FOR

FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM (FUSRAP) ST. LOUIS SITES
ST. LOUIS, MISSOURI

PREPARED BY

US Army Corps of Engineers®

ST. LOUIS DISTRICT

August 23, 2004

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FINAL

Five-Year Review Report

Initial Five-Year Review Report

for

FUSRAP St. Louis Sites

St. Louis, Missouri

August 23, 2004

PREPARED BY

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ACRONYMS AND ABBREVIATIONS

µCi/mL	microcuries per milliliter
µg/L	micrograms per liter
µL/L/hr	microliters per liter per hour
Ac	actinium
ADM	Archer Daniels Midland
AEC	Atomic Energy Commission
ARAR	applicable or relevant and appropriate requirement
As	arsenic
ATD	alpha track detector
AWQC	ambient water quality criteria
bgs	below ground surface
Cd	cadmium
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	curies
cm	centimeter
cm/s	centimeter/second
COC	contaminant of concern
CSR	Code of State Regulations
C-T	columbium and tantalum
CWP	Construction Work Plan
CY	calendar year
DCE	dichloroethene
DCGL	Derived Concentration Guideline Limit
DDE	deep dose equivalent
DOE	U.S. Department of Energy
EDE	effective dose equivalent
EE/CA	engineering evaluation/cost analysis
EMDAR	Environmental Monitoring Data and Analysis Report
FFA	Federal Facility Agreement
FS	feasibility study
FSS	Final Status Survey
FUSRAP	Formerly Utilized Sites Remedial Action Program
FY	fiscal year
gal	gallon(s)
GIFREHC	General Investment Funds Real Estate Holding Company
GRAAA	Ground-Water Remedial Action Alternative Assessment
HISS	Hazelwood Interim Storage Site
HU	hydrostratigraphic unit
HZ	hydrostratigraphic zone
IA	investigation area
IL	investigative limit
in.	inch(es)
IT	IT Corporation
K-Pad	Building K foundation
LTS	long-term stewardship

ACRONYMS AND ABBREVIATIONS (Cont'd)

MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	maximum contaminant level
MDNR	Missouri Department of Natural Resources
MED	Manhattan Engineer District
m^2	square meter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MI	Mallinckrodt, Inc.
MOU	Memorandum of Understanding
mrem/hr	millirem per hour
mrem/yr	millirem per year
MSD	Metropolitan St. Louis Sewer District
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	non-detect
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
O&M	operations and maintenance
ORNL	Oak Ridge National Laboratory
OU	operable unit
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pCi/m^2/s	picocuries per square meter per second
PRG	preliminary remediation goal
Ra	Radium
RAO	Remedial action objective
RAWP	Removal Action Work Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RG	Remediation Goal
RI	remedial investigation
Rn	Radon
ROD	record of decision
ROW	right-of-way
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act of 1986
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
SLS	St. Louis Sites
SMCL	secondary maximum contaminant level
SOR	sum of ratios
SU	survey unit
TCE	Trichloroethene
TEDE	total effective dose equivalent

ACRONYMS AND ABBREVIATIONS (Cont'd)

Th	Thorium
TLD	thermoluminescent dosimeter
U	Uranium
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VP	vicinity property
yd^3	cubic yard

EXECUTIVE SUMMARY

As the lead agency for the Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites (SLS), the U. S. Army Corps of Engineers, St. Louis District (USACE) conducted a five-year review of the response actions conducted at the SLS pursuant to Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). USACE is conducting these response actions pursuant to CERCLA and the NCP under the legislative authority contained in the Energy and Water Development Appropriations Act for Fiscal Year 2000 (FY00), Public Law 106-60, §611 (HR 2605).

The SLS consists of two locations designated as the St. Louis Downtown Site (SLDS) and the North St. Louis County sites that contain radiological contamination resulting from previous Manhattan Engineering District/Atomic Energy Commission (MED/AEC) operations. The triggering action for the five-year review was September 8, 1998, the day when field operations for the remedial actions at the SLDS began.

The SLDS is comprised of the Mallinckrodt, Inc. (MI) property and the 34 surrounding vicinity properties. This site is located near the Mississippi River, north of downtown St. Louis, Missouri. The selected remedy presented in the 1998 SLDS Record of Decision (ROD) requires the excavation and disposal of radiological and chemical contamination in surface and subsurface accessible soil resulting from MED/AEC processing activities. The selected remedy also includes monitoring of the Mississippi Alluvial Aquifer.

The following table lists the SLDS remedial action covered by the period of this report (September 1998 through August 2003):

Table ES-1. St. Louis Downtown Site Remedial Action Summary

Loc.	Property	Start	Complete	CY Removed
DT-2	City Property Vicinity Property	October 1998	July 1999	4,260
MI	Plant 2	October 1998	August 2000	9,660
MI	Plant 1	July 2000	March 2002	2,490
DT-7	Midwest Waste Vicinity Property	May 2001	February 2003	3,910
MI	Plant 6 East Half (EH) and East (E)	November 2000	July 2003	18,880
DT-6	Heintz Steel Vicinity Property	April 2003	In Progress	1,660
MI	Plant 7E	July 2003	In Progress	1,775
			Total Volume =	42,635

CY = cubic yards (In-Situ)

Although no soil was remediated at the Archer Daniels Midland (ADM) Vicinity Property (VP) (DT-1), a final status survey was performed that indicated the residual radioactivity was below the SLDS ROD remediation goals. Based on this finding, the property was released without radiological restrictions.

For the SLDS, a Ground-Water Remedial Action Alternative Assessment (GRAAA) was initiated because concentrations of arsenic and uranium in ground-water samples collected from the Mississippi Alluvial Aquifer exceeded investigative limits (ILs) established in the SLDS

ROD. The conclusion of Phase 1 of the GRAAA (assessment) was that Phase 2 of the GRAAA (investigation) should be conducted (USACE 2003a).

The North St. Louis County sites are located near the Lambert-St. Louis International Airport in St. Louis County, Missouri and are composed of the following properties:

- St. Louis Airport Site (SLAPS);
- Latty Avenue Properties, including the Hazelwood Interim Storage Site and Futura Coatings (HISS/Futura), and eight vicinity properties; and
- SLAPS VPs, consisting of approximately 78 properties between the SLAPS, the HISS, Coldwater Creek and the properties along Coldwater Creek.

Several removal actions have been implemented at the North St. Louis County sites. These removal actions were evaluated in Engineering Evaluation/Cost Analyses (EE/CA) documents and subsequently were authorized by Action Memoranda. Removal actions at the SLAPS were evaluated and authorized in accordance with the following EE/CAs and Action Memoranda:

- *St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA)* and *SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material* (DOE 1997a and 1997b).
- *Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum* (USACE 1999a).

The following table summarizes the removal actions conducted at the SLAPS:

Table ES-2. SLAPS Removal Action Summary

Designation	Start	Complete	CY Removed
West End – Sedimentation Basin	September 1998	May 1999	10,530
East End	October 1998	May 2003	65,120
Radium Pits	March 2000	October 2000	36,910
Phase 1	December 2001	May 2003	74,670
Phases 2 and 3	December 2002	In Progress	24,630
		Total Volume =	211,860

CY = cubic yards (In-Situ)

Removal actions for the SLAPS VPs were evaluated in the Engineering Evaluation/Cost Analysis-Environmental Assessment for the Proposed Decontamination of Properties in the Vicinity of the Hazelwood Interim Storage Site (DOE 1992), and approved in a subsequent Action Memorandum (DOE 1995).

The removal action at the HISS was evaluated in the Engineering Evaluation/Cost Analysis (EE/CA) for the Hazelwood Interim Storage Site (HISS) (USACE 1998a), and approved in the Action Memorandum (USACE 1998b). A major accomplishment during the reporting period (September 1998 through August 2003) was the removal of the waste material stockpiled at the HISS and VP-2(L), as summarized in the following table:

Table ES-3. HISS and VP-2(L) Removal Action Summary

Stockpile Designation	Start	Complete	CY Removed
East Piles 1 and 2	April 2000	June 2000	6,880
Railroad Spur Spoil Piles A and B	March 2000	June 2000	5,590
Supplemental Pile	September 2000	October 2000	4,710
Main Pile – Northern Portion	November 2000	January 2001	4,440
Main Pile – Phase 1 – South Half	March 2001	May 2001	11,950
Main Pile – Phase 2 – North Half	September 2001	October 2001	5,905
		Total Volume =	39,475

CY = cubic yards

This five-year review comes at a time when site response actions are being implemented and construction is ongoing. This review, therefore, is not typical of the reviews that will be conducted over the long-term management period. The typical long-term management five-year review process is designed to examine remedies that are in place. In the future, after construction completion, five-year review reports will examine land use, institutional control monitoring and enforcement, long-term monitoring, and other long-term management activities.

The assessment of this five-year review determined that the remedial action implemented at the SLDS is in accordance with the requirements of the SLDS ROD. Likewise, this five-year review found that the North St. Louis County sites removal actions are being conducted in accordance with applicable Action Memoranda.

The response actions implemented to date at the SLDS and the North St. Louis County sites are functioning as designed and have been found to be protective of human health and the environment. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: **Formerly Utilized Sites Remedial Action Program (FUSRAP) - St. Louis Sites (SLS)**		
EPA ID: MOD980633176		
Region: VII	**State: MO**	**City/County: St. Louis**

SITE STATUS	
NPL status: SLAPS, HISS and Futura Coatings (HISS/Futura)	
Remediation status: Operating at the SLDS. Removal operations ongoing at North St. Louis County sites.	
Multiple OUs? YES	**Construction completion date:** Not applicable
Has site been put into reuse? The SLDS, Futura Coatings, and various Latty Avenue properties and the SLAPS VPs have functioning businesses. The City Property Vicinity Property (DT-2) and Mallinckrodt (MI) Plant 2 have been returned to their respective owners for reuse.	

