FINAL

ENVIRONMENTAL MONITORING IMPLEMENTATION FOR THE ST. LOUIS SITES FOR FY03

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

Ac	actinium
AEC	Atomic Energy Commission
ATD	alpha track detector
AOC	area of contamination
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Aquatic Water Quality Criteria
BMP	best management practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
CFR	Code of Federal Regulations
COPC	constituent of potential concern
DOE	U.S. Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
EMDAR	Environmental Monitoring Data and Analysis Report
EMG	Environmental Monitoring Guide
EMP	Environmental Monitoring Program
EMIFY	Environmental Monitoring Implementation Fiscal Year
FFA	Federal Facilities Agreement
FS	Feasibility Study
FUSRAP	Formerly Utilized Sites Remedial Action Program
FY	Fiscal year
GRAAA	Ground-Water Remedial Action Alternatives Assessment
HISS	Hazelwood Interim Storage Site
HU	hydrostratigraphic unit
HZ	hydrostratigraphic zones
IDW	investigation derived wastes
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDA	minimum detectable activity
MDNR	Missouri Department of Natural Resources
mg/L	milligrams per liter
mg/kg	milligram per kilogram
mrem/yr	millirem per year
MSD	Metropolitan Sewer District
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
Pa	protactinium
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
pCi/L	picocuries per liter
$pCi/m^2/s$	picocuries per square meter per second
pCi/m^3	picocuries per cubic meter

ACRONYMS AND ABBREVIATIONS (CONT'D)

QA/QC	quality assurance/quality control
Ra	radium
RCRA	Resource Conservation and Recovery Act
Rn	radon
ROD	Record of Decision
s	second
SAG	Sampling and Analysis Guide
SDWA	Safe Drinking Water Act
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
SLS	St. Louis Sites
SQB	Sediment Quality Benchmarks
SQRT	Sediment Quick Reference Table
SVOC	semi-volatile organic compound
TEDE	total effective dose equivalent
Th	thorium
TLD	thermoluminescent dosimeters
TOC	toxic organic compound
U	uranium
UMTRCA	Uranium Mill Tailings Radiation Control Act
USACE	U.S. Army Corps of Engineers
USACE-SLD	U.S. Army Corps of Engineers- St. Louis District
USEPA	U.S. Environmental Protection Agency
UTL	upper tolerance level
VOC	volatile organic compound
VP	Vicinity Property
WD	work description

1.0 INTRODUCTION

1.1 PROGRAM OVERVIEW

This Environmental Monitoring Implementation Fiscal Year 2003 (EMIFY03) applies to the St. Louis Sites (SLS) within the Formerly Utilized Sites Remedial Action Program (FUSRAP) [See Figure 1-1]. These sites are the St. Louis Downtown Site (SLDS), St. Louis Airport Site (SLAPS), and the Hazelwood Interim Storage Site (HISS) [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, transferred to the U.S. Army Corps of Engineers (USACE) on October 13, 1997, is responsible for the characterization and remediation of contamination associated with the historical AEC facilities that supported the nation's early nuclear defense-related activities. One primary element of the FUSRAP mission is the environmental monitoring of sites where remedial measures are being implemented or actions have been completed with contaminants left in place. Continued environmental monitoring of sites where contaminants remain 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 EMIFY03 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 substantive requirements, and implementation of remedial actions. Accordingly, program-level requirements with respect to field sampling procedures, sample management requirements, analytical protocols, and quality assurance/quality control (QA/QC) activities that are unlikely to change are specified in an upper tier document titled *Sampling and Analysis Guide for the St. Louis Sites* (SAG) (USACE, 2000a). The *Environmental Monitoring Guide for the St. Louis Sites* (EMG) (USACE, 1999) describes the overall objective, program structure, media to be monitored and program requirements of the environmental monitoring program (EMP). In order to address changing monitoring objectives, annual EMIFYs are issued under the EMG and specifically identify sampling locations, frequencies, monitoring parameters, and criteria for evaluation of the resultant data that are specific for the subject year. Non-periodic environmental sampling activities such as soil sampling to define unit boundaries for design purposes or verify compliance with clean-up objectives or other special studies are specified in other implementation plans, activity-specific Work Descriptions (WD) or Final Status Survey Plans. In accordance with requirements of the Federal Facilities Agreement (FFA), data obtained from EMIFY or WD activities are reported to the U.S. Environmental Protection Agency (USEPA) Region VII in quarterly FFA reports. An evaluation of the data obtained from monitoring under each EMIFY during each fiscal year is provided in an Annual Environmental Monitoring Data and Analysis Report (EMDAR) for each calendar year.

The remainder of Section 1 contains a summary description of the contents of this document.

Section 2 presents evaluation criteria and guidelines derived from various environmental regulations that will be used for assessment of the data obtained under this EMIFY03.

Section 3 presents the various types of monitoring to be conducted at the SLS.

Section 4 references the SAG, which is necessary to fulfill the requirements of this EMIFY, including field sampling procedures, sample management requirements, sample packaging and shipping requirements, management of investigation derived wastes (IDW), analytical protocols and QA/QC requirements.

