FINAL

ENVIRONMENTAL MONITORING IMPLEMENTATION FOR THE ST. LOUIS SITES FOR FY05

ST. LOUIS, MISSOURI

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prepared by

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

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ACRONYMS AND ABBREVIATIONS

AEC	Atomic Energy Commission
AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
ATD	alpha track detector
BMP	best management practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
COD	Chemical oxygen demand
CSR	Code of State Regulations
CY	calendar year
DOE	U.S. Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis
EMDAR	Environmental Monitoring Data and Analysis Report
EMG	Environmental Monitoring Guide
EMIFY	Environmental Monitoring Implementation Fiscal Year
EMP	Environmental Monitoring Program
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
FS	Feasibility Study
FSS	Final Status Survey
FUSRAP	Formerly Utilized Sites Remedial Action Program
FY	fiscal year
HISS	Hazelwood Interim Storage Site
HU	hydrostratigraphic unit
HZ	hydrostratigraphic zone
IDW	investigation-derived waste
IL	investigative limit
MDNR	Missouri Department of Natural Resources
MED	Manhattan Engineer District
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mrem	millirem(s)
MSD	Metropolitan Sewer District
mrem/yr	millirem(s) per year
NESHAP	National Emission Standard for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity units
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pCi/m^3	picocuries per cubic meter
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RA	Remedial/Removal Action

ACRONYMS AND ABBREVIATIONS (CONT'D)

Ra	Radium
Rn	Radon
ROD	Record of Decision
SAG	Sampling and Analysis Guide
SAIC	Science Applications International Corporation
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
SLS	St. Louis Sites
Th	Thorium
TLD	thermoluminescent dosimeter
TOC	total organic carbon
TOX	total organic halogen
U	Uranium
USACE	U.S. Army Corps of Engineers
UTL	upper tolerance limit
VP	vicinity property
WD	work description
WQC	water quality criteria
μCi/ml	microcuries per milliliter
μg/L	microgram per liter
μmhos/cm^3	micromhos per cubic centimeter

1.0 INTRODUCTION

1.1 PROGRAM OVERVIEW

This Environmental Monitoring Implementation Fiscal Year 2005 (EMIFY05) plan applies to the St. Louis Sites (SLS) within the Formerly Utilized Sites Remedial Action Program (FUSRAP) (see Figure 1-1). SLS FUSRAP consists of the St. Louis Downtown Site (SLDS) with its associated vicinity properties (VPs), the St. Louis Airport Site (SLAPS), SLAPS VPs, and the Latty Avenue Properties. The Latty Avenue Properties include Futura, the Hazelwood Interim Storage Site (HISS), and other VPs. (see Figures 1-2, 1-3, and 1-4).

The FUSRAP program was initiated in 1974 by the Atomic Energy Commission (AEC), the predecessor to the U.S. Department of Energy (DOE). FUSRAP was transferred to the U.S. Army Corps of Engineers (USACE) on October 13, 1997. The USACE is responsible for the management and execution of FUSRAP to cleanup sites used in the nation's early atomic energy program. One element of the FUSRAP mission is the environmental monitoring of sites where response actions either are being implemented or have been completed but where contaminants remain on-site above levels that allow for the unrestricted use or unlimited exposure.

The environmental monitoring of sites where contaminants remain above levels that allow for unlimited use and unrestricted exposure is a statutory requirement under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Environmental monitoring serves as a critical tool to evaluate potential future migration of residual contaminants, whether as a component of remedial actions or as a best management practice (BMP).

This EMIFY05 SLS-FUSRAP document serves as a component of an integrated approach to collecting environmental data at the SLS. It is recognized that monitoring requirements and data objectives for the SLS will change as a result of promulgation of new regulations, issuance of permits, meeting of substantive requirements, and/or the implementation of remedial actions. Accordingly, program-level requirements with respect to field sampling procedures, sample management requirements, analytical protocols, and quality assurance (QA)/quality control (QC) activities that are unlikely to change are specified in an upper-tier document entitled *Sampling and Analysis Guide for the St. Louis Sites, St. Louis, Missouri,* (SAG) (USACE, 2000a). The *Environmental Monitoring Guide for the St. Louis Sites, St. Louis, Missouri,* (EMG) (USACE, 1999a) describes the overall objective, program structure, media to be monitored, and program requirements of the Environmental Monitoring Program (EMP). Annual EMIFYs are issued under the EMG to address changing monitoring objectives and specifically identify sampling locations, frequencies, monitoring parameters, and criteria for evaluation of the resultant data specific for periodic sampling activities for the subject year. Non-periodic sampling activities such as soil sampling to define unit boundaries for design purposes or verify compliance with cleanup objectives or other special studies are specified in other implementation plans throughout the year. In accordance with requirements of the Federal Facilities Agreement (FFA), data obtained from the EMIFY are reported to the U.S. Environmental Protection Agency (EPA) Region VII in quarterly FFA reports. An evaluation of the data obtained from monitoring under each EMIFY during each fiscal year (FY) is provided in an annual Environmental Monitoring Data and Analysis Report for each calendar year (EMDAR). Sampling results for CY04 will be

compared to the evaluation criteria for each of the media cited in this report or contaminants of concern (COCs) listings for the North St. Louis County Sites Record of Decision (ROD), whichever is applicable at the time.

The remainder of Section 1.0 contains a summary description of the contents of this document. Section 2.0 presents evaluation criteria and guidelines derived from various environmental regulations that will be used for assessment of the data obtained under this EMIFY05. Section 3.0 presents the various types and locations of monitoring to be conducted at the SLS. Section 4.0 references the SAG procedures necessary to fulfill the requirements of this EMIFY, including field-sampling procedures, sample management requirements, sample packaging and shipping requirements, management of investigation-derived waste (IDW), analytical protocols, and QA/QC requirements.