REVIEW STATUS	
Lead agency: U.S. Army Corps of Engineers (USACE)	
Author name: USACE, St. Louis District Office (USACE)	
Author title: USACE, St. Louis District Office	**Author affiliation:** USACE, St. Louis District
Review period: 09/08/1998 to 08/31/03	
Date(s) of site inspection: North St. Louis County sites: April 8 – 10, 2003 SLDS: May 8 – 9, 2003	
Type of review: SLDS-Statutory: The five-year review of the Accessible Soil and Ground-Water OU of the SLDS is being conducted pursuant to statute because the remedial action at this OU is a post-SARA remedial action that, when complete, will leave hazardous substances, pollutants, or contaminants on-site above levels that allow for unlimited use and unrestricted exposure. North St. Louis County sites (SLAPS, HISS/Latty, SLAPS VPs) - Policy: The five-year review of the North St. Louis County sites is being conducted as a matter of USEPA policy because a removal action is taking place at a site that is on the National Priorities List.	
Review number: 1 (first)	
Triggering action: Commencement of USACE field operations at the SLDS.	
Triggering action date: 09/08/1998	
Due date *(five years after triggering action date)*: 09/08/2003	

Note: "OU" refers to operable unit.

Five-Year Review Summary Form (Cont'd.)

Issues:

St. Louis Downtown Site

Residual radioactivity concentrations in the St. Louis Downtown Site (SLDS) inaccessible soil: Radionuclides may remain in the SLDS inaccessible soil at concentrations above levels that allow for unlimited use and unrestricted exposure. USACE is currently developing the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documentation necessary to address inaccessible soil at the SLDS. A Long-Term Stewardship Plan will be prepared to document processes and procedures with respect to requirements under CERCLA.

North St. Louis County Sites

Thin cover material at the Hazelwood Interim Storage Site (HISS): The cover material (soil) at the HISS is seeded several times per year; however, site drainage patterns appear to be impeding the establishment of vegetative cover. Thin vegetative cover could result in erosion of the soil cover by surface water and wind. However, even with total loss of the soil cover, the rock and protective geofrabric under the soil cover would prevent further erosion at the HISS.

Recommendations and Follow-Up Actions:

St. Louis Downtown Site

USACE is currently developing the CERCLA documentation necessary to address inaccessible soil at the SLDS. A Long-Term Stewardship Plan will be prepared to document processes and procedures with respect to requirements under CERCLA.

North St. Louis County Sites

USACE will continue to monitor the site to ensure that erosion does not result in an off-site discharge. Any area that is determined by USACE to be impacted by erosion will be covered (e.g., seeded, crushed rock, geomembrane, clean soil) to prevent migration. USACE continues efforts to establish vegetation as a means of preventing erosion of the soil cover by surface water and wind.

Five-Year Review Summary Form (Cont'd.)

Protectiveness Statement(s):

St. Louis Downtown Site

The remedy being implemented at the SLDS Operable unit is expected to be protective of human health and the environment upon attainment of the cleanup goals established in the ROD. In the interim, exposures that could result in unacceptable risks are being controlled through access controls and work place management practices. Some areas with soil contamination deeper than four feet and some areas with contamination under permanent structures will be managed in place using institutional controls to limit use. Long-term ground-water monitoring is being used to confirm that the remedy is protective of the alluvial aquifer.

North St. Louis County Sites

The removal actions being implemented at the North St. Louis County sites operable unit are expected to be protective of human health and the environment upon attainment of the soil cleanup goals established in the EE/CAs. In the interim, exposures that could result in unacceptable risks are being controlled through access controls, surveillances and maintenance, and coordination with property owners and utility companies. In May 2003, the USACE published a Proposed Plan for remedial action designed to address all remaining contamination at the North St. Louis County Sites. Public comment has been received. A ROD is currently under development and will be made available upon finalization.

I. INTRODUCTION

A five-year review was conducted for the Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites (SLS). This five-year review comes at a time when site response actions are being implemented and construction is ongoing. This review, therefore, is not typical of the reviews that will be conducted over the long-term management period. The typical long-term management five-year review process is designed to examine remedies that are in place. In the future, after construction completion, five-year review reports will examine land use, institutional control monitoring and enforcement, long-term monitoring, and other long-term activities.

The SLS are composed of two locations designated as the St. Louis Downtown Site (SLDS) and the North St. Louis County sites. The five-year period covered by this review is from September 1998 through August 2003. The methods, findings, recommendations, and conclusions of the five-year review are documented in this five-year review report. This is the first five-year review conducted for the FUSRAP St. Louis Sites.

As the lead agency for the St. Louis Sites, the U. S. Army Corps of Engineers, St. Louis District (USACE) prepared this five-year review report pursuant to Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA §121), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and to the National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan (NCP). CERCLA §121 (c) states the following:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The U.S. Environmental Protection Agency (USEPA) interpreted this requirement further in the NCP at 40 Code of Federal Regulations (CFR) 300 [specifically 40 CFR 300.430(f)(4)(ii)], which states the following:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

The USACE conducted a five-year review of the response actions implemented at the Accessible Soil and Ground-Water Operable Unit (OU) of the SLDS and the North St. Louis County sites in St. Louis, Missouri. This review was conducted from January 2003 through August 2003 and covers the period from September 1998 through August 2003. The results of the review are documented in this report. USACE was assisted in the five-year review by the following entities: USEPA Region VII and the Missouri Department of Natural Resources (MDNR). USEPA

Region VII and MDNR provided comments and suggestions on the analyses presented in this five-year review report.

From April 8 to 10, 2003, site inspections were conducted by USACE at the North St. Louis County sites as part of the five-year review. The following individuals participated in the site inspection: J. Mattingly, USACE; S. Roberts, USACE; D. Wall, USEPA Region VII; and J. Groboski, MDNR.

On May 8 and 9, 2003, a site inspection was conducted by USACE at the SLDS as part of the five-year review. The following individuals participated in the site inspection: J. Mattingly, USACE; G. Allen, USACE; D. Wall, USEPA Region VII; and J. Wade, MDNR.

This is the first five-year review for the SLS. As stated previously, this five-year review addresses the remedial action conducted at the SLDS Accessible Soil and Ground-Water OU and removal actions conducted at the North St. Louis County sites. The trigger date for the five-year review is September 8, 1998, the day when field operations for the remedial action at the SLDS began. The five-year review of the Accessible Soil and Ground-Water OU of the SLDS is being conducted pursuant to statute because the remedial action at this OU is a post-SARA remedial action that, when complete, will leave hazardous substances, pollutants, or contaminants on-site above levels that allow for unlimited use and unrestricted exposure.

There is yet no triggering action for the other OU at the SLDS, the Inaccessible Soil OU. The buildings and inaccessible soil that comprise the Inaccessible Soil OU will be addressed under a future CERCLA action. USACE is currently developing the approach to issue a Record of Decision (ROD) for the Inaccessible Soil OU. The Inaccessible Soil ROD for the SLDS has not yet been completed. EPA and MDNR will be invited to participate in this process. As of August 2003, only removal actions have taken place at the North St. Louis County sites. The five-year review of the North St. Louis County sites is being conducted as a matter of USEPA policy because a removal action is taking place at a site that is on the National Priorities List (NPL) [the St. Louis Airport Site (SLAPS) and the Hazelwood Interim Storage Site (HISS) and Futura Coatings]. Thus far, no remedial action has taken place at the North St. Louis County sites.

II. SITE CHRONOLOGY

A summary of the SLS chronology of site events is presented in Table II-1 below. The highlighted events are applicable to the review period of this report.

Table II-1. Chronology of Site Events

SITE	EVENT	DATE
SLDS	MI Chemical Works performed work under contract to the Manhattan Engineer District/Atomic Energy Commission (MED/AEC).	1942 – 1957
North County	SLAPS: Acquired by MED/AEC to store uranium-bearing residues and scrap from the SLDS.	1946
SLDS	MI Plants 1 and 2: Decontaminated to meet AEC criteria then in effect.	1948 – 1950
SLDS	Plants 1 and 2: AEC released for use without radiological restrictions.	1951
SLDS	AEC managed decontamination efforts in MI Plants 10, 7, and 6E to meet criteria then in effect; plants returned to MI for use without radiological restrictions.	1962
North County	Continental Mining and Milling Company of Chicago, Illinois, purchased and began moving wastes from the SLAPS to the HISS.	1966
North County	HISS: Used to store radioactive material purchased from the AEC prior to shipment to Colorado.	1966 – 1973
North County	SLAPS: Ownership transferred from MED/AEC to St. Louis Airport Authority.	1973
North County	HISS: Radiological surveys conducted by the Nuclear Regulatory Commission (NRC) indicated the presence of residual uranium and thorium (Th) concentrations in the soil above guidelines for unrestricted use of land areas.	1976
North County	SLAPS: The U.S. Department of Energy (DOE) performed a radiological survey and found elevated radionuclide levels on-site and north of the site in ditches north and south of McDonnell Boulevard.	1976 and 1978
SLDS	Radiological survey conducted by Oak Ridge National Laboratory (ORNL) found alpha and radiological levels in excess of guidelines for release of the property for use without radiological restrictions (ORNL 1981).	1977
North County	HISS: Contaminated soil from the adjacent Futura parcel stockpiled on the HISS in support of construction of a manufacturing facility.	1979
North County	HISS: DOE performed response actions including clearing, excavating, and stockpiling contaminated soil from excavation of the property at 9200 Latty Avenue.	1984
North County	HISS: Supplemental pile is created as the result of DOE radiological monitoring support of Latty Avenue drainage and street improvements.	1986
North County	NPL: USEPA placed the SLAPS, HISS, and Futura properties on the NPL.	Oct. 4, 1989
SLS	USEPA, Region VII, and DOE entered into a Federal Facility Agreement (FFA).	June 1990
SLDS	DOE issued *Engineering Evaluation/Cost Analysis for Decontamination of the St. Louis Downtown Site,* St. Louis, MO, DOE/OR/23701-02.2, May 1991 (DOE 1991).	May 1991
North County	DOE issued *Engineering Evaluation/Cost Analysis for the Proposed Decontamination of the Properties In the Vicinity of the Hazelwood Interim Storage Site, Hazelwood, Missouri*, DOE/EA/0489, Rev. 1, March 1992 (DOE 1992).	March 1992
SLDS	DOE submitted the Remedial Investigation (RI) report for the St. Louis Site.	1992
SLDS	Interim action at MI: 50 Series Buildings - decontamination, demolition, and crushing pursuant to DOE 1991.	1996
SLDS	Interim action at MI: Plants 6 and 7- decontamination, asbestos abatement, demolition to floor elevation grade, and crushing, pursuant to DOE 1991.	1997
SLDS	Interim action at MI: Plant 10 area - subsurface soil excavation and off-site shipment pursuant to DOE 1991.	1997

