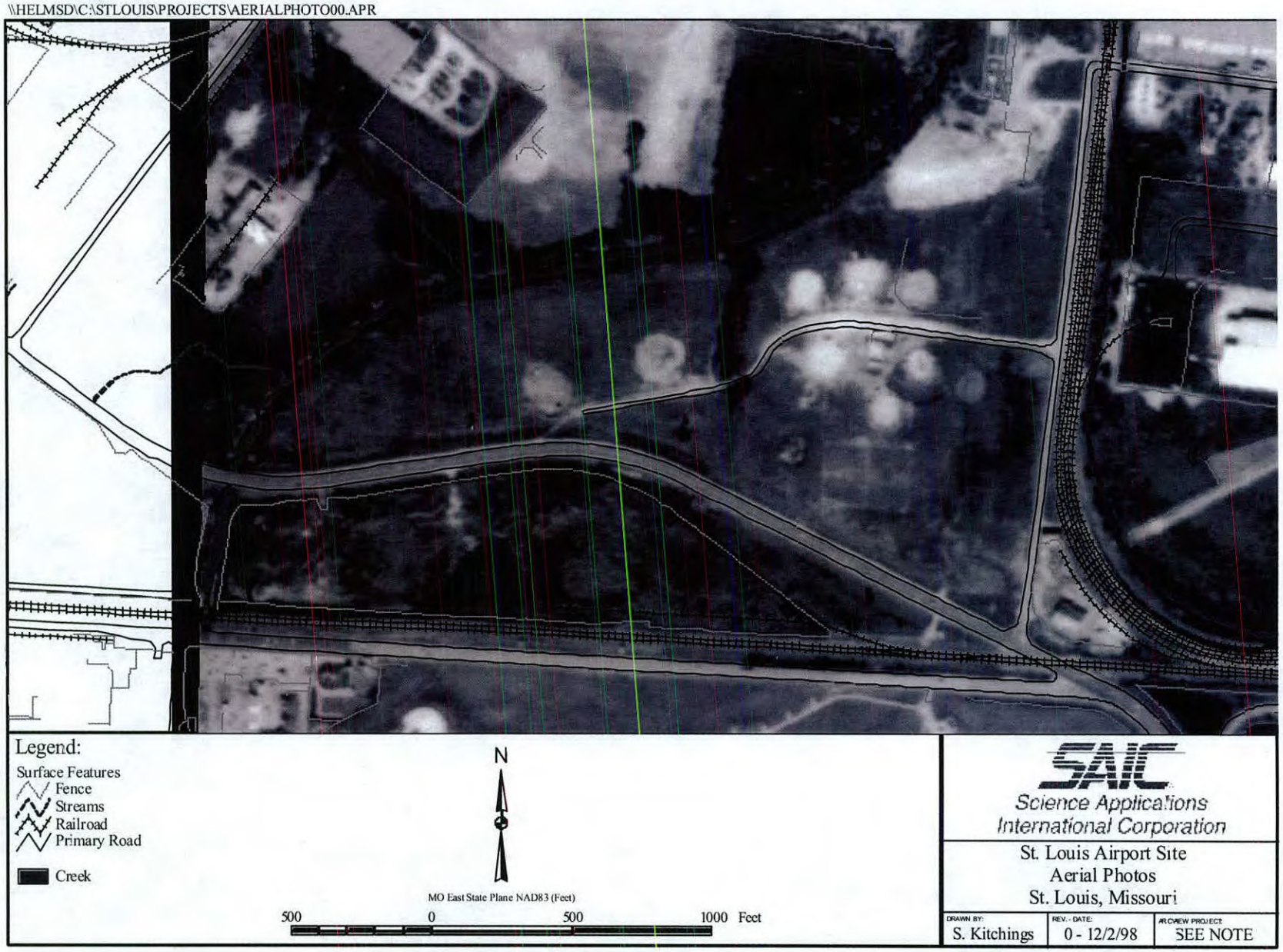


Figure 1-13. Oct. 8 1980 Aerial Photo

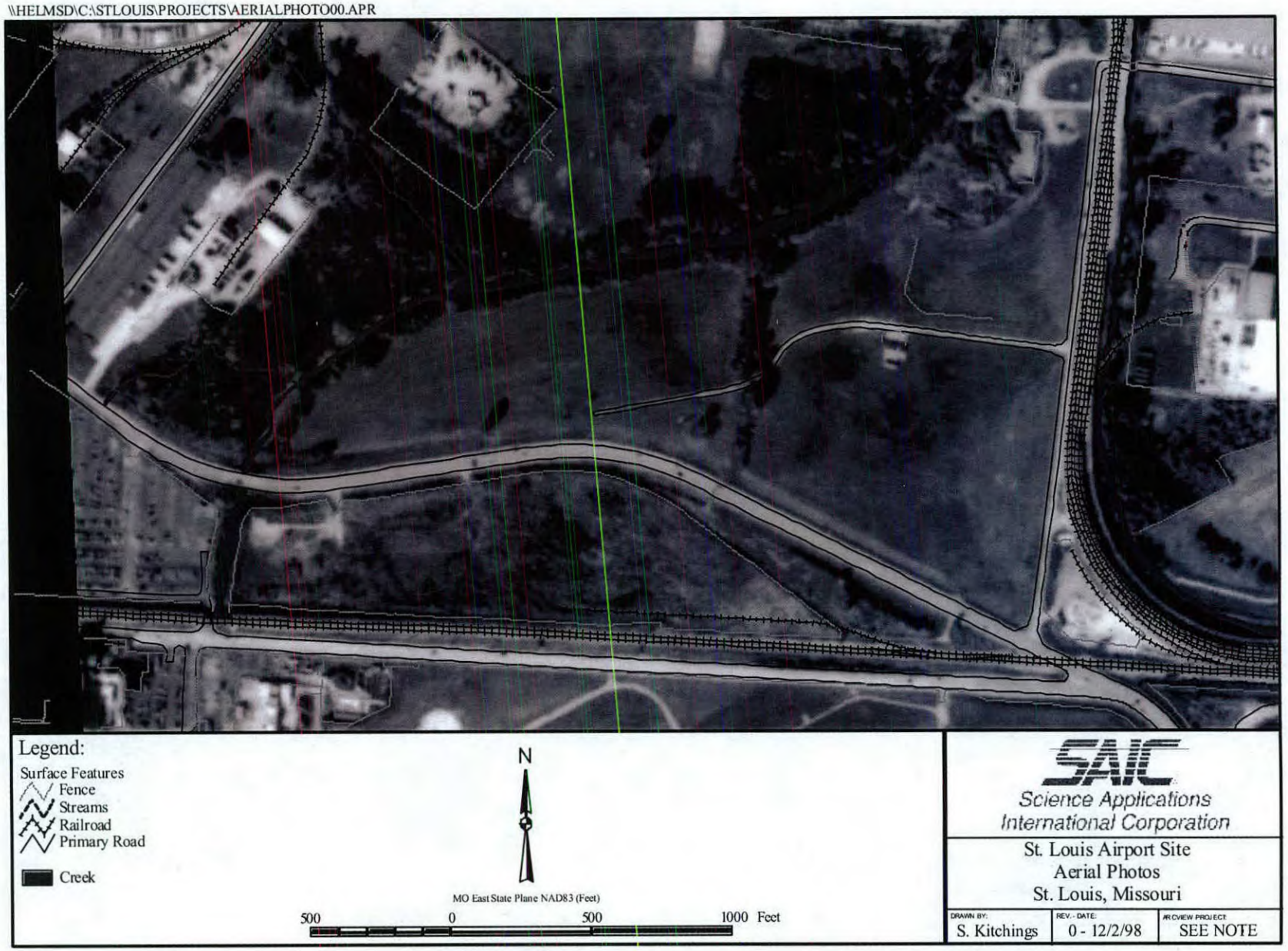


Figure 1-14. Oct. 22 1993 Aerial Photo

Zone	Period	Epoch	Stratigraphic	Thickness (ft.)	Description
Hydrostratigraphic zone (HZ)-A	Quaternary	Holocene	FILL/TOPSOIL	0-14	**Unit 1** Fill - Sand, silt, clay, concrete, rubble. Topsoil - Organic silts, clayey silts, wood, fine sand.
		Pleistocene	LOESS (CLAYEY SILT)	11-32	**Unit 2** Clayey silts, fine sands, commonly mottled with iron oxide staining. Scattered roots and organic material, and a few fossils.
			GLACIO-LACUSTRINE SERIES: SILTY CLAY	19-75 (3) 9-27 (3T)	**UNIT 3** Silty clay with scattered organic blebs and peat stringers. Moderate plasticity. Moist to saturated. (3T)
Hydrostratigraphic zone (HZ)-B			VARVED CLAY	0-8	Alternating layers of dark and light clay as much as 1/16 inch thick (3M)
			CLAY	0-26	Dense, stiff, moist, highly plastic clay. (3M)
Hydrostratigraphic zone (HZ)-C			SILTY CLAY	0-29	Similar to upper silty clay. Probable uncomforable contact with highly plastic clay. (3B)
			BASAL CLAYEY & SANDY GRAVEL	0-6	**UNIT 4** Glacial clayey gravels, sands, and sandy gravels. Mostly Chert.
Hydrostratigraphic zone (HZ)-D	Pennsylvanian		Cherokee (?) group (undifferentiated)	0-35	**UNIT 5** BEDROCK: Interbedded silty clay/shale, lignite/coal, sandstone, and siltstone. Erosionally truncated by glaciolacustrine sequences. (Absent at HISS).
Hydrostratigraphic zone (HZ)-E	Mississippian		STE GENEVIEVE ST. LOUIS LIMESTONES	100+	**UNIT 6** BEDROCK: Hard, white to olive, well cemented, sandy limestone with interbedded shale laminations.

Figure 1-15 Generalized Stratigraphic Column for SLAPS

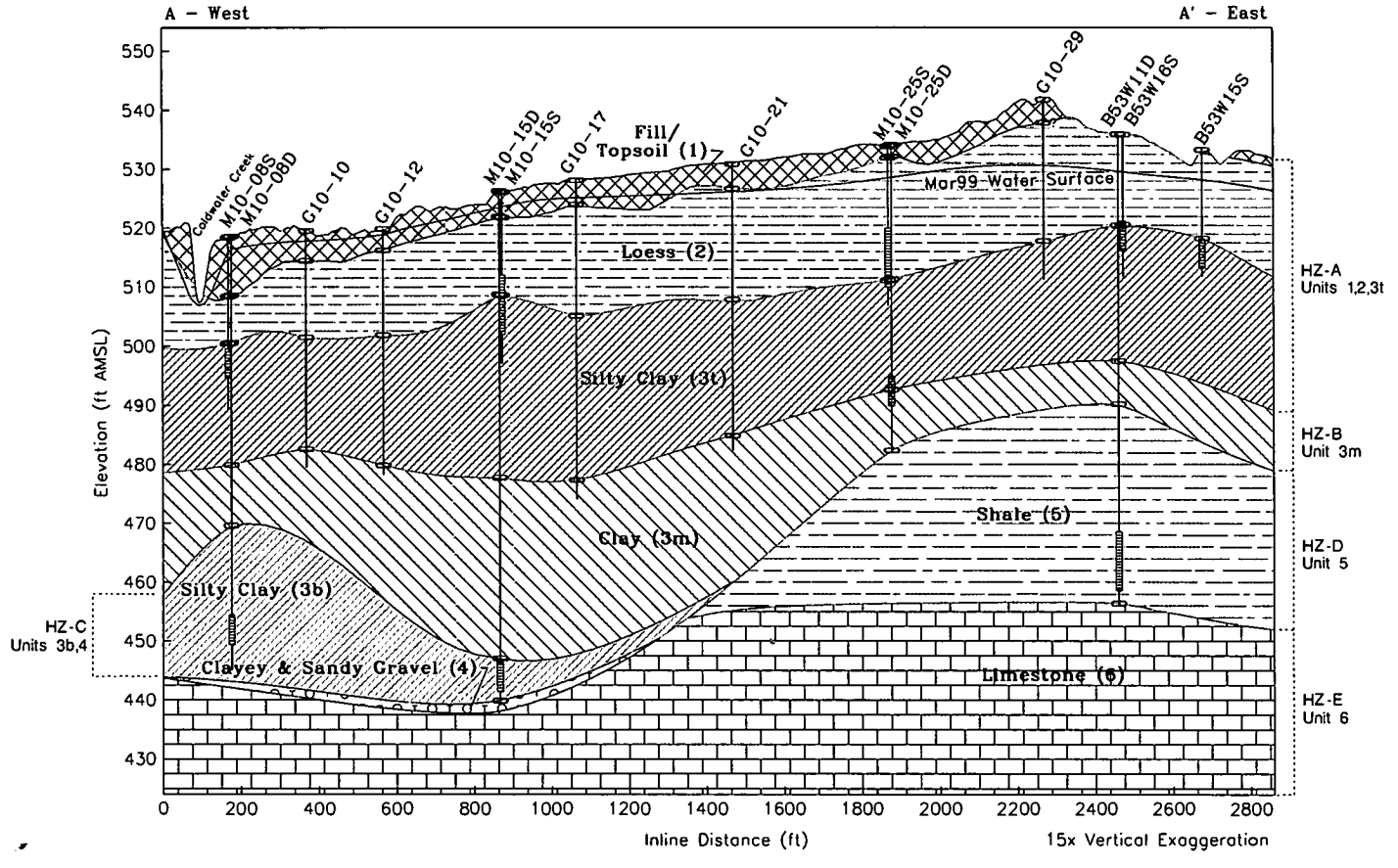


Figure 1-16.
SLAPS Geologic
Cross-Section A-A'

Notes

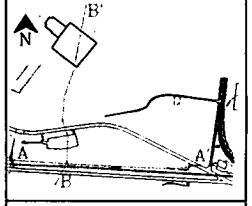
Geologic data used in the cross section collected through 2000.

Legend

Borehole pick

Well screen

Cross Section Location Map



FUSRAP

St. Louis Airport Site
St. Louis, Missouri

Drawn By: N. Voorhies

Rev. No. / Date: 0 / 29 Aug 00

File: SLAPSGlg05ExtendedAAS.sho

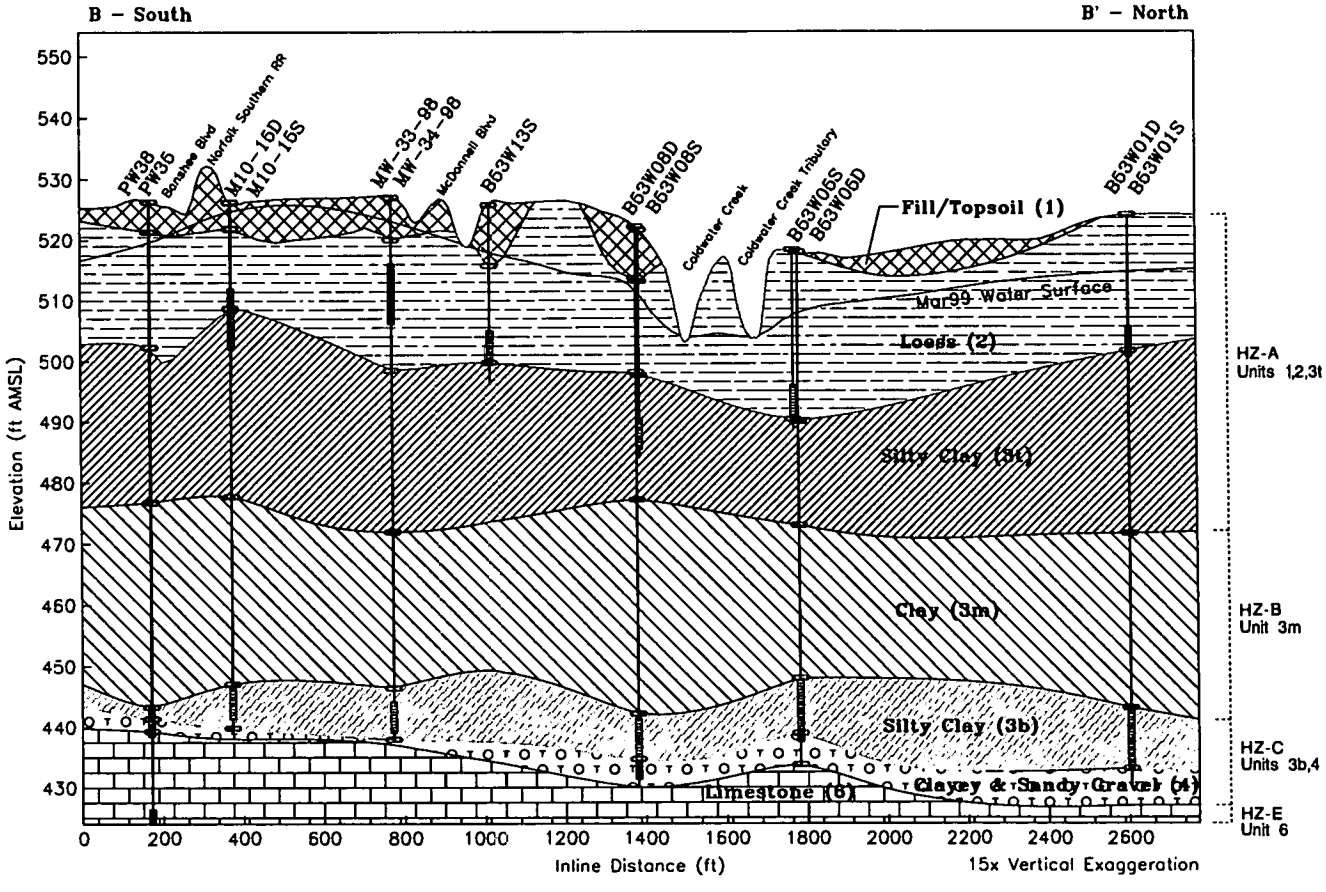


Figure 1–17.
SLAPS Geologic
Cross–Section B–B'

Notes

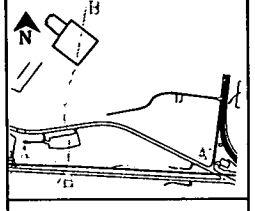
Geologic data used in the cross section collected through 2000.

Legend

Borehole pick

Well screen

Cross Section Location Map



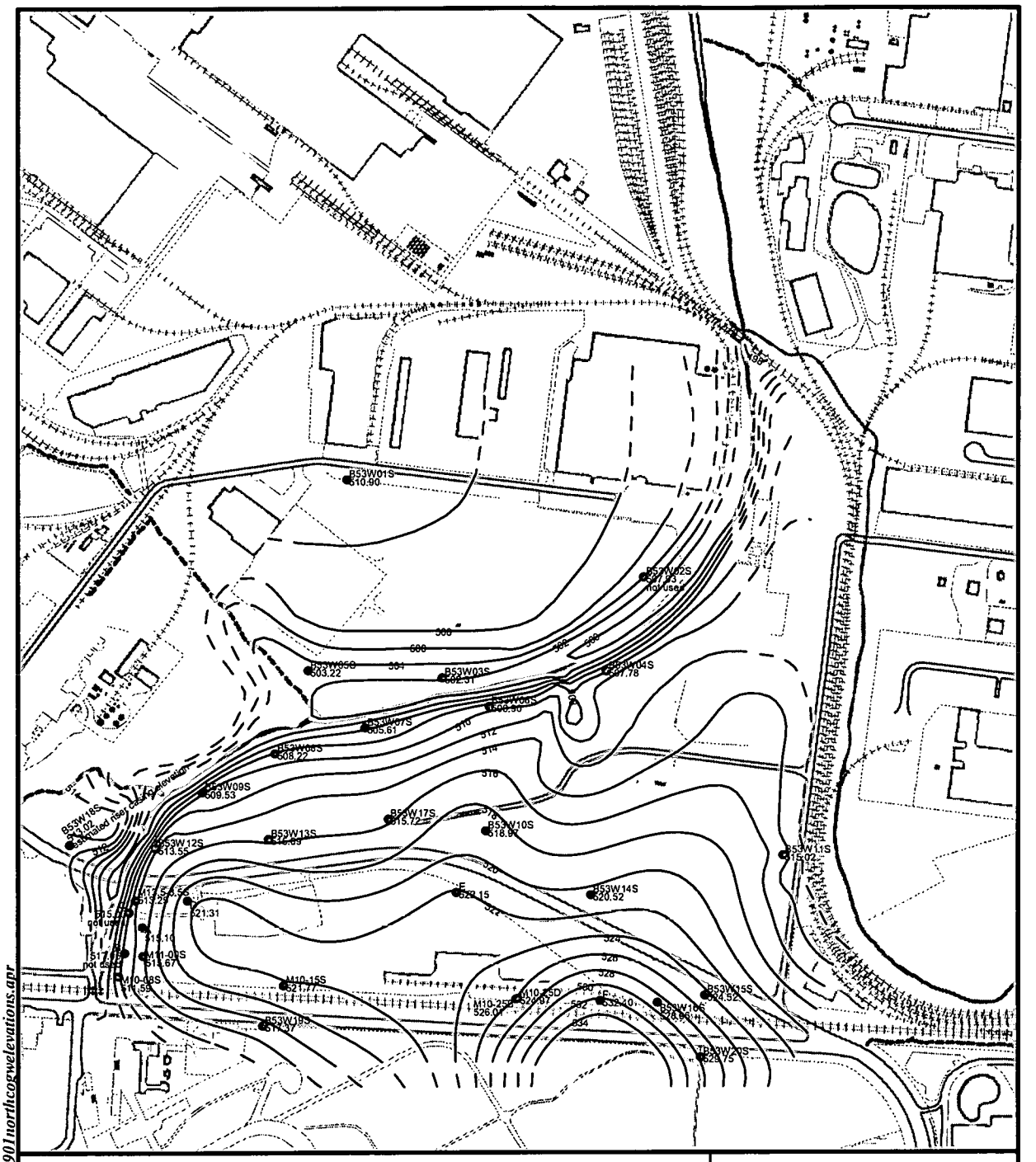
FUSRAP

St. Louis Airport Site
St. Louis, Missouri

Drawn By: N. Voorhies

Rev. No. / Date: 0 / 29 Aug 00

File: SLAPSGlg05ExtendedBBS.sho



Legend:

- Upper Zone Monitoring Well Locations
- Upper Zone Ground-Water Elevations

Anomalous ground-water elevations for wells B53W02S, B, and C posted, but not used to construct potentiometric surface.

Ground-water elevations in feet AMSL, two foot contour interval shown.
Contours dashed where inferred.
Wells screened at least partially in Unit 1, Unit 2, and/or Unit 3T are shown (where water level measurements were taken). Only the wells shown were used to construct this potentiometric surface.

400 0 400 800 Feet

MO-East State Plane (NAD 83, feet)

N

SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1997 (1 Sept. 1997)

FUSRAP

DRAWN BY:	REV.	DATE:
R. Smith	0	11 September 2000

u:\gis\northco\projects\19970901northcogwelevations.apr

Figure: 1-18. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1997 (1 September 1997)

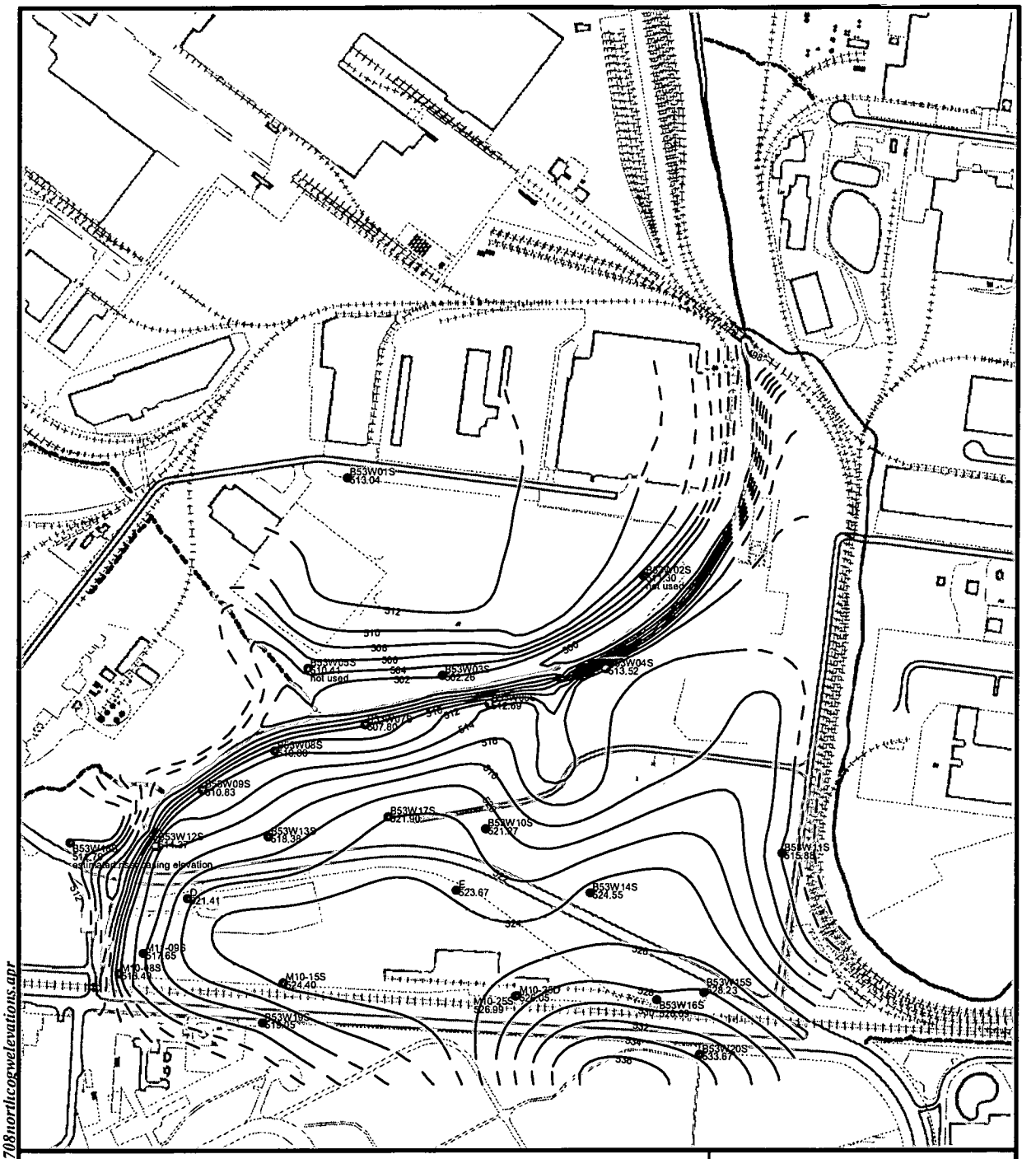


Figure: 1-19. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1998 (8 July 1998)

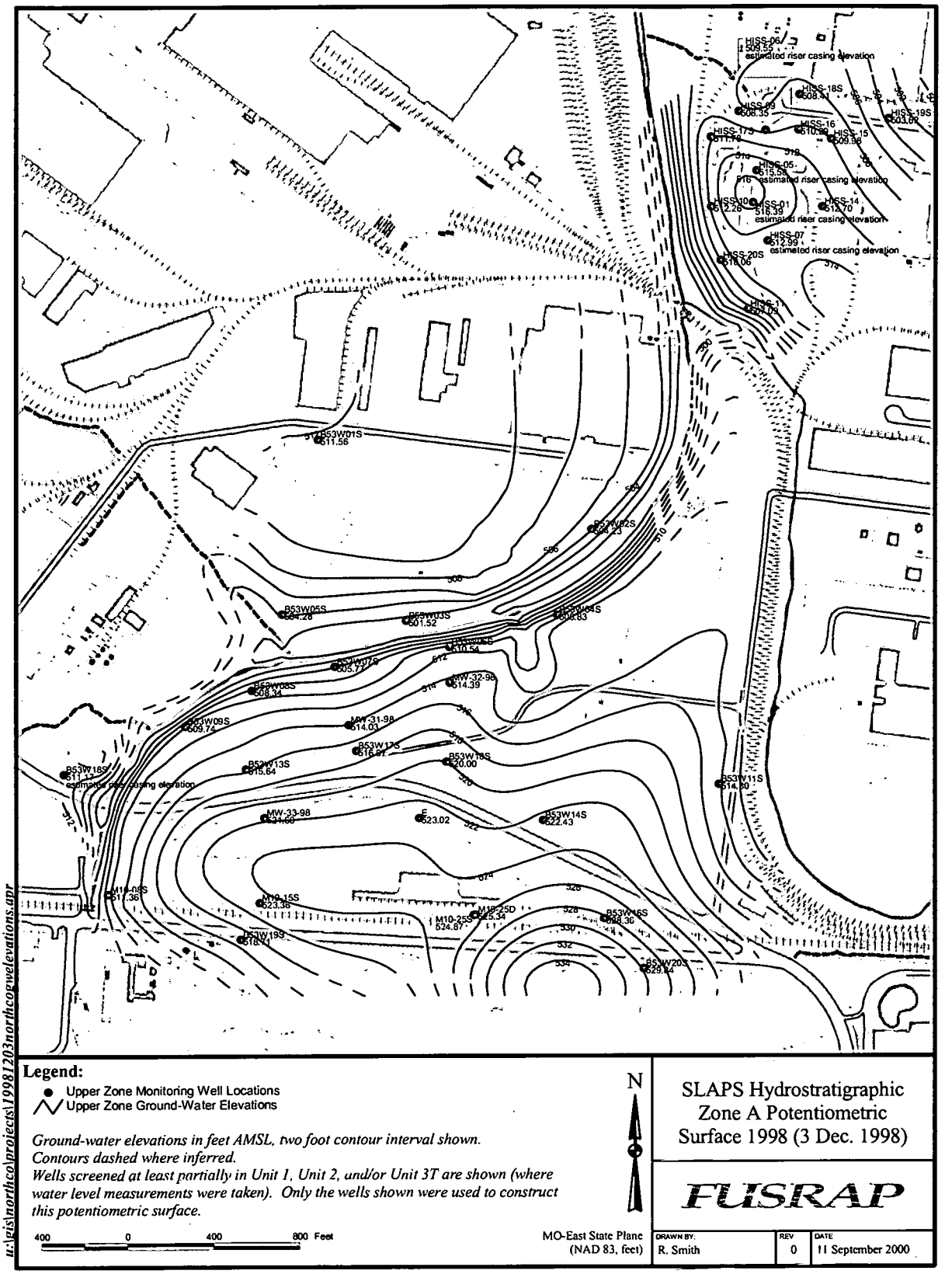


Figure: 1-20. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1998 (3 December 1998)

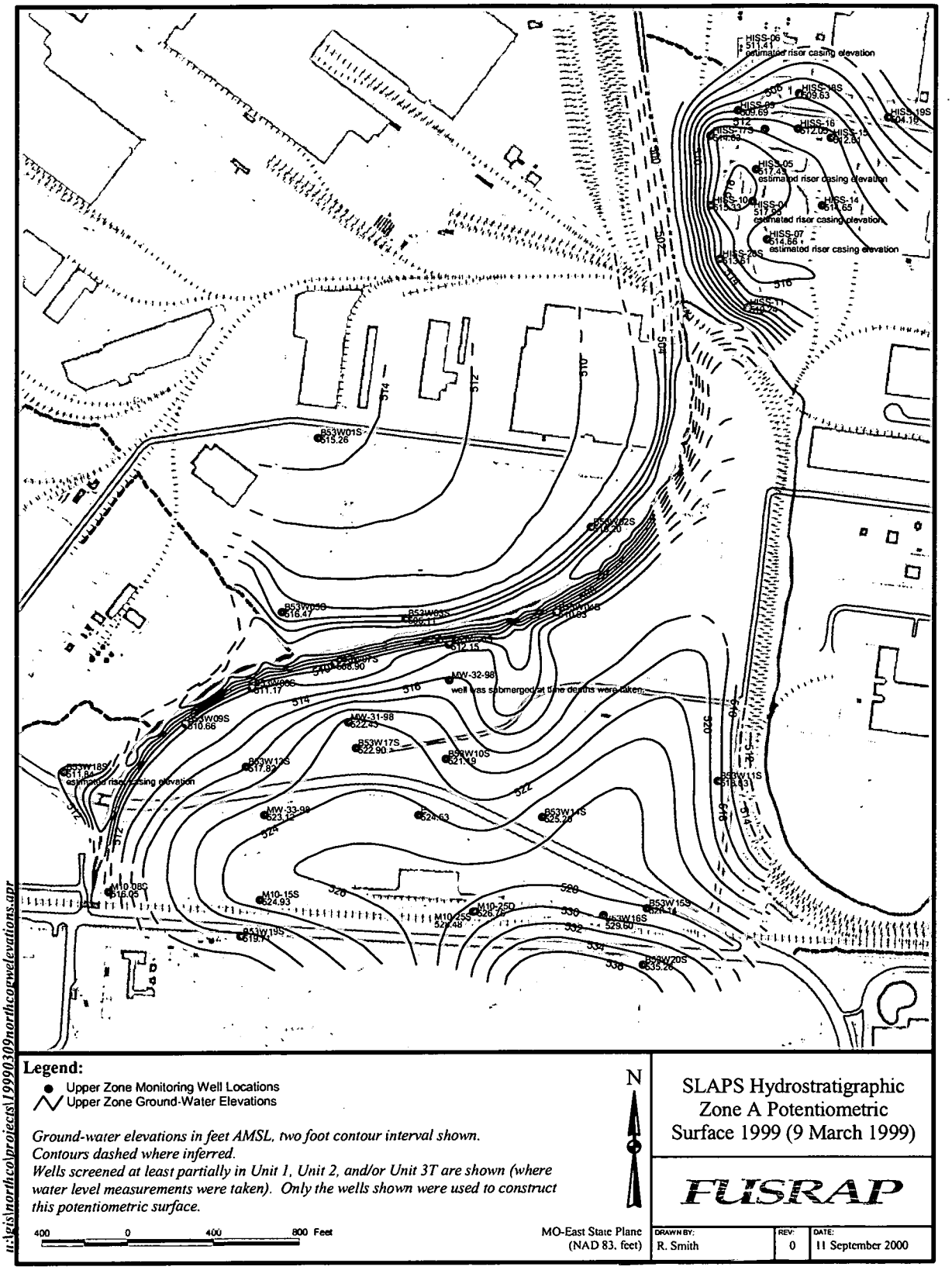


Figure: 1-21. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1999 (9 March 1999)

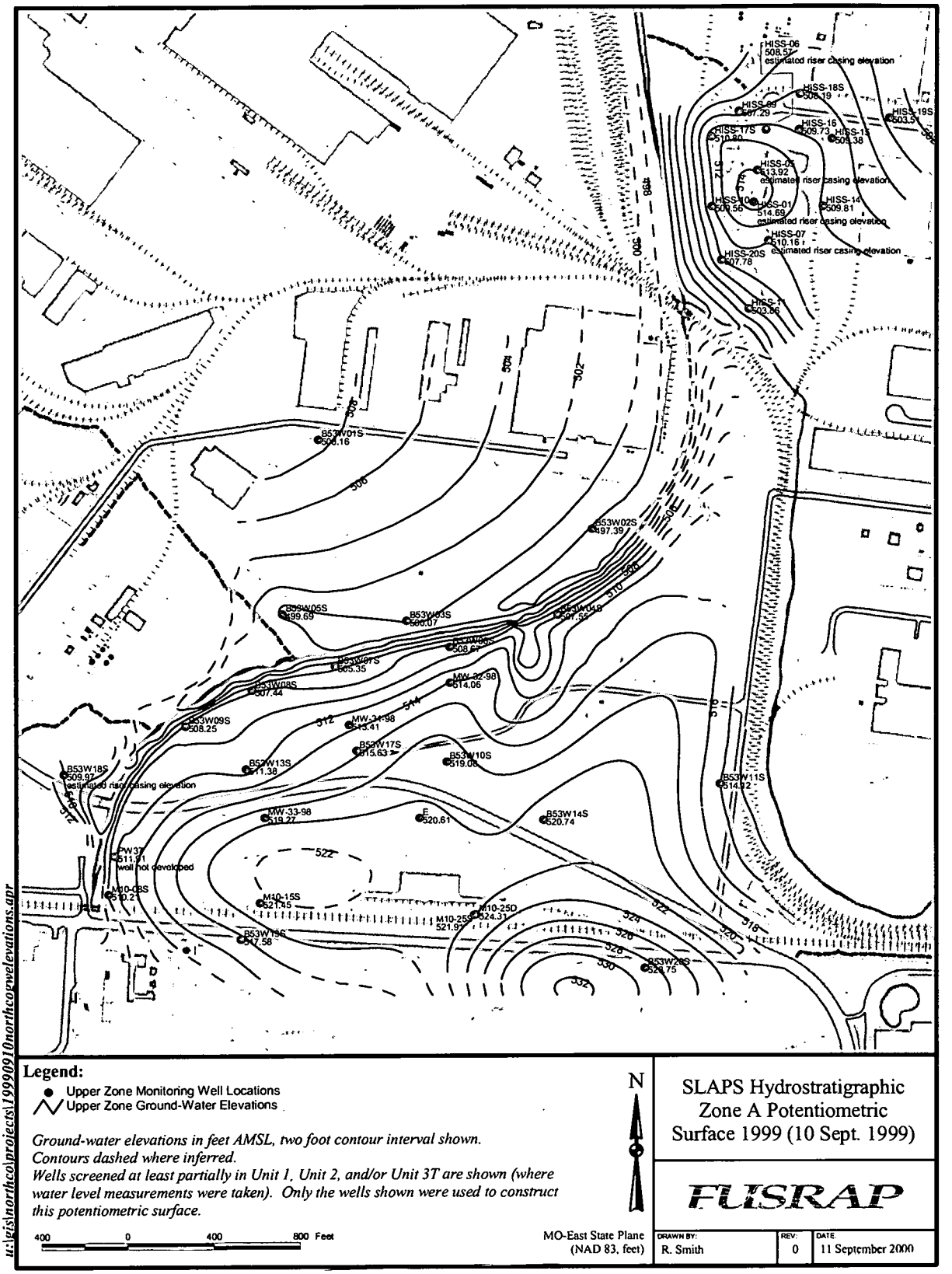


Figure: 1-22. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 1999 (10 September 1999)

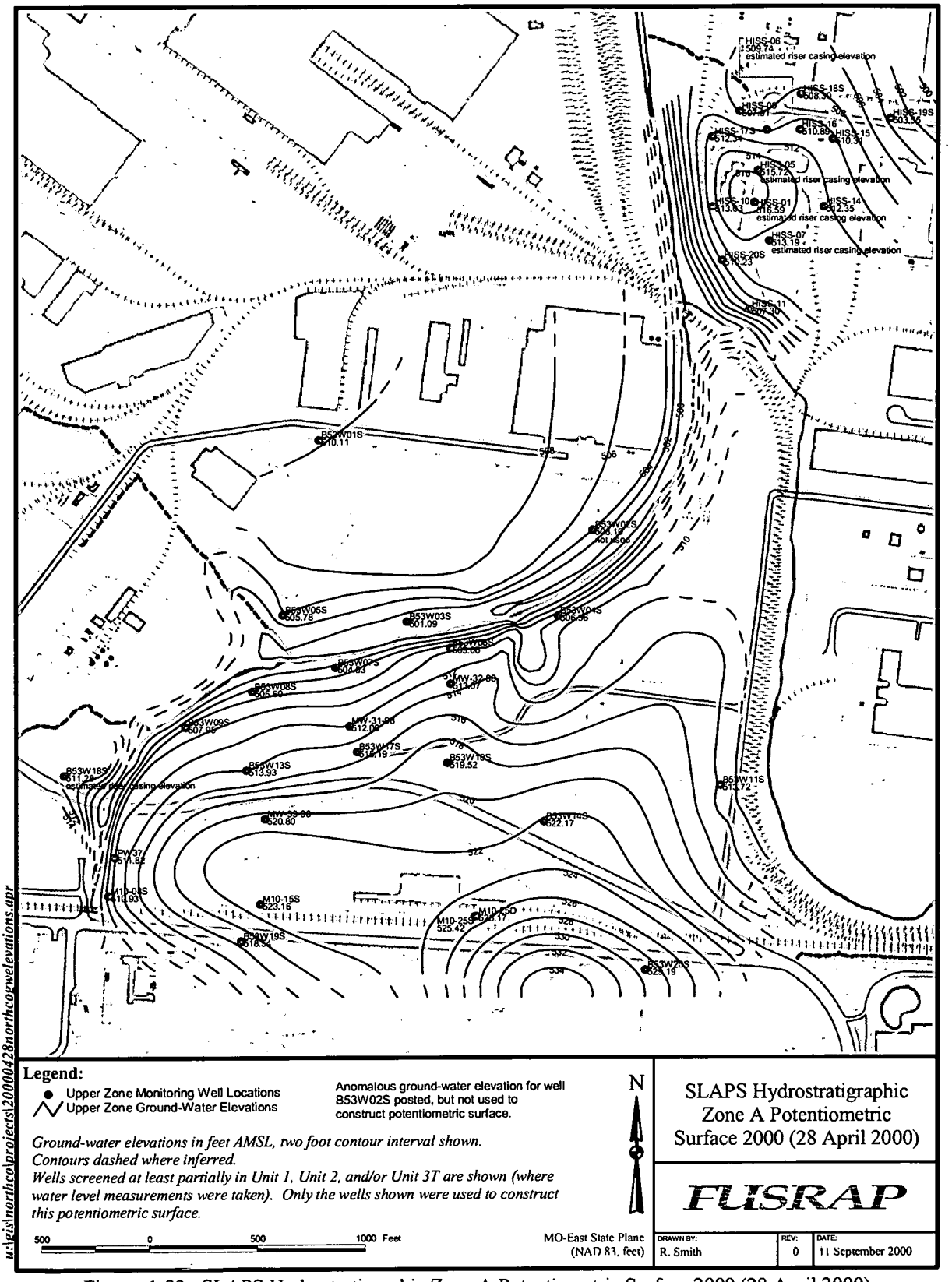


Figure: 1-23. SLAPS Hydrostratigraphic Zone A Potentiometric Surface 2000 (28 April 2000)

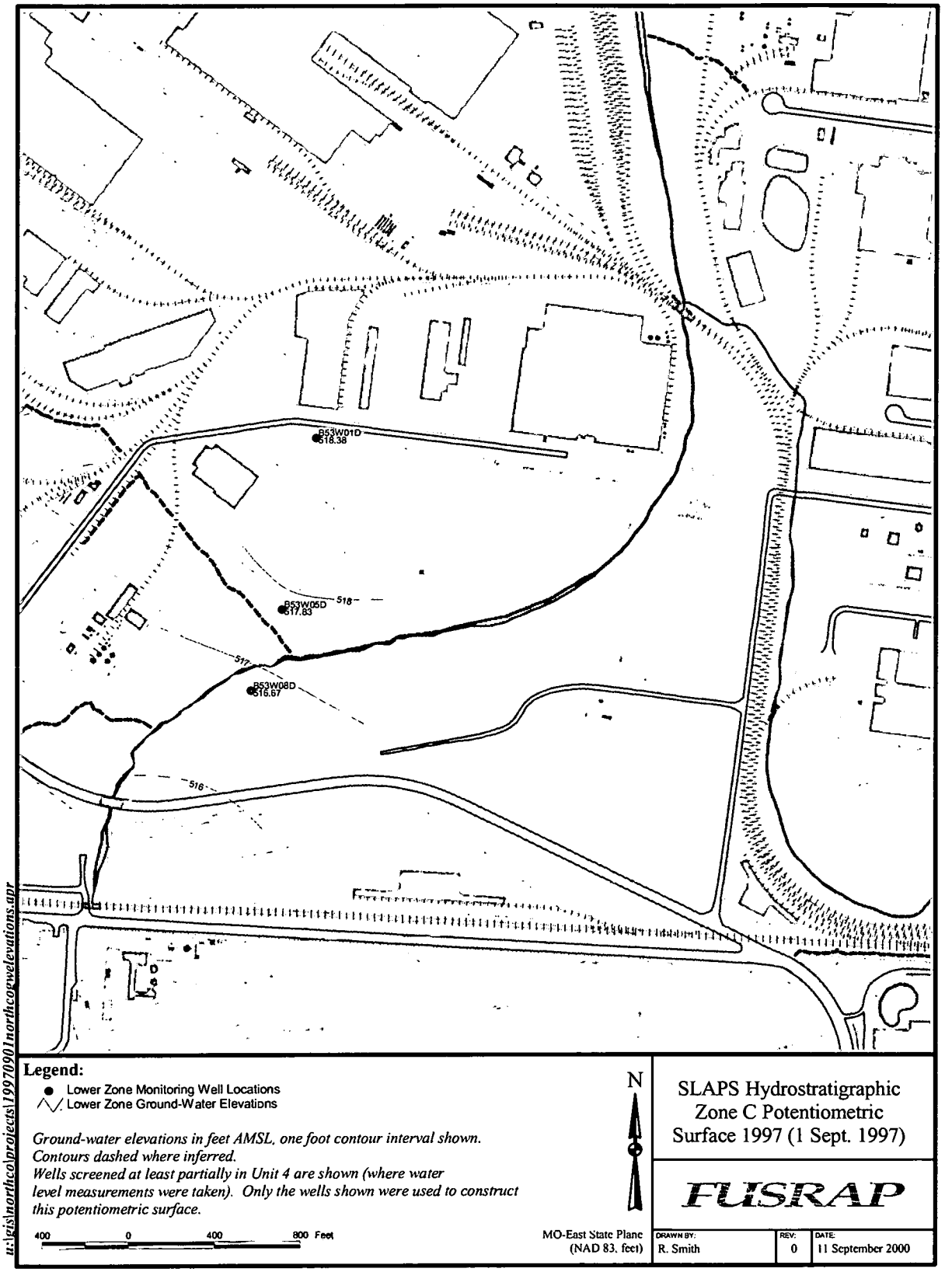


Figure: 1-24. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1997 (1 September 1997)

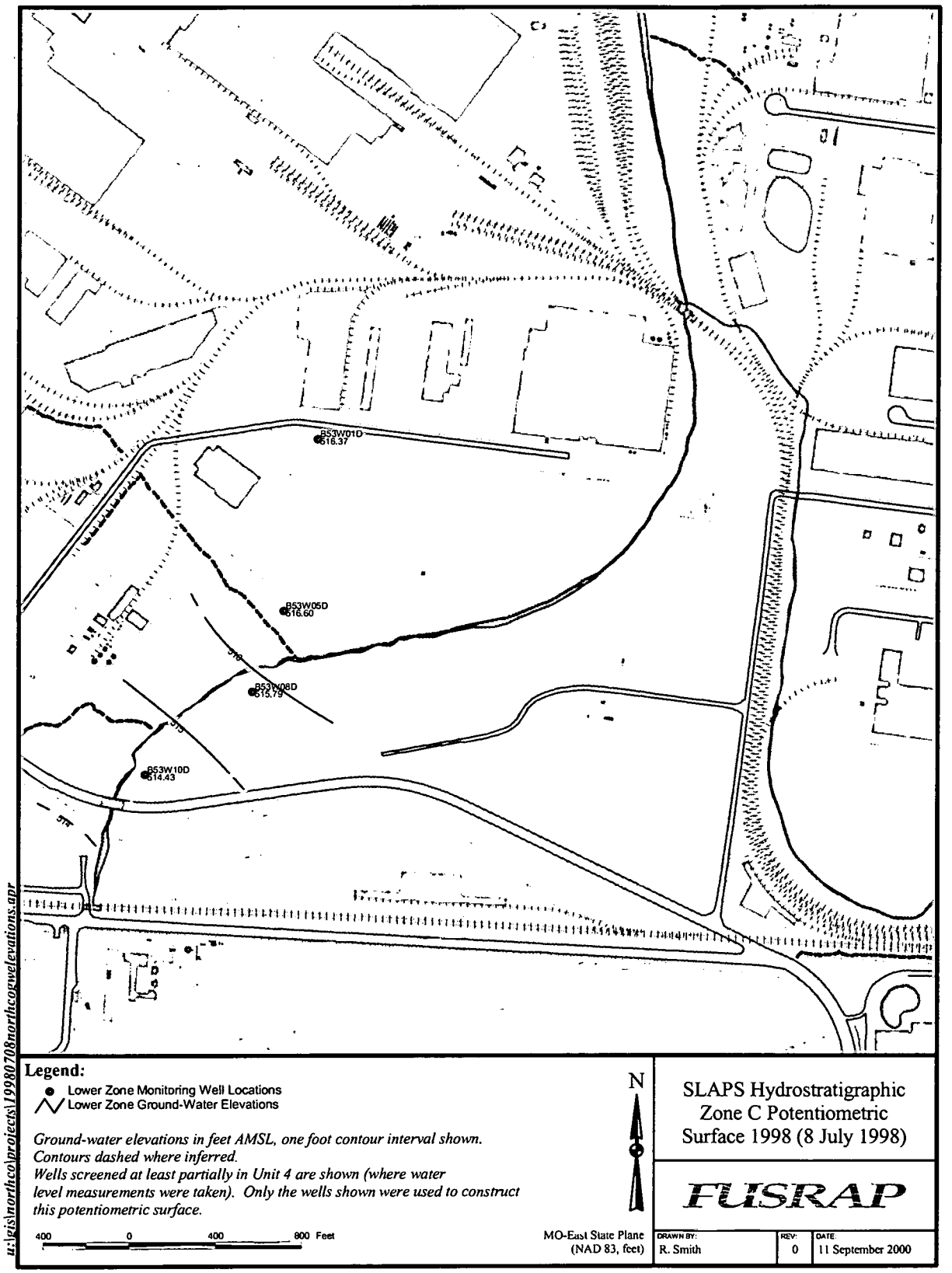


Figure: 1-25. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1998 (8 July 1998)