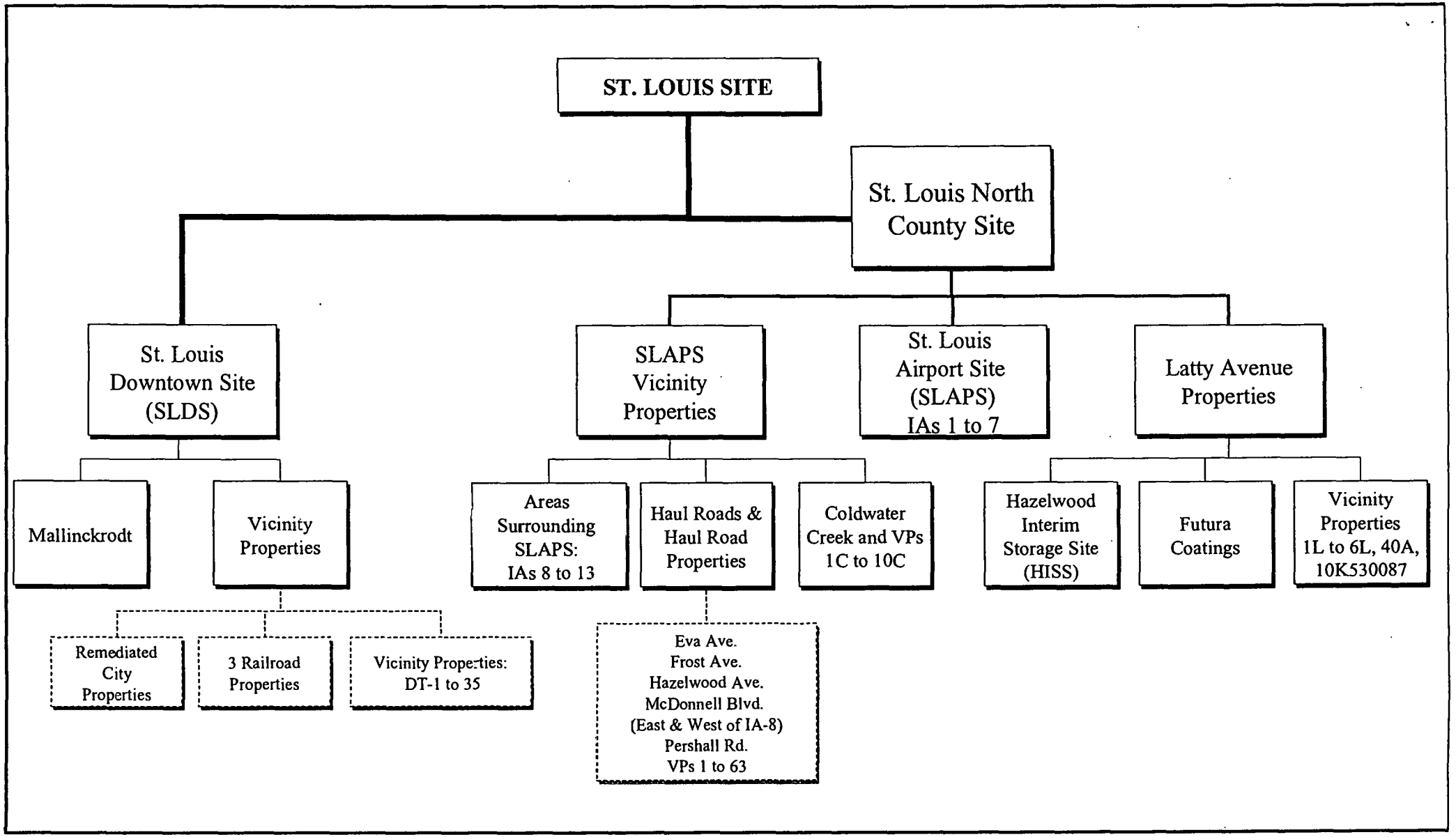

Figure 1-1. Schematic Representation of the FUSRAP St. Louis Site

U:\CAD\SLDS\DWGS\EMP\EMIFY Documents\EMIFY03\EMIFY03E34DPROPR00.dwg

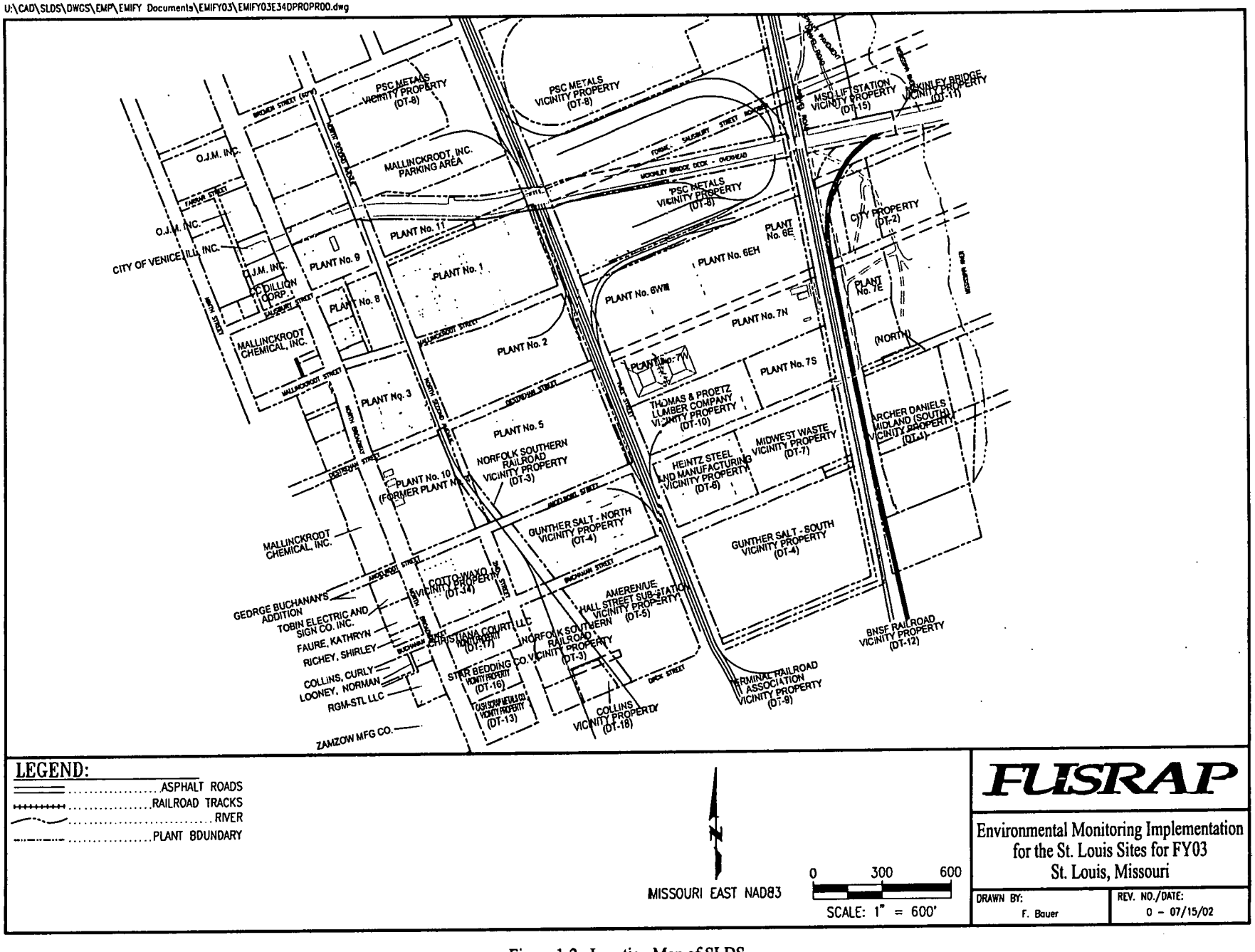

Figure 1-2. Location Map of SLDS

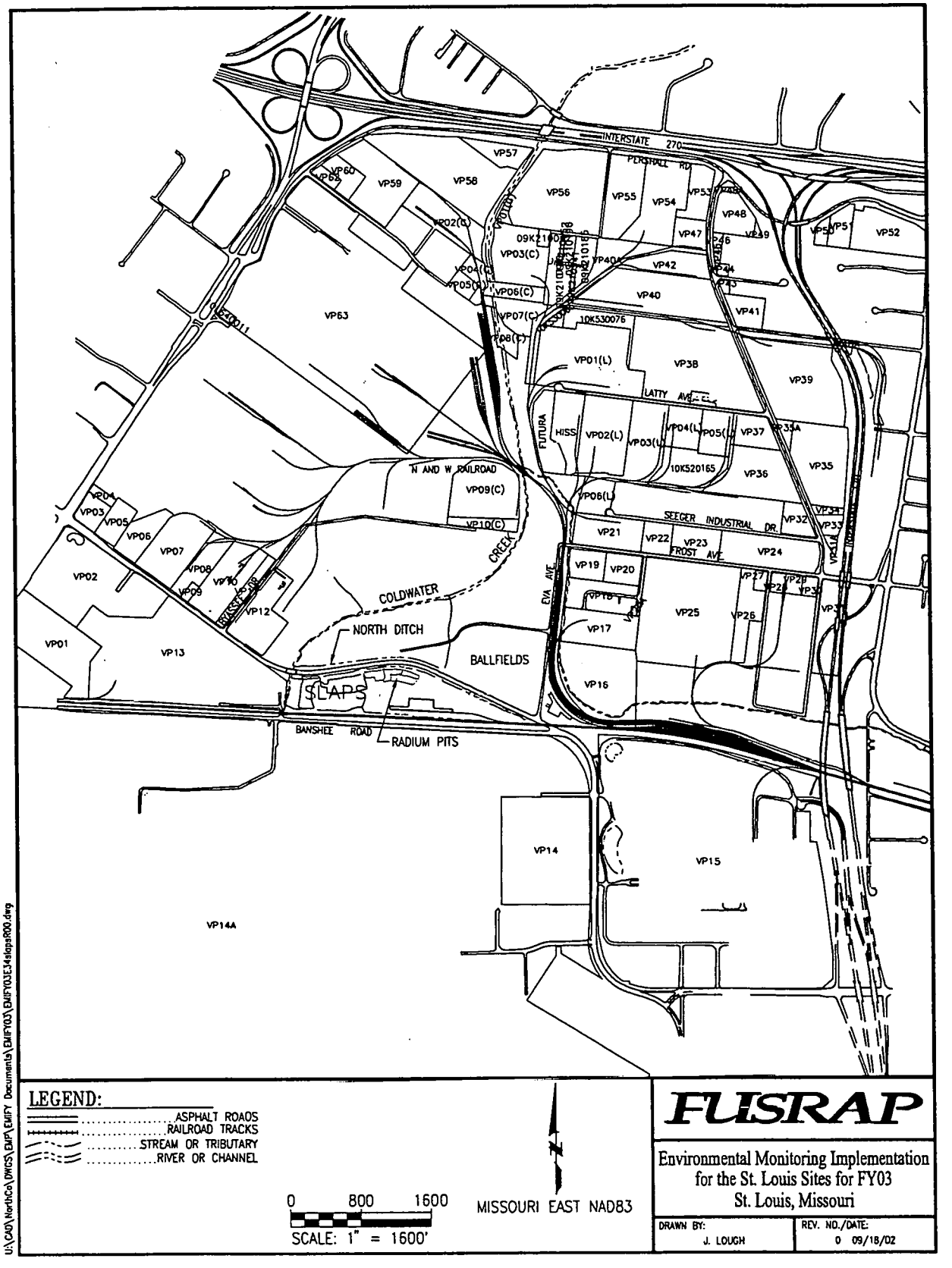

Figure 1-3. Location Map of SLAPS

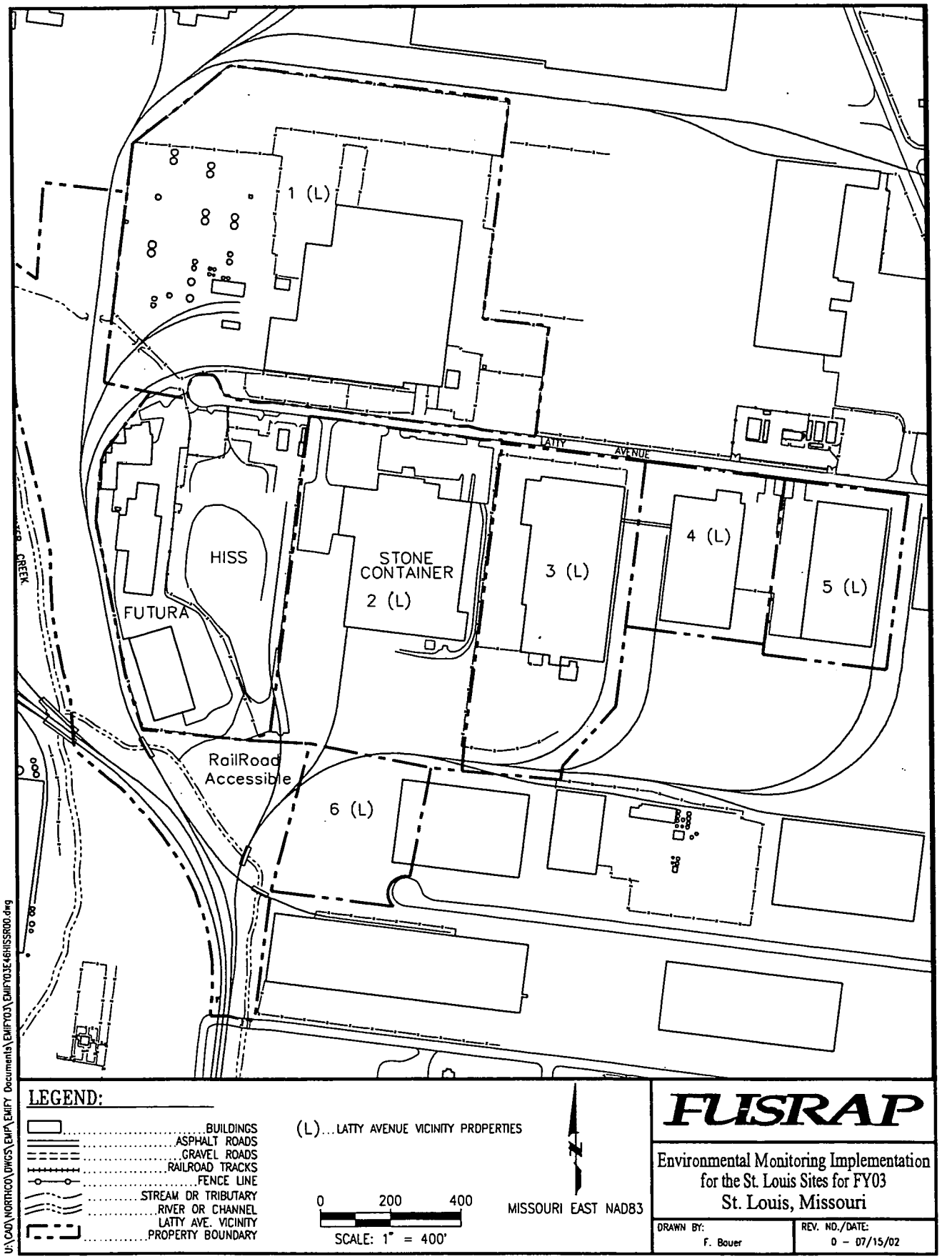

Figure 1-4. Location Map of HISS and Latty Avenue Vicinity Properities

2.0 OBJECTIVES AND EVALUATION GUIDELINES FOR THE ENVIRONMENTAL MONITORING PROGRAM FOR 2003

2.1 PROGRAM OBJECTIVES FOR FY03

The objectives for EMP during FY03 are identified below.

- Conduct periodic monitoring as required to meet substantive requirements or permit conditions of each of the SLS;
- Collect environmental data for site re-evaluation as required by CERCLA or agreed to by the USACE at the sites; and,
- Conduct BMP monitoring to obtain data for impact evaluation relative to guidelines derived from other environmental regulations.

In order to fulfill these objectives, Section 3.0 identifies sampling locations and frequencies for various environmental media based on: applicable or relevant and appropriate requirements (ARARs); permit conditions; site characteristics; risk assessment considerations and other site factors. Such sampling locations may 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 that are identified in Section 3.0 were selected from permit conditions or best professional judgment based on historical site studies, the *Feasibility Study for the St. Louis North County Site* (USACE, 2000b) and other CERCLA decision documents.

2.2 EVALUATION GUIDELINES FOR ENVIRONMENTAL MONITORING DATA

Data acquired during FY03 will be evaluated with respect to ARARs or permit conditions and guidelines derived from other environmental regulations. The remainder of this section identifies these various criteria.

2.2.1 Evaluation Guidelines for Ground-water Data

Criteria and guidelines for evaluating groundwater data collected at the North County sites during this EMIFY03 are derived from the maximum contaminant levels (MCL) of the Safe Drinking Water Act (SDWA) and the secondary maximum contaminant levels (SMCL) from 40 CFR 143. The criteria for ground-water sampling will be revised when a final Record of Decision (ROD) is issued and signed for the North County Sites. The criteria and guidelines for evaluation of ground-water sampling data at SLDS are determined by investigation limits (IL). These criteria are provided in Table 2-1.

Table 2-1. Evaluation Criteria for Ground-Water Data[a]

Constituent	Expected Background Criteria[b], Shallow	Expected Background Criteria[b], Deep	MCL, Secondary MCL or MCLG
Radiochemical Parameters			
Ra-226 + Ra-228 (pCi/L)	0.91	1.03	
U-238 (pCi/L)	2.28	0.11	NA-NG
U-234 (pCi/L)	6.07	[c]	NA-NG
U-235 (pCi/L)	0.47	0.49	NA-NG
Ra-226 (pCi/L)	0.91	1.03	NA-NG
Ra-228 (pCi/L)	[c]	[c]	NA-NG
Th-230 (pCi/L)	1.18	0.63	NA-NG
Th-232 (pCi/L)	0.25	[c]	NA-NG
Th-228 (pCi/L)	0.66	0.62	NA-NG
Metals-TAL			
Aluminum (mg/L)	[c]	0.05	0.05-0.2[b]
Antimony (mg/L)	[c]	[c]	0.006
Arsenic (mg/L)	[c]	0.08	0.05
Barium (mg/L)	0.20	0.42	2
Beryllium (mg/L)	[c]	[c]	0.004
Boron (mg/L)	0.06	0.21	NA-NG
Cadmium (mg/L)	[c]	[c]	0.005
Chromium (mg/L)	0.01	0.01	0.1
Cobalt (mg/L)	[c]	[c]	NA-NG
Copper (mg/L)	0.01	[c]	1.0[b] (1.3)
Iron (mg/L)	[c]	15.2	0.3[b]
Lead (mg/L)	[c]	[c]	0.015 (0)
Lithium (mg/L)	0.01	[c]	NA-NG
Manganese (mg/L)	1.58	0.23	0.05[b]
Mercury (mg/L)	[c]	[c]	0.002
Molybdenum (mg/L)	[c]	[c]	NA-NG
Nickel (mg/L)	[c]	[c]	NA-NG
Silicon (mg/L)	7.95	8.36	NA-NG
Strontium (mg/L)	0.32	0.74	NA-NG
Selenium (mg/L)	[c]	[c]	0.05
Silver (mg/L)	[c]	[c]	0.15[b]
Titanium (mg/L)	[c]	0.01	NA-NG
Thallium (mg/L)	[c]	[c]	0.002 (0.0005)
Uranium (mg/L)	[c]	[c]	0.020
Vanadium (mg/L)	[c]	[c]	NA-NG
Zinc (mg/L)	0.01	0.05	5[b]
Field Parameters			
pH	NA-NG	NA-NG	6.5-8.5[b]
Color (color units)	NA-NG	NA-NG	15[b]
Total Dissolved Solids (mg/L)	MISC	NA-NG	500[b]
Volatile Organic Compounds (VOCs)			
Benzene (mg/L)	[c]	[c]	0.005 (0)
Carbon Tetrachloride (mg/L)	[c]	[c]	0.005 (0)
Chlorobenzene (mg/L)	[c]	[c]	0.1
Chloroform (mg/L)	[c]	[c]	NA-NG
Ethylbenzene (mg/L)	[c]	[c]	0.7
Methylene Chloride (mg/L)	[c]	[c]	0.005 (0)
Styrene (mg/L)	[c]	[c]	0.1
Tetrachloroethene (mg/L)	[c]	[c]	0.005
Toluene (mg/L)	[c]	[c]	1
Trichloroethylene (mg/L)	[c]	[c]	0.005

Table 2-1. Evaluation Criteria for Ground-Water Data[a] (Cont'd)

Constituent	Expected Background Criteria[b], Shallow	Expected Background Criteria[b], Deep	MCL, Secondary MCL or MCLG
Vinyl Chloride (mg/L)	[c]	[c]	0.002 (0)
Chloromethane (mg/L)	[c]	[c]	NA-NG
Xylenes, Total (mg/L)	[c]	[c]	10
1,1,1-Trichloroethane (mg/L)	[c]	[c]	0.2
1,1,2,2-Tetrachloroethane (mg/L)	[c]	[c]	0.00017 (0)
1,1,2-Trichloroethane (mg/L)	[c]	[c]	0.005
1,2-Dichloroethene (mg/L)	[c]	[c]	0.007
1,2-Dichloroethane (mg/L)	[c]	[c]	0.005 (0)
1,2-Dichloropropane (mg/L)	[c]	[c]	100
Cis-1,2,-Dichloroethlyene (mg/L)	[c]	[c]	0.07
Trans-1,2-Dichloroethlyene (mg/L)	[c]	[c]	0.1
Dibromochloropropane (mg/L)	[c]	[c]	0
1,2-Dichloropropane (mg/L)	[c]	[c]	0
Semi-volatile Organic Compounds (SVOCs)			
1,2,4-Trichlorobenzene (mg/L)	[c]	[c]	0.07
2,4,5-Trichlorophenol(mg/L)	[c]	[c]	2.6
2,4,6-Trichlorophenol(mg/L)	[c]	[c]	0.002
2,4-Dichlorophenol (mg/L)	[c]	[c]	0.093
2,4-Dimethylphenol(mg/L)	[c]	[c]	0.54
2,4-Dinitrophenol(mg/L)	[c]	[c]	0.07
2-Chlorophenol (mg/L)	[c]	[c]	0.1
Anthracene (mg/L)	[c]	[c]	NA-NG
Benzo(a)anthracene (mg/L)	[c]	[c]	NA-NG
Benzo(a)pyrene (mg/L)	[c]	[c]	0.0002
Benzo(b)fluoranthene (mg/L)	[c]	[c]	NA-NG
Benzo(k)fluoranthene (mg/L)	[c]	[c]	NA-NG
Bis(2-chloroethyl)ether (mg/L)	[c]	[c]	NA-NG
Bis(2-ethylhexyl)phthalate (mg/L)	[c]	[c]	0.006
Butyl Benzyl Phthalate(mg/L)	[c]	[c]	NA-NG
Di-n-butyl Phthalate (mg/L)	[c]	[c]	NA-NG
Diethyl Phthalate(mg/L)	[c]	[c]	NA-NG
Dimethyl Phthalate (mg/L)	[c]	[c]	NA-NG
Fluoranthene (mg/L)	[c]	[c]	NA-NG
Fluorene (mg/L)	[c]	[c]	NA-NG
Hexachlorobenzene (mg/L)	[c]	[c]	0.001
Hexachlorobutadiene (mg/L)	[c]	[c]	NA-NG
Hexachlorocyclopentadiene (mg/L)	[c]	[c]	0.05
Isophorone (mg/L)	[c]	[c]	NA-NG
N-Nitrosodiphenylamine (mg/L)	[c]	[c]	NA-NG
Naphthalene (mg/L)	[c]	[c]	NA-NG
Nitrobenzene(mg/L)	[c]	[c]	NA-NG
Pentachlorophenol (mg/L)	[c]	[c]	0
Phenol (mg/L)	[c]	[c]	NA-NG
Pyrene (mg/L)	[c]	[c]	NA-NG
Geochemical Parameters			
Ammonia	0.29	6.7	NA-NG
Alkalinity	[c]	[c]	NA-NG
Chloride (mg/L)	13.4	1.21	250[b]
Fluoride (mg/L)	0.25	0.24	4 (2[b])
Nitrate (as Nitrogen) (mg/L)	0.72	0.10	10
Nitrite (as Nitrogen) (mg/L)	[c]	0.00	1
Total nitrate and Nitrite (as Nitrogen) (mg/L)	0.72	0.10	10
Sulfate (mg/L)	376	6.93	250[b]

Table 2-1. Evaluation Criteria for Ground-Water Data[a] (Cont'd)

Constituent	Expected Background Criteria[b], Shallow	Expected Background Criteria[b], Deep	MCL, Secondary MCL or MCLG
Pesticide/ Polychlorinated Biphenyls (PCBs)			
Heptachlor	[c]	[c]	0.0004
Heptachlor Epoxide (mg/L)	[c]	[c]	0.0002
Toxaphene (mg/L)	[c]	[c]	0.003
Endosulfan I (mg/L)	[c]	[c]	NA-NG
Aroclor-1016(mg/L)	[c]	[c]	0.005 (0)
Aroclor-1221(mg/L)	[c]	[c]	0.005 (0)
Aroclor-1232(mg/L)	[c]	[c]	0.005 (0)
Aroclor-1242(mg/L)	[c]	[c]	0.005 (0)
Aroclor-1248(mg/L)	[c]	[c]	0.005 (0)
Aroclor-1254 (mg/L)	[c]	[c]	0.005 (0)
Aroclor-1260 (mg/L)	[c]	[c]	0.005 (0)
Chlordane (mg/L)	[c]	[c]	0.002
Lindane (mg/L)	[c]	[c]	0.0002
Endrin (mg/L)	[c]	[c]	0.002
Herbicides			
2,4 D (mg/L)	[c]	[c]	0.07
Dalapon (mg/L)	[c]	[c]	0.2
Dinoseb (mg/L)	[c]	[c]	0.007
MCPP (mg/L)	[c]	[c]	NA-NG

[a] Source: MCL or MCLG and Secondary MCL = 40 CFR 141 and 40 CFR 143, respectively and Ground Water Quality Criteria = 10 CSR 20-7 Table A Class I, VII.

[b] Background Criteria = expected to be established in coming Feasibility Study for the St. Louis North County Site

[c] Assigned as 0.00 for analytes never detected in background.

NA-NG = not applicable, no guidance is available.

2.2.2 Evaluation Guidelines for Storm-water Data, Waste-water Data, and Coldwater Creek Surface-water Data

The MDNR has issued a National Pollutant Discharge Elimination System (NPDES) permit for HISS that requires monitoring of the discharge from three outfalls. USACE-SLD has sought release from the HISS permit. Action on this request is pending. The MDNR has also issued an ARAR document outlining limits for the four storm-water outfalls (includes outfall at emergency spillway) at SLAPS. The Metropolitan Sewer District of St. Louis (MSD) has issued a discharge authorization letter for the SLDS that establishes discharge limit-based criteria. The pollutants addressed for all SLS are identified in Table 2-2. These discharge limits will be used as evaluation criteria for storm-water monitoring data obtained under this EMIFY03.