Table II-1. Chronology of Site Events (Cont'd)

SITE	EVENT	DATE
SLDS	Interim action at City Property Vicinity Property (VP): Riverfront Trail area - excavation and off-site shipment pursuant to DOE 1991.	1997
North County	DOE issued *Interim Action Engineering Evaluation/Cost Analysis (EE/CA)* for the *St. Louis Airport Site (SLAPS)*, DOE/OR/21950-1026, September 1997 (DOE 1997a).	September 1997
North County	Removal action at the SLAPS: West End – excavation and removal of contaminated soil east of Coldwater Creek bank gabion wall on the SLAPS pursuant to DOE 1997.	1997
SLS	FUSRAP responsibility transferred from DOE to the USACE.	Oct. 13, 1997
North County	SLAPS VP-56: Removal action completed.	1998
North County	SLAPS: Construction of a loadout facility and 1200 feet rail spur.	1998
SLDS	SLDS ROD signed by U.S. Army Director of Civil Works and by the Regional Administrator of USEPA, Region 7.	August 1998
SLDS	USACE commenced field operations at the SLDS.	Sept. 8, 1998
North County	USACE issued *Engineering Evaluation/Cost Analysis (EE/CA) for the Hazelwood Interim Storage Site (HISS)*, October 1998 (USACE 1998a).	October 1998
North County	SLAPS: VP St. Denis Street Bridge replacement support, Florissant, MO.	1998
North County	SLAPS: North Ditch Removal Action and Sedimentation Basin Installation.	1998 – 1999
North County	Latty Avenue Properties: Rail spur constructed at the HISS.	1998 – 1999
SLDS	City Property VP: Remedial action initiated and completed.	1998 – 1999
SLDS	MI Plant 2: Remedial action initiated and completed.	1998 – 2002
North County	USACE issued *Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum*, March 1999 (USACE 1999a).	March 1999
North County	SLAPS: East End, East End Extension, and Right-of-Way (ROW) Work Areas: Removal Action initiated and completed.	1999 – 2001
North County	SLAPS VPs: Removal action conducted in the North Ditch area between McDonnell Boulevard and the former ballfield area.	1999
SLDS	Current SLDS Remedial Action Work Plan: Revision 1 issued.	Dec. 1999
North County	SLAPS: East End and ROW Work Areas – removal action initiated and completed.	1999 – 2001
North County	SLAPS: Current Site Wide Removal Action Work Plan, Addendum 1 to Revision 0 issued.	March 2000
North County	SLAPS: Radium Pits Work Area – removal action initiated and completed.	2000
North County	SLAPS VP: VP-38 Removal action initiated and partially completed.	2000
North County	Latty Avenue Properties: HISS and Futura stockpiled material removed and shipped out of state to disposal facilities.	2000 – 2001
SLDS	MI Plant 1: Remedial action initiated and completed.	2000 – 2002
SLDS	MI Plant 6E and 6EH: Remedial action initiated and completed.	2000 – 2003
SLDS	Midwest Waste VP: Remedial action initiated and completed.	2001 – 2003
North County	SLAPS: Phase 1 Work Area – removal action initiated and completed.	2001 – 2003
North County	SLAPS: Phases 2 and 3 Work Area – removal action initiated and in progress.	Dec. 2002
SLDS	Heintz Steel VP: Remedial action initiated and in progress.	April 2003
North County	Feasibility Study and Proposed Plan for the St. Louis North County Site issued (USACE 2003b, c).	May 2003
SLDS	Phase 1 Ground Water Remedial Action Alternative Assessment (GRAAA) at the SLDS issued (USACE 2003a).	June 2003
SLDS	MI Plant 7E: Remedial action initiated and in progress.	July 2003

III. BACKGROUND

Background information on each of the SLS is presented hereafter by site. The locations of the SLS in relation to each other and the City of St. Louis are shown on Figure III-1.

ST. LOUIS DOWNTOWN SITE

The Mallinckrodt, Inc. plants and Vicinity Properties (VPs) that comprise the SLDS are shown on Figure III-2 and are listed in Table III-1. The VPs are also listed according to their associated USACE property designation number (e.g., DT-1). It should be noted that as new data were obtained and new civil land survey information became available during the ongoing pre-design investigation efforts, the size, designation, and number of VPs have increased subsequent to signature of the SLDS ROD (USACE 1998c). Such information indicated that certain property boundaries and, in some cases, the associated property owners, were incorrect when originally identified. The property boundaries shown on Figure III-2 reflect the current understanding of the SLDS property boundaries. The SLDS is defined in the SLDS ROD (USACE 1998c) as consisting of the Mallinckrodt, Inc. Property and the VPs.

The final remedial action for the accessible soil and ground-water operable unit contaminated as the result of MED/AEC uranium manufacturing and processing activities at the SLDS is discussed in detail in the SLDS ROD. As agreed to under the FFA, hazardous wastes resulting from releases on the site during the Mallinckrodt, Inc. operations for the MED/AEC are the subject of the remedial action at the SLDS. The SLDS has been separated into two OUs: (1) the Accessible Soil and Ground-Water OU and (2) the Inaccessible Soil OU. The Accessible Soil and Ground-Water OU consists of the accessible soil and ground water contaminated as the result of MED/AEC uranium processing activities at the Mallinckrodt, Inc. plant. The Inaccessible OU consists of buildings within the site perimeter (including Buildings 25 and 101 on the Mallinckrodt Property) and contaminated soil that is currently inaccessible due to the presence of buildings, active rail lines, roadways, the levee, and other permanent structures. The Inaccessible Soil OU was excluded from the scope of the SLDS ROD (USACE 1998c) because the inaccessible soil did not present a significant threat in its current configuration and because activities critical to the continued operation of Mallinckrodt, Inc. prevented excavation beneath the encumbrances (e.g., roads, active railroads, Buildings 25 and 101). Contamination present within Building 25 also did not present an excessive risk under its current configuration. Because land use has remained the same on the Mallinckrodt, Inc. Property and VPs since the SLDS ROD (USACE 1998c) was signed, these determinations hold true today. As stated previously, this five-year review report addresses only the Accessible Soil and Ground-Water OU of the SLDS.

SLDS Physical Characteristics

The SLDS comprises a 45-acre chemical manufacturing complex owned by Mallinckrodt, Inc. and over 30 adjacent vicinity properties located in an industrialized area about 2 miles north of the St. Louis downtown area (see Figure III-2). The SLDS is situated within the floodplain adjacent to the western bank of the Mississippi River and is separated from the river by the St. Louis Flood Protection system (a combination of man-made levees and floodwall structures). The local topography of the site is generally flat. Surface drainage is directed through ditches and catchment basins into an extensive storm drainage system that discharges to a nearby sewage treatment plant. Extensive industrial and commercial development has largely obliterated the upper portion of the native soil column. Fill was placed on top of the original floodplain as the area was being developed. A generalized stratigraphic column for the SLDS is shown on Figure III-3.