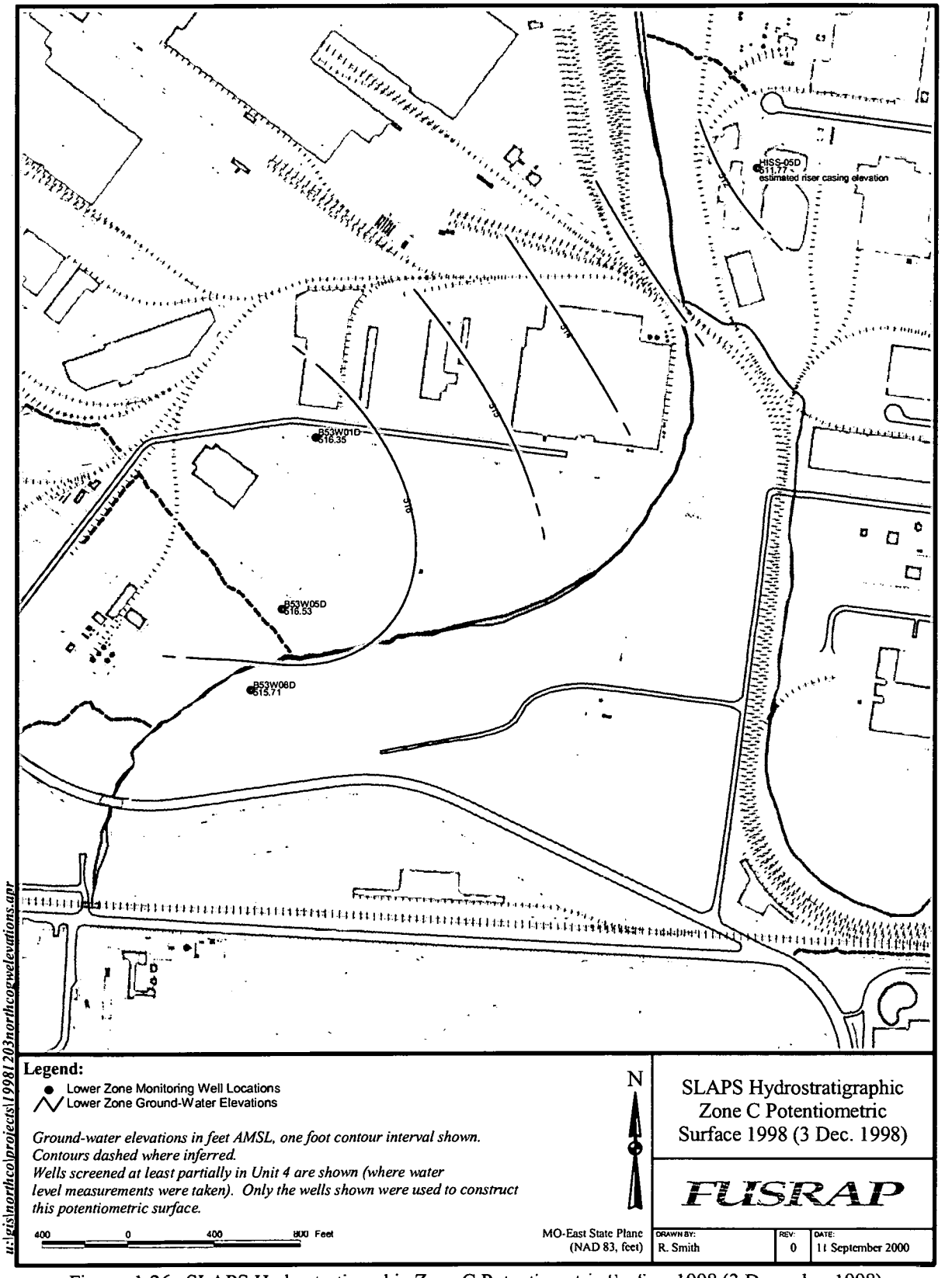


Figure: 1-26. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1998 (3 December 1998)

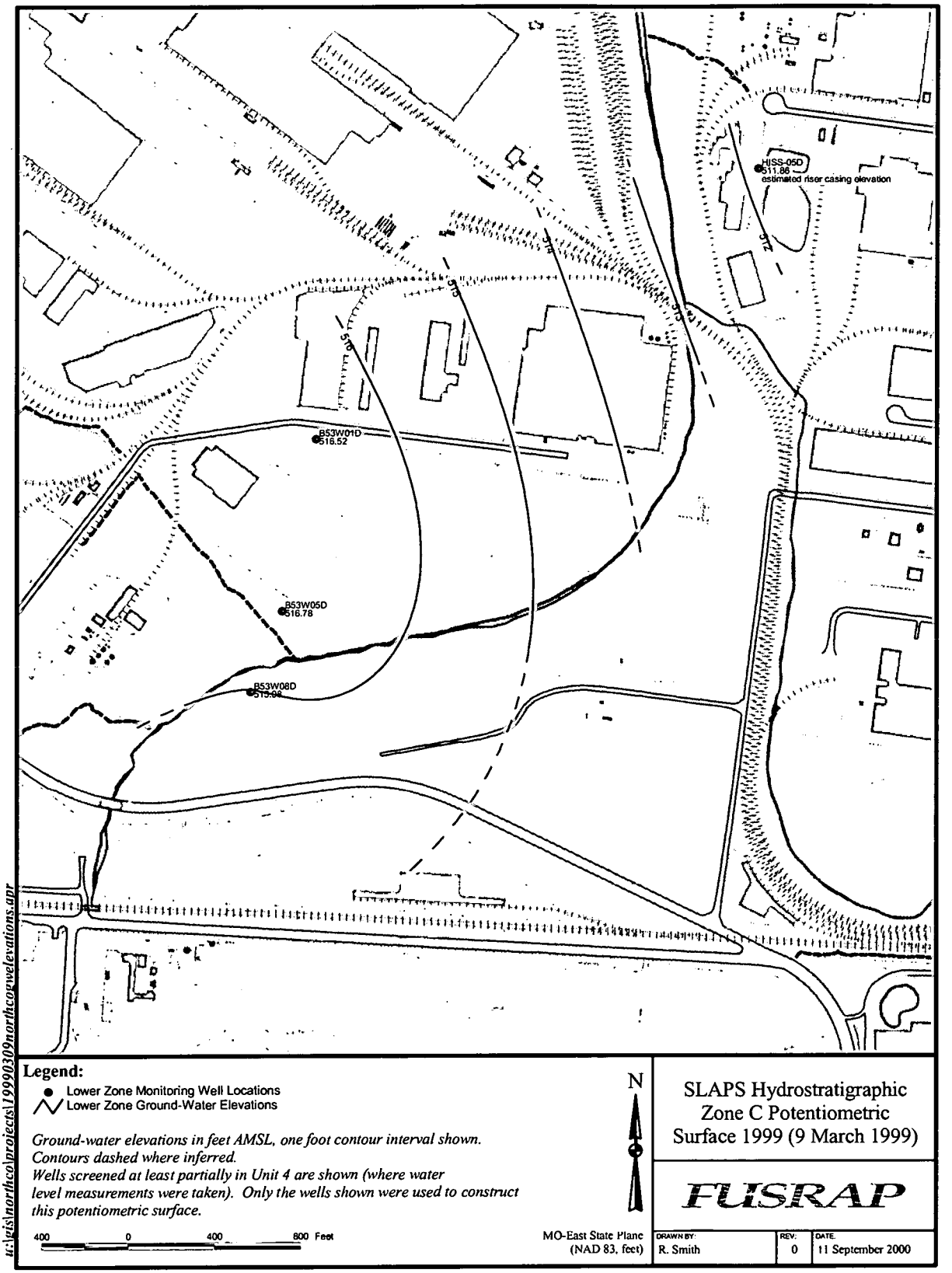


Figure: 1-27. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1999 (9 March 1999)

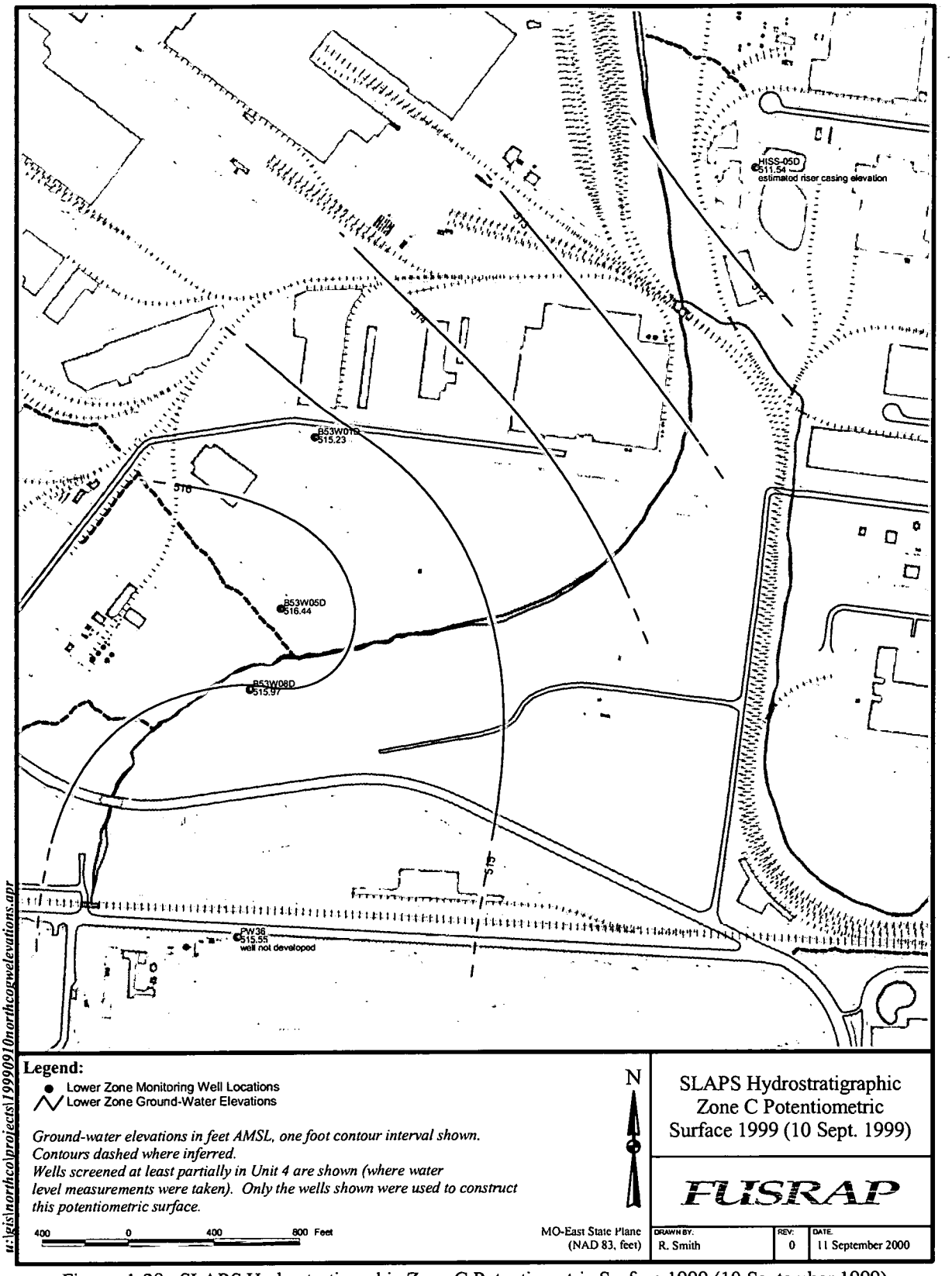


Figure: 1-28. SLAPS Hydrostratigraphic Zone C Potentiometric Surface 1999 (10 September 1999)

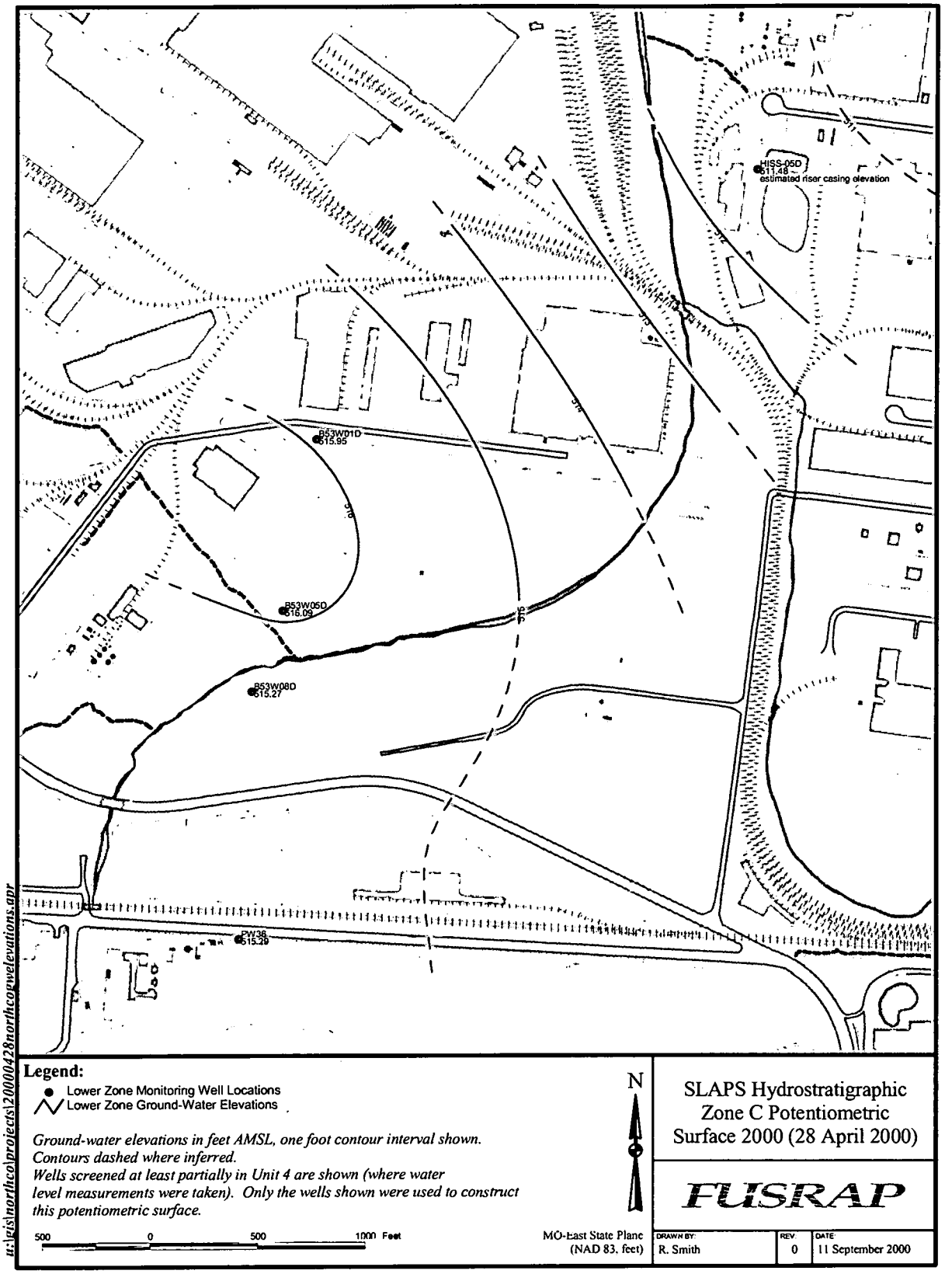


Figure: 1-29. SLAPS Hydrostratigraphic Zone C Potcntiometric Surface 2000 (28 April 2000)

SECTION 2.0

CURRENT INVESTIGATION ACTIVITIES

2.0 CURRENT INVESTIGATION ACTIVITIES

2.1 GEOPHYSICAL INVESTIGATION

2.1.1 Rationale

Geophysical techniques provide physical methods of determining subsurface features such as utilities, buried metal, and other objects which may be of concern during drilling and other remediation activities. As such, geophysical techniques can provide indirect characterization of the subsurface where little information currently exists. Electromagnetic (EM) and magnetic surveys covered an estimated area of 8.1 ha (20 acres) and were performed to delineate the depth and lateral extent of suspected fill areas, buried structures, and waste disposal areas within SLAPS. In addition, geophysical data collected in the north ditches area was used to delineate possible utility corridors and conduits. Geophysical surveys were completed prior to disturbance of the site by USACE remediation activities.

2.1.2 Methods

An EM31, EM61, and a cesium magnetometer were used at SLAPS in an attempt to define the lateral extent of the buried waste and debris and to define any buried building foundations. The EM31 is an electromagnetic terrain conductivity tool that measures the subsurface conductivity as an operator carries the equipment across the site. The EM31 was used to delineate lateral variations of subsurface material containing ferrous metals. The EM31 survey was conducted in the vertical dipole orientation, with in-phase and quadrature-phase data collected.

Like all EM methods, electrical conductivity (terrain conductivity) surveys utilize the principle that a magnetic field can be created by a changing electric field and that an electric field can be created by a changing magnetic field. When this technique is used, a time varying primary magnetic field is induced by passing an audio frequency alternating current through a transmitting coil. If conductive material is present, this primary field in turn induces *eddy* currents which flow in closed loops normal to the direction of the magnetic field. The magnitude of these *eddy* current loops is directly proportional to the conductivity of the earth in that vicinity.

The *eddy* currents in turn induce a secondary magnetic field of proportionate strength. The phase of the secondary field may differ from that of the primary field, and the strength will typically be much less. The resultant total magnetic field (primary and secondary) produces an output voltage within a receiving coil, which has been placed a fixed distance away. With constant coil spacing and orientation, the primary field has constant intensity. Thus, any variations in the total magnetic field are related only to the conductive materials in the subsurface. Terrain conductivity, measured in millimhos per meter (mM/m), is the inverse of resistivity, which is normally measured in ohms per meter (ohms/m).

Most rocks and soils are electrical insulators of very low conductivity. In general, the subsurface conductivity that is being measured during an electrical conductivity survey is electrolytic and takes place through moisture-filled pores and passages within the subsurface. Therefore, the conductivity in the subsurface will be directly proportional to the porosity,

permeability, moisture content, temperature, concentration of dissolved electrolytes, and the composition of colloids present in the soil and rock matrices.

Two different parts of the EM field are measured. The quadrature phase of the electromagnetic field (90 degrees out of phase with the primary magnetic field) is measured to determine conductivity. Conductivity data is normally presented in millimhos per meter (mM/m). In addition, the in-phase data (inphase relative to the primary magnetic field) are sometimes used to determine the existence of a very good subsurface conductor, such as metals.

The EM61 is a high-sensitivity metal detector that was pulled across the site by an operator. The EM61 generates 150 EM pulses per second and measures secondary EM fields which are induced in moderately conductive soils and in metallic objects. Conventional inductive metal detectors are generally limited in depth of exploration due to design factors idealized for detecting small objects at shallow depths. The EM61 can distinguish near-surface metals from metal objects buried at depths by using two separate coils. The design of the second coil is such that the near-surface response can be made virtually zero, increasing the detection of deeper targets. The EM61 method was used to determine the presence and depth of any metallic materials beneath the surface.

The cesium magnetometer survey was conducted because the effective depth of the EM61 is approximately 3.6 to 4.5 m (12 to 15 ft), depending upon subsurface conditions and size of the target. The cesium magnetometer is capable of detecting metallic material up to a depth of 9.1 m (30 ft) below ground surface (bgs), depending on the size of the target. However, the cesium magnetometer is much more sensitive to surface metal in certain sensor orientations. Because there are numerous factors that affect magnetic fields, there is no unique interpretation of a set of magnetometry data. Conversely, there is no unique magnetic anomaly produced by a particular kind of buried object. Factors that influence the response of a magnetometer include the size, shape, depth, orientation, and magnetic susceptibility. Magnetometers may locate many objects of interest at hazardous waste sites (particularly buried ferromagnetic materials such as drums, tanks, pipes, and iron scrap). However, difficulties are often encountered in interpreting and attempting to identify the source of magnetic anomalies.

Induced magnetization in an object produces a local magnetic field which either reinforces (positive magnetic susceptibility) or reduces (negative susceptibility) the external applied field. The variations in an otherwise homogeneous field caused by the presence of the object is called a magnetic anomaly, and observations of such anomalies can be used to infer the presence of magnetic objects.

Due to the presence of high conductivities (greater than 70 mM/m) in the shallow subsurface, the ground-penetrating radar (GPR) proposed in the SAP (USACE, 1998a) survey was not completed. Typically, GPR is not effective in soils with conductivities greater than 20 mM/m.

2.1.3 Study Area and Measurement Spacing

The area within the SLAPS security fence and north ditches represents the area of greatest interest at the site. After mechanically clearing the brush, the geophysical survey grid was established by licensed Missouri surveyors. The potentially unsafe areas such as the heavy trees,

debris piles, unstable mounds, and standing water were avoided. No interpretation of subsurface conditions was made or inferred in these areas.

The EM31, EM61, and magnetometer surveys were conducted along north/south traverses. Based on the Missouri State Plane System, a 50-m by 50-m survey grid was established at SLAPS by a Missouri licensed surveyor. Each node on the 50-m by 50-m grid was marked in the field with a wooden stake that contained the Missouri state plane corresponding coordinate. Alternating colored flagging was tied to the perimeter fence to mark the 2-m interval traverses. Corresponding colored polyvinyl chloride (PVC) push flags were put in every 25 m to aid line of sight for the EM31 and EM61 surveys and to provide inline distance markers for horizontal control during the data collection.

2.1.4 Data Collection

The EM31 and EM61 equipment used at this site were manufactured by Geonics Ltd. of Mississaugua, Canada. Data from both of these units were collected and stored on a digital recorder known as a Polycorder manufactured by Omnidata of Logan, Utah. Interface firmware modules were provided by Geonics Ltd., for the interaction between the EM31 and EM61 and the Polycorder.

EM61 data collection locations along each traverse were monitored through the use of a hip chain inline distance measuring device. This device is accurate to within 0.2 percent of the survey distance. A differential GPS was utilized for horizontal location of the EM31 data. The EM31 data was recorded in point mode at a rate of 1 point per second. The GPS data is processed and corrected using satellites or a United States Coast Guard beacon. Due to the close proximity of a beacon located along the Mississippi River, the data was collected in real-time correction mode. No further processing was required. The GPS is accurate to within 30 cm.

A Geometrics Model G858 cesium gradiometer was utilized to collect the magnetic data. The data was collected and stored in the gradiometer's internal storage system.

Geophysical equipment was calibrated according to manufacturer's specifications. Calibration was verified on a daily basis. Each morning, prior to any data collection, each picce of geophysical equipment was taken to a predetermined base station, and at least 20 data points were collected and saved in a base station file. This base station data verified the consistency of measurements from day to day during the survey.

Digitally recorded EM31, EM61, and magnetometer data were downloaded to a field computer at least once each day. The downloaded data was examined by the equipment operator for the presence of data and preliminary evaluation of data quality. Before the data was removed from the geophysical equipment, the downloaded data was copied onto floppy discs. In the field logs, geophysical equipment operators noted the names of all the data files and what traverses were contained in the files.

2.1.5 Data Processing

The EM31 data were processed and presented using a recent version of the commercial software DAT-31 (Version 3.33) manufactured by Geonics. Data were presented in profile form,

showing in-phase and quadrature-phase data. The EM31 data were exported to line, distance, and value (X, Y, Z) files for mapping. The resulting EM data are discussed in Section 3.0.

The EM61 data were processed and presented using a recent version of the commercial software DAT-61 (Version 1.50). Data were presented in profile form showing upper and lower antenna response and the differential. The EM61 data were exported to line, distance, and value (X, Y, Z) files for mapping. The resulting EM data are discussed in Section 3.0.

The magnetometer data were processed and presented using a recent version of the commercial software MAGMAPPER98. Data files containing line and station coordinates and total magnetic field and/or vertical magnetic gradient readings were exported to line, distance, and value (X, Y, Z) files for mapping. The resulting magnetometer data are discussed in Section 3.0.

For plan view presentation, the EM31, EM61, and magnetometer data were processed and presented using the commercial software SURFER (Version 6.0). The data is presented as a classed post. Each individual data measurement is presented by a colored dot. A specific color is assigned to a specific range in response from the measuring device. Because of the concentration and amount of data collected, the data was not contoured. Color scales were adjusted to enhance the data interpretation and presentation.

2.2 SOIL BORING AND SAMPLING

2.2.1 Rationale

Existing soils data from previous surface and subsurface sampling locations were evaluated for radiological and nonradiological constituents. The evaluation of the raw data indicated that additional soil sampling was required. The delineation of the extent of contamination (primarily radiological) was necessary in several areas for planned construction and remediation. Additional soil sampling data for nonradiological constituents was required to support the evaluation of potential contaminants of concern (PCOC).

Several criteria were used to propose soil sampling locations. The existing data were first evaluated against the Department of Energy (DOE) 5400.5 radiological standard used in previous investigations and Engineering Evaluation/Cost Analysis Reports (EE/CAs) for samples with a Sum of Ratios (SOR) greater than one. The primary intent of this evaluation was to determine if sample locations with radiological results above the SOR criteria were bounded horizontally and vertically by samples with radiological results below the SOR criteria. For evaluation purposes, the horizontal boundary distance was established at 15.2 m (50 ft), while the vertical boundary depth was established at 1.52 m (5 ft). If soil samples above the SOR criteria were unbounded beyond these distances by soil samples below the SOR criteria, then additional soil samples were proposed. Additionally, if an existing sample location was below the SOR criteria but was not analyzed for thorium-230 (Th-230), and was unbounded as described above, that location was proposed for reanalysis. The evaluation methods described above were evaluated for every historical sample depth across SLAPS and the CPs. The results of this evaluation was a proposed surface sampling plan and boring plan for subsurface soil samples (USACE, 1998a). The planned sampling was intended to provide a more complete site evaluation. These sampling interests were not intended

to limit waste characterization activities or more detailed sampling regimes for removal /remediation concerns.

The surface soil sampling plan included sample depths from 0 to 15 cm (0.5 ft) and 30.5 to 61 cm (1 to 2 ft). The boring plan included three types of soil borings - shallow, medium, and deep. The shallow borings were advanced to 1.52 m (5 ft) with 1 soil sample collected from the 0.9 to 1.5 m (3- to 5-ft) depth. The medium borings were advanced to 3 m (10 ft) with 1 soil sample collected from the 2.4 to 3 m (8 to 10 ft) depth. The deep borings were drilled to 6 m (20 ft) deep with 2 soil samples collected from the 3.9 to 4.6 m (13 to 15 ft) and the 5.5 to 6 m (18 to 20 ft) depth. In each instance, the geographic location and depth of sample were determined prior to mobilization to the site, based on data already collected. Since only data gaps were targeted for sampling, no samples were collected when the soil- sampling device could not reach the desired depth.

2.2.1.1 Surface and Shallow Boring Soil Sampling

Sampling protocols that were implemented for the collection of the five types of soil samples (surface soil, shallow soil, shallow borings, medium borings, and deep borings) are described in detail in the USACE Environmental Sampling Instructions (USACE, 1998a). Surface soil samples were collected using the trowel-and-scoop method. The shallow soil samples were collected using either three-inch-diameter continuous split spoons, the Central Mine Equipment (CME) continuous barrel sampler, a direct-push technique, or the manual methods described in the EM 200-1-3 manual (USACE, 1994b). With the trowel-and-scoop method, the top layer of soil to the desired sample depths was removed with a pre-cleaned or decontaminated trowel. A pre-cleaned, stainless-steel scoop or trowel was then used to collect a sample from the desired depth.

2.2.1.2 Medium and Deep Sampling Procedures

The deep borings were collected using a CME 75 auger rig equipped with a 5-ft CME sampler or by a Geoprobe. The CME sampler or the continuous barrel sampler collects samples in 5 ft increments. The split barrel sampler is used in conjunction with the hollow-stem auger rig. The 10 cm (4-in)-diameter sampler fits inside the lead hollow-stem auger and collects soil as the auger is advanced into the soil. The sampler is then withdrawn from the boring and opened in a similar fashion to the split spoon sampler. The direct-push technology sample collection method involves a Geoprobe® and a 0.6 m (2 ft) or 1.2 m (4 ft) long stainless-steel sample tube. The stainless-steel sample tube is fitted with a disposable, internal acetate liner and the tube is then equipped with a cutting shoe which is pushed into the ground. The tube is then retrieved from the ground, the cutting shoe is removed, and the internal acetate liner is removed from the stainless-steel tube. The acetate liner is then cut lengthwise with a pre-cleaned stainless-steel knife. All sampling equipment that contacts the soil during collection activities was decontaminated between sample collection points. Decontamination procedures for sampling equipment were presented in the *Site Safety and Health Plan (SSHP) for Site Activities at the St. Louis Airport Site* (USACE, 2000).

2.2.2 Sample Description and Location

During the collection of soil samples and the installation of the soil borings, logging of the soil was completed in accordance with the USACE Logging Manual (USACE, 1998a). Each soil

collection interval was identified and classified according to the USCS. The soil descriptions were documented on the drilling log.

Soil samples collected were screened in the field for the relative concentration of total VOCs and beta-gamma activity. An organic vapor analyzer (OVA) equipped with a photoionization detector (PID) was used to screen the soil. Calibration procedures for the OVA are presented in the *Quality Assurance Project Plan (QAPP) for the St. Louis Airport Site and Contiguous Properties* (SAIC, 1998). Each soil sample was screened with a beta-gamma detector prior to sample handling. Calibration procedures for a scintillation detector were presented in the QAPP (SAIC, 1998).

The location of all borings and soil sampling points were flagged and field located using GPS prior to sampling. The GPS was referenced to the Missouri State Plane Grid established at the site for the geophysical survey.

2.3 GROUND-WATER WELL INSTALLATION, DEVELOPMENT, AND SURVEYING

Ground-water monitoring locations are shown on Figure 2-1. Thesc locations were chosen to define background chemistry parameters, further define the impacts of radionuclide, organic, and inorganic constituents to the groundwater, and provide for additional points for compliance monitoring. Input from the (ground water) Technical Working Group was solicited prior to finalization of well locations. As of September 1999, eight wells have been installed.

2.3.1 Installation

The drilling and sampling of subsurface materials and the installation of ground-water monitoring wells at SLAPS and the CPs were completed in accordance to protocol and specifications of USACE Logging Manual and Manual 1110-1-4000 (USACE, 1994a). The "Monitor Well Design, Installation, and Documentation" manual (USACE, 1994a) provides the basic elements for consideration for monitoring well work such as drilling operations, borehole logging, well installation, and other elements. Requirements of the MDNR regarding well drilling, installation, and construction (RSM.256.600-640 and 10 CRS 23) were followed for the installation of monitoring wells at SLAPS. Wells were installed by a Missouri licensed driller and well installer. The soil/rock cutting and fluids produced by the drilling and installation of new wells were managed as investigation derived waste (IDW). Drilling logs are located in Appendix A.

In the upper zone boreholes, sampling work included the acquisition of continuous split-spoon samples of the soil sediments to total depth. Soil samples were lithologically described. In the new lower zone boreholes, soil samples were acquired using a split-spoon sampler in the upper 6 m (20 ft) as done for the upper zone boreholes. From a depth of 6 m (20 ft) or the top of bedrock, the subsurface material were continuously cored to obtain a 5 to 7.5 cm (2- to 3-in)-diameter core of the material. Each core sample was described by a geologist or soil scientist in accordance to protocols of the USACE Logging Manual and were screened with a PID.

The wells completed in the soil and rock units (wells MW-31-98, MW-32-98, MW-33-98, MW-34-98, PW35, PW36, PW37, and PW38) were constructed using 5 cm (2 in)-diameter PVC

screen and riser pipe. The screen of the shallow wells (MW-31, MW-32, MW-33) was placed to intercept the seasonal variation of the ground-water table. Wells PW36 and PW34 were screened within Unit 4. Well PW35 was screened within the Mississippian limestone. Monitoring wells PW37 and PW38 were screened above and below a contact between a meander of Coldwater Creek and the underlying loess.

The wells were installed in a minimum 15 cm (6 in)-diameter borehole made by hollow-stem augering methods. The screened intervals were packed with an appropriate-sized sand (Morie No. 0 sand or equivalent) by use of a tremie pipe. A minimum 0.9 m (3 ft) bentonite seal was placed on the sand pack. Bentonite pellets were used to form the seal below the water table. A cement/bentonite grout was placed from the bentonite seal to surface. A side-discharging tremie pipe was used for grout placement. A protective steel casing with a locking cap was installed on each well. The drilling and installation procedures and materials for these wells complied with the requirements of Manual EM-1110-1-4000 (Chapters 3, 4, 5, and 7).

2.3.2 Well Development

Well development was completed on the newly installed wells in accordance to USACE Manual EM 1110-1-4000 protocol (USACE, 1994a). Well development was done after the grout around a well had cured for at least 48 hours. Each well was developed prior to commencement of ground-water sampling to remove drill cuttings and fine sediment in the sand pack, maximize yield, and restore hydraulic conductivity after its installation. The well development process included pumping, bailing, and surging methods. A bailer was raised and lowered throughout the screened zone of the well. The well was then pumped until the water was clear or other criteria were met. Air was not used as part of the development process. The volume of added water (if any) was recorded and was removed from the well. The development process was completed when the turbidity of the well was as low as possible [below 50 nephelometric turbidity units (NTUs)] and minimal sediment (less than 0.2 cm (0.1 ft) remains at the well bottom. Field parameters (pH, conductivity, dissolved oxygen, and temperature) were taken before, during, and after the development process. A well development record was prepared for each well. All water and sediment removed from the new wells was disposed within the SLAPS perimeter fencc. Development of PW35 has not yielded a well with low turbidity measurements. This is attributed to the low permeability of the limestonc bedrock at this location. All other wells installed as part of this work effort were successfully developed.

2.3.3 Surveying

At the completion of monitoring well construction activities, each new well was surveyed for horizontal and vertical control in accordance to EM 1110-1-4000 protocol (Chapter 9). The elevation of the inner well casing (at a designated marked point on the rim) and the ground surface at each new location was established by a certified state surveyor. The well location was also be established in the x,y plane relative to the existing state plane coordinate system. Vertical measurements were made to the nearest 0.02 cm (0.01 ft), and horizontal measurements were taken to the nearest 30 cm (1 ft). The identification, coordinates, and elevations of the new wells will be plotted on maps to show their location with references to existing wells and other site features.

2.3.4 Geotechnical Sampling

To adequately determine the mechanisms that control contaminant transport and attenuation at SLAPS, it is necessary to identify the physical and chemical properties of the unconsolidated deposits beneath the site. At MW-34-98 continuous sampling and Shelby tube sampling was performed to the top of bedrock. The physical and morphological properties of the material was logged in accordance with the USACE Logging Manual. A Shelby tube was collected on 1.5 m (5 ft) spacing. Geotechnical determinations were visual classification (ASTM D 2488-90), moisture content (ASTM D2217-90), grain size analysis (ASTM D422-63), and plasticity tests (ASTM D4318). Hydraulic conductivity tests using the triaxial cell backpressure method (ASTM D5084-90) were performed on Shelby tube samples. The results of physical testing will identify the transmissive character of each identifiable unit or member. This data was used to determine hydraulic characteristics of each unit.

Rock core was collected from PW35 to confirm bedrock lithology. The core was examined by both USACE and MDNR. Examination of the core showed it to be a tight, massive limestone consistent with the typical description of the Mississippian Age limestone.

2.4 GROUND-WATER SAMPLING

Several ground-water sampling events have been performed previously at SLAPS (USACE, 1998b). Many of these previous sampling events have focused on the presence of radionuclides. Baseline chemical sampling establishing the concentration trends for inorganic and organic chemicals continued to be needed to clarify site conditions. One sampling event was performed in July and August of 1998. Additional sampling events were performed in the winter of 1998, spring of 1999 and fall of 1999. Data presented in this document is limited to the summer 1998 data sets. The results of the additional sampling rounds are presented in the Environmental Monitoring Annual Reports for 1998 and 1999.

The baseline ground-water sampling event, including sampling for organic and inorganic parameters, was performed prior to the installation of any new monitoring wells in July and August of 1998. For this initial event, ground-water samples were collected from 24 selected monitoring wells at North County Properties. Results of this sampling effort were used to verify the findings of the 1997 ground-water sampling event and provide guidance for placement of new monitoring wells.

Ground-water sampling and sample analyses tasks followed EM 200-1-3, Appendix C, and Appendix E (USACE, 1994b). Collection of ground-water samples from monitoring wells was accomplished in three general steps: 1) well purging; 2) measurement of field parameters; and 3) ground-water sample collection. Ground-water levels in each of the wells were measured with an electronic water level indicator on a single day prior to ground-water purging and sampling. The measurement was made to the nearest 0.01 ft from the marked top of the riser pipe of the well.

Purging and sampling of monitoring wells was accomplished using a peristaltic pump. The inlet of the tubing was placed at the midpoint of the screen interval when the screen was below the water table. This level was adjusted for wells where the static water level was within the well screen.

Micro-purging techniques were employed in all wells to minimize the volume of purge water and minimize disturbance of the aquifer and samples. The field parameters (pH, conductivity, temperature, dissolved oxygen, and turbidity) were monitored during micro-purging. The purge rate was adjusted, as necessary, to avoid purging any well to dryness to prevent aeration and to equal the recharge of the saturated zone. Purging was considered complete when the field parameters stabilized after a minimum of 3 readings at 5-minute intervals as follows: pH - within 0.2 units; temperature - within 0.5 degrees; and other parameters - within 5 percent.

Ground-water samples acquired from all locations were analyzed for the analytes listed in Table 2-5 of the SAP (USACE, 1998a) using the methods and detection limits specified in the QAPP (SAIC, 1998). Results were reported for both filtered [0.45 micrometers (μm)] and unfiltered samples from each sampled location. A full suite of analyses were performed on all unfiltered samples. All filtered samples were analyzed for metals and radionuclides. The filtration of ground-water samples was completed in the field prior to preservation in accordance to USACE protocol (USACE, 1998a). Off-site laboratory analytical analysis of the acquired ground-water samples was provided at the confirmatory level of documentation. The analytical protocol used for the planned sampling events followed the Abbreviated Sampling Plan (dated September 1997), Appendix C of EM 200-1-3, and the project QAPP.

The collection of ground-water samples from a monitoring well began immediately after completion of purging. All ground-water samples were transferred directly into laboratory sample containers from the pump tubing. Sample containers designated for volatile organic analysis were filled so that no headspace was present in the containers. Immediately after collection of samples and completion of sample container label information, each container was placed into an ice-filled cooler to ensure preservation in accordance to EM 200-1-3 protocol. Collected samples were submitted to the selected laboratory for analyses using proper handling, shipping, and chain-of-custody procedures.

Purging and sampling equipment was decontaminated before use and between sampling locations/intervals to prevent the potential for cross-contamination of samples. The decontamination proccdure for this equipment that was in contact with the sample is presented in the SSHP (USACE, 2000). Dedicated teflon tubing was installed in each well sampled.

Generated water from purging of all wells was discharged onto the ground at the decontamination station on the SLAPS property.

SECTION 2.0

FIGURES

TABLE OF CONTENTS

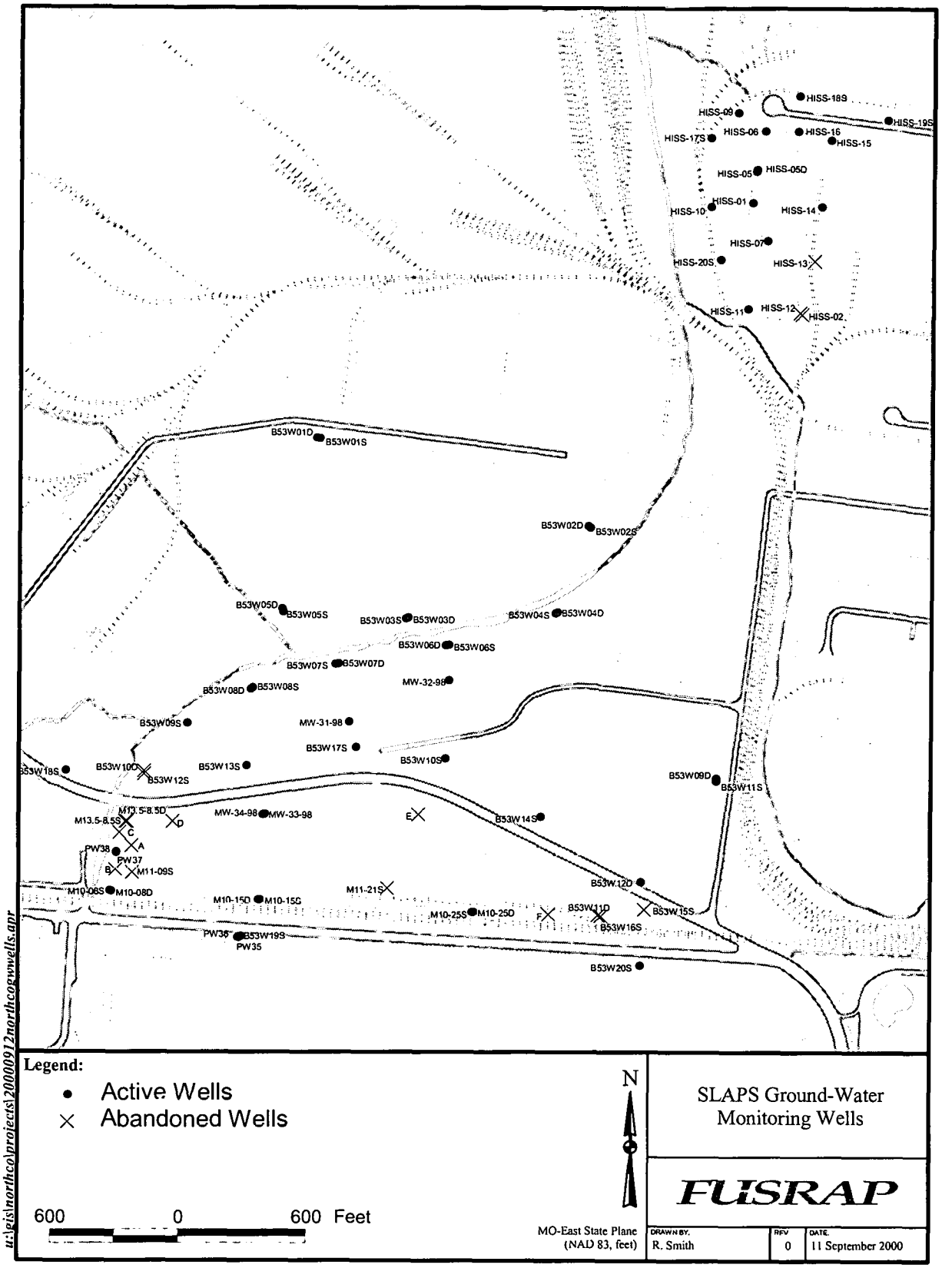


Figure: 2-1. Location Map of Ground-Water Monitoring Wells

SECTION 3.0

SITE PHYSICAL CHARACTERISTICS

3.0 SITE PHYSICAL CHARACTERISTICS

3.1 GEOPHYSICAL SURVEY RESULTS

The geophysical survey consisted of EM31 terrain conductivity, EM61 metal detection, and cesium magnetometer surveys. The surveys were completed at SLAPS prior to the mobilization of construction equipment and field storage trailers. The results of these surveys were used to identify differences in subsurface conditions across the site. The survey results are screening-level data that are not sufficiently specific to provide definitive limits of the subsurface materials. Therefore, the survey results are not used to delineate the boundaries of specific waste or debris areas, but to augment the interpretation of borehole results.

3.1.1 EM31 Survey Considerations

Terrain conductivity surveying is a reconnaissance method of determining the electric and magnetic properties of subsurface materials. The vertical dipole orientation discriminates against near-surface anomalies and has 70 percent of its signal response within the first 18 ft of the subsurface.

The measured conductivity value is dependent upon the density, permeability, moisture content, and presence or absence of electrolytes or colloids in the subsurface materials. Typically, soils have a high conductivity, and bedrock typically has a low conductivity because of the relatively low permeability and low porosity present within the rock matrix. Because of the variety of factors that affect terrain conductivity measurements, the actual magnitude of the terrain conductivity values measured is less important than the trends, variations, and anomalies in the measurements.

Since metal objects are not considered a natural part of the subsurface, the electronics of the EM31 instrumentation respond in a unique fashion when metal objects are present. The apparent subsurface conductivity, as measured by the EM31 equipment, ceases to correlate with the true conductivity of the subsurface at values greater than approximately 100 mM/m. While the electronics of the instrument allow for conductivities of up to 300 mM/m to be measured, the true conductivity is actually less than the measured conductivity at this level. The instrument's electronic configuration allows for all conductivities greater than 300 mM/m to appear as negative values. Experience shows that equipment-response negative values of conductivity often represent metal objects in the subsurface. The negative response values are also reported.

3.1.2 EM31 Survey Results

Figure 3-1 presents, in plan view, the apparent conductivity as measured at the site. The apparent conductivity data suggest that there is significant variability in the subsurface materials within the SLAPS area inside the perimeter fence. Table 3-1 presents the interpretation of the major observed anomalies in the EM31 map (Figure 3-1).

Table 3-1. EM31 Apparent Conductivity Anomalies

Anomaly	Interpretation
1	More conductive material possibly associated with building foundation
2	More conductive material possibly associated with building foundation
3	More conductive material associated with buried concrete pad
4	More conductive material - possibly buried metallic debris
5	More conductive material - possibly buried metallic debris
6	More conductive material - possibly buried metallic debris
7	Metallic features
8	More conductive material associated with soil stockpile
9	Likely associated with fence

Several areas of elevated conductivities (>13 mM/M) were measured, indicating the presence of more conductive materials or buried wastes. Anomalies 1 through 8 appear to be associated with such conductive material. Anomalies 1 and 2, located in the driving/parking area, coincides with old building foundations observed in historical aerial photographs of the site. Anomaly 3 appears to be a buried concrete pad discovered during the later excavating activities. Anomalies 4, 5, and 6 are located on the eastern portion of the site and suggest the presence of more conductive material. The EM31 data inphase response suggest that these areas may also include metal objects. Anomalies 7 and 8 are located on the western portion of the site and suggest the presence of more conductive material. During the initial site walkover, a covered and secured stockpile was discovered in the southwest area of the site. Anomaly 8 is located at this stockpile.

The effects of the metal fences are also observed as elevated conductivities near the perimeter of the site. Anomaly 9 is likely associated with the fence surrounding the site.

The large areas of slightly elevated apparent conductivity (between 4 and 13 mM/m) suggest that these areas are underlain by more conductive soil materials, and possibly the soil may contain a higher percentage of water.

3.1.3 EM61 Survey Considerations

The EM61 is a high sensitivity metal detector capable of discriminating between earth materials and metallic features such as underground storage tanks (USTs), drums, and buried metal objects.

EM61 data are relatively simple to display and analyze. Two channels of secondary responses in millivolts (mV) are measured by the coils. One channel responds to near-surface metal, while the other channel responds to deeper metallic objects. The effects of near-surface metallic objects can, thus, be subtracted from the readings. This is referred to as the differential. Peaks in the data show the locations of the metal objects.

3.1.4 EM61 Survey Results

Figure 3-2 presents, in plan view, the metallic response as measured at the site. Negative metallic responses indicate several areas where surface cultural noise (caused by power lines, metal objects, etc.) was present. The effects of the fences are observed as elevated responses (>50 mV).

As with the EM31 data, the metallic response data suggest that there is variability in the materials underlying the site. Areas of elevated metallic response (>250 mV) indicate features with significant metallic content (i.e., buried metal objects). Areas with responses of between 50 mV and 250 mV indicate materials with small amounts of metal debris. Areas with responses of less than 50 mV are expected to contain little or no metallic debris.

Table 3-2 presents the interpretation of the major observed anomalies in the EM61 map (Figure 3-2). Several areas of elevated metallic responses (>250 mV) were measured, indicating the presence of buried metallic material. Nine anomalies were identified (labeled A through I) as containing moderate to significant amounts of metallic material. Anomalies A and B coincide with the anomalies labeled 1 and 2 in the EM31 data on Figure 3-1. These anomalies coincide with the locations of a known buried building foundation. Anomalies C and G are part of the large anomaly labeled as 3 on the EM31 Figure. These two anomalies appear to be part of a buried concrete pad discovered during later excavation activities by others. Anomalies D, E, and F are located on the eastern portion of the property and suggest the presence of metallic material; together with the EM31 and magnetometer data, the EM61 data suggest that these areas include metallic material. At anomaly F, there is also surface debris containing metal objects, which may be causing interference with the EM data. Anomaly H is located in the west portion of SLAPS. This anomaly includes areas where raffinate stockpiles and empty barrels were stored (Figure 1-3).

Table 3-2. EM61 Metallic Anomalies

Anomaly	Interpretation
A	Large metallic objects associated with former building foundations
B	Large metallic objects associated with former building foundations
C	Metallic object associated with the buried concrete pad
D	Area with smaller metallic objects
E	Area with large metallic objects
F	Area with smaller metallic objects
G	Metallic object associated with the buried concrete pad
H	Area associated with soil stockpile
I	Area with small metallic object

The effects of the metal fences are also observed as elevated conductivities (50 to 100 mV) near the perimeter of the site.

3.1.5 Magnetometer Survey Considerations

The magnetometer is a high sensitivity metal detector capable of discriminating between less conductive earth materials and highly conductive metallic features such as USTs, drums, and buried

metallic waste. Magnetometer data consists of two readings of secondary responses in nanoTeslas (nT) measured by the two sensors. One set of data is the vertical magnetic gradient, and the second set of data is the total magnetic field.