Environmental monitoring data concerning surface-water quality in Coldwater Creek obtained under this EMIFY will be evaluated relative to guidelines derived from environmental regulatory programs. Regulatory guidelines selected for evaluation of the surface-water monitoring data are the 10 CSR 20-7 Table A Class I, and V. These various criteria are presented in Table 2-2.

Table 2-2. Evaluation Criteria for Surface-water, Waste-water, and Storm-water Data

Constituent	Background Criteria[b]	Ambient Water Quality Criteria	SLAPS Discharge Limit-Based Criteria NPDES/MSD	SLDS Discharge Limit-Based Criteria	HISS Discharge Limit-Based Criteria
Radiochemical Parameters					
Ra-226 (pCi/L)[c]	0.88	5	NL[a]/10[c]	NP	NL[a]
Ra-228 (pCi/L)[c]	0.34	5	NL[a]/30[c]	NP	NL[a]
Th-228 (pCi/L)	NP	NP	2000[c]	NP/2000[c]	NP
Th-230 (pCi/L)[c]	4.65	NA-NG	NL[a]/1000[c]	NP/1000[c]	NL[a]
Th-232 (pCi/L)[c]	[d]	NA-NG	NL[a]	NP	NL[a]
U-234 (pCi/L)	3.9	NA-NG	NP/3000[c]	NP/3000[c]	NP
U-235 (pCi/L)	[d]	NA-NG	NP/3000[c]	NP/3000[c]	NP
U-238 (pCi/L)	5.05	NA-NG	NP/3000[c]	NP/3000[c]	NP
Gross Alpha (pCi/L)	7.86	15	NL[a]/3000[c]	3000	NL[a]
Gross Beta (pCi/L)	41.8	4 mrem/yr	NL[a]	50	NL[a]
Lead 210 (pCi/L)	NA-NG	NA-NG	NP	NP	NL[a]
Metals- TAL					
Aluminum (mg/L)	1.13	0.75	NP	NP	NP
Antimony (mg/L)	0.04	4.3	NP	NP	NP
Arsenic (mg/L)	0.01	0.02	0.1	NP	NP
Barium (mg/L)	10	NP	NP	NP	NP
Beryllium (mg/L)	[d]	0.005	NP	NP	NP
Cadmium (mg/L)	[d]	0.094	0.094	NP	NP
Chromium (mg/L)	0.05	0.28	0.28	NP	NP
Copper (mg/L)	0.02	0.084	0.084	NP	NP
Iron (mg/L)	2.15	1	NP	NP	NP
Lead (mg/L)	0.01	0.15	0.19/0.4[c]	NP	NP
Manganese (mg/L)	0.63	NA-NG	NP	NP	NP
Mercury (mg/L)	[d]	0.0024	NP	NP	NP
Molybdenum (mg/L)	0.01	NA-NG	NP	NP	NP
Nickel (mg/L)	0.01	6.9	NP	NP	NP
Orthophosphate (mg/L)	0.46	NA-NG	NP	NP	NP
Selenium (mg/L)	[d]	0.005	NP/0.2[c]	NP	NP
Silver (mg/L)	[d]	0.1[b]	NP	NP	NP
Thallium (mg/L)	[d]	NA-NG	NP	NP	NP
Titanium (mg/L)	0.03	NA-NG	NP	NP	NP
Zinc (mg/L)	0.06	2.073	NP	NP	NP
Field Parameters					
Total Organic Carbon (mg/L)	NL	NA-NG	NP	NP	NL[a]
Total Organic Halogens (mg/L)	NL	NA-NG	NP	NP	NL[a]
Specific Conductance (micromhos/cm)	NL	NA-NG	NP	NP	NL[a]
Chemical Oxygen Demand (mg/L)	NL	NA-NG	90	NP	NP
Oil and Grease (mg/L)	NL	10	10	NP	NP
Total Petroleum Hydrocarbon (mg/L)	NL	NA-NG	10	NP	NP
VOCs					
Dimethylbenzene (mg/L)	[d]	10	NP	NP	NP
Methylene Chloride (mg/L)	[d]	1.6	NP	NP	NP
Acetone (mg/L)	0.02	NA-NG	NP	NP	NP
Trichloroethene (mg/L)	[d]	NA-NG	NP	NP	NP

Table 2-2. Evaluation Criteria for Surface-water, Waste-water, and Storm-water Data (Cont'd)

Constituent	Background Criteria[b]	Ambient Water Quality Criteria	SLAPS Discharge Limit-Based Criteria NPDES/MSD	SLDS Discharge Limit-Based Criteria	HISS Discharge Limit-Based Criteria
Tetrachloroethene (mg/L)	[d]	NA-NG	NP	NP	NP
Ethyl Benzene (mg/L)	[d]	0.32	NP	NP	NP
SVOCs					
Bis(2-ethylhexyl)phthalate (mg/L)	0.01	NA-NG	NP	NP	NP
2,4-Dichlorophenol (mg/L)	[d]	0.007	NP	NP	NP
2-Chloronaphthalene (mg/L)	[d]	4.3	NP	NP	NP
Phemanthrene (mg/L)	[d]	0.049	NP	NP	NP
Benzo(a)anthracene (mg/L)	[d]	0.049	NP	NP	NP
Benzo(b)fluoranthene (mg/L)	[d]	0.049	NP	NP	NP
Benzo(k)fluoranthene (mg/L)	[d]	0.049	NP	NP	NP
Benzo(a)pyrene (mg/L)	[d]	0.049	NP	NP	NP
Indeno(1,2,3-cd)pyrene (mg/L)	[d]	0.049	NP	NP	NP
Dibenzo(a,b)anthralene (mg/L)	[d]	0.049	NP	NP	NP
Benzo(g,h,i)perylene (mg/L)	[d]	0.049	NP	NP	NP
Fluoranthene (mg/L)	[d]	0.3	NP	NP	NP
Hexachlorocyclopentadiene (mg/L)	[d]	0.0005	NP	NP	NP
Geochemical Parameters					
Sulfate (mg/L)	210	250	NP	NP	NP
Nitrite (mg/L)	0.19	1	NP	NP	NP
Nitrate (mg/L)	2.51	10	NP	NP	NP
Chloride (mg/L)	240	860	NP	NP	NP
Fluoride (mg/L)	1.10	4	4	NP	NP

Sources: Aquatic Water Quality Criteria (AWQC) - 10 CRS 20-7, Table A Class I, and V.
HISS - MDNR, NPDES permit number MO – 0111252.
SLAPS - MDNR, NPDES, ARAR document letter from MDNR to USACE dated 10/2/98.
SLDS - MSD discharge authorization letter dated 10/30/98 from MSD to IT as revised in 7/02.
[a] Monitoring only requirement
[b] Includes contributions from Thorium and Uranium
[c] 10 CFR 20 limits apply and are more restrictive:
[d] Assigned as 0.00 for analytes never detected in background.
[e] SLAPS – MSD discharge authorization letter dated 7/23/01 from MSD to S. Cotner.
NL = No limit
NA-NG = not applicable, no guidance is available.
NP = not required as a monitoring parameter.

2.2.3 Evaluation Guidelines for Coldwater Creek Sediment Data

Data collected from Coldwater Creek sediment during this EMIFY03 will be compared to the 95% Upper Confidence Level (UCL) preliminary North County background concentrations. The background concentrations were established for the *Feasibility Study of the St. Louis North County Site* (USACE 2000b). Where background data does not exist a comparison with National Oceanic and Atmospheric Administration (NOAA) Sediment Quick Reference Table (SQRT) values or USEPA Sediment Quality Benchmarks (SBQ) will be performed. These various criteria are presented in Table 2-3.

Table 2-3. Evaluation Criteria for Sediment Data

		EPA			NOAA	
Constituent	**Background Criteria[a]**	**SQC**	**SQB[b]**	**EQP SQB**	**TEL**	**PEL**
Radiochemical Parameters						
Ra-226 (pCi/g)	4.7	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Ra-228 (pCi/g)	1.3	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Th-228 (pCi/g)	1.3	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Th-230 (pCi/g)	2.2	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Th-232 (pCi/g)	1.2	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
U-234 (pCi/g)	4.3	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
U-235 (pCi/g)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
U-238 (pCi/g)	4.3	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Metals –TAL						
Aluminum (mg/kg)	51000	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Antimony (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Arsenic (mg/kg)	13	NA-NG	NA-NG	NA-NG	5.9	17
Barium (mg/kg)	890	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Beryllium (mg/kg)	2	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Boron (mg/kg)	75.9	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Cadmium (mg/kg)	4	NA-NG	NA-NG	NA-NG	0.596	3.53
Calcium (mg/kg)	116000	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Chromium (mg/kg)	140	NA-NG	NA-NG	NA-NG	37.3	90
Cobalt (mg/kg)	31	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Copper (mg/kg)	330	NA-NG	NA-NG	NA-NG	35.7	197
Iron (mg/kg)	42000	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Lead (mg/kg)	380	NA-NG	NA-NG	NA-NG	35	91.3
Magnesium (mg/kg)	2100	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Manganese (mg/kg)	3200	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Mercury (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	0.174	0.486
Molybdenum (mg/kg)	6.0	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Nickel (mg/kg)	72.0	NA-NG	NA-NG	NA-NG	18	35.9
Potassium (mg/kg)	15000	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Selenium (mg/kg)	54.4	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Silver (mg/kg)	4	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Sodium (mg/kg)	10000	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Thallium (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Uranium (mg/kg)	8.69	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Vanadium (mg/kg)	99	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Zinc (mg/kg)	1370	NA-NG	NA-NG	NA-NG	123	315
VOCs						
1,1,1-Trichloroethane (mg/kg)	[d]	NA-NG	NA-NG	0.030[b]	NA-NG	NA-NG
1,1,2,2-Tetrachloroethane (mg/kg)	[d]	NA-NG	NA-NG	1.4[b]	NA-NG	NA-NG
1,1,2-Trichloroethane (mg/kg)	[d]	NA-NG	NA-NG	1.2[b]	NA-NG	NA-NG
1,1-Dichloroethane (mg/kg)	[d]	NA-NG	NA-NG	0.027[b]	NA-NG	NA-NG
1,1-Dichloroethene (mg/kg)	[d]	NA-NG	NA-NG	0.031[b]	NA-NG	NA-NG
1,2-Dichloroethane (mg/kg)	[d]	NA-NG	NA-NG	0.250[b]	NA-NG	NA-NG
1,2-Dichloropropane (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
1,3-cis-Dichloropropene (mg/kg)	[d]	NA-NG	NA-NG	5.10E-04	NA-NG	NA-NG
2-Butanone (mg/kg)	[d]	NA-NG	NA-NG	0.27[b]	NA-NG	NA-NG
2-Hexanone (mg/kg)	[d]	NA-NG	NA-NG	0.022[b]	NA-NG	NA-NG
Acetone (mg/kg)	[d]	NA-NG	NA-NG	0.0087[b]	NA-NG	NA-NG
Benzene (mg/kg)	[d]	NA-NG	NA-NG	0.160[b]	NA-NG	NA-NG
Carbon Disulfide (mg/kg)	[d]	NA-NG	NA-NG	0.00085[b]	NA-NG	NA-NG
Carbon Tetrachloride (mg/kg)	[d]	NA-NG	NA-NG	0.047[b]	NA-NG	NA-NG
Chlorobenzene (mg/kg)	[d]	NA-NG	NA-NG	0.410[b]	NA-NG	NA-NG
Chloroform (mg/kg)	[d]	NA-NG	NA-NG	0.022[b]	NA-NG	NA-NG
Ethylbenzene (mg/kg)	[d]	NA-NG	NA-NG	0.089[b]	NA-NG	NA-NG
Methylene Chloride (mg/kg)	0.03	NA-NG	NA-NG	0.37	NA-NG	NA-NG

Table 2-3. Evaluation Criteria for Sediment Data (Cont'd)

		EPA			NOAA	
Constituent	**Background Criteria[a]**	**SQC**	**SQB[b]**	**EqP SQB**	**TEL**	**PEL**
Tetrachloroethene (mg/kg)	[d]	NA-NG	NA-NG	0.410[b]	NA-NG	NA-NG
Toluene (mg/kg)	0.002	NA-NG	NA-NG	0.050[b]	NA-NG	NA-NG
Trichloroethene (mg/kg)	[d]	NA-NG	NA-NG	0.220[b]	NA-NG	NA-NG
Xylenes, Total (mg/kg)	[d]	NA-NG	NA-NG	0.16	NA-NG	NA-NG
SVOCs						
1,2,4-Trichlorobenzene (mg/kg)	[d]	NA-NG	NA-NG	9.6[b]	NA-NG	NA-NG
1,2-Dichlorobenzene (mg/kg)	[d]	NA-NG	NA-NG	0.33[b]	NA-NG	NA-NG
1,3-Dichlorobenzene (mg/kg)	[d]	NA-NG	NA-NG	1.7[b]	NA-NG	NA-NG
1,4-Dichlorobenzene (mg/kg)	[d]	NA-NG	NA-NG	0.340[b]	NA-NG	NA-NG
2,4-Dimethylphenol (mg/kg)	[d]	NA-NG	NA-NG	0.029	NA-NG	NA-NG
2-Methylnaphthalene (mg/kg)	[d]	NA-NG	NA-NG	0.130[b]	NA-NG	NA-NG
2-Methylphenol (mg/kg)	[d]	NA-NG	NA-NG	0.012[b]	NA-NG	NA-NG
4-Methylphenol (mg/kg)	[d]	NA-NG	NA-NG	0.67	NA-NG	NA-NG
Acenaphthene (mg/kg)	0.25	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Anthracene (mg/kg)	0.20	NA-NG	NA-NG	0.220[b]	NA-NG	NA-NG
Benzo(a)anthracene (mg/kg)	2.3	NA-NG	NA-NG	0.110[b]	0.031	0.385
Benzo(a)pyrene (mg/kg)	1.7	NA-NG	NA-NG	0.140[b]	0.031	0.782
Benzo(b)fluoranthene (mg/kg)	1.5	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Benzo(g,h,i)perylene (mg/kg)	1.8	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Benzo(k)fluoranthene (mg/kg)	1.4	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Bis(2-ethylhexyl)phthalate (mg/kg)	0.56	NA-NG	NA-NG	890.0[b]	NA-NG	NA-NG
Butyl Benzyl Phthalate (mg/kg)	[d]	NA-NG	NA-NG	11.0[b]	NA-NG	NA-NG
Chrysene (mg/kg)	2.4	NA-NG	NA-NG	NA-NG	0.057	0.862
Di-n-butyl Phthalate (mg/kg)	0.047	NA-NG	11	11.0[b]	NA-NG	NA-NG
Di-n-octyl Phthalate (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Dibenzo(a,h)anthracene (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Dibenzofuran (mg/kg)	0.086	NA-NG	2	0.420[b]	NA-NG	NA-NG
Diethyl Phthalate (mg/kg)	[d]	NA-NG	NA-NG	0.60[b]	NA-NG	NA-NG
Dimethyl Phthalate (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Fluoranthene (mg/kg)	7.1	2.9	NA-NG	6.2[c]	0.111	2.36
Fluorene (mg/kg)	0.2	NA-NG	0.54	0.540[b]	NA-NG	NA-NG
Hexachloroethane (mg/kg)	[d]	NA-NG	NA-NG	1.0[b]	NA-NG	NA-NG
Indeno(1,2,3-cd)pyrene (mg/kg)	1.5	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Naphthalene (mg/kg)	0.04	NA-NG	0.48	0.240[b]	NA-NG	NA-NG
Phenanthrene (mg/kg)	5.7	0.85	NA-NG	1.8[c]	0.41	0.515
Phenol (mg/kg)	0.97	NA-NG	NA-NG	0.42	NA-NG	NA-NG
Pyrene (mg/kg)	4	NA-NG	NA-NG	NA-NG	0.053	0.875
Pesticides/PCBs						
Endosulfan Sulfate (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
Endrin ketone (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG
PCB Total (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	0.0341	0.277
Aroclor 1221 (mg/kg)	[d]	NA-NG	NA-NG	0.12	NA-NG	NA-NG
Aroclor 1232 (mg/kg)	[d]	NA-NG	NA-NG	0.2	NA-NG	NA-NG
Aroclor 1242 (mg/kg)	[d]	NA-NG	NA-NG	0.17	NA-NG	NA-NG
Aroclor 1248 (mg/kg)	[d]	NA-NG	NA-NG	1	NA-NG	NA-NG
Aroclor 1254 (mg/kg)	[d]	NA-NG	NA-NG	0.81	NA-NG	NA-NG
Aroclor 1220 (mg/kg)	[d]	NA-NG	NA-NG	NA-NG	NA-NG	NA-NG

[a] Source: *Feasibility Study for the St. Louis North County Site* (USACE, 2000b).
[b] Secondary chronic derived SQB value.
[c] USEPA proposed sediment quality criteria.
[d] Assigned as 0.00 for analytes never detected in background.
EqP = Equilibrium Partitioning SQB based on 1% toxic organic compound (TOC) in sediment.