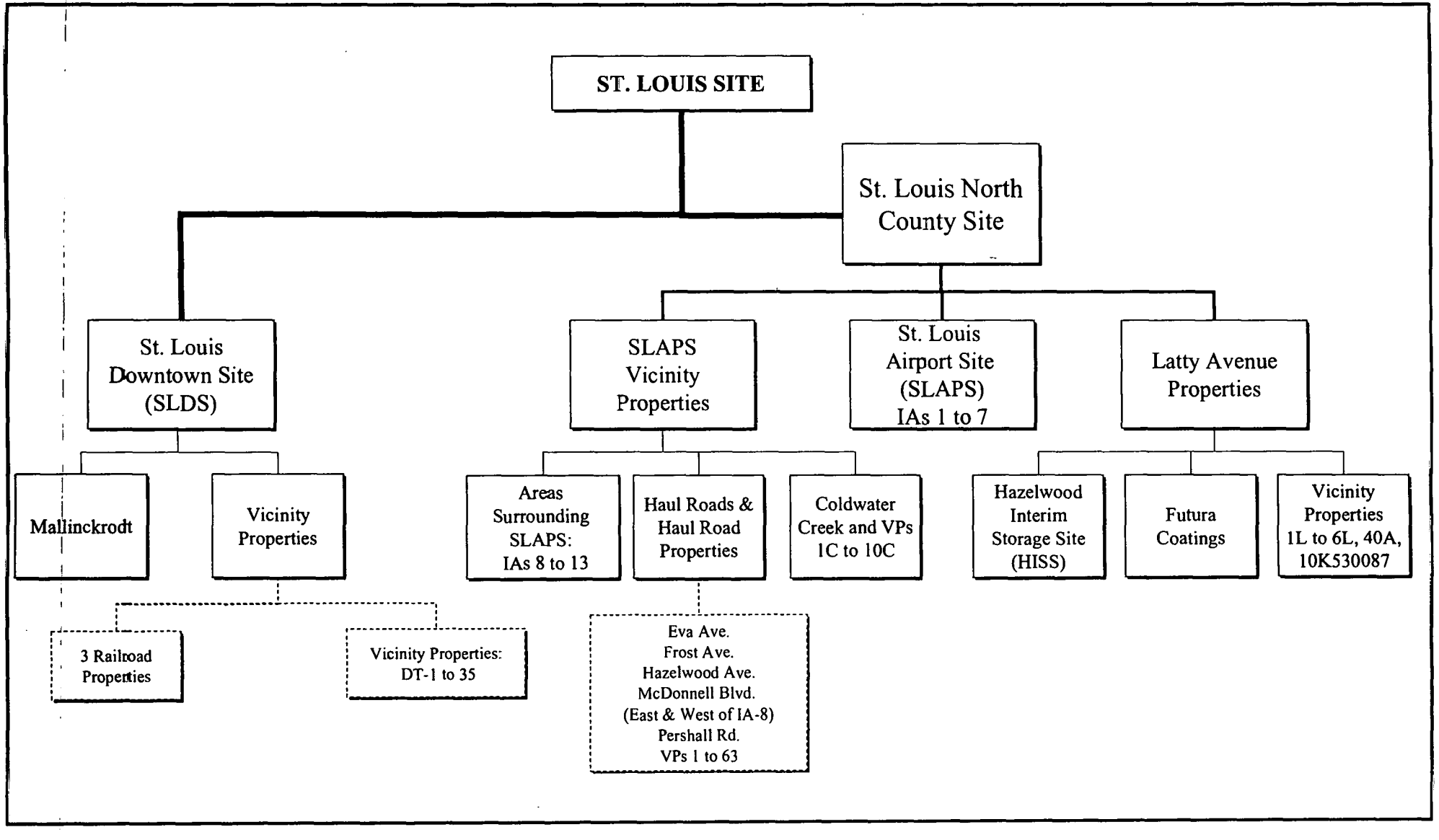

Figure 1-1. Schematic Representation of the FUSRAP St. Louis Site

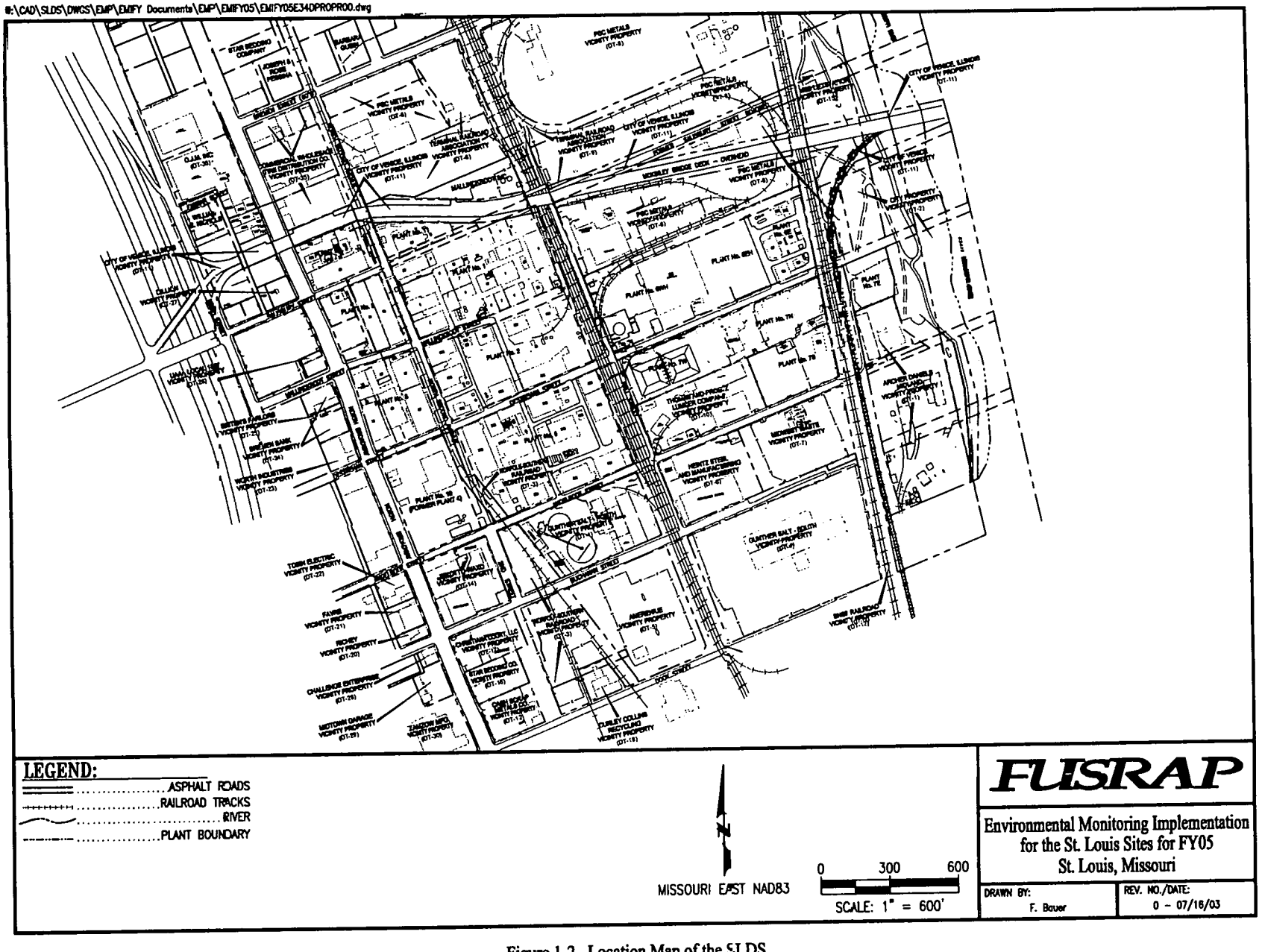

Figure 1-2. Location Map of the SLDS

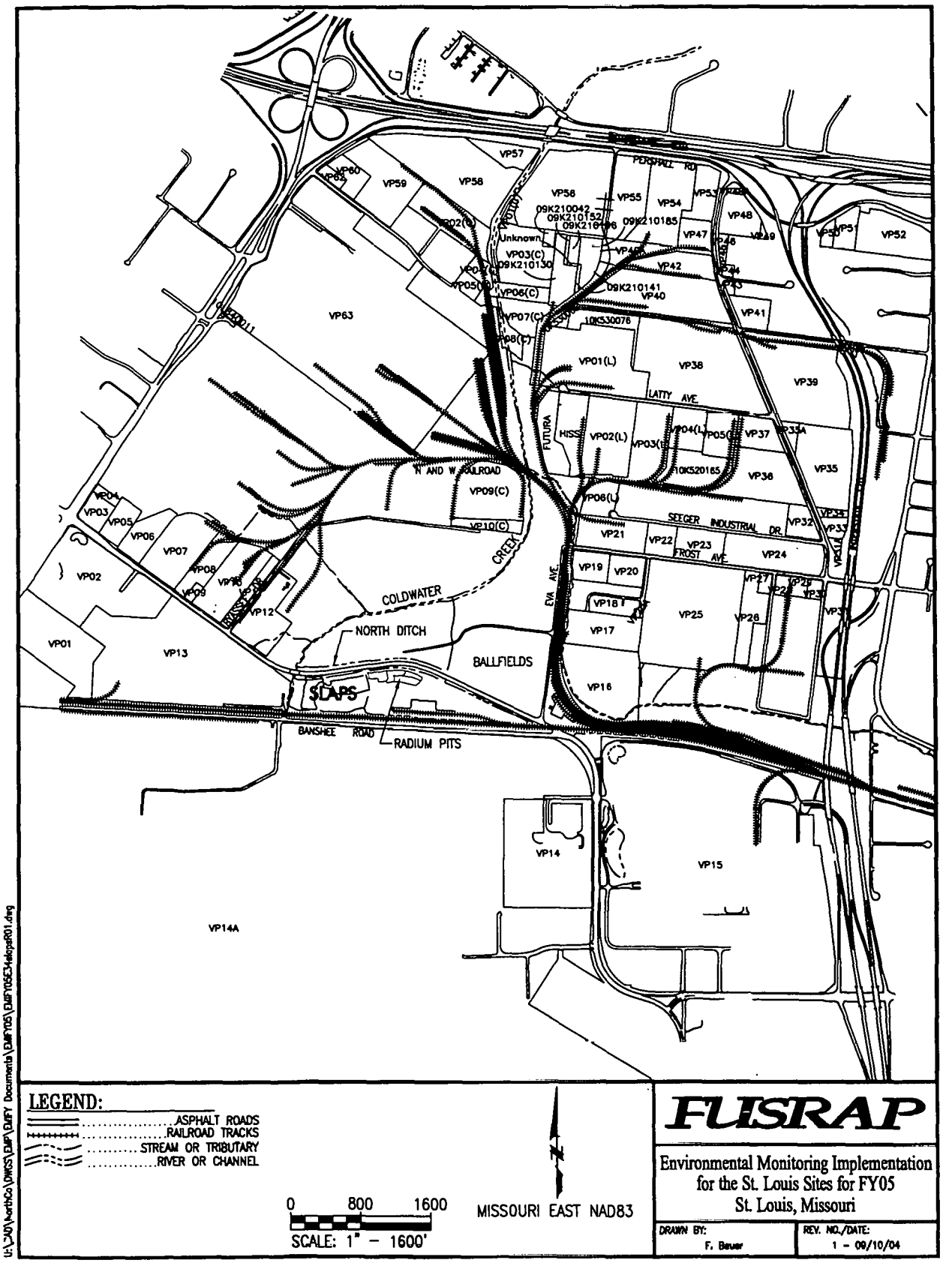

Figure 1-3. Location Map of the SLAPS and SLAPS Vicinity Properties

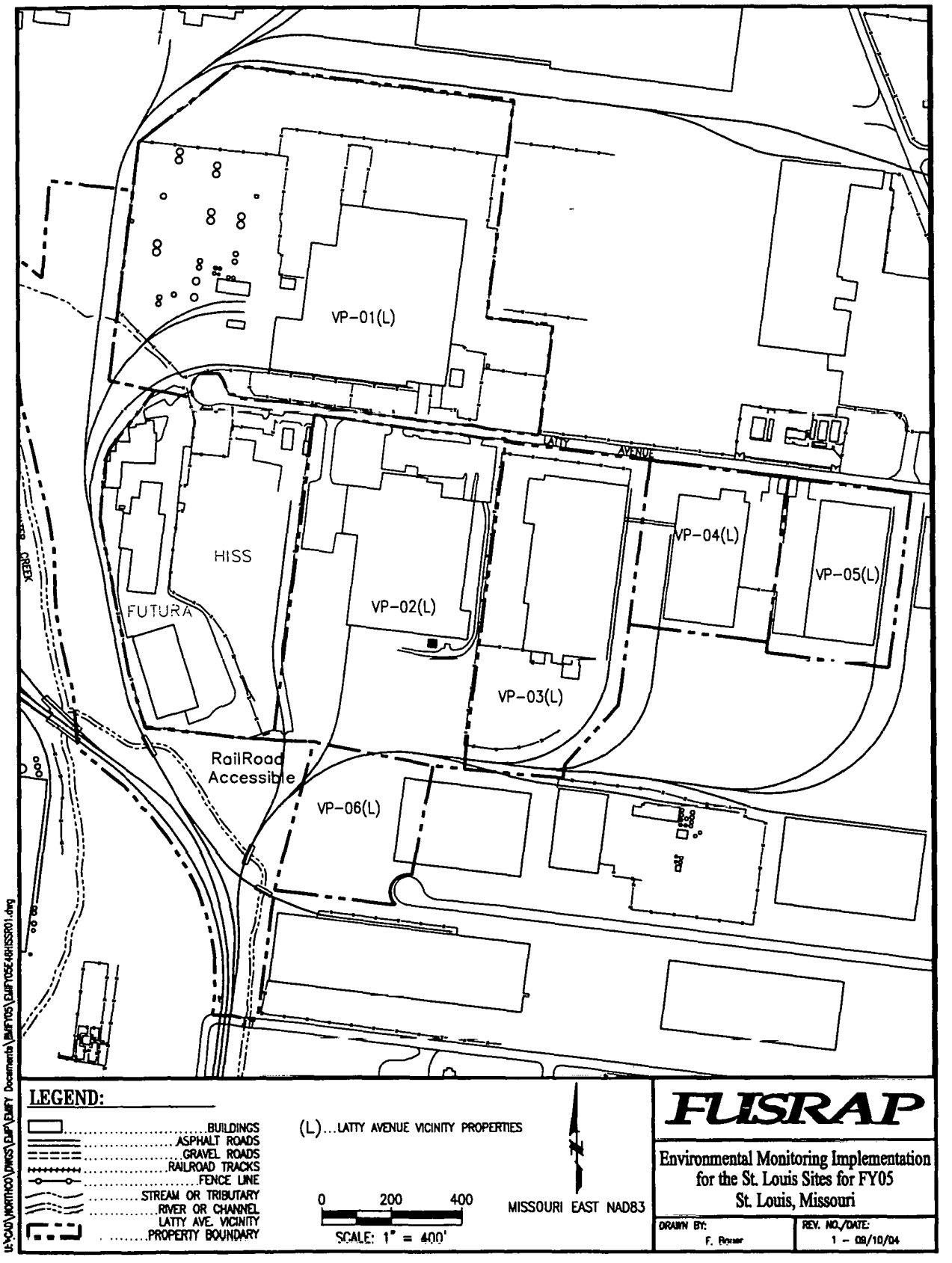

Figure 1-4. Location Map of the HISS and Latty Avenue Vicinity Properities

2.0 OBJECTIVES AND EVALUATION GUIDELINES FOR THE ENVIRONMENTAL MONITORING PROGRAM FOR FY05

2.1 PROGRAM OBJECTIVES FOR FY05

The objectives for the EMP during FY05 are identified below.

- Conduct best management practice (BMP) monitoring to obtain data for impact evaluation relative to guidelines derived from other environmental regulations.
- Collect environmental data for site evaluation as required by CERCLA or agreed to by the USACE at the sites.
- Conduct periodic monitoring as required to meet substantive requirements or permit or applicable or relevant and appropriate requirement (ARAR) conditions for each of the SLS.

To fulfill these objectives, Section 3.0 identifies sampling locations and frequencies for various environmental media based on ARARs, permit conditions, site characteristics, risk assessment considerations, and other site factors. Such sampling locations can include the area of contamination (AOC), points of compliance at the AOC boundary, receptor areas, off-site unaffected areas, critical receptors, and migration pathways. Similarly, the monitoring parameters identified in Section 3.0 were selected from permit conditions, best professional judgment based on historical site studies, the *Feasibility Study for the St. Louis North County Site* (USACE, 2003a), and other CERCLA decision documents (i.e., EE/CAs or ROD) as available.

2.2 EVALUATION GUIDELINES FOR ENVIRONMENTAL MONITORING DATA

Data acquired during FY05 will be evaluated with respect to ARARs or permit conditions, guidelines derived from other environmental regulations, and environmental documents [i.e., Engineering Evaluation/Cost Analysis (EE/CA), Record of Decision (ROD)]. The remainder of this section identifies the evaluation criteria. These evaluation criteria are used for comparison and discussion purposes only.

2.2.1 Evaluation Criteria and Guidelines for Site Radiological Data

Outdoor air monitoring will be conducted as a BMP activity under this EMIFY05. Site radiological monitoring is appropriate at the fence line and/or in the vicinity of excavation areas and areas accessible to members of the public. Sampling results from airborne particulate monitoring will be evaluated with respect to regulatory guidelines from 40 CFR 61 and 10 CFR 20. In accordance with 40 CFR 61, dose from radioactive airborne particulates (excluding radon) to the hypothetical maximum exposed member of the public is limited to less than 10 millirem per year (mrem/yr). This value applies to the critical receptor receiving the highest dose as determined by modeling and/or monitoring that considers inputs such as wind direction and duration of human occupancy. Exposure to the public from operating activities is limited to 100 mrem/yr from all pathways by 10 CFR 20. Guidance is given in 10 CFR 20 on how to use monitoring data to demonstrate compliance with the 100 mrem/yr standard when considering all pathways.

Annual radon monitoring results will be evaluated with respect to regulatory guidelines from 10 CFR 20 that limit radon concentrations to 0.3 picocuries per liter (pCi/L) above background (based on 30 percent equilibrium between radon-222 and progeny) at the site perimeter. Lists of regulatory commitments and a general description of how the commitments will be implemented are provided in Tables 2-1 through 2-3. All evaluation criteria for air monitoring data are provided in Table 2-4.

Table 2-1. Evaluation Criteria for Air and Direct Radiation Monitoring Data at SLAPS and SLDS

Media	Parameter	Regulatory Based Guideline	Type of Monitoring
Outdoor Air	Radon	Radon concentration 0.3 pCi/L above background[a]	Radon (alpha track) at fence line and other locations. Other locations to be in the vicinity of excavation areas and areas accessible to members of the public.
	Radiation Dose to Public	Total dose to member of public from all pathways ≤100 mrem/yr. Airborne particulate dose to member of public <10 mrem/yr (exclusive of radon).	Air particulates, radon, and thermoluminescent dosimeters at fence line and other locations. Other locations to be in the vicinity of excavation areas and areas accessible to members of the public.

[a] 10 *Code of Federal Regulations* (CFR) 20 Appendix B value of 0.1 pCi/L at 100% equilibrium with progeny is calculated to be 0.3 pCi/L at 30 percent equilibrium using methodology contained in 10 CFR 835.

Table 2-2. Summary of National Emission Standard for Hazardous Air Pollutants Air Emissions at SLAPS and SLDS

Regulation: NESHAPs Air Emissions		
Regulation	**Description/Standard**	**Implementation**
40 CFR 61 Subpart I [ARAR in SLDS ROD (USACE 1998a) and EE/CAs for SLAPS and HISS (USACE 1999b USACE 1998b]	Radionuclide emissions of ambient air particulates from federal facilities other than Nuclear Regulatory Commission licensees shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent in excess of 10 mrem/yr exclusive of radon.	Compliance with this standard will be demonstrated through measurement of radionuclide air concentrations at site or excavation area perimeters and the use of the EPA computer code CAP88PC and/or measurement of radionuclide air concentrations at critical receptor locations in accordance with 40 CFR 61, 107(b)(5). EPA concurrence is required to use environmental measurements to show compliance. Reporting Data will be documented in the annual Environmental Monitoring Data and Analysis Report for the calendar year.

Table 2-3. Summary of Uranium Mill Tailings Radiation Control Act Radon Emissions Regulation

Regulation: UMTRCA Radon Emissions		
Regulation	**Description/Standard**	**Implementation**
40 CFR 192, Subpart A § 192.02 and 40 CFR 192, Subpart D [ARAR in SLDS ROD (USACE 1998a). The equivalent of this standard, 40 CFR 61 Subpart Q, was listed in the EE/CAs for SLAPS and HISS (USACE, 1998b; USACE 1998c)]	Standards for Control of Residual Radioactive Materials from Inactive Uranium Processing Sites Radon measurements to ensure the average annual concentration is ≤0.5 pCi/L at or above the site.	For HISS and SLAPS, radon measurements will be performed at the site perimeter (the fence line) using Rn alpha track detectors as described in 40 CFR 61 Appendix B, Method 114, Method A-7. For SLDS, Radon measurements will be performed at locations in the vicinity of excavation areas and areas accessible to members of the public using the same methodology as stated above. The USACE has chosen to comply with 10 CFR 20 as a best management practice. The results will be reported in the annual Environmental Monitoring Data and Analysis Report for the calendar year. Note: 10 CFR 20 air effluent limit is 0.1 pCi/L when radon-222 is in 100 percent equilibrium with progeny. The limit for St. Louis Formerly Utilized Sites Remedial Action Program is 0.3 pCi/L, adjusting the value is the standard for 30 percent equilibrium with progeny.

Table 2-4. Summary of Dose Limits to Individual Members of the Public Regulation

Regulation: 10 CFR 20.1301 Dose Limits to Individual Members of the Public		
Regulation	**Description/Standard**	**Implementation**
10 CFR 20 § 20.1301 10 CFR 20, Appendix B, Air Effluent Limit	Dose limits for individual members of the public shall not exceed 100 mrem/yr, exclusive from the dose contributions from background radiation.	Compliance with this standard will be demonstrated using a combination of TLDs, passive radon detectors, and air samples for particulate radionuclides. Monitoring locations will be at the fence line and/or in the vicinity of excavation areas and areas accessible to members of the public. The summation of the doses calculated from the results of monitoring with TLDs, radon detectors, and particulate air samples will be used to demonstrate compliance with the 100 mrem/yr criterion. The dose contribution from water pathways is negligible and is not considered when calculating total effective dose equivalent to the critical receptor. Dose from the fence line or other monitoring locations to critical receptors will be modeled to maximally exposed receptor locations in accordance with 10 CFR 20.1302(b)(1) to demonstrate compliance with the dose limit in 10 CFR 20.1301. The U.S. Army Corps of Engineers has chosen to comply with 10 CFR 20 as a best management practice. The results will be reported in the annual Environmental Monitoring Data and Analysis Report for the calendar year.

2.2.2 Evaluation Criteria for Storm-Water Data and Excavation-Water Data

The Missouri Department of Natural Resources (MDNR) issued a National Pollutant Discharge Elimination System (NPDES) permit for the HISS that expired in 1999. The permit required monitoring of the discharge from three outfalls. The USACE issued a letter to Mr. Phillip A. Schroeder, MDNR Permit Chief, on November 18, 2003 indicating that they no longer consider this expired permit valid for the HISS (USACE, 2003c). No samples will be taken or reports prepared for the HISS. The MDNR has also issued an ARAR document outlining limits for the storm-water outfalls (including an outfall at the emergency spillway) at the SLAPS. However, recent remedial action has removed the sedimentation basin, the emergency spillway and both associated outfalls. The Metropolitan St. Louis Sewer District (MSD) has issued discharge authorization letters for the SLAPS and the SLDS that establishes discharge-limit-based criteria (MSD, 1998 and MSD, 2001). The pollutants addressed for all SLS are identified in Table 2-5. These discharge limits will be used as evaluation criteria for storm-water and excavation-water monitoring data obtained under this EMIFY05 and reported in the annual EMDAR for CY04. For cases where the governing authorities have not provided discharge limits for SLS radiological contaminants of concern, the 10 CFR 20 Appendix B water effluent values have been provided for comparison purposes only.

Table 2-5. Evaluation Criteria for Excavation Water and Storm Water

Constituent	SLAPS Discharge-Limit-Based Criteria NPDES/MSD[a]	SLDS Discharge-Limit-Based Criteria MSD[a]	10 CFR 20 App. B Surface Water Comparison Values[b]
Radiochemical Parameters			
Ra-226 (pCi/L)	NP/10	10	60
Ra-228 (pCi/L)	NP/30	30	60
Total Radium (µg/L), (pCi/L)	NL[c]/NP	NP	NA
Th-228 (pCi/L)	NP/2,000	2,000	200
Th-230 (pCi/L)	NP/1,000	1,000	100
Th-232 (pCi/L)	NP/NP	NP	30
Total Thorium (µg/L), (pCi/L)	NL[c]/NP	NP	NA
U-234 (pCi/L)	NP/3,000	3,000	300
U-235 (pCi/L)	NP/3,000	3,000	300
U-238 (pCi/L)	NP/3,000	3,000	300
Total Uranium (µg/L) (pCi/L)	NL[c]/NP	NP	300
Gross Alpha (pCi/L)	NL[c]/3,000	3,000	NA
Gross Beta (pCi/L)	NL[c]/NP	50	NA
Lead-210 (pCi/L)	NP/NP	NP	NA
Protactinium-231 (pCi/L)	NL[c]/NL	NL[c]	NA
Actinium-227 (pCi/L)	NL[c]/NL	NL[c]	NA
Radon (pCi/L)	NL[c]/NP	NP	NA
Metals Parameters			
Arsenic (mg/L)	0.1/NP	NP	NA
Barium (mg/L)	NP/10	10	NA
Cadmium (mg/L)	0.094/NP	NP	NA
Chromium (mg/L)	0.28/NP	NP	NA
Copper (mg/L)	0.084/NP	NP	NA
Lead (mg/L)	0.19/0.4	NP	NA

Table 2-5. Evaluation Criteria for Excavation Water and Storm Water (Cont'd)

Constituent	SLAPS Discharge-Limit-Based Criteria NPDES/MSD[a]	SLDS Discharge-Limit-Based Criteria MSD[a]	10 CFR 20 App. B Surface Water Comparison Values[b]
Selenium (mg/L)	NP/0.2	NP	NA
Miscellaneous Parameters			
Total Organic Carbon (TOC) (mg/L)	NP/NP	NP	NA
Total Organic Halogens (TOX) (mg/L)	NP/NP	NP	NA
Specific Conductance (mmhos/cm^3)	NP/NP	NP	NA
Chemical Oxygen Demand (mg/L)	90[d]/NP	NP	NA
Oil and Grease (mg/L)	10[d]/NP	NP	NA
Total Petroleum Hydrocarbon (mg/L)	10[d]/NP	NP	NA
pH[c]	NP/NP	NP	NA
Settleable Solids (mL/L/hr)	1.0[d]/NP	NL	NA
Total Suspended Solids (mL/L/hr)	1/NL	NL	NA
Polychlorinated Biphenyls (µg/L)	<0.5/NP	NP	NA
Fluoride (mg/L)	NP/4	NP	NA

[a] Sources: **SLAPS** - MDNR NPDES ARAR document letter from MDNR to USACE dated 10/2/98 and MSD authorization letter dated July 23, 2001. **SLDS** - MSD discharge authorization letter dated 10/30/98 from MSD to IT Corporation as modified in MSD letter issued July 23, 2001.

[b] 10 CFR 20 Appendix B values are not limits and are for comparison purposes only. 10 CFR 20 requires annual dose-based limits (Table 2-4) to be met for members of the public. USACE complies with these limits through receptor modeling (Section 2.2.4). The values listed in this column provide the contractor with comparison values for best management practices.

[c] Monitoring only requirement for NPDES or equivalent

[d] Monthly Average

NP not required as a monitoring parameter

NL No limit

NA Not applicable or relevant

2.2.3 Evaluation Guidelines for Coldwater Creek Surface-Water and Sediment Data

Data collected from Coldwater Creek surface water and sediment during this EMIFY05 will be compared to the North St. Louis County sites (SLAPS, HISS, VPs) background concentrations as listed in Table 2-6. Water Quality Criteria (WQC) in 10 *CSR* 20-7.031 Table A Classifications I, II and V will be used if no background value exists for a given constituent. However, these would not apply to the upper reach of Coldwater Creek, as it remains unclassified by the MDNR. These evaluation criteria are used for comparison and discussion purposes in the annual EMDAR for CY04.