3.1.6 Magnetometer Survey Results

Figure 3-3 presents, in plan view, the magnetometer responses as measured at the site. Negative metallic responses indicate several areas where surface cultural noise was present. The effects of the fences are also observed as elevated responses (>1000 nT).

As with the EM31 and EM61 data, the magnetometer response data suggest that there is variability in the materials underlying the site. Areas of elevated magnetic response (>1000 nT) indicate features with significant metallic content. Areas with responses of between 500 and 1000 nT indicate materials with small amounts of metallic material. Areas with responses of less than 500 nT are expected to contain little or no metallic debris.

Table 3-3 presents the interpretation of the major observed anomalies in the magnetometer map (Figure 3-3). Several areas of the elevated magnetic response (>1000 nT) indicate the presence of buried metallic material. Eight anomalies were identified as containing moderate to significant amounts of metallic material. Anomaly 1 is the buried building foundation previously identified by the EM31 and EM61 data. A large stockpile of utility poles is located at Anomaly 2. Anomaly 3 is also observed in the EM61 data at Anomaly I. Anomalies 4, 5, and 6 are also observed on the EM61 data as anomalies D, E, and F, respectively. The geophysical investigation is unable to provide information on the subsurface at anomalies 7 and 8 due to the abundance of surface metal and concrete debris.

Table 3-3. Cesium Magnetometer Vertical Gradient Data

Anomaly	Interpretation
1	More magnetic material - possibly associated with building foundation
2	More magnetic material - associated with debris pile
3	More magnetic buried material
4	More magnetic buried material
5	More magnetic buried material
6	More magnetic buried material
7	More magnetic buried material
8	More magnetic material - associated with soil stockpile

3.2 SITE SOILS/STRATIGRAPHY

Borings using hand augers and soil auger rigs were installed across the site in locations specified in the SLAPS SAP. Borings were not installed within the paved areas of Banshee Road and McDonnell Boulevard and within the Norfolk and Southern Railroad right-of-way due to health and safety issues (roadways), discovery of previously collected data after initiation of field activities, and a lack of access agreements. Locations are illustrated in Figures 3-4 and 3-5.

Borings completed within the SLAPS fence encountered surface fill and debris underlain by fine silts and clays (ML-CL) and unconsolidated soils. Most borings were completed to the desired depth without difficulty. Borings at the west end encountered significant concrete debris.

Soil borings completed across SLAPS penetrated predominantly the Nevin silt loam soil that has been relatively undisturbed over some of the site. Depths of disturbed soil and fill reportedly range from absent to approximately 4.3 m (14 ft) near where the drainage ditch that crosses the ballfields enters Coldwater Creek. A review of the soil boring data over most of the middle and eastern sections of SLAPS indicates predominantly undisturbed native Nevin soils with very thick black surface layers that are classified as mollic epipedons (indicative of soils formed under prairie grassland conditions). In this area of SLAPS, surface fill layers ranging from 0 to 60 cm (0 to 2 ft) thick consist of clayey subsoil materials which reportedly were placed over the site in an effort to "clay cap" the site. Other areas of SLAPS to the west and closer to Coldwater Creek reportedly encountered much thicker fill materials consisting of concrete, metal, asphalt, etc. Common, prominent soil drainage mottling was observed in the soil borings consistent with the soil survey description, and manganese stains and nodules and iron-cemented concretions were also present. The depth of the pedogenic (acted upon by current soil-forming processes) soil materials ranges from approximately 1 to 1.5 m (40 to 60 in), and below that, a mixture of silty loess and lacustrine deposits was encountered consisting of light brownish-gray silt loams (ML/CL) and silty clay loams (CL) with apparent zones of saturation.

Geotechnical analyses previously performed on SLAPS soil samples from a depth of [0-60 cm (0-2 ft)] revealed that characteristics of the soils are consistent with reported values (USDA-SCS, 1982). Three of the four samples were from the Nevin silt loam, and one was from the Nevin-Urban land complex. The samples from the Nevin silt loam had liquid limits ranging from 34 to 35 percent and plasticity indexes of 13 to 14. This agrees with reported values of 35 to 45 percent for liquid limits and 10 to 20 for plasticity indexes. One subsoil sample [collected from the 0.6 to 1.2 m (2 to 4 ft) depth interval] from the Nevin silt loam had values of 51 percent for liquid limit and 28 percent for plasticity index. Reported values for this interval are 40 to 50 percent for liquid limits and 20 to 30 percent for plasticity indexes. The sample from the Nevin-Urban land complex had a liquid limit of 35 percent and a plasticity index of 14 percent, which also agree with reported values. Data summarized in the soil survey indicate that soil permeability ranges from 4.2×10^{-4} to 1.4×10^{-3} cm/sec (0.6 to 2 in per hour) in the 0 to 1.5 m (0 to 60 in) depth in both the Nevin and Menfro soils. The average available water capacity is approximately 0.2 inches of water per inch of soil on a volume basis (USDA-SCS, 1982).

3.3 SITE HYDROGEOLOGY

The potentiometric surface of both Upper Zone (HZ-A, lithostratigraphic Units 1 and 2) and Lower Zone (HZ-B, HZ-C, HZ-D, and HZ-E, lithostratigraphic Units 3M, 3B, 4 and bedrock) wells at SLAPS was determined using data collected between June 1997 and April 2000 (Figures 1-18 through 1-29). The depth to ground-water measurements were collected by SAIC on July 7 and 8 of 1998, in 40 wells, including 26 Upper Zone wells and 14 Lower Zone wells. The June 1997, September 1997, and July 19998 depth to ground-water measurements and determined ground-water surface elevations in the monitoring wells at SLAPS and surrounding properties are presented in Table 3-4.

Table 3-4. Ground-water Surface Elevations in Monitoring Wells at SLAPS

Well Location	Casing Elevation (ft, msl)	June 1997		September 1997		July 1998	
		Depth to Ground water (ft below casing)	Ground water Elevation (ft, msl)	Depth to Ground water (ft below casing)	Ground water Elevation (ft, msl)	Depth to Ground water (ft below casing)	Ground water Elevation (ft, msl)
B53W01D	527.10	10.56	516.54	8.72	518.38	10.73	516.37
B53W01S	527.00	14.77	512.23	16.1	510.90	13.96	513.04
B53W02D	517.50	5.08	512.42	2.67	514.83	6.50	511.00
B53W02S	517.80	8.54	509.26	9.87	507.93	5.52	512.28
B53W03D	519.10	2.22	516.88	1.11	517.99	2.41	516.69
B53W03S	518.90	16.92	501.98	16.59	502.31	16.64	502.26
B53W04D	528.38	14.76	513.62	16.4	511.98	17.68	510.70
B53W04S	528.76	18.19	510.57	20.98	507.78	15.24	513.52
B53W05D	519.80	3.02	516.78	1.97	517.83	3.20	516.60
B53W05S	520.50	11.59	508.91	17.28	503.22	10.09	510.41
B53W06D	526.13	10.70	515.43	11.78	514.35	10.86	515.27
B53W06S	525.87	14.47	511.40	16.97	508.90	13.18	512.69
B53W07D	526.53	10.57	515.96	9.93	516.6	10.73	515.80
B53W07S	525.21	18.88	506.33	19.6	505.61	17.41	507.80
B53W08D	525.57	9.62	515.95	8.90	516.67	9.78	515.79
B53W08S	525.04	15.57	509.47	16.82	508.22	14.24	510.80
B53W09D	522.6	5.10	517.50	5.53	517.07	4.68	517.92
B53W09S	524.35	14.30	510.05	14.82	509.53	13.52	510.83
B53W10S	529.74	8.97	520.77	10.77	518.97	8.47	521.27
B53W11D	537.60	13.72	523.88	13.37	524.23	14.27	523.33
B53W11S	522.82	8.09	514.73	7.80	515.02	6.94	515.88
B53W12D	530.05	9.73	520.32	9.33	520.72	8.67	521.38
B53W12S	526.90	13.70	513.20	13.35	513.55	12.53	514.37

Table 3-4. Ground Water Surface Elevations in Monitoring Wells at SLAPS (Cont'd)

Well Location	Casing Elevation (ft, msl)	June 1997		September 1997		July 1998	
		Depth to Ground water (ft below casing)	Ground water Elevation (ft, msl)	Depth to Ground water (ft below casing)	Ground water Elevation (ft, msl)	Depth to Ground water (ft below casing)	Ground water Elevation (ft, msl)
B53W13S	527.00	10.15	516.85	11.31	515.69	8.62	518.38
B53W14S	531.42	7.91	523.51	10.90	520.52	6.87	524.55
B53W15S	531.80	5.88	525.92	7.28	524.52	3.57	528.23
B53W16S	537.60	9.38	528.22	8.65	528.95	8.91	528.69
B53W17S	529.54	10.41	519.13	13.82	515.72	7.64	521.90
B53W18S	524.07	12.72	511.35	11.28	512.79	12.51	511.56
B53W19S	525.74	7.30	518.44	8.37	517.37	6.69	519.05
B53W20S	541.43	10.22	531.21	11.68	529.75	7.76	533.67
A	526.6	13.28	513.32	11.50	515.10	NM	NM
B	528.9	15.83	513.07	11.85	517.05	NM	NM
C	526.5	14.32	512.18	11.50	515.0	NM	NM
D	524.2	3.84	520.36	2.89	521.31	2.79	521.41
E	531.3	8.25	523.05	9.15	522.15	7.63	523.67
F	544	14.66	529.34	11.60	532.40	NM	NM
M10-15D	526.40	10.43	515.97	10.32	516.08	10.63	515.77
M10-15S	527.50	4.61	522.89	5.73	521.77	3.10	524.40
M10-25D	534.21	8.38	525.83	9.24	524.97	8.16	526.05
M10-25S	534.26	8.99	525.27	8.25	526.01	7.27	526.99
M10-8D	520.32	4.93	515.39	4.16	516.16	5.00	515.32
M10-8S	521.17	10.47	510.70	9.58	511.59	7.68	513.49
M11-21	530.20	5.55	524.65	6.69	523.51	NM	NM
M11-9	526.8	10.92	515.88	11.13	515.67	9.15	517.65
M13.5-8.5D	522.90	9.36	513.54	9.03	513.87	NM	NM
M13.5-8.5S	523.00	10.53	512.47	9.75	513.25	NM	NM

NM - not measured (decommissioned well).

3.3.1 Potentiometric Surfaces of Upper Zone (HZ-A)

The potentiometric surface of the Upper HZ (HZ-A), based on July 1998 data, is presented on Figure 1-19. The depth to ground water in this zone as of July 1998 ranged between 0.9 and 5.5 m (3 and 18 ft) below grade level (bgl). As observed in September 1997, the highest potentiometric surface measurements were taken in wells located at the eastern end of SLAPS, which corresponds to the area of highest surface topography. The Upper Zone (HZ-A) potentiometric surface varied between 533.67 ft msl as measured in well B53W20S and 513.49 ft msl in well M10-8S. The potentiometric surface of HZ-A declines in elevation in northerly, northwesterly, and westerly directions from the eastern end of SLAPS towards Coldwater Creek as illustrated on Figures 1-18 though 1-23. The horizontal gradient of the HZ-A in July 1998 ranged between 0.006 and 0.018. The ground-water flow direction in the HZ-A at SLAPS, interpreted as perpendicular to ground-water equipotential contours, is westerly to northwesterly toward Coldwater Creek. Shallow ground-water beneath CPs located north of the creek also converge to the creek as shown on Figure 1-19. Localized steep hydraulic gradients appear to occur along Coldwater Creek at the western end of SLAPS and near the central part of the ballfields. Shallow ground water of the unconfined Upper Zone is interpreted to discharge into Coldwater Creek.

The potentiometric surface elevations in the Upper Zone (HZ-A) wells measured in July 1998 are, in most cases, higher compared to elevations of September 1997 (see Figure 1-18). Although the potentiometric surface configuration is very similar to that determined in September 1997, the 1998 measured ground-water surface elevations in many wells were approximately 0.3 to 1.2 m (1 to 4 ft) higher, with some wells exceeding 1.5 m (5 ft). The potentiometric surface of Well D, which has remained relatively constant, may be the result of a perched ground-water system as previously reported (USACE, 1998b).

3.3.2 Potentiometric Surface of Lower Zone (HZ-C)

The potentiometric surface of the Lower Zone (HZ-C) based on September 1997 through April 2000 data is illustrated on Figures 1-24 through 1-29. As shown by these maps, the highest potentiometric surface elevations for HZ-C are measured in the northwestern portion of the site. Based on the April 2000 map (Figure 1-29), the horizontal gradient is approximately 0.002 in a northeasterly direction from the highest HZ-C potentiometric surface in the vicinity of wells B53W01D and B53W05D. As previously reported, the potentiometric surface of HZ-C does not appear influenced by Coldwater Creek (USACE, 1998b).

3.3.3 Vertical Gradients

The vertical gradients between the Upper (HZ-A) and Lower Zones (HZ-C) were evaluated by comparing the April 2000 potentiometric surface measurements of three well clusters. The potentiometric surfaces recorded in well clusters B53W01S/B53W01D, B53W05S/B53W05D, and B53W08S/B53W08D located in the northern portion of the site, in the ballfields and along Coldwater Creek, exhibit an upward vertical gradient. The difference in hydraulic head ranges between approximately 5 to 10 ft in these wells. Less data is available concerning the southeastern portion of the site, but based on the historical data and a comparison of the potentiometric maps for

HZ-A and HZ-C, a downward gradient potential is interpreted to occur beneath much of the eastern portion of SLAPS.

3.4 GEOTECHNICAL INVESTIGATION

MW-34-98 was continuously sampled as it was bored from surface to its final depth of 86 ft. Undisturbed soil samples were collected using a Shelby tube on approximate 1.5 m (5 ft) centers during the augering. Samples were collected from each 1.5 m (5 ft) interval and submitted for radionuclide analysis. Upon confirmation by the radiological analysis that no radionuclide exceeding release levels were in the soils, the Shelby tubes were submitted to a geotechnical laboratory for analysis.

The results of the geotechnical analyses are presented in Table 3-5. Laboratory descriptions of the recovered soils consistently identified the soils as clay with varying degrees of iron (Fe) staining and occasional silt zones. The intervals from 5 to 47 ft consistently noted rare small roots and root holes in the recovered Shelby tubes. The water content throughout this interval varied between 21 and 28 percent and the Plasticity Index (PI) varied from 6 to 32. Grain sizes as determined by hydrometer are less than 0.08 millimeters (mm). This interval generally corresponds to the Units 2 and 3T. The interval from 47 to 82 ft below grade reported water content from 28 to 53 percent with a PI varying from 5 to 62.Grain sizes as measured by hydrometer are consistently smaller than 0.08 mm. This interval generally corresponds to the Units 3M and 3B.The final Shelby tube sample collected above the limestone bedrock was from the interval 85 to 86.8. This interval was described as a sandy clay with 20 percent water and a PI of 9. This sample contained about 4 percent sand grains and 20 percent silt-sized particles. This interval corresponds to the lithostratigraphic Unit 4 at SLAPS.

Table 3-5. Geotechnical Summary of Results

Sample No.	Depth (ft)	Description	Water Content (%)	Atterberg limits				Permeability (cm/sec)
				LL	PL	PI	+No. 40	
SLA 02077	5.0-7.0	Brown lean clay with some small roots and root holes, some iron stains, rare small iron nodules, sl blocky	28	37	23	14	<1	2.7 E-06
SLA 02078	10.0-12.0	Grey silt with some iron stains, occasional iron nodules, some roots	28	31	25	6	<1	6.0E-07
SLA 02079	15.0-17.0	Pinkish-gray lean clay with some iron stains, occasional iron nodules, some roots, occasional root holes	27	33	23	10	<1	1.3E-05
SLA 02081	25.0-27.0	Grey lean clay with some iron stains, occasional iron nodules, rare small roots	22	49	17	32	<1	7.5E-09
SLA 02082	30.0-32.0	Pinkish grey lean clay, with numerous iron stains, and iron nodules, slightly blocky	21	36	18	18	<1	7.6E-08
SLA 02083	35-37.0	Pinkish grey lean clay, with some iron stains, occasional iron nodules, occasional small roots, rare black organics	26	37	17	20	<1	1.3E-07
SLA 02084	45.0-46.4	Light grey silt with occasional small roots and root holes, occasional thin f sand stringers	26	31	24	7	<1	3.8E-07
	46.4-47.0	Medium grey lean clay with rare small roots, some thin f sand stringers	21	NA	NA	NA	NA	NA
SLA 02085	50.0-52.0	Light grey silt with thin grey clay stringers	30	30	24	6	<1	1.9E-06
SLA 02086	55.0-57.0	Gray fat clay with rare silt stringers	47	71	23	48	<1	3.4E-08
SLA 02087	60.0-62.0	Dark grey fat clay with iron stains on bedding planes	44	66	24	42	<1	1.9E-08
SLA 02088	65.0-67.0	Gray fat clay with rate light grey silt stringers	53	67	24	43	<1	1.7E-08
SLA 02089	70.0-72.0	Grey fat clay with iron stains on bedding planes	49	72	24	48	<1	1.6E-08
SLA 02090	75.0-77.0	Dark grey fat clay, with iron stains	51	93	31	62	<1	1.4E-08
SLA 02091	80.0-82.0	Dark brown silt, with some clay	28	28	23	5	<1	4.6E-07
SLA 02092	85.0-86.8	Dark grey sandy clay with occasional grey fine sand stringers	20	26	17	9	5-10	2.1E-07

NA - Analysis still being performed.

SECTION 3.0

FIGURES

TABLE OF CONTENTS

Figure 3-1 EM-31 Inphase Response Data at the St. Louis Airport Site

Figure 3-2 EM-61 Differential Response at the St. Louis Airport Site

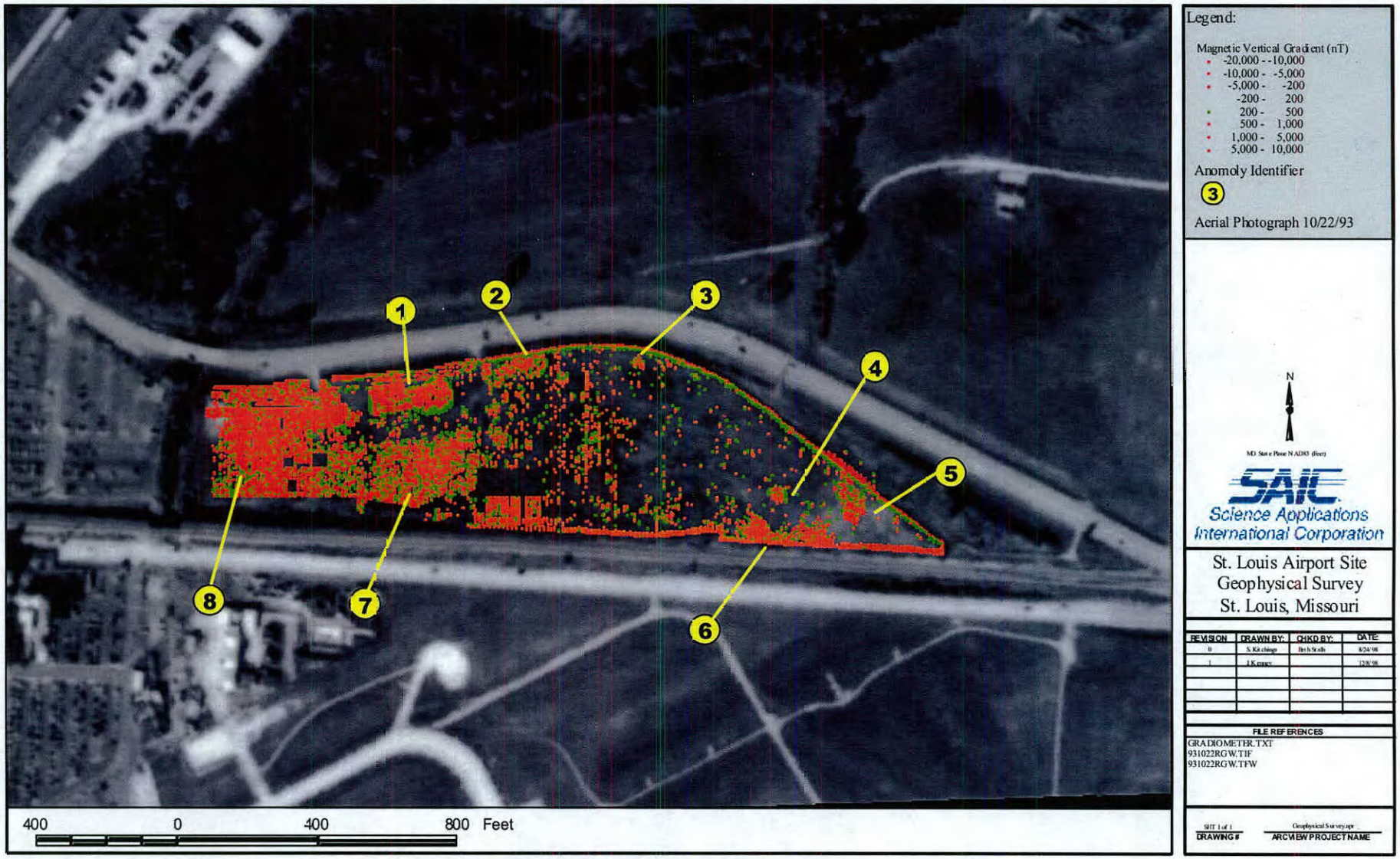


Figure 3-3 Magnetic Vertical Gradient at the St. Louis Airport Site

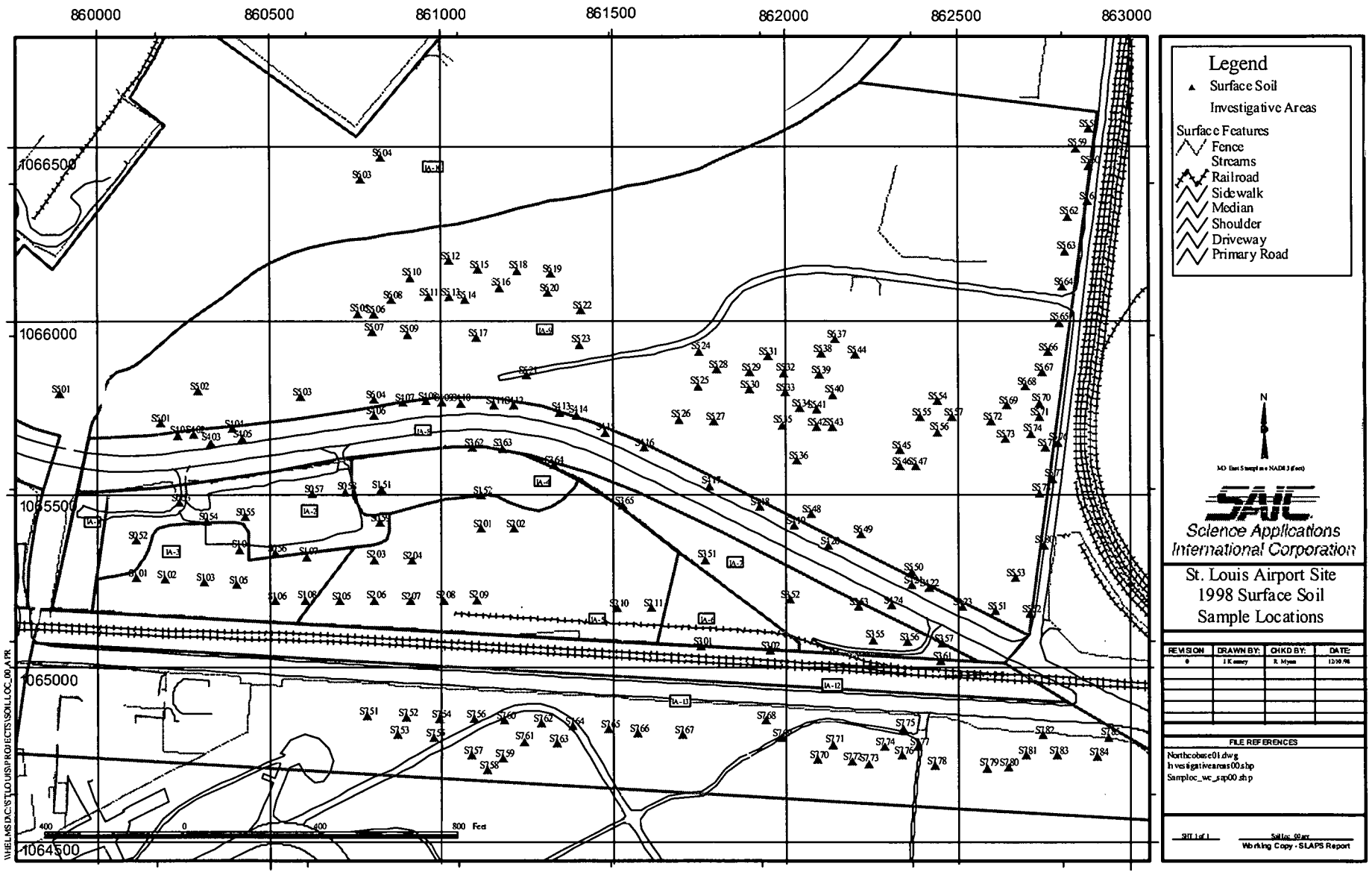


Figure 3-4. 1998 Surface Soil Sample Locations

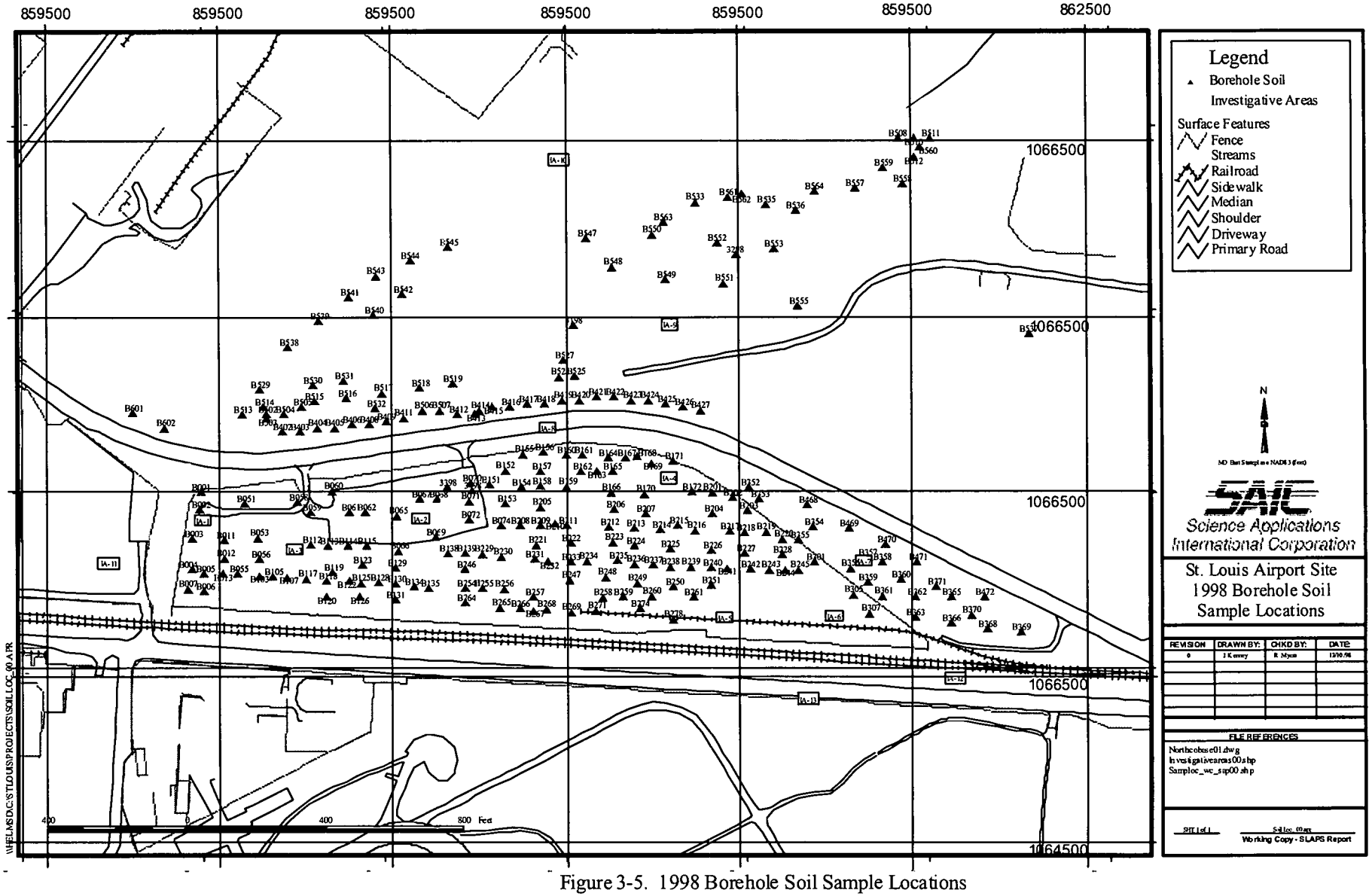


Figure 3-5. 1998 Borehole Soil Sample Locations

SECTION 4.0

RADIOLOGICAL AND CHEMICAL CHARACTERISTICS

4.0 RADIOLOGICAL AND CHEMICAL CHARACTERISTICS

Soil and ground-water samples were analyzed in SLAPS for the list of parameters identified in the SLAPS SAP (USACE, 1998a). Analyses were conducted by the on-site USACE radiological laboratory and by Quanterra Analytical Services Laboratory (St. Louis, Missouri). The list of site-specific PCOCs and investigative action levels (IALs) was provided in the SAP and is identified on Table 4-1. These PCOCs and IALs will be used for interpreting the results of the 1998 soil and ground-water sampling in addition to previous and historical data collected at the site. Appendix G contains the Quality Control Summary Report (QCSR) which has the laboratory analysis at SLAPS and the CPs.

4.1 BACKGROUND CONDITIONS

Soil locations were identified to represent background conditions (Figure 4-1). Samples from these locations were collected using the procedures identified in the SAP, and the results are discussed in the following sections. The sampling locations were chosen because they matched soils mapped at the investigation area, were historically unrelated to any FUSRAP activity, and lacked industrial development.

4.1.1 Background Concentrations in Soil

Background samples were collected from 14 sites at Howderschell Park, Abuchon Park, and adjacent to Interstate 70 south of the airport during the 1998 characterization sampling activities. Three locations (B801, B802, and B803) were soil borings with sampling performed to a depth of 4.9 m (16 ft). The remaining 11 locations (S801 through S811) collected surface soil samples at 0 to 0.15 m (0.5 ft). This resulted in a total of 23 samples analyzed for the suite of parameters identified in the SAP.

The RI addendum historical data (DOE, 1994) from background areas contained results for 10 samples for inorganics, semi-volatile organics, and volatile organic compounds. No analyses were reported for herbicides, pesticides, or PCBs in the addendum. A detailed summary of the 1998 background soils results is included in Table 4-2, and the sample locations are shown on Figure 4-1.

The recorded descriptions of the soil materials encountered in the background borings indicate within the surface 0.6 m (2 ft), ML and CL (silt and silty clay textures) are present. Dark colored soils with a soft (dry) consistency (typical of silty mollic epipedons) are described. These characteristics indicate remnants of the Nevins soils or similar soils in an urban setting. Beneath the surface 0.6 m (2 ft), textures of CL (silty clay and silty clay loam) were reported and soil consistency becomes more firm and hard with depth.

Table 4-1. List of PCOCs and IALs for SLAPS and CPs

	Constituent	Media With Elevated Detects	SSL	Potential Soil IAL	Source	Potential G.W. IAL	Source
Radionuclides	Ra-226	S, W, O	No	5/15 pCi/g	DOE/NRC	20 pCi/L	MCL MDNR (Ra-226 + Ra-228)
	Th-230	S, W, O	No	5/15 pCi/g	DOE/NRC	20 pCi/L	MCL
	Th-232	S, W, O	No	5/15 pCi/g	DOE/NRC	20 pCi/L	MCL
	U-Total (234, 235, 238)	G, S, W, O	No	50/100 pCi/g	DOE/NRC	14 pCi/L (20 µg/L)	MCL
	Ac-227	NT	No	2.7/8.9 pCi/g	EPA PRGs* (Res/Ind)	0.14 pCi/L	EPA PRGs* (Res)
	Pa-231	NT	No	1.3/5.9 pCi/g	EPA PRGs* (Res/Ind)	0.32 pCi/L	EPA PRGs* (Res)
Inorganics	Arsenic (As)	G, S, O	Yes	11; 23/610 mg/kg	Missouri ASL; RBC (Res/Ind)	50 µg/L	MCL
	Barium (Ba)	S, W	Yes	3,900; 5,500/140,000 mg/kg	Missouri ASL; RBC (Res/Ind)	2000 µg/L	MCL
	Beryllium (Be)	W	Yes	1.2; 0.15/1.3 mg/kg	Missouri ASL; RBC (Res/Ind)	4 µg/L	MCL
	Cadmium (Cd)	S, W	Yes	28; 39/1,000 mg/kg	Missouri ASL; RBC (Res/Ind)	5 µg/L	MCL
	Chromium (Cr)	O	Yes	280; 50,000; 78,000/100,000 mg/kg	Missouri ASL; RBC (Res/Ind)	100 µg/L	MCL
	Cobalt (Co)	S, W	No	4,700/120,000 mg/kg	RBC (Res/Ind)	250 µg/L	SMCL
	Copper (Cu)	S, W, O	No	3,100/82,000 mg/kg	RBC (Res/Ind)	1/1.3 mg/L	SMCL/MCL
	Lead (Pb)	S, W, O	No	240; 400 mg/kg	Missouri ASL; EPA Guidance	15 µg/L	MCL
	Mercury (Hg)	S	Yes	17; 23/610 mg/kg	Missouri ASL; RBC (Res/Ind)	2 µg/L	MCL
	Molybdenum (Mo)	S, W, O	No	280; 390/10,000 mg/kg	Missouri ASL; RBC (Res/Ind)	180 µg/L	RBC (tap water)
	Nickel (Ni)	S, O	Yes	1,100; 1,600/41,000 mg/kg	Missouri ASL; RBC (Res/Ind)	100 µg/L	MCL
	Nitrate	G	No	130,000/1,000,000 mg/kg	RBC (Res/Ind)	10 mg/L	MCL
	Selenium (Se)	G, S, W	Yes	280; 390/10,000 mg/kg	Missouri ASL; RBC (Res/Ind)	50 µg/L	MCL
	Silver (Ag)	W	Yes	280; 390/10,000 mg/kg	Missouri ASL; RBC (Res/Ind)	100 µg/L	SMCL
	Thallium (Tl)	W	Yes	3.9; 6.3/160 mg/kg	Missouri ASL; RBC (Res/Ind)	2 µg/L	MCL
	Vanadium (V)	S, O, W	Yes	390; 550/14,000 mg/kg	Missouri ASL; RBC (Res/Ind)	260 µg/L	RBC (tap water)
	Zinc (Zn)	S, O, W	Yes	17,000; 23,000/610,000 mg/kg	Missouri ASL; RBC (Res/Ind)	5 mg/L	SMCL
Organics	Toluene	S	Yes	490; 16,000/410,000 mg/kg	Missouri ASL; RBC (Res/Ind)	1000 µg/L	MCL
	Trichloroethene (TCE)	G, S,	Yes	340; 58/520 mg/kg	Missouri ASL; RBC (Res/Ind)	5 µg/L	MCL
	Dichloromethane (methylene chloride)	G	Yes	670; 85/760,000 mg/kg	Missouri ASL; RBC (Res/Ind)	5 µg/L	MCL
	trans-1,2-Dichloroethene	S	Yes	1,100; 1,600/41,000 mg/kg	Missouri ASL; RBC (Res/Ind)	100 µg/L	MCL
	Heptachlor	S	Yes	1.1; 0.14/1.3 mg/kg	Missouri ASL; RBC (Res/Ind)	0.4 µg/L	MCL
	Polychlorinated Biphenyls (PCBs)	NT	Yes	0.32/2.9 mg/kg	RBC (Res/Ind)	0.5 µg/L	MCL

NA = Not Applicable

G = Groundwater; S = Soil; W = former Wastes; O = original Ores; NT = not tested sufficiently

IAL = Investigative Action Level; ASL = Any use Soil Level; RBC = Risk-Based Concentration Level (Soil Ingestion), EPA Region III; MCL = Maximum contaminant Level, EPA and Missouri Drinking Water Standard; Res = Residential criteria; Ind = Industrial criteria

SMCL = Secondary Maximum Contaminant Level, EPA and Missouri drinking water criteria

SSL = Soil Screening Level; Soil Screening Guidance: Users Guide, EPA, July 1996

*10^{-6} total pathway risk-based preliminary remediation goals (PRGs) (http://risk.lsd.ornl.gov/homepage/rap_tool.htm), February 3, 1998, last revision.

Table 4-2. Summary of SLAPS 1998 Soil Characterization Data - Background Area

Media	Group	CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean	Investigative Action Level
RADIONUCLIDES														
Soil	All Depths	14274829	BKGD	RALPHA	Thorium-228	pCi/g	1.12	0.32	0.63	1.93	23/ 23	L	1.25	
Soil	All Depths	14269637	BKGD	RALPHA	Thorium-230	pCi/g	1.65	0.59	0.94	2.89	23/ 23	L	1.89	5.0
Soil	All Depths	NS1554	BKGD	RALPHA	Thorium-232	pCi/g	0.99	0.27	0.53	1.52	23/ 23	N	1.08	5.0
Soil	All Depths	14952400	BKGD	RGAMM	Actinium-227	pCi/g	0.41	0.25	0.15	0.82	17/ 23	N	0.50	2.7
Soil	All Depths	14596102	BKGD	RGAMM	Americium-241	pCi/g	0.01	0.03			0/ 23	D	0.02	
Soil	All Depths	10045973	BKGD	RGAMM	Cesium-137	pCi/g	0.12	0.14	0.05	0.39	11/ 23	D	0.17	
Soil	All Depths	14331852	BKGD	RGAMM	Protactinium-231	pCi/g	0.28	0.36	1.06	1.13	2/ 23	D	0.41	1.3
Soil	All Depths	13966002	BKGD	RGAMM	Potassium-40	pCi/g	14.90	1.15	12.73	17.28	23/ 23	N	15.30	
Soil	All Depths	13982633	BKGD	RGAMM	Radium-226	pCi/g	0.73	0.11	0.56	0.91	23/ 23	L	0.77	5.0
Soil	All Depths	15262201	BKGD	RGAMM	Radium-228	pCi/g	0.88	0.09	0.72	1.08	23/ 23	L	0.92	
Soil	All Depths	15117961	BKGD	RGAMM	Uranium-235	pCi/g	0.07	0.07	0.25	0.25	1/ 23	D	0.09	50.0
Soil	All Depths	24678828	BKGD	RGAMM	Uranium-238	pCi/g	1.08	0.33			0/ 23	D	1.20	50.0
INORGANICS														
Soil	All Depths	7429905	BKGD	INORG	Aluminum	mg/kg	7400.00	1750.00	5030.00	11400.00	23/ 23	L	8080.00	
Soil	All Depths	7440360	BKGD	INORG	Antimony	mg/kg	2.07	0.89	4.50	5.20	2/ 23	D	2.38	
Soil	All Depths	7440382	BKGD	INORG	Arsenic	mg/kg	7.92	3.36	4.30	18.00	23/ 23	L	9.19	11
Soil	All Depths	7440393	BKGD	INORG	Barium	mg/kg	139.00	31.70	102.00	251.00	23/ 23	X	150.00	3,900
Soil	All Depths	7440417	BKGD	INORG	Beryllium	mg/kg	0.29	0.05			0/ 23	D	0.31	1.2
Soil	All Depths	7440428	BKGD	INORG	Boron	mg/kg	4.78	2.19	2.80	9.90	20/ 23	N	5.57	
Soil	All Depths	7440439	BKGD	INORG	Cadmium	mg/kg	0.26	0.15	0.36	0.62	6/ 23	D	0.31	28
Soil	All Depths	7440702	BKGD	INORG	Calcium	mg/kg	7580.00	8350.00	1700.00	28900.00	23/ 23	X	10600.00	
Soil	All Depths	7440473	BKGD	INORG	Chromium	mg/kg	11.60	2.07	8.10	16.50	23/ 23	L	12.40	280
Soil	All Depths	7440484	BKGD	INORG	Cobalt	mg/kg	6.46	2.23	2.70	11.90	23/ 23	L	7.45	4,700
Soil	All Depths	7440508	BKGD	INORG	Copper	mg/kg	12.90	3.05	8.50	22.30	23/ 23	L	14.10	3,100
Soil	All Depths	7439896	BKGD	INORG	Iron	mg/kg	13800.00	4380.00	8180.00	27100.00	23/ 23	L	15400.00	
Soil	All Depths	7439921	BKGD	INORG	Lead	mg/kg	26.10	19.40	7.40	79.70	23/ 23	L	37.20	240
Soil	All Depths	7439932	BKGD	INORG	Lithium	mg/kg	4.55	2.06	3.60	8.10	15/ 23	N	5.29	
Soil	All Depths	7439954	BKGD	INORG	Magnesium	mg/kg	4530.00	5140.00	1210.00	18400.00	23/ 23	X	6370.00	
Soil	All Depths	7439965	BKGD	INORG	Manganese	mg/kg	599.00	260.00	191.00	1090.00	23/ 23	L	741.00	
Soil	All Depths	7439976	BKGD	INORG	Mercury	mg/kg	0.07	0.14	0.06	0.69	7/ 23	D	0.12	17

Table 4-2. Summary of SLAPS 1998 Soil Characterization Data - Background Area (Cont'd)

Media	Group	CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean	Investigative Action Level
Soil	All Depths	7439987	BKGD	INORG	Molybdenum	mg/kg	0.57	0.34	1.00	1.80	3/ 23	D	0.69	280
Soil	All Depths	7440020	BKGD	INORG	Nickel	mg/kg	15.20	8.44	5.70	47.00	23/ 23	L	18.30	1,100
Soil	All Depths	7440097	BKGD	INORG	Potassium	mg/kg	811.00	185.00	514.00	1220.00	23/ 23	N	878.00	
Soil	All Depths	7782492	BKGD	INORG	Selenium	mg/kg	0.27	0.16	0.34	0.55	7/ 23	D	0.33	280
Soil	All Depths	7440224	BKGD	INORG	Silver	mg/kg	0.37	0.02			0/ 23	D	0.38	280
Soil	All Depths	7440235	BKGD	INORG	Sodium	mg/kg	110.00	63.30	51.40	279.00	20/ 23	L	149.00	
Soil	All Depths	7440246	BKGD	INORG	Strontium	mg/kg	17.30	5.36	10.30	26.00	23/ 23	X	19.20	
Soil	All Depths	7440280	BKGD	INORG	Thallium	mg/kg	0.33	0.15			0/ 23	D	0.39	3.9
Soil	All Depths	7440326	BKGD	INORG	Titanium	mg/kg	183.00	46.10	101.00	269.00	23/ 23	N	200.00	
Soil	All Depths	7440611	BKGD	INORG	Uranium	mg/kg	7.54	0.44			0/ 23	D	7.70	
Soil	All Depths	7440622	BKGD	INORG	Vanadium	mg/kg	19.70	4.16	14.40	31.00	23/ 23	L	21.30	390
Soil	All Depths	7440666	BKGD	INORG	Zinc	mg/kg	64.40	50.90	35.40	278.00	23/ 23	X	82.70	17,000
HERBICIDES														
Soil	All Depths	93765	BKGD	ORHERB	2,4,5-T	mg/kg	0.01	0.00			0/ 23	D	0.01	
Soil	All Depths	93721	BKGD	ORHERB	2,4,5-TP (Silvex)	mg/kg	0.01	0.00			0/ 23	D	0.01	
Soil	All Depths	94757	BKGD	ORHERB	2,4-D	mg/kg	0.05	0.00			0/ 23	D	0.05	
Soil	All Depths	94826	BKGD	ORHERB	2,4-DB	mg/kg	0.05	0.00			0/ 23	D	0.05	
Soil	All Depths	75990	BKGD	ORHERB	Dalapon	mg/kg	0.02	0.00			0/ 23	D	0.03	
Soil	All Depths	1918009	BKGD	ORHERB	Dicamba	mg/kg	0.02	0.00			0/ 23	D	0.03	
Soil	All Depths	120365	BKGD	ORHERB	Dichloroprop	mg/kg	0.05	0.00			0/ 23	D	0.05	
Soil	All Depths	88857	BKGD	ORHERB	Dinoseb	mg/kg	0.01	0.00			0/ 23	D	0.01	
Soil	All Depths	94746	BKGD	ORHERB	MCPA	mg/kg	4.91	0.26			0/ 23	D	5.00	
Soil	All Depths	93652	BKGD	ORHERB	MCPP (Mecoprop)	mg/kg	4.91	0.26			0/ 23	D	5.00	
PESTICIDES														
Soil	All Depths	72548	BKGD	ORPEST	4,4'-DDD	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	72559	BKGD	ORPEST	4,4'-DDE	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	50293	BKGD	ORPEST	4,4'-DDT	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	309002	BKGD	ORPEST	Aldrin	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	5103719	BKGD	ORPEST	Alpha Chlordane	mg/kg	0.00	0.00	0.01	0.01	1/ 23	D	0.00	
Soil	All Depths	319846	BKGD	ORPEST	Alpha-BHC	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	319857	BKGD	ORPEST	Beta-BHC	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	319868	BKGD	ORPEST	Delta-BHC	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	60571	BKGD	ORPEST	Dieldrin	mg/kg	0.00	0.00	0.00	0.00	2/ 23	D	0.00	

Table 4-2. Summary of SLAPS 1998 Soil Characterization Data - Background Area (Cont'd)

Media	Group	CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean	Investigative Action Level
Soil	All Depths	959988	BKGD	ORPEST	Endosulfan I	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	33213659	BKGD	ORPEST	Endosulfan II	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	1031078	BKGD	ORPEST	Endosulfan Sulfate	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	72208	BKGD	ORPEST	Endrin	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	7421934	BKGD	ORPEST	Endrin Aldehyde	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	53494705	BKGD	ORPEST	Endrin Ketone	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	5103742	BKGD	ORPEST	Gamma Chlordane	mg/kg	0.00	0.00	0.01	0.01	1/ 23	D	0.00	
Soil	All Depths	58899	BKGD	ORPEST	Gamma-BHC (Lindane)	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	76448	BKGD	ORPEST	Heptachlor	mg/kg	0.00	0.00			0/ 23	D	0.00	1.1
Soil	All Depths	1024573	BKGD	ORPEST	Heptachlor Epoxide	mg/kg	0.00	0.00	0.00	0.00	1/ 23	D	0.00	
Soil	All Depths	72435	BKGD	ORPEST	Methoxychlor	mg/kg	0.01	0.00			0/ 23	D	0.01	
Soil	All Depths	8001352	BKGD	ORPEST	Toxaphene	mg/kg	0.11	0.01			0/ 23	D	0.11	
PCBs														
Soil	All Depths	12674112	BKGD	ORPCB	Aroclor-1016	mg/kg	0.02	0.00			0/ 23	D	0.02	0.32
Soil	All Depths	11104282	BKGD	ORPCB	Aroclor-1221	mg/kg	0.04	0.00			0/ 23	D	0.04	0.32
Soil	All Depths	11141165	BKGD	ORPCB	Aroclor-1232	mg/kg	0.02	0.00			0/ 23	D	0.02	0.32
Soil	All Depths	53469219	BKGD	ORPCB	Aroclor-1242	mg/kg	0.02	0.00			0/ 23	D	0.02	0.32
Soil	All Depths	12672296	BKGD	ORPCB	Aroclor-1248	mg/kg	0.02	0.00			0/ 23	D	0.02	0.32
Soil	All Depths	11097691	BKGD	ORPCB	Aroclor-1254	mg/kg	0.02	0.00			0/ 23	D	0.02	0.32
Soil	All Depths	11096825	BKGD	ORPCB	Aroclor-1260	mg/kg	0.02	0.00			0/ 23	D	0.02	0.32
SEMIVOLATILE ORGANIC COMPOUNDS														
Soil	All Depths	120821	BKGD	ORSVOC	1,2,4-Trichlorobenzene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	95501	BKGD	ORSVOC	1,2-Dichlorobenzene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	541731	BKGD	ORSVOC	1,3-Dichlorobenzene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	106467	BKGD	ORSVOC	1,4-Dichlorobenzene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	108601	BKGD	ORSVOC	2,2'-oxybis (1-chloropropane)	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	95954	BKGD	ORSVOC	2,4,5-Trichlorophenol	mg/kg	0.49	0.03			0/ 23	D	0.50	
Soil	All Depths	88062	BKGD	ORSVOC	2,4,6-Trichlorophenol	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	120832	BKGD	ORSVOC	2,4-Dichlorophenol	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	105679	BKGD	ORSVOC	2,4-Dimethylphenol	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	51285	BKGD	ORSVOC	2,4-Dinitrophenol	mg/kg	0.49	0.03			0/ 23	D	0.50	
Soil	All Depths	121142	BKGD	ORSVOC	2,4-Dinitrotoluene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	606202	BKGD	ORSVOC	2,6-Dinitrotoluene	mg/kg	0.20	0.01			0/ 23	D	0.21	

Table 4-2. Summary of SLAPS 1998 Soil Characterization Data - Background Area (Cont'd)