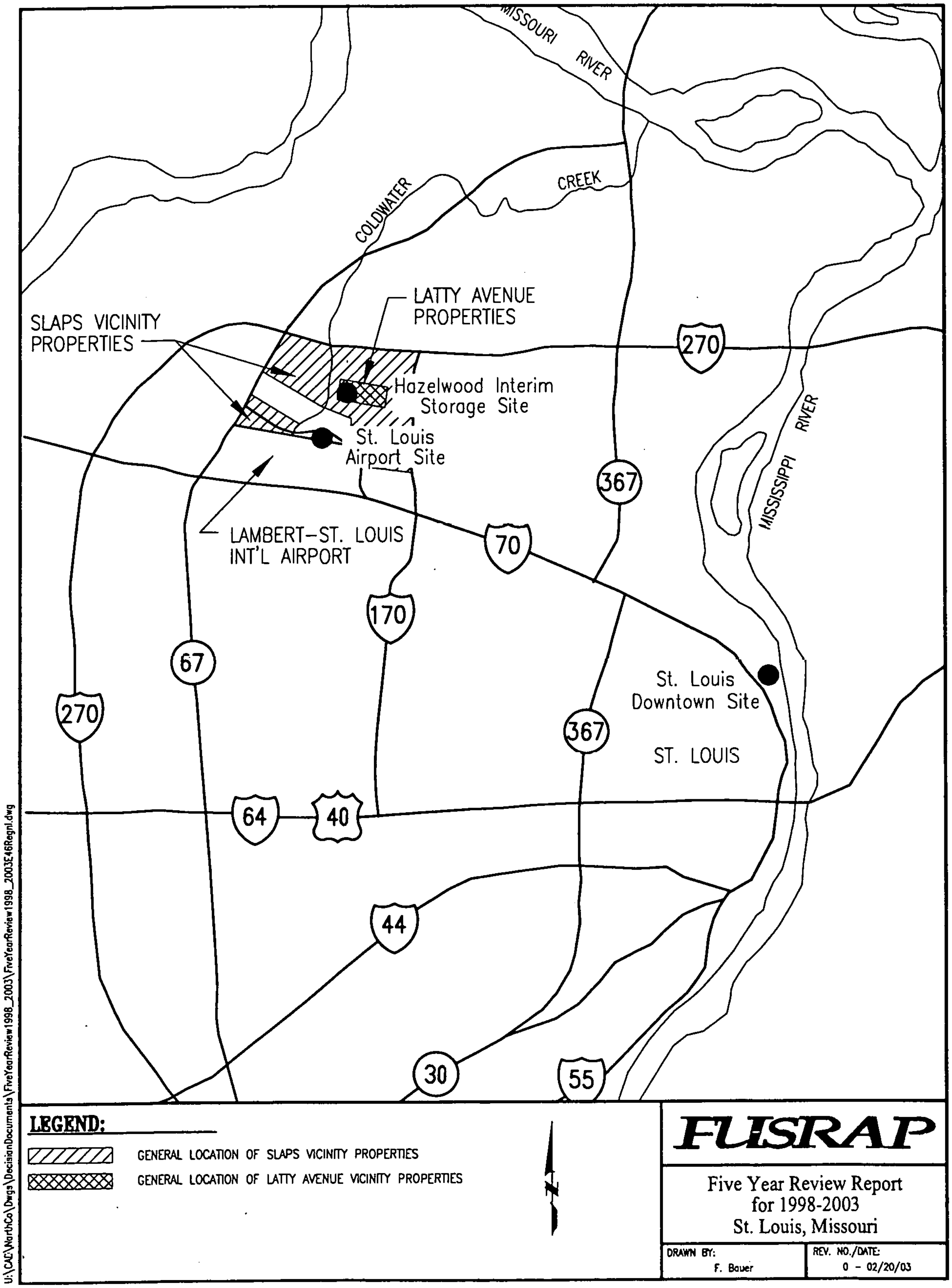

Figure III-1. Location Map of the St. Louis Sites

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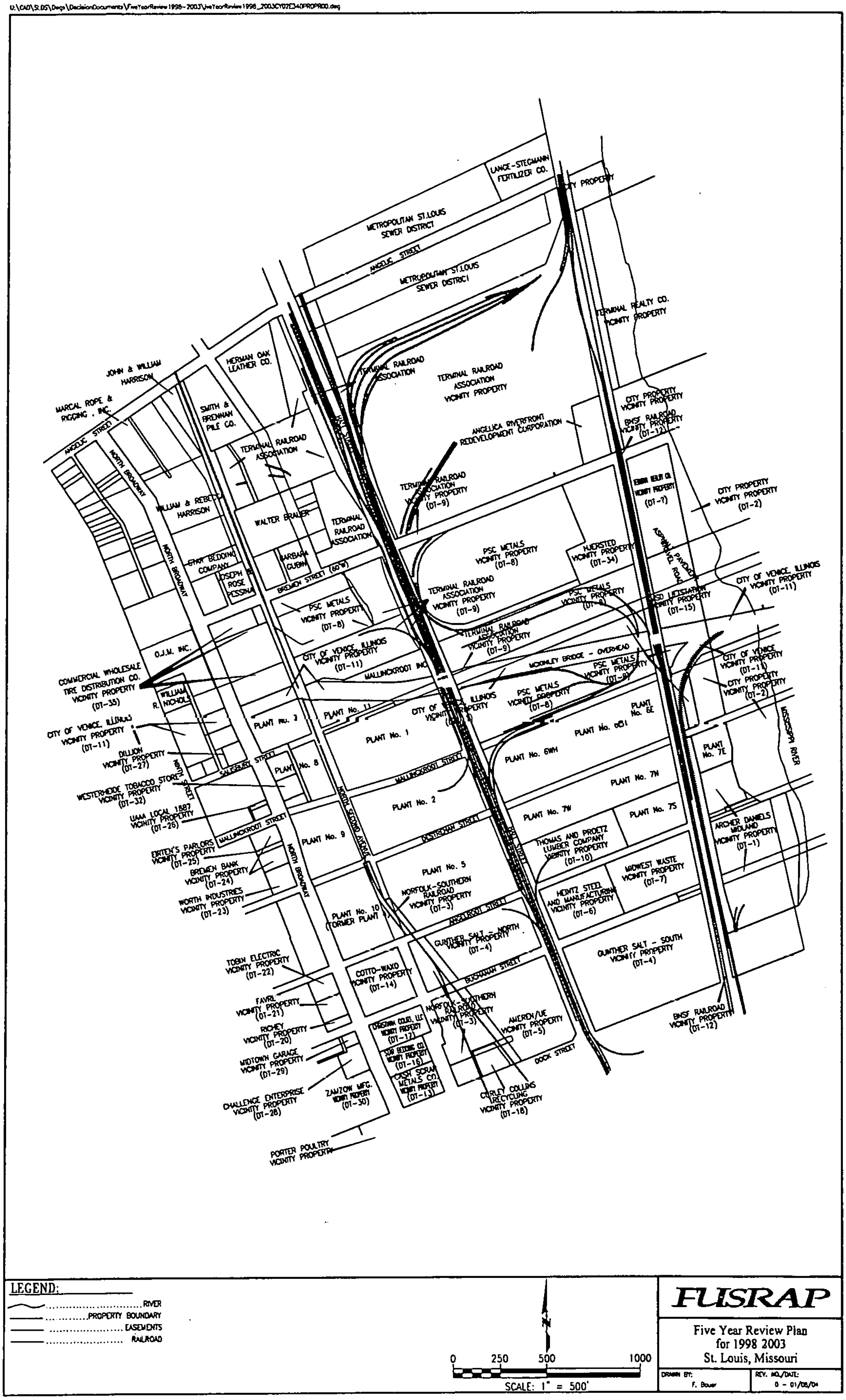

Figure III-2. Plan View of the SLDS

Table III-1. St. Louis Downtown Site Properties

Property	ID	City Block/ Tract Number and/or Address
Mallinckrodt, Inc.	N/A	Multiple
Archer Daniels Midland (ADM)	DT-1	2543; 2544
City Properties	DT-2	Multiple
Norfolk Southern Railroad	DT-3	1198; 1200; 1201
Gunther Salt	DT-4	1198-E; 101 Buchanan St.
AmerenUE	DT-5	660-W
Heintz Steel & Manufacturing	DT-6	2541; 2542; 3300 Hall St.
Midwest Waste	DT-7	2543
PSC Metals, Inc.	DT-8	Multiple; 3620 Hall St.
Terminal Railroad Association	DT-9	2520
Thomas & Proetz Lumber Company	DT-10	2540; 3400 Hall St.
McKinley Bridge	DT-11	2536; 2540; 2541
Burlington-Northern Santa Fe Railroad	DT-12	2526; 2540; 2541
Cash's Scrap Metal	DT-13	304-W; 3144 N. Broadway
Cotto-Waxo Company	DT-14	1197; 3330 N. Broadway
City Properties (MSD Lift Station)	DT-15	2543; 2544
Star Bedding Company	DT-16	308-W; 3240 N. Broadway
Christiana Court, LLC	DT-17	309-E
Curley Collins Recycling	DT-18	308-E
City Streets	DT-19	Multiple
Richey	DT-20	1196; 3301 N. Broadway
Favre	DT-21	1196; 3319 N. Broadway
Tobin Electric	DT-22	1196; 3321 N. Broadway
InterChem	DT-23	1196; 3501 N. Broadway
Bremen Bank	DT-24	1205; 3529 N. Broadway
Eirten's Parlors (aka O.T. Hodges)	DT-25	1205; 3523 N. Broadway
UAAA Local 1887	DT-26	1214; 3607 N. Broadway
Dillon	DT-27	1217; 3707 N. Broadway
Challenge Enterprise	DT-28	309-W; 3237 N. Broadway
Midtown Garage	DT-29	2545; 309-W; 3227 N. Broadway
ZamZow Manufacturing	DT-30	2545; 309-W; 3201 N. Broadway
Porter Poultry	DT-31	309-W; 3123 N. Broadway
Westerheide Tobacco Store (purchased by Mallinckrodt)	DT-32	1213
MoDOT	DT-33	1204/1215
Hjersted	DT-34	2526
Factory Tire Outlet	DT-35	2536; 3812 N. Broadway
OJM, Inc.	DT-36	1217; 3737 N. Broadway
Lange-Stegmann	DT-37	2520; #1 Angelica St.

Ground water at the SLDS is found within the following three hydrostratigraphic units (HUs):

- HU-A, the upper unit that consists of fill material on top of naturally deposited clays and silts;
- HU-B, the lower unit referred to as the Mississippi Alluvial Aquifer, which consists of naturally deposited alluvium; and
- HU-C, limestone bedrock.

Unit Designation	Graphic Column	Approximate Thickness(ft)	Description
Upper Hydrostratigraphic Unit (HU-A)		0-25	**RUBBLE and FILL** Grayish black (N2) to brownish black (5YR2/1). Dry to slightly moist, generally becoming moist at 5-6 ft and saturated at 10-12 ft. Slight cohesion, variable with depth, moisture content and percentage of times present. Consistency of relative density is unrepresentative due to large rubble fragments. Rubble is concrete, brick, glass, and coal slag. Percentage of fines as silt or clay increases with depth from 5 to 30 percent. Some weakly cemented aggregations of soil particles. Adhesion of fines to rubble increases with depth and higher moisture content. Degree of compaction is slight to moderate with frequent large voids
		0-10	**Silty CLAY (CH)** Layers are mostly olive gray (5Y2/1), with some olive black (5Y2/1). Predominantly occurs at contact of undisturbed material, or at boundary of material with elevated activity. Abundant dark, decomposed organics. Variable percentages of silt and clay composition.
		0-5	**CLAY (CL)** Layers are light olive gray (5Y5/2), or dark greenish gray (5GY4/1). Slightly moist to moist, moderate cohesion, medium stiff consistency. Tends to have lowest moisture content. Slight to moderate plasticity.
		0-2.5	**Interbedded CLAY, silty CLAY, SILT and Sandy SILT (CL, ML, SM)** Dark greenish gray (5GY4/1) to Light olive gray (5Y6/1). Moist to saturated, dependent on percentage of particle size. Contacts are sharp, with structure normal to sampler axis to less than 15 degrees downdip. Layer thicknesses are variable, random in alternation with no predictable vertical gradiation or lateral continuity. Some very fine-grained, rounded silica sand as stringers. Silt in dark mafic, biotite flakes. Some decomposed organics.
Lower Hydrostratigraphic Unit (HU-B)		0-10	**Sandy SILT (ML)** Olive gray (5Y4/1). Moist with zones of higher sand content saturated. Slight to moderate cohesion, moderate compaction. Stiff to very stiff consistency, rapid dilatancy, nonplastic. Sand is well sorted, very fine and fine-grained rounded quartz particles.
		0-50	**Silty SAND and SAND (SM, SP, SW)** Olive gray (5Y4/1). Saturated, slight cohesion, becoming noncohesive with decrease of silt particles with depth. Dense, moderate compaction. Moderate to well-graded, mostly fine- and medium-grained, with some fine- and coarse-grained particles. Mostly rounded with coarse grains slightly subrounded. Gradual gradation from upper unit, silty sand has abundant dark matic/biotite flakes. Sand is well-graded, fine gravel to fine sand. Mostly medium-grained, with some fine-grained and few coarse-grained and fine gravel.
Bedrock Hydrostratigraphic Unit (HU-C)		Total thickness not penetrated during drilling	**LIMESTONE** Light olive gray (5Y4/1) with interbedded chart modules. Generally hard to very hard; difficult to scratch with knife. Slightly weathered, moderately fresh with little to no discoloration or staining. Top 5 ft is moderately fractured, with 99 percent of joints normal to the core axis. Joints are open, planar, and smooth. Some are slightly discolored with trace of hematite staining.