TEL = Threshold Effects Level.
PEL = Probable Effects Level.
NA-NG = not applicable, no guidance is available.
SQC = Sediment Quality Criteria
SQB = Sediment Quality Benchmark

2.2.4 Evaluation Criteria and Guidelines for Air Monitoring Data

Outdoor air monitoring will be conducted as BMP activities under this EMIFY03. Air monitoring is appropriate at the site boundaries. Other locations for airborne particulate monitoring will be evaluated with respect to regulatory guidelines from 40 CFR 61 and 10 CFR 20. Regulation 40 CFR 61 limits dose to the maximum exposed member of the public to less than 10 mrem/yr from radioactive airborne particulates (excluding radon). This value applies to the critical receptor receiving the highest dose as determined by modeling and/or monitoring which considers inputs such as wind direction and duration of human occupancy. Title 10 Code of Federal Regulation Part 20 (10 CFR 20) limits exposure to the public from operating activities to 100 mrem/yr from all pathways. 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 2.0 pCi/L above background (based on 5% equilibrium between Rn-222 and progeny) at the site perimeter.

All evaluation criteria for air monitoring data are provided in Table 2-4. Tables 2-5 through 2-7 list regulatory commitments and a general description of how the commitments will be implemented.

Table 2-4. Evaluation Criteria for the Air and Direct Radiation Monitoring Data

Media	Parameter	Regulatory Based Guideline	Type of Monitoring
Outdoor Air	Radon	Radon concentration 2.0 pCi/L above background[a]	Radon (alpha track) at fenceline and other locations
	Radiation Dose to Public	Total dose to member of public from all pathways <100 mrem/yr. Airborne particulate dose to member of public <10mrem/yr (exclusive of Rn).	Air Particulates and thermoluminescent dosimeters (TLDs) at fenceline and other locations

[a] 10 CFR 20 Appendix B value of 0.1 pCi/L at 100% equilibrium with progeny is calculated to be 2.0 pCi/L at 5% equilibrium using methodology continued in 10 CFR 835.

Table 2-5. Summary of National Emission Standard for Hazardous Air Pollutants (NESHAPs) Air Emissions Regulation

Regulation: NESHAP* Air Emissions		
Regulation	**Description/Standard**	**Implementation**
40 CFR 61 Subpart I {ARAR in SLDS ROD (USACE, 1998b) and EE/CAs for SLAPS and HISS (USACE, 1998c; 1998e}	Radionuclide emissions of ambient air particulates from federal facilities other than Nuclear Regulatory Commission (NRC) licensees shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr	Compliance with this standard will be demonstrated through 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 analyses report for the calendar year.

Table 2-6. Summary of Uranium Mill Tailings Radiation Control Act (UMTRCA) 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, 1998b). The equivalent of this standard, 40 CFR 61 Subpart Q, was listed in the EE/CAs for SLAPS and HISS (USACE, 1998c; 1998e}	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	Radon measurements will be performed at the site perimeter (the fence line) using radon alpha track detectors (ATDs) as described in 40 CFR 61 Appendix B, Method 114, Method A-7. The USACE has chosen to comply with 10 CFR 20 as a best engineering practice. The results will be reported in the annual environmental monitoring data and analyses report for the calendar year. Note: 10 CFR 20 air effluent limit is 0.1 pCi/L when Rn-222 is in 100% equilibrium with progeny. The limit for St. Louis FUSRAP is 2.0 pCi/L, adjusting the value in the standard for 5% equilibrium with progeny.

Table 2-7. 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 dose from background	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 areas occupied by members of the public. The summation of the dose measured with the TLD, and the calculated dose from radon detectors and particulate air sample results 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 (TEDE) to the critical receptor. Dose from fenceline to critical receptors will be modeled to maximally exposed receptor location in accordance with 10 CFR 20.1302(b)(1) to demonstrate compliance with the dose limit in 10 CFR 20.1301. The USACE has chosen to comply with 10 CFR 20 as a best engineering practice. The results will be reported in the annual environmental monitoring data and analyses report for the calendar year.

3.0 ENVIRONMENTAL MONITORING ACTIVITIES FOR FY03

This section describes the periodic sampling and analysis selected for FY03 to achieve the objectives of the EMP. These EMIFY03 activities will be implemented in conjunction with the program objectives defined as the EMG and program protocols described in the SAG. This section of the EMIFY summarizes the sampling locations, frequencies, and analytes of concern. The SAG details the specific sampling and analytical protocols necessary for field implementation. 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 WDs, unless otherwise captured in 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 follow:

- Provide surveillance of public exposure routes through sampling and analysis;
- Verify compliance with regulations;
- Provide indication and methods to quantify release of materials from the site; and,
- Characterize trends in environmental measurements, especially as they are impacted by site remedial actions.

Measurement objectives to meet regulatory requirements follow.

- Determine the total effective dose equivalent to the hypothetical maximally exposed members of the public from all pathways.
- Determine the effective dose equivalent from airborne emissions to the hypothetical maximally exposed members of the public.
- Calculate radon concentrations at the fence line.
- Determine the direct external gamma exposure in areas accessible to members of the public at the site fenceline.
- Determine background values for the parameters of concern from off-site locations.

Thermoluminescent dosimeters (TLDs), radon alpha track detectors (ATDs), and particulate air filters will be used in various combinations at the SLS to monitor gamma exposure levels and airborne radionuclide emissions. Data from these measurements will be reduced, evaluated, and in some cases converted into effective dose equivalent. Reports to the USACE and the U.S. Environmental Protection Agency (EPA) will be made to meet regulatory and contract requirements.

3.1.2 Sample Locations

Locations for TLD, radon ATDs, and particulate air samples are shown for the three SLS in Figures 3-1, 3-2 and 3-3. Figure 3-4 provides the location of the North County 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.

External Gamma Monitoring (TLD)

TLDs will measure direct gamma exposure from background and residual radioactivity at the SLS. The TLDs will be located at site perimeters (property fence lines) 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 precision.

TLD locations at SLAPS and HISS will be relatively evenly spaced around the perimeter. There are no industries or residences near the SLAPS and, therefore, the fence line monitoring locations arc assumed to be very conservative for estimating exposure to members of the public. At 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 outside locations assumed to be representative of areas accessible to the public (or Mallinckrodt's employees, who are not occupationally monitored for radiation exposure). Areas immediately surrounding Plant No. 5 controlled by Mallinckrodt's radioactive materials license will be avoided.

A background monitoring location is selected for measuring of background exposure rate. This location will be located at the SAIC Holtwick office (see Figure 3-4).

Radon Monitoring (Radon Alpha Track Detectors)

Radon ATDs will be used to measure alpha particle emissions from Radon (primarily Rn-222) and its associated decay products. The radon emissions are expected to increase during remedial actions such as excavation of soils. ATD results are reported as radon air concentrations in picocuries per liter (pCi/L) and are then converted to dose equivalent. Radon ATDs will generally be located with the TLDs at site perimeters. Additional QC duplicates will be used to evaluate measurement precision.

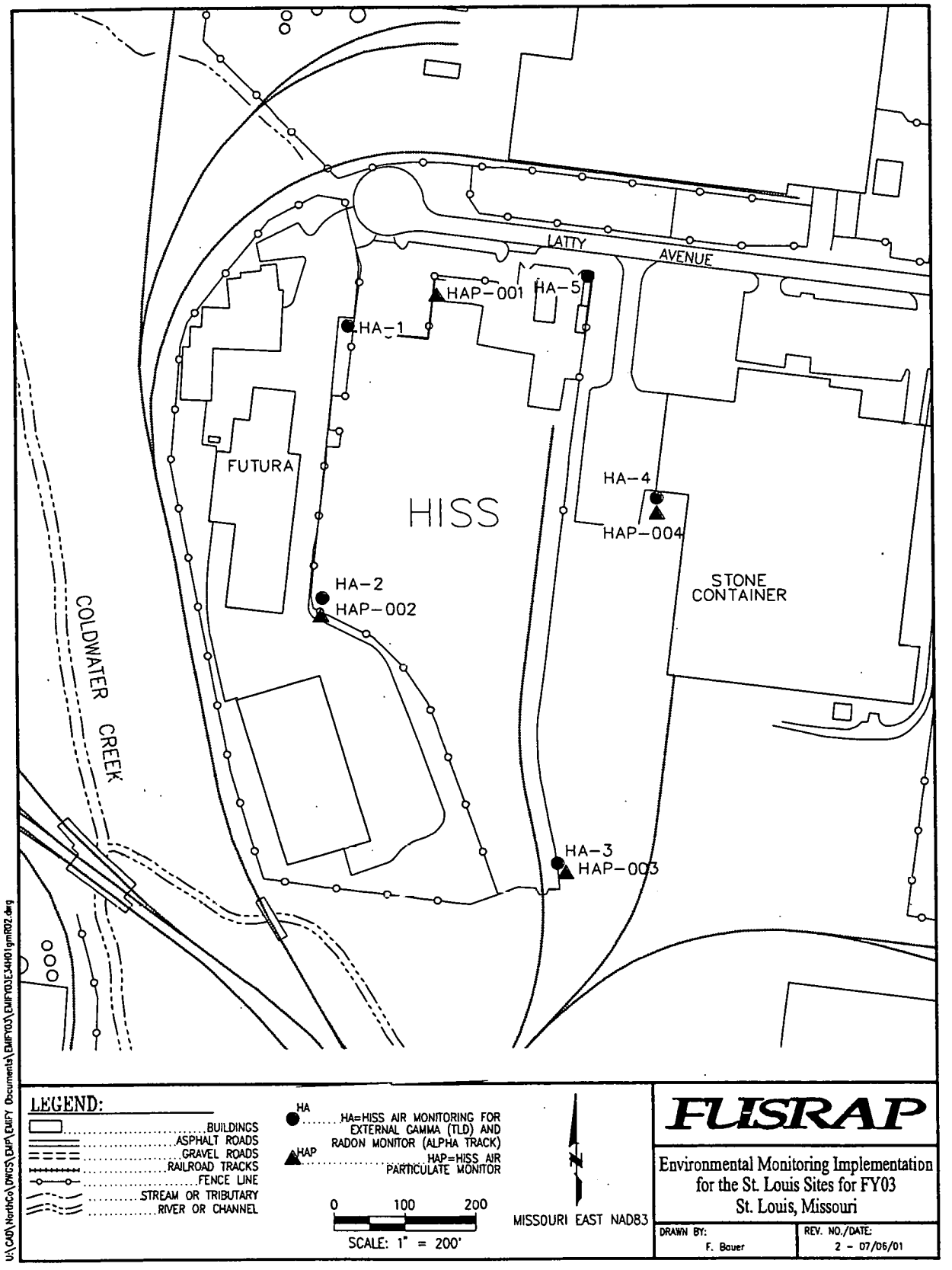

Figure 3-1. Gamma Radiation, Radon-222, and Particulate Air Monitoring Stations at the HISS for FY03

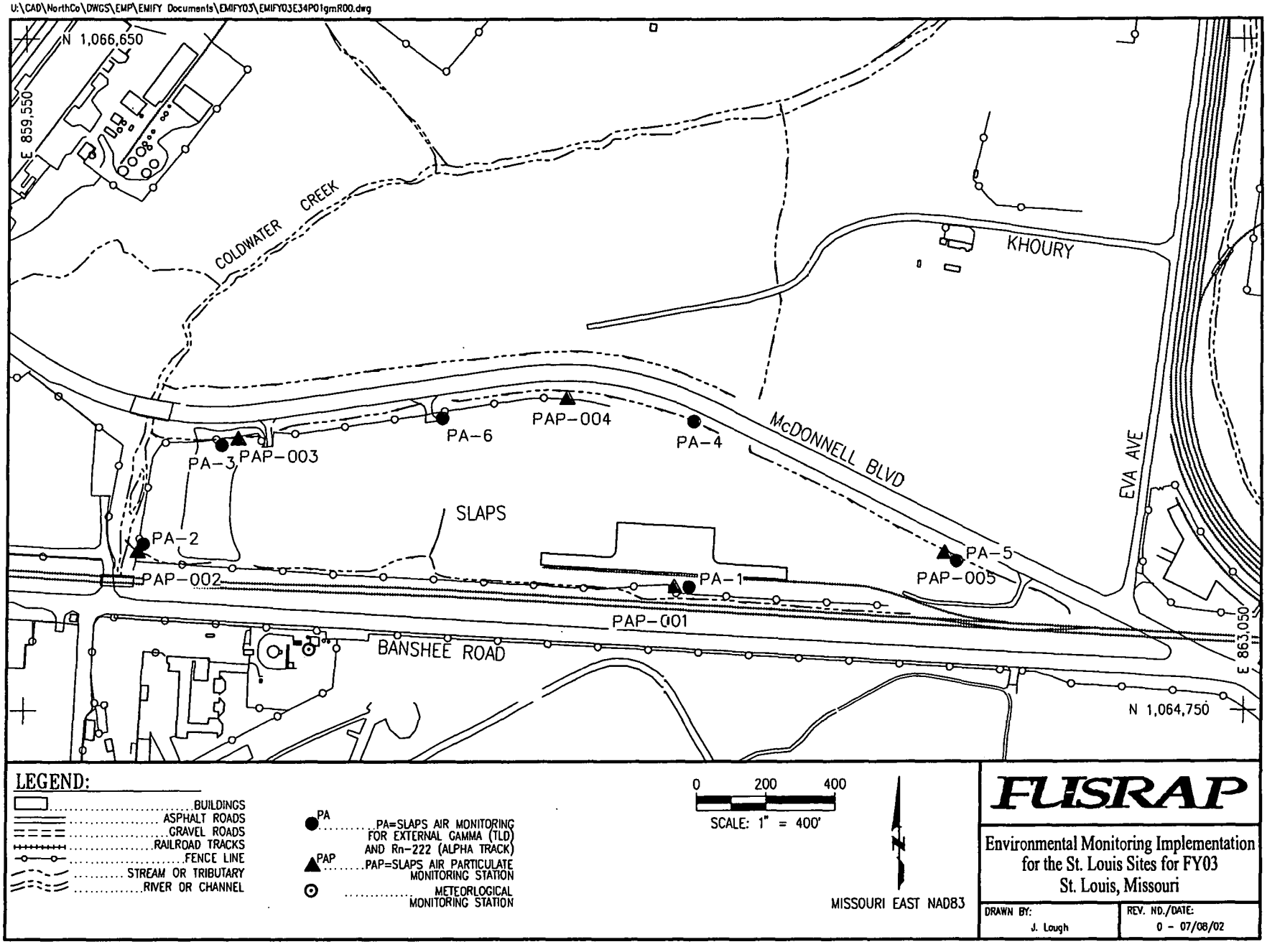

Figure 3-2. Gamma Radiation, Radon-222, and Particulate Air Monitoring Stations at the SLAPS for FY03