Media	Group	CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean	Investigative Action Level
Soil	All Depths	91587	BKGD	ORSVOC	2-Chloronaphthalene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	95578	BKGD	ORSVOC	2-Chlorophenol	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	91576	BKGD	ORSVOC	2-Methylnaphthalene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	95487	BKGD	ORSVOC	2-Methylphenol	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	88744	BKGD	ORSVOC	2-Nitroaniline	mg/kg	0.49	0.03			0/ 23	D	0.50	
Soil	All Depths	88755	BKGD	ORSVOC	2-Nitrophenol	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	91941	BKGD	ORSVOC	3,3'-Dichlorobenzidine	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	99092	BKGD	ORSVOC	3-Nitroaniline	mg/kg	0.49	0.03			0/ 23	D	0.50	
Soil	All Depths	534521	BKGD	ORSVOC	4,6-Dinitro-o-Cresol	mg/kg	0.49	0.03			0/ 23	D	0.50	
Soil	All Depths	101553	BKGD	ORSVOC	4-Bromophenyl-phenyl Ether	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	59507	BKGD	ORSVOC	4-chloro-3-methylphenol	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	106478	BKGD	ORSVOC	4-Chloroaniline	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	7005723	BKGD	ORSVOC	4-Chlorophenyl-phenylether	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	106445	BKGD	ORSVOC	4-Methylphenol	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	100016	BKGD	ORSVOC	4-Nitroaniline	mg/kg	0.49	0.03			0/ 23	D	0.50	
Soil	All Depths	100027	BKGD	ORSVOC	4-Nitrophenol	mg/kg	0.49	0.03			0/ 23	D	0.50	
Soil	All Depths	83329	BKGD	ORSVOC	Acenaphthene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	208968	BKGD	ORSVOC	Acenaphthylene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	120127	BKGD	ORSVOC	Anthracene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	56553	BKGD	ORSVOC	Benzo(a)anthracene	mg/kg	0.21	0.02	0.25	0.28	2/ 23	D	0.22	
Soil	All Depths	50328	BKGD	ORSVOC	Benzo(a)pyrene	mg/kg	0.19	0.05	0.05	0.06	3/ 23	D	0.20	
Soil	All Depths	205992	BKGD	ORSVOC	Benzo(b)fluoranthene	mg/kg	0.20	0.02	0.16	0.22	4/ 23	D	0.21	
Soil	All Depths	191242	BKGD	ORSVOC	Benzo(g,h,i)perylene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	207089	BKGD	ORSVOC	Benzo(k)fluoranthene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	111911	BKGD	ORSVOC	Bis(2-chloroethoxy)methane	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	111444	BKGD	ORSVOC	Bis(2-chloroethyl)ether	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	117817	BKGD	ORSVOC	Bis(2-ethylhexyl)phthalate	mg/kg	0.20	0.02	0.14	0.15	3/ 23	D	0.21	
Soil	All Depths	85687	BKGD	ORSVOC	Butyl Benzyl Phthalate	mg/kg	0.21	0.01	0.25	0.25	1/ 23	D	0.21	
Soil	All Depths	86748	BKGD	ORSVOC	Carbazole	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	218019	BKGD	ORSVOC	Chrysene	mg/kg	0.19	0.03	0.06	0.18	4/ 23	D	0.20	
Soil	All Depths	53703	BKGD	ORSVOC	Dibenzo(a,h)anthracene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	132649	BKGD	ORSVOC	Dibenzofuran	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	84662	BKGD	ORSVOC	Diethyl Phthalate	mg/kg	0.20	0.01			0/ 23	D	0.21	

Table 4-2. Summary of SLAPS 1998 Soil Characterization Data - Background Area (Cont'd)

Media	Group	CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean	Investigative Action Level
Soil	All Depths	131113	BKGD	ORSVOC	Dimethyl Phthalate	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	84742	BKGD	ORSVOC	Di-n-butyl Phthalate	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	117840	BKGD	ORSVOC	Di-n-octyl Phthalate	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	206440	BKGD	ORSVOC	Fluoranthene	mg/kg	0.19	0.05	0.05	0.08	3/ 23	D	0.21	
Soil	All Depths	86737	BKGD	ORSVOC	Fluorene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	118741	BKGD	ORSVOC	Hexachlorobenzene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	87683	BKGD	ORSVOC	Hexachlorobutadiene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	77474	BKGD	ORSVOC	Hexachlorocyclopentadiene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	67721	BKGD	ORSVOC	Hexachloroethane	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	193395	BKGD	ORSVOC	Indeno(1,2,3-cd)pyrene	mg/kg	0.21	0.02	0.27	0.27	2/ 23	D	0.22	
Soil	All Depths	78591	BKGD	ORSVOC	Isophorone	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	91203	BKGD	ORSVOC	Naphthalene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	98953	BKGD	ORSVOC	Nitrobenzene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	621647	BKGD	ORSVOC	N-Nitroso-di-n-propylamine	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	86306	BKGD	ORSVOC	N-Nitrosodiphenylamine	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	87865	BKGD	ORSVOC	Pentachlorophenol	mg/kg	0.49	0.03			0/ 23	D	0.50	
Soil	All Depths	85018	BKGD	ORSVOC	Phenanthrene	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	108952	BKGD	ORSVOC	Phenol	mg/kg	0.20	0.01			0/ 23	D	0.21	
Soil	All Depths	129000	BKGD	ORSVOC	Pyrene	mg/kg	0.21	0.02	0.16	0.27	8/ 23	D	0.22	
VOLATILE ORGANIC COMPOUNDS														
Soil	All Depths	71556	BKGD	ORVOC	1,1,1-Trichloroethane	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	79345	BKGD	ORVOC	1,1,2,2-Tetrachloroethane	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	76131	BKGD	ORVOC	1,1,2-Trichloro-1,2,2-trifluoroethane	mg/kg	0.01	0.00			0/ 23	D	0.01	
Soil	All Depths	79005	BKGD	ORVOC	1,1,2-Trichloroethane	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	75343	BKGD	ORVOC	1,1-Dichloroethane	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	75354	BKGD	ORVOC	1,1-Dichloroethene	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	107062	BKGD	ORVOC	1,2-Dichloroethane	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	540590	BKGD	ORVOC	1,2-Dichloroethene	mg/kg	0.00	0.00			0/ 23	D	0.00	1,100
Soil	All Depths	78875	BKGD	ORVOC	1,2-Dichloropropane	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	10061015	BKGD	ORVOC	1,3-cis-Dichloropropene	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	10061026	BKGD	ORVOC	1,3-trans-Dichloropropene	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	78933	BKGD	ORVOC	2-Butanone	mg/kg	0.01	0.00	0.02	0.02	2/ 23	D	0.01	
Soil	All Depths	591786	BKGD	ORVOC	2-Hexanone	mg/kg	0.01	0.00			0/ 23	D	0.01	

Table 4-2. Summary of SLAPS 1998 Soil Characterization Data - Background Area (Cont'd)

Media	Group	CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean	Investigative Action Level
Soil	All Depths	108101	BKGD	ORVOC	4-Methyl-2-pentanone	mg/kg	0.01	0 00			0/ 23	D	0.01	
Soil	All Depths	67641	BKGD	ORVOC	Acetone	mg/kg	0.01	0.01			0/ 23	D	0.01	
Soil	All Depths	71432	BKGD	ORVOC	Benzene	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	75274	BKGD	ORVOC	Bromodichloromethane	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	75252	BKGD	ORVOC	Bromoform	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	74839	BKGD	ORVOC	Bromomethane	mg/kg	0.01	0.00			0/ 23	D	0.01	
Soil	All Depths	75150	BKGD	ORVOC	Carbon Disulfide	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	56235	BKGD	ORVOC	Carbon Tetrachloride	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	108907	BKGD	ORVOC	Chlorobenzene	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	75003	BKGD	ORVOC	Chloroethane	mg/kg	0.01	0.00	0.02	0.02	1/ 23	D	0.01	
Soil	All Depths	67663	BKGD	ORVOC	Chloroform	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	74873	BKGD	ORVOC	Chloromethane	mg/kg	0.01	0.00			0/ 23	D	0.01	
Soil	All Depths	124481	BKGD	ORVOC	Dibromochloromethane	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	100414	BKGD	ORVOC	Ethylbenzene	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	75092	BKGD	ORVOC	Methylene Chloride	mg/kg	0.00	0.00	0.00	0.01	9/ 23	D	0.00	670
Soil	All Depths	100425	BKGD	ORVOC	Styrene	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	127184	BKGD	ORVOC	Tetrachloroethene	mg/kg	0.00	0.00			0/ 23	D	0.00	
Soil	All Depths	108883	BKGD	ORVOC	Toluene	mg/kg	0.00	0.00	0.00	0.00	1/ 23	D	0.00	490
Soil	All Depths	79016	BKGD	ORVOC	Trichloroethene	mg/kg	0.00	0.00			0/ 23	D	0.00	340
Soil	All Depths	75014	BKGD	ORVOC	Vinyl Chloride	mg/kg	0.01	0.00			0/ 23	D	0.01	
Soil	All Depths	1330207	BKGD	ORVOC	Xylenes, Total	mg/kg	0.00	0.00			0/ 23	D	0.00	

[1]Results less than the detection limit were set to 1/2 the reported detection limit.
[2]Distribution Codes: L-distribution most similar to lognormal. (Land statistic used for UCL.)
N-distribution most similar to normal. (t-distribution used for UCL.)
X-distribution significantly different from normal and lognormal.(t-distribution used for UCL.)
D-distribution not determined because fewer than 5 detects or less than 50% detects.(t-dist)
Z-distribution with negative results and therefore treated as normal.

4.1.1.1 Background Radiological Concentrations in Soil

There are three naturally occurring radiation decay series of primary importance at SLAPS. They are the uranium series, the actinium series, and the thorium series (see Figures 4-2 through 4-4). The uranium series begins with uranium-238 (U-238). U-238 decays by emitting an alpha particle from its nucleus. By emitting an alpha particle, the U-238 atom transforms into a Th-234 atom. The Th-234 atom is also radioactive and eventually decays by emitting a beta particle, changing into a protactinium-234 (Pa-234) atom. This process continues over time until a stable (non-radioactive) atom is produced. The stable atom at the bottom of the uranium series is lead-206 (Pb-206). Similar decay series are displayed by the decay of actinium and thorium.

The amount of time for the U-238 atom to become a Pb-206 atom depends on the half-life of the radionuclides in the series. A half-life is defined as the amount of time it takes for the initial amount of radioactivity to be reduced by one half. The half-life of U-238 is 4.5 billion years. It, therefore, takes 4.5 billion years for 1 picocurie (pCi) of U-238 to be reduced to 0.5 pCi. Other radionuclides have relatively short half-lives. Th-234 has a half-life of 24 days. So as U-238 decays into Th-234 very slowly, Th-234 decays into the next radionuclide (Pa-234) quickly. A condition called secular equilibrium occurs when short-lived decay products follow a long-lived parent, as is the case for the decay series U-238, Th-234, and Pa-234. Radionuclides have the same activity once secular equilibrium is reached (after about seven half-lives of the decay product). In the uranium example, Th-234 and Pa-234 are in secular equilibrium with U-238 and have the same activity.

There are three classes of radionuclides found in nature: primordial, cosmogenic, and man-made. Primordial radionuclides have been present on Earth since it was formed and include the three radioactive decay series headed by U-238, U-235, and Th-232. The major primordial radionuclides that decay directly into stable nuclides include potassium-40 (K-40) and rubidium-87 (Rb-87). Potassium-40 makes up only 0.01% of all potassium, but potassium is so widespread that K-40 contributes a significant fraction of the radiation dose received from all natural sources. The average K-40 concentration in soil across the United States is approximately 11 picocuries per gram (pCi/g). Rubidium-87 is much less abundant in soil than K-40 and does not contribute significantly to the total dose from natural sources.

Cosmogenic radionuclides are produced when cosmic radiation interacts with atmospheric nuclei. The most important of these include carbon-14 (C-14), tritium (H-3), and beryllium-7 (Be-7). Sources of man-made radionuclides include emissions from federal facilities such as DOE facilities, facilities licensed by the Nuclear Regulatory Commission (NRC) facilities, emissions from some mineral extraction industrial facilities, and fallout from nuclear weapons tests. Radionuclides from these sources include cesium-137 (Cs-137), strontium-90 (Sr-90), H-3, C-14, iodine-131 (I-131), and mercury-202 (Hg-203).

A summary of the individual sample analyses for the radiological isotopes is included in Table 4-2. As previously mentioned, all these samples were from locations identified in the 1998 SLAPS characterization sampling event. The radiological PCOCs included on Table 4-3 include actininum-227 (Ac-227), Pa-231, radium-226 (Ra-226), Th-230, and Th-232. No U-238 was detected in any background sample, and only one sample had a detectable value of U-235. All species of thorium and radium were detected in all background samples. The average, maximum detected, and 95 percent Upper Confidence Level (UCL) results of the 1998 background soil sampling for the remaining radionuclides of concern are listed in Table 4-3.

Table 4-3. Radionuclide Statistical Background Summary

Radionuclide	Average Result (pCi/g)	Maximum Detected Result (pCi/g)	95 Percent UCL (pCi/g of mean)
Thorium-230	1.65	2.89	1.89
Thorium-232	0.99	1.52	1.08
Actinium-227	0.41	0.82	0.50
Protactinium-231*	0.28	1.13	0.41
Radium-226	0.73	0.91	0.77

* Only 2 of 23 samples had detectable results.

4.1.1.2 Background Chemical Characteristics

The chemical parameters analyzed in the background soils included inorganic TAL metals, pesticides, herbicides, PCBs, SVOCs, and VOCs. Table 4-4 provides a detailed summary and statistical analysis of the results of each of the metals in the background soil areas.

Table 4-4. TAL Metal Statistical Background Summary

Analyte	Average Result (mg/kg)	Maximum Detect (mg/kg)	95 percent UCL of Mean
Arsenic	7.29	18.00	8.30
Barium	140.00	279.00	153.00
Beryllium	0.35	0.56	0.38
Cadmium	0.45	0.62	0.54
Chromium	11.30	16.50	11.90
Cobalt	6.75	11.90	7.50
Copper	13.10	22.30	14.00
Lead	22.0	79.70	27.20
Mercury	0.07	0.69	0.12
Molybdenum	3.57	22.70	5.12
Nickel	15.00	47.00	17.10
Selenium	0.26	0.55	0.30
Silver	0.68	2.60	0.84
Thallium*	0.31		0.35
Vanadium	17.50	31.00	19.10
Zinc	57.20	278.00	70.10

* No thallium detected in any background samples.

4.2 CHARACTERIZATION OF RADIOLOGICAL CONSTITUENTS IN SOIL

The section below describes the extent of Ra-226, Th-230, U-238, protactinium and actinium. This information was gathered using gamma walkovers, surface soil sampling and collection of soil samples at depth.

4.2.1 Gamma Walkover

In the spring of 1998 a total gamma-emission survey, known as a gamma walkover, was conducted of the surface soils at SLAPS. SAIC mobilized an all terrain vehicle (ATV) to perform the gamma walkovers. Two types of total gamma radiation detectors were mounted on a platform extended from the front of the ATV. One detector contained a '2x2' NaI (a Bicron model), and the other detector was a FIDLER (Alpha Spectra 5-inch diameter unit) that were elevated approximately 6 in from the ground surface during operation. One detector type was located on the right of the platform, and the other was on the left. Each detector was connected to its own rate meter (Ludlum Model 3 or a Ludlum Model 12). Rate meters were hard-wired into a data logger. Response from each detector was recorded every second. Figures 4-5 and 4-6 illustrate the responses measured with the FIDLER and '2x2' NaI detectors, respectively. The location of the ATV was determined by utilizing GPS. The GPS hardware used on site included a base station located on the parking area in SLAPS and a rover unit mounted on the bed of the ATV. The rover received position data from the base station via radio frequency signals and then relayed that data to an on-board data recorder. The GPS signal, once received by the data collector, was merged with detector responses and relayed to an on-board computer. The system collected real-time data that was mapped on the computer screen in the ATV. The operator can collect gamma and GPS data while viewing progress on the computer screen. The mapping program is designed to differentiate by color varying levels of gamma activity.

The operator completed surveys by lowering the detector platform into a horizontal position and driving the ATV over a designated area. The ATV speed was maintained at a rate of 0.9 to 1.2 m (3 to 4 ft) per second (depending on terrain). There were areas that the ATV could not traverse because of standing or perched water (or general marshy conditions), surface debris (concrete fragments, stacked telephone poles, dirt stockpiles, and rapid changes in topography.

Personnel performed two source checks daily, once at the beginning and once at the end of the work shift. A "quality check" was performed daily that included the collection of data at a fixed on-site location. One location inside and one outside the fence were repetitively measured to perform this quality check. Source check data was recorded.

4.2.2 Nature and Extent of Ra-226, Th-230, and U-238 Contamination

Approximately 700 soil samples were collected and analyzed for radioisotopes in 1998. An additional 2,500 soil samples were used from the historical data for this assessment at SLAPS. Appendix B presents the analytical results for radioisotopes analyzed in soils at SLAPS. These results are for the 1998 sampling only. An analytical summary of both the historical and 1998 soil sample results, used for the interpretation, are provided in Appendix C. Figure 4-7 provides a key for identifying the individual investigation areas (IAs).

4.2.2.1 Nature and Extent of Ra-226 in Soils

Figures 4-8 through 4-14 illustrate the measured activities of Ra-226 in depth sequenced series based on both the historical and 1998 sampling at SLAPS. Sampling locations are only shown for those constituents analyzed for Ra-226 and are illustrated in color by concentration ranges. Historical and 1998 sampling events are illustrated differently via symbol type. Data which was below 5 to 15 pCi/g (surface/subsurface criteria) are shown in green, whereas concentrations of Ra-226 above this threshold are shown in shades of red. Based on these illustrations, radium above 5 pCi/g is found surficially across SLAPS (IA-1 through IA-6), along the north and south ditches of McDonnell Boulevard (IA-8), the east end of SLAPS (IA-7), and in one localized area at the north central area of the ballfields (IA-9). Ra-226 in soils above 15 pCi/g extends with depth across SLAPS (IA-2 through IA-5 primarily) and along the north ditch in the southwest corner of the ballfields (IA-9). The majority of radium in soil above 15 pCi/g extends no deeper than approximately 10 ft.

4.2.2.2 Nature and Extent of Th-230 in Soils

Th-230 was found to be present in soil at SLAPS in all samples. The highest measured thorium concentration, based on the 1998 sampling activities, was measured at a concentration of 3,780 pCi/g in IA-7. Figures 4-15 through 4-21 illustrate the activities of Th-230 in two-dimensional depth layers. Again, both historical (pre-1998) and sampling results performed per the SLAPS SAP are shown in these illustrations. Figures 4-15 through 4-21 illustrate the sampling locations tested for Th-230 and indicate concentration ranges for each depth interval.

Th-230 is distributed surficially in nearly every investigative area of the site. Only sporadic surficial samples above the IAL are present in the Coldwater flood plain north of Coldwater Creek (IA-10). Broad areas of surficial thorium are present across SLAPS (IA-1 through IA-7), McDonnell Boulevard and its ditches (IA-8), the ballfields (IA-9), the railroad facility south of SLAPS (IA-12), and along the airport property south of SLAPS (IA-13). Th-230 with depth extends primarily at SLAPS (IA-2 through IA-6) to maximum depths of 4.5 to 6 m (15 to 20 ft) and along the north ditch in the southwest corner of the ballfields (IA-9), to depths of up to 4.5 m (15 ft) bgs.

4.2.2.3 Nature and Extent of U-238 in Soil

U-238 was likewise found in soil material at SLAPS. The maximum U-238 concentration was found in IA-2 at concentrations of 309.5 pCi/g, based on the 1998 sampling event. Figures 4-22 through 4-28 illustrate the activities of U-238 in depth two-dimensional view. Based on these illustrations, U-238 is present at activities above its IAL primarily within SLAPS and along the ditches south of McDonnell Boulevard. The maximum depth of elevated U-238 in soil extends to approximately 3 m (10 ft) bgs.

4.2.3 Nature and Extent of Pa-231 and Ac-227 in Soil

Protactinium-231 (Pa-231) and actinium-227 (Ac-227) were also analyzed during the 1998 sampling efforts. Analytical results for these radionuclides are summarized in Appendix B. Soil sampling performed prior to 1998 did not routinely analyze Pa-231 and Ac-227.

4.2.3.1 Nature and Extent of Pa-231 in Soil

Pa-231 was detected in all investigative areas sampled during the 1998 sampling efforts except IA-1. The highest concentration detected in the 1998 sampling was found in IA-7 at a concentration of 685.8 pCi/g. Figures 4-29 through 4-35 illustrate the activities of Pa-231 in two-dimensional depth layers at SLAPS. These data are illustrated for all sampling locations tested for Pa-231 in soil. Figures 4-29 through 4-35 illustrate the concentrations detected in these soil samples, compared to the residential and industrial IALs identified for this PCOC, respectively. No sampling and analysis for Pa-231 has been conducted in IA-10, IA-11, and IA-12. The extent of Pa-231 above its IALs is not well defined beyond SLAPS (IA-1 through IA-6).

Figures 4-36 through 4-39 illustrate the occurrence of both Pa-231 and Th-230 in the soils at SLAPS and the CPs. These presentations with depth reinforce the lack of correlation between the occurrence of PA-231 and Th-230.

4.2.3.2 Nature and Extent of Ac-227 in Soil

Ac-227 was likewise detected in soil samples at SLAPS based on the 1998 sampling. A maximum concentration of 695.7 pCi/g was detected based on the 1998 sampling efforts in IA-7. Figures 4-40 through 4-46 illustrate the activities of Ac-227 in soil at SLAPS. Like Pa-231, Ac-227 was not as extensively sampled as the three primary radioisotopes, based on historical sampling results. The extent of Ac-227 above its respective IAL for residential and industrial levels is less extensive than that of Pa-231. The apparent extent of elevated Ac-227 appears to be confined to SLAPS (IA-2 through IA-7) and the north ditch of McDonnell Boulevard, just to the west of Coldwater Creek along IA-8. The maximum vertical extent of Ac-227 in soil above its IAL appears to be no deeper than 3 m (10 ft) bgs.

4.3 CHARACTERIZATION OF INORGANICS IN SOIL

Results of all metal and inorganic analytes sampled during the 1998 soil sampling at the SLAPS investigation areas is included in Appendix B. The lack of property owner access agreements prohibited collection of samples from IA-11 and IA-12. The following assessment of the TAL metals includes both the results of the 1998 and the historical sampling. A statistical summary of both of these data sets is provided in Appendix C.

4.3.1 Arsenic

The IAL for arsenic, based on the Missouri Any-Use Soil Level (ASL) is 11 milligrams per kilogram (mg/kg). The average concentration in background areas was 7.29 mg/kg and ranged from 0.84 mg/kg to 18 mg/kg. Arsenic was detected in all samples collected in the investigative areas. The maximum detectable concentration of 668 mg/kg was identified in IA-10. Other areas with maximum detectable levels above the investigative action level included IA-2 at 237 mg/kg; IA-3 at 11.7 mg/kg; IA-4 at 50.8 mg/kg; IA-5 at 26.2 mg/kg; IA-7 at 11.8 mg/kg; and IA-9 at 98.7 mg/kg.

4.3.2 Barium

The IAL for barium is 3,900 mg/kg. The average concentration in the background area was 140 mg/kg, with a maximum detected value of 279 mg/kg. While no area had an average barium concentration above the IAL, maximum detected concentrations in IA-5 (4,550 mg/kg) and IA-7 (13,600 mg/kg) exceeded the IAL.

4.3.3 Beryllium

The IAL for beryllium is 1.2 mg/kg. The average concentration in the background areas was 0.35 mg/kg. No beryllium was detected in IA-8 or IA-13. While no area had average concentrations above the IAL, maximum detectable levels above the IAL were identified in IA-3 (2.4 mg/kg), IA-5 (1.40 mg/kg), IA-9 (1.40 mg/kg), and IA-10 (1.5 mg/kg).

4.3.4 Cadmium

The IAL for cadmium is 28 mg/kg. The average background was 0.45 mg/kg and ranged to a maximum detectable value of 0.62 mg/kg. All average concentrations in the investigative areas were below the IAL. IA-3 contained the only maximum detected concentration above the IAL (50.4 mg/kg).

4.3.5 Chromium

The IAL for chromium is 280 mg/kg. The average background concentration was 11.3 mg/kg and ranged to a maximum detectable value of 16.5 mg/kg. The maximum detectable concentration of chromium was observed in IA-3 at 3,240 mg/kg. However, all other areas have average concentrations less than the IAL for chromium. The maximum detected values in all the remaining investigation areas were less than 43 mg/kg (IA-9) and, therefore, significantly less than the IAL.

4.3.6 Cobalt

The IAL for cobalt is 4,700 mg/kg. The average background concentration is 6.75 mg/kg and ranged to a maximum detectable concentration of 11.9 mg/kg. IA-7 had the highest maximum detectable concentration (6,050 mg/kg) of cobalt. No other IA had any concentrations above the IAL.

4.3.7 Copper

The IAL for copper is 3,100 mg/kg. The average background concentration was observed to be 13.1 mg/kg, with a maximum detected value of 22.3 mg/kg. Again, the highest average concentration (666 mg/kg) and maximum detected value (4,400 mg/kg) was reported in IA-7. No other IA had any concentrations above the IAL.

4.3.8 Lead

The IAL for lead is 240 mg/kg. The average background concentration is 22.1 mg/kg and ranged to a maximum detected concentration of 79.7 mg/kg. The highest average concentration was

reported for IA-3 at 197 mg/kg. However, maximum detected concentrations were observed above the IAL in IA-3 (1,200 mg/kg), IA-4 (408 mg/kg), IA-7 (933 mg/kg), IA-8 (500 mg/kg) and IA-9 (240 mg/kg).

4.3.9 Mercury

The IAL for mercury in soils is 17 mg/kg. The average background concentration was 0.07 mg/kg and ranged to a maximum detected value of 0.69 mg/kg. No mercury was detected in IA-1, IA-2, IA-5, or IA-10. The maximum mercury concentration detected was in IA-7 at 2.10 mg/kg. These results indicate that mercury is well below the IAL of 17 mg/kg.

4.3.10 Molybdenum

The IAL for molybdenum is 280 mg/kg. The average background concentration was 3.57 mg/kg and ranged to a maximum detected value of 22.7 mg/kg. The maximum average concentration of molybdenum was identified in IA-10 at 57.1 mg/kg. However, the maximum detected concentration in IA-10 (754 mg/kg) was above the IAL. No other maximum detected concentrations were reported above the IAL.

4.3.11 Nickel

The IAL for nickel is 1,100 mg/kg. The average background concentration was 15.0 mg/kg and ranged to a maximum detected concentration of 47.0 mg/kg. Nickel was detected in every soil sample collected among the investigative areas and background area. The highest average concentration was reported for IA-7 at 1,110 mg/kg. The highest detectable nickel concentration was also detected in IA-7 at 7,570 mg/kg. IA-3 and IA-4 also had maximum detected values above the IAL at 1,460 mg/kg and 2,010 mg/kg, respectively.

4.3.12 Selenium

The IAL for selenium is 280 mg/kg. The average background concentration was determined to be 0.26 mg/kg and ranged to a maximum detected value of 0.55 mg/kg. No selenium was detected in any of the samples from IA-1, IA-3, IA-6, or IA-13. No other areas had maximum detected concentrations above the IAL of 280 mg/kg.

4.3.13 Silver

The IAL for silver is 280 mg/kg. Only one historical background soil sample had a detectable silver concentration of 2.6 mg/kg. Silver was only detected in 4 of 102 samples collected among all the investigation areas. Areas IA-5 and IA-10 had one detected silver sample each, and IA-8 had two detected silver samples. The maximum detected value of silver was 13.9 mg/kg in IA-10. Therefore, silver concentrations are well below the IAL of 280 mg/kg.

4.3.14 Thallium

The IAL for thallium is 3.9 mg/kg. No thallium was detected in the background soil samples. Thallium was not detected in samples from IA-1, IA-2, IA-6, IA-7, and IA-8. There are a total of three soil samples detected above the IAL: two samples in IA-10 (approximately

20 mg/kg) and one sample in IA-9. The reported detection limit for non-detected values from the historical data set does not allow evaluation of the data with respect to the IAL. The reported detection limit for the 1998 sample results was below the IAL (3.9 mg/kg) and, therefore, adequate data is available to evaluate the extent of thallium above the IAL.

4.3.15 Vanadium

The IAL for vanadium is 390 mg/kg. The average background concentration was 17.50 mg/kg and ranged to a maximum detected concentration of 31 mg/kg. All but one soil sample collected had detectable concentrations of vanadium. The highest average concentration was in IA-2 at 294 mg/kg. However, maximum detected concentrations above the IAL of 390 mg/kg were determined in IA-2 (890 mg/kg) and IA-6 (630 mg/kg).

4.4 CHARACTERIZATION OF ORGANIC COMPOUNDS IN SOIL

4.4.1 Soil Gas Survey

SAIC performed a passive soil gas survey adjacent and south of monitoring well B53W17S, based on detections of VOCs [primarily trichloroethene (TCE)] in previous ground-water sampling events. The SAP (USACE, 1998a) identified an area upgradient of B53W17S as the investigation target area to investigate a potential surface source area of VOCs in this well.

On June 23, 1998, SAIC deployed 42 Emflux7 passive soil cartridges at the locations shown on Figure 4-47. Four ambient air and one trip blank were also collected and analyzed. Emflux7 cartridges were retrieved on June 30, 1998, and submitted to a laboratory for analysis by overnight courier.

The cartridges were thermally desorbed and analyzed using gas chromatography/mass spectrometry (GC/MS) equipment using EPA Method 8260 on July 2, 1998. The EMFLUX soil gas report is provided in Appendix D.

The soil gas survey detected several VOCs at very low concentrations. Benzene was reported at sample point 34 [0.29 nanograms per liter (ng/L)], point 19 (0.05 ng/L), and point 4 (0.06 ng/L). These points trend in a northeast-southwest direction, with the concentration diminishing toward the southwest. Toluene (0.45 ng/L) and total xylenes (0.05 ng/L) were detected at point 2. Chloroethane at concentrations of 1.38 ng/L, 4.12 ng/L, and 1.10 ng/L were detected at points 16, 19, and 8, respectively. Chloroform was detected at concentrations below 0.12 ng/L at points 42, 41, and 40.

No significant, pervasive VOCs were detected by the passive soil gas survey, and TCE was not detected in any of the samples. The low detection levels and lack of persistence of the chemicals detected do not support a near-surface source of any volatile organic compounds for contaminating the ground water at B53W17S.

4.4.2 Characterization of Organic Compounds in Soil

Approximately 92 soil samples were collected during the 1998 sampling efforts for organic analyses. These analyses included full suite VOCs, SVOCs, pesticides, herbicides, and PCBs. Previous sampling for organic compounds in soil was somewhat limited at this site, and no previous analyses for SVOCs, pesticides, herbicides, or PCBs were performed within the investigative areas of SLAPS. Approximately 40 soil samples were collected historically and analyzed for VOCs. A summary of the combined 1998 and historical sampling results for these compounds is provided in Appendix C. In accordance with the SAP, sampling for organic constituents was conducted on approximately 1 out of every 10 samples collected in 1998 sampling efforts. Due to limited access, no soil samples for organic analyses were collected in IA-11 and IA-12. In addition, due to soil removal efforts which had begun along the new railroad spur, no samples were collected in IA-6.

The list of PCOCs and associated IALs identified for this sampling effort (Table 4-1) were used as an initial screening criteria for detected organic compounds. None of the detected organic constituents found in soil during this or previous investigations exceeded any of the IALs listed on Table 4-1. Because many of the constituents tested during this sampling effort were not tested historically, organic constituents which were not identified as PCOCs were further screened according to criteria identified in the Missouri ASL criteria. Based on this criteria, only three compounds exceed any of the Missouri ASL screening criteria. These include one polynuclear aromatic hydrocarbon (PAH) (benzo[a]pyrene) and two herbicides (MCPA and MCPP [mecoprop]). With the exception of one sample detected for MCPA in IA-5, the other samples which exceeded the Missouri ASL criteria were found beyond SLAPS in IA-8, IA-9, and IA-10. The detected compounds identified during the 1998 and historical sampling are described further below.

4.4.2.1 Volatile Organic Compounds

Three VOCs were established as PCOCs for this sampling and analysis effort. These included toluene, TCE, and dichloromethane (methylene chloride). Although these VOCs were detected in several samples, their concentrations were low and did not exceed the established IALs. The maximum detected concentration of toluene was 0.21 mg/kg in IA-2; the maximum detected concentration of TCE was 0.06 mg/kg in IA-2; and the maximum concentration of methylene chloride was 0.13 mg/kg in IA-3. A list of the other VOCs which were detected in site soils included 1,2-dichloroethane (DCA), 1,2-dichloroethene (DCE), 2-butanone, acetone, carbon disulfide, carbon tetrachloride, xylenes, ethylbenzene, 1,1,1-trichloroethane (TCA), and 1,1,2-trichloro-1,2,2-trifloroethane. As identified above, none of these 13 detected VOCs exceeded either the IALs or Missouri ASLs (for non-PCOC identified constituents).

4.4.2.2 Semi-Volatile Organic Compounds

A total of 21 SVOCs were detected during the 1998 sampling efforts. The detected constituents were primarily associated with PAHs. The detected compounds included the following: 2-methylnaphthalene, acenaphthalene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, butylbenxylthalate, carbazole, chrysene, di-N-butyl thalate, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, and fluorene. As discussed above, only one of these detected compounds (benzo[a]pyrene) had a maximum detection

of 1.6 mg/kg in one sample was above the Missouri ASL of 0.68 mg/kg. This sample, and most of the highest detected PAH concentrations, were detected in IA-8, along McDonnell Boulevard.

4.4.2.3 Pesticides/Herbicides/PCBs

A total of five pesticides, four herbicides, and one PCB was detected during the 1998 sampling efforts at SLAPS and the CPs. The detected pesticides included 4,4-DDD, 4,4-DDE, 4,4-DDT, dieldrin, and toxaphene. None of these detected concentrations were above the Missouri ASLs. With the exception of toxaphene detected in one sample at a concentration of 0.05 mg/kg in IA-2, all detected pesticides were found in samples contained in IA-9.

The four detected herbicides included 2,4,5-TP(silvex), dalapon, MCPA, and MCPP (mecaprop). These herbicides were detected in IA-5, IA-8, IA-9, and IA-10. MCPA was only detected in three samples. Only one sample exceeded the Missouri ASL of 28 mg/kg (found in IA-5 at 49 mg/kg). MCPP was detected in five samples, and two of these samples exceeded the Missouri ASL of 56 mg/kg. One sample found in IA-9 at a concentration of 62 mg/kg and one sample collected in IA-10 at a concentration of 120 mg/kg exceeded these criteria. As described above, these compounds were not identified as PCOCs for this investigation.

PCB analyses included testing for arochlors 10, 16, 1221, 1232, 1242, 1248, 1254, and 1260. Only one sample was detected with any of these arochlors. This included one sample collected in IA-9 for arochlor-1260 at a concentration of 0.041 mg/kg. No Missouri ASL is reported for this constituent.

4.5 WASTE DISPOSAL ACCEPTANCE/CHARACTERIZATION

A summary of the TCLP results for four soil samples collected for waste characterizations from IA-4 and IA-5 in 1998 are included in Table 4-5. A total of 34 samples were previously analyzed (pre-1998) from areas IA-1 through IA-6. Additional sample results from IA-4 and IA-5 are included in Table 4-5. No regulated volatile or semi-volatile organic compounds or pesticides or herbicides were detected in any of the 1998 TCLP analyses (only one previous sample had a detectable concentration of heptachlor, a pesticide). Of the remaining TAL metals, only mercury and selenium had a maximum detected value above the allowable concentration for each metal. However, the average concentrations were significantly below the maximum allowable concentration due to predominantly non-detectable and low concentrations for these metals.

Other waste characterization analyses, including ignitability, pH, sulfide/cyanide reactivity, and free liquids are also summarized on Table 4-5. All of these results are below the maximum allowable criteria for Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste (40 CFR 261.24, Table C).

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
INORGANICS											
7440382	IA-1	TCLPIN	Arsenic	µg/L	50	0			0/ 2	D	50
7440382	IA-2	TCLPIN	Arsenic	µg/L	50	0			0/ 6	D	50
7440382	IA-3	TCLPIN	Arsenic	µg/L	50	0			0/ 4	D	50
7440382	IA-4	TCLPIN	Arsenic	µg/L	50	0			0/ 6	D	50
7440382	IA-4	TCLPIN	Arsenic	µg/L	9.1		9.1	9.1	1/ 1	D	
7440382	IA-5	TCLPIN	Arsenic	µg/L	50	0			0/ 12	D	50
7440382	IA-5	TCLPIN	Arsenic	µg/L	4	0			0/ 2	D	4
7440382	IA-6	TCLPIN	Arsenic	µg/L	50	0			0/ 2	D	50
7440382	IA-9	TCLPIN	Arsenic	µg/L	50	0			0/ 4	D	50
7440382	IA-13	TCLPIN	Arsenic	µg/L	50	0			0/ 4	D	50
7440393	IA-1	TCLPIN	Barium	µg/L	1420	863	809	2030	2/ 2	D	5270
7440393	IA-2	TCLPIN	Barium	µg/L	1340	657	732	2480	6/ 6	L	2490
7440393	IA-3	TCLPIN	Barium	µg/L	899	398	536	1360	4/ 4	D	1370
7440393	IA-4	TCLPIN	Barium	µg/L	1780	646	1010	2850	6/ 6	L	2780
7440393	IA-4	TCLPIN	Barium	µg/L	4270		4270	4270	1/ 1	D	
7440393	IA-5	TCLPIN	Barium	µg/L	1570	768	585	3400	12/ 12	L	2160
7440393	IA-5	TCLPIN	Barium	µg/L	1520	989	822	2220	2/ 2	D	5930
7440393	IA-6	TCLPIN	Barium	µg/L	2620	127	2530	2710	2/ 2	D	3190
7440393	IA-9	TCLPIN	Barium	µg/L	912	277	638	1290	4/ 4	D	1240
7440393	IA-13	TCLPIN	Barium	µg/L	968	501	659	1710	4/ 4	D	1560
7440439	IA-1	TCLPIN	Cadmium	µg/L	2.5	0			0/ 2	D	2.5
7440439	IA-2	TCLPIN	Cadmium	µg/L	37.9	84.8	6.5	211	2/ 6	D	108
7440439	IA-3	TCLPIN	Cadmium	µg/L	2.5	0			0/ 4	D	2.5
7440439	IA-4	TCLPIN	Cadmium	µg/L	5.98	5.75	5.1	17.3	3/ 6	D	10.7
7440439	IA-4	TCLPIN	Cadmium	µg/L	10.4		10.4	10.4	1/ 1	D	
7440439	IA-5	TCLPIN	Cadmium	µg/L	5.28	5.64	7.4	19.3	3/ 12	D	8.21
7440439	IA-5	TCLPIN	Cadmium	µg/L	1.05	0.0707			0/ 2	D	1.37
7440439	IA-6	TCLPIN	Cadmium	µg/L	2.5	0			0/ 2	D	2.5
7440439	IA-9	TCLPIN	Cadmium	µg/L	2.5	0			0/ 4	D	2.5
7440439	IA-13	TCLPIN	Cadmium	µg/L	2.5	0			0/ 4	D	2.5
7440473	IA-1	TCLPIN	Chromium	µg/L	5	0			0/ 2	D	5
7440473	IA-2	TCLPIN	Chromium	µg/L	5	0			0/ 6	D	5
7440473	IA-3	TCLPIN	Chromium	µg/L	5	0			0/ 4	D	5
7440473	IA-4	TCLPIN	Chromium	µg/L	5	0			0/ 6	D	5
7440473	IA-4	TCLPIN	Chromium	µg/L	10.4		10.4	10.4	1/ 1	D	
7440473	IA-5	TCLPIN	Chromium	µg/L	5	0			0/ 12	D	5
7440473	IA-5	TCLPIN	Chromium	µg/L	4.18	3.29	6.5	6.5	1/ 2	D	18.9
7440473	IA-6	TCLPIN	Chromium	µg/L	5	0			0/ 2	D	5
7440473	IA-9	TCLPIN	Chromium	µg/L	5	0			0/ 4	D	5
7440473	IA-13	TCLPIN	Chromium	µg/L	5	0			0/ 4	D	5
7440508	IA-4	TCLPIN	Copper	µg/L	3110		3110	3110	1/ 1	D	
7440508	IA-5	TCLPIN	Copper	µg/L	16.8	19.2			0/ 2	D	103

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization (Cont'd)

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
7439921	IA-1	TCLPIN	Lead	µg/L	45	0			0/ 2	D	45
7439921	IA-2	TCLPIN	Lead	µg/L	45	0			0/ 6	D	45
7439921	IA-3	TCLPIN	Lead	µg/L	45	0			0/ 4	D	45
7439921	IA-4	TCLPIN	Lead	µg/L	45	0			0/ 6	D	45
7439921	IA-4	TCLPIN	Lead	µg/L	259		259	259	1/ 1	D	
7439921	IA-5	TCLPIN	Lead	µg/L	52.5	26	135	135	1/ 12	D	66
7439921	IA-5	TCLPIN	Lead	µg/L	140	193	276	276	1/ 2	D	1000
7439921	IA-6	TCLPIN	Lead	µg/L	45	0			0/ 2	D	45
7439921	IA-9	TCLPIN	Lead	µg/L	45	0			0/ 4	D	45
7439921	IA-13	TCLPIN	Lead	µg/L	45	0			0/ 4	D	45
7439976	IA-1	TCLPIN	Mercury	µg/L	0.1	0			0/ 2	D	0.1
7439976	IA-2	TCLPIN	Mercury	µg/L	0.1	0			0/ 6	D	0.1
7439976	IA-3	TCLPIN	Mercury	µg/L	0.183	0.165	0.43	0.43	1/ 4	D	0.377
7439976	IA-4	TCLPIN	Mercury	µg/L	0.1	0			0/ 6	D	0.1
7439976	IA-4	TCLPIN	Mercury	µg/L	0.2				0/ 1	D	
7439976	IA-5	TCLPIN	Mercury	µg/L	0.1	0			0/ 12	D	0.1
7439976	IA-5	TCLPIN	Mercury	µg/L	0.2	0			0/ 2	D	0.2
7439976	IA-6	TCLPIN	Mercury	µg/L	0.1	0			0/ 2	D	0.1
7439976	IA-9	TCLPIN	Mercury	µg/L	0.1	0			0/ 4	D	0.1
7439976	IA-13	TCLPIN	Mercury	µg/L	0.1	0			0/ 4	D	0.1
7782492	IA-1	TCLPIN	Selenium	µg/L	50	0			0/ 2	D	50
7782492	IA-2	TCLPIN	Selenium	µg/L	50	0			0/ 6	D	50
7782492	IA-3	TCLPIN	Selenium	µg/L	94	88	226	226	1/ 4	D	198
7782492	IA-4	TCLPIN	Selenium	µg/L	165	113	122	316	4/ 6	D	259
7782492	IA-4	TCLPIN	Selenium	µg/L	45.9		45.9	45.9	1/ 1	D	
7782492	IA-5	TCLPIN	Selenium	µg/L	242	329	268	1180	5/ 12	D	412
7782492	IA-5	TCLPIN	Selenium	µg/L	5.2	0			0/ 2	D	5.2
7782492	IA-6	TCLPIN	Selenium	µg/L	166	85.6	105	226	2/ 2	D	547
7782492	IA-9	TCLPIN	Selenium	µg/L	108	76.3	119	211	2/ 4	D	197
7782492	IA-13	TCLPIN	Selenium	µg/L	118	90.1	132	240	2/ 4	D	224
7440224	IA-1	TCLPIN	Silver	µg/L	5	0			0/ 2	D	5
7440224	IA-2	TCLPIN	Silver	µg/L	5	0			0/ 6	D	5
7440224	IA-3	TCLPIN	Silver	µg/L	5	0			0/ 4	D	5
7440224	IA-4	TCLPIN	Silver	µg/L	5	0			0/ 6	D	5
7440224	IA-4	TCLPIN	Silver	µg/L	1.8				0/ 1	D	
7440224	IA-5	TCLPIN	Silver	µg/L	5	0			0/ 12	D	5
7440224	IA-5	TCLPIN	Silver	µg/L	1.8	0			0/ 2	D	1.8
7440224	IA-6	TCLPIN	Silver	µg/L	5	0			0/ 2	D	5
7440224	IA-9	TCLPIN	Silver	µg/L	5	0			0/ 4	D	5
7440224	IA-13	TCLPIN	Silver	µg/L	5	0			0/ 4	D	5
7440666	IA-4	TCLPIN	Zinc	µg/L	570		570	570	1/ 1	D	
7440666	IA-5	TCLPIN	Zinc	µg/L	434	472	100	767	2/ 2	D	2540

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization (Cont'd)

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
HERBICIDES											
93765	IA-1	TCLPHB	2,4,5-T	µg/L	2.5	0			0/ 2	D	2.5
93765	IA-2	TCLPHB	2,4,5-T	µg/L	2.5	0			0/ 6	D	2.5
93765	IA-3	TCLPHB	2,4,5-T	µg/L	2.5	0			0/ 4	D	2.5
93765	IA-4	TCLPHB	2,4,5-T	µg/L	2.5	0			0/ 6	D	2.5
93765	IA-5	TCLPHB	2,4,5-T	µg/L	2.5	0			0/ 12	D	2.5
93765	IA-6	TCLPHB	2,4,5-T	µg/L	2.5	0			0/ 2	D	2.5
93765	IA-9	TCLPHB	2,4,5-T	µg/L	2.5	0			0/ 4	D	2.5
93765	IA-13	TCLPHB	2,4,5-T	µg/L	2.5	0			0/ 4	D	2.5
93721	IA-1	TCLPHB	2,4,5-TP (Silvex)	µg/L	2.5	0			0/ 2	D	2.5
93721	IA-2	TCLPHB	2,4,5-TP (Silvex)	µg/L	2.5	0			0/ 6	D	2.5
93721	IA-3	TCLPHB	2,4,5-TP (Silvex)	µg/L	2.5	0			0/ 4	D	2.5
93721	IA-4	TCLPHB	2,4,5-TP (Silvex)	µg/L	2.5	0			0/ 6	D	2.5
93721	IA-4	TCLPHB	2,4,5-TP (Silvex)	µg/L	5				0/ 1	D	
93721	IA-5	TCLPHB	2,4,5-TP (Silvex)	µg/L	2.5	0			0/ 12	D	2.5
93721	IA-5	TCLPHB	2,4,5-TP (Silvex)	µg/L	5	0			0/ 3	D	5
93721	IA-6	TCLPHB	2,4,5-TP (Silvex)	µg/L	2.5	0			0/ 2	D	2.5
93721	IA-9	TCLPHB	2,4,5-TP (Silvex)	µg/L	2.5	0			0/ 4	D	2.5
93721	IA-13	TCLPHB	2,4,5-TP (Silvex)	µg/L	2.5	0			0/ 4	D	2.5
94757	IA-1	TCLPHB	2,4-D	µg/L	5	0			0/ 2	D	5
94757	IA-2	TCLPHB	2,4-D	µg/L	5	0			0/ 6	D	5
94757	IA-3	TCLPHB	2,4-D	µg/L	5	0			0/ 4	D	5
94757	IA-4	TCLPHB	2,4-D	µg/L	5	0			0/ 6	D	5
94757	IA-4	TCLPHB	2,4-D	µg/L	20				0/ 1	D	
94757	IA-5	TCLPHB	2,4-D	µg/L	5	0			0/ 12	D	5
94757	IA-5	TCLPHB	2,4-D	µg/L	20	0			0/ 3	D	20
94757	IA-6	TCLPHB	2,4-D	µg/L	5	0			0/ 2	D	5
94757	IA-9	TCLPHB	2,4-D	µg/L	5	0			0/ 4	D	5
94757	IA-13	TCLPHB	2,4-D	µg/L	5	0			0/ 4	D	5
PESTICIDES											
5103719	IA-1	TCLPPP	Alpha Chlordane	µg/L	0.55	0			0/ 2	D	0.55
5103719	IA-2	TCLPPP	Alpha Chlordane	µg/L	0.55	0			0/ 6	D	0.55
5103719	IA-3	TCLPPP	Alpha Chlordane	µg/L	0.575	0.0866			0/ 4	D	0.677
5103719	IA-4	TCLPPP	Alpha Chlordane	µg/L	0.617	0.0683			0/ 6	D	0.673
5103719	IA-5	TCLPPP	Alpha Chlordane	µg/L	0.553	0.0509			0/ 12	D	0.58
5103719	IA-6	TCLPPP	Alpha Chlordane	µg/L	0.48	0.0283			0/ 2	D	0.606
5103719	IA-9	TCLPPP	Alpha Chlordane	µg/L	0.688	0.075			0/ 4	D	0.776
5103719	IA-13	TCLPPP	Alpha Chlordane	µg/L	0.563	0.0479			0/ 4	D	0.619
57749	IA-4	TCLPPP	Chlordane	µg/L	2.5				0/ 1	D	
57749	IA-5	TCLPPP	Chlordane	µg/L	2.5	0			0/ 3	D	2.5
72208	IA-1	TCLPPP	Endrin	µg/L	0.108	0.00354			0/ 2	D	0.123
72208	IA-2	TCLPPP	Endrin	µg/L	0.108	0.00258			0/ 6	D	0.11
72208	IA-3	TCLPPP	Endrin	µg/L	0.116	0.016			0/ 4	D	0.135
72208	IA-4	TCLPPP	Endrin	µg/L	0.121	0.0139			0/ 6	D	0.132