SOURCE: MODIFIED FROM BNI 1994.
NOTE: THE CODES IN PARENTHESES FOLLOWING LITHOLOGIES ARE THE UNIFIED SOIL CLASSIFICATION SYSTEM CODES.

NOT TO SCALE

FUSRAP

Five Year Review Report for 1998-2003 St. Louis, Missouri

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Figure III-3. Generalized Stratigraphic Column for the SLDS

SLDS Land and Resource Use

The SLDS comprises a large chemical manufacturing complex owned and operated by Mallinckrodt, Inc., and adjacent commercial and city-owned VPs. The VPs encompass over 165 acres of land surrounding the 45-acre Mallinckrodt, Inc. Property. Mallinckrodt, Inc. has used the property for chemical manufacturing and related operations since 1867. Mallinckrodt currently maintains 24-hour security at the property and limits site access to employees, subcontract employees, and authorized visitors. The Mallinckrodt Property is enclosed by a well-maintained and patrolled security fence.

The land usages and physical features at the VPs are varied and include active businesses (e.g., lumber yard, metal salvage, and steel fabrication), inactive/abandoned businesses [e.g., the ADM VP (DT-1)] railroad lines, bridge structures (the McKinley Bridge), and a portion of the earthen levee and concrete floodwall that protects the St. Louis area from Mississippi River floodwaters. The SLDS has been used as an industrial area for well over a century. The SLDS is currently zoned industrial, which does not allow residential land use. The long-term plans for the SLDS area are to retain the industrial uses; encourage the wholesale produce district; and phase out the remaining, marginal residential uses.

HU-A is not an aquifer and is not considered a potential source of drinking water because it has insufficient yield, poor natural water quality, and susceptibility to surfacc water contaminants due to the industrial setting of the SLDS. The Mississippi Alluvial Aquifer (HU-B) is a principal aquifer in the St. Louis area, including the SLDS. Aquifers in this area also exist in the bedrock formations underlying the alluvial deposits. Ground-water aquifers in the St. Louis area are often mineralized (resulting in poor quality) and do not meet drinking water standards without treatment. HU-B is currently not used as a source of drinking water. The future use of HU-B as a drinking water source at the SLDS is expected to be minimal for several reasons: the Mississippi and Missouri rivers provide a readily available source of drinking water; the SLDS is located in an industrial setting; and the SLDS is bordered to the east by the Mississippi River. HU-C would be an unlikely water supply source, as it is deeper and a less productive HU. The expected future use of ground water at the SLDS is not expected to change from current use.

History of Contamination at the SLDS

Mallinckrodt was contracted by the MED/AEC from 1942 to 1957 to process uranium ore for the production of uranium metal. From 1942 to 1945, Plants 1, 2, and 4 (where Plant 10 is now located) were involved in the development of uranium-processing techniques, uranium compounds and metal production and uranium metal recovery from residues and scrap.

Plant 6 produced uranium dioxide from pitchblende ore starting in 1946. During 1950 and 1951, Plant 4 was modified and used as a metallurgical pilot plant for processing uranium metal. Plant 4 continued to operate until 1956 when it was closed and operations began at Plants 6 and 7. MED/AEC operations in Plant 6 ended in 1957. Residuals of the process, including spent pitchblende ore; process chemicals; and radium (Ra), thorium (Th), and uranium (U), were inadvertently released from the Mallinckrodt Property and into the environment through handling and disposal practices. Radioactive materials, specifically those involved in the processing of columbium and tantalum (C-T), were used in activities for commercial clients within the Mallinckrodt Property from approximately 1961 to 1990. The radiological contamination in soil on the VPs may be attributed to inadvertent releases of radionuclides to the environment during the MED/AEC uranium processing operations, Mallinckrodt's C-T processing operations, or operations unique to the VP itself. Buildings and/or other structures on the VPs may also have been affected by the inadvertent release of radionuclides during both the MED/AEC and C-T operations. AEC managed decontamination efforts (removal of radiologically contaminated buildings, equipment, and soil disposed off-site) in Plants 4, 7, and 6 to meet AEC criteria and returned the plants to Mallinckrodt in 1962 for use without radiological restrictions.

A radiological survey conducted at the SLDS in 1977 found radiological contamination that exceeded existing guidelines. Elevated gamma radiation levels were measured at outdoor locations and within some of the historical processing buildings. Additionally, Ra-226 and U-238 concentrations in certain soil samples significantly exceeded background concentrations. In response to this survey, it was determined that further investigation of the site was necessary to characterize the nature and extent of the contamination. In 1990, USEPA Region VII and the DOE entered into the FFA that established schedules and deliverables for the CERCLA process at the SLS. In 1994, DOE submitted the RI report for the SLS.

SLDS Interim Actions

Four interim actions were performed by DOE at the SLDS prior to signing of the 1998 SLDS ROD. The first interim action consisted of the decontamination, demolition, and crushing of the 50-Series Buildings (Buildings 50, 51, 51A, 52, and 52A). In this action, 1,000 cubic yard (yd^3) of contaminated material were shipped off-site, and 1,000 yd^3 of crushed concrete (crushate) were generated. In the second interim action, asbestos abatement, decontamination, demolition to floor elevation, grading, and crushing operations were conducted at Plants 6 and 7 (Buildings 100, 116, 116B, 117, 700, 704, 705, 706, 707, and 708). In this interim action, 2,673 yd^3 of contaminated material were shipped off-site and 7,000 yd^3 of crushate were generated. The third interim action consisted of contaminated soil excavation in Plant 4 (currently Plant 10). A total of 15,043 yd^3 of contaminated material was shipped off-site. In the fourth interim action, 750 yd^3 of contaminated material were excavated from the Riverfront Trail area and shipped off-site.

SLDS Basis for Taking Action

Characterization activities at the SLDS have determined that contamination related to MED/AEC activities is present in the accessible surface and subsurface soil of the Mallinckrodt plant and VPs at levels that require remedial action. The contamination detected likely resulted from both MED/AEC and C-T activities. In addition, other contaminants have likely leached from the coal slag and cinders used as fill in the area. As agreed to under the FFA, all wastes resulting from or associated with uranium manufacturing or processing activities conducted at the SLDS for the MED/AEC are the subject of the remedial action selected in the SLDS ROD (USACE 1998c). Other chemical or radiological wastes that are mixed or commingled with wastes resulting from or associated with MED/AEC uranium manufacturing or processing activities conducted at the SLDS are also subject to this remedial action. Contaminants resulting from other actions or pre-existing contaminants at the SLDS are being addressed through actions being carried out by other authorities. This includes both radioactive and hazardous substances that are the responsibility of other parties. The other actions being carried out include termination of a Mallinckrodt NRC license for Plant 5 (C-T processing) and a Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) for the entire Mallinckrodt facility. Mallinckrodt currently addresses air emissions and wastewater/stormwater monitoring requirements at the facility. USEPA, MDNR, USACE, NRC, and Mallinckrodt are working together to assure that the non-FUSRAP potential hazards at the SLDS are properly addressed.

NORTH ST. LOUIS COUNTY SITES

The general location of the North St. Louis County sites including the HISS, the SLAPS, and the VPs is shown on Figure III-4. The VPs are also listed according to their associated USACE property designation number (e.g., VP-24) in Tables III-2, III-3, and III-4. Additional detail of the HISS is shown on Figure III-5.