Table 2-6. Evaluation Criteria for Surface Water and Sediment

Chemical Inorganics	Surface Water[a]	WQC[b]	Sediment[a]
Antimony	4 µg/L	4,300 µg/L	8.1 mg/kg
Arsenic	4 µg/L	20 µg/L	MSR
Barium	220 µg/L	NL	MSR
Cadmium	NR	94 µg/L	0.4 mg/kg
Chromium	10 µg/L	280 µg/L	200 mg/kg
Molybdenum	30 µg/L	NL	9.7 mg/kg
Nickel	3 µg/L	6,900 µg/L	27 mg/kg

Table 2-6. Evaluation Criteria for Surface Water and Sediment (Cont'd)

Chemical Inorganics	Surface Water[a]	WQC[b]	Sediment[a]
Selenium	2 µg/L	5 µg/L	NR
Thallium	3 µg/L	6.3 µg/L	0.7 mg/kg
Vanadium	36 µg/L	NL	66 mg/kg
Actinium-227	NA	NL	NR
Protactinium-231	NA	NL	NR
Ra-226	NR	NL	1.2 pCi/g
Ra-228[c]	NR	NL	0.3 pCi/g
Th-228	3 pCi/L	NL	0.6 pCi/g
Th-230	5 pCi/L	NL	2.2 pCi/g
Th-232	1 pCi/L	NL	0.5 pCi/g
Total Uranium	17 pCi/L	NL	0.5 pCi/g
U-234	4 pCi/L	NL	NA
U-235	NR	NL	NR
U-238	5 pCi/L	NL	0.5 pCi/g

[a] Source: Based on the analytical results from the upstream (background) location, (C002) for the soil COC analytes as listed in the North St. Louis County Feasibility Study (USACE, 2003a)

[b] Source: WQC Missouri Water Quality Criteria Water Quality Standards, 10 CSR 20-7.031 Table A, Designated Uses I, II and V.

[c] Only analyzed for when Ra-226 concentration exceeds 3 pCi/L.

NR Not reported. No detected samples for that analyte.

MSR More sample data are required to determine the background concentration for this analyte.

NA Analytes not analyzed.

NL No limit for given constituent.

2.2.4 Evaluation Criteria for Ground-Water Data

At the North St. Louis County Sites (SLAPS, HISS, VPs), the only protected hydrostratigraphic zone is the deep HZ-E unit. The Evaluation Criteria for assessing ground-water data collected at the North St. Louis County sites (SLAPS, HISS, VPs) during this EMIFY05 were derived from the soil contaminants of concern (COCs) identified in the North St. Louis County Feasibility Study. The 95% upper tolerance limit (UTL) value was used as the ground-water background concentration for each COC for the deep units monitored (HZ-C and HZ-E). The methodology for this determination is detailed in Appendix D of the *Annual Environmental Monitoring Data and Analysis Report for CY02* (EMDAR, CY02). The criteria for ground-water sampling will be revised when the ROD is issued and approved for the North St. Louis County sites (SLAPS, HISS, VPs).

For the shallow ground water at the North St. Louis County sites (SLAPS, HISS, VPs), the Water Quality Standards (i.e., 10 CSR 20-7.031 Table A) are used as a guide and not as a limit for action. The standards are used for discussion and comparison purposes only. For some analytes such as molybdenum, vanadium, actinium, protactinium, radium, thorium and uranium, no limit is provided in the referenced Water Quality Standards. For these analytes, where no limit is provided, the background concentration will be used for comparison purposes.

The evaluation criteria for assessing ground-water sampling data at SLDS are determined by investigative limits (ILs) as identified in the *St. Louis Downtown Site, Record of Decision* (USACE, 1998a). Evaluation criteria for ground-water data at FUSRAP-SLS are provided in Table 2-7 and will be used as evaluation criteria for comparison and discussion purposes in the annual EMDAR for CY04.

Table 2-7. Evaluation Criteria for Ground Water

Chemical[a] Inorganics (µg/L)	Background Concentration[b]	Water Quality Criteria[c]	Investigative Limits (ILs)[d]
Antimony	4	6	–
Arsenic	180	50	50
Barium	1,400	2,000	–
Cadmium	2	5	5
Chromium	13	100	–
Molybdenum	68	NL	–
Nickel	18	100	–
Selenium	2	50	–
Thallium	7	2	–
Vanadium	18	NL	–
Radionuclides (pCi/L)			
Actinium-227	NR	NL	–
Protactinium-231	NR	NL	–
Radium-226	4	NL	5[e]
Radium-228	NR	NL	–
Thorium-228	2	NL	–
Thorium-230	4	NL	–
Thorium-232	2	NL	–
Total Uranium	7	NL	14 (20 µg/L)
Uranium-234	4	NL	–
Uranium-235	NR	NL	–
Uranium-238	3	NL	–

[a] Based on soil COC analytes as listed in FS for North St. Louis County (USACE, 2003a) ground water and on the ground-water COC analytes as listed in the SLDS ROD (USACE, 1998a)

[b] Source: Appendix D Annual EMDAR CY02 (USACE, 2002a). For shallow ground water at the North St. Louis County (HISS, SLAPS and VPs) Sites, the deep background values will only be used when no Water Quality Criteria are available.

[c] Source: Water Quality Criteria , 10 *CSR* 20-7.031 Table A Designated Use VII. These values are used as a guide for discussion and comparison purposes only.

[d] Source: SLDS ROD (USACE, 1998a)

[e] Combined MCL for Ra-226 / Ra-228

– Not Applicable

NL - No limit given, background concentration was used

NR - Not reported – no detected samples for that analyte

3.0 ENVIRONMENTAL MONITORING ACTIVITIES FOR FY05

This section describes the periodic sampling and analysis selected for FY05 to achieve the objectives of the EMP. These EMIFY05 activities will be implemented in conjunction with the program objectives defined in the EMG and program protocols described in the SAG. This section of the EMIFY summarizes the sampling locations, frequencies, and analytes of concern. Details of the specific sampling and analytical protocols necessary for field implementation are provided in the SAG. Characterization efforts, monitoring to support treatability studies, and remedial action confirmation sampling are considered non-periodic monitoring activities outside of the scope of the EMIFY and are implemented through issuance of work descriptions (WDs) or other implementation plans.

3.1 AIR MONITORING AND DIRECT GAMMA RADIATION MONITORING

3.1.1 Rationales and Objectives for Air and Direct Gamma Radiation Monitoring

Objectives for air and direct gamma radiation monitoring are identified to:

- provide surveillance of public exposure routes through sampling and analysis;
- verify compliance with regulations;
- provide indication and methods to quantify release of radioactive materials from the site; and,
- characterize trends in environmental radiation measurements, especially as they are affected by site remedial actions.

Measurement objectives to meet regulatory requirements are identified to:

- calculate the total effective dose equivalent to the hypothetical maximally exposed members of the public from all complete and applicable pathways;
- calculate the effective dose equivalent from airborne particulate emissions exclusive of radon to the hypothetical maximally exposed members of the public;
- determine radon concentrations at the fence line and/or at locations in the vicinity of excavation areas and areas accessible to members of the public;
- determine the direct external gamma exposure in areas accessible to members of the public at the site fence line and/or at locations in the vicinity of excavation areas, and at areas accessible to members of the public;
- determine the concentration of air particulate radionuclides at the fenceline and/or in the vicinity of excavation areas and areas accessible to members of the public; and,
- determine background values for the parameters of concern at off-site locations.

Thermoluminescent dosimeters (TLDs), radon alpha tract detectors (ATDs), and particulate air filters will be used in various combinations at the SLS to monitor gamma exposure levels, radon, and airborne particulate radionuclide emissions (exclusive of radon). Data from these

measurements will be reduced, evaluated, and in some cases converted into effective dose equivalent. Reports to the EPA will be made to meet regulatory requirements.

3.1.2 Sample Locations

Locations for TLD, radon ATDs, and particulate air samples are shown for the HISS, SLAPS and SLDS in Figures 3-1, 3-2 and 3-3. Figure 3-4 provides the location of the North St. Louis County sites (SLAPS, HISS, VPs) air background gamma radiation, radon alpha track, and particulate air sampling station. See Table 3-1 for type, frequency, and location of air particulate, radon, and gamma radiation monitoring. The North St. Louis County sites (SLAPS, HISS, VPs) background sampling results are assumed to be representative for the entire St. Louis metropolitan area.

External Gamma Monitoring (TLD)

TLDs will be used to measure direct gamma exposure from background and residual radioactivity at the SLS. The TLDs will be located at site perimeters (property fence lines) and/or at locations in the vicinity of excavation areas and areas accessible to members of the public, and at an off-site location assumed to be representative of background exposure levels. QC TLDs will include shipment blanks (to evaluate the exposure received in transit) and duplicate TLDs to evaluate measurement (field) precision.

TLD locations at the SLAPS and the HISS will be relatively evenly spaced around the site perimeter. There are no residences adjacent to the SLAPS, and therefore, the fence-line monitoring locations are assumed to be very conservative for estimating exposure to members of the public. At the HISS, there are two industries on the contiguous properties, Futura Coatings and Stone Container Corporation. TLDs will be located at fence locations that are assumed to be closest to each of the private industries.

TLD locations at the SLDS will be in the vicinity of excavation areas and/or representative of areas accessible to the public (including Mallinckrodt employees, who are not occupationally monitored for radiation exposure). Placement of TLDs in areas immediately surrounding Plant Number. 5 will be avoided.

A background monitoring location will be selected for the measuring of background exposure rate. The background TLD monitoring station is currently located at the USACE Service Base on Arsenal Street (see Figure 3-4).

Radon Monitoring

Radon ATDs will be used to measure alpha particle emissions from radon (primarily radon-222) and its associated decay products. The radon emissions are expected to increase during remedial actions such as excavation of soil. ATD results are reported as radon air concentrations in pCi/L and are then converted to dose equivalent. Radon ATDs will generally be co-located with the TLDs.

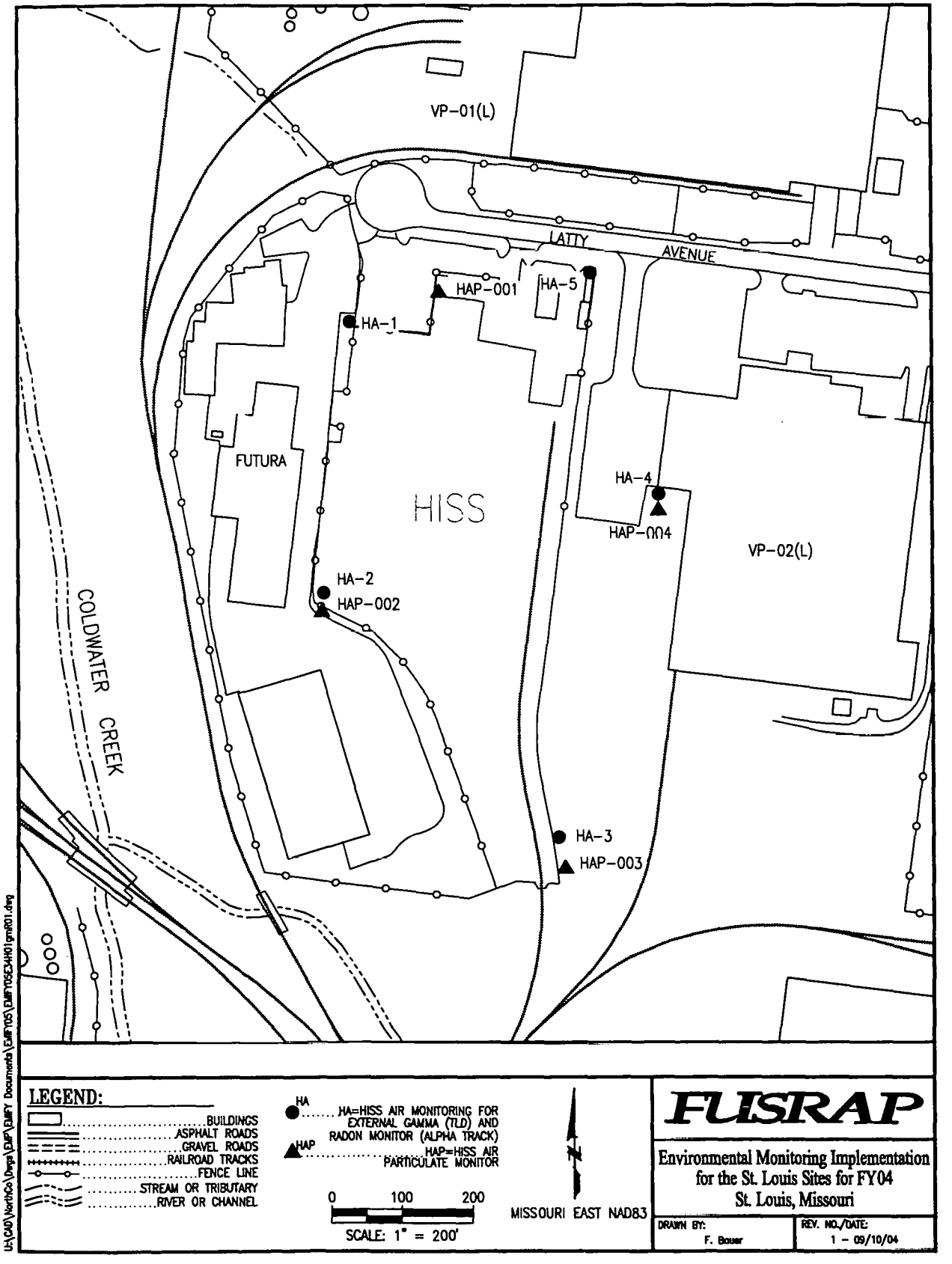

Figure 3-1. Gamma Radiation, Radon-222, and Particulate Air Monitoring Stations at the HISS for FY05

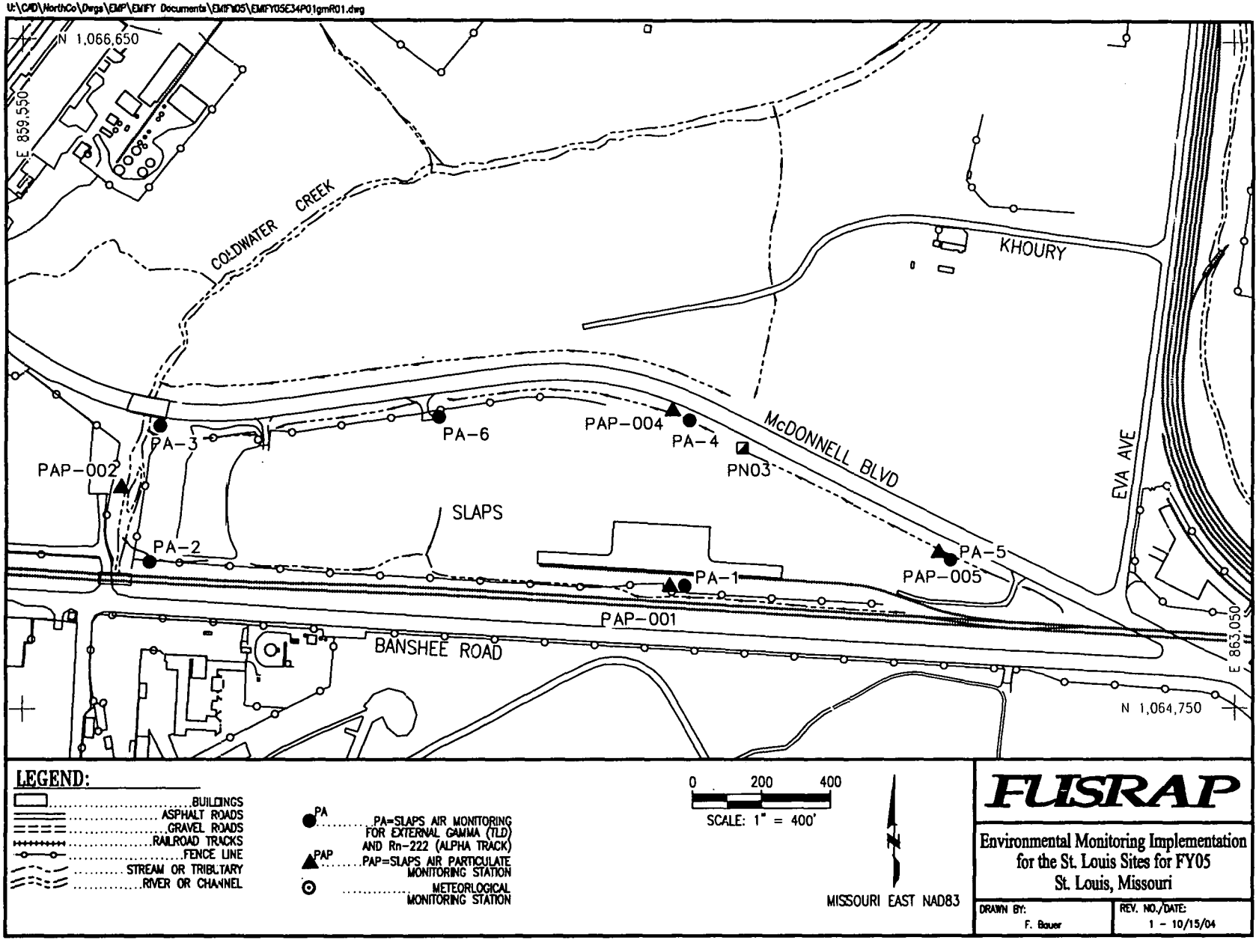

Figure 3-2. Gamma Radiation, Radon-222, and Particulate Air Monitoring Stations at the SLAPS for FY05