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization (Cont'd)

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
72208	IA-4	TCLPPP	Endrin	µg/L	0.25				0/ 1	D	
72208	IA-5	TCLPPP	Endrin	µg/L	0.111	0.00949			0/ 12	D	0.116
72208	IA-5	TCLPPP	Endrin	µg/L	0.25	0			0/ 3	D	0.25
72208	IA-6	TCLPPP	Endrin	µg/L	0.095	0.00707			0/ 2	D	0.127
72208	IA-9	TCLPPP	Endrin	µg/L	0.136	0.016			0/ 4	D	0.155
72208	IA-13	TCLPPP	Endrin	µg/L	0.11	0.00913			0/ 4	D	0.121
5103742	IA-1	TCLPPP	Gamma Chlordane	µg/L	0.55	0			0/ 2	D	0.55
5103742	IA-2	TCLPPP	Gamma Chlordane	µg/L	0.55	0			0/ 6	D	0.55
5103742	IA-3	TCLPPP	Gamma Chlordane	µg/L	0.575	0.0866			0/ 4	D	0.677
5103742	IA-4	TCLPPP	Gamma Chlordane	µg/L	0.617	0.0683			0/ 6	D	0.673
5103742	IA-5	TCLPPP	Gamma Chlordane	µg/L	0.553	0.0509			0/ 12	D	0.58
5103742	IA-6	TCLPPP	Gamma Chlordane	µg/L	0.48	0.0283			0/ 2	D	0.606
5103742	IA-9	TCLPPP	Gamma Chlordane	µg/L	0.688	0.075			0/ 4	D	0.776
5103742	IA-13	TCLPPP	Gamma Chlordane	µg/L	0.563	0.0479			0/ 4	D	0.619
58899	IA-1	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.055	0			0/ 2	D	0.055
58899	IA-2	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.055	0			0/ 6	D	0.055
58899	IA-3	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.0575	0.00866			0/ 4	D	0.0677
58899	IA-4	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.0617	0.00683			0/ 6	D	0.0673
58899	IA-4	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.25				0/ 1	D	
58899	IA-5	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.0553	0.00509			0/ 12	D	0.058
58899	IA-5	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.25	0			0/ 3	D	0.25
58899	IA-6	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.048	0.00283			0/ 2	D	0.0606
58899	IA-9	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.0688	0.0075			0/ 4	D	0.0776
58899	IA-13	TCLPPP	Gamma-BHC (Lindane)	µg/L	0.0563	0.00479			0/ 4	D	0.0619
76448	IA-1	TCLPPP	Heptachlor	µg/L	0.055	0			0/ 2	D	0.055
76448	IA-2	TCLPPP	Heptachlor	µg/L	0.055	0			0/ 6	D	0.055
76448	IA-3	TCLPPP	Heptachlor	µg/L	0.0575	0.00866			0/ 4	D	0.0677
76448	IA-4	TCLPPP	Heptachlor	µg/L	0.178	0.177	0.38	0.43	2/ 6	D	0.323
76448	IA-4	TCLPPP	Heptachlor	µg/L	0.25				0/ 1	D	
76448	IA-5	TCLPPP	Heptachlor	µg/L	0.0957	0.0668	0.04	0.26	6/ 12	L	0.143
76448	IA-5	TCLPPP	Heptachlor	µg/L	0.25	0			0/ 3	D	0.25
76448	IA-6	TCLPPP	Heptachlor	µg/L	0.048	0.00283			0/ 2	D	0.0606
76448	IA-9	TCLPPP	Heptachlor	µg/L	0.0688	0.0075			0/ 4	D	0.0776
76448	IA-13	TCLPPP	Heptachlor	µg/L	0.0563	0.00479			0/ 4	D	0.0619
1024573	IA-1	TCLPPP	Heptachlor Epoxide	µg/L	0.055	0			0/ 2	D	0.055
1024573	IA-2	TCLPPP	Heptachlor Epoxide	µg/L	0.055	0			0/ 6	D	0.055
1024573	IA-3	TCLPPP	Heptachlor Epoxide	µg/L	0.0575	0.00866			0/ 4	D	0.0677
1024573	IA-4	TCLPPP	Heptachlor Epoxide	µg/L	0.0617	0.00683			0/ 6	D	0.0673
1024573	IA-4	TCLPPP	Heptachlor Epoxide	µg/L	0.25				0/ 1	D	
1024573	IA-5	TCLPPP	Heptachlor Epoxide	µg/L	0.0553	0.00509			0/ 12	D	0.058
1024573	IA-5	TCLPPP	Heptachlor Epoxide	µg/L	0.25	0			0/ 3	D	0.25
1024573	IA-6	TCLPPP	Heptachlor Epoxide	µg/L	0.048	0.00283			0/ 2	D	0.0606
1024573	IA-9	TCLPPP	Heptachlor Epoxide	µg/L	0.0688	0.0075			0/ 4	D	0.0776
1024573	IA-13	TCLPPP	Heptachlor Epoxide	µg/L	0.0563	0.00479			0/ 4	D	0.0619
72435	IA-1	TCLPPP	Methoxychlor	µg/L	0.55	0			0/ 2	D	0.55

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization (Cont'd)

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
72435	IA-2	TCLPPP	Methoxychlor	µg/L	0.55	0			0/ 6	D	0.55
72435	IA-3	TCLPPP	Methoxychlor	µg/L	0.575	0.0866			0/ 4	D	0.677
72435	IA-4	TCLPPP	Methoxychlor	µg/L	0.617	0.0683			0/ 6	D	0.673
72435	IA-4	TCLPPP	Methoxychlor	µg/L	0.5				0/ 1	D	
72435	IA-5	TCLPPP	Methoxychlor	µg/L	0.553	0.0509			0/ 12	D	0.58
72435	IA-5	TCLPPP	Methoxychlor	µg/L	0.5	0			0/ 3	D	0.5
72435	IA-6	TCLPPP	Methoxychlor	µg/L	0.48	0.0283			0/ 2	D	0.606
72435	IA-9	TCLPPP	Methoxychlor	µg/L	0.688	0.075			0/ 4	D	0.776
72435	IA-13	TCLPPP	Methoxychlor	µg/L	0.563	0.0479			0/ 4	D	0.619
8001352	IA-1	TCLPPP	Toxaphene	µg/L	1.08	0.0354			0/ 2	D	1.23
8001352	IA-2	TCLPPP	Toxaphene	µg/L	1.08	0.0258			0/ 6	D	1.1
8001352	IA-3	TCLPPP	Toxaphene	µg/L	1.16	0.16			0/ 4	D	1.35
8001352	IA-4	TCLPPP	Toxaphene	µg/L	1.21	0.139			0/ 6	D	1.32
8001352	IA-4	TCLPPP	Toxaphene	µg/L	10				0/ 1	D	
8001352	IA-5	TCLPPP	Toxaphene	µg/L	1.11	0.0949			0/ 12	D	1.16
8001352	IA-5	TCLPPP	Toxaphene	µg/L	10	0			0/ 3	D	10
8001352	IA-6	TCLPPP	Toxaphene	µg/L	0.95	0.0707			0/ 2	D	1.27
8001352	IA-9	TCLPPP	Toxaphene	µg/L	1.36	0.16			0/ 4	D	1.55
8001352	IA-13	TCLPPP	Toxaphene	µg/L	1.1	0.0913			0/ 4	D	1.21
SEMIVOLATILE ORGANIC COMPOUNDS											
106467	IA-1	TCLPSV	1,4-Dichlorobenzene	µg/L	50	0			0/ 2	D	50
106467	IA-2	TCLPSV	1,4-Dichlorobenzene	µg/L	50	0			0/ 6	D	50
106467	IA-3	TCLPSV	1,4-Dichlorobenzene	µg/L	50	0			0/ 4	D	50
106467	IA-4	TCLPSV	1,4-Dichlorobenzene	µg/L	50	0			0/ 6	D	50
106467	IA-4	TCLPSV	1,4-Dichlorobenzene	µg/L	25				0/ 1	D	
106467	IA-5	TCLPSV	1,4-Dichlorobenzene	µg/L	50	0			0/ 12	D	50
106467	IA-5	TCLPSV	1,4-Dichlorobenzene	µg/L	25	0			0/ 3	D	25
106467	IA-6	TCLPSV	1,4-Dichlorobenzene	µg/L	50	0			0/ 2	D	50
106467	IA-9	TCLPSV	1,4-Dichlorobenzene	µg/L	50	0			0/ 4	D	50
106467	IA-13	TCLPSV	1,4-Dichlorobenzene	µg/L	50	0			0/ 4	D	50
95954	IA-1	TCLPSV	2,4,5-Trichlorophenol	µg/L	250	0			0/ 2	D	250
95954	IA-2	TCLPSV	2,4,5-Trichlorophenol	µg/L	250	0			0/ 6	D	250
95954	IA-3	TCLPSV	2,4,5-Trichlorophenol	µg/L	250	0			0/ 4	D	250
95954	IA-4	TCLPSV	2,4,5-Trichlorophenol	µg/L	250	0			0/ 6	D	250
95954	IA-5	TCLPSV	2,4,5-Trichlorophenol	µg/L	250	0			0/ 12	D	250
95954	IA-5	TCLPSV	2,4,5-Trichlorophenol	µg/L	25	0			0/ 2	D	25
95954	IA-6	TCLPSV	2,4,5-Trichlorophenol	µg/L	250	0			0/ 2	D	250
95954	IA-9	TCLPSV	2,4,5-Trichlorophenol	µg/L	250	0			0/ 4	D	250
95954	IA-13	TCLPSV	2,4,5-Trichlorophenol	µg/L	250	0			0/ 4	D	250
88062	IA-1	TCLPSV	2,4,6-Trichlorophenol	µg/L	50	0			0/ 2	D	50
88062	IA-2	TCLPSV	2,4,6-Trichlorophenol	µg/L	50	0			0/ 6	D	50
88062	IA-3	TCLPSV	2,4,6-Trichlorophenol	µg/L	50	0			0/ 4	D	50
88062	IA-4	TCLPSV	2,4,6-Trichlorophenol	µg/L	50	0			0/ 6	D	50
88062	IA-5	TCLPSV	2,4,6-Trichlorophenol	µg/L	50	0			0/ 12	D	50

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization (Cont'd)

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
88062	IA-5	TCLPSV	2,4,6-Trichlorophenol	µg/L	25	0			0/ 2	D	25
88062	IA-6	TCLPSV	2,4,6-Trichlorophenol	µg/L	50	0			0/ 2	D	50
88062	IA-9	TCLPSV	2,4,6-Trichlorophenol	µg/L	50	0			0/ 4	D	50
88062	IA-13	TCLPSV	2,4,6-Trichlorophenol	µg/L	50	0			0/ 4	D	50
121142	IA-1	TCLPSV	2,4-Dinitrotoluene	µg/L	50	0			0/ 2	D	50
121142	IA-2	TCLPSV	2,4-Dinitrotoluene	µg/L	50	0			0/ 6	D	50
121142	IA-3	TCLPSV	2,4-Dinitrotoluene	µg/L	50	0			0/ 4	D	50
121142	IA-4	TCLPSV	2,4-Dinitrotoluene	µg/L	50	0			0/ 6	D	50
121142	IA-4	TCLPSV	2,4-Dinitrotoluene	µg/L	25				0/ 1	D	
121142	IA-5	TCLPSV	2,4-Dinitrotoluene	µg/L	50	0			0/ 12	D	50
121142	IA-5	TCLPSV	2,4-Dinitrotoluene	µg/L	25	0			0/ 3	D	25
121142	IA-6	TCLPSV	2,4-Dinitrotoluene	µg/L	50	0			0/ 2	D	50
121142	IA-9	TCLPSV	2,4-Dinitrotoluene	µg/L	50	0			0/ 4	D	50
121142	IA-13	TCLPSV	2,4-Dinitrotoluene	µg/L	50	0			0/ 4	D	50
95487	IA-1	TCLPSV	2-Methylphenol	µg/L	50	0			0/ 2	D	50
95487	IA-2	TCLPSV	2-Methylphenol	µg/L	50	0			0/ 6	D	50
95487	IA-3	TCLPSV	2-Methylphenol	µg/L	50	0			0/ 4	D	50
95487	IA-4	TCLPSV	2-Methylphenol	µg/L	50	0			0/ 6	D	50
95487	IA-5	TCLPSV	2-Methylphenol	µg/L	50	0			0/ 12	D	50
95487	IA-5	TCLPSV	2-Methylphenol	µg/L	25	0			0/ 2	D	25
95487	IA-6	TCLPSV	2-Methylphenol	µg/L	50	0			0/ 2	D	50
95487	IA-9	TCLPSV	2-Methylphenol	µg/L	50	0			0/ 4	D	50
95487	IA-13	TCLPSV	2-Methylphenol	µg/L	50	0			0/ 4	D	50
106445	IA-1	TCLPSV	4-Methylphenol	µg/L	50	0			0/ 2	D	50
106445	IA-2	TCLPSV	4-Methylphenol	µg/L	50	0			0/ 6	D	50
106445	IA-3	TCLPSV	4-Methylphenol	µg/L	50	0			0/ 4	D	50
106445	IA-4	TCLPSV	4-Methylphenol	µg/L	50	0			0/ 6	D	50
106445	IA-5	TCLPSV	4-Methylphenol	µg/L	50	0			0/ 12	D	50
106445	IA-5	TCLPSV	4-Methylphenol	µg/L	25	0			0/ 2	D	25
106445	IA-6	TCLPSV	4-Methylphenol	µg/L	50	0			0/ 2	D	50
106445	IA-9	TCLPSV	4-Methylphenol	µg/L	50	0			0/ 4	D	50
106445	IA-13	TCLPSV	4-Methylphenol	µg/L	50	0			0/ 4	D	50
118741	IA-1	TCLPSV	Hexachlorobenzene	µg/L	50	0			0/ 2	D	50
118741	IA-2	TCLPSV	Hexachlorobenzene	µg/L	50	0			0/ 6	D	50
118741	IA-3	TCLPSV	Hexachlorobenzene	µg/L	50	0			0/ 4	D	50
118741	IA-4	TCLPSV	Hexachlorobenzene	µg/L	50	0			0/ 6	D	50
118741	IA-4	TCLPSV	Hexachlorobenzene	µg/L	25				0/ 1	D	
118741	IA-5	TCLPSV	Hexachlorobenzene	µg/L	50	0			0/ 12	D	50
118741	IA-5	TCLPSV	Hexachlorobenzene	µg/L	25	0			0/ 3	D	25
118741	IA-6	TCLPSV	Hexachlorobenzene	µg/L	50	0			0/ 2	D	50
118741	IA-9	TCLPSV	Hexachlorobenzene	µg/L	50	0			0/ 4	D	50
118741	IA-13	TCLPSV	Hexachlorobenzene	µg/L	50	0			0/ 4	D	50
87683	IA-1	TCLPSV	Hexachlorobutadiene	µg/L	50	0			0/ 2	D	50
87683	IA-2	TCLPSV	Hexachlorobutadiene	µg/L	50	0			0/ 6	D	50
87683	IA-3	TCLPSV	Hexachlorobutadiene	µg/L	50	0			0/ 4	D	50

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization (Cont'd)

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
87683	IA-4	TCLPSV	Hexachlorobutadiene	µg/L	50	0			0/ 6	D	50
87683	IA-4	TCLPSV	Hexachlorobutadiene	µg/L	25				0/ 1	D	
87683	IA-5	TCLPSV	Hexachlorobutadiene	µg/L	50	0			0/ 12	D	50
87683	IA-5	TCLPSV	Hexachlorobutadiene	µg/L	25	0			0/ 3	D	25
87683	IA-6	TCLPSV	Hexachlorobutadiene	µg/L	50	0			0/ 2	D	50
87683	IA-9	TCLPSV	Hexachlorobutadiene	µg/L	50	0			0/ 4	D	50
87683	IA-13	TCLPSV	Hexachlorobutadiene	µg/L	50	0			0/ 4	D	50
67721	IA-1	TCLPSV	Hexachloroethane	µg/L	50	0			0/ 2	D	50
67721	IA-2	TCLPSV	Hexachloroethane	µg/L	50	0			0/ 6	D	50
67721	IA-3	TCLPSV	Hexachloroethane	µg/L	50	0			0/ 4	D	50
67721	IA-4	TCLPSV	Hexachloroethane	µg/L	50	0			0/ 6	D	50
67721	IA-4	TCLPSV	Hexachloroethane	µg/L	25				0/ 1	D	
67721	IA-5	TCLPSV	Hexachloroethane	µg/L	50	0			0/ 12	D	50
67721	IA-5	TCLPSV	Hexachloroethane	µg/L	25	0			0/ 3	D	25
67721	IA-6	TCLPSV	Hexachloroethane	µg/L	50	0			0/ 2	D	50
67721	IA-9	TCLPSV	Hexachloroethane	µg/L	50	0			0/ 4	D	50
67721	IA-13	TCLPSV	Hexachloroethane	µg/L	50	0			0/ 4	D	50
98953	IA-1	TCLPSV	Nitrobenzene	µg/L	50	0			0/ 2	D	50
98953	IA-2	TCLPSV	Nitrobenzene	µg/L	50	0			0/ 6	D	50
98953	IA-3	TCLPSV	Nitrobenzene	µg/L	50	0			0/ 4	D	50
98953	IA-4	TCLPSV	Nitrobenzene	µg/L	50	0			0/ 6	D	50
98953	IA-4	TCLPSV	Nitrobenzene	µg/L	25				0/ 1	D	
98953	IA-5	TCLPSV	Nitrobenzene	µg/L	50	0			0/ 12	D	50
98953	IA-5	TCLPSV	Nitrobenzene	µg/L	25	0			0/ 3	D	25
98953	IA-6	TCLPSV	Nitrobenzene	µg/L	50	0			0/ 2	D	50
98953	IA-9	TCLPSV	Nitrobenzene	µg/L	50	0			0/ 4	D	50
98953	IA-13	TCLPSV	Nitrobenzene	µg/L	50	0			0/ 4	D	50
87865	IA-1	TCLPSV	Pentachlorophenol	µg/L	250	0			0/ 2	D	250
87865	IA-2	TCLPSV	Pentachlorophenol	µg/L	250	0			0/ 6	D	250
87865	IA-3	TCLPSV	Pentachlorophenol	µg/L	250	0			0/ 4	D	250
87865	IA-4	TCLPSV	Pentachlorophenol	µg/L	250	0			0/ 6	D	250
87865	IA-5	TCLPSV	Pentachlorophenol	µg/L	250	0			0/ 12	D	250
87865	IA-5	TCLPSV	Pentachlorophenol	µg/L	125	0			0/ 2	D	125
87865	IA-6	TCLPSV	Pentachlorophenol	µg/L	250	0			0/ 2	D	250
87865	IA-9	TCLPSV	Pentachlorophenol	µg/L	250	0			0/ 4	D	250
87865	IA-13	TCLPSV	Pentachlorophenol	µg/L	250	0			0/ 4	D	250
110861	IA-1	TCLPSV	Pyridine	µg/L	50	0			0/ 2	D	50
110861	IA-2	TCLPSV	Pyridine	µg/L	50	0			0/ 6	D	50
110861	IA-3	TCLPSV	Pyridine	µg/L	50	0			0/ 4	D	50
110861	IA-4	TCLPSV	Pyridine	µg/L	50	0			0/ 6	D	50
110861	IA-4	TCLPSV	Pyridine	µg/L	25				0/ 1	D	
110861	IA-5	TCLPSV	Pyridine	µg/L	50	0			0/ 12	D	50
110861	IA-5	TCLPSV	Pyridine	µg/L	25	0			0/ 3	D	25
110861	IA-6	TCLPSV	Pyridine	µg/L	50	0			0/ 2	D	50
110861	IA-9	TCLPSV	Pyridine	µg/L	50	0			0/ 4	D	50

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization (Cont'd)

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
110861	IA-13	TCLPSV	Pyridine	µg/L	50	0			0/ 4	D	50
VOLATILE ORGANIC COMPOUNDS											
75354	IA-1	TCLPVO	1,1-Dichloroethene	µg/L	25	0			0/ 2	D	25
75354	IA-2	TCLPVO	1,1-Dichloroethene	µg/L	25	0			0/ 6	D	25
75354	IA-3	TCLPVO	1,1-Dichloroethene	µg/L	25	0			0/ 4	D	25
75354	IA-4	TCLPVO	1,1-Dichloroethene	µg/L	25				0/ 1	D	
75354	IA-4	TCLPVO	1,1-Dichloroethene	µg/L	25	0			0/ 6	D	25
75354	IA-5	TCLPVO	1,1-Dichloroethene	µg/L	25	0			0/ 3	D	25
75354	IA-5	TCLPVO	1,1-Dichloroethene	µg/L	25	0			0/ 12	D	25
75354	IA-6	TCLPVO	1,1-Dichloroethene	µg/L	25	0			0/ 2	D	25
75354	IA-9	TCLPVO	1,1-Dichloroethene	µg/L	25	0			0/ 4	D	25
75354	IA-13	TCLPVO	1,1-Dichloroethene	µg/L	25	0			0/ 4	D	25
107062	IA-1	TCLPVO	1,2-Dichloroethane	µg/L	25	0			0/ 2	D	25
107062	IA-2	TCLPVO	1,2-Dichloroethane	µg/L	25	0			0/ 6	D	25
107062	IA-3	TCLPVO	1,2-Dichloroethane	µg/L	25	0			0/ 4	D	25
107062	IA-4	TCLPVO	1,2-Dichloroethane	µg/L	25				0/ 1	D	
107062	IA-4	TCLPVO	1,2-Dichloroethane	µg/L	25	0			0/ 6	D	25
107062	IA-5	TCLPVO	1,2-Dichloroethane	µg/L	25	0			0/ 3	D	25
107062	IA-5	TCLPVO	1,2-Dichloroethane	µg/L	25	0			0/ 12	D	25
107062	IA-6	TCLPVO	1,2-Dichloroethane	µg/L	25	0			0/ 2	D	25
107062	IA-9	TCLPVO	1,2-Dichloroethane	µg/L	25	0			0/ 4	D	25
107062	IA-13	TCLPVO	1,2-Dichloroethane	µg/L	25	0			0/ 4	D	25
78933	IA-1	TCLPVO	2-Butanone	µg/L	50	0			0/ 2	D	50
78933	IA-2	TCLPVO	2-Butanone	µg/L	50	0			0/ 6	D	50
78933	IA-3	TCLPVO	2-Butanone	µg/L	50	0			0/ 4	D	50
78933	IA-4	TCLPVO	2-Butanone	µg/L	100				0/ 1	D	
78933	IA-4	TCLPVO	2-Butanone	µg/L	50	0			0/ 6	D	50
78933	IA-5	TCLPVO	2-Butanone	µg/L	100	0			0/ 3	D	100
78933	IA-5	TCLPVO	2-Butanone	µg/L	50	0			0/ 12	D	50
78933	IA-6	TCLPVO	2-Butanone	µg/L	50	0			0/ 2	D	50
78933	IA-9	TCLPVO	2-Butanone	µg/L	50	0			0/ 4	D	50
78933	IA-13	TCLPVO	2-Butanone	µg/L	50	0			0/ 4	D	50
71432	IA-1	TCLPVO	Benzene	µg/L	25	0			0/ 2	D	25
71432	IA-2	TCLPVO	Benzene	µg/L	25	0			0/ 6	D	25
71432	IA-3	TCLPVO	Benzene	µg/L	25	0			0/ 4	D	25
71432	IA-4	TCLPVO	Benzene	µg/L	25				0/ 1	D	
71432	IA-4	TCLPVO	Benzene	µg/L	25	0			0/ 6	D	25
71432	IA-5	TCLPVO	Benzene	µg/L	25	0			0/ 3	D	25
71432	IA-5	TCLPVO	Benzene	µg/L	25	0			0/ 12	D	25
71432	IA-6	TCLPVO	Benzene	µg/L	25	0			0/ 2	D	25
71432	IA-9	TCLPVO	Benzene	µg/L	25	0			0/ 4	D	25
71432	IA-13	TCLPVO	Benzene	µg/L	25	0			0/ 4	D	25
56235	IA-1	TCLPVO	Carbon Tetrachloride	µg/L	25	0			0/ 2	D	25
56235	IA-2	TCLPVO	Carbon Tetrachloride	µg/L	25	0			0/ 6	D	25

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization (Cont'd)

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
56235	IA-3	TCLPVO	Carbon Tetrachloride	µg/L	25	0			0/ 4	D	25
56235	IA-4	TCLPVO	Carbon Tetrachloride	µg/L	25				0/ 1	D	
56235	IA-4	TCLPVO	Carbon Tetrachloride	µg/L	25	0			0/ 6	D	25
56235	IA-5	TCLPVO	Carbon Tetrachloride	µg/L	25	0			0/ 3	D	25
56235	IA-5	TCLPVO	Carbon Tetrachloride	µg/L	25	0			0/ 12	D	25
56235	IA-6	TCLPVO	Carbon Tetrachloride	µg/L	25	0			0/ 2	D	25
56235	IA-9	TCLPVO	Carbon Tetrachloride	µg/L	25	0			0/ 4	D	25
56235	IA-13	TCLPVO	Carbon Tetrachloride	µg/L	25	0			0/ 4	D	25
108907	IA-1	TCLPVO	Chlorobenzene	µg/L	25	0			0/ 2	D	25
108907	IA-2	TCLPVO	Chlorobenzene	µg/L	25	0			0/ 6	D	25
108907	IA-3	TCLPVO	Chlorobenzene	µg/L	25	0			0/ 4	D	25
108907	IA-4	TCLPVO	Chlorobenzene	µg/L	25				0/ 1	D	
108907	IA-4	TCLPVO	Chlorobenzene	µg/L	25	0			0/ 6	D	25
108907	IA-5	TCLPVO	Chlorobenzene	µg/L	25	0			0/ 3	D	25
108907	IA-5	TCLPVO	Chlorobenzene	µg/L	25	0			0/ 12	D	25
108907	IA-6	TCLPVO	Chlorobenzene	µg/L		0			0/ 2	D	25
108907	IA-9	TCLPVO	Chlorobenzene	µg/L		0			0/ 4	D	25
108907	IA-13	TCLPVO	Chlorobenzene	µg/L		0			0/ 4	D	25
67663	IA-1	TCLPVO	Chloroform	µg/L		0			0/ 2	D	25
67663	IA-2	TCLPVO	Chloroform	µg/L		0			0/ 6	D	25
67663	IA-3	TCLPVO	Chloroform	µg/L		0			0/ 4	D	25
67663	IA-4	TCLPVO	Chloroform	µg/L					0/ 1	D	
67663	IA-4	TCLPVO	Chloroform	µg/L		0			0/ 6	D	25
67663	IA-5	TCLPVO	Chloroform	µg/L		0			0/ 3	D	25
67663	IA-5	TCLPVO	Chloroform	µg/L		0			0/ 12	D	25
67663	IA-6	TCLPVO	Chloroform	µg/L		0			0/ 2	D	25
67663	IA-9	TCLPVO	Chloroform	µg/L		0			0/ 4	D	25
67663	IA-13	TCLPVO	Chloroform	µg/L		0			0/ 4	D	25
127184	IA-1	TCLPVO	Tetrachloroethene	µg/L		0			0/ 2	D	25
127184	IA-2	TCLPVO	Tetrachloroethene	µg/L		0			0/ 6	D	25
127184	IA-3	TCLPVO	Tetrachloroethene	µg/L		0			0/ 4	D	25
127184	IA-4	TCLPVO	Tetrachloroethene	µg/L					0/ 1	D	
127184	IA-4	TCLPVO	Tetrachloroethene	µg/L		0			0/ 6	D	25
127184	IA-5	TCLPVO	Tetrachloroethene	µg/L	25	0			0/ 3	D	25
127184	IA-5	TCLPVO	Tetrachloroethene	µg/L	25	0			0/ 12	D	25
127184	IA-6	TCLPVO	Tetrachloroethene	µg/L	25	0			0/ 2	D	25
127184	IA-9	TCLPVO	Tetrachloroethene	µg/L	25	0			0/ 4	D	25
127184	IA-13	TCLPVO	Tetrachloroethene	µg/L	25	0			0/ 4	D	25
79016	IA-1	TCLPVO	Trichloroethene	µg/L	25	0			0/ 2	D	25
79016	IA-2	TCLPVO	Trichloroethene	µg/L	25	0			0/ 6	D	25
79016	IA-3	TCLPVO	Trichloroethene	µg/L	25	0			0/ 4	D	25
79016	IA-4	TCLPVO	Trichloroethene	µg/L	25				0/ 1	D	
79016	IA-4	TCLPVO	Trichloroethene	µg/L	25	0			0/ 6	D	25
79016	IA-5	TCLPVO	Trichloroethene	µg/L	25	0			0/ 3	D	25
79016	IA-5	TCLPVO	Trichloroethene	µg/L	25	0			0/ 12	D	25

Table 4-5. Summary Statistics for Combined 1998 SLAPS Characterization and RI Addendum Historical Data from Soil Samples - Waste Characterization (Cont'd)

CAS Number	Location	Analysis Type	Analyte	Units	Average Result	Standard Deviation	Minimum Detect	Maximum Detect	Results >Detection Limit[1]	Dist. Code[2]	95% UCL of Mean
79016	1A-6	TCLPVO	Trichloroethene	µg/L	25	0			0/ 2	D	25
79016	1A-9	TCLPVO	Trichloroethene	µg/L	25	0			0/ 4	D	25
79016	1A-13	TCLPVO	Trichloroethene	µg/L	25	0			0/ 4	D	25
75014	1A-1	TCLPVO	Vinyl Chloride	µg/L	50	0			0/ 2	D	50
75014	1A-2	TCLPVO	Vinyl Chloride	µg/L	50	0			0/ 6	D	50
75014	1A-3	TCLPVO	Vinyl Chloride	µg/L	50	0			0/ 4	D	50
75014	1A-4	TCLPVO	Vinyl Chloride	µg/L	50				0/ 1	D	
75014	1A-4	TCLPVO	Vinyl Chloride	µg/L	50	0			0/ 6	D	50
75014	1A-5	TCLPVO	Vinyl Chloride	µg/L	50	0			0/ 3	D	50
75014	1A-5	TCLPVO	Vinyl Chloride	µg/L	50	0			0/ 12	D	50
75014	1A-6	TCLPVO	Vinyl Chloride	µg/L	50	0			0/ 2	D	50
75014	1A-9	TCLPVO	Vinyl Chloride	µg/L	50	0			0/ 4	D	50
75014	1A-13	TCLPVO	Vinyl Chloride	µg/L	50	0			0/ 4	D	50
MISCELLANEOUS											
N419	1A-4	MISC	Free Liquids		0.00				D	0/ 1	
N384	1A-4	MISC	Ignitability (Flashpoint)	C	30.00				D	0/ 1	
N704	1A-4	MISC	pH	STD UN	7.52		7.52	7.52	D	1/ 1	
57125	1A-4	INOCYA	Cyanide	mg/kg	0.305				0/ 1	D	
18496258	1A-4	GENERA	Sulfide	mg/kg	9.68	5.74	13.8	23.8	3/ 15	D	12.3
N419	1A-5	MISC	Free Liquids		0.00	0.00			D	0/ 3	0.00
N384	1A-5	MISC	Ignitability (Flashpoint)	C	60.00	0.00	60.00	60.00	D	3/ 3	60.00
N704	1A-5	MISC	pH	STD UN	7.59	0.54	7.23	8.21	D	3/ 3	8.50
57125	1A-5	INOCYA	Cyanide	mg/kg	0.387	0.189	0.772	0.772	1/ 6	D	0.542
18496258	1A-5	GENERA	Sulfide	mg/kg	9.26	5.8	19.4	23.5	2/ 16	D	11.8

[1]Results less than the detection limit were set to 1/2 the reported detection limit.
[2]Distribution Codes: L-distribution most similar to lognormal. (Land statistic used for UCL.)
N-distribution most similar to normal. (t-distribution used for UCL.)
X-distribution significantly different from normal and lognormal.(t-distribution used for UCL.)
D-distribution not determined because fewer than 5 detects or less than 50% detects.(t-dist)
Z-distribution with negative results and therefore treated as normal.

4.6 CHARACTERIZATION OF CONTAMINANTS IN GROUND WATER

The distribution of various chemicals in ground water based on the July and August 1998 ground-water sampling results are described in this section. A total of 28 wells were sampled for various parameters in the summer of 1998. The results of the ground-water analytical data are represented in three major categories: radiological compounds, metals and inorganics, and organic compounds. The ground-water chemistry data acquired in the 1998 sampling events at SLAPS are compared to EPA-designated maximum contaminant levels (MCLs), estimated background concentration, and other historical data of the various parameters, as applicable. The ground-water chemistry data were provided with laboratory and review qualifications. The data discussed in this report all had acceptable "review qualifier" annotations. Results are presented in Appendix E.

4.6.1 Radiological Compounds

Ground-water samples collected in July and August 1998 were analyzed for total uranium (metals analysis), individual radioisotopes of uranium (U-234, U-235, and U-238), Ra-226, Th-228, Th-230, and Th-232. Previous ground-water sampling results indicated that uranium occurred in the ground water and was considered the primary radiological parameter of interest. Historical data indicated non-detectable to low concentrations of the other radiological compounds.

4.6.1.1 Total Uranium in Groundwater

Elevated total uranium concentrations above its MCL and estimated background values were detected in some ground-water samples from SLAPS and surrounding off-site wells. The EPA proposed MCL for total uranium is 20 micrograms per liter (μg/L) and its estimated site-specific background concentrations for the upper and lower zone ground waters are less than 5 μg/L and less than 1.5 μg/L, respectively. The concentrations of total uranium detected in the 1998 ground-water sampling event at SLAPS are presented in Table 4-6. The uranium concentrations presented in this table are a summary of the individual radioisotopes of uranium, which were reported in picocuries per liter (pCi/L) and then converted to μg/L. The total uranium concentration by metals analyses methods are also provided in Table 4-6. The total uranium concentrations of 1997 presented in the table also represent the total uranium metals analysis concentrations. Of the 27 wells sampled for uranium, uranium concentrations exceeding its MCL were detected in 6 wells, all of which are located in the Upper Hydrostratigraphic Zone (HZ-A). Wells D, E, M10-8S, M10-25S, and M11-9S are located within the boundaries of SLAPS. Well B53W06S is located in the ballfields. The greatest concentrations of total uranium were detected in ground-water samples from beneath the western portion of SLAPS. The highest dissolved uranium concentration was 5,273 μg/L in Well M11-9S. Eight additional ground-water samples contained total uranium concentrations above the estimated ground-water background value in both upper and lower zone wells. These elevated uranium values were detected in wells within SLAPS and at surrounding off-site properties. One of these eight wells, B53W11D, is screened in the shale (HZ-D). The distribution of total uranium in ground water at SLAPS, based on the 1998 data, is illustrated on Figure 4-48.

Table 4-6. Historical Concentrations of Total Uranium (µg/L) in Groundwater at SLAPS (1984-1992 and 1997-1998)

Well ID	1984*	1985*	1986*	1987*	1988*	1989*	1990*	1991*	1992*	1997	1998
A	1812	3345	1667	1604	2394	2908	3429	5312	--	6060	--
B	8028	6669	9254	8210	7873	7438	6413	9318	--	7330	--
C	56.3	50.7	22.5	18.3	25	28.2	26.8	22.5	--	42.5	--
D	328	667	897	897	669	1088	971	1242	--	540	400 (384)
E	182	161	761	811	278	1154	266	287	--	182	274 (226)
F	199	249	206	149	373	375	285	569	--	467	--
B53W01D	--	--	--	--	5.6	--	--	7	--	<1.5	<2.0
B53W01S	--	--	--	--	4.2	--	--	8.5	--	2.3	<2.6
B53W02D	--	--	--	--	--	--	--	--	--	<1.5	--
B53W02S	--	--	--	--	--	--	--	--	--	5.3	--
B53W03D	--	--	--	--	--	--	--	--	--	<1.5	--
B53W03S	--	--	--	--	--	--	--	--	--	2.4	1.7
B53W04D	--	--	--	--	--	--	--	--	--	<1.5	--
B53W04S	--	--	--	--	--	--	--	--	--	<1.5	--
B53W05D	--	--	--	--	--	--	--	--	--	<1.5	--
B53W05S	--	--	--	--	--	--	--	--	--	<1.5	--
B53W06D	--	--	--	--	--	--	--	--	--	<1.5	<1.1
B53W06S	--	--	--	--	--	--	--	--	--	75.4	31.9
B53W07D	--	--	--	--	--	--	--	--	--	<1.5	<1.5
B53W07S	--	--	--	--	--	--	--	0.8	--	11.8	9.8
B53W08D	--	--	--	--	--	--	--	--	--	<1.5	--
B53W08S	--	--	--	--	--	--	--	--	--	<1.5	--
B53W09D	--	--	--	--	--	--	--	--	--	10.5	--
B53W09S	--	--	--	--	--	--	--	--	--	7.1	8.8
B53W10D	--	--	--	--	--	--	--	6.7	--	<1.5	<1.1
B53W10S	--	--	--	--	--	--	--	3.1	3.9	3.8	4.9
B53W11D	--	--	--	--	--	--	5.6	23.9	26.2	3.6	7.0
B53W11S	--	--	--	--	--	--	--	--	--	<1.5	--
B53W12D	--	--	--	--	--	--	--	--	--	2.1	--
B53W12S	--	--	--	--	--	--	--	7.3	20	17.6	15.1
B53W13S	--	--	--	--	--	--	--	4.5	12.7	14.3	15.9
B53W14S	--	--	--	--	--	--	--	--	0.6	<1.5	--
B53W15S	--	--	--	--	--	--	--	11.3	8.7	1.7	4.1
B53W16S	--	--	--	--	--	--	--	8.5	--	2.6	1.1
B53W17S	--	--	--	--	--	--	--	--	7.1	3.6	--
B53W18S	--	--	--	--	--	--	--	--	8.0	6.6	6.0
B53W19S	--	--	--	--	--	--	--	--	2.9	1.7	<1.4
B53W20S	--	--	--	--	--	--	--	--	5.0	<1.5	<1.5
M10-8D	--	--	--	7.0	5.6	7.0	5.6	5.6	0.1	<1.5	<1.5
M10-8S	--	--	--	45.1	26.8	29.6	8.5	46.5	8.6	191	157 (163)
M10-15D	--	--	--	12.7	7.0	4.2	8.5	8.5	--	<1.5	<1.3
M10-15S	--	--	--	15.5	12.7	15.5	7.0	15.5	--	6.0	7.3
M10-25D	--	--	--	5.6	5.6	4.2	4.2	11.3	--	2.6	2.9
M10-25S	--	--	--	35.2	54.9	46.5	81.7	50.7	--	113	104
M11-9S	--	--	--	6448	6507	6770	2727	8654	7409	6420	5273 (5310)
M11-21S	--	--	--	63.4	103	135	117	231	--	151	--
M13.5-8.5D	--	--	--	--	--	--	8.5	7.0	0.8	<1.5	--
M13.5-8.5S	--	--	--	5.6	5.6	4.2	5.6	8.5	14.4	4.3	--

Notes:
-- Data not available.
* Yearly averaged data.
All 1984-92 samples are assumed to be unfiltered.
All 1997 and 1998 samples are filtered.
All results reported to the nearest 0.1 µg/L for concentrations below 100 µg/L.
The EPA MCL for total uranium is 20 µg/L.
Historic data from BNI 1994, SAIC 1994, USACE 1998a
< - Reported concentration below sample quantitation limit based on either "Laboratory" or "Reviewer Qualifier".
Values reported in parentheses ( ) are total uranium concentrations by total metals analysis.

A comparison of the September 1997 and July/August 1998 concentrations of total uranium in ground-water beneath SLAPS indicate similar values. Elevated concentrations of total uranium continue to occur beneath the western portion of the site at Well M11-9S and Wells D and E. An elevated uranium concentration was again detected at Well B53W06S located north of SLAPS along Coldwater Creek. A total uranium concentration of 31.9 µg/L was detected in July 1998 compared to a concentration of 75.4 µg/L detected in September 1997.

4.6.1.2 Radium 226 in Groundwater

The Ra-226 concentrations detected in ground water at SLAPS during the 1998 sampling event are presented in Table 4-7. The maximum Ra-226 concentration was measured at 2.89 pCi/L in the ground-water sample from Well B53W07D. Most ground-water samples from on-site and off-site wells contained non-detected concentrations of Ra-226. No ground-water samples collected in 1998 contained a Ra-226 concentration exceeding its MCL of 5 pCi/L. The ground-water samples with detectable Ra-226 concentrations in 1998 generally have a slightly higher reported Ra-226 concentration than the values reported in 1997.

Table 4-7. Historical Concentrations of Radium-226 (pCi/L) in Ground Water at SLAPS (1984-1992 and 1997-1998)

Well ID	1984*	1985*	1986*	1987*	1988*	1989*	1990*	1991*	1992*	1997	1998
A	0.3	0.2	0.3	0.3	0.4	0.4	0.5	0.3	--	<0.1	--
B	0.3	0.2	0.3	0.3	0.6	0.6	0.6	0.4	--	0.2	--
C	0.3	0.2	0.3	0.4	0.5	0.5	0.5	0.3	--	0.4	--
D	0.2	0.1	0.3	0.1	0.3	0.5	0.4	0.2	--	0.2	<1.54
E	0.6	0.2	0.5	0.3	0.6	0.6	0.5	0.5	--	0.4	<1.18
F	0.2	0.1	0.2	0.3	0.6	0.4	0.5	0.2	--	0.1	--
B53W01D	--	--	--	--	1.1	1.0	1.0	0.9	--	0.8	<0.74
B53W01S	--	--	--	--	0.6	0.7	0.4	0.9	--	<0.1	<1.53
B53W02D	--	--	--	--	--	--	--	--	--	0.6	--
B53W02S	--	--	--	--	--	--	--	--	--	<0.1	--
B53W03D	--	--	--	--	--	--	--	--	--	0.7	--
B53W03S	--	--	--	--	--	--	--	--	--	0.1	1.0
B53W04D	--	--	--	--	--	--	--	--	--	0.4	--
B53W04S	--	--	--	--	--	--	--	--	--	<0.1	--
B53W05D	--	--	--	--	--	--	--	--	--	0.7	--
B53W05S	--	--	--	--	--	--	--	--	--	0.2	--
B53W06D	--	--	--	--	--	--	--	--	--	0.2	<1.26
B53W06S	--	--	--	--	--	--	--	--	--	<0.1	<1.01
B53W07D	--	--	--	--	--	--	--	--	--	0.6	2.89
B53W07S	--	--	--	--	--	--	--	0.8	--	0.1	<0.73
B53W08D	--	--	--	--	--	--	--	--	--	0.8	--
B53W08S	--	--	--	--	--	--	--	--	--	0.8	--
B53W09D	--	--	--	--	--	--	--	--	--	0.5	--
B53W09S	--	--	--	--	--	--	--	--	--	0.3	1.24
B53W10D	--	--	--	--	--	--	--	0.2	--	0.3	<0.8
B53W10S	--	--	--	--	--	--	--	0.3	1.3	0.5	<1.12
B53W11D	--	--	--	--	--	--	0.8	0.5	33.8	0.1	<1.07

Table 4-7. Historical Concentrations of Radium-226 (pCi/L) in Ground Water at SLAPS (1984-1992 and 1997-1998) (Cont'd)

Well ID	1984*	1985*	1986*	1987*	1988*	1989*	1990*	1991*	1992*	1997	1998
B53W11S	--	--	--	--	--	--	--	--	--	<0.1	--
B53W12D	--	--	--	--	--	--	--	--	1.6	0.2	--
B53W12S	--	--	--	--	--	--	--	0.1	--	0.2	<1.05
B53W13S	--	--	--	--	--	--	--	0.2	1.7	0.4	<1.29
B53W14S	--	--	--	--	--	--	--	--	1.76	0.2	--
B53W15S	--	--	--	--	--	--	0.3	0.8	2.3	0.1	<0.4
B53W16S	--	--	--	--	--	--	0.2	0.5	--	0.2	<1.08
B53W17S	--	--	--	--	--	--	--	--	0.6	0.2	--
B53W18S	--	--	--	--	--	--	--	--	1.0	0.8	1.83
B53W19S	--	--	--	--	--	--	--	--	0.2	0.3	<1.32
B53W20S	--	--	--	--	--	--	--	--	0.3	0.1	<2.37
M10-8D	--	--	--	0.3	0.6	0.6	0.8	0.9	0.9	0.4	<1.17
M10-8S	--	--	--	0.4	0.5	0.4	0.5	0.4	0.9	0.3	<0.94
M10-15D	--	--	--	0.4	0.9	0.9	0.6	1.2	--	0.4	<1.18
M10-15S	--	--	--	0.3	0.8	0.4	0.5	1.2	--	0.2	<0.93
M10-25D	--	--	--	0.2	0.4	0.7	0.7	1.6	--	0.4	<0.86
M10-25S	--	--	--	0.2	0.6	0.5	0.5	0.6	--	0.3	<1.17
M11-9S	--	--	--	0.5	0.8	0.5	0.3	0.3	--	0.2	<1.5
M11-21S	--	--	--	0.5	0.7	0.7	0.5	2.3	--	0.1	--
M13.5-8.5D	--	--	--	0.5	0.6	0.6	1.5	0.6	1.8	0.2	--
M13.5-8.5S	--	--	--	0.5	0.8	0.5	0.7	0.9	2.6	0.3	--

Notes:
-- Data not available.
* Yearly averaged data.
All 1984-1992 samples are assumed to be unfiltered.
All 1997 and 1998 samples are filtered.
The EPA MCL for Radium-226 and Radium-228 (combined) is 5 pCi/L.
Historic data from BNI 1994, SAIC 1994, USACE 1998a.
< - Reported concentration below sample quantitation limit based on either "Laboratory" or "Reviewer Qualifier".

4.6.1.3 Thorium in Groundwater

Ground-water samples collected in 1998 from SLAPS were also analyzed for Th-228, Th-230, and Th-232. Concentrations below 1 pCi/L for Th-238 and Th-232 were reported as non-detects. Several ground-water samples contained detectable concentrations of Th-230. The highest Th-230 concentrations were detected in samples from Well B53W16S at 7.93 pCi/L, Well M11-9S at 6.57 pCi/L, and Well B53W18S at 3.08 pCi/L. These three wells are located at the eastern end of SLAPS, the western end of SLAPS, and off-site west of Coldwater Creek, respectively. The ground-water sample from Well B53W11D, which is constructed in the shale bedrock, contained a dissolved Th-230 concentration of 3.6 pCi/L. This is not consistent with the unfiltered ground-water thorium concentration of 'not detected' also reported for this well. The unfiltered ground-water sample from Well B53W16S contained a Th-230 concentration of less than 0.81 pCi/L. Ground-water samples from seven other monitoring wells at SLAPS and the surrounding property contained Th-230 concentrations greater than 1 pCi/L. No EPA MCL has been established for this radionuclide. A summary of the historical ground-water analyses for Th-230 at SLAPS is provided on Table 4-8.

Table 4-8. Historical Concentrations of Thorium-230 (pCi/L) in Groundwater at SLAPS (1984-1992 and 1997-1998)

Well ID	1984*	1985*	1986*	1987*	1988*	1989*	1990*	1991*	1992*	1997	1998
A	9.5	2.3	<0.4	0.8	2.8	2.9	4.1	2.7	--	0.2	--
B	0.3	0.3	1.2	1.4	2.0	1.1	1.2	0.9	--	<0.1	--
C	0.2	0.2	0.2	0.9	0.3	0.1	0.2	0.7	--	<0.1	--
D	0.9	1.3	0.3	0.9	0.9	1.4	1.4	1.5	--	<0.1	1.65
E	0.3	1.0	0.4	0.9	4.8	1.7	0.6	1.3	--	0.2	1.07
F	0.4	1.1	0.2	1.7	2.0	0.8	0.4	1.2	--	<0.1	--
B53W01D	--	--	--	--	0.2	0.4	0.4	0.6	--	<0.1	1.4
B53W01S	--	--	--	--	0.2	0.3	0.2	0.7	--	<0.1	<0.69
B53W02D	--	--	--	--	--	--	--	--	--	<0.1	--
B53W02S	--	--	--	--	--	--	--	--	--	<0.1	--
B53W03D	--	--	--	--	--	--	--	--	--	<0.1	--
B53W03S	--	--	--	--	--	--	--	--	--	<0.1	0.64
B53W04D	--	--	--	--	--	--	--	--	--	<0.1	--
B53W04S	--	--	--	--	--	--	--	--	--	<0.1	--
B53W05D	--	--	--	--	--	--	--	--	--	<0.1	--
B53W05S	--	--	--	--	--	--	--	--	--	<0.1	--
B53W06D	--	--	--	--	--	--	--	--	--	<0.1	<1.15
B53W06S	--	--	--	--	--	--	--	--	--	<0.1**	<1.16
B53W07D	--	--	--	--	--	--	--	--	--	<0.1	<0.83
B53W07S	--	--	--	--	--	--	--	0.2	--	<0.1	0.53
B53W08D	--	--	--	--	--	--	--	--	--	<0.1	--
B53W08S	--	--	--	--	--	--	--	--	--	<0.1	--
B53W09D	--	--	--	--	--	--	--	--	--	<0.1	--
B53W09S	--	--	--	--	--	--	--	--	--	<0.1	0.78
B53W10D	--	--	--	--	--	--	--	0.2	--	<0.1	0.84
B53W10S	--	--	--	--	--	--	--	0.2	0.9	<0.1	<0.94
B53W11D	--	--	--	--	--	--	2.0	0.8	8.9	<0.1	3.6
B53W11S	--	--	--	--	--	--	--	--	--	<0.1	--
B53W12D	--	--	--	--	--	--	--	--	--	<0.1	--
B53W12S	--	--	--	--	--	--	--	0.2	2.6	<0.1	0.93
B53W13S	--	--	--	--	--	--	--	0.2	0.4	<0.1	<1.0
B53W14S	--	--	--	--	--	--	--	--	0.34	<0.1	--
B53W15S	--	--	--	--	--	--	0.7	1.4	0.6	<0.1	3.1
B53W16S	--	--	--	--	--	--	0.2	0.7	--	<0.1	7.93
B53W17S	--	--	--	--	--	--	--	--	0.1	<0.1	--
B53W18S	--	--	--	--	--	--	--	--	<0.2	<0.1	3.08
B53W19S	--	--	--	--	--	--	--	--	0.1	<0.1	0.75
B53W20S	--	--	--	--	--	--	--	--	0.6	<0.1	<1.43
M10-8D	--	--	--	<0.1	0.3	0.3	0.9	1.0	0.3	<0.1	1.6
M10-8S	--	--	--	0.2	0.5	0.3	0.2	0.6	0.9	<0.1	1.09
M10-15S	--	--	--	1.8	5.3	1.3	1.0	24.1	--	<0.1	<1.0
M10-15D	--	--	--	0.4	1.3	1.1	0.5	0.8	--	<0.1	<1.26
M10-25D	--	--	--	0.8	0.5	0.8	0.9	1.5	--	<0.1	<1.12
M10-25S	--	--	--	0.2	0.4	0.1	0.3	1.2	--	<0.1	1.52
M11-9S	--	--	--	0.3	1.0	0.8	0.2	1.6	1.4	0.1	6.57
M11-21S	--	--	--	15.2	52	11	11.9	28	--	<0.1	--
M13.5-8.5D	--	--	--	<0.1	0.7	0.6	0.6	0.5	0.4	<0.1	--
M13.5-8.5S	--	--	--	0.4	0.7	0.2	0.3	1.6	0.8	<0.1	--

Notes:
-- Data not available.
* Yearly averaged data.
** Indicates analysis performed on unfiltered sample. Filtered sample analysis not available.
All 1984-92 samples are assumed to be unfiltered.
All 1997 and 1998 samples are filtered (except as noted).
There is no established EPA MCL for Thorium-230.
Historic data from BNI 1994, SAIC 1994, USACE 1998a
< - Reported concentration below sample quantitation limit based on either "Laboratory" or "Reviewer Qualifier".