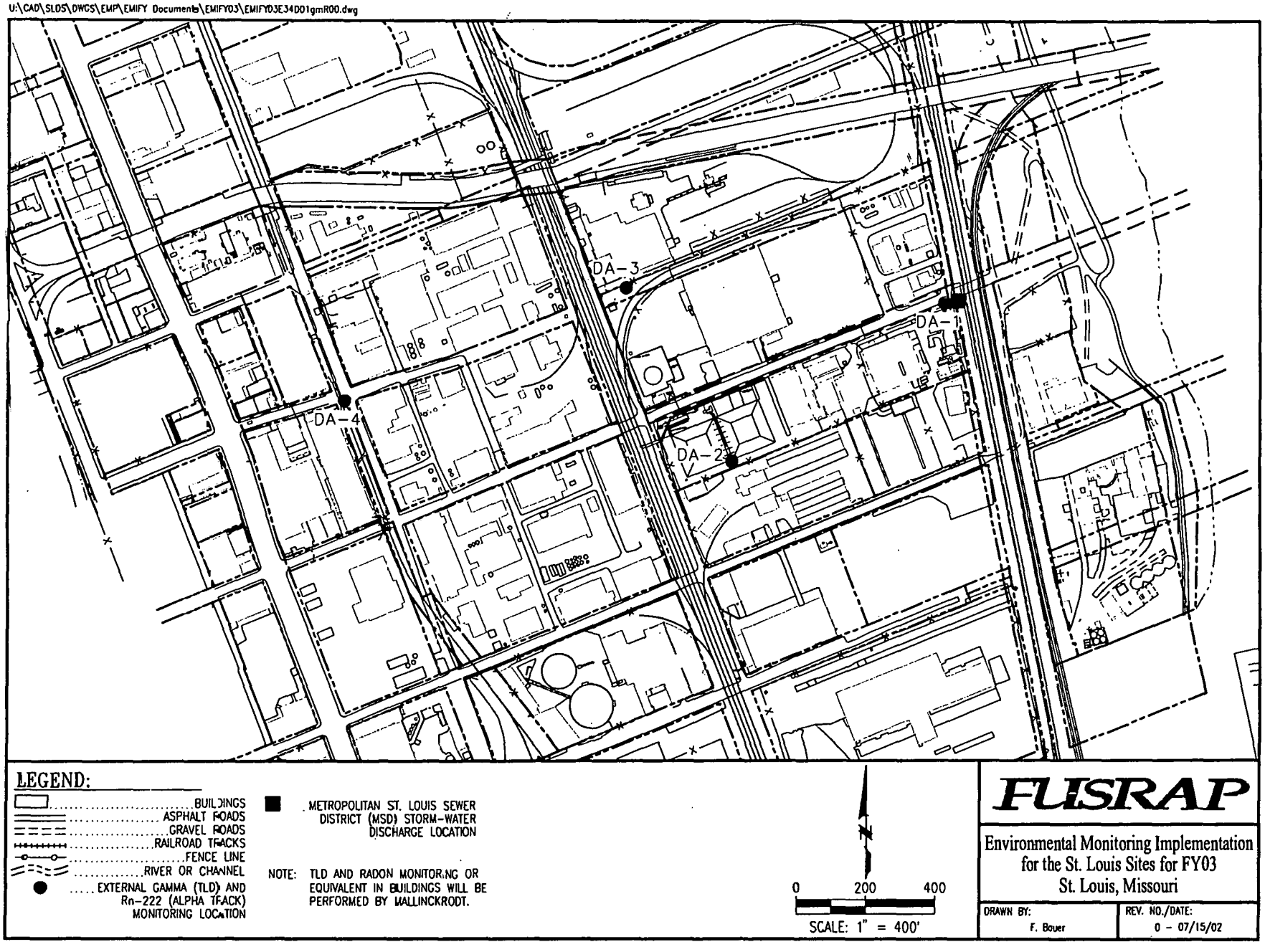

Figure 3-3. Gamma Radiation, Radon-222 and Air Monitoring Stations at the SLDS for FY03

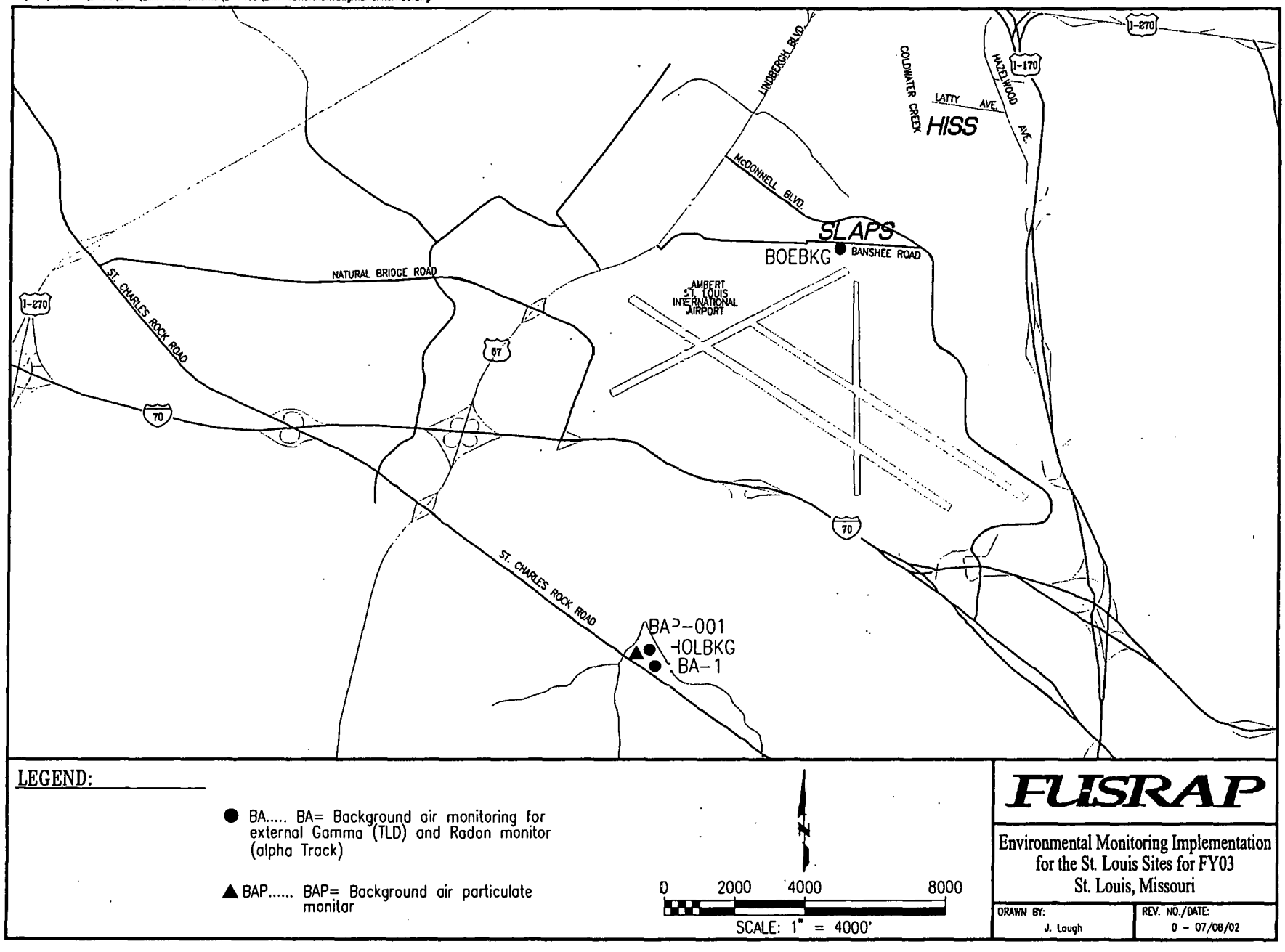

Figure 3-4. Location of Background Air Monitoring Station

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	Semi-annual	Rn-222 and progeny	EMP - public exposure
	4	Filter	Weekly + operation specific	Particulate radionuclides	EMP - NESHAP
SLAPS	6	TLD	Quarterly	External gamma radiation	EMP - public exposure
	6	Alpha track	Semi-annual	Ra-222 and progeny	EMP - public exposure
	5	Filter	Weekly + operation specific	Particulate radionuclides	EMP - NESHAP
SLDS	4	TLD	Quarterly	External gamma	EMP - public exposure
	4	Alpha track	Semi-annual	Rn-222 and progeny	EMP - public exposure
Background	1	TLD	Quarterly	External gamma radiation	EMP - public exposure
	1	Alpha Track	Semi-annual	Rn-222 and progeny	EMP - public exposure
	1	Filter	Weekly + operation specific	Particulate radionuclides	EMP - NESHAP

[a] Public exposure monitoring requirements: 40 CFR 61 Subpart I; 10 CFR 20.1301; 40 CFR 192.32. Fenceline levels and/or concentrations are used to calculate TEDE to the hypothetical maximally exposed critical receptor from the site.

The proposed radon monitoring locations are identical to those described for the TLDs. Locations were chosen with consideration given to predominant wind direction and areas of contamination. Southerly winds predominate from May through November, and northwesterly winds predominate from December through April. The outside locations were selected on north and southeast points of the property fence line to monitor airborne emissions at points that are likely to be highest at the fence line. Additional monitoring locations were relatively evenly spaced around the perimeter. The background location will be co-located with the background TLD stations at the SAIC Holtwick Office (see Figure 3-4).

Particulate Air Monitors

Particulate air samplers will be located at site perimeter locations in predominant wind directions and in areas accessible to members of the public. Additional air samplers may be placed 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 north and southeast points of the property line to monitor airborne emissions at points that are 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 will be co-located with the background TLD station at the SAIC Holtwick Office (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 being collected at least weekly, but possibly more frequently due to operational considerations such as dust loading on the filters, which can reduce the sample flow. The number of samples/measurements and the frequency is tabulated in Table 3-1.

3.1.4 Field and Laboratory Analysis

The selection of parameters to monitor, and samples to collect was based on the regulatory requirements with consideration for the radionuclides and their concentrations at each of the SLS.

Rationale for Analytes

The radionuclides found at the SLS are mainly uranium series nuclides. Each site has radionuclides in the uranium series that may predominant (such as Ra-226 or U-238 or Th-230), thus each radionuclide must be assessed separately. The analytes selected for the air sampling

and analysis program are radionuclides and/or the decay products known to be present in the soil or waste material.

HISS: HISS contains the most homogenous radionuclide distribution of the three sites. The waste piles formerly associated with the HISS (i.e., Main Storage Pile, Supplemental Pile, Spoils Piles, and East Piles) have been remediated and transported to a licensed disposal facility in accordance with the HISS EE/CA (USACE, 1998e). Th-230 was significantly enhanced in 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 pile with the U-235 daughters showing higher concentrations than the U-235. Thorium series nuclides (Th-232 and Ra-228) in the pile were, however, observed to be at the U.S. average background levels for soil. Although the waste piles have been removed from the site, it is assumed that the soil below the piles contains radonuclides 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 *Engineering Evaluation/Cost Analysis (EE/CA) for the Hazelwood Interim Storage Site (HISS)* (USACE, 1998e).

SLAPS: SLAPS is known to contain elevated areas of contamination due to the burial of various uranium by-products over the history of the site. Radionuclides from all three natural decay series may 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) Interim Action Engineering Evaluation/Cost Analysis (EE/CA)* (DOE, 1997).

SLDS: 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* (SLDS FS) (USACE, 1998a).

Analysis Methods

Details regarding the analytical testing methods to be used for analysis of TLDs, radon detectors, 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 laboratorics or through analysis at the HISS laboratory using their approved Laboratory Quality Assurance Plan and standard operating and analysis procedures.

A summary of the type of radiological samples, analysis methods, and the target detection levels for the proposed radiological sampling in FY03 are provided in Table 3-2. Justification for the detection levels is based in part on the capabilities of the instrumentation and in part to meet a fraction of the desired regulatory standard. All detection levels are assumed to meet the definition for minimum detectable activity (MDA) 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 Media	Analytes Measured	Analysis Method	Target Detection Levels
TLD	Direct external gamma exposure from residual contamination	Processed by a qualified vendor.	0.1 mrem/3 months
Alpha Track	Airborne Rn-222 and alpha emitting progeny which originates from Ra-226	40 CFR 61, Appendix B, Method 114, Method A-7, Radon-222 ATDs.	0.2 pCi/L
Particulate Air Filter	Airborne particulate radionuclides: U-234, U-235, U-238 Th-228, Th-230, Th-232, Ra-226, Ra-228	40 CFR 61, Appendix B Method 114, Method A-2, Radiochemistry Alpha Counting. 40 CFR 61, Appendix B Method 114, Method G-1 High Resolution Gamma Spectroscopy. 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 mrem/3 months is approximately 0.3% 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 2 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 lab. 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 2.0 pCi/L based on a 5% equilibrium between radon and its progeny.

The detection level concentrations for uranium and thorium isotopes in particulate air sampling is based on three analytical methods found in 40 CFR 61, Appendix B, Method 114. Method A-2, radiochemistry alpha counting, chemically extracts and separates isotopes which are then evaluated using an alpha counter to determine activity. Method A-2 is normally only used to establish isotopic ratios at a given sampling location but may be used for other purposes such as the determination of isotope specific contaminant levels. Once isotopic ratios have been identified and 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. 40 CFR 61 Appendix B, Method 114, Methods A-2 and A-4 have a detection level of 3.4E-15 µCi/ml and Method B-4 has a detection level of 2.2E-12 µCi/ml which will provide adequate minimum detection levels for dose assessment estimates. Method G-1, high resolution gamma spectroscopy will be utilized as needed to evaluate samples on a case-by-case basis.

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

At least one duplicate TLD station shall be designated at each site for quality control purposes. A duplicate TLD (to be removed every 3 months after placement) shall be installed, collected, and analyzed at the same time as the sample TLDs.

At least one duplicate radon monitoring station shall be designated at each site for quality control purposes. A duplicate detector shall 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.

External Gamma Radiation

External gamma exposure rates are measured using environmental TLDs (aluminum oxide) housed in the PVC holders/shelters positioned at the perimeter boundaries. 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 and background.

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 3 ft above the ground surface at both fence line and off-site locations.

Radon Alpha Track Detectors

Radon (Rn) 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. The ATDs can be purchased from various EPA-approved manufacturers. The ATDs will be placed in the perimeter stations at each site along with the TLDs described in the previous section.

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 30-50 L/min (8-13 gpm), draw ambient air through a 0.45 μm particulate filter. The filter must have a high efficiency for removal of sub-micron particles. The air pumps are equipped with calibrated measurement devices (i.e., rotometers) to monitor air flow rates. Air flow rates may 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 lab for analyses.

Siting of the particulate monitoring stations must be done carefully so that appropriate measurement of particulate concentrations in an area are collected. As discussed in Section 3.1, the stationary air monitoring locations were selected based on the predominant wind directions during the summer and winter months.

During remedial activities additional particulate monitoring may be required 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 shall 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, date of removal for each detector shall be logged. An unexposed TLD shall 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 manufactures and should remain sealed until they are placed in the detector housings. At the time of deployment, the location, date and type of detector shall be recorded. The new unexposed detector shall be placed in the detector housing with the air inlet holes unobstructed. At the end of the six-month exposure period, a self-adhering circular seal (available from the manufacturer) is 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 lab. The date of removal shall be logged. The exposed detectors shall then be packaged in zip-lock type bags and sent to the lab.

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 the filter is removed from the filter housing and final flow rate of the air pump will again 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 total flow volume over the sampling period. Calibrated rotometers will be used to establish initial and final flow rates. Rotometers should be calibrated annually.

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

The length of time between filter change out may 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 two-week sampling period. However, during remedial activities, more dust may be generated requiring more frequent filter change out.

3.1.6.3 Field Quality Control Sampling Procedures

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

3.1.6.4 Field Decontamination

Field decontamination is not required for the measurement and samples obtained for direct radiation exposure and air monitoring.

3.2 GROUND WATER

3.2.1 Objectives for Ground-water Sampling

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

Purpose of the ground-water monitoring effort at the SLS is to:

- Identify potential impacts to ground-water quality resulting from remedial action activities;
- Ensure compliance with ARARs;
- Obtain requisite data for CERCLA remedial performance evaluations; and,
- Determine 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 site description of the geology and the hydrogeology of each site can be found in prior decision documents and the EMG (USACE, 1999).

Objectives for SLDS follow:

- Evaluate ground-water contaminant occurrence and migration within the lower hydrostratigraphic unit (HU-B) with emphasis on the uppermost HU-B surface beneath SLDS and its downgradient perimeter.
- Meet commitments made in ROD.
- Assess background conditions and ground-water quality in several known contamination source areas that will undergo remediation.
- Evaluate potential impacts to ground-water quality resulting from remedial actions.
- Provide data necessary for the CERCLA evaluation process.
- Monitor the ground-water head relative to that of the Mississippi River.