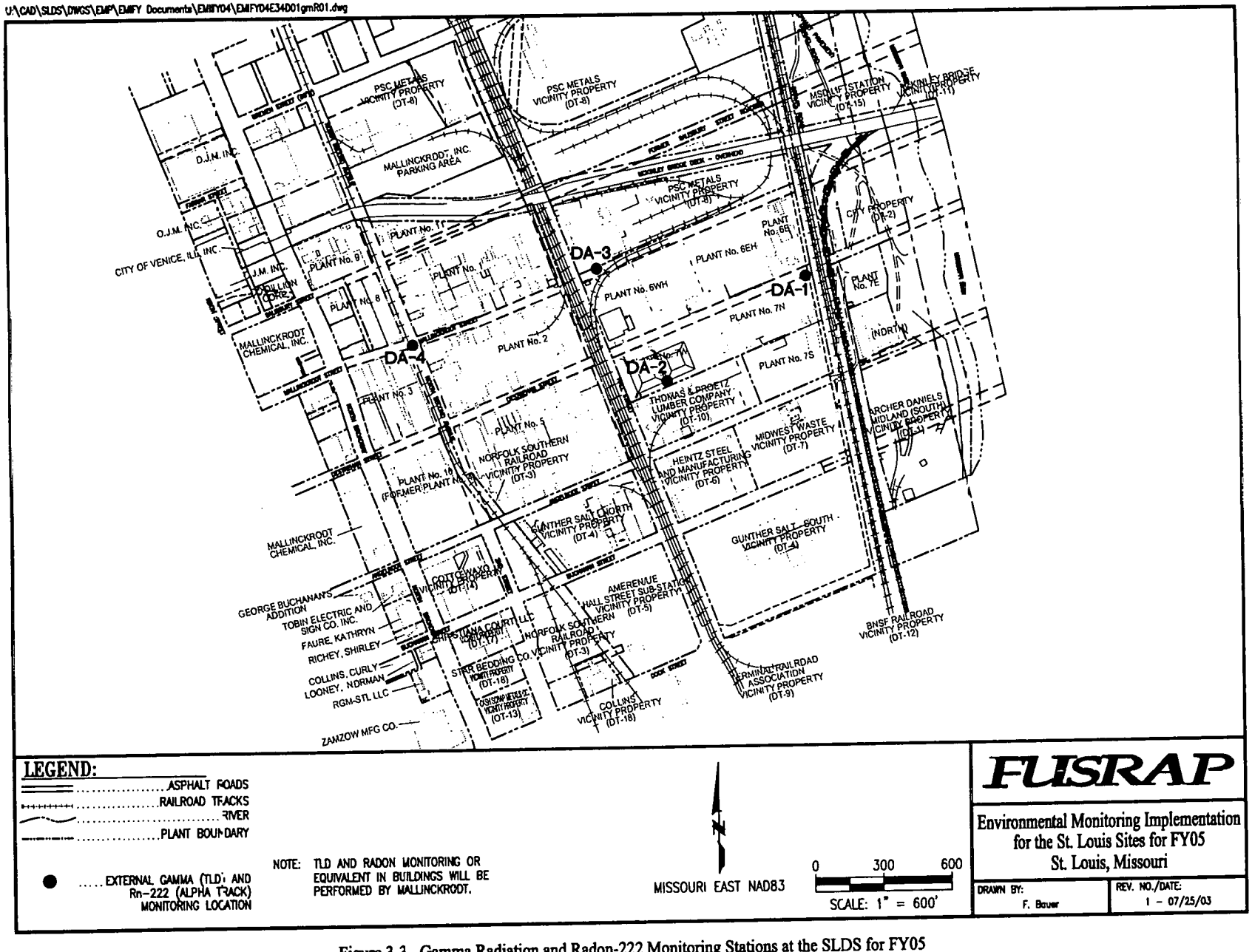

Figure 3-3. Gamma Radiation and Radon-222 Monitoring Stations at the SLDS for FY05

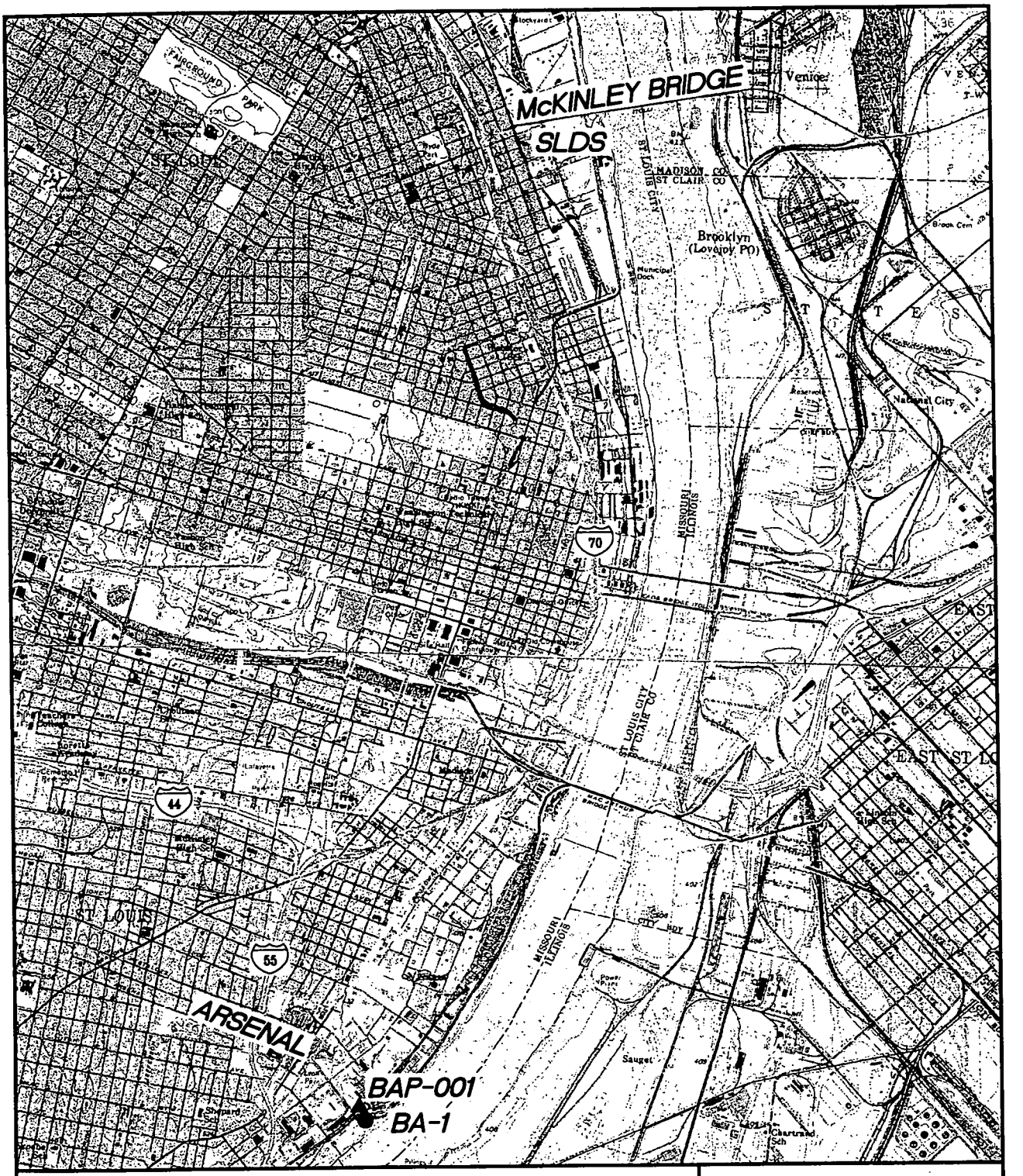

Figure 3-4. Location of the Background Monitoring Stations

Table 3-1. Air Particulate, Radon, and Gamma Radiation Monitoring

Site	Number of Monitoring Locations	Media/Sample Type	Frequency	Parameters	Driver/Purpose[a]
HISS	5	TLD	Quarterly	External gamma radiation	EMP – public exposure
	5	Alpha track	Semiannually	Rn-222 and progeny	EMP – public exposure
	4	Filter	Weekly and operation-specific	Particulate radionuclides	EMP – NESHAPs/public exposure
SLAPS	6	TLD	Quarterly	External gamma radiation	EMP – public exposure
	6	Alpha track	Semiannually	Rn-222 and progeny	EMP – public exposure
	4	Filter	Weekly and operation-specific	Particulate radionuclides	EMP – NESHAPs/public exposure
SLDS	4	TLD	Quarterly	External gamma radiation	EMP – public exposure
	4	Alpha track	Semiannually	Rn-222 and progeny	EMP – public exposure
	[b]	Filter	During active excavations	Particulate radionuclides	EMP – NESHAPs/public exposure
Background	1	TLD	Quarterly	External gamma radiation	EMP – public exposure
	1	Alpha Track	Semiannually	Rn-222 and progeny	EMP – public exposure
	1	Filter	Weekly	Particulate radionuclides	EMP – NESHAPs/public exposure

[a] Public exposure monitoring requirements: 40 CFR 61 Subpart I; 10 CFR 20.1301; 40 CFR 192.32. Fence-line (or other appropriate monitoring location) levels and/or concentrations are used to calculate total effective dose equivalent to the hypothetical maximally exposed critical receptor from the site.

[b] The environmental remediation contractor conducts particulate air sampling at appropriate locations around active excavations. This data is used for NESHAP and public exposure evaluations.

The proposed radon monitoring locations will be identical to those described for external gamma radiation monitoring. Locations were chosen with consideration given to predominant wind direction and sources of contamination. Southerly winds predominate from May through November, and northwesterly winds predominate from December through April. The outside locations were selected on northern and southeastern points of the property fence line to monitor airborne emissions at points likely to be highest at the fence line and/or in the vicinity of excavations and accessible to members of the public. The background location is currently located with the background TLD at the USACE Service Base on Arsenal Street (see Figure 3-4).

Particulate Air Samplers

Particulate air samplers will be located at site perimeter locations in predominant wind directions and/or in areas accessible to members of the public. Additional air samplers may be placed between the airborne source and areas accessible to members of the public during work activities that are disturbing the soils and have a potential to generate airborne particulates. The locations of these air samples will be downwind of the work activities. Airborne particulate radionuclide samples will be collected and subsequently analyzed for relevant radionuclides and/or gross alpha and gross beta activity.

As stated in the previous section, southerly winds predominate from May through November, and northwesterly winds predominate from December through April. Particulate air monitoring locations were, therefore, selected on northern and southeastern points of the property line to monitor airborne emissions at points likely to be highest at the fence line. The particulate air monitoring stations are expected to be affected mainly during periods of remediation when there is the greatest potential for generation of airborne particulate radionuclide emissions. Additional particulate air samplers may be placed around the perimeters of the work zone during remedial activities. The background air particulate station is currently co-located with the background TLD and ATD stations at the USACE Service Base on Arsenal Street (see Figure 3-4).

3.1.3 Sample Frequency

Monitors will be left in place to continuously monitor the sample locations. TLDs will be replaced and analyzed every quarter. Radon ATDs will be replaced and analyzed every six months. Particulate air samplers will operate continuously, with samples usually being collected at least weekly but possibly more frequently because of operational considerations such as dust loading on the filters, which can reduce the sample flow. Particular air samplers at SLDS will operate continuously during excavation. The number of samples/measurements and the frequency are illustrated in Table 3-1.

3.1.4 Field and Laboratory Analyses

The selection of the various parameters to monitor and samples to collect were based on the regulatory requirements with consideration of the radionuclides and their concentrations at each of the SLS. The following sections summarize the rationales for analytes and the analysis methods.

Rationale for Analytes

The radionuclides found at the SLS are mainly uranium-series nuclides. Each site has radionuclides in the uranium series that may be predominant (such as radium-226, uranium-238, or thorium-230); thus, each radionuclide must be assessed separately. Therefore, previous soil sampling results from each site have been used to determine source concentration ratios of the individual radionuclides to use in evaluating gross alpha and gross beta sampling results.

HISS

The HISS contains the most homogenous radionuclide distribution of the three sites. The excavation piles formerly associated with the HISS (i.e., Main Storage Pile, Supplemental Pile, Spoils Piles, and East Piles) have been removed and transported to a licensed disposal facility in accordance with the HISS EE/CA and Action Memorandum (USACE, 1998b). Thorium-230 (Th-230) was present at significantly higher concentrations than the other uranium series radionuclides at the HISS. Other uranium-series radionuclides (U-238, U-234, and Ra-226) were also elevated, although not as significantly as Th-230. The actinium-series long-lived nuclides (U-235, Pa-231, and Ac-227) were also elevated in the HISS piles, with the U-235 daughters showing higher concentrations than the U-235. Thorium-series nuclides (Th-232 and Ra-228) in the piles were, however, observed to be at the United States average background levels for soil. Although the excavation piles have been removed from the site, it is assumed that the soil below the piles contains radionuclides with the same relative radionuclide concentrations as the piles. The relative concentrations of the various radionuclides can be found in Table 2-1 of the EE/CA for the HISS (USACE, 1998b).

SLAPS

The SLAPS is known to contain elevated areas of radioactive contamination resulting from the burial of various uranium by-products over the history of the site. Radionuclides from all three natural decay series could be present in elevated concentrations. The relative concentrations of individual radionuclides can be found in Table C-2 of the *St. Louis Airport Site (SLAPS) Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS), St. Louis, Missouri* (USACE, 1999b).

SLDS

The SLDS areas are also variable with regard to the predominant radionuclide, with some areas showing higher concentrations of U-238, Th-230, and Ra-226. The relative concentration levels for individual radionuclides can be found in the *Feasibility Study for the St. Louis Downtown Site, St. Louis, Missouri* (USACE, 1998c).

Analysis Methods

Details regarding the analytical testing methods to be used for analysis of TLDs, radon ATDs, and particulate radionuclide air samples are presented in the SAG for the SLS. Analysis of the various media will be accomplished through purchase orders with qualified laboratories or

through analysis at the HISS laboratory using a USACE Center of Expertise validated Laboratory QA Plan and standard operating and analysis procedures.

A summary of the type of radiological samples, analysis methods, and target detection levels for the proposed radiological sampling in FY05 is provided in Table 3-2. Justification for the detection levels is based in part on the capabilities of the instrumentation and in part on meeting a fraction of the desired regulatory standard. All detection levels are assumed to meet the definition for minimum detectable activity at the 95% confidence level with appropriate conversion factors, factors for efficiency, chemical yield, and volumes to convert the measurement to the desired units.

Table 3-2. Summary of Laboratory Analysis Methods and Target Detection Levels

Detector/Sample Medium	Analytes Measured	Analysis Method	Target Detection Levels
Thermoluminescent Dosimeter	Direct external gamma exposure from residual contamination and background	Processed by a qualified vendor	0.1 mrem/3 months
Alpha Track	Airborne Rn-222 and alpha emitting progeny that originate from Ra-226	40 CFR 61, Appendix B, Method 114, Method A-7, Rn-222 alpha track detectors	0.2 pCi/L
Particulate Air Filter	Airborne particulate radionuclides: gross alpha and gross beta	40 CFR 61 Appendix B, Method 114, Method A-4, Direct Alpha Counting and Method B-4 Gross Beta Counting	3.4E-15 µCi/mL 2.2E-12 µCi/mL

The TLD target detection level of 0.1 millirem (mrem)/3 months is approximately 0.3 percent of the annual background dose equivalent rate from external exposure and well below the regulatory limit for members of the public of 100 mrem/yr. Even when the 100 mrem/yr limit is reduced by a factor of two to account for exposure from pathways other than direct gamma exposure, the detection level is still a factor of 500 lower than the limit.

The alpha track target detection level of 0.2 pCi/L is the level achievable at the laboratory. This level is below the 0.5 pCi/L standard contained in 40 CFR 192 Subpart A for locations outside a disposal site and the 10 CFR 20 limit of 0.3 pCi/L based on a 30-percent equilibrium between radon and its progeny.

The detection level concentrations for uranium and thorium isotopes in particulate air sampling are based on three analytical methods found in 40 CFR 61, Appendix B, Method 114. Since radionuclide-specific concentrations have already been established, Method A-4, direct alpha counting (gross alpha determination) and Method B-4, direct beta counting (gross beta determination) will be used to routinely evaluate activity levels of samples. This method will determine alpha activity of the sample without extraction and separation of isotopes. Detection levels of 3.4E-15 microcuries per milliliter (μCi/ml) as stated in 40 CFR 61 Appendix B, Method 114 and Method A-4, and the detection level of 2.2E-12 μCi/ml as stated in Method B-4, will provide adequate minimum detection levels for dose assessment estimates. Method G-1, high-

resolution gamma spectroscopy, will be used as needed to evaluate samples on a case-by-case basis.