The North St. Louis County sites are located in St. Louis County, Missouri throughout an area immediately north of Lambert-St. Louis International Airport and about 11 miles northwest of the SLDS. The North St. Louis County sites are composed of the following properties:

- SLAPS
- Latty Avenue Properties, which include the HISS/Futura, and eight VPs
- SLAPS VPs, which include approximately 78 properties near the SLAPS and properties along Coldwater Creek

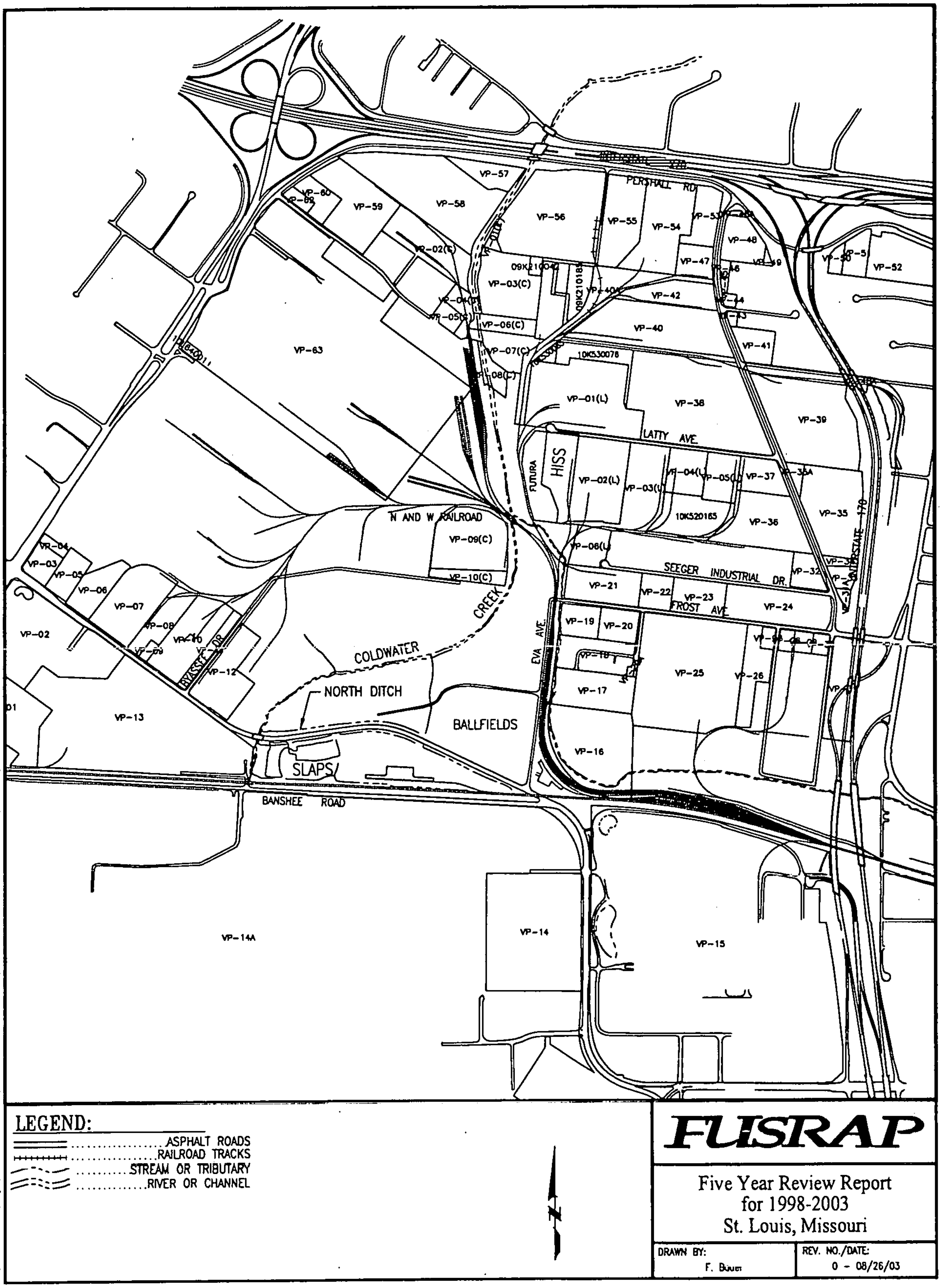

Figure III-4. North St. Louis County Site Map

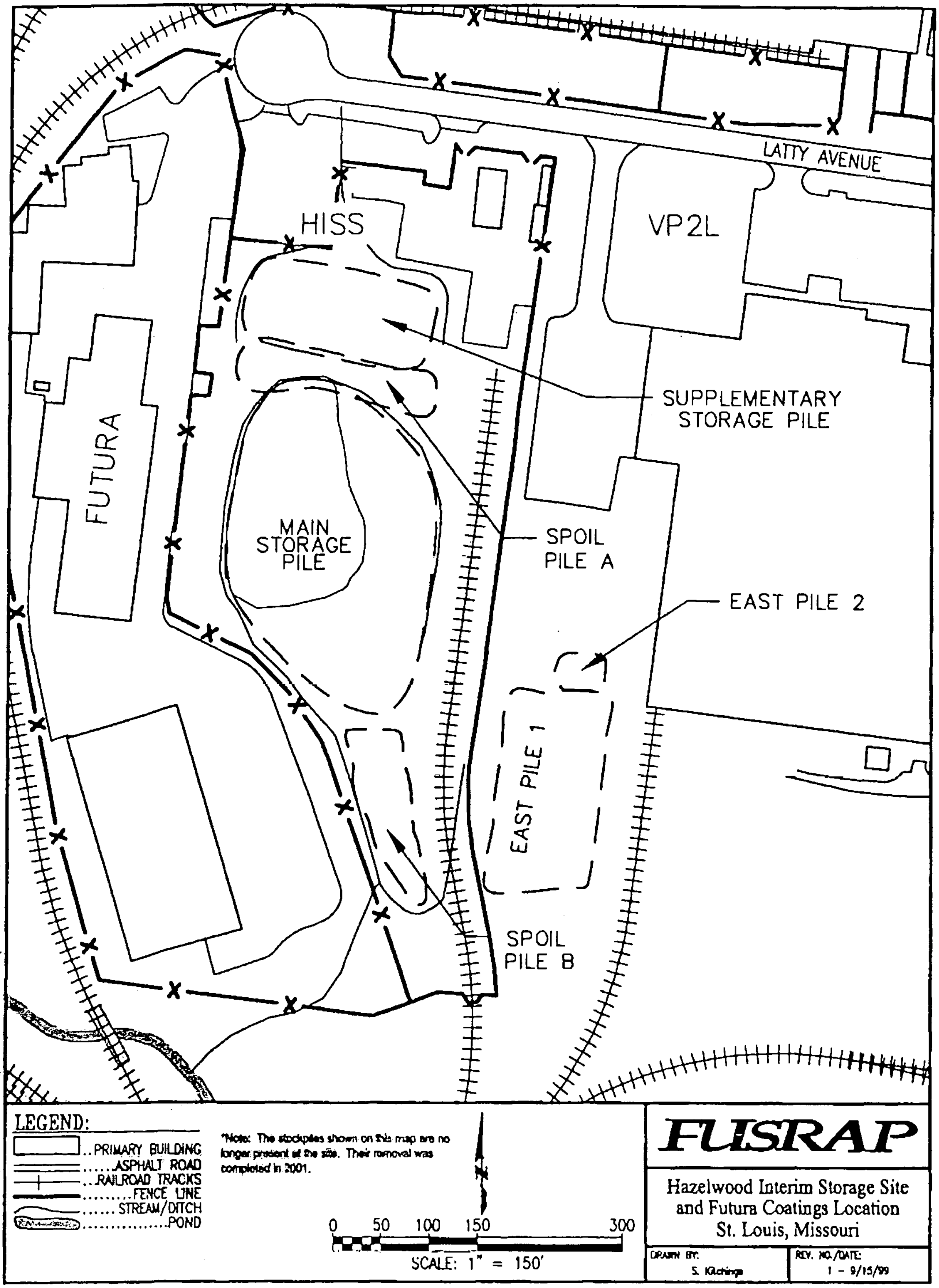

Figure III-5. Location of Hazelwood Interim Storage Site (HISS)

Table III-2. North St. Louis County Site Properties – SLAPS and SLAPS VPs

Site Location	Property Owner	VP Number	County Locator Number
SLAPS VPs	Boeing/McDonnell	1	10L220893 5800 N. Lindbergh Boulevard Hazelwood, Missouri
SLAPS VPs	Boeing/McDonnell	2	10L240093 32 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	Boeing/McDonnell	3	10L330123 5900 N. Lindbergh Boulevard Hazelwood, Missouri
SLAPS VPs	Boeing/McDonnell	4 and 5	10L330114 183 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	Boeing/McDonnell	6	10L330040 163 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	Boeing/McDonnell	7	10L330031 153 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	Boeing/McDonnell	N/A	11L630022
SLAPS VPs	Florissant Valley Sheltered Workshop	8	10L330022 143 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	Union Electric Co.	9	10L330073 141 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	St. Louis Steel Products, Inc.	10 and 11	10L340151 133 McDonnell Boulevard Hazelwood, Missouri 63042
SLAPS VPs	Mijon IV, L.L.C.	12	10L340142 123 McDonnell Boulevard Hazelwood, Missouri
SLAPS VPs	GKN Aerospace Services, Inc.	13	10L310011 5290 Banshee Road Hazelwood, Missouri
SLAPS VPs	City of St. Louis	Wells	Lambert International Airport
SLAPS VPs	City of St. Louis Properties Manager	NE Corner of Airport Airfield	Lambert International Airport
SLAPS VPs	St. Louis Co. Department of Highways and Traffic (MoDOT)	McDonnell Boulevard from Lindbergh to ~2,500 feet south of Banshee	McDonnell Boulevard
SLAPS VPs	Norfolk Southern Railway Company	Railway in and around the SLAPS, the Latty/HISS, and the SLAPS VPs	Railway right-of-way in and around the SLAPS, the Latty/HISS, and the SLAPS VPs and County Parcel ID No. 10K520143

Table III-2. North St. Louis County Site Properties – SLAPS and SLAPS VPs (Cont'd)

Site Location	Property Owner	VP Number	County Locator Number
SLAPS VPs	Boeing/McDonnell	14	11K510035 6367 McDonnell Boulevard Hazelwood, Missouri 63042
SLAPS VPs	Boeing/McDonnell	15	11K520056 8901 Airport Road Berkeley, Missouri 63134
SLAPS VPs	MoDOT	31	Locator Number not available. SE Corner Jonas Place and Frost Berkeley, Missouri 63134
SLAPS VPs	Norfolk Southern Railway Company	40A	10L340041
SLAPS VPs	Midwestern Corporation	40	09K220140 7275 Hazelwood Avenue Hazelwood, Missouri 63042
SLAPS VPs	Ronald Schacht, Trustee	42	09K220041 7301 Hazelwood Avenue Hazelwood, MO 63042
SLAPS VPs	Jamestown Investment Corporation	44	09K220030 8841 Heather Lane Hazelwood, Missouri 63042
SLAPS VPs	Sydney Kurtz	45	09K220195 7310 Hazelwood Ave Hazelwood, Missouri 63042
SLAPS VPs	Bi-State Loading Dock Specialists Inc	46	09K220074 7314 Hazelwood Avenue Hazelwood, Missouri 63042
SLAPS VPs	ProLogis	47	09K220085 7351 Hazelwood Avenue Hazelwood, Missouri 63042
SLAPS VPs	John J. Steuby Company	48 and 48A	09K220184 and 09K220173 7320 Hazelwood Avenue Hazelwood, Missouri 63042
SLAPS VPs	Jamestown Investment Corporation	49	09K220195 7310 Hazelwood Avenue Hazelwood, Missouri 63042
SLAPS VPs	Billy and Dorothy Coleman	50 and 51	09K310197 8784 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	Schnucks Markets, Inc.	52	09K324475 8780 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	Delaware Golden Arch Limited Ptnsp	52	09K324486 8700 Pershall Road Hazelwood, MO 63042
SLAPS VPs	Ralph A. Petersen, Trustee and Marie C. Petersen, Trustee	53	09K220162 7373 Hazelwood Avenue Hazelwood, Missouri 63042
SLAPS VPs	The Pillsbury Company	54	09K220205 8840 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	Metro Partners, L.L.C.	55	09K210217 8900 Pershall Road Hazelwood, Missouri 63042