Ground water at SLDS is found within three HUs: the upper soil unit, referred to as the HU-A; the lower soil unit, referred to as either the Mississippi River Alluvial Aquifer or the HU-B; and, the limestone bedrock, referred to as the HU-C (Figure 3-5) (USACE, 1998b). The 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 the industrial setting (USACE, 1998b). The use of the 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 and the city's drinking water supply, and the poor natural water quality of the HU-B (USACE, 1998b). However, the 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* (USEPA, 1988). The HU-C would be an unlikely water supply source, as it is deeper and a less productive hydrostratigraphic unit (USACE, 1998b).

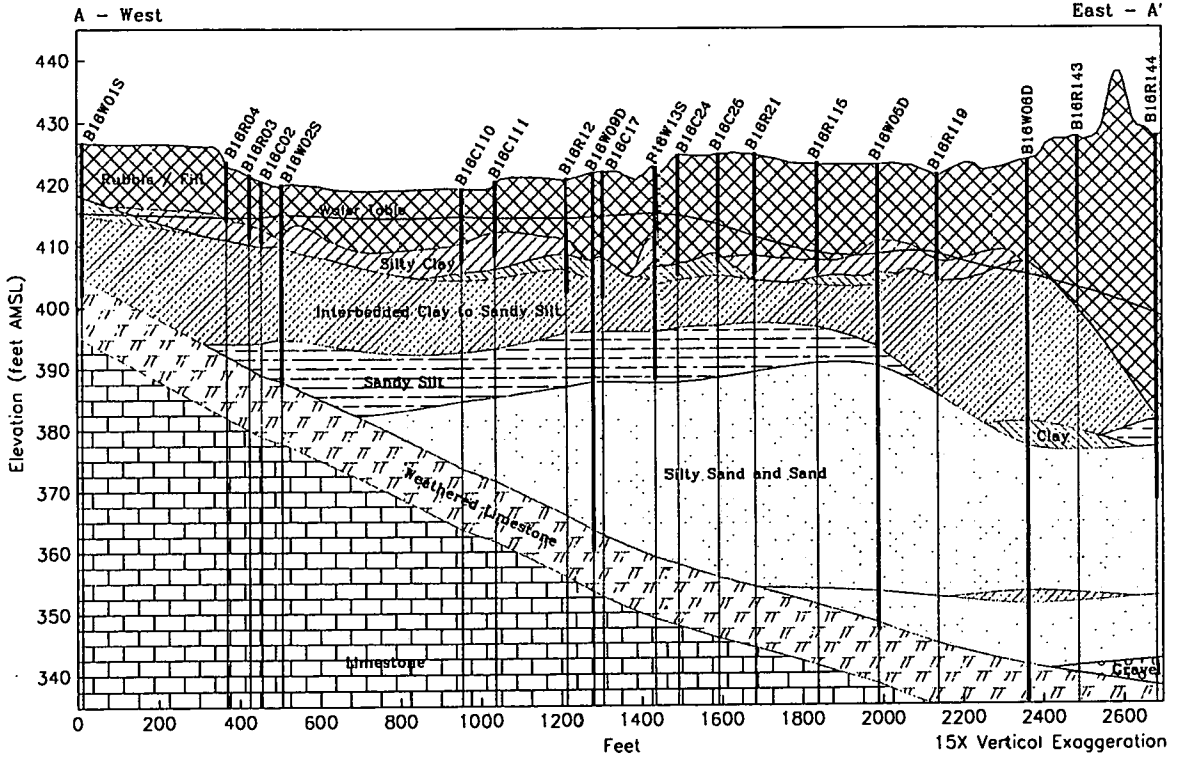

Figure 3-5.
Geologic Cross Section A – A' at SLDS

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

The ground-water monitoring well network for SLDS is identified in Figure 3-6. Figures 3-7 and 3-8 describe the methodologies used to determine the parameter analyzed for each monitoring well and at what sample interval, respectively. Ground-water sampling parameters are listed in Table 3-3. The parameter and interval may be modified based on a review of data as specified in Figures 3-7 and 3-8.

Table 3-3. Ground-Water Monitoring by Site

Site	Parameter [a]	Driver/Purpose
SLDS	1,2,3	ROD (USACE, 1998b)
SLAPS and Vicinity Properties (VPs)	1,2,3,4,5,6,7,8	EMP[b]
HISS	1,2,3,4,5,6,7,8	EMP[b]

[a] Figures 3-5 and 3-6 are used to determine the parameter analyzed and at what specific sample interval for each monitoring well.

[b] Subject to modifications on finalization of Feasibility Study for the St. Louis North County Site.

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, Protactinium-231.

2. **Metals – TAL** include Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Titanium, Uranium, Vanadium, Zinc. (NOTE: Arsenic and Cadmium are the only metals analyzed at SLDS).

3. **Field parameters** include Hardness, pH, Conductance, Eh, Temperature, Dissolved Oxygen, Turbidity, static water levels.

4. **VOCs** include Chloromethane, Bromomethane, Vinyl Chloride, Chloroethane, Methylene Chloride, Acetone, Carbon disulfide, 1,1-Dichloroethene, 1,1-Dichloroethane, 1,2-Dichloroethene (total), Chloroform, 1,2-Dichloroethane, 2-Butanone, 1,1,1,-Trichloroethane, Carbon tetrachloride, Bromodichloromethane, 1,2-Dichloropropane, *cis*-1,3-Dichloropropene, Trichloroethene, Dibromochloromethane, 1,1,2-Trichloroethane, Benzene, *trans*-1,3-Dichloropropene, 4-Methyl-2-pentanone, 2-Hexanone, Tetrachloroethene, Toluene, 1,1,2,2-Tetrachloroethane, Chlorobenzene, Ethylbenzene, Styrene, Xylenes [dimethybenzene] (total), 1,1,2,-Trichloroethane, 1,2,2-Trifluoroethane.

5. **SVOCs** includes Phenol, bis(2-Chloroethyl) ether, 2-Chlorophenol, 4-Chlorobenzenamine, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 1,2-Dichlorobenzene, 2-Methylphenol, bis(2-chloroisopropyl) ether, 4-Methylphenol, 2-Nitrobenzenamine, 3-Nitrobenzenamine, 4-Nitrobenzenamine, N-nitroso-di-n-dipropylamine, Hexachloroethane, Nitrobenzene, Isophorone, 2-Nitrophenol, 2,4-Dimethylphenol, Bis(2-chlorethoxy) methane, 2,4-Dichlorophenol, 1,2,4-Trichlorobenzene, Naphthalene, Hexachlorobutadiene, 4-Chloro-3-methylphenol, 2-Methylnaphthalene, Hexachlorocyclopentadiene, 2,4,6-Trichlorophenol, 2,4,5-Trichlorophenol, 2-Chloronaphthalene, Dimethylphthalate, Acenaphthylene, 2,6-Dinitrotoluene, Acenaphthene, 2,4-Dinitrophenol, 4-Nitrophenol, Dibenzofuran, 2,4-Dinitrotoluene, Diethylphthalate, 4-Chlorophenyl-phenyl ether, Fluorene, 4,6-Dinitro-2-methylphenol, N-Nitrosodiphenylamine, 4-Bromophenyl-phenylether, Hexachlorobenzene, Pentachlorophenol, Phenanthrene, Anthracene, Carbazole, Di-n-butylphthalate, Fluoranthene, Pyrene, Butylbenzylphthalate, 3,3'-Dichlorobenzidine, Benzo(a)anthracene, Chrysene, Bis(2-Ethylhexyl)phthalate, Di-n-octylphthalate, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene.

6. **Geochemical Parameters** include Ammonia, Alkalinity, Hardness, Nitrate, Sulfate, Chloride, Fluoride, Phosphorus, Total Organic Carbon, Total Suspended Solids, Total Dissolved Solids.

7. **Herbicides** include 2,4-D, 2,4-DB, 2,4,5-TP (Silvex), 2,4,5-T, Dalapon, Dicamba, Dichloroprop, Dinoseb, MCPA, MCPP.

8. **Pesticides** include Alpha-BHC, Beta-BHC, Delta-BHC, gamma-BHC, Heptachlor, Aldrin, Heptachlor epoxide, Endosulfan I, Dieldrin, 4,4'-DDE, Endrin, Endosulfan II, 4,4'-DDD, Endosulfan sulfate, 4,4'-DDT, Methoxychlor, Endrin ketone, Endrin aldehyde, Alpha-Chlordane, Lindane, Gamma-Chlordane, Toxaphene, Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, Aroclor-1260.