A comparison of historical Th-230 concentrations in ground-water to the 1998 results indicates that slightly higher Th-230 concentrations were detected in the 1998 samples. The 1998 results correlate better with thorium results of 1991 and 1992.

4.6.2 Metals and Inorganics

Numerous metals and inorganic chemicals were analyzed in the ground-water samples collected in July and August 1998. As identified in the Ground-water Characterization Report (USACE, 1998b), the main inorganic parameters of interest are arsenic, manganese, nitrate, and selenium. This section will discuss the current concentrations of these four parameters in site ground-water as well as any additional inorganic parameters of potential interest.

4.6.2.1 Arsenic in Ground-Water

Of the 28 wells sampled in 1998, ground-water samples from 4 wells contained arsenic above its MCL of 50 µg/L. These four wells are exposed to ground-water of the Lower Hydrostratigraphic Zone (Unit 4) as previously identified in the September 1997 ground-water data. A maximum dissolved arsenic concentration of 100 µg/L was detected in well B53W10D which also contained the highest arsenic concentration in 1997. The highest arsenic concentration detected in ground-water of the Upper Hydrostratigraphic Zone (HZ-A) was 6 µg/L in well M10-8S. The elevated arsenic concentrations in the deeper HZ intervals ground water are interpreted to be naturally occurring background concentrations.

4.6.2.2 Manganese in Ground-Water

Concentrations of manganese above its SMCL of 50 µg/L were detected in ground-water samples from 21 of the 28 wells sampled in July and August 1998. These ground-water samples were collected from both HZ-A and deeper HZ interval. The estimated background concentration for manganese for the Upper Zone (HZ-A) ground-water has been reported at 25 µg/L (BNI, 1998). A total of 17 Upper Zone (HZ-A) wells contained manganese above its estimated background concentration. The highest concentrations of manganese above 2,000 µg/L were detected in several wells located at the western end of SLAPS. The highest concentrations of manganese in HZ-A wells are at Well D (4,150 µg/L) and at Well M11-9 (3,240 µg/L). In addition, an elevated manganese concentration of 2,560 µg/L was detected in the ground-water sample from Well B53W06S. The estimated background concentration for manganese for deeper HZ interval (Lower Zone) ground-water is reported at 215 µg/L (BNI, 1998). Of the eight Lower Zone wells sampled in 1998, ground-water samples from each deep well contained manganese at or above its estimated background concentration. The highest manganese concentration detected in the Lower Zone ground-water was at Well M10-25D at 3,740 µg/L. Concentrations of manganese above its background concentration were also detected in several off-site wells such as B53W06D and B53W07D. As identified in previous reports, the occurrence of manganese in the Lower Zone ground-water is likely due to natural conditions, and the estimated background concentration in the Lower Zone appears greater than 215 µg/L. The historical concentrations of manganese in ground-water at surrounding SLAPS are provided in Table 4-9.

Table 4-9. Historical Concentrations of Manganese, Nitrate, and Selenium in Ground Water at SLAPS

Well ID	Manganese (µg/L)			Nitrate (mg/L)			Selenium (µg/L)		
	1988-89*	1997	1998	1989	1997	1998	1988-89*	1997	1998
A	487	349	--	--	27.6	--	448	522	--
B	1,360	2,070	--	--	444	--	184	272	--
C	659	553	--	--	24.1	--	118	<3.4	--
D	6,012	6,420/	4,150	--	11	44.2	<82	7.4	13.8
E	33	<11.6	<15	--	537	353	4,898	4,300	3,910
F	15	<3.9	--	--	<0.1	--	143	134	--
B53W01D	1,690	215**	210	BDL	<0.1	<0.02	--	<3.4**	<2.6
B53W01S	1,068	43.1**	<15	0.2	0.7	0.49	--	<3.4**	<2.6
B53W02D	--	245	--	--	<0.1	--	--	<3.4	--
B53W02S	--	<7.2**	--	--	1.7	--	--	12.4**	--
B53W03D	--	237**	--	--	<0.1	--	--	<3.4**	--
B53W03S	--	774**	157	--	0.1	0.38	--	6.1**	<5
B53W04D	--	1,360	--	--	<0.1	--	--	<3.4	--
B53W04S	--	81	--	--	0.2	--	--	<3.4	--
B53W05D	--	229**	--	--	<0.1	--	--	<3.4**	--
B53W05S	--	431**	--	--	0.5	--	--	<3.4**	--
B53W06D	--	447*	491	--	<0.1	<0.02	--	<3.4**	<2.6
B53W06S	--	3660**	2,560	--	162	59.5	--	8.4**	<2.6
B53W07D	--	218	243	--	<0.1	0.43	--	<3.4	<2.6
B53W07S	--	<3.9	63	--	44.2	65	--	<3.4	<2.6
B53W08D	--	277	--	--	<0.1	--	--	<3.4	--
B53W08S	--	747	--	--	<0.1	--	--	3.6	--
B53W09D	--	214	--	0.1	0.6	--	--	3.4	--
B53W09S	--	<5.6	42	--	96.5	91.5	--	444	375
B53W10D	--	358	384	--	<0.1	0.04	--	<3.4	<2.6
B53W10S	--	2,310	844	--	0.4	<0.02	--	<3.4	<2.6
B53W11D	--	249	215	BDL	<0.1	<0.02	--	<3.4	<2.6
B53W11S	--	28.3	--	0.2	<0.1	--	--	<3.4	--
B53W12D	--	681	--	--	<0.2	--	--	<3.4	--
B53W12S	--	216**	968	--	33.9	29.3	--	186**	134
B53W13S	--	<0.3/	30	--	110	107	--	506	443
B53W14S	--	1510**	--	--	<0.1	--	--	<3.4**	--
B53W15S	--	178**	125	--	0.2	0.04	--	<3.4**	<2.6
B53W16S	--	28.3**	73	0.49	1.2	0.98	--	<3.4**	<2.6
B53W17S	--	<3.3**	170	--	293	341	--	120**	97
B53W18S	--	553**	616	--	0.2	<0.02	--	<3.4**	<2.6
B53W19S	--	217**	50	--	0.8	3.17	--	<3.4**	5.8
B53W20S	--	<0.49	<15	--	0.8	2.54	--	<3.4	9.3

Table 4-9. Historical Concentrations of Manganese, Nitrate, and Selenium in Ground Water at SLAPS (Cont'd)

Well ID	Manganese (µg/L)			Nitrate (mg/L)			Selenium (µg/L)		
	1988-89*	1997	1998	1989	1997	1998	1988-89*	1997	1998
M10-8D	2,190	400	451	--	<0.1	0.17	<82	<3.4	<2.6
M10-8S	5,578	1,080/	1,360	--	32.8/	14.9**	<82	42.4	45
M10-15D	4,336	1,130	1,590	--	<0.1	<0.02	<83	<3.4	<2.6
M10-15S	122	<22.6	48	--	188	203	414	623	628
M10-25D	2,232	4,090	3,740	--	0.2	0.25	<82	<3.4	<2.6
M10-25S	1,911	<160	106	--	1.1	1.42	<84	8	5.7
M11-9S	4,270	3,460	3,240	--	569	613	140	336	317
M11-21S	295	<134	--	--	3.2	--	498	677	--
M13.5-8.5D	1,312	270	--	--	<0.1	--	<82	<3.4	--
M13.5-8.5S	3,286	1,220	--	--	17	--	<82	<3.4	--

Notes:
-- Data not available.
BDL - Below detection limit.
* Yearly averaged data.
** Analysis performed on unfiltered sample. Filtered sample analysis not available.
All 1988-89 samples are assumed to be unfiltered.
All 1997 and 1998 samples are filtered (except as noted).
The EPA MCL and SMCL for selenium and manganese are 50 µg/L, and the EPA MCL for nitrate is 10 mg/L.
Historic data from BNI 1994, SAIC 1994, USACE 1998a
< - Reported concentration below SQL based on either "Laboratory" or "Reviewer Qualifier".

4.6.2.3 Nitrate in Ground-Water

Dissolved nitrate above its MCL of 10 milligrams per liter (mg/L) was detected in 11 of the 28 wells sampled in 1998 at SLAPS. The distribution of nitrate concentrations in the sampled wells is illustrated on Figure 4-49. The highest nitrate concentration was detected in well M11-9S at 613 mg/L. Other elevated concentrations of nitrates above 100 mg/L were detected in Wells E, B53W13S, B53W17S, and M10-15S. The ground-water sample from Well M11-9S also contained the maximum nitrate concentration detected in 1997. The distribution of nitrate appears limited to the Upper Hydrostratigraphic Zone (HZ-A). The maximum nitrate concentration in a deeper HZ interval well was reported at less than 0.5 mg/L. Elevated nitrates occur in HZ-A ground-water beneath the western part of SLAPS and along Coldwater Creek as exhibited in Wells B53W06S and B53W07S. This condition also existed in 1997. Historical concentration of nitrate in site ground-water at SLAPS is provided in Table 4-9.

4.6.2.4 Selenium in Ground-Water

Concentrations of dissolved selenium based on the 1998 ground-water sampling results are shown in Table 4-9. The 1998 results are similar to selenium concentrations of 1997. Dissolved selenium above its MCL of 50 µg/L was detected in 7 of the 28 wells sampled in 1998. These eight wells are completed in the Upper Hydrostratigraphic Zone (HZ-A). The distribution of dissolved selenium in site ground water is shown on Figure 4-50. Thc maximum concentration of selenium in 1998 was detected in Well E at 3,910 µg/L. This well also contained the highest selenium concentration in 1997. The estimated background concentration of selenium in the shallow ground-water is 5 µg/L. Selenium concentrations above its estimated background were detected in

upgradient Wells B53W19S and B53W20S in 1998. Selenium was not detected in ground water from the eight Lower Zone ground-water monitoring wells sampled in 1998.

4.6.2.5 Nickel in Ground-Water

Dissolved nickel was detected above its MCL of 100 μg/L in ground-water samples of three wells sampled in 1998 (B53W16S, B53W18S, and B53W19S). The highest nickel concentration was 323 μg/L at Well B53S18S, which is located off-site north of Coldwater Creek. A similar nickel concentration (341 μg/L) was detected in this well in 1997. An elevated nickel concentration was also detected in up gradient off-site Well B53W19S in 1997.

4.6.3 Organic Compounds

Ground-water samples collected at SLAPS in 1998 were analyzed for priority pollutant VOCs and SVOCs, as well as herbicides, pesticides, and PCBs. Three VOCs (TCE, 1,1,1-trichloroethane, and 1,2-dichloroethene) were detected above detection limits in ground-water samples collected in July and August of 1998.

4.6.3.1 Trichloroethene in Ground-Water

TCE was detected above its detection limit and MCL of 5 μg/L in ground-water samples from four wells (B53W12S, B53W13S, B53W17S, and M11-9). Three additional wells contain estimated TCE concentrations between 2 and 4 μg/L. The maximum TCE concentration was detected in the ground-water sample from Well B53W17S at 840 μg/L. The distribution of TCE in site ground-water based on 1998 data is illustrated on Figure 4-51. A comparison of TCE concentrations of 1997 and 1998 indicate higher concentrations at most sampled wells in 1998. For example, TCE increased from 600 to 840 μg/L at off-site Well B53W17S and from 91 to 140 μg/L at Well M11-9. These concentration variations may be seasonal fluctuations.

4.6.3.2 1,2-Dichloroethene in Ground-Water

The compound 1,2-dichloroethene (1,2-DCE), a transformation product of TCE, was detected in Well M11-9 at 110 μg/L. This compound was also measured at estimated values less than 5 μg/L in several wells, including B53W12S, B53W13S, B53W17S, B53W18S, and Well D. Only one well (M11-9) contained 1,2-DCE above its MCL of 70 μg/L. A low concentration (6 μg/L) of 1,1,1-trichloroethane was detected in the ground-water sample from Well B53W19S.

4.6.3.3 Other Organic Compounds in Ground-Water

Four SVOCs were detected in the ground-water samples collected in the summer of 1998 at SLAPS. The concentrations of these SVOCs were measured at or below their respective detection limits. Two of the compounds were also detected at trace concentrations in quality assurance/quality control (QA/QC) blank samples collected during the 1998 sampling event. One compound (bis-2-ethylhexyl-phthalate) was detected at 45 μg/L in the ground-water sample from off-site Well B53W03S. Because this compound was detected at low concentrations in numerous samples, including QA/QC blank samples, it is likely a laboratory-induced contaminant and is probably not present in site ground water. This SVOC was not detected in site ground-water in 1997.

Trace concentrations of four pesticides were detected in two monitoring wells at SLAPS based on the 1998 ground-water sampling results. The ground-water sample from Well M11-9 contained trace concentrations of Endosulfane I and II and Lindane at concentrations of 0.14, 0.05, and 0.05 µg/L, respectively. Methoxychlor at 0.6 µg/L was detected in the ground-water sample from Well B53W13S. The detected concentrations of Lindane and Methoxychlor are below their respective MCLs of 0.2 and 40 µg/L. No herbicides or PCBs were detected in the ground-water samples collected at SLAPS in 1998. No detectable concentrations of PCBs or pesticides were identified in the 1997 ground-water data (USACE, 1998b).

The compounds 2-butanone, acetone, methylene chloride, and xylene were also detected in ground-water samples collected during the 1998 sampling event; however, these compounds were determined to be present in QA/QC blank samples and are considered not to occur in site ground water. Of particular interest is the absence of detectable methylene chloride in Well M10-25D sample. An elevated methylene chloride concentration (610 µg/L) was detected in the sample for this well in 1997 (USACE, 1998b), which was apparently due to laboratory contamination.

4.7 SLAPS SURFACE WATER SAMPLING

As directed by USACE, SAIC collected three surface water samples at the point where Coldwater Creek leaves the culvert, upstream of SLAPS. Samples were collected on July 28, 1998, August 10, 1998, and August 20, 1998, during low flow conditions on the creek. Low flow conditions are less than 0.15 cubic meters (5 cubic feet) per second.

Surface water samples were analyzed for full suite chemistry and radiological parameters. Filtered and unfiltered samples were collected. Results are summarized in Appendix F.

Most compounds were reported as below minimum detection limits. U-238 was reported in the unfiltered August 28, September 10, and September 20, 1998, samples at 5.05 pCi/L, 1.42 pCi/L, and 1.35 pCi/L, respectively. No other radionuclides were reported. Various inorganics, including aluminum, calcium, iron, magnesium, manganese, potassium, sodium, strontium, and zinc were reported in all three samples.

With the exception of acetone, semi-volatile and volatile organic compounds were not detected above minimum detection levels. Herbicides, pesticides, and PCBs were not reported above minimum detection levels for any of the samples.

A storm water runoff sample was collected from the easternmost drainage culvert prior to initiation of the north ditch and the east end of the construction activities. This sample was collected after a thunderstorm with approximately 0.75 inches of rainfall over a 3-hour period. The sample was collected at the mouth of the culvert on the north side of McDonnell Boulevard.

Radionuclides detected in unfiltered samples included Th-230 at 16.86 pCi/L, U-234 at 108 pCi/L, U-235 at 8.11 pCi/L, and U-238 at 117.9 pCi/L.

The same metals were detected as in the Coldwater Creek upstream samples. No pesticides, herbicides, volatile or semi-volatile compounds were detected in this sample.

SECTION 4.0

FIGURES

TABLE OF CONTENTS

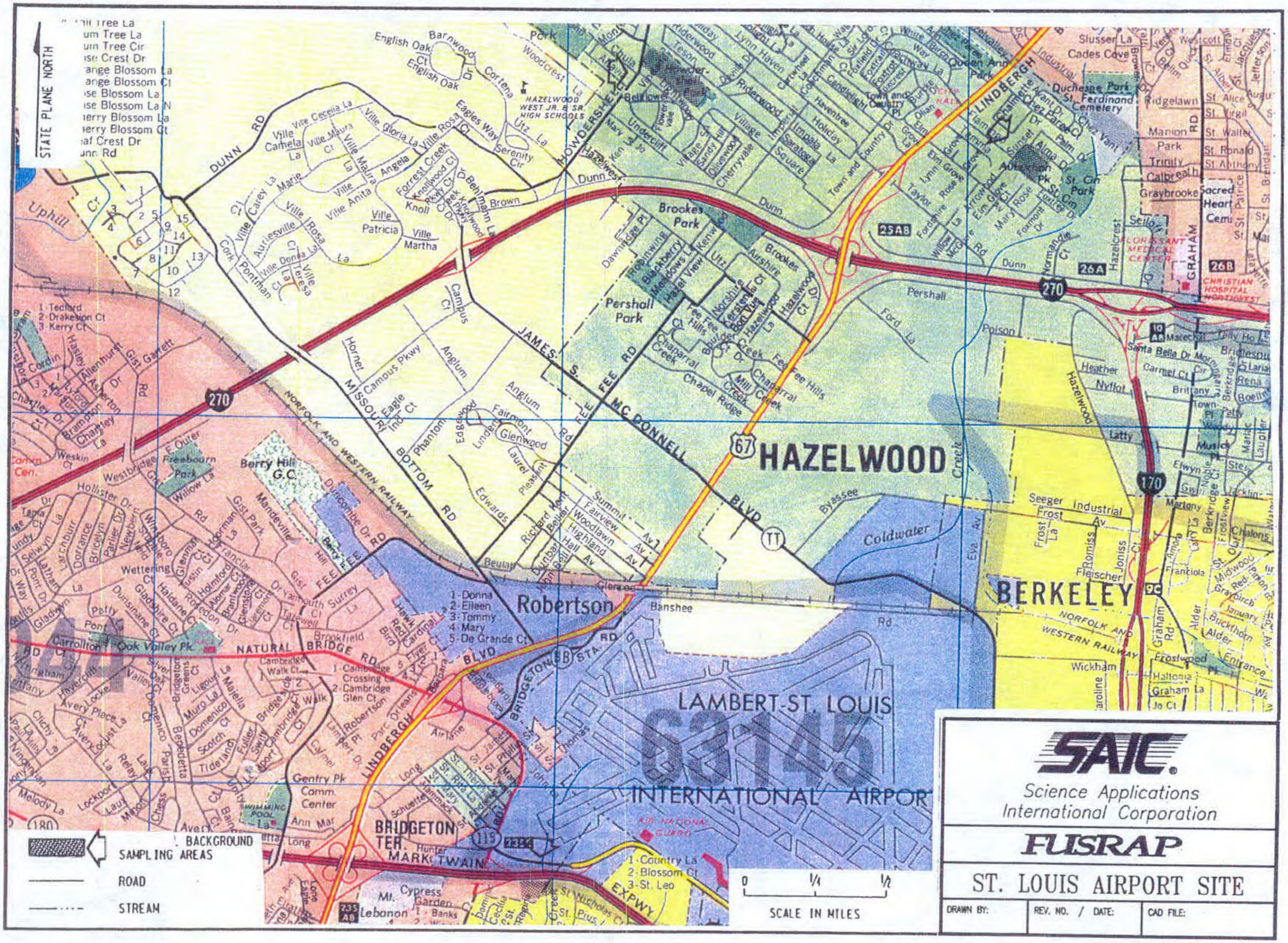


FIGURE 4-1

Locations for

Background Soil Samples

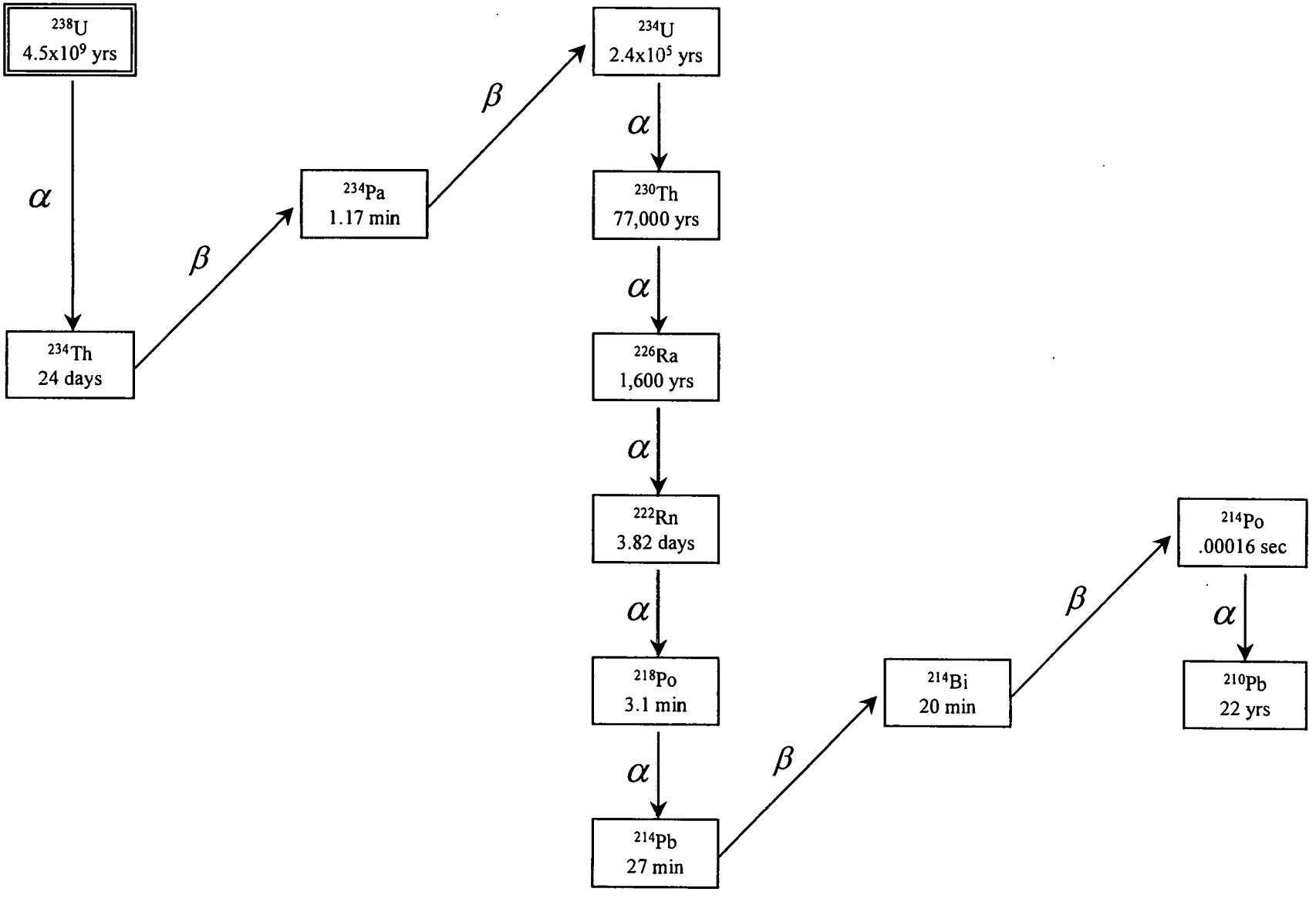


FIGURE 4-2 Decay Series for Uranium-238

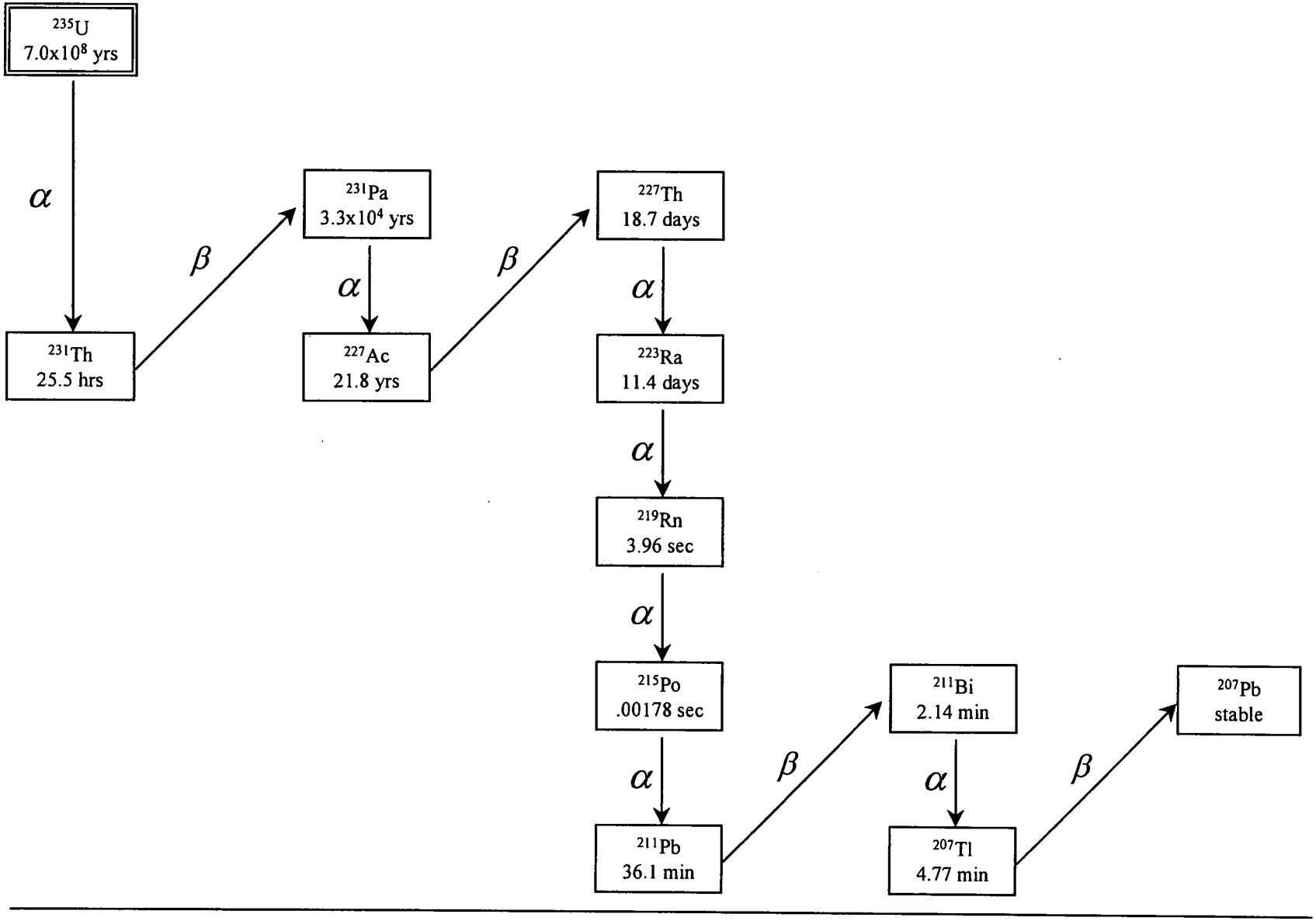


FIGURE 4-3 Decay Series for Uranium-235

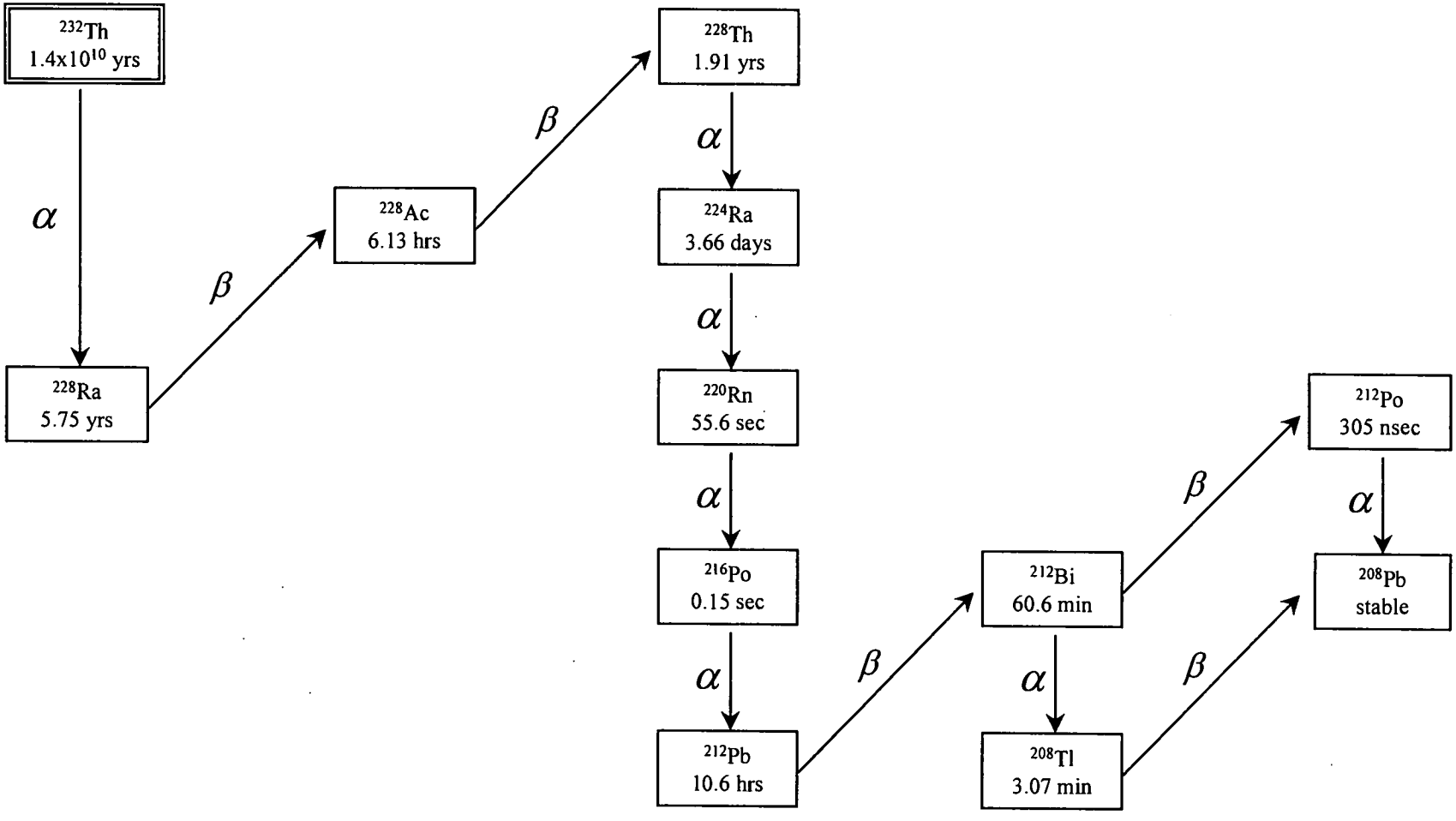


FIGURE 4-4 Decay Series for Thorium-232

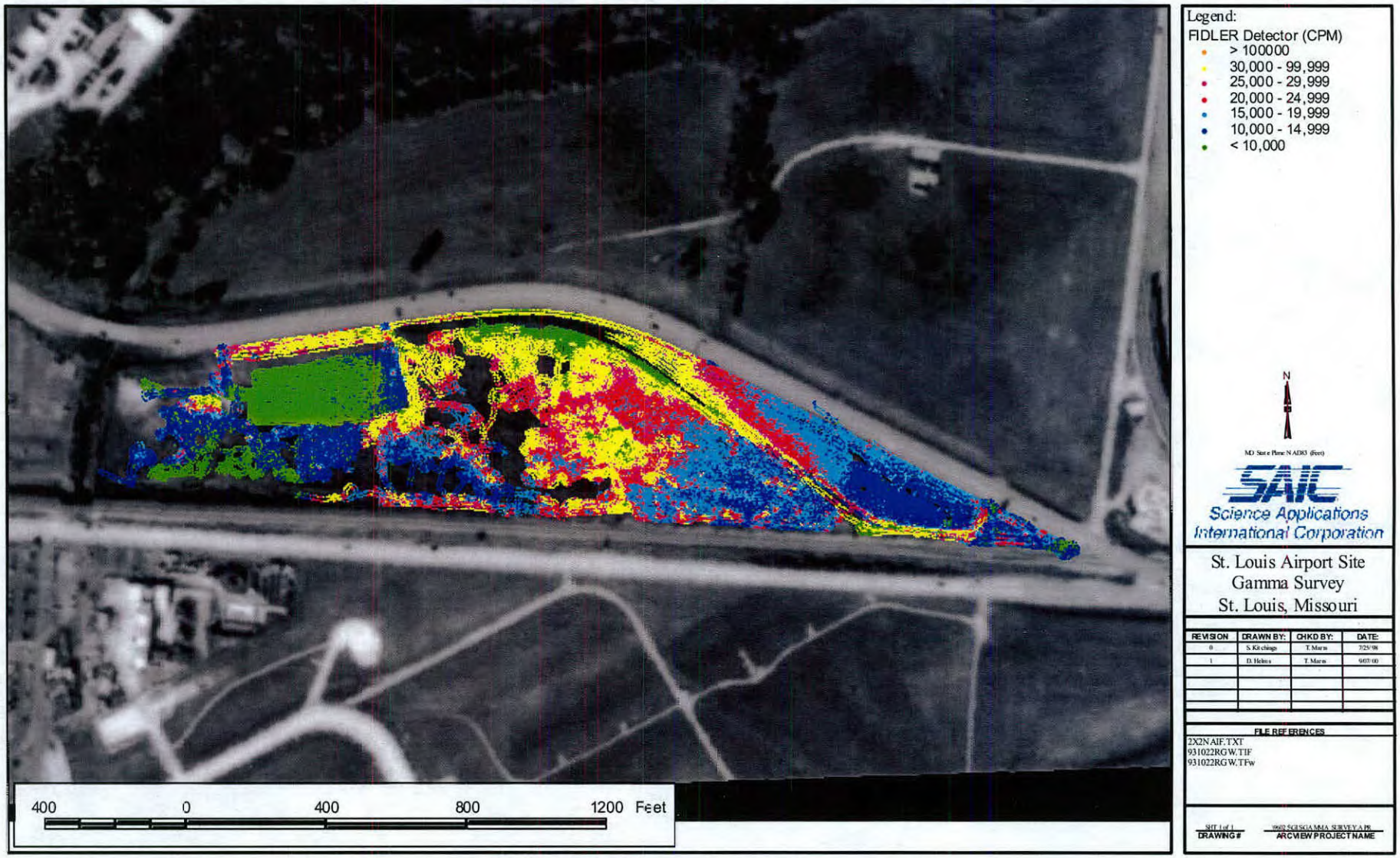


Figure 4-5 St. Louis Airport Site FIDLER Detector Data

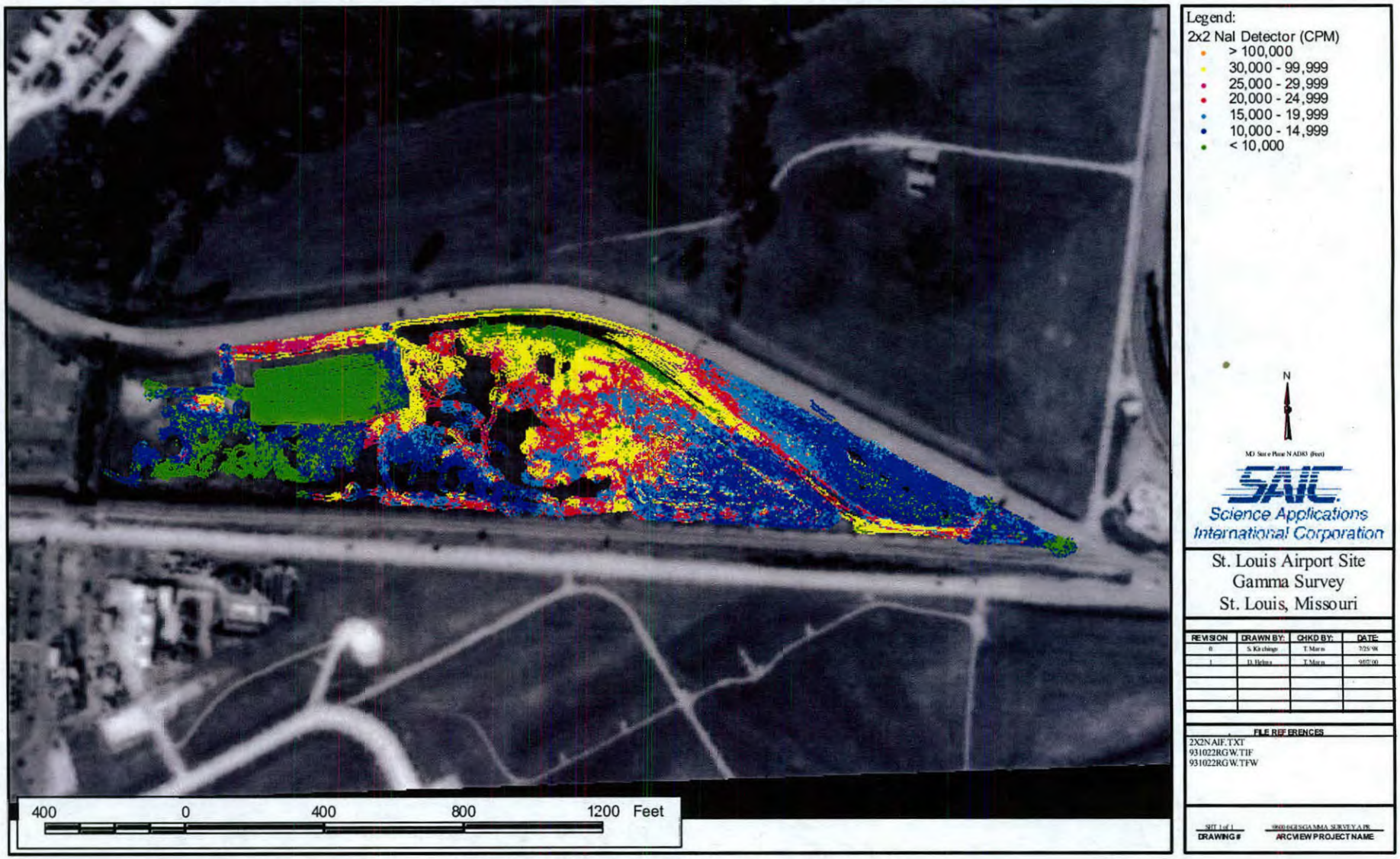


Figure 4-6 St. Louis Airport Site 2x2 NaI Detector Data

Figure 4-7. Investigative Areas

Figure 4-8. Radium 226 in Soil (0 - 0.5 ft)

Figure 4-9. Radium 226 in Soil (0.5 - 2 ft)

Figure 4-10. Radium 226 in Soil (2 - 5 ft)

Figure 4-11. Radium 226 in Soil (5 - 10 ft)

Figure 4-12. Radium 226 in Soil (10 - 15 ft)

Figure 4-13. Radium 226 in Soil (15 - 20 ft)

Figure 4-14. Radium 226 in Soil (> 20 ft)

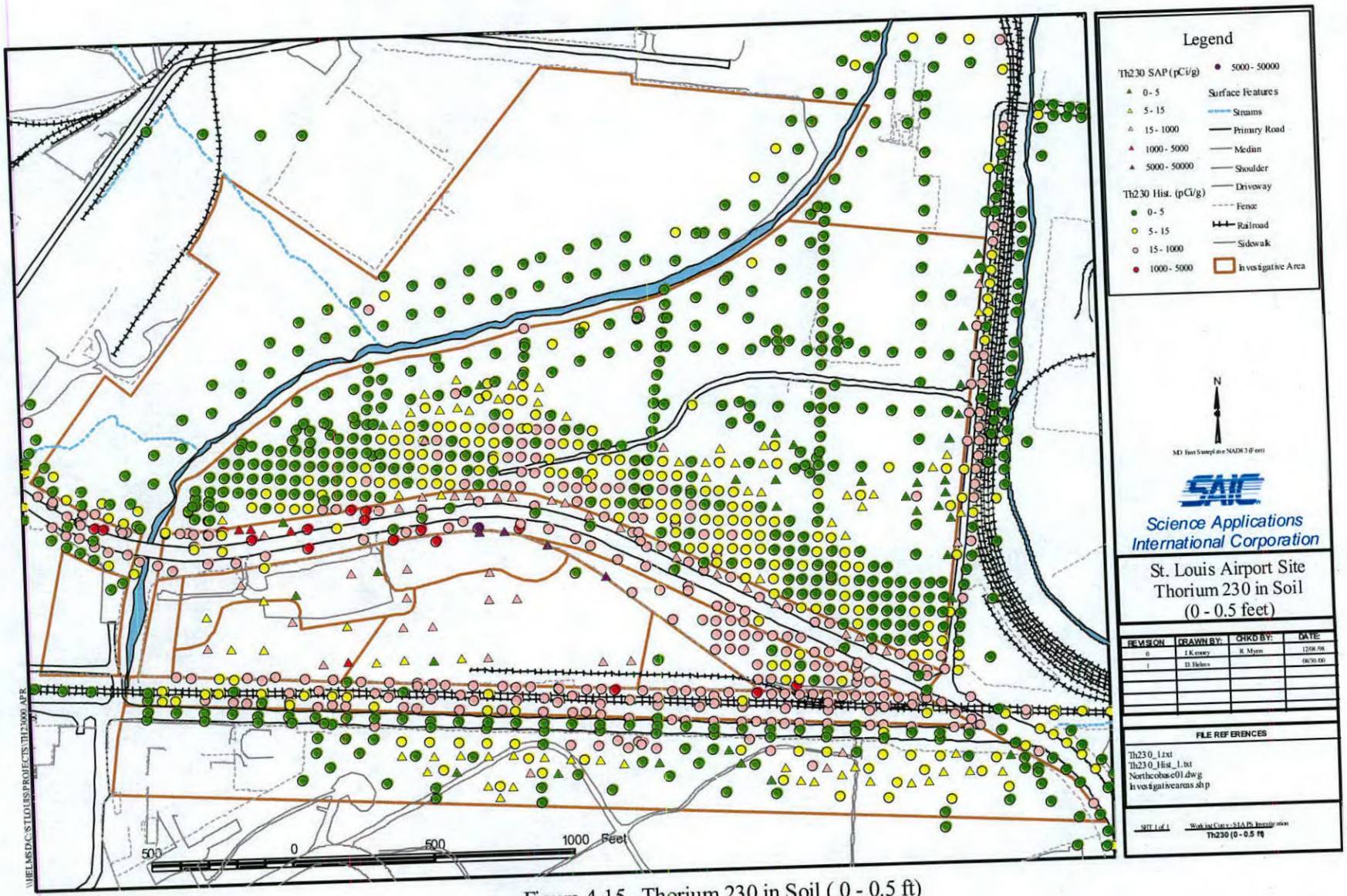


Figure 4-15. Thorium 230 in Soil (0 - 0.5 ft)

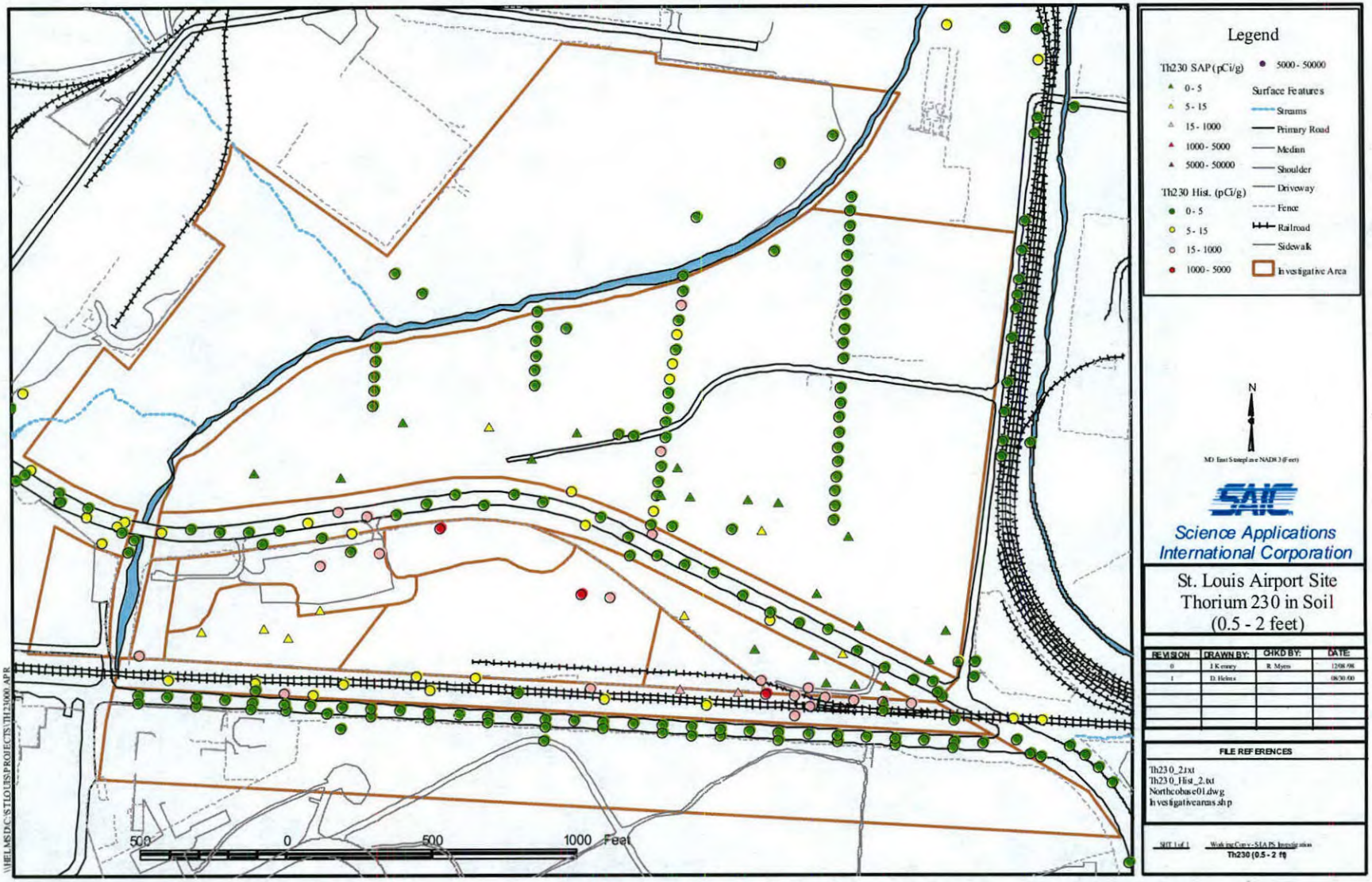


Figure 4-16. Thorium 230 in Soil (0.5 - 2 ft)

Figure 4-17. Thorium 230 in Soil (2 - 5 ft)

Figure 4-18. Thorium 230 in Soil (5 - 10 ft)

Figure 4-19. Thorium 230 in Soil (10 - 15 ft)

Figure 4-20. Thorium 230 in Soil (15 - 20 ft)

Figure 4-21. Thorium 230 in Soil (> 20 ft)

Figure 4-22. Uranium 238 in Soil (0 - 0.5 ft)