3.1.5 Field QC Samples

Two types of QC samples will be collected or used during environmental air monitoring and direct gamma radiation monitoring. The QC samples include duplicates and trip blanks.

QC Duplicates

Duplicate samples or measurements will be collected using the same protocol and procedures used for obtaining the initial samples and measurements. Duplicate sample/measurements are used to evaluate the field precision of the sampling and measurement process. Duplicate analysis of the same measurement device may be performed at the laboratory to evaluate the reproducibility of the counting technique.

At least one duplicate TLD will be designated at each site for QC purposes. Duplicate TLDs will be installed, collected, and analyzed at the same time as the sample TLD at that location.

At least one duplicate radon ATD will be designated at each site for QC purposes. Duplicate ATDs will be placed, collected, and analyzed at the same time as the sample at the location.

Trip Blanks

TLD trip blanks will be used to evaluate the integrated dose to the dosimeter when the dosimeters are not in the monitoring locations. These trip blanks will measure the dose while the dosimeters are in storage and in transit to the processing laboratory.

3.1.6 Equipment and Sampling Methods

3.1.6.1 Equipment

The following sections describe the types of detectors that will be used to quantify radioactive emissions from the SLS. The types of detectors include external gamma radiation, radon alpha track detection and airborne particulate samplers.

External Gamma Radiation

External gamma exposure rates are measured using environmental TLDs (aluminum oxide) housed in the polyvinyl chloride (PVC) holders/shelters positioned at the site perimeter locations and/or in the vicinity of excavations and areas accessible to members of the public. Each TLD measures a cumulative dose over the period of exposure and is expressed in mrem/quarter. The measurements must be corrected for shelter absorption, background, and time of exposure to normalize the measurement to exactly one quarter of exposure.

When exposed to gamma radiation, the TLD stores a portion of the energy. When the TLD is heated, the stored energy is emitted as light that can be amplified, measured, and used to

calculate dose equivalent. The TLD shelters are located approximately three feet above the ground surface at all monitoring locations.

Radon Alpha Track Detection

Radon (Rn-222) gas concentrations are measured using ATDs that are designed to record alpha emissions within the sensitive element of the detector. These detectors contain film that, when exposed to alpha particles from the radioactive decay of radon, create submicron damage tracks on the film. After exposure, the detectors are returned to the manufacturer for processing. The film is placed in a caustic etching solution that amplifies the damage tracks, which are counted using a microscope or automated counting system. The number of tracks per unit area is correlated to the radon concentration in air. ATDs can be purchased from various EPA-approved manufacturers. The ATDs will be co-located with the TLDs at each site.

Airborne Particulate Samplers

Airborne particulate samplers provide a means to collect particulate radionuclides from the ambient air. Low-volume air pumps, with typical flow rates of 30 to 50 liters per minute draw ambient air through a 0.45-micron particulate filter. The filter will have a high efficiency for removal of submicron particles. The air pumps are equipped with calibrated measurement devices (i.e., rotometers) to monitor air flow rates. Air flow rates can also be measured externally with portable rotometers. Average flow rates are calculated using before/after sample loading data. At the end of the sample period, the filters are removed from the housing and sent to a laboratory for analyses.

Siting of the particulate monitoring stations is done carefully so that appropriate measurements of particulate concentrations in an area are collected. As discussed in Section 3.1, the stationary air monitoring locations are selected based on the predominant wind directions during the summer and winter months. During remedial activities, additional particulate monitoring may be required at appropriate locations around the remedial activity and must be evaluated on a task-by-task basis.

3.1.6.2 Sampling Methods

The following section describes the field sampling for direct gamma radiation and air monitoring at the three SLS. It is not intended to replace the detailed guidance contained in project instruction guides. The chain-of-custody protocols, sample labeling, identification and shipment procedures, and field logbooks/documentation described in the SAG for the SLS are applicable to each of the following procedures.

External Gamma Monitoring

TLDs will be placed in each ambient-air monitoring station at the beginning of each monitoring period. These TLDs will be replaced and analyzed after three months. The location, date of installation, and date of removal for each detector will be logged. A control/background TLD will accompany the exposed dosimeter during shipment to detect any exposure incurred by the dosimeter during shipment.

Radon Alpha Track Detection

Unexposed, preassembled detectors packaged in sealed foil are available from various manufacturers and will remain sealed until they are placed in the detector housings. At the time of deployment, the location, date, and type of detector will be recorded. The new, unexposed detector will be placed in the detector housing with the air inlet holes unobstructed. At the end of the 6-month exposure period, a self-adhering circular seal (available from the manufacturer) will be placed on the exposed detector, covering the air inlet holes. The seals are used to prevent further exposure of the detector to radon or thoron during transport to the laboratory. The date of removal will be logged. The exposed detectors will then be packaged in zip-lock-type bags and sent to the laboratory.

Air Particulate Monitoring

Data collection will consist of logging the sample location, date, and time that the sample collection is started and the initial flow rate of the air pump. At the end of the sampling period, the date and time that the sample collection is ended and final flow rate of the air pump will be logged. If the initial air flow rate is different than the final flow rate, the average of the two values will be used to determine the total flow volume over the sampling period. Calibrated rotometers will be used to establish initial and final flow rates. Rotometers will be calibrated annually.

As the filter is removed from the filter housing, care will be taken not to disturb the collected particulate. The filter will be placed in a suitable container such that sample integrity is not lost during transport to the laboratory.

The length of time between filter change-out can vary depending on the activities at the site. For example, if no remedial activities are being conducted, it is recommended that filter change-out occur after a 2-week sampling period. However, during remedial activities, more dust could be generated, requiring more frequent filter change-out.

3.1.6.3 Field QC Sampling Procedures

Duplicate samples will be collected in association with the TLD and ATD measurements. Duplicates will be collected using the same equipment and sampling methods as defined in Section 3.1.6.2.

3.1.6.4 Field Decontamination

The sampling techniques described above are one time use/dedicated sampling media. Based on this information, field decontamination is not required for the measurement and samples obtained for direct radiation exposure. In addition, field decontamination is not required for air (radon and air particulate) monitoring equipment.

3.2 STORM-WATER AND EXCAVATION-WATER DISCHARGE SAMPLING

Storm-water and excavation-water sampling is considered a principal component of the EMIFY at the SLAPS and the SLDS. It is known that response actions at both sites could result in

discharges that are covered under separate discharge requirements. Monitoring will be conducted to meet ARAR permit equivalent or permit conditions at each respective site. Parameters for each of the SLS can be found in Table 3-3 along with sampling locations, and sampling frequencies.

The purpose of storm-water and excavation-water discharge sampling at the SLS is to meet:

- MSD discharge permit (2/11/04) for the HISS on-site laboratory;
- MDNR – NPDES ARARs document dated October 2, 1998, for the SLAPS;
- MSD discharge for the SLAPS excavation water authorization letter dated July 23, 2001 (MSD, 2001a); and
- MSD discharge authorization letter dated October 30, 1998 and modified in letter dated July 23, 2001, for the SLDS (MSD, 1998, MSD, 23001b).

Objectives for the SLAPS and the VPs:

The NPDES permit for storm-water discharges from the SLAPS and SLAPS VPs requires that outfalls be sampled in accordance with the NPDES ARARs document (NPDES permit equivalent). The NPDES ARARs document specifies ARAR discharge limits for monitoring purposes at this site. In addition, monitoring to meet MSD discharge requirements is also conducted. The outfall locations and MSD excavation-water discharge point are shown on Figure 3-5.

MSD Permit Renewal for Radiological Laboratory:

The USACE owns the Radiological Laboratory located at 8945 Latty Avenue. The lab operates under a Special Discharge Permit granted by MSD. The MSD special discharge permit requires annual renewal in compliance with discharge regulations (Ordinance 8472, 10177, and 10082). The MSD requires analysis of pH, total solids, total suspended solids, chemical oxygen demand (COD), cadmium, chromium, copper, iron, lead, nickel, zinc, and the volatile organic priority pollutants. Radionuclide analysis includes isotopic radium, thorium, and uranium constituents. The MSD discharge point for waste water from the HISS laboratory is shown on Figure 3-6.

Objectives for the SLDS:

SLDS excavation-water discharge monitoring is conducted in accordance with the MSD authorization letter dated October 30, 1998 and revised in a letter dated July 23, 2001. The excavation water is storm water and ground water that accumulates at the SLDS. Excavation-water discharge results from work-related remedial activities such as dewatering of soil excavations, soil dewatering, and equipment decontamination. The excavation-water discharge location for SLDS is shown on Figure 3-7. The USACE has requested MSD approval for discharge of excavation water to additional locations (up to 6) at the SLDS. MSD approval had not been received at the time of preparation of this document and will be used for discharge as needed when approval is received.

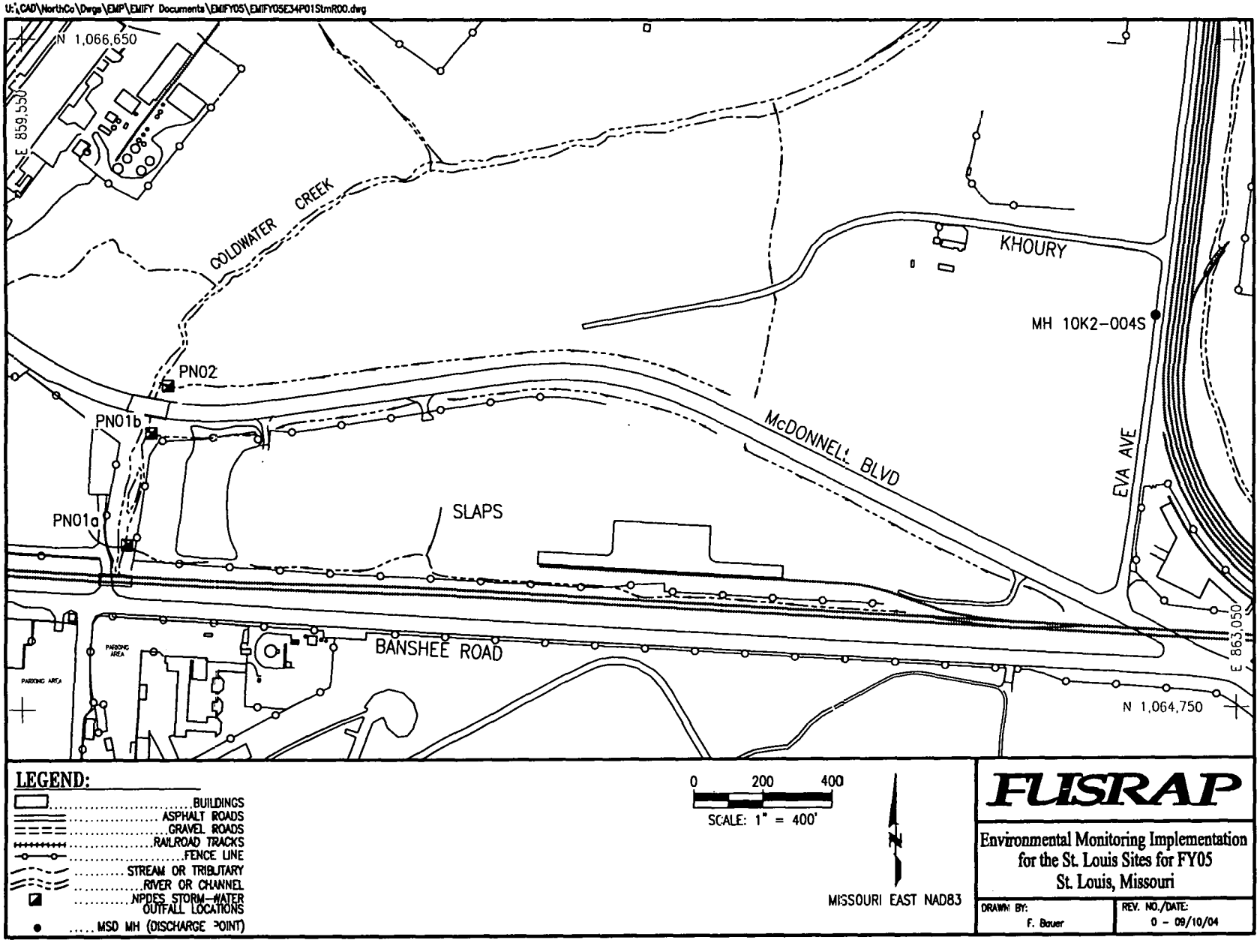

Figure 3-5. Storm-water Outfalls and MSD Excavation-water Discharge Point at the SLAPS