Table III-2. North St. Louis County Site Properties – SLAPS and SLAPS VPs (Cont'd)

Site Location	Property Owner	VP Number	County Locator Number
SLAPS VPs	Supervalu Holdings, Inc.	55	09K210228 8880 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	Bernadette Business Forms, Inc.	56	09K210064 8950 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	Allied Systems, Ltd.	57 and 58	09K140015 and 09K140026 9050 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	Tayco Three Oaks, L.P.	59	09K110304 9124 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	MoDOT	Pershall Road from east of Lindbergh to just west of Hazelwood Avenue	Location number not available
SLAPS VPs	United Automobile Workers Local 325	60 and 61	09K130104 161 Ford Lane Hazelwood, Missouri 63042
SLAPS VPs	Emerson Community Credit Union	62	09K130038 9150 Pershall Road Hazelwood, Missouri 63042
SLAPS VPs	City of Florissant	VP Number not assigned	County Bridge No. 14650211

Table III-3. North St. Louis County Site Properties – The HISS and HISS/Latty VPs

Site Location	Property Owner	Bechtel Locator Number	County Locator # and Address
HISS	N/A	N/A	Location number not available
HISS/Latty	Federal Mogul Corp.	1L	10K530087 and 10K530098 9151 Latty Avenue Berkeley, Missouri 63134
HISS/Latty	General Investment Funds Real Estate Holding Company (GIFREHC)	2 L	10K510012 9150 Latty Avenue Hazelwood, Missouri 63134
HISS/Latty	SLT Development Corp.	3L	10K520022 9060 Latty Avenue Berkeley, Missouri 63134
HISS/Latty	Graham Packaging Company, L.P.	4L and 5L	10K520033, 10K520044, and 10K520165 8942 and 8966 Latty Avenue Berkeley, Missouri
HISS/Latty	Van Waters & Rogers, Inc.	6L	10K510067 8999 Seeger Ind. Drive Berkeley, Missouri 63134
HISS/Latty	Jarboe Realty & Investment Company	Futura	10K510023 9200 Latty Avenue Berkeley, Missouri 63134
HISS/Latty	Jarboe Realty & Investment Company	HISS	10K510090 9170 Latty Avenue Berkeley, Missouri 63134

Table III-3. North St. Louis County Site Properties – The HISS and HISS/Latty VPs (Cont'd)

Site Location	Property Owner	Bechtel Locator Number	County Locator # and Address
SLAPS VPs	City of St. Louis	Ballfields	10K11-0021 and 10K130014 McDonnell Boulevard and Eva Avenue
SLAPS VPs	City of St. Louis	16	10K210064 6685 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Boeing/McDonnell	17	10K210053 6709 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Boeing/McDonnell	18	10K230051 6745 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Leo & Velma Vasquez	19	10K230031 9080 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Boeing/McDonnell	20A	10K210031 9060 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Leo & Velma Vasquez	20	10K230040 9040 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	First Industrial, L.P.	21 and 23	10K230073 and 10K240094 9043 and 8921 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	STL Distribution Services, LLC	22	10K240106 9015 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Chart Automotive Group, Inc.	(See VP-37) 24	10K330360 8801 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	EDO, L.C	24 (Part)	10K330360 8875 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Boeing/McDonnell	25	10K210031 and 10K220195 8900 and 9060 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Sutton & Son's Refuse Disposal Service	26	10K240207 8870 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Alfred Fleischer & Eva Fleischer	27 and 28	10K330030 and 10K330351 8838 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	Jacqueline Gutman Stern, Trustee	29	10K330223 8822 Frost Avenue Berkeley, Missouri 63134
SLAPS VPs	a. Stern Bros (Gutman) b. Barron	30	10K330232 8810 Frost Avenue Berkeley, Missouri 63134

Table III-3. North St. Louis County Site Properties – The HISS and HISS/Latty VPs (Cont'd)

Site Location	Property Owner	Bechtel Locator Number	County Locator # and Address
SLAPS VPs	Sid Boedeker Safety Shoe Co.	31a	10K330342 and 10K330131 6822 and 6824 Hazelwood Avenue Berkeley, Missouri 63134
SLAPS VPs	T.M. Properties L.L.C.	32	10K330241 8801 Seeger Ind. Drive Berkeley, Missouri 63134
SLAPS VPs	Supervalu Holdings Inc.	33, 34, 35, 35a, 38, 39, and 55 (Part)	10K330333 (6826 Haz)VP-33 10K330324 (6830 Haz)VP-34 10K610178(6850 Haz) VP-35 and VP-35a 10K540097 (7101 Haz)VP-38 10K630363 (7100 Haz)VP-39 09K210228 (8880 Pershall Rd.) VP 55pt
SLAPS VPs	FR Development Services, Inc.	36	10K520198 6857 Hazelwood Avenue Berkeley, Missouri 63134
SLAPS VPs	Chart Automotive Group, Inc.	(See VP-24) 37	10K520066 8920 Latty Avenue Berkeley, Missouri 63134
SLAPS VPs	Dale Anthony Lakenburger	41	10K540031 8827 Nyflot St. Louis, Missouri 63140
SLAPS VPs	Laurie Porter	43	10K540075 8834 Heather Lane, Suite A Hazelwood, Missouri 63042
SLAPS VPs	Ford Motor Co.	63	10K430042 6250 N. Lindbergh Boulevard Hazelwood, Missouri 63042

Table III-4. North St. Louis County Site Properties – Coldwater Creek

Site Location	Property Owner	Bechtel Locator Number	County Locator Number
Coldwater Creek	Bernadette Business Forms, Inc.	1-C	09K210064 8950 Pershall Road Hazelwood, Missouri 63042
Coldwater Creek	Norfolk Southern Railway Company	2-C	N/A
Coldwater Creek	Tubular Steel, Inc.	3-C	09K120040
Coldwater Creek	Cortrol Process Systems, Inc.	4-C	09K120127
Coldwater Creek	Cortrol Process Systems, Inc.	5-C	09K120116
Coldwater Creek	Norfolk Southern Railway Company	6-C (Part)	10K440113
Coldwater Creek	Robert Matulewic Rln, Inc.	6-C (Part)	10K440104
Coldwater Creek	Tubular Steel, Inc.	7-C	10K440096
Coldwater Creek	Alois G. Hutter	8-C	10K440074
Coldwater Creek	Contico International, L.L.C	9-C	10K420010
Coldwater Creek	Contico International, L.L.C.	10-C	10K140024
Coldwater Creek	M&M Ellenbracht, Trs		07J520900

These properties are located within the City of Hazelwood and the City of Berkeley, and include the airport property owned by the City of St. Louis. The SLAPS VPs consist of the properties between the SLAPS and the HISS, along Coldwater Creek, and the open fields immediately north of the SLAPS (the former Ballfields area). These properties were formally designated by DOE as VPs based on preliminary characterizations. Properties contiguous to the SLAPS were grouped into investigation areas (IAs) to facilitate implementation of characterization studies. These areas were designated as IA-8 through IA-13. Although the SLAPS was initially subdivided into IAs, this subdivision was later changed to subdivision by phases. The Latty Avenue properties include the HISS, Futura, and eight VPs [designated 1(L) – 6(L), 40A, and 10k530087]. For those North St. Louis County sites VPs that have split into multiple parcels for sale subsequent to designation, a letter designation is added after the VP identifying number (e.g., VP-24a, VP-24b, and VP-24c).

North St. Louis County Sites Physical Characteristics

The SLAPS covers 22 acres bounded by McDonnell Boulevard on the north, Coldwater Creek on the west, and Norfolk Southern railroad tracks on the south. A 1,000-foot-long railroad spur, constructed in 1998, parallels and connects to these tracks. The local topography of the SLAPS is relatively flat due to previous construction, demolition, and grading activities. The native soil column has been largely disturbed or covered by fill during the previous activities. Depth to bedrock ranges from about 55 feet on the eastern portion of the SLAPS to a maximum of 90 feet on the western portion of the SLAPS near Coldwater Creek. A generalized stratigraphic column for the SLAPS and the HISS is shown on Figure III-6. Surface drainage from the SLAPS is directed through four drainage ditches that ultimately discharge to Coldwater Creek.

The local terrain of the remainder of the North St. Louis County sites (i.e., Latty Avenue properties and the SLAPS VPs) is generally flat with surface run-off toward Coldwater Creek, either directly or via intermittent tributaries. Coldwater Creek is the main drainage for the North St. Louis County sites. Flooding occurs annually in Coldwater Creek. Water quality in the creek is generally poor and has been affected by industrial discharges from multiple facilities, including storm-water run-off and discharges from three sewage treatment facilities.