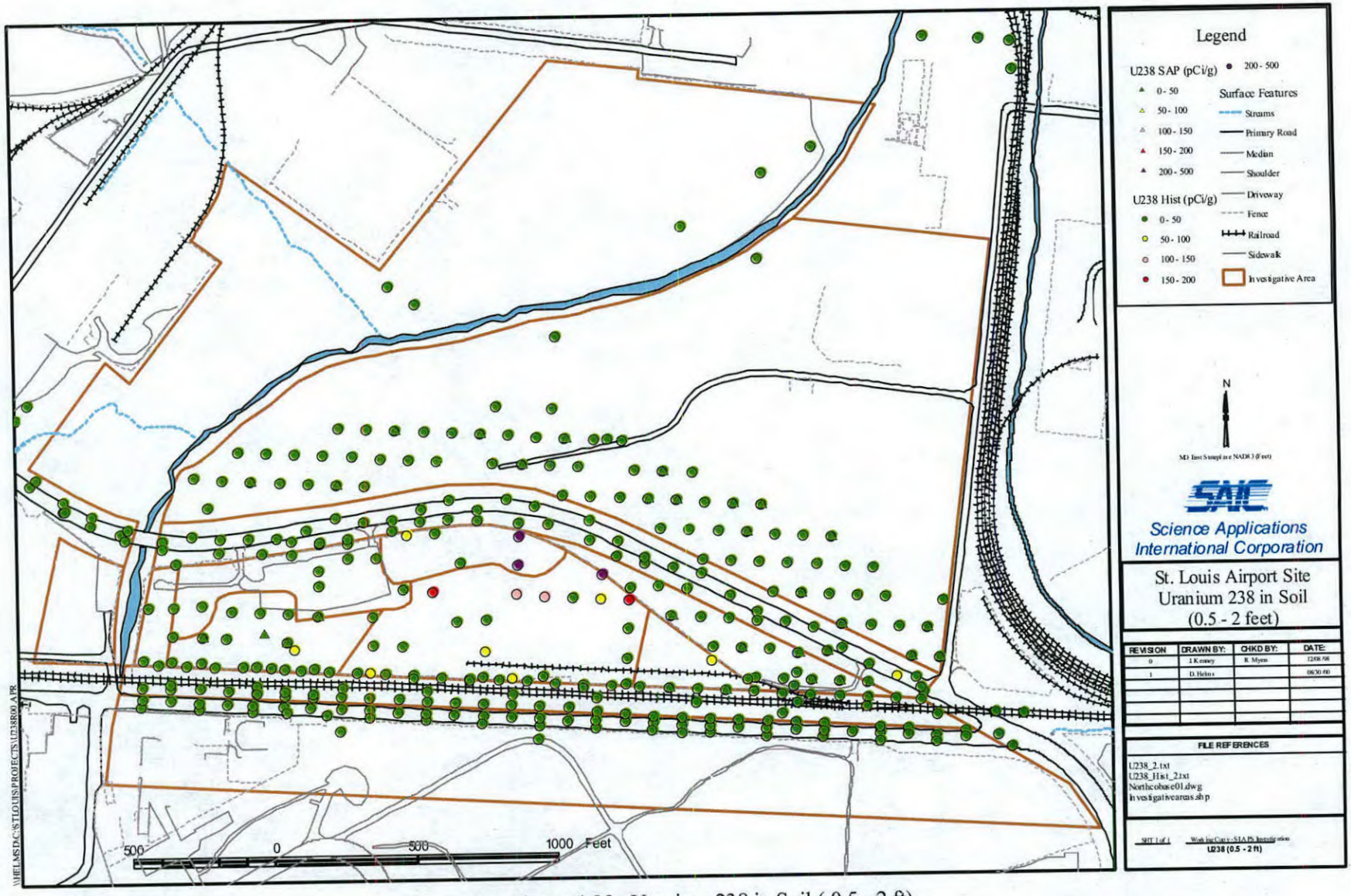


Figure 4-23. Uranium 238 in Soil (0.5 - 2 ft)

Figure 4-24. Uranium 238 in Soil (2 - 5 ft)

Figure 4-25. Uranium 238 in Soil (5 - 10 ft)

Figure 4-26. Uranium 238 in Soil (10 - 15 ft)

Figure 4-27. Uranium 238 in Soil (15 - 20 ft)

Figure 4-28. Uranium 238 in Soil (> 20 ft)

Figure 4-29. Pa231 in Soil (0 - 0.5 ft)

Figure 4-30. Pa231 in Soil (0.5 - 2 ft)

Figure 4-31. Pa231 in Soil (2 - 5 ft)

Figure 4-32. Pa231 in Soil (5 - 10 ft)

Figure 4-33. Pa231 in Soil (10 - 15 ft)

Figure 4-34. Pa231 in Soil (15 - 20 ft)

Figure 4-35. Pa231 in Soil (> 20 ft)

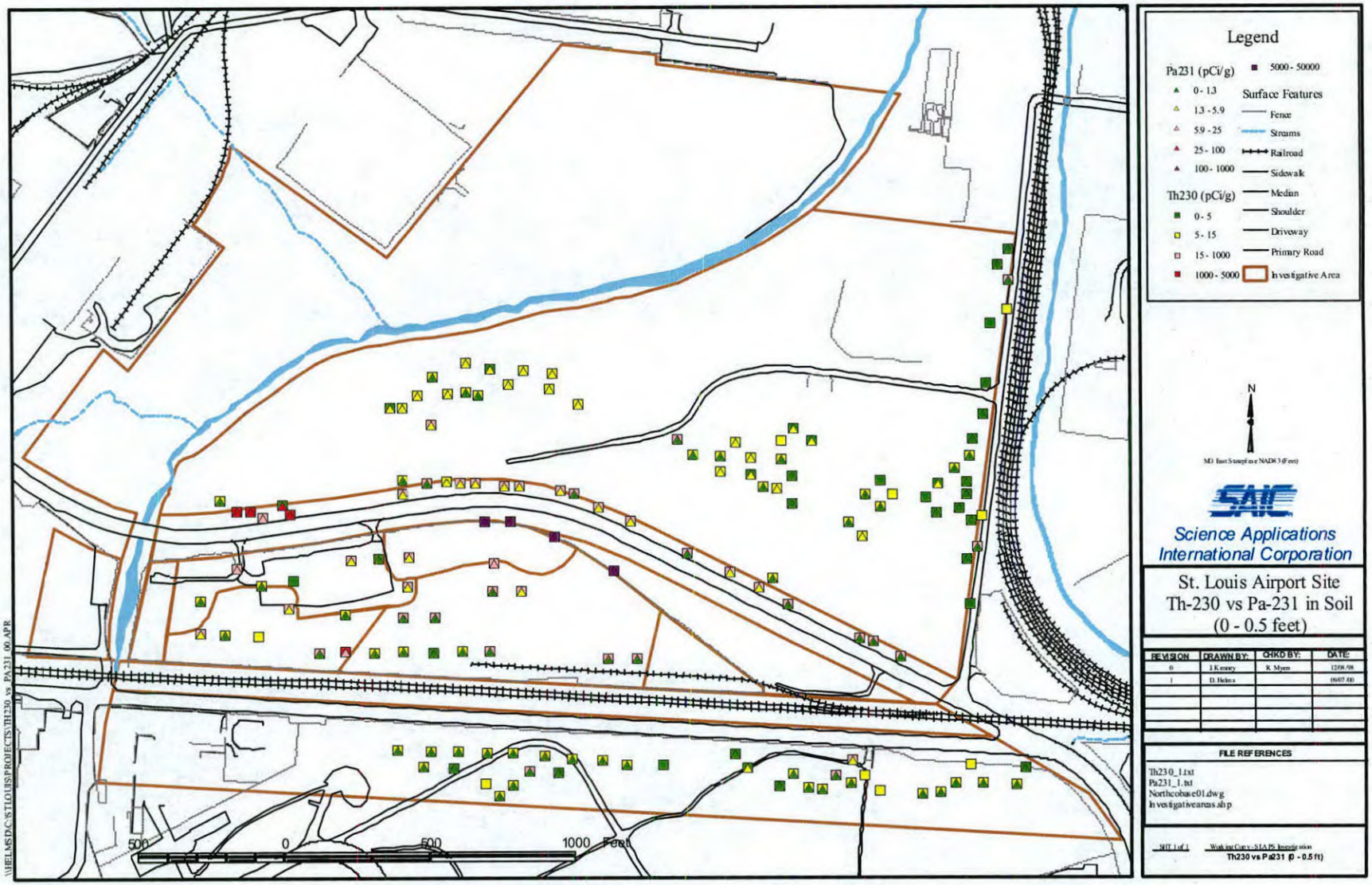


Figure 4-36. Th230 vs Pa231 in Soil (0 - 0.5 ft)

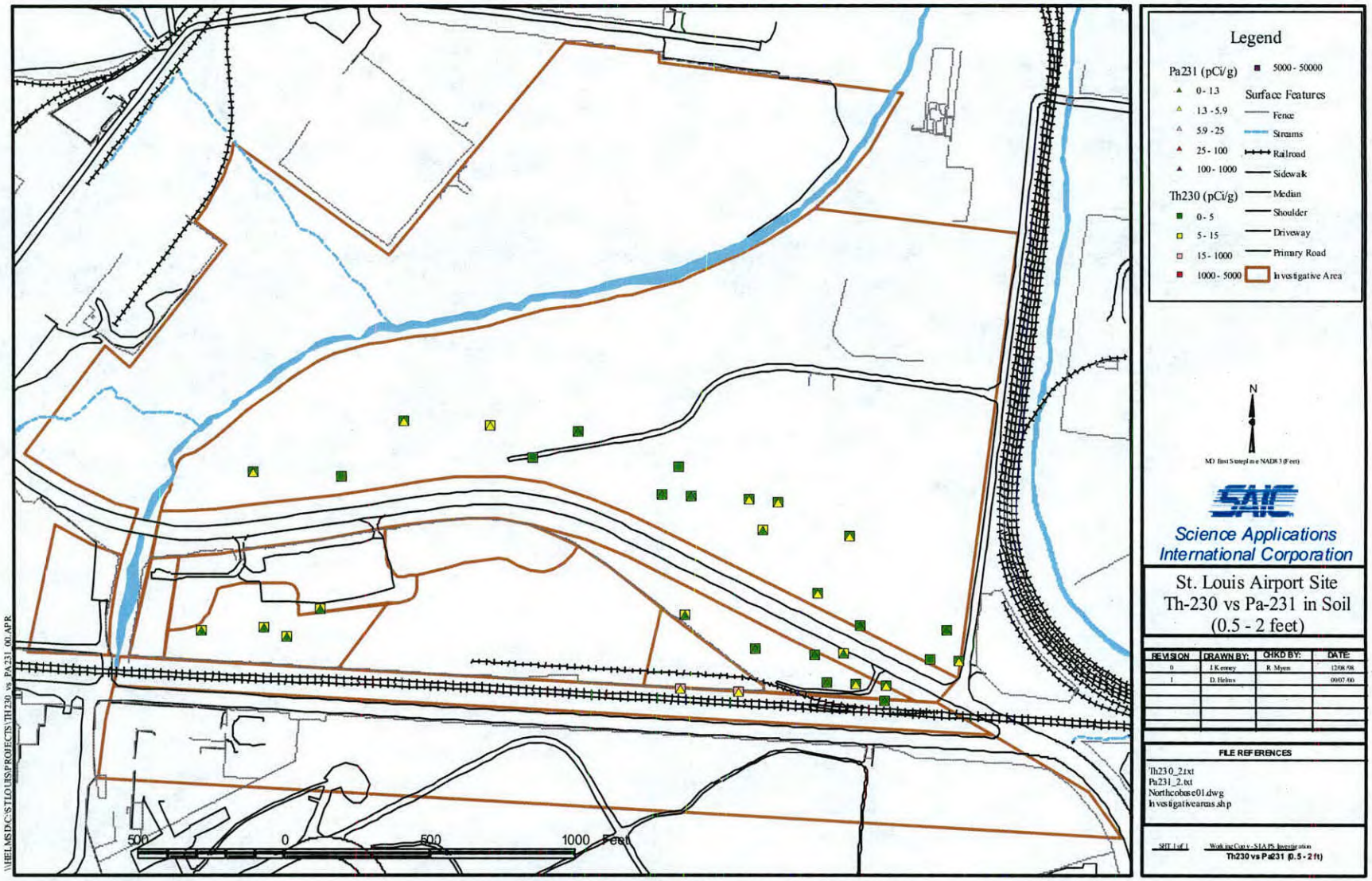


Figure 4-37. Th230 vs Pa231 in Soil (0.5 - 2 ft)

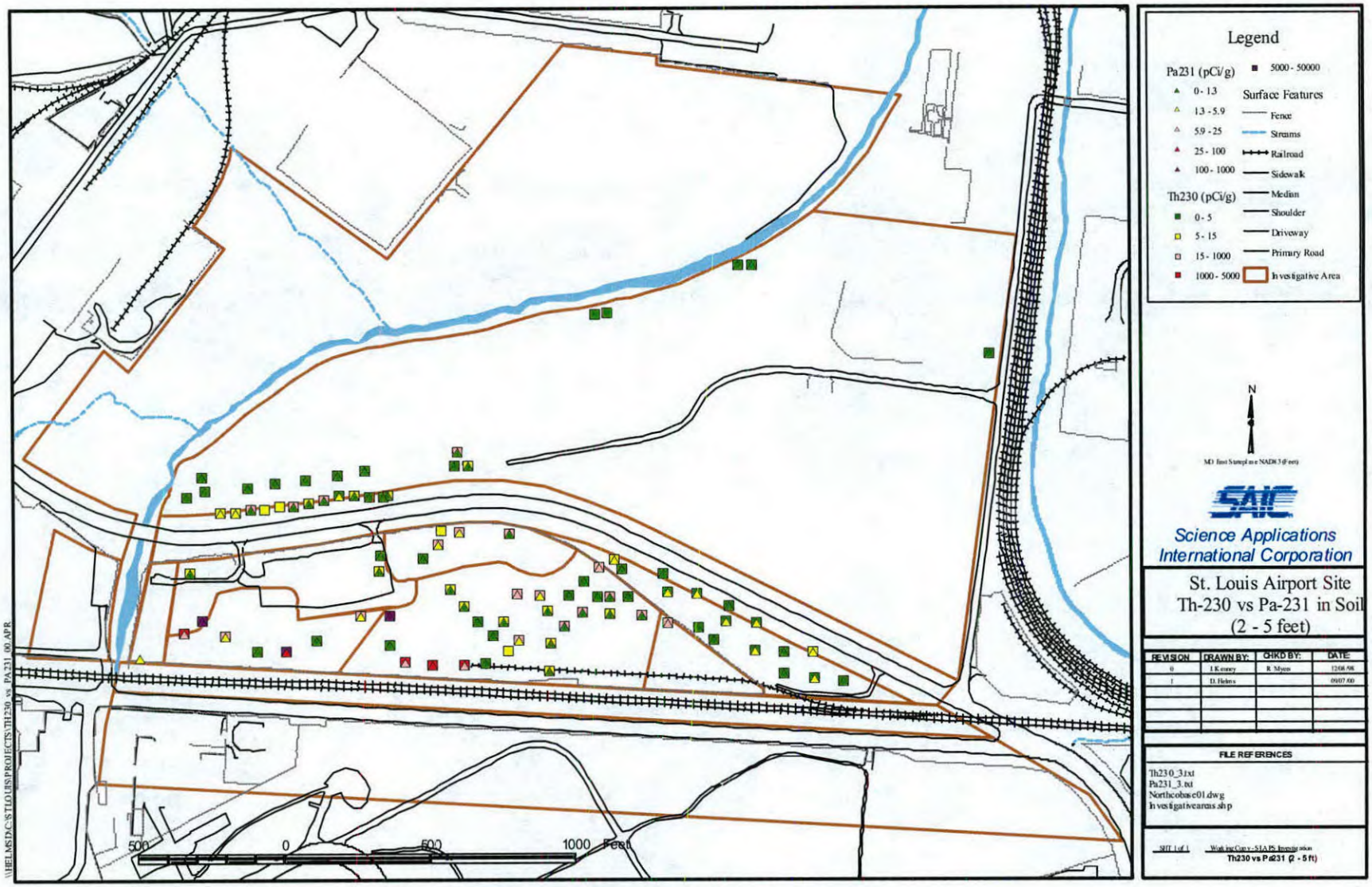


Figure 4-38. Th230 vs Pa231 in Soil (2 - 5 ft)

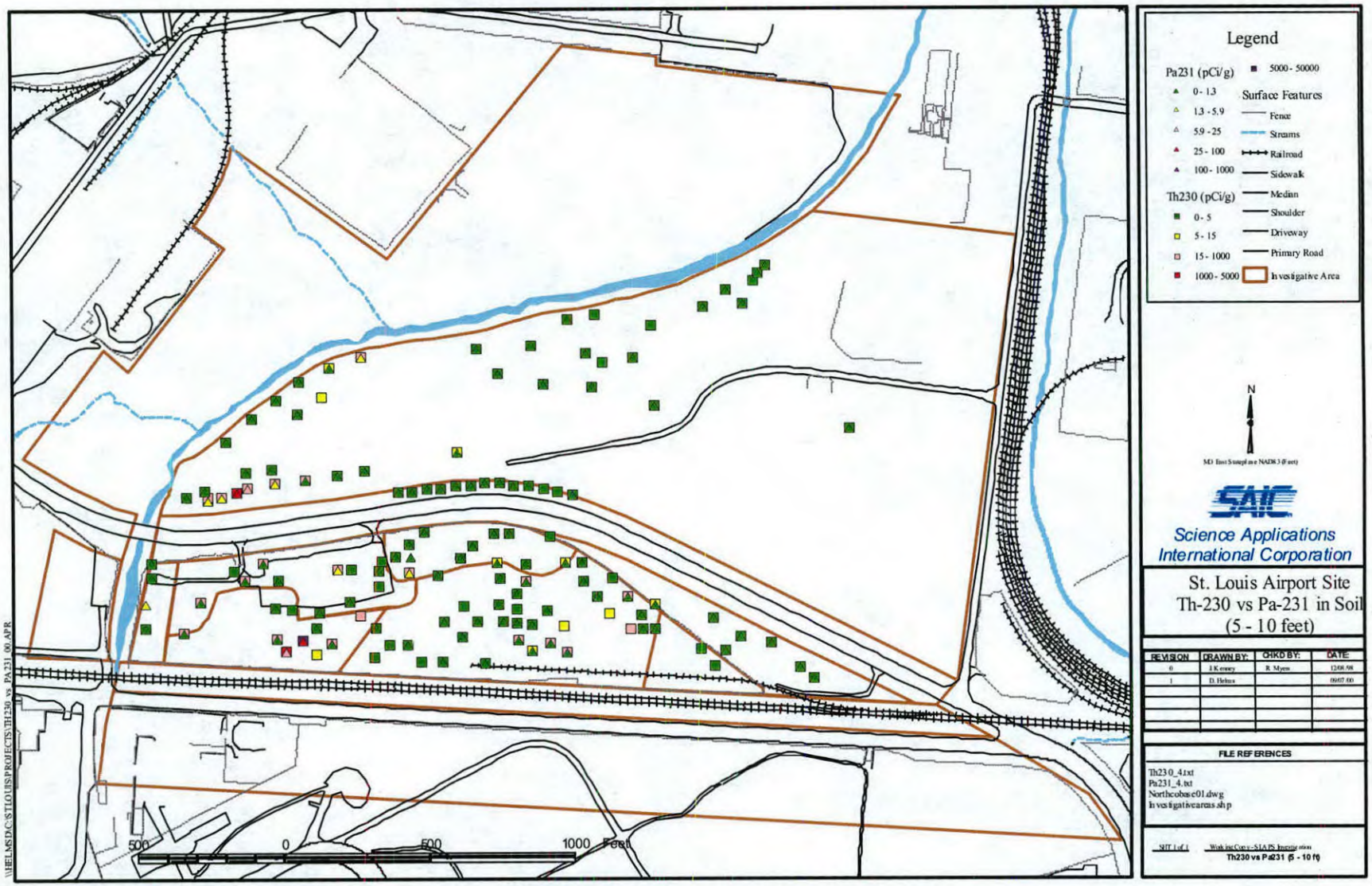


Figure 4-39. Th230 vs Pa231 in Soil (5 - 10 ft)

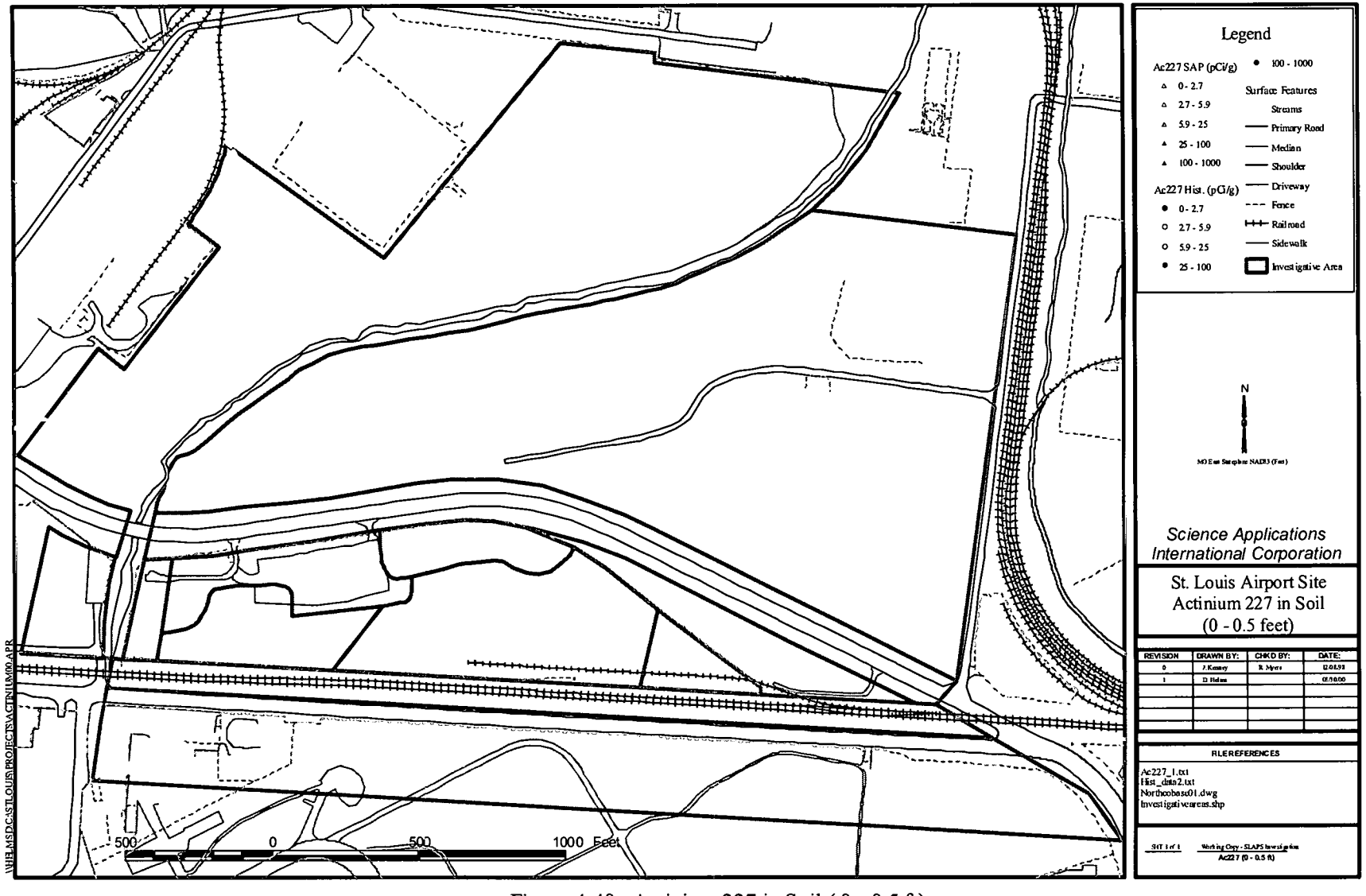


Figure 4-40. Actinium 227 in Soil (0 - 0.5 ft)

Figure 4-41. Actinium 227 in Soil (0.5 - 2 ft)

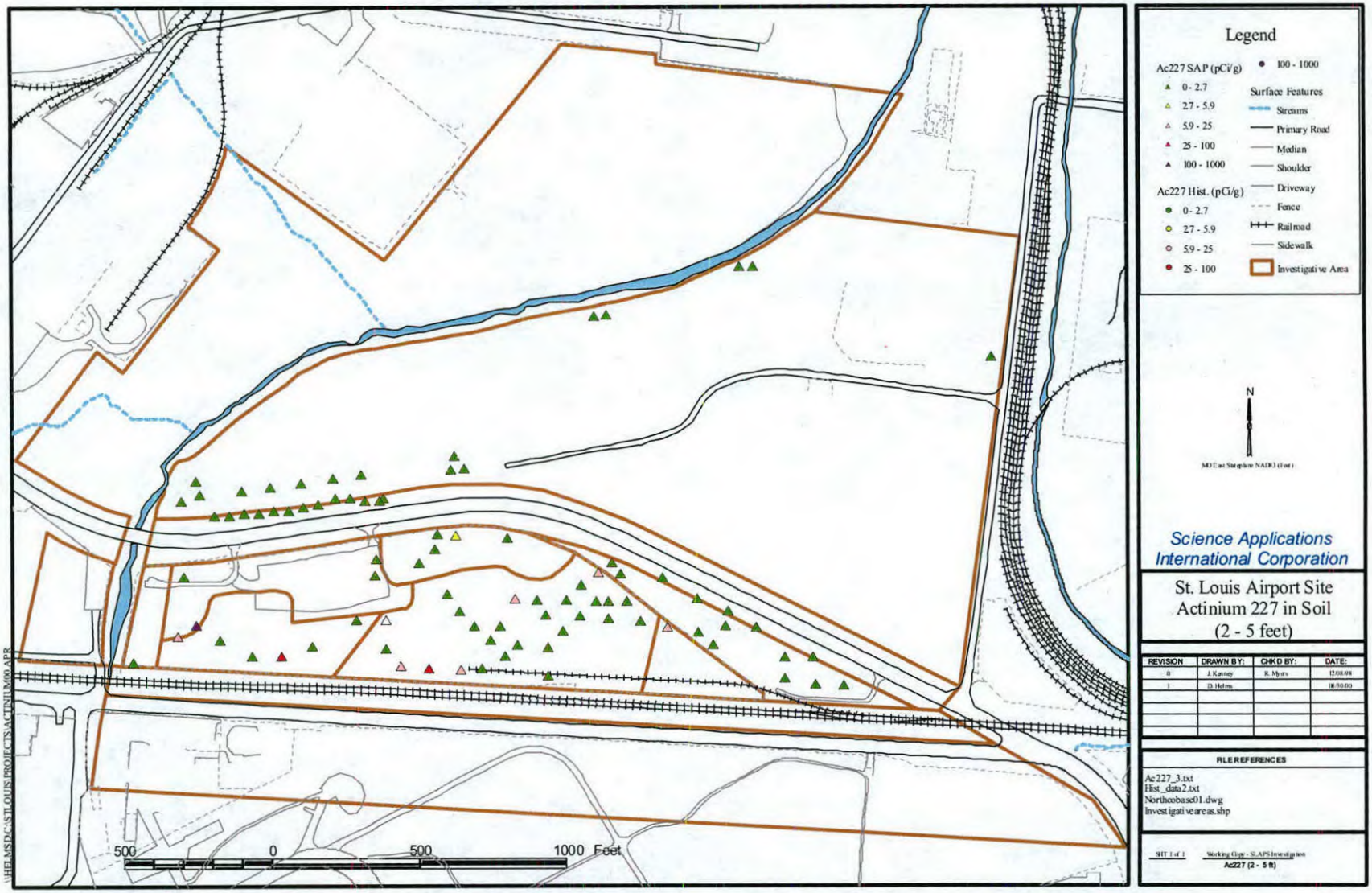


Figure 4-42. Actinium 227 in Soil (2 - 5 ft)

Figure 4-43. Actinium 227 in Soil (5 - 10 ft)

Figure 4-44. Actinium 227 in Soil (10 - 15 ft)

Figure 4-45. Actinium 227 in Soil (15 - 20 ft)

Figure 4-46. Actinium 227 in Soil (> 20 ft)

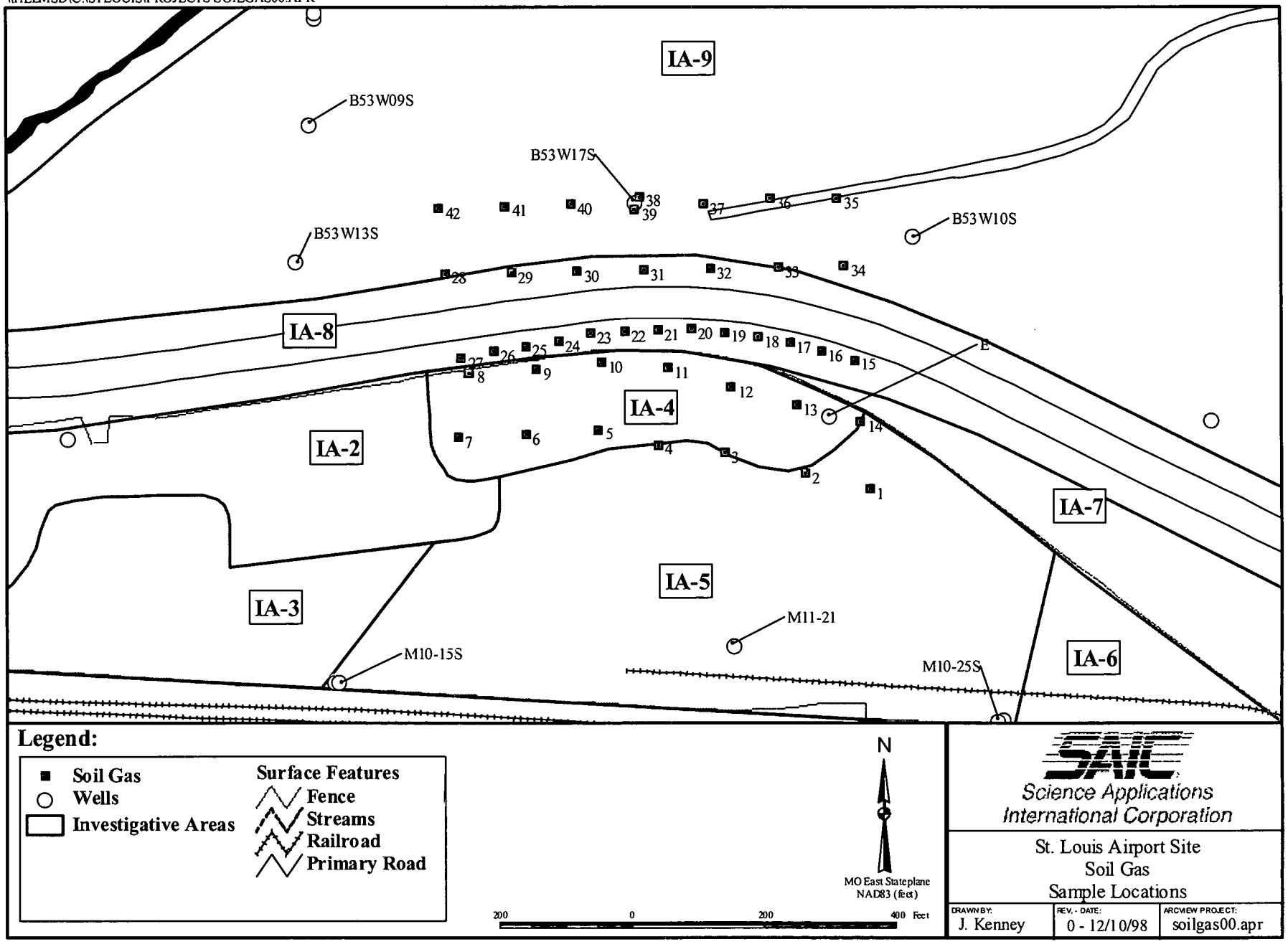
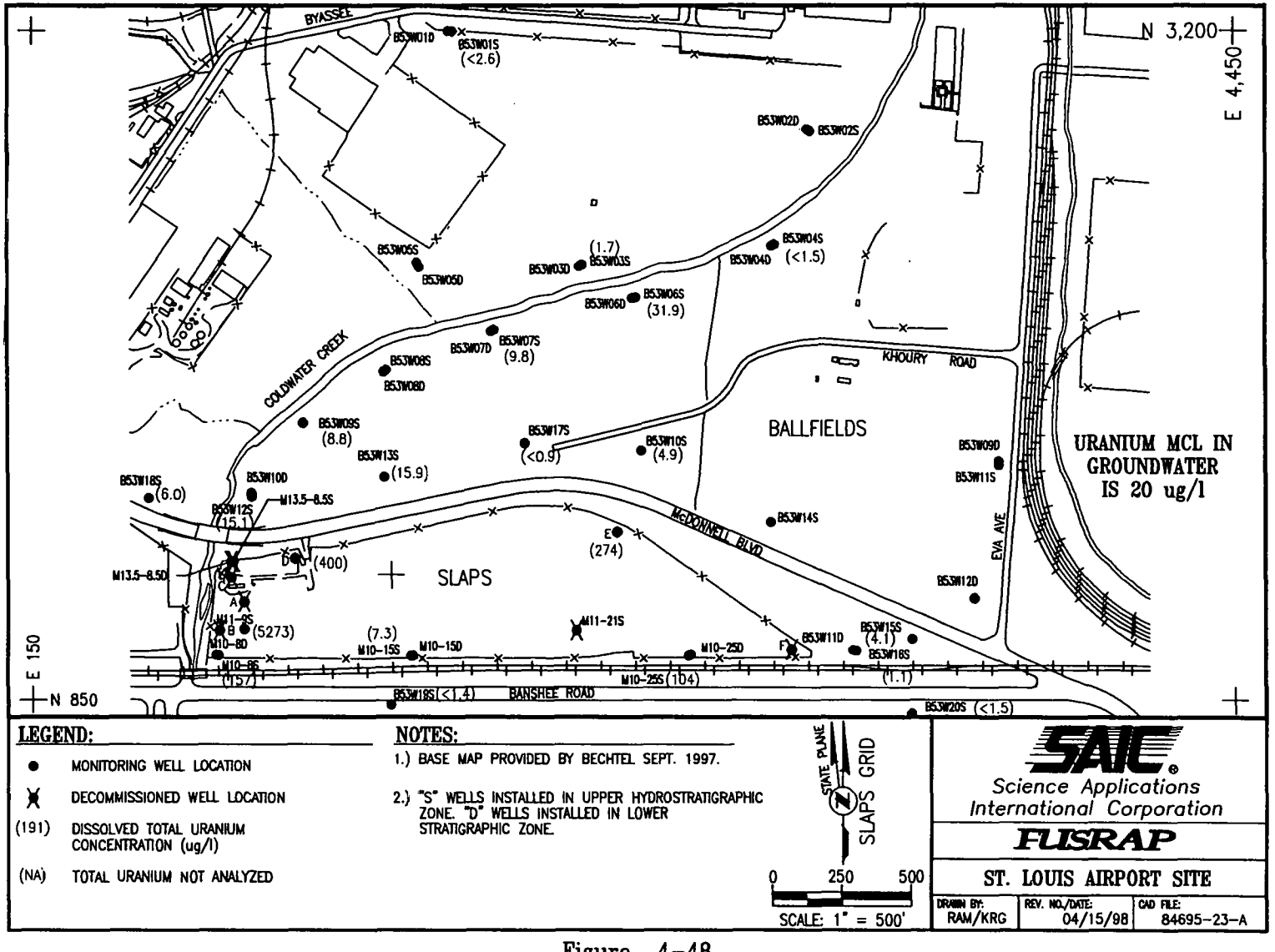


Figure 4-47. Soil Gas Sample Locations



LEGEND:

- ● MONITORING WELL LOCATION
- ✕ DECOMMISSIONED WELL LOCATION
- (191) DISSOLVED TOTAL URANIUM CONCENTRATION (ug/l)
- (NA) TOTAL URANIUM NOT ANALYZED

NOTES:

1.) BASE MAP PROVIDED BY BECHTEL SEPT. 1997.

2.) "S" WELLS INSTALLED IN UPPER HYDROSTRATIGRAPHIC ZONE. "D" WELLS INSTALLED IN LOWER STRATIGRAPHIC ZONE.

STATE PLANE / SLAPS GRID

0 250 500

SCALE: 1" = 500'

SAIC® Science Applications International Corporation

FUSRAP

ST. LOUIS AIRPORT SITE

DRAWN BY:	REV. NO./DATE:	CAD FILE:
RAM/KRG	04/15/98	84695-23-A

Figure 4-48
1998 Total Uranium Concentrations
in Shallow Groundwater

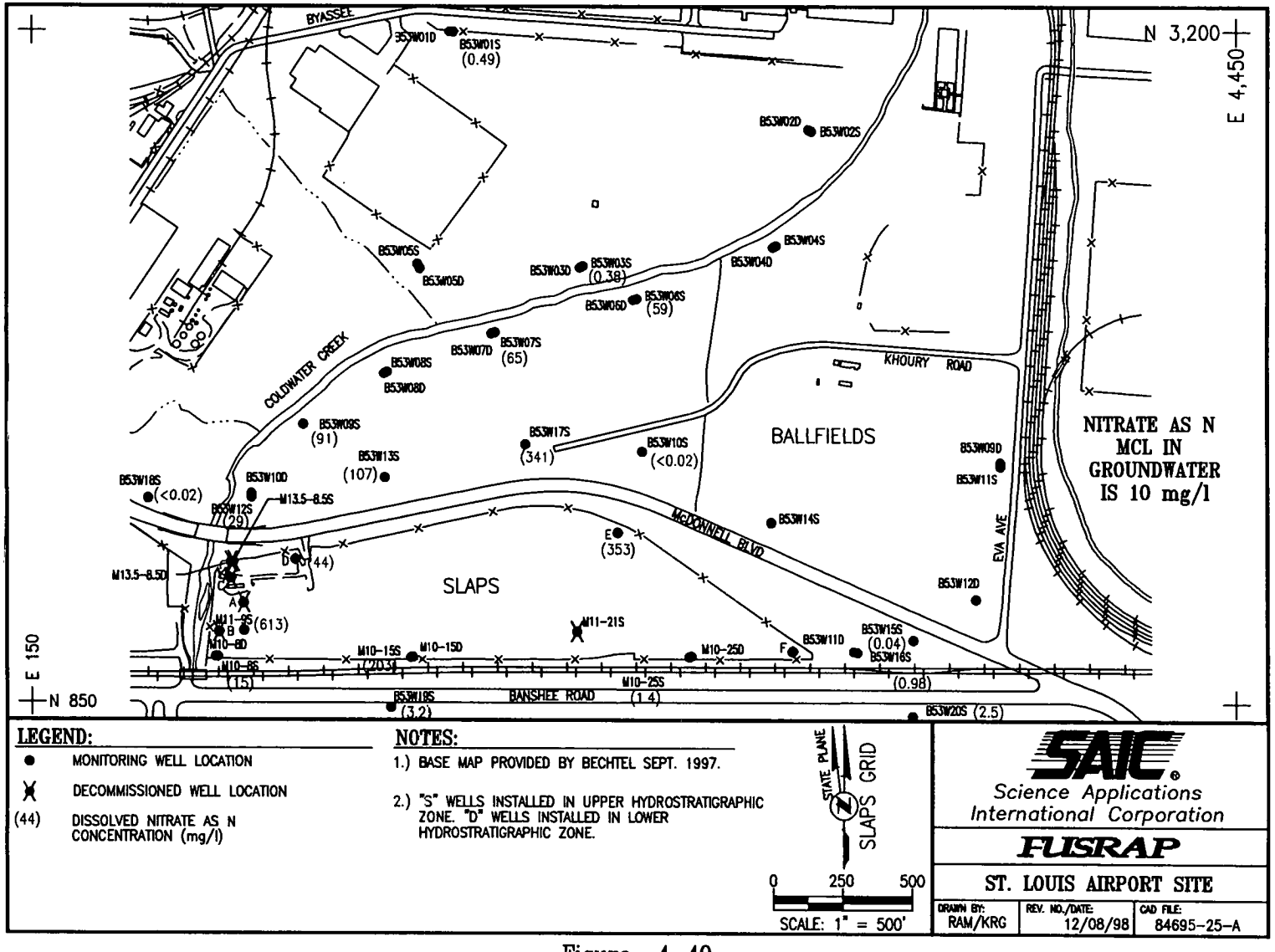
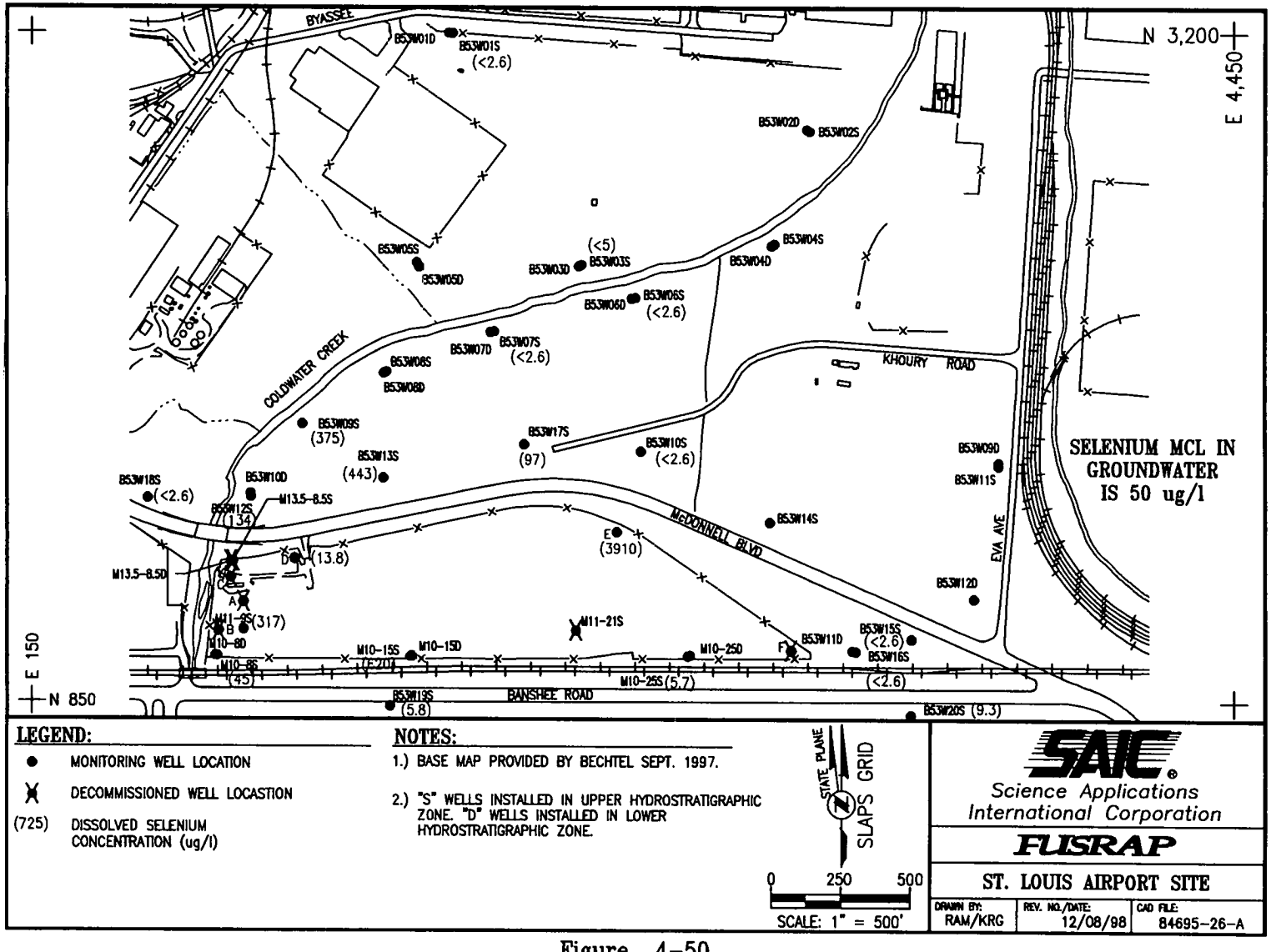


Figure 4-49
1998 Nitrate Concentrations
in Shallow Groundwater



LEGEND:

- ● MONITORING WELL LOCATION
- X DECOMMISSIONED WELL LOCASTION
- (725) DISSOLVED SELENIUM CONCENTRATION (ug/l)

NOTES:

1.) BASE MAP PROVIDED BY BECHTEL SEPT. 1997.

2.) "S" WELLS INSTALLED IN UPPER HYDROSTRATIGRAPHIC ZONE. "D" WELLS INSTALLED IN LOWER HYDROSTRATIGRAPHIC ZONE.

STATE PLANE SLAPS GRID

0 250 500

SCALE: 1" = 500'

SAIC® Science Applications International Corporation

FUSRAP

ST. LOUIS AIRPORT SITE

DRAWN BY:	REV. NO./DATE:	CAD FILE:
RAM/KRG	12/08/98	84695-26-A

Figure 4-50
1998 Selenium Concentrations
in Shallow Groundwater

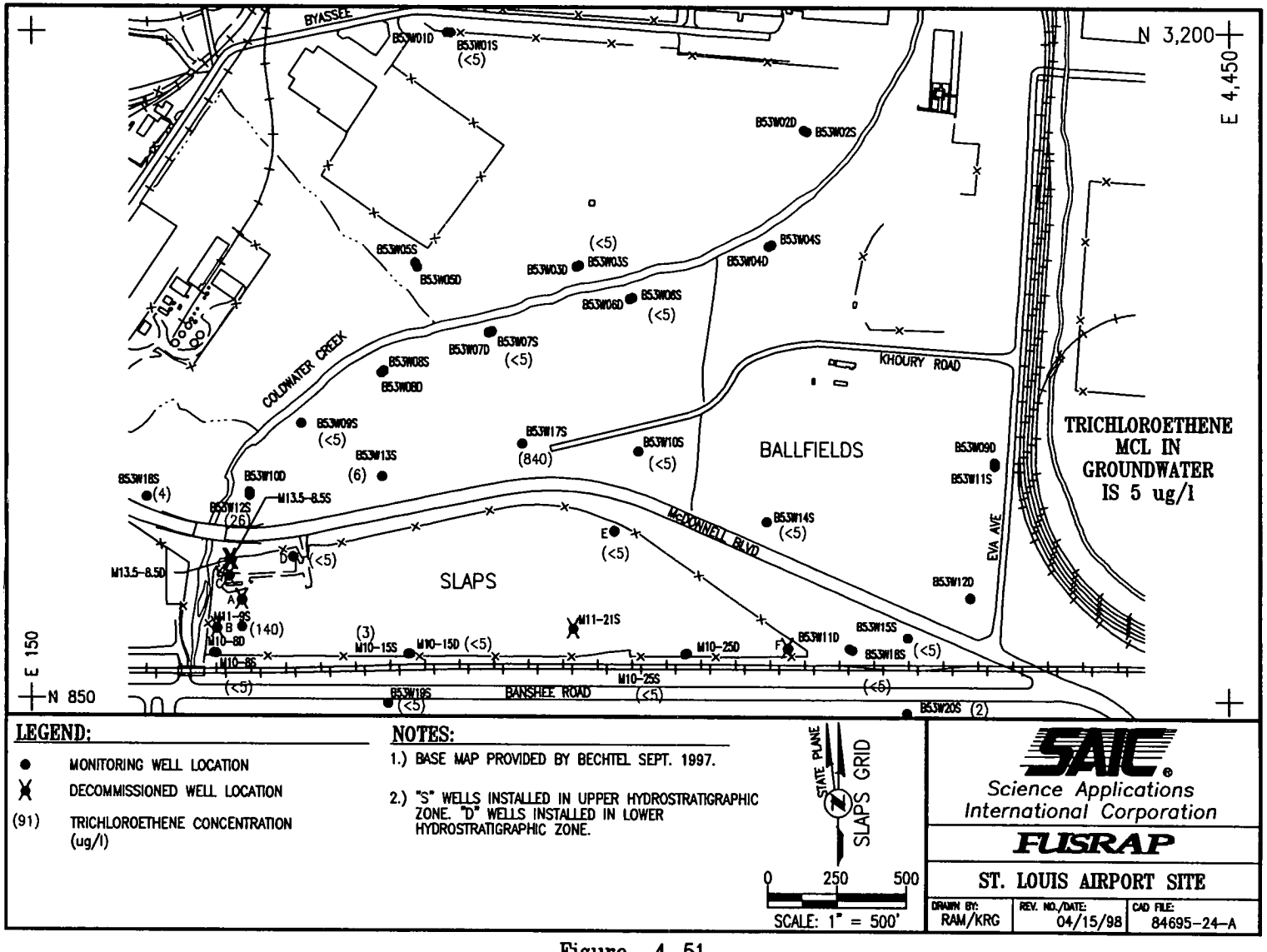


Figure 4-51
1998 Trichloroethene Concentrations
in Shallow Groundwater

SECTION 5.0

CONCLUSIONS

5.0 CONCLUSIONS

5.1 CONCLUSIONS REGARDING SOIL PHYSICAL PARAMETERS

Geotechnical analysis of soil samples collected from boring MW-34-98 reported consistently clayey soils with relict root structures and occasional small roots in the surface to 14.3 m (47 ft) interval. Triaxial permeability values generated for the samples ranged from 1.3E-05 cm/s at sample depth of 4.5 m (15 ft) to 1.4E-08 cm/s at a depth of 23 m (76 ft). The fluctuation of three orders of magnitude in the triaxial permeabilities is consistent with variabilities found in normal soil profiles. The reported values indicate the soil has a low to very low hydraulic conductivity.