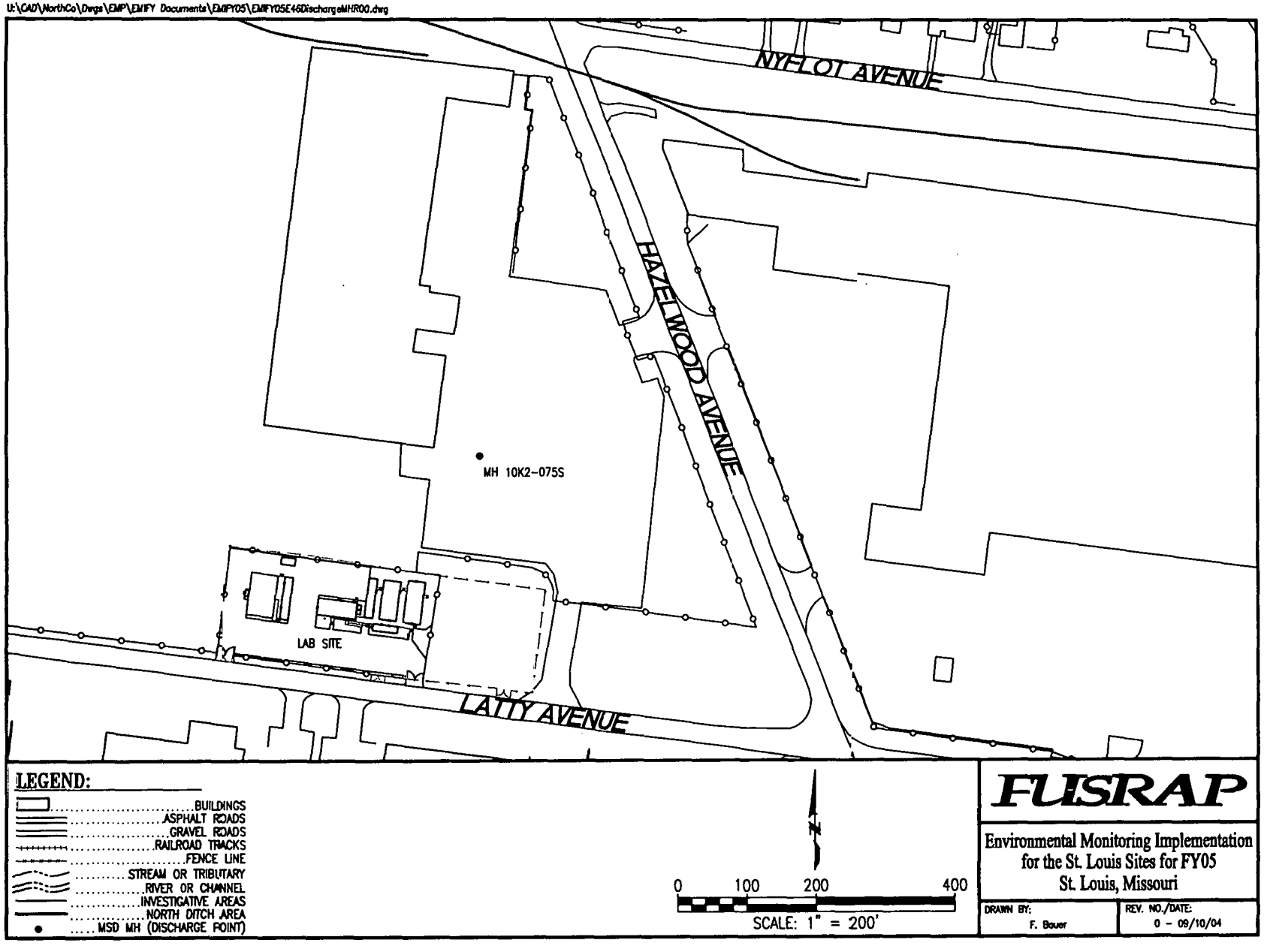

Figure 3-6. MSD Discharge Point for Wastewater from the HISS Laboratory

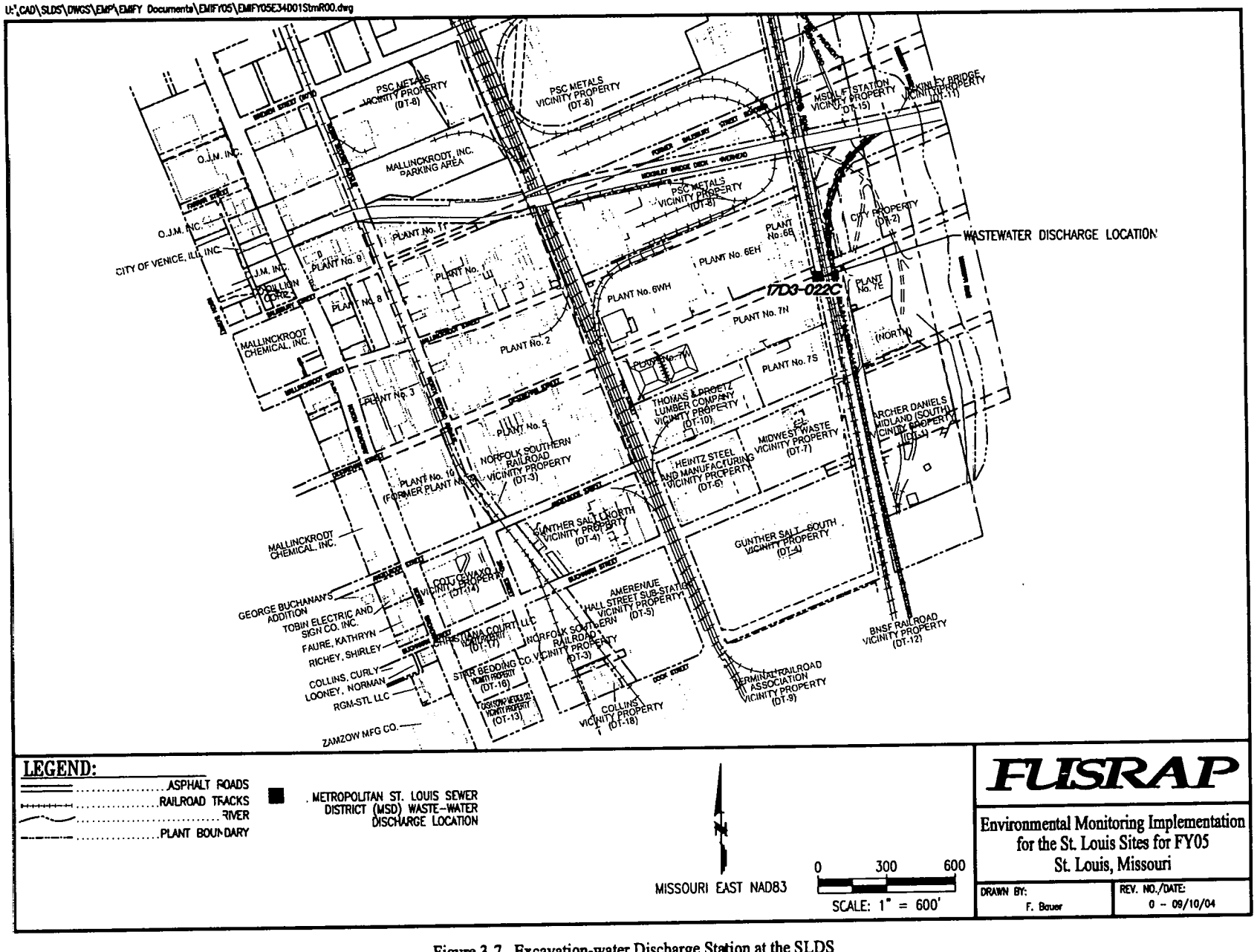

Figure 3-7. Excavation-water Discharge Station at the SLDS

3.3 SEDIMENT AND SURFACE-WATER SAMPLING

Sediment samples will be collected along Coldwater Creek to assess the potential transport of contaminants that may not be detected in their soluble form. The constituents are typically found attached to transportable sediments or dissolved in water and could impact water quality in Coldwater Creek. The sediment sample locations and analyses will coincide with those for the surface-water samples.

Objectives for Coldwater Creek Sampling:

- assess affects of remedial activities along Coldwater Creek;
- assess the potential fate and transport of contaminants for CERCLA reevaluation process;
- compare contaminant concentrations in both their soluble and insoluble forms; and,
- compare sediment and surface-water data to differentiate impacts from upstream sources of each of the sites.

The sediment sample locations, which will all be co-located with the surface-water locations, are shown in Figure 3-8. Sampling frequency, along with sampling parameters and locations, are listed along with surface-water information in Table 3-3. This sampling will be conducted at Coldwater Creek's base flow. Samples will be taken twice over a two to three-day period during the first and third quarters to obtain representative samples of base-flow water conditions for the year.

Table 3-3. Storm-Water, Excavation-Water, Surface-Water and Sediment Monitoring Location, Frequencies, and Parameters

Site	Monitoring Location	Sample ID/ Outfall	Media/Sample Type	Frequency[a]	Parameters[b,c]	Driver / Purpose	Status	Comments
SLAPS	#001	PN01 a and b[1]	Storm water/ grab	Monthly – List 1	List 1	NPDES	Active	ARAR document letter from MDNR to USACE dated 10/02/98.
	#002	PN02	Storm water/ grab	Annual – List 1	List 1	NPDES	Bermed excavation	As per MDNR letter from Mathew Sikes addressed to Sharon Cotner dated 2/19/02, sampling at outfall 002 has been reduced to once per year.
	#003	PN03	Storm water/ grab	NA	List 1	NPDES	Inactive	As per MDNR letter from Mathew Sikes addressed to Sharon Cotner dated 2/19/02, sampling at outfall 003 has been discontinued.
	MSD Sewer	On-Site Sewer	Storm water/grab	Per Batch	Various[d]	MSD	Active	Sampling is batch-dependent and, therefore, conducted on a non-routine basis. MSD Discharge Letter to USACE dated 7/23/01 from MSD to Shaw Group.
Radiological Laboratory	MSD Sewer	On-Site Sewer	Wastewater /grab	Per Batch	Various[e]	MSD	Active	Per annual permit, samples are collected and analyzed
CWC	Location 1	CWC002	Surface water – sediment	Semiannually – List 2	List 2	EMP	Active	
	Location 2	CWC003	Surface water – sediment	Semiannually – List 2	List 2	EMP	Active	
	Location 3	CWC004	Surface water – sediment	Semiannually – List 2	List 2	EMP	Active	
	Location 4	CWC005	Surface water – sediment	Semiannually – List 2	List 2	EMP	Active	
	Location 5	CWC006	Surface water – sediment	Semiannually – List 2	List 2	EMP	Active	
	Location 6	CWC007	Surface water – sediment	Semiannually – List 2	List 2	EMP	Active	
SLDS	MSD Sewer	MSD Inlet 17D3-022C[2]	Runoff/ground water excavation water or treated ground water	Per Batch	Various[f]	MSD	Active	Sampling is batch-dependent and, therefore, conducted on a non-routine basis. MSD discharge authorization letter dated 10/30/98 from MSD to IT Corporation; revised 07/23/01.

*Parameters are referenced from the Quality Assurance Project Plan for the SLS. See Below

[1] As per January 2004, Sample locations PN01a and PN01b are considered a single discharge point for Outfall #001.

[2] The number of discharge locations may increase to seven; however, at the time of preparation of this document, the USACE has not received approval for the additional locations.

Table continued on next page

Table 3-3. Storm-Water, Excavation-Water, Surface-Water and Sediment Monitoring Location, Frequencies, and Parameters (Cont.)

[a] **Definition of Frequency Lists**

List 1 includes all parameters once per month, and total uranium, total radium, total thorium, gross alpha, gross beta, protactinium 231, actinium 227 – per runoff event and radon – twice per year.

List 2 includes COCs – semi-annual.

[b] Subject to modifications when a final ROD is issued and approved for the St. Louis North St. Louis County sites (SLAPS, HISS, VPs).

[c] **Definition of Parameter Lists**

List 1 includes flow (mgd), oil and grease (mg/L), total petroleum hydrocarbons (mg/L), chemical oxygen demand (mg/L), settleable solids (mL/L/hr), arsenic (total recoverable) (µg/L), cadmium (total recoverable) (µg/L), chromium (total recoverable) (µg/L), copper (total recoverable) (µg/L), lead (total recoverable) (µg/L), gross alpha (pCi/L), gross beta (pCi/L), polychlorinated biphenyls (µg/L), radium (total) (pCi/L and µg/L), thorium (total) (pCi/L and µg/L), uranium (total) (pCi/L and µg/L), protactinium-231 (pCi/L), actinium-227 (pCi/L), radon (pCi/L), pH.
List 2 includes radiochemical parameters, metals, field parameters.

Definitions for Parameters

Radiochemical parameters include gross alpha, gross beta, uranium-234, uranium-235, uranium-238, thorium-228, thorium-230, thorium-232, radium-226, radium-228.
Metals include antimony, arsenic, barium, cadmium, chromium, molybdenum, nickel, selenium, thallium, vanadium.
Field parameters include temperature, ph, conductivity, and oxidation reduction potential (for sediment only) and dissolved oxygen (for water only).

[d] Per the July 23, 2001 MSD letter, effluent must meet the following standards: MSD Ordinance 8472; the Nuclear Regulatory Commission in 10 *CFR* 20; and Missouri Department of Health 19 CSR 20-10

[e] Per the annual permit, analysis required includes pH, total solids, total suspended solids, chemical oxygen demand (COD), cadmium, chromium, copper, iron, lead, nickel, zinc, and the volatile organic priority pollutants. Radionuclides include, isotopic radium, thorium, and uranium.

[f] Per the October 30, 1998 and July 23, 2001 MSD letters, effluent must be tested for pH, suspended solids, COC and total metal parameters having numeric limits in Ordinance 8472 Article V, Section 2B. Also identified are VOCs by excavation water method 624; SVOCs by Method 625; PCBs by Method 608; gross alpha radioactivity; gross beta radioactivity; U-235; U-238; RA-226; RA-223 and Th-230 and Th-232.

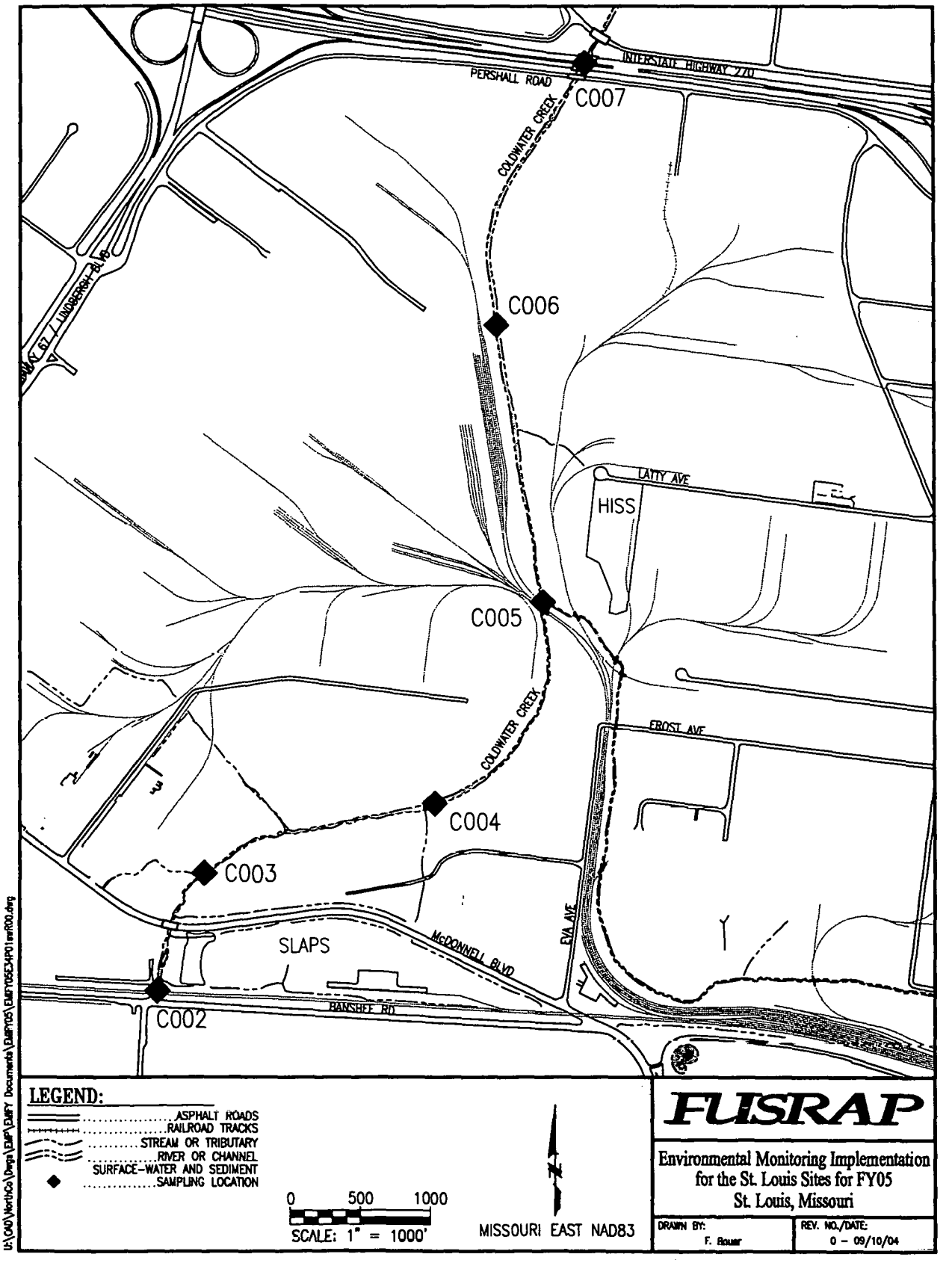

Figure 3-8. Surface-water and Sediment Sampling Locations at Coldwater Creek

3.4 GROUND WATER

3.4.1 Objectives for Ground-Water Sampling

Ground-water monitoring at the three subject SLS will be completed to meet various federal and state requirements.

The purposes of the ground-water monitoring effort at the SLS are to:

- identify potential impacts to ground-water quality resulting from remedial action;
- ensure compliance with ARARs;
- obtain requisite data for CERCLA remedial performance evaluations; and,
- determine and monitor background water quality at each of the sites.

The primary objectives and a summary of the hydrogeology of each site are briefly discussed below. A detailed description of the geology and hydrogeology of each site can be found in prior environmental documents and the EMG (USACE, 1999a).

The objectives for SLDS include the following:

- evaluate ground-water contaminant occurrence and migration within the lower hydrostratigraphic unit (HU-B), with emphasis on the uppermost HU-B surface beneath the SLDS and its downgradient perimeter;
- meet the commitments made in the ROD;
- assess background conditions and ground-water quality in several known contamination source areas that will undergo remediation;
- evaluate potential affects on ground-water quality resulting from remedial action;
- provide data necessary for the CERCLA evaluation process; and,
- monitor the pieziometric levels relative to that of the Mississippi River.

Ground water at the SLDS is found within three (3) HUs: the upper soil unit, referred to as HU-A; the lower soil unit, referred to as either the Mississippi River Alluvial Aquifer or HU-B; and the limestone bedrock, referred to as the HU-C (see Figure 3-9) (USACE, 1998a). HU-A is not an aquifer and is not a potential source of drinking water because it has insufficient yield, poor natural water quality, and susceptibility to surface-water contaminants of its industrial setting (USACE, 1998a). The use of HU-B for a drinking-water resource is highly unlikely for several reasons: the industrial setting of the SLDS, the site's proximity to both the Mississippi River and the city's drinking water supply, and the poor natural water quality of HU-B (USACE, 1998a).

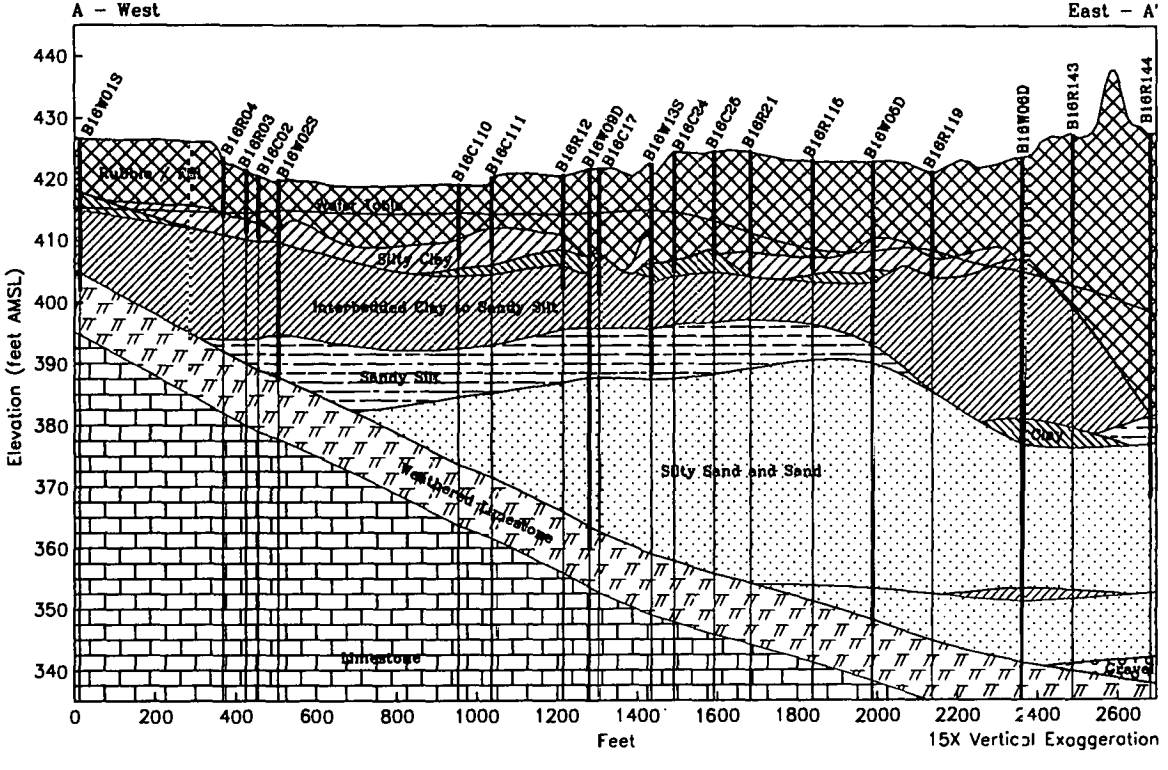

Figure 3-9.
Geologic Cross Section A – A' at SLDS

Geologic data used in the cross section collected prior to 1998.