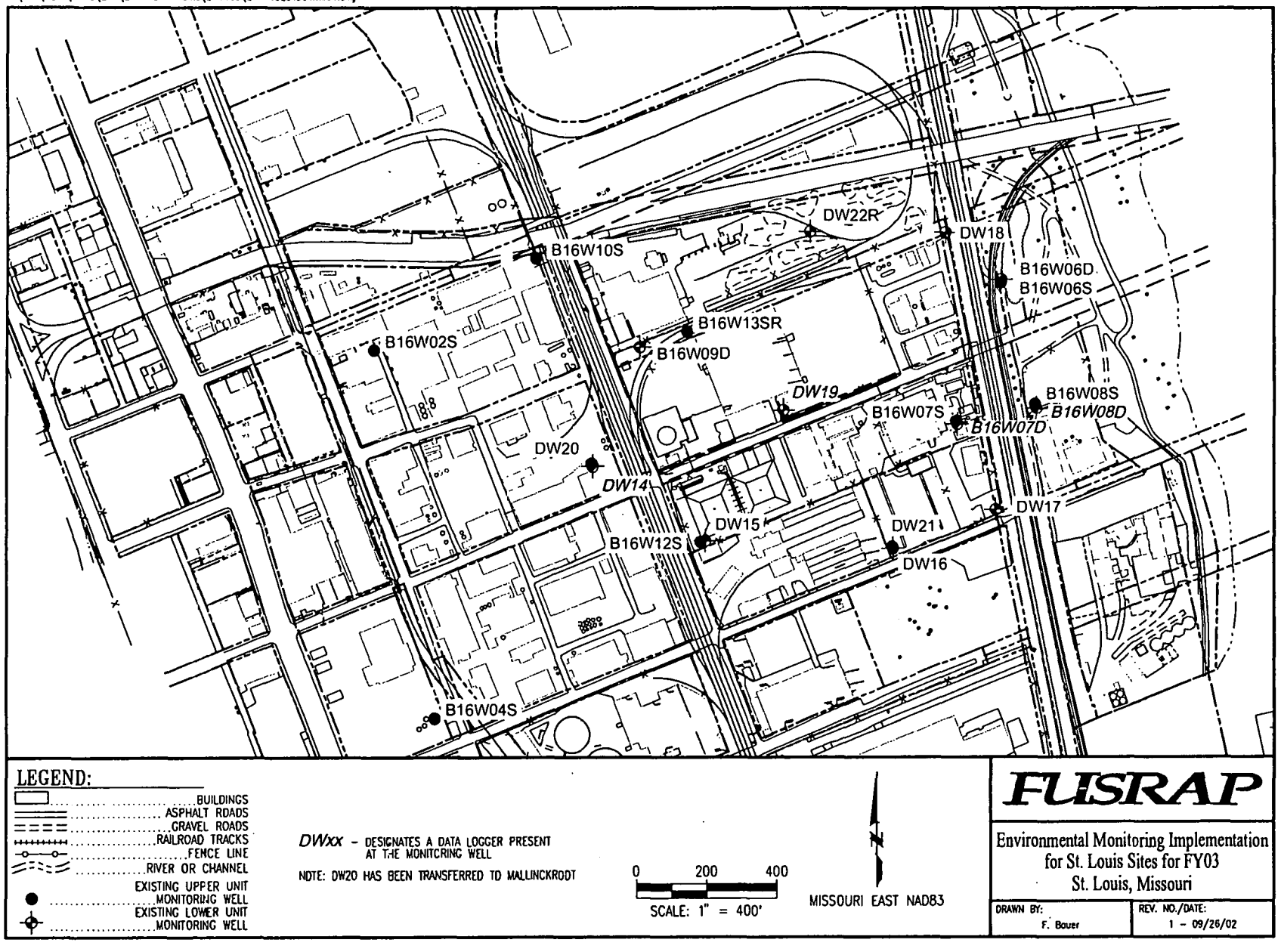

Figure 3-6. Ground-water Monitoring Well Locations at the SLDS

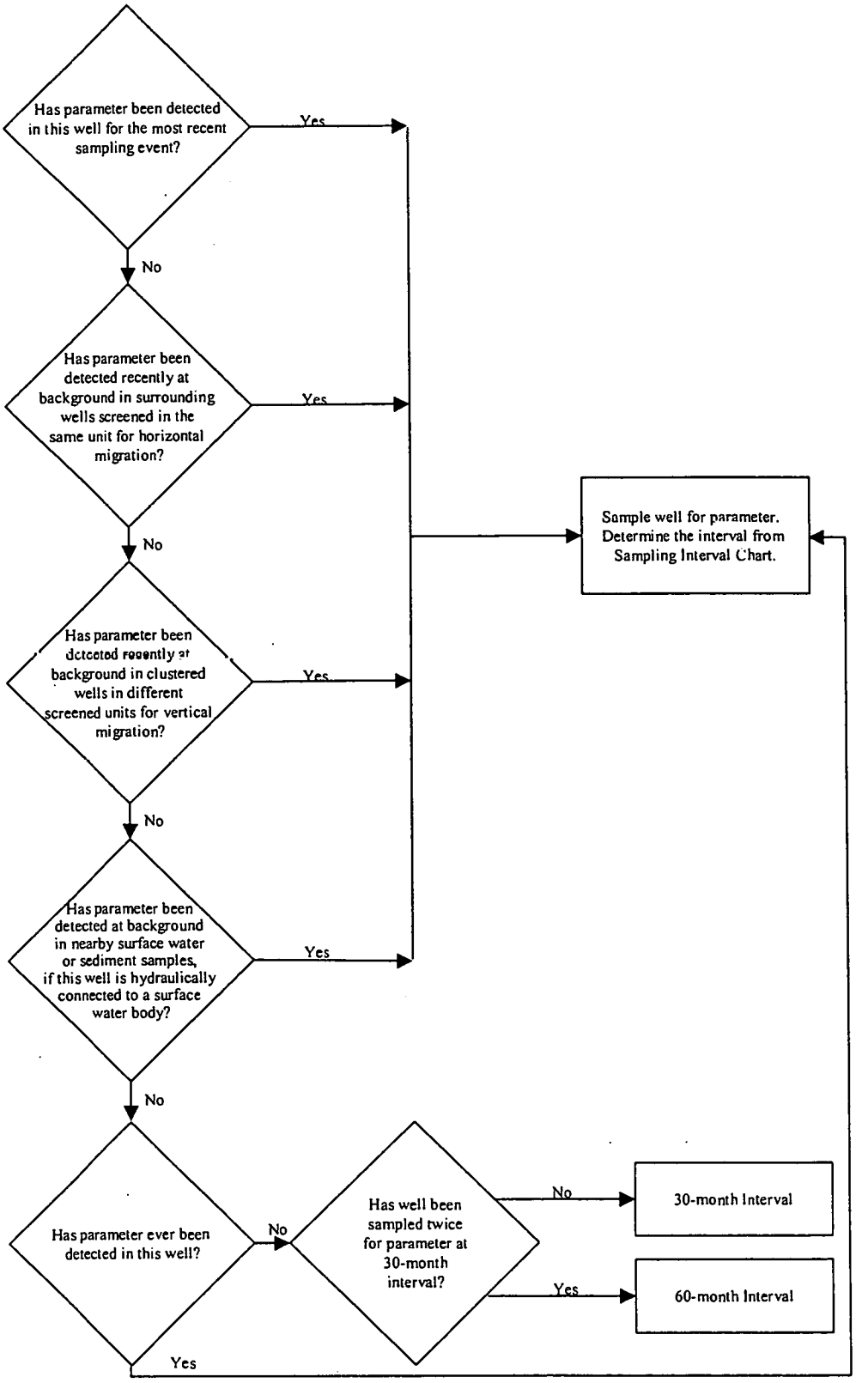

Figure 3-7. Sampling Parameter Chart

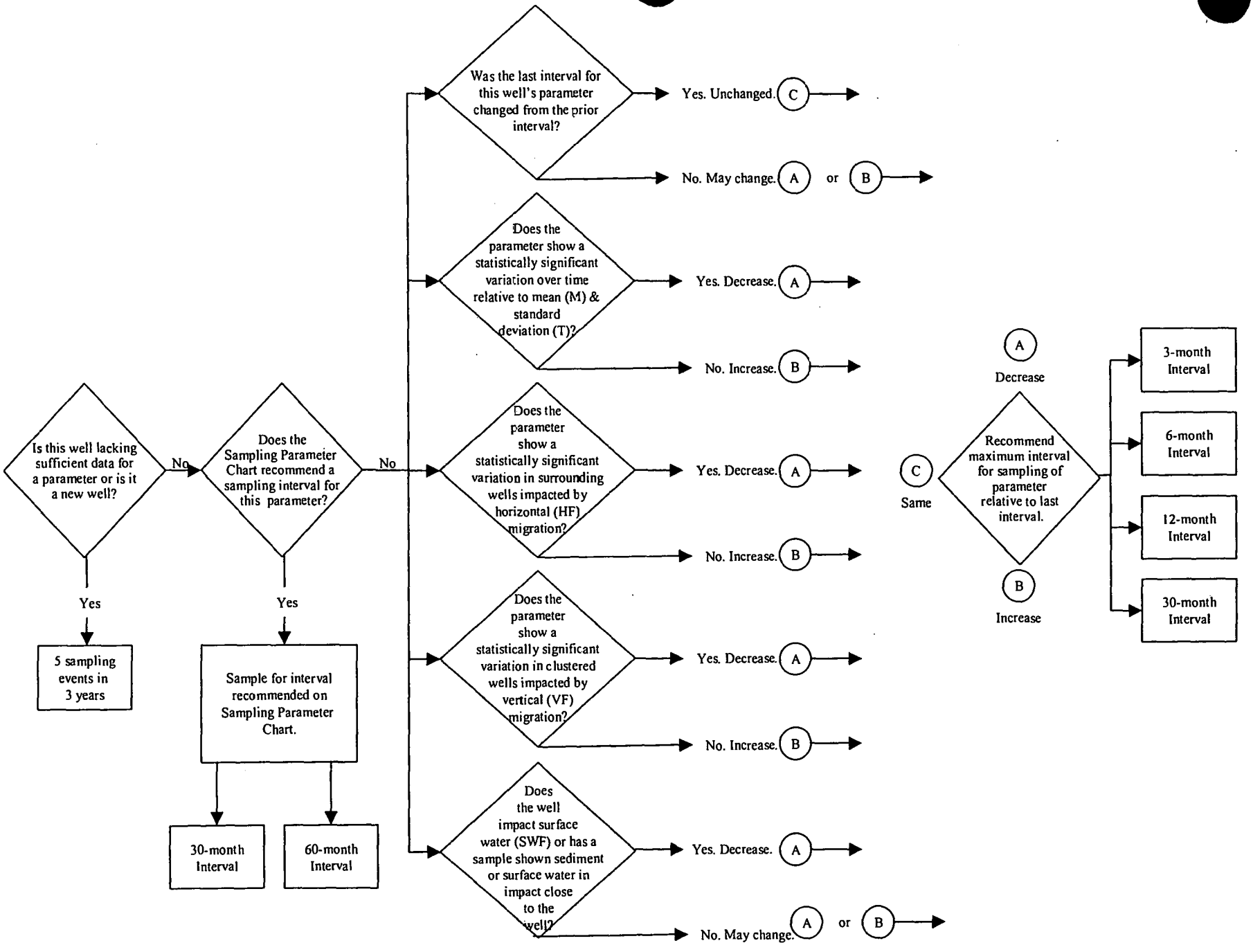

Figure 3-8. Sampling Interval Chart

Objectives for St. Louis Airport Site and VPs follow.

- Evaluate potential ground-water contaminant migration and flow primarily in the upper hydrostratigraphic zone.
- Monitor contaminant discharge to Coldwater Creek.
- Evaluate potential impacts to ground-water quality resulting from remedial actions and provide data necessary for CERCLA evaluation.

There are five hydrostratigraphic zones (HZs) recognized beneath SLAPS (see Figure 3-9). The surficial deposits include topsoil and anthropogenic fill (Unit 1) and the Pleistocene glacially-related sediments of stratigraphic Unit 2 and Subunit 3T comprise the HZ-A. A clay with low vertical permeability comprising Subunit 3M of stratigraphic Unit 3 is HZ-B. HZ-C is comprised of the stratigraphic Subunit 3B and Unit 4. The shale and limestone are recognized as HZ-D and HZ-E, respectively.

The ground-water monitoring well network for SLAPS and VPs is identified in Figure 3-10. No new monitoring wells are planned for SLAPS. Figures 3-7 and 3-8 describe the methodologies used to determine the parameter analyzed for each monitoring well and at what sample interval, respectively. Ground-water sampling parameters are listed in Table 3-3. The parameter and interval may be modified based on a review of data as specified in Figures 3-7 and 3-8.

Objectives for HISS follow:

- Evaluate the ground-water contaminant occurrence and migration primarily in the upper hydrostratigraphic zone.
- Monitor contaminant discharge to Coldwater Creek.
- Evaluate potential impacts to ground-water quality resulting from remedial actions and provide data necessary for CERCLA evaluation.

The hydrogeologic and geologic setting at HISS is similar to that at SLAPS (see Figure 3-9), with an exception: the Pennsylvanian shale bedrock unit (HZ-D) present at SLAPS is absent at HISS.

The current ground-water monitoring well network for HISS is identified in Figure 3-11. No new monitoring wells are planned for installation at HISS. Figures 3-7 and 3-8 describe the methodologies used to determine the parameter analyzed for each monitoring well and at what sample interval, respectively. Ground-water sampling parameters are listed in Table 3-3. The parameter and interval may be modified based on a review of data as specified in Figures 3-7 and 3-8.

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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Environmental Monitoring Implementation for the St. Louis Sites for FY03 St. Louis, Missouri

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Figure 3-9. Generalized Stratigraphic Column for SLAPS and HISS

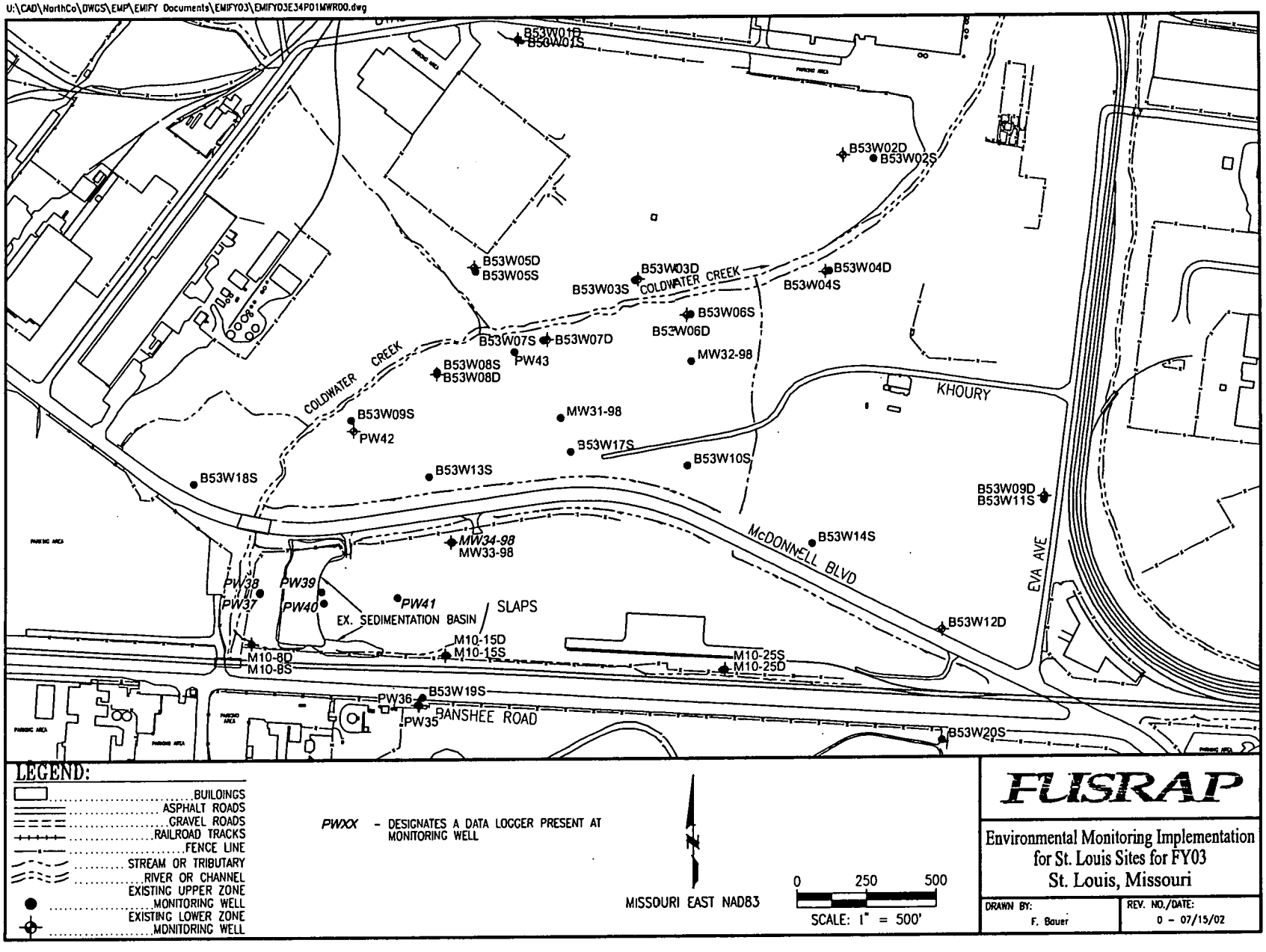

Figure 3-10. Ground-water Monitoring Well Locations at SLAPS and Vicinity Properties for FY03

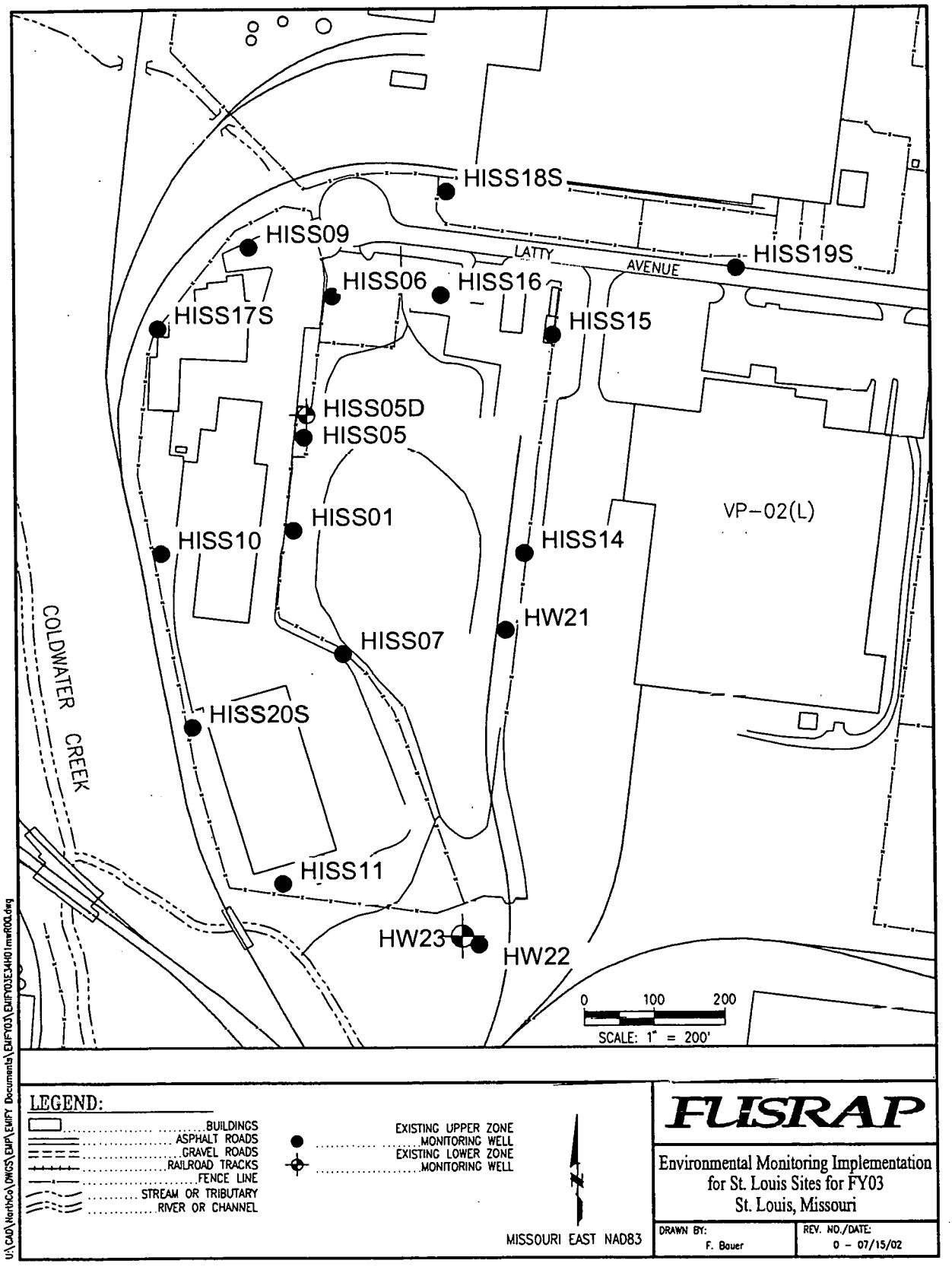

Figure 3-11. Ground-water Monitoring Well Locations at the HISS for FY03

3.2.2 Proposed New Ground-water Monitoring Wells

No new ground-water monitoring wells are planned for SLS. As identified in Section 3.2.1, ground-water monitoring at the three SLS will be completed to meet various federal and state requirements. To accomplish these and other ground-water related objectives, additional wells or well replacements may need to be installed during FY03, should conditions change. Specific objectives which may be considered at each site are identified below.

General rationale for new ground-water monitoring wells at the SLS for FY03:

- 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/confirm background water quality at each of the sites. Ensure adequate monitoring network is established for potentiometric and ground-water, quality monitoring at each key hydrostratigraphic zone.
- Evaluate ground-water contaminant occurrence and migration.
- Evaluate existing monitoring network and provide recommendations for additional well or wells to be abandoned or replaced.

3.2.3 Rationale for Ground-water Sampling

The rationale for the sampling programs established for each site is based on site-specific requirements and conditions and on well analyte history. Rationale for the ground-water monitoring plan correlates with the evaluation criteria identified in Section 2 with the exception of SLDS. The ROD requirements determined ground-water monitoring rationale at SLDS (USACE, 1998b). At the North County Site analytes targeted for monitoring will include constituents of potential concern (COPCs) as identified in the Baseline Risk Assessment (DOE, 1993) and other CERCLA documents and selected indicator constituents with high mobility that may serve as early indicators of contaminant migration.

3.2.4 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 from the ground-water monitoring well network at each site will undergo laboratory analytical analysis for the parameters previously identified in Table 3-3. Following signature of a North County SLS ROD, 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 analysis 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, balers, 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 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. All ground-water samples collected for analysis of metal, radiological, and water quality (new wells only) parameters will be collected as unfiltered, unless the turbidity is 50 NTU or greater, in which case both filtered and unfiltered samples may be collected.

QA Split Samples

In addition to the sampling conducted for the field measurements described above, QA split samples will be collected for 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.

3.3 STORM-WATER AND WASTE-WATER DISCHARGE SAMPLING

Storm-water sampling is considered a principal component of the EMIFY at SLAPS, HISS, and SLDS. It is planned that remedial actions at all three sites will result in waste-water discharges that are covered under separate discharge requirements. Monitoring will be conducted to meet ARAR permit conditions at each site. Parameters for each of the SLS can be found along with sampling locations, parameters, and sampling frequencies in Table 3-4.