5.2 CONCLUSIONS REGARDING RADIOLOGICAL PARAMETERS IN SOILS

The results of the 1998 and historical soil sampling at the site identified significant areas of radionuclides above the IALs. The primary radionuclides of concern in surface and subsurface soils include Ra-226, Th-230, and U-238. Other radionuclides of interest in surface and subsurface soils include daughter decay products Pa-231 and Ac-227. The interpreted extent of soil which exceed the IALs identified in the SAP for the primary radionuclides are provided in Figures 5-1 through 5-3 for Ra-226, Th-230, and U-238, respectively. The maximum interpreted extent of Pa-231 above its residential and industrial IALs are illustrated on Figures 5-4 and 5-5, respectively. Similarly, the interpreted maximum areal extent of Ac-227 above its residential and industrial IALs are illustrated on Figures 5-6 and 5-7.

Th-230 represents the widest extent and volume of radionuclide impacted soil above its IAL. East-west and north-south cross sections which illustrate the interpreted depth of Th-230 above its IAL are further illustrated on Figures 5-8 and 5-9. According to the characterization results presented in Section 4.0, the surficial extent of Th-230 across the areas of investigation are only sporadically expressed across SLAPS (IA-1 through IA-6) but are broader in extent across the ballfields, McDonnell Boulevard, and portions of the railroad tracks (IA-7, IA-8, IA-9, and IA-12), which are adjacent to the former landfill. The apparent mechanism of transport to these areas include both wind and surface water deposition from the former landfill area. Transportation of residues to/from this former facility has also been documented to contribute to the transport mechanisms of this radionuclide. Th-230 is also present with depth (up to 15 ft) almost exclusively to the former landfill facility in IA-1 through IA-6. Most of the radionuclides in IA-1 were removed during the former west end remediation; however, small pockets of thorium and other radionuclides remain both beneath and surrounding this remedial area. A localized area of subsurface radionuclide impact is also present along the north ditch, along the boundary of IA-8 and IA-9, near Coldwater Creek. The source of this subsurface expression is considered to be primarily from surface water transport of sediments during or prior to former construction activity associated with installation of McDonnell Boulevard, circa 1953.

Characterization of Pa-231 and Ac-227 in soil has been accomplished at SLAPS. For the SLAPS VPs, Pa-231 and Ac-227 will be characterized prior to remediation. The extent of Pa-231 appears to be more extensive than that of Ac-227, when compared to the IALs provided in the SAP.

5.3 CONCLUSIONS REGARDING SOIL CHEMICAL PARAMETERS

Approximately 240 soil samples were reviewed from the 1998 and historical sampling for evaluation of metals and other inorganics in soils at SLAPS and the CPs. In addition, approximately 100 samples for organics, including VOCs, SVOCs, pesticides, herbicides, and PCBs, were also available from the 1998 and historical sampling.

Thirteen of the seventeen inorganic PCOCs for this investigation were detected in the soil above their respective IALs. These constituents included arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, thallium, and vanadium. The areal extent of inorganics in site soils does not appear to be extensive.

None of the VOCs detected in any of the soil samples based on the 1998 and historical sampling exceeded any of the identified IALs. Although 13 VOCs were detected in the soil across the site, all of the concentrations detected fell below Missouri ASL screening levels. No surface or subsurface source of VOCs were identified during the Emflux soil gas survey.

A total of 21 SVOCs were detected in soil samples from the site, based on the 1998 and historical sampling results. None of the chemical IALs established for this investigation in the SAP were exceeded based on detected concentrations of SVOC compounds. The detected SVOCs were comprised primarily of PAHs. Only one compound was found above the Missouri ASL screening level. This constituent was identified as benzo(a)pyrene, which was found in elevated concentrations in IA-8, along McDonnell Boulevard. Benzo(a)pyrene was not found in site ground water, and SVOCs are not considered to be COCs in site ground water.

No IALs were established in the SAP prior to this sampling for pesticides, herbicides, or PCBs, as no previous sampling had been conducted at the site for these constituents. The Missouri ASL for soil were used as the default reference concentrations. Although several of these constituents were detected in soil samples, only two herbicides (MCPA and MCPP) were found at concentrations just above their respective Missouri ASL soil screening levels. Only 3 of the approximately 100 soil samples tested were detected for MCPA, whereas only 5 of the 100 samples tested were detected for MCPP. Therefore, there is no apparent extent of any of these constituents. Further, no herbicides or PCBs were detected in site ground-water or surface water collected in 1998. No elevated concentrations of pesticides were found in site ground water.

Based on a review of the recent and historical sampling for waste characterization analysis, the recent 1998 sampling results confirm that hazardous constituents (40 CFR 261) are not associated with any of the radionuclide-impacted soils.

5.4 CONCLUSIONS REGARDING GROUND-WATER

The shallow ground water of HZ-A does not have a direct connection with the aquifer HZ-E. HZ-C's Unit 4 gravel are recognized as the surrogate, recoverable water for the North County SLS.

The ground-water monitoring data indicate localized impacts to water in HZ-A and an absence of impacts to lower HZ water. Uranium, manganese, nitrate, selenium, TCE, and 1,2-DCE were found in HZ-A. Manganese was found in the lower HZs and may be from natural sources, as concentrations approximated those in background wells. Arsenic, interpreted to be from natural sources, was also found in the lower HZs. The highest uranium concentrations were found at the western end of SLAPS in HZ-A.

Although the primary radioisotopes were detected in site ground water, they were not present above their respective IALs. Only total uranium continues to be the primary ground-water constituent of concern above its MCL.

Arsenic, manganese, selenium and nickel were detected in the ground water at the site at concentrations which exceed their respective IALs.

TCE and 1,2 DCE were detected in concentrations above their respective MCLs of 5 µg/L and 70 µg/L, although at low concentrations at SLAPS. There was a detection of 840 µg/L TCE in B53W17S on the ballfields. Acetone, methylene chloride, xylene and 2-butanone were also detected in the ground-water samples, but these compounds were also found in QA/QC blanks, indicating that their detections may be laboratory artifacts.

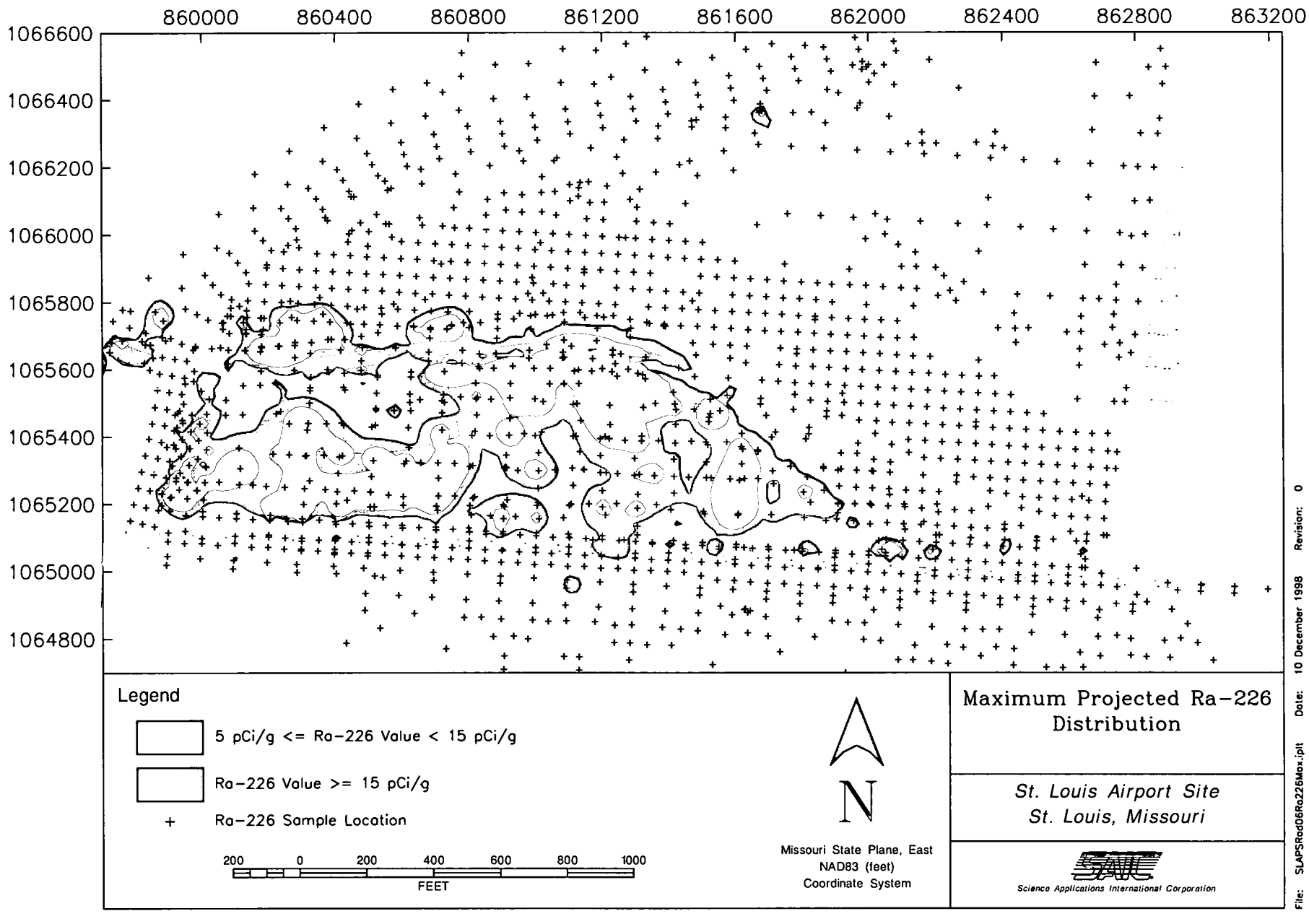
The SVOC bis-2-ethlhexyl-phthalate was detected at a concentration of 45 µg/L in Well B53W13S. This compound was also detected in QA/QC blanks and is likely a laboratory artifact.

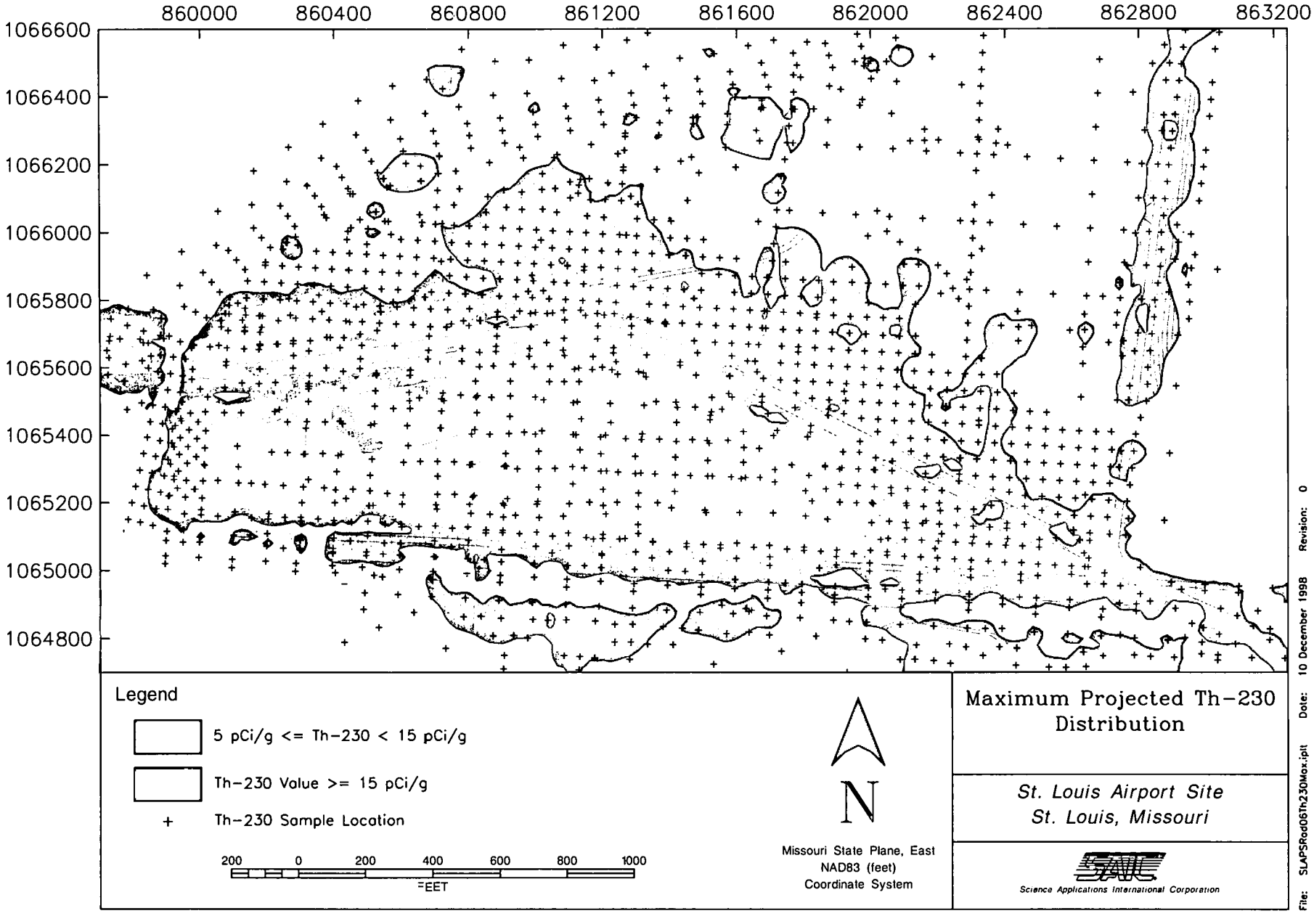
No herbicides or PCBs were detected in ground-water samples collected in the summer of 1998. Trace concentrations of the pesticides Endosulfane, Lindane, and Methoxychlor were detected in Well M11-9 and B53W13S.

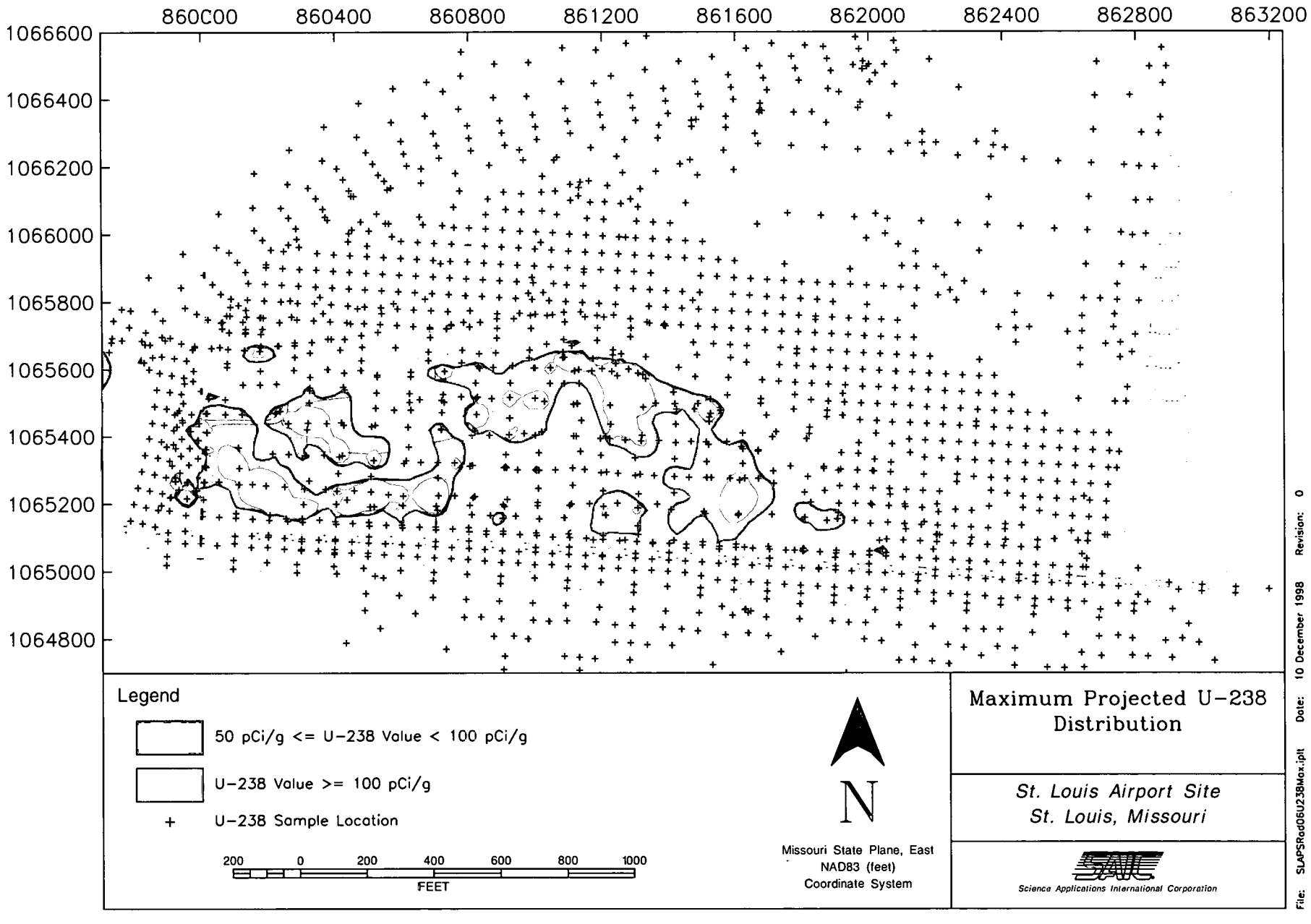
SECTION 5.0

FIGURES

TABLE OF CONTENTS


860000
860400
860800
861200
861600
862000
862400
862800
863200
1066600
1066400
1066200
1066000
1065800
1065600
1065400
1065200
1065000
1064800
Legend
5 pCi/g <= Ra-226 Value < 15 pCi/g
Ra-226 Value >= 15 pCi/g
Ra-226 Sample Location
200 0 200 400 600 800 1000
FEET
N
Missouri State Plane, East
NAD83 (feet)
Coordinate System
Maximum Projected Ra-226 Distribution
St. Louis Airport Site
St. Louis, Missouri
Science Applications International Corporation
File: SLAPSRod06Ra226Max.iplt Date: 10 December 1998 Revision: 0


860000
860400
860800
861200
861600
862000
862400
862800
863200
1066600
1066400
1066200
1066000
1065800
1065600
1065400
1065200
1065000
1064800
Legend
5 pCi/g <= Th-230 < 15 pCi/g
Th-230 Value >= 15 pCi/g
Th-230 Sample Location
200 0 200 400 600 800 1000
FEET
N
Missouri State Plane, East
NAD83 (feet)
Coordinate System
Maximum Projected Th-230 Distribution
St. Louis Airport Site
St. Louis, Missouri
Science Applications International Corporation
File: SLAPSRod06Th230Max.jpt Date: 10 December 1998 Revision: 0


860C00
860400
860800
861200
861600
862000
862400
862800
863200
1066600
1066400
1066200
1066000
1065800
1065600
1065400
1065200
1065000
1064800
Legend
50 pCi/g <= U-238 Value < 100 pCi/g
U-238 Value >= 100 pCi/g
U-238 Sample Location
200 0 200 400 600 800 1000
FEET
N
Missouri State Plane, East
NAD83 (feet)
Coordinate System
Maximum Projected U-238 Distribution
St. Louis Airport Site
St. Louis, Missouri
Science Applications International Corporation
File: SLAPSRod06U238Max.jplt
Date: 10 December 1998
Revision: 0

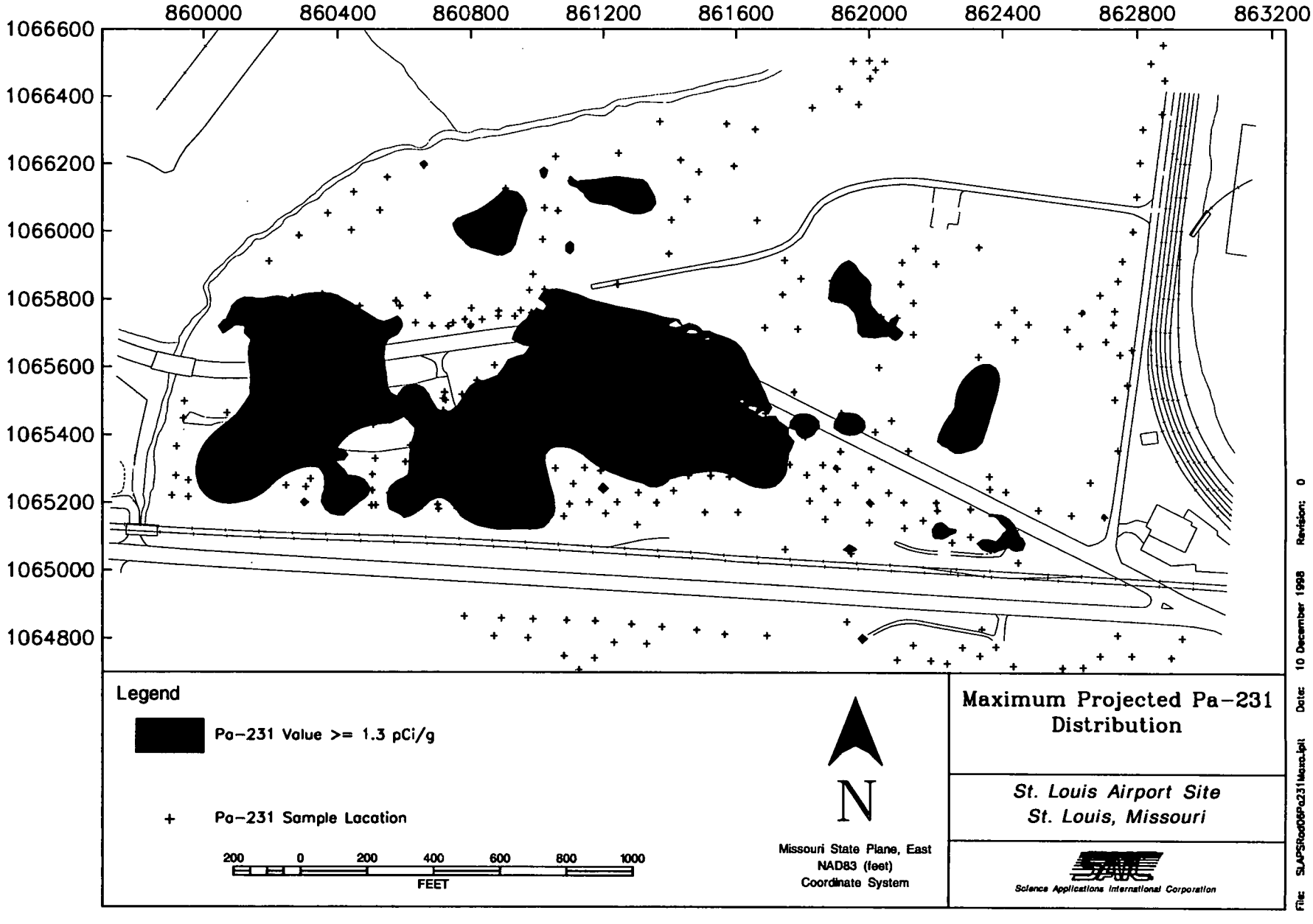
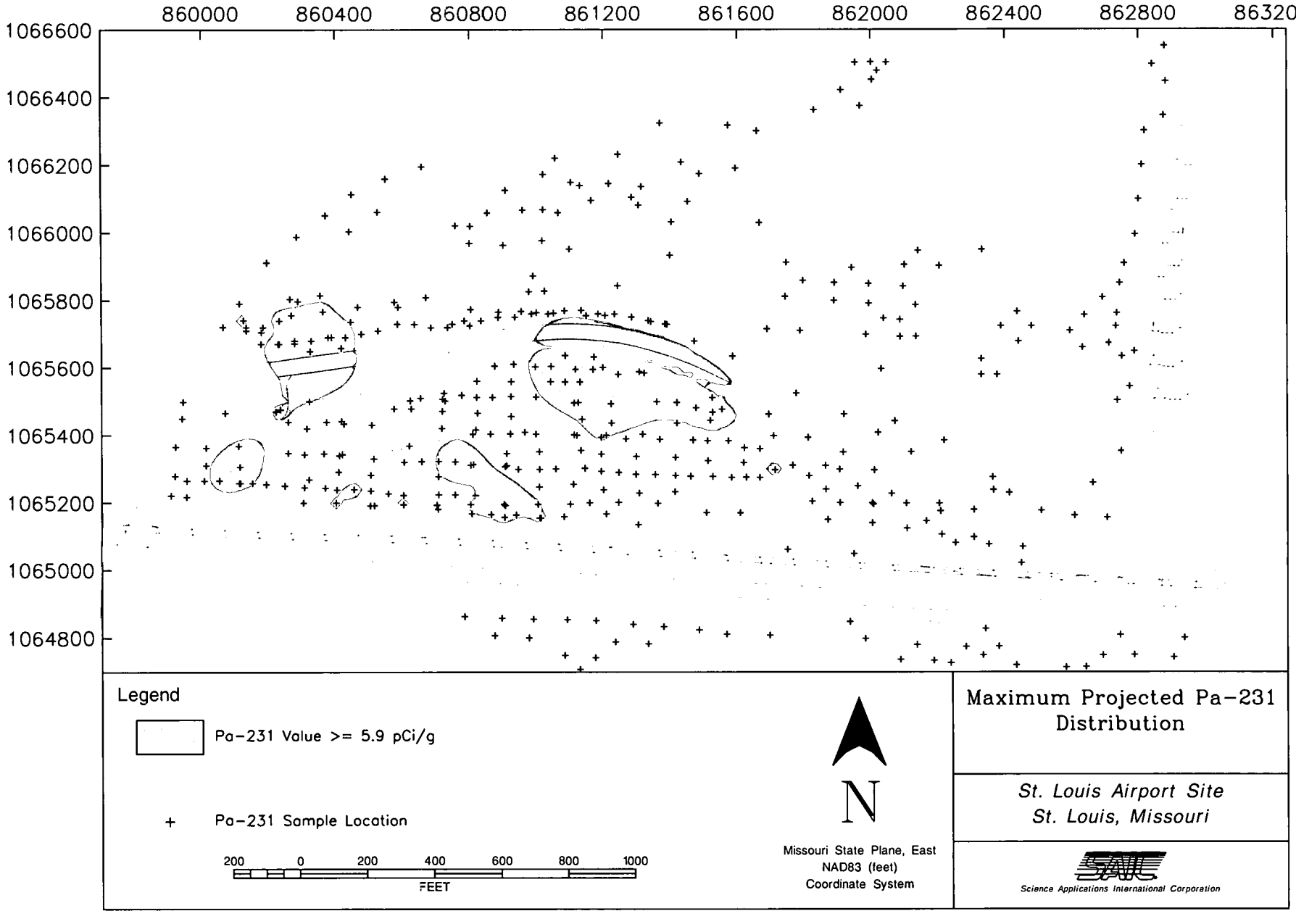

860000
860400
860800
861200
861600
862000
862400
862800
863200
1066600
1066400
1066200
1066000
1065800
1065600
1065400
1065200
1065000
1064800
Legend
Pa-231 Value >= 1.3 pCi/g
Pa-231 Sample Location
200 0 200 400 600 800 1000
FEET
N
Missouri State Plane, East
NAD83 (feet)
Coordinate System
Maximum Projected Pa-231 Distribution
St. Louis Airport Site
St. Louis, Missouri
Science Applications International Corporation
File: SLAPSRod09Pa231Maxp.jpt Date: 10 December 1998 Revision: 0

FIGURE 5-4


860000
860400
860800
861200
861600
862000
862400
862800
863200
1066600
1066400
1066200
1066000
1065800
1065600
1065400
1065200
1065000
1064800
Legend
Pa-231 Value >= 5.9 pCi/g
Pa-231 Sample Location
200 0 200 400 600 800 1000
FEET
N
Missouri State Plane, East
NAD83 (feet)
Coordinate System
Maximum Projected Pa-231 Distribution
St. Louis Airport Site
St. Louis, Missouri
Science Applications International Corporation
File: SLAPSRod06Pa231Maxb.jpll Date: 10 December 1998 Revision: 0

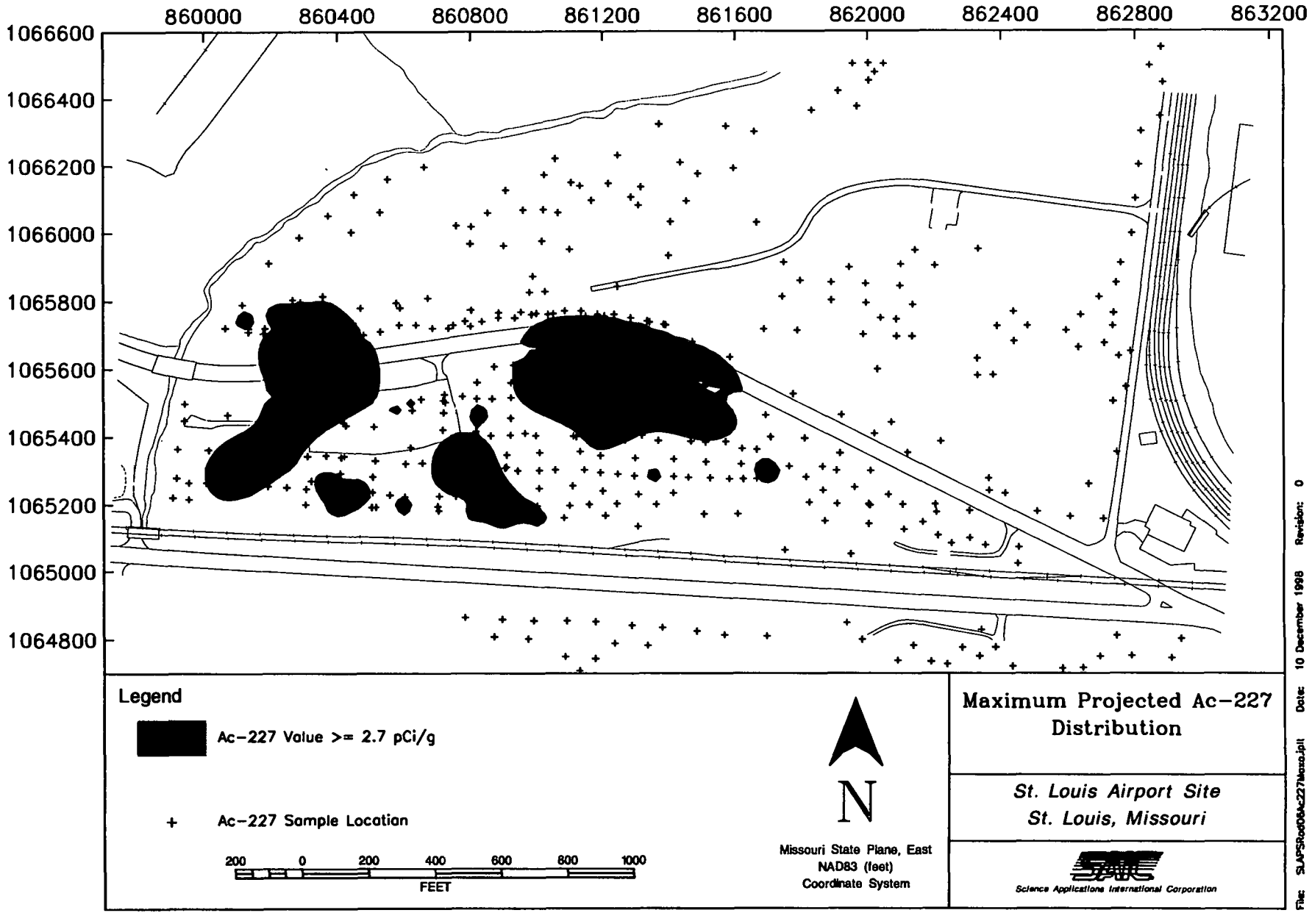

860000
860400
860800
861200
861600
862000
862400
862800
863200
1066600
1066400
1066200
1066000
1065800
1065600
1065400
1065200
1065000
1064800
Legend
Ac-227 Value >= 2.7 pCi/g
Ac-227 Sample Location
200 0 200 400 600 800 1000
FEET
N
Missouri State Plane, East
NAD83 (feet)
Coordinate System
Maximum Projected Ac-227 Distribution
St. Louis Airport Site
St. Louis, Missouri
Science Applications International Corporation
File: SLAPSRod06Ac227Maxp.jpll Date: 10 December 1998 Revision: 0

FIGURE 5-6

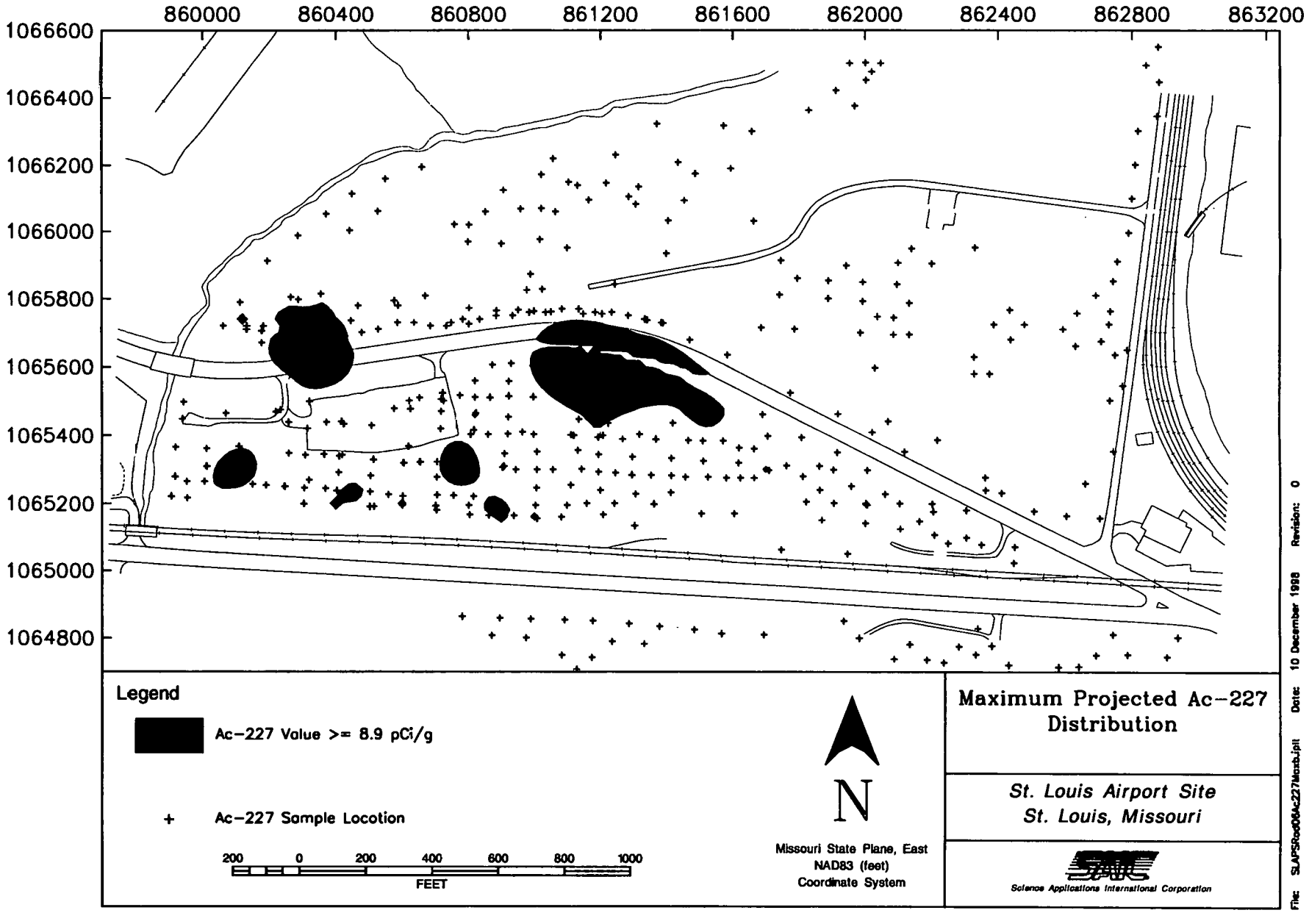
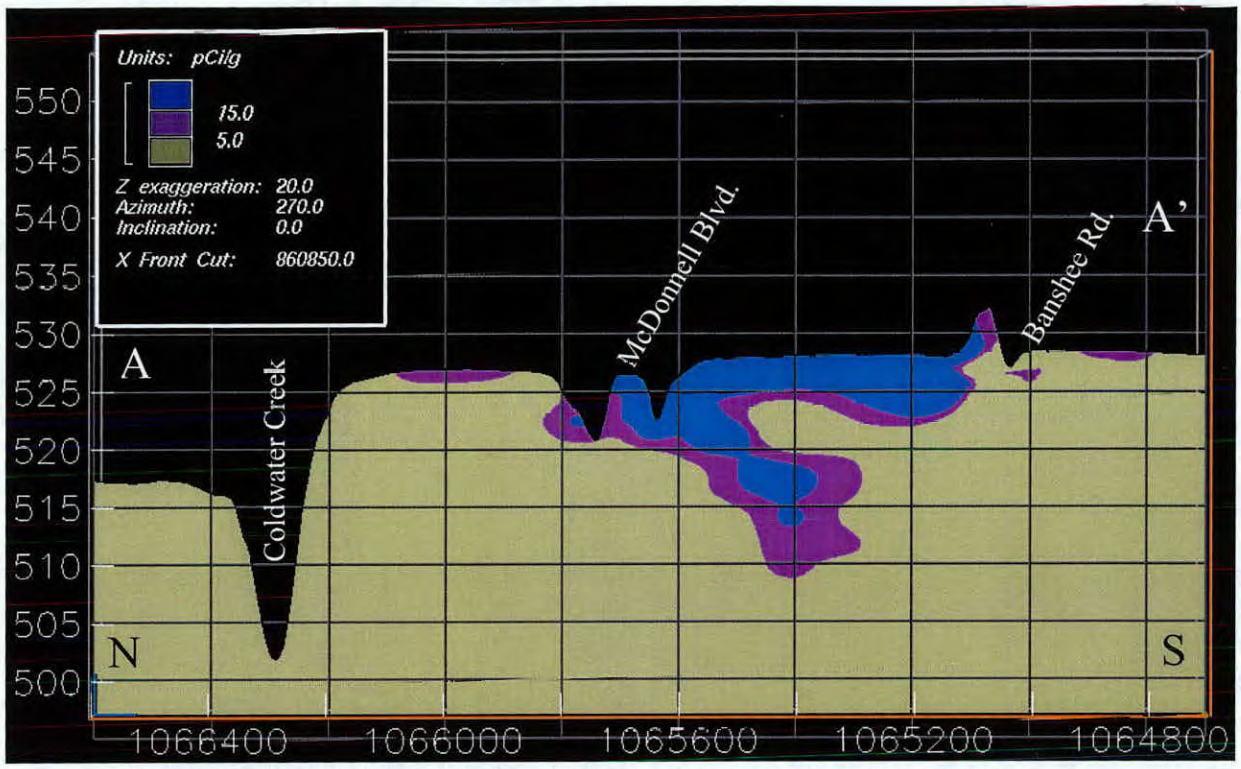
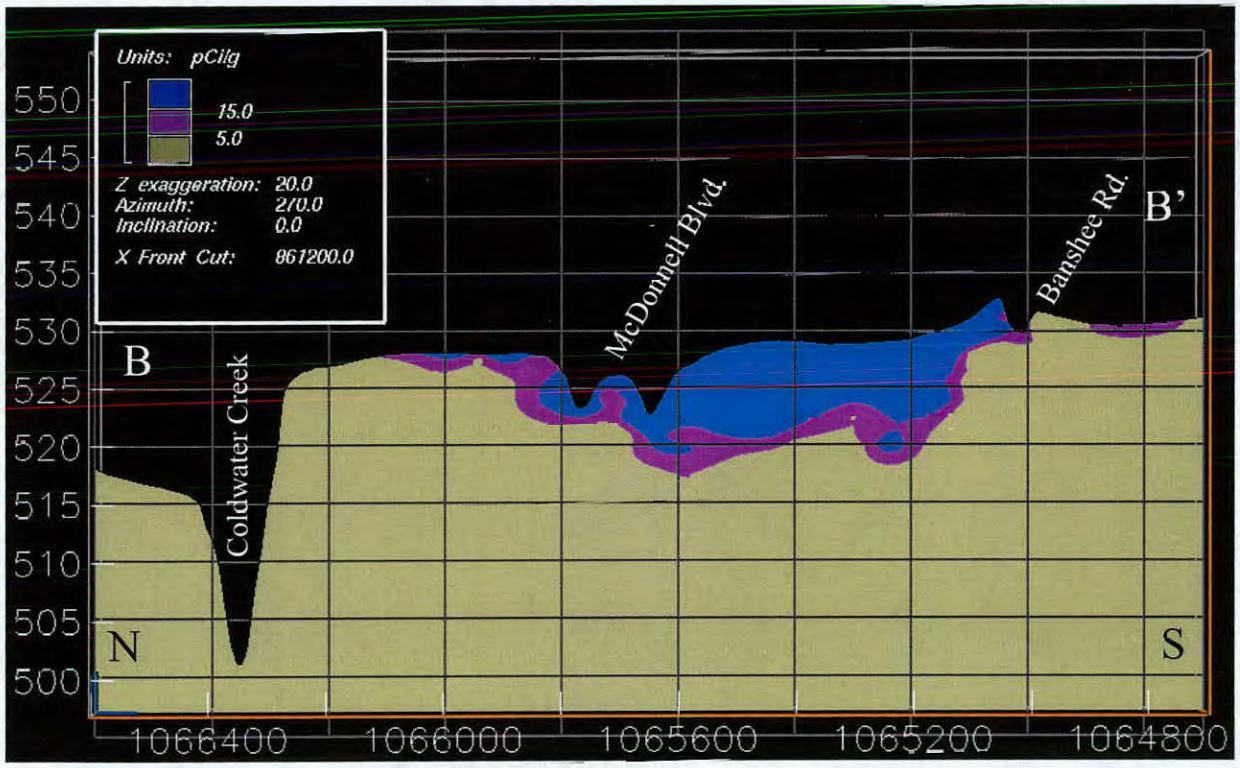

860000
860400
860800
861200
861600
862000
862400
862800
863200
1066600
1066400
1066200
1066000
1065800
1065600
1065400
1065200
1065000
1064800
Legend
Ac-227 Value >= 8.9 pCi/g
Ac-227 Sample Locotion
200
0
200
400
600
800
1000
FEET
N
Missouri State Plane, East
NAD83 (feet)
Coordinate System
Maximum Projected Ac-227 Distribution
St. Louis Airport Site
St. Louis, Missouri
Science Applications International Corporation
File: SLAPSRod06Ac227Maxb.jpll
Date: 10 December 1998
Revision: 0

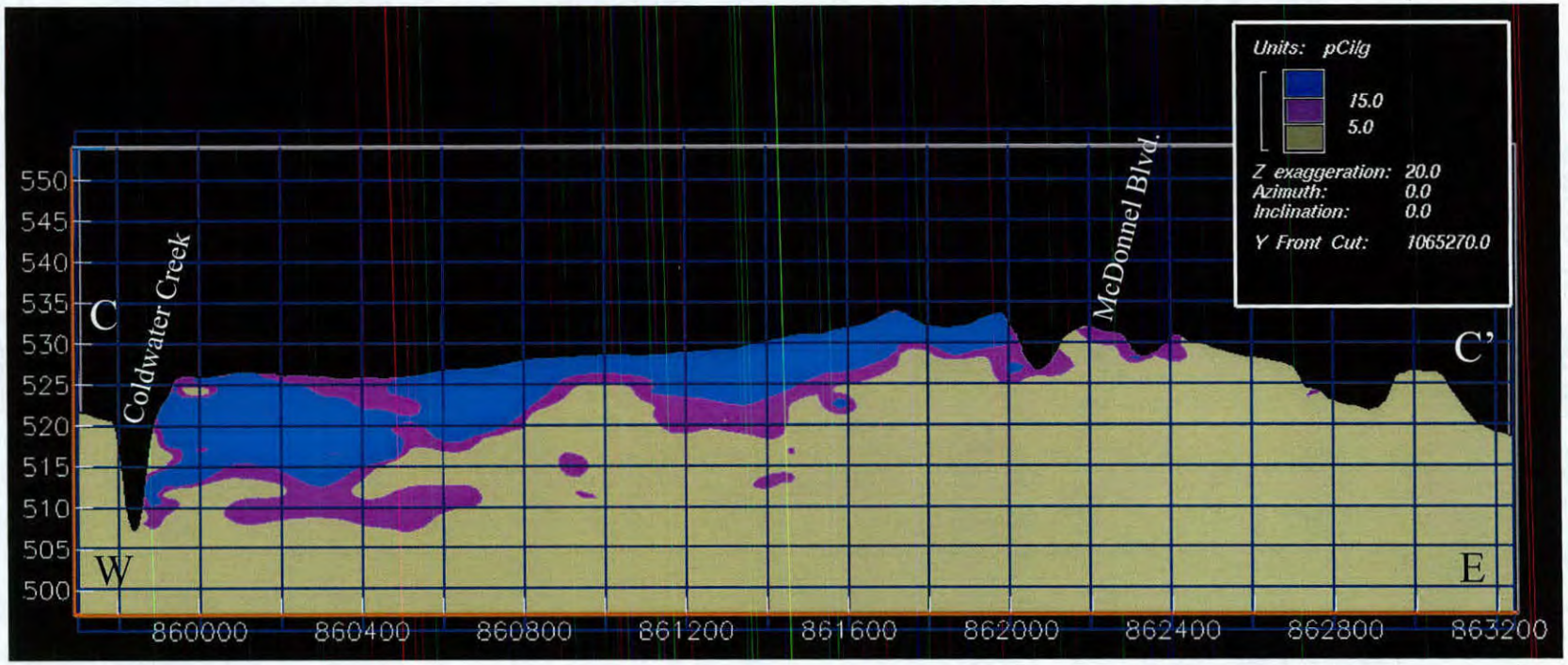
FIGURE 5-7



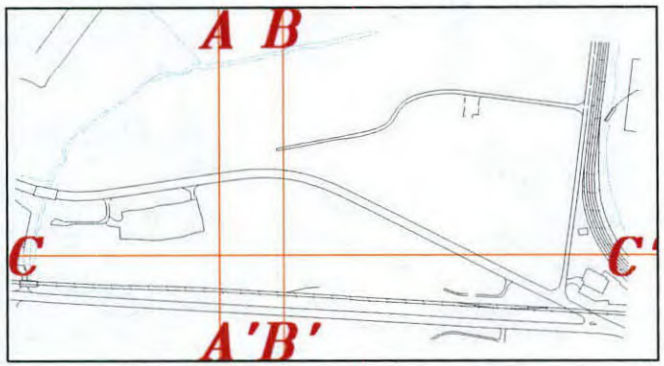
Thorium−230 A−A' Cross Section at SLAPS Along Easting Cut at 860850



Thorium−230 B−B' Cross Section at SLAPS Along Easting Cut at 861200



Thorium−230 C−C' Cross Section at SLAPS Along Northing Cut at 1065270



Cross Section Traverse Location Map

SECTION 6.0

REFERENCES

6.0 REFERENCES

BNI, 1994. *Remedial Investigation Report for the St. Louis Site,* DOE/OR/21949-280. January.

BNI, 1998. *Post Remedial Action Report for the Remedial Actions Conduct in St. Louis During Calendar Year 1997*, DOE/OR/21949-409. Draft, June.

DOE, 1994. *Feasibility Study/Environmental Impact Statement for the St. Louis Site, St. Louis, Missouri.* DOE/OR/21950-130. Draft, April.

Federal Emergency Management Agency (FEMA), 1983. *Flood Insurance Rate Map, City of Hazelwood, St. Louis County, Missouri,* Community-Panel No. 290357-0005-6. January.

Science Applications International Corporation (SAIC), 1992. *Final, Initial Screening of Alternatives Report for the St. Louis Site; St. Louis, Missouri*; DOE/OR/21590-777. October.

SAIC, 1995. *Remedial Investigation Addendum Report for the St. Louis Site, St. Louis, Missouri.* DOE/OR/21950-132. September.

SAIC, 1998. *Quality Assurance Project Plan (QAPP) for the St. Louis Airport Site and Contiguous Properties, St. Louis, Missouri.* June.

USACE, 1994a. *Monitor Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites,* Engineer Manual, EM 1110-1-4000. August.

USACE, 1994b. *Requirements for the Preparation of Sampling and Analysis Plans*, Engineer Manual, EM 200-1-3. September.

USACE, 1995. *Technical Project Planning Guidance for HTRW Data Quality Design, Engineer Manual*, EM 200-1-2. July.

USACE, 1998a. *Sampling and Analysis Plan for the St. Louis Airport and Downtown Sites, St. Louis MO*, USACE/OR/DACA62-1045. June.

USACE, 1998b. *Ground-water Characterization Report of 1997 Baseline Data for the St. Louis Airport Site (SLAPS), St. Louis, Missouri*, USACE/OR/DACA62-1040. May.

USACE, 2000. *Site Safety and Health Plan (SSHP) for Site Activities at the St. Louis Airport Site, St. Louis, Missouri.* January.

United States Department of Agriculture (USDA), Soil Conservation Service 1982. Soil Survey of the St. Louis County and St. Louis City, Missouri. April.

USEPA, 1989. *National Priorities List, St. Louis Airport/Hazelwood Interim Storage/Future Coatings Company, St. Louis County, Missouri*, NPL-U8-2-6-10/89. October.

Zoning Codes, 1992. City of St. Louis, City of Berkeley, City of Hazelwood.