Cross Section Location Map

FUSRAP

St. Louis Downtown Site
St. Louis, Missouri

Drawn By: R. Smith

Rev. No. / Date: 0 / 24 Mar 99

File: SLDSGlg01XSectA.sho

Figure 3-9 Geologic Cross Section A-A' at SLDS

However, HU-B does qualify as a potential source of drinking water under the *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy* (EPA, 1988). HU-C would also be an unlikely water supply source, as it is deeper and a less-productive HU (USACE 1998a).

The ground-water monitoring well network for the SLDS is identified in Figure 3-10. The methodologies used to determine the parameters analyzed for each monitoring well and the appropriate sampling intervals are described in Figures 3-11 and 3-12, respectively. Ground-water sampling parameters for all of the FUSRAP-SLS are listed in Table 3-4. The parameters and intervals may be modified based on a review of data as specified in Figures 3-11 and 3-12. There are no plans to decommission wells at SLDS in the coming FY; however, the need to decommission a well may arise through the year.

Table 3-4. Ground-Water Monitoring by Site

Site	Parameter [a]	Driver/Purpose
SLDS and VPs	1, 3, 4	ROD (USACE 1998a)
SLAPS and Vicinity Properties	1, 2, 4	EMP[b](EMDAR 2003a, Appendix D)
HISS and Latty Properties	1, 2, 4	EMP[b](EMDAR 2003a, Appendix D)

[a] The methodologies used to determine the parameters analyzed and the appropriate sampling intervals for each monitoring well, are described in Figures 3-7 and 3-8. In addition to the parameters listed here, the USACE may elect to add any parameters identified in the Quality Assurance Project Plan section of the SAG as part of the monitoring.

[b] Subject to modification when a final ROD is issued and approved for the North St. Louis County sites (SLAPS, HISS, VPs).

Definition for Parameters:

1. Radiochemical parameters include uranium-234, uranium-235, uranium-238, thorium-228, thorium-230, thorium-232, radium-226, radium-228, actinium-227, and protactinium-231.
2. Metals–include antimony, arsenic, barium, cadmium, chromium, molybdenum, nickel, selenium, thallium, and vanadium.
3. Arsenic and cadmium are the only metals analyzed at the SLDS.
4. Field parameters include hardness, pH, conductance, oxidation reduction potential, temperature, dissolved oxygen, turbidity, and static water levels.

The sampling objectives for SLAPS and SLAPS VPs include the following:

- evaluate potential ground-water contaminant migration and flow primarily in the upper hydrostratigraphic zone (HZ);
- monitor discharge to Coldwater Creek to confirm there is no contaminant migration;
- evaluate potential impacts to ground-water quality in various horizons that may result from RA; and,
- provide data necessary for CERCLA evaluation.

Five HZs are recognized beneath the SLAPS (see Figure 3-13). The surficial deposits, consisting of topsoil and anthropogenic fill (Unit 1), and the Pleistocene glacially-related sediments of stratigraphic Unit 2 and Subunit 3T comprise the HZ-A. HZ-B is a clay with low vertical permeability comprising Subunit 3M of stratigraphic Unit 3. HZ-C includes the stratigraphic

Subunit 3B and Unit 4. The shale and limestone are recognized as HZ-D and HZ-E, respectively. The existing ground-water monitoring well network for the SLAPS VPs is illustrated in Figure 3-14.

One or two new remedial-action evaluation well(s) are planned to be installed in the west end of the SLAPS. Four monitoring wells at the SLAPS were decommissioned in FY 04. There are no plans to decommission additional wells at SLAPS or SLAPS VPs in the coming FY. The need to decommission a well may arise through the year depending on the RA and its impact on the existing wells. The methodologies used to determine the parameters analyzed for each monitoring well and the appropriate sampling intervals are described in Figures 3-11 and 3-12, respectively. Ground-water sampling parameters are listed in Table 3-4. The parameters and sampling intervals may be modified based on a review of data as specified in Figures 3-11 and 3-12.

The objectives for HISS sampling include the following:

- evaluate potential ground-water contaminant occurrence and migration primarily in the upper HZ;
- monitor discharge to Coldwater Creek to confirm there is no contaminant migration;
- evaluate potential impacts to ground-water quality in various horizons that may result from RA; and,
- provide data necessary for CERCLA evaluation.

The hydrogeologic and geologic setting at the HISS is similar to that at the SLAPS (see Figure 3-13), with one exception. The Pennsylvanian shale bedrock unit (HZ-D) present at the SLAPS is absent from the HISS.

The current ground-water monitoring well network for the HISS is identified in Figure 3-15. No new monitoring wells are planned for installation at the HISS. The methodologies used to determine the parameters analyzed for each monitoring well and the appropriate sampling intervals are described in Figures 3-11 and 3-12, respectively. Ground-water sampling parameters are listed in Table 3-4. The parameters and sampling intervals may be modified based on a review of data as specified in Figures 3-11 and 3-12. There are currently no plans to decommission any monitoring wells at the HISS; however, the need to decommission a well may arise through the year.

3.4.2 Proposed New Ground-Water Monitoring Wells

Up to two new ground-water monitoring well(s) may be installed at the SLS. As identified in Section 3.4.1, ground-water monitoring at the three SLS will be completed to meet various

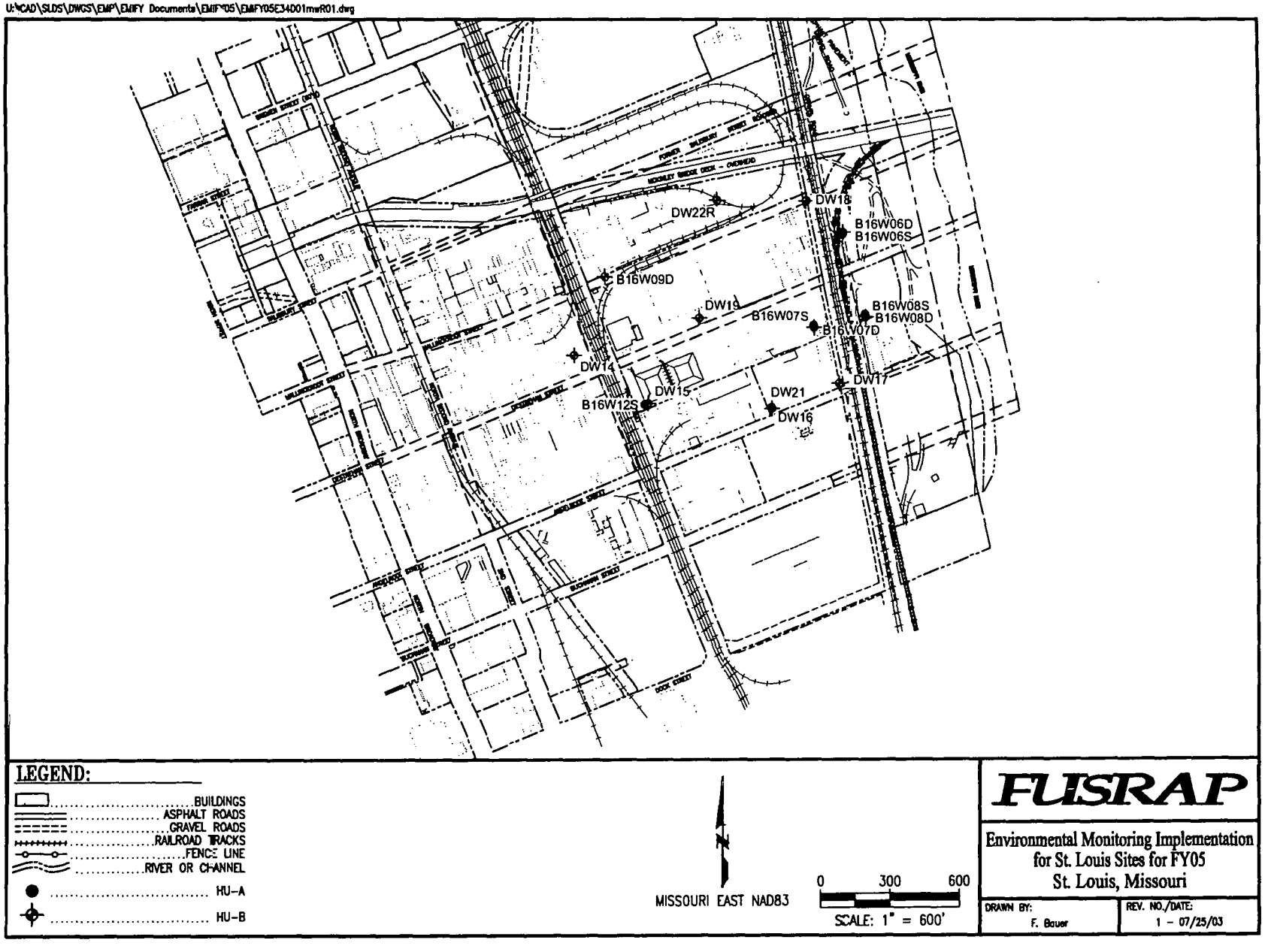

Figure 3-10. Ground-Water Monitoring Well Locations at the SLDS for FY05

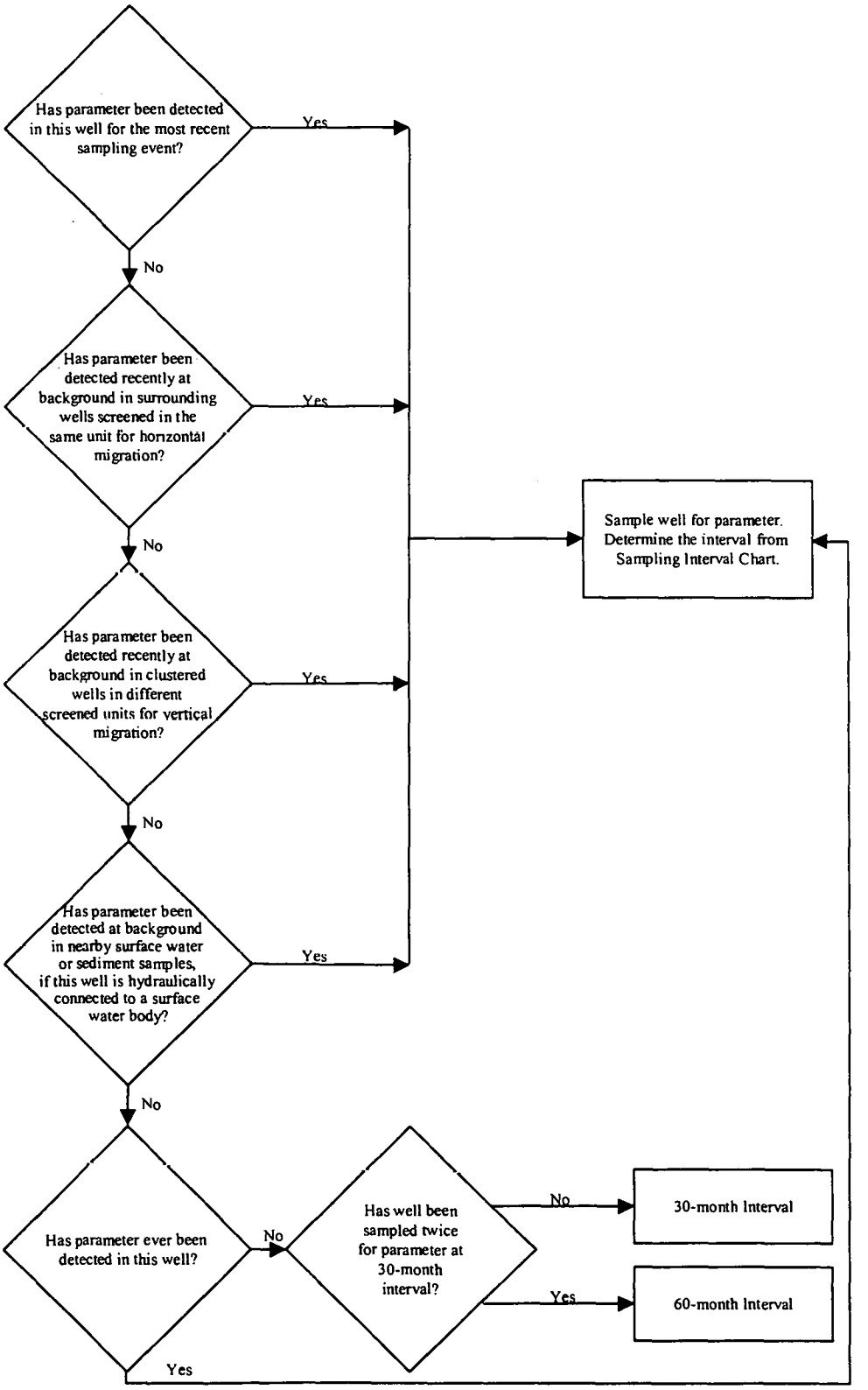

Figure 3-11. Sampling Parameter Chart

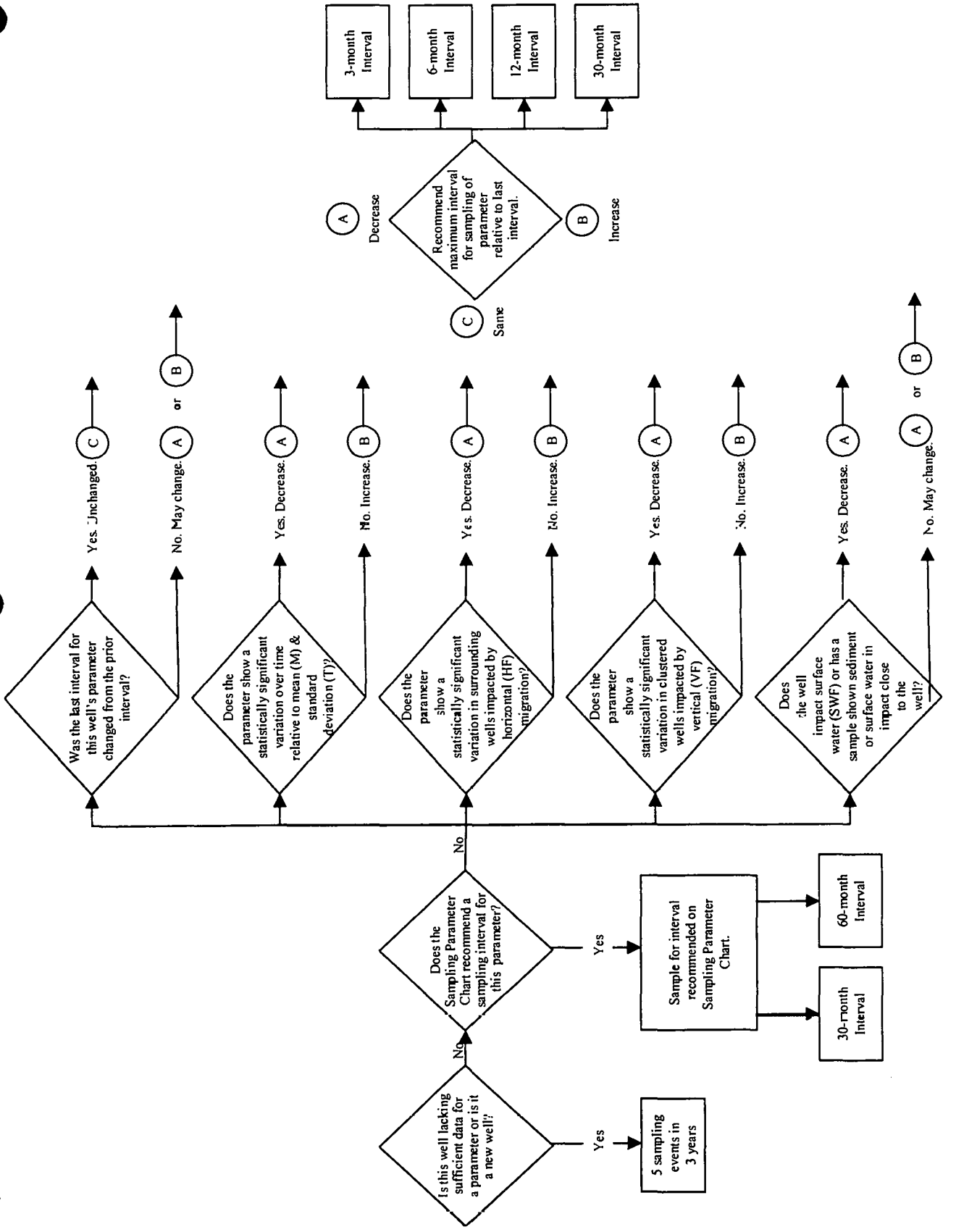

Figure 3-12. Sampling Interval Chart

Zone	Period	Epoch	Stratigraphy	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	10-29	Similar to upper silty clay. Probable unconformable 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	10+	**UNIT 6** BEDROCK: Hard, white to olive, well cemented, sandy limestone with interbedded shale laminations.