Purpose of storm-water and waste-water discharge sampling at the SLS includes the following:

- MDNR storm-water discharge requirements per NPDES permit number MO-0111252 for the HISS.
- Metropolitan Sewer District discharge permit for the HISS on-site laboratory.
- MDNR - NPDES ARAR document dated October 2, 1998 for the SLAPS.
- Metropolitan Sewer District (MSD) discharge for SLAPS excavation water authorization letter dated July 23, 2001.
- MSD discharge authorization letter dated July 23, 2001 for SLDS.

Objective for SLAPS and VP

The NPDES permit for storm water discharges from SLAPS requires that outfalls be sampled in accordance with the NPDES ARAR document (NPDES permit equivalent).The NPDES ARAR document specifies ARAR discharge limits for monitoring purposes at this site. In addition, monitoring to meet MSD discharge requirements is also conducted. These sample locations are shown on Figure 3-2.

Objective for HISS

The NPDES permit for storm-water discharge from HISS requires that outfalls be sampled in accordance with the State operating permit which meets MDNR specifications/recommendations. The Missouri State operating permit (MO-0111252) specifies recommended limits for the storm-water discharge monitoring being conducted. These outfall locations are shown on Figure 3-1.

Objectives for SLDS

SLDS waste-water discharge monitoring is conducted in accordance with the MSD authorization letter dated July 23, 2001. The waste-water is storm-water and ground-water that accumulates at SLDS. Wastewater discharge results from work-related remedial activities such as dewatering of soil excavations, soil dewatering and equipment decontamination.

3.4 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 analysis will coincide with those for the surface-water samples.

Objectives for Coldwater Creek:

- Assess impacts of remedial activities along Coldwater Creek.
- Assess the water quality of the creek to ensure the state Aquatic Water Quality Criteria (AWQC) for Class I waters are not exceeded at the Mississippi River.
- Assess the potential fate and transport of contaminants for CERCLA re-evaluation process.
- Compare contaminant concentrations in both their soluble and insoluble forms.
- Determine upgradient water quality and sediment levels for background purposes.
- Compare sediment data and surface water data to differentiate impacts from upstream sources of each of the sites.

Figure 3-12 shows the sediment sample locations which will all be co-located with the surface-water locations. Sampling frequency, along with sampling parameters and locations are listed along with surface water data in Table 3-4. This sampling will be conducted at Coldwater Creek's baseflow. Samples will be taken over a seven day period during the third quarter to obtain representative samples of baseflow water conditions for the year.

Table 3-4. Storm-Water, Waste-Water, Surface-Water and Sediment Monitoring Location, Frequencies, and Parameters

Site	Monitoring Location	Sample ID	Media/Sample Type	Frequency[a]	Parameters[b]	Driver / Purpose	Status	Comments
HISS	#001	HN01	Storm water/composite*	Quarterly – List 1	List 1	NPDES	Active	Permit: MO-0111252
	#002	HN02	Storm water/composite*	Quarterly – List 1	List 1	NPDES	Active	Composite = minimum of 4 grab samples collected within 24 hours.
	#003	HN03	Storm water/composite*	Quarterly – List 1	List 1	NPDES	Active	Composite = minimum of 4 grab samples collected within 24 hours.
SLAPS	#001	PN01 a and b	Storm water/grab	Monthly – List 2	List 2	NPDES	Active	ARAR document letter from MDNR to USACE dated 10/02/98
	#002	PN02	Storm water/grab	Monthly – List 2	List 2	NPDES	Bermed excavation	Grab sample = collected during rainfall that results in discharge
	#003	PN03	Storm water/grab	Monthly – List 2	List 2	NPDES	Active-bales block culvert	For total U, Ra and Th: µg/L – once/month MSD discharge authorization letter to USACE dated 7/23/01.
CWC	Location 1	CWC002	Surface water-sediment	Semi-annual – List 3	List 3	EMP	Active	
	Location 2	CWC003	Surface water-sediment	Semi-annual – List 3	List 3	EMP	Active	
	Location 3	CWC004	Surface water – sediment	Semi-annual – List 3	List 3	EMP	Active	
	Location 4	CWC005	Surface water – sediment	Semi-annual – List 3	List 3	EMP	Active	
	Location 5	CWC006	Surface water – sediment	Semi-annual – List 3	List 3	EMP	Active	
	Location 6	CWC007	Surface water – sediment	Semi-annual – List 3	List 3	EMP	Active	
SLDS						MSD		Sampling is batch dependent and therefore conducted on a non-routine basis. MSD discharge authorization letter dated 10/30/98 from MSD to IT. Revised 07/23/01.

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

[a]Definition of Frequency Lists

List 1 includes Settleable solids-monthly; Total rainfall – daily (24-hr); Flow rate – daily (24 hr); 1st quarter – Mar; 2nd quarter – Jun; 3rd quarter – Sept; 4th quarter – Dec; Weekly (SLAPS sedimentation basin Remedial /Removal Action).

List 2 includes all parameters once/month, except as noted in comments; Radon – twice year.

List 3 includes COCs – semi-annual; Pesticides.

[b]Definition of Parameter Lists

List 1 includes Rainfall (in), Flow (MGD), Settleable solids (mL/L/hr), Specific conductance (µmhos/cm), TOC (mg/L), TOX (mg/L), Gross alpha (pCi/L), Gross beta (pCi/L) Radium-226 (pCi/L), Radium-228 (pCi/L), Thorium-232 (pCi/L), Thorium-230 (pCi/L), Uranium (total) (pCi/L), pH.

List 2 includes Flow (MGD), Oil and grease (mg/L), Total petroleum hydrocarbons (mg/L), COD (mg/L, Settleable solids (mL/L/hr), Arsenic (total recoverable) (mg/L), Cadmium (total recoverable) (mg/L), Chromium (total recoverable) (mg/L), Copper (total recoverable) (mg/L), Lead (total recoverable) (mg/L), Gross alpha (pCi/L), Gross beta (pCi/L), PCBs (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 3 includes Radiochemical Parameters, TAL metals, SVOCs, VOCs, Pesticides, Geochemical Parameters (surface water only), Chloride, Nitrate, Sulfate, Oil and grease (surface water only), 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, Actonium-227, Protactinium-231.

TAL metals include Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium. Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Molybotenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Titanium, Uranium, Vanadium, Zinc.

Field Parameters include Temperature, pH, Conductivity, and Eh (for sediment only) and Dissolved Oxygen (for water only)

VOCs (surface water only) include Chloromethane, Bromomethane, Vinyl Chloride, Chloroethane, Methylene Chloride, Acetone, Carbon disulfide, 1,1-Dichloroethene, 1,1-Dichloroethane, 1,2-Dichloroethene, Chloroform, 1,2-Dichloroethane, 2-Butane, 1,1,1,-Trichloroethane, Carbon tetrachloride, Bromodichloromethane, 1,2-Dichloropropane, cis-1,3-Dichloropropene, Trichloroethene, Dibromochloromethane, 1,1,2-Trichloroethane, Benzene, trans-1,3-Dichloropropene, Tribromomethane, 4-Methyl-2-pentanone, 2-Hexanone, Tetrachloroethene, Toluene, 1,1,2,2-Tetrachloroethane, Chlorobenzene, Ethylbenzene, Styrene, Xylenes [dimethylbenzene], Freon.

SVOCs includes Phenol, bis(2-Chlorethyl) ether, 2-Chlorophenol, 1,3-Dichlorobenzene, 1,4-Dichlorbenzene, 1,2-Dichlorobenzene, 2-Methylphenol, 2-Nitrobenzenamine, 4-Methylphenol, N-nitroso-di-n-dipropylamine, Hexachloroethane, Nitrobenzene, Isophorone, 2-Nitrophenol, 2,4-Dimethylphenol. Bis(2-chlorethoxy) methane, 2,4-Dichlorophenol, 1,2,4-Trichlorobenzene, Naphthalene, Hexachlorobutadiene, 4-Chloro-3-methylphenol, 2-Methylnaphthalene, Hexachlorocyclopentadiene, 2,4,6-Trichlorophenol, 2,4,5-Trichlorophenol, 2-Chloronaphthalene, 3- Nitrobenzenamine , Dimethylphthalate, Acenaphthylene, 2,6-Dinitrotoluene, Acenaphthene, 2,4-Dinitrophenol, 4-Nitrophenol, Dibenzofuran, 2,4-Dinitrotoluene, Diethylphthalate, 4-Chlorophenyl-phenyl ether, Fluorene, 4,6-Dinitro-2-methylphenol, N-nitrosodiphenylamine, 4- Nitrobenzenamine , 4-bromophenyl-phenylether, Hexachlorobenzene, Pentachlorophenol, Phenanthrene, Anthracene, Carbazole, Di-n-butylphthalate, Fluoranthene, Pyrene, Butylbenzylphthalate, 3,3'-Dichlorobenzidine, Benzo(a)anthracene, Chrysene, Bis(2-Ethylhexyl)phthalate, Di-n-octylphthalate, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene, bis(2-chloroisopropyl)ether.

Geochemical Parameters (surface water only) include Ammonia, Alkalinity, Nitrate, Nitrite, Sulfate, Chloride, Fluoride, Phosphorus, Orthophosphorus, Hardness, Total Suspended Solids (for sediments only).

Herbicides include 2,4-D, 2,4-DB, 2,4,5-TP (Silvex), 2,4,5-T, Dalapon, Dicamba, Dichloroprop, Dinoseb, MCPA, MCPP.

Pesticides (sediment only) include Alpha-BHC, Beta-BHC, Delta-BHC, gamma-BHC, Heptachlor, Aldrin, Heptachlor epoxide, Endosulfan I, Dieldrin, 4,4'-DDE, Endrin, Endosulfan II, 4,4'-DDD, Endosulfan sulfate, 4,4'-DDT, Methoxychlor, Endrin ketone, Endrin aldehyde, Alpha-Chlordane, Lindane, Gamma-Chlordane, Toxaphene, Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, Aroclor-1260

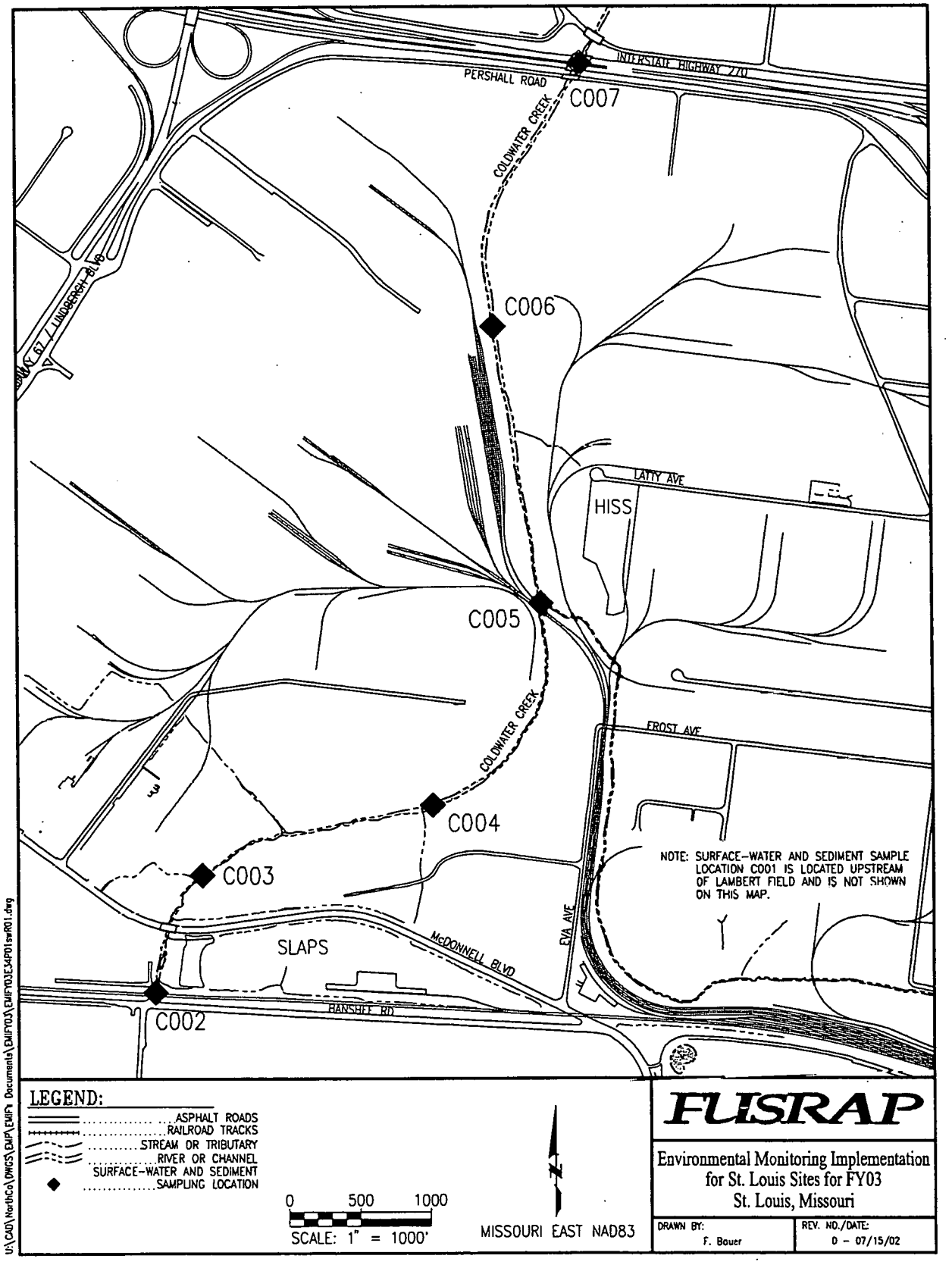

Figure 3-12. Surface-water and Sediment Sampling Locations at Coldwater Creek

4.0 PROGRAM PROTOCOLS

4.1 ORGANIZATION

The U.S. Army Corp of Engineers-St. Louis District (USACE-SLD) shall issue an annual EMIFY for each fiscal year 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 shall correspond to those delineated in the *Sampling and Analysis Guide for the St. Louis Sites* (SAG) or other implementation plan (USACE, 2000a). 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 shall be issued that describes the activity-specific requirements. Each WD shall 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 fiscal year vicinity property characterization plan.

4.2 SAMPLING PROCEDURES

Field sampling procedures for the various media monitored by the EMIFY shall 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. The SAG specifies sample documentation requirements, which includes the sample numbering system, logbook requirements, and sample labels that pertain to samples collected under the EMG. Chain of custody requirements for EMIFY samples are specified in the SAG.

4.4 ANALYTICAL PROTOCOLS

Samples collected under this EMIFY shall 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 EMIFY03 will be managed in accordance with the requirements of the *EPA Guide to Management of Investigation-Derived Wastes* (USEPA, 1992).

Table 4-1 outlines the management of IDW that is generated from various activities at the FUSRAP.

Table 4-1. Investigation Derived Wastes 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., Resource Conservation and Recovery Act (RCRA)]: containerize and place in storage until receipt of analytical results. Non regulated or non-suspect: containerize and store in designated storage area (i.e., generated at SLDS stored at SLDS or generated in North County stored at HISS). IT disposition waste water at SLDS and SAIC to manage purge water from North County wells at HISS.
	Surface water	Characterization activities	
	Decontamination water	Decontamination of equipment	Disposition in controlled area such that it will not pond, runoff site or through an outfall.
Soil	Soils and/or sediment	Drill cuttings Soil sampling	Known or suspect contaminated area: Place soils in a contaminated soils 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	PPE	Sample activities Other misc. activities	Reusable: decontaminate. Disposable: dispose with other radiological trash. If used to sample suspect hazardous wastes, segregate and dispose as directed by task manager.
	Equipment	Sampling equipment Monitoring equipment (swipes, filters, etc)	Reusable: decontaminate. Disposable: dispose as radiological trash. If used to sample suspect hazardous wastes segregate, and dispose as directed by task manager.
Laboratory Wastes	Soil, filter papers, test tubes, other radiological trash, etc	Analysis	Dispose as radiological trash. If used to sample suspect hazardous wastes segregate and dispose as directed by task manager.
	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 storage until receipt of analytical results 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 and follow the EPA guidance.
[b] Options may be modified on case-by-case basis, but will follow the EPA guidance.

5.0 REFERENCES

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