Five hydrostratigraphic zones (HZs) are present at the North St. Louis County sites. These HZs are the shallow ground-water zone, HZ-A; the underlying HZ-B and HZ-C; and the underlying shale (HZ-D) and limestone bedrock (HZ-E). HZ-E is the protected aquifer for the North St. Louis County sites. All five HZs (HZ-A through HZ-E) occur beneath the SLAPS. However, HZ-D (shale) is not present beneath the HISS or Futura. A highly impermeable clay aquitard separates HZ-A from the remaining underlying HZs at the SLAPS and the HISS. The presence of this aquitard, along with available analytical data, indicates there is little to no communication between ground water in HZ-A and the lower HZs at the SLAPS. This interpretation of negligible communication between HZ-A and the lower HZs is supported by anion and cation compositions of ground-water samples, differing piezometric surfaces, and tritium data. Additionally, the available ground-water monitoring data indicate localized effects on ground water in HZ-A and an absence of these effects in lower HZ ground water (USACE 2003b). The total dissolved solids values in HZ-A ground water, combined with poor water extraction rates due to low hydraulic conductivities [on the order of 10^{-6} to 10^{-8} centimeter/second (cm/s)], provide confirmation that HZ-A does not produce water in sufficient quantities to fit the definition of an aquifer or to serve as a drinking water supply. Furthermore, the low yields of HZ-A preclude the discharge from HZ-A to Coldwater Creek from contributing an important part of the base flow for the creek and from resulting in contaminant levels above water quality standards in creek surface water.

North St. Louis County Sites Land and Resource Use

Approximately 50% of the contaminated soil at the SLAPS has been removed and the excavations backfilled and covered with either recently established turf or temporary crushed stone surfacing. Removal actions are in progress on the site. Temporary construction operation and support facilities are located on the site and include a modular field office complex, parking areas, and water storage and treatment facilities, as well as a sedimentation basin located on the west end of the site.

Typical Latty Avenue properties consist of commercial, industrial and warehouse facilities, and buildings with adjoining paved and turfed areas. The HISS/Futura property covers an 11-acre tract. Stockpiled material was removed from the HISS and shipped to an out-of-state disposal facility during the period of this five-year review. A 700-foot long rail spur, constructed in 1999, extends along the eastern edge of the property and, though not currently in use, remains operational. The Futura Coatings portion of the site consists of a manufacturing facility surrounded by paved and turfed areas.

The SLAPS VPs consist of 78 properties between the SLAPS and the HISS, as well as railroad lines, the open field area immediately north of the SLAPS (the former ballfield area), and Coldwater Creek. Generally, the SLAPS VPs are used similarly to the Latty Avenue properties. The former ballfield area is covered with grass and is not used, except for one portion occupied by the City of Berkeley Shooting Range and Mulch Storage Area. Coldwater Creek, from Highway 67 to the Missouri River, is a Class C waterway (periodic no-flow conditions) designated for livestock and aquatic life use.

HZ-A is not an aquifer and is not considered a current or potential future source of drinking water because it has insufficient yield and has been affected by broad-scale human activity. HZ-B through HZ-D are not considered protected aquifers, but HZ-E is a protected aquifer at the North St. Louis County sites. Given the proximity of the Missouri and Mississippi rivers and the availability of treated water, HZ-E is not used as a drinking water source at the North St. Louis County sites. The expected future use of ground water at the North St. Louis County sites is not expected to change from current use.

North St. Louis County Sites History of Contamination

In 1946, MED/AEC acquired the 22-acre tract of land now known as the SLAPS to store residues and scrap resulting from uranium processing at the SLDS. Several wastes and by-products were transported to the SLAPS for storage, including radium-bearing residues, raffinate cake, barium sulfate cake, and C-liner slag. The MED/AEC ultimately obtained title to the SLAPS by condemnation proceedings on January 3, 1947. By 1960 there were approximately 50,000 empty drums and 3,500 tons of contaminated steel and alloy scrap stored at the SLAPS.

Continental Mining and Milling Company of Chicago purchased uranium-bearing residues from the Manhattan Engineer District (MED) and removed them from SLAPS in 1966. The company placed the residues in storage at a property on Latty Avenue (later known as the HISS/Futura properties) under an Atomic Energy Commission (AEC) license. In January 1967, the Commercial Discount Corporation of Chicago, Illinois, purchased the residues. Much of the

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.
Hydrostratigraphic zone (HZ)-A	Quaternary	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.
Hydrostratigraphic zone (HZ)-A	Quaternary	Pleistocene	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	Quaternary	Pleistocene	VARVED CLAY	0-8	Alternating layers of dark and light clay as much as 1/16 inch thick (3M)
Hydrostratigraphic zone (HZ)-B	Quaternary	Pleistocene	CLAY	0-26	Dense, stiff, moist, highly plastic clay. (3M)
Hydrostratigraphic zone (HZ)-C	Quaternary	Pleistocene	SILTY CLAY	10-29	Similar to upper silty clay. Probable unconformable contact with highly plastic clay. (3B)
Hydrostratigraphic zone (HZ)-C	Quaternary	Pleistocene	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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Five Year Review Report for 1998-2003 St. Louis, Missouri

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Figure III-6. Generalized Stratigraphic Column for the SLAPS and the HISS material was dried and shipped to Canon City, Colorado. The material remaining at the Latty Avenue storage site was sold to Cotter Corporation in December 1969. From August through November 1970, Cotter Corporation dried some of the remaining residues and shipped them to its mill in Canon City. Over time, residues migrated from other sites or were deposited as the residues were hauled along transportation routes, contaminating the soils and sediments of the vicinity properties.

In 1979, the owner of the Futura property excavated approximately 13,000 yd^3 of soil and debris from the western portion of the property prior to constructing a manufacturing facility. This excavated material was placed at the eastern end of the HISS property in a storage pile, subsequently referred to as the Main Pile.

With regard to the Latty Avenue properties, DOE supported construction activities at the Futura property in 1984. These activities resulted in the generation of approximately 14,000 yd^3 of contaminated soil that were added to the Main Pile at the HISS. In 1986, the DOE provided radiological support to the cities of Hazelwood and Berkeley for a drainage and road improvement project along Latty Avenue. This project generated another approximately 4,600 yd^3 of contaminated material that was placed in a storage pile at the HISS. This storage pile later became known as the Supplemental Pile.

At the SLAPS, the first removal action was conducted by DOE in the spring of 1985. To mitigate gully erosion that had occurred in the western portion of the SLAPS along the bank of Coldwater Creek, a gabion retaining wall was constructed along the bank.

In 1996, the owner of the property to the east of the HISS/Futura Site, GIFREHC, in consultation with DOE, made commercial parking and drainage improvements on the property. These actions resulted in the creation of two contaminated soil piles on the southwest portion of the property, now referred to as VP-2(L). These piles were known as East Piles 1 and 2. A high-density polyethylene liner was placed over the material in both piles, followed by "clean" soil and a vegetative cover. In addition, two small piles, referred to as the HISS Railroad Spur Spoil Piles A and B (contaminated soil and debris), were generated during construction of the railroad spur onto the HISS in early 1999. Spoil Pile A was located between the Main Pile and the Supplemental Pile (created as a result of a 1986 drainage and road improvement project along Latty Avenue) and Spoil Pile B was located south of the Main Pile.

North St. Louis County Sites Initial Responses

The USACE conducted a second removal action in the fall of 1997 to address contamination in an area immediately east of the gabion wall. Approximately 5,100 in-situ yd^3 of contaminated material were removed under this action and transported off-site pursuant to the 1997 EE/CA (DOE 1997a) and Action Memorandum (DOE 1997b).

Removal actions have also been conducted at several of the SLAPS VPs and other Latty Avenue VPs. In 1995, DOE excavated contaminated soil from six residential SLAPS VPs and two industrial Latty Avenue VPs pursuant to the 1992 EE/CA (DOE 1992) and 1995 Action Memorandum (DOE 1995).

North St. Louis County Sites Basis for Taking Action

Previous characterization activities conducted at the North St. Louis County sites have determined that contamination related to MED/AEC activities is present in the accessible surface and subsurface soil of the site properties that requires response actions. The contamination detected resulted from the uncontrolled storage and subsequent transportation of MED/AEC affected materials generated at the SLDS. As agreed to under the FFA, all wastes resulting from or associated with uranium manufacturing or processing activities conducted at the SLDS are also subject to the response actions conducted at the North St. Louis County sites.

IV. ST. LOUIS SITES RESPONSE ACTIONS

SLS response actions consisted of a remedial action performed at a non-NPL site known as the SLDS (Mallinckrodt property and VPs) in accordance with the SLDS ROD (USACE 1998c), and removal actions at the North St. Louis County sites (SLAPS, HISS/Futura, and VPs) performed in accordance with their corresponding Action Memoranda (DOE 1997b and USACE 1999a; USACE 1998b; DOE 1995). The respective action and the implementation of the action at each site is presented in subsequent paragraphs.

ST. LOUIS DOWNTOWN SITE

As stated previously, this five-year review concerns the remedial action conducted at the SLDS Accessible Soil and Ground-Water OU from September 1998 through August 2003. The remedial action for the SLDS Accessible Soil and Ground-Water OU presented in the SLDS ROD (USACE 1998c) is expected to be protective of human health and the environment, will meet applicable or relevant and appropriate requirements (ARARs), and was developed to provide the best balance of effectiveness, cost, and implementability. The scope and role of the remedial action set forth in the SLDS ROD (USACE 1998c) is to remediate accessible soil and ground-water contamination that resulted from MED/AEC uranium manufacturing and processing activities conducted at the Mallinckrodt plant.

The SLDS ROD (USACE 1998c) was signed on August 3, 1998, by Russell L. Fuhrman, Major General, U.S. Army Director of Civil Works and on August 27, 1998 by Dennis Grams, P.E. Regional Administrator, USEPA Region VII.

The other OU at the SLDS is the Inaccessible Soil OU. The Inaccessible Soil OU is comprised of buildings and soil that is inaccessible due to the presence of Buildings 25 and 101, active rail lines, roads, the levee, and other buildings and encumbrances (e.g., Building 8). The buildings and inaccessible soil that compose the Inaccessible Soil OU will be addressed in accordance with a future CERCLA action. USACE is currently developing the approach to issuance of a ROD for the Inaccessible Soil OU. MDNR