NOT TO SCALE

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Figure 3-13. Generalized Stratigraphic Column for the SLAPS and the HISS

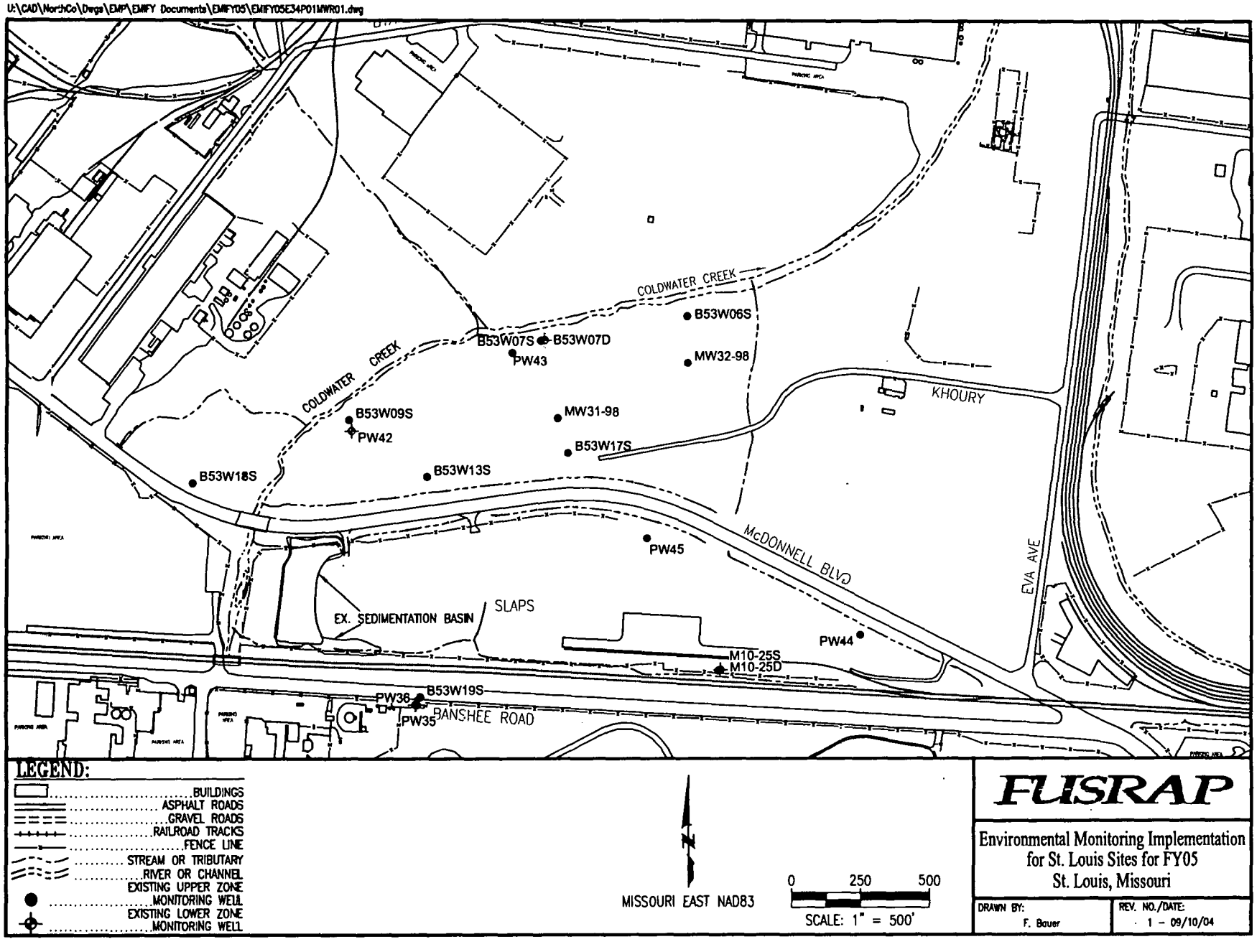

Figure 3-14. Existing Monitoring Well Locations at the SLAPS and SLAPS VPs for FY05

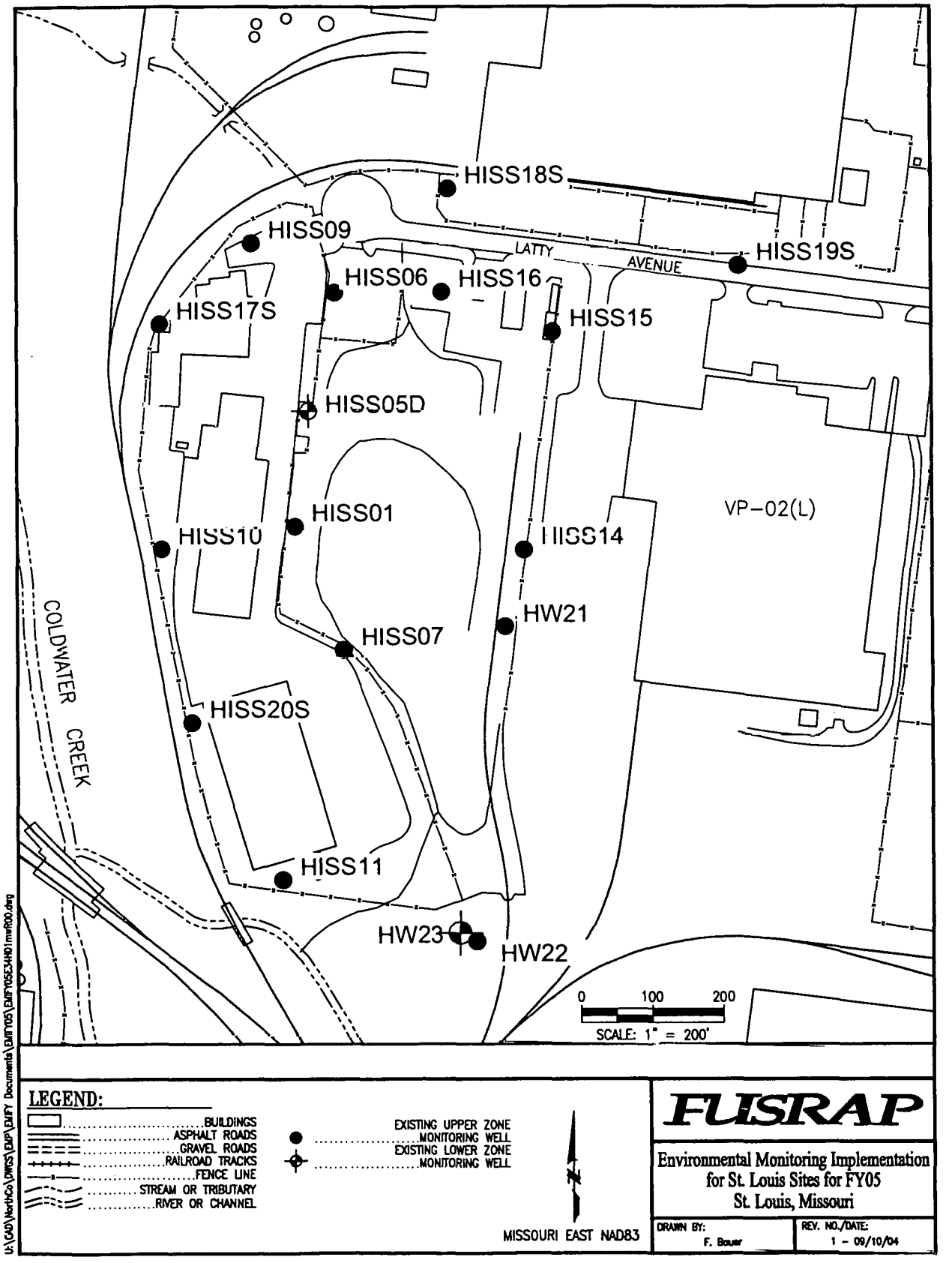

Figure 3-15. Existing Monitoring Well Locations at the HISS for FY05

federal and state requirements. To accomplish these and other ground-water-related objectives, additional wells or well replacements may need to be installed during FY05, should conditions change. Specific objectives that may be considered at each site are:

- identify potential impacts to ground-water quality resulting from remedial or removal action activities;
- ensure compliance with ARARs;
- obtain requisite data for CERCLA remedial performance evaluations;
- determine or monitor background water quality at each of the sites;
- ensure an adequate monitoring network is established for potentiometric and ground-water-quality monitoring at each key HU or HZ;
- evaluate ground-water contaminant occurrence and migration;
- evaluate the existing monitoring network; and,
- replace a decommissioned well.

3.4.3 Rationale for Ground-Water Sampling

The rationale for the sampling programs established for each site is based on well-analyte history and site-specific requirements and conditions. The rationale for the ground-water monitoring plan correlates with the evaluation criteria identified in Section 2.2.4. The ROD requirements determined the ground-water monitoring rationale at the SLDS (USACE, 1998a). At the North St. Louis County sites (SLAPS, HISS, VPs), analytes targeted for monitoring will include soil COCs as identified in the *Feasibility Study for the St. Louis North County Site* (USACE, 2003a), as well as selected indicator constituents with high mobility that can serve as early indicators of contaminant migration. These monitoring requirements will be revised when the ROD for the North St. Louis County sites (SLAPS, HISS, VPs) is issued and approved. Analytes may be added to this list at the discretion of USACE.

3.4.4 Field and Laboratory Analysis

Based on previous soil and ground-water sampling conducted at the three St. Louis FUSRAP sites, categories of known or potential ground-water contaminants have been identified for each site. Based on the identified categories, ground-water samples collected at each site will undergo laboratory analytical analyses for the parameters previously identified in Table 3-3. Following approval of the ROD for the North St. Louis County sites (SLAPS, HISS, VPs), the basis for ground-water sampling will be revised to the ROD-specified parameters. Details regarding the analytical testing methods to be used for chemical analyses of these ground-water samples are presented in the SAG.

Purging and sampling of ground-water monitoring wells will be accomplished using dedicated bladder-type pumps, non-dedicated electrical submersible or peristaltic pumps, bailers, or similar equipment. Field measurements of static water level, pH, specific conductance, temperature, dissolved oxygen, and turbidity will be recorded during purging and sampling activities.

In cases where ground-water recharge into a monitoring well is rapid, ground-water samples will be collected immediately after completion of purging. However, in cases where recharge is slow, ground-water samples will be collected as soon as sufficient ground water is present in the well. If the volume of the ground-water sample collected from a slow-recharge well is not sufficient to perform both field parameter and chemical analyses, the entire volume of the sample will be used for chemical analysis, and field parameter measurements will not be conducted. Ground-water samples collected for analysis of metal, radiological, and water-quality (new wells only) parameters will be collected as unfiltered. The USACE may elect to take filtered and unfiltered samples at any monitoring well, particularly new wells in which the turbidity is greater than 50 nephelometric turbidity units (NTU).

QA Split Samples

In addition to the sampling conducted for the field measurements described above, QA split samples will be collected by the USACE during performance of ground-water sampling activities. The monitoring well locations selected for split sampling will be random. The exact number of split samples collected will depend on the total number of ground-water samples collected during each quarterly sampling event. Approximately one split sample will be collected for every 20 ground-water samples collected and will be proportionally distributed between the three subject sites. The QA split samples will be analyzed for the same ground-water parameters as the samples collected in accordance with this plan. Additional information regarding field QA/QC sampling requirements, and the analytical testing methods to be used for chemical analysis of QA/QC samples, is presented in the SAG.

4.0 PROGRAM PROTOCOLS

4.1 ORGANIZATION

The USACE-St. Louis District will issue an annual EMIFY for each FY that defines the program monitoring requirements for the upcoming year with respect to sampling locations, frequencies, monitoring parameters, and the rationale for their selection. Organizational responsibilities for implementation of the EMIFY will correspond to those delineated in the SAG (USACE, 2000a) or other implementation plans. Where non-periodic environmental sampling activities are required to meet CERCLA objectives at the SLS and are not discussed in an implementation plan, a WD or final status survey (FSS) plan will be issued that describes the activity-specific requirements. Each WD or FSS will describe responsibilities for its implementation to the extent those roles differ from those specified by the SAG, or other implementation guide, such as the annual FY VP characterization plan.

4.2 SAMPLING PROCEDURES

Field sampling procedures for the various media monitored by the EMIFY will conform to the requirements specified in the SAG. No unique sampling procedures are required to meet the objectives defined in this annual EMIFY.

4.3 SAMPLE MANAGEMENT

Samples collected under this EMIFY will be managed in the field, as specified in the SAG. Sample container, preservation, and holding-time requirements for samples collected under the EMIFY are also specified in the SAG. Sample documentation requirements, which include the sample numbering system, logbook requirements, and sample labels that pertain to samples collected under the EMG, are presented in the SAG. Chain-of-custody requirements for EMIFY samples are also specified in the SAG.

4.4 ANALYTICAL PROTOCOLS

Samples collected under this EMIFY will be quantified by the methods specified in the SAG. No unique analytical protocols are necessary to meet the objectives identified in the EMIFY.

4.5 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

IDW resulting from implementation of the EMIFY05 will be managed in accordance with the requirements of the *EPA Guide to Management of Investigation-Derived Wastes* (EPA, 1992). The management of IDW generated from various activities at FUSRAP is outlined in Table 4-1.

Table 4-1. Investigation-Derived Waste Management Options

Waste Type	IDW [a]	Generation Process	Management Option [b]
Water	Ground water	Well development Well sampling and/or purging Other characterization activities	Regulated or Suspect (i.e., RCRA): containerize and place in storage or treat on-site (i.e., HISS-09 and PW45). Non-regulated or non-suspect: purged water, in general for all North County wells, except for regulated purge water or wells with known organic contamination (i.e., B53W13S and B53W17S) will be placed on nearby unremediated vegetated ground such that it will not pond or runoff. SLDS and SLDS' VP wells purge water will be provided to Shaw Group at the SLDS site.
	Surface water	Characterization activities	Excess surface water is not anticipated from this activity.
	Decontamination water	Decontamination of equipment	Disposition in controlled area such that it will not pond or run off site or through an outfall.
Soil	Soils and/or sediment	Drill cuttings Soil sampling	Known or suspect contaminated area: place soil in a contaminated soil pile or other designated location. Known or suspect uncontaminated area: backfill location or spread cuttings around sample location.
Waste	Containerized wastes	Sampling	Return unused portion to original source container.
Sample Equipment	Personal protective equipment	Sample activities Other miscellaneous activities	Reusable: decontaminate. Disposable: dispose of with other radiological trash. If used to sample suspect hazardous wastes, segregate and dispose of as directed by task manager.
	Equipment	Sampling equipment Monitoring equipment (swipes, filters, etc.)	Reusable: decontaminate. Disposable: dispose of as radiological trash. If used to sample suspect hazardous wastes, segregate and dispose of as directed by task manager or designee.
Laboratory Wastes	Soil, filter papers, test tubes, other radiological trash, etc.	Analysis	Dispose of as radiological trash. If used to sample suspect hazardous wastes, segregate and dispose of as directed by task manager or designee.
	Acid wastes	Analysis	Neutralize with caustic soda at point of generation and store in 55-gallon container.
	Other liquid wastes	Analysis Equipment decontamination	Regulated or suspect regulated (i.e., RCRA): containerize and place in satellite accumulation until waste is properly containerized for shipment off site for treatment and disposal. Non-regulated or non-suspect: containerize and store in designated storage area.

[a] Management and disposition of wastes not listed here will be evaluated on case-by-case following the referenced EPA guidance.

[b] Options may be modified on case-by-case basis but will follow the EPA guidance.

5.0 REFERENCES

ANL (Argonne National Laboratory) 1993. *Baseline Risk Assessment for Exposure to Contaminants at the St. Louis Site*, St. Louis, Missouri, DOE/OR/23701-41, November.

EPA (U.S. Environmental Protection Agency) 1988. *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy*, June.

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MSD (Metropolitan St. Louis Sewer District) 1998. Letter dated October 30, 1998. From Bruce H. Litzsinger, Civil Engineer, to Ken Axetel, International Technology Corporation.

MSD 2001a. Letter dated July 23, 2001. From Bruce H. Litzsinger, Civil Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: St. Louis Airport Site, File: SD-St. Louis FUSRAP Site, 110 McDonnell.

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USACE (United States Army Corps of Engineers) 1998a. *Record of Decision for the St. Louis Downtown Site, St. Louis, Missouri*, October.

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USACE 2003b. *Annual Environmental Monitoring and Data Analysis Report for CY02, St. Louis, Missouri*, August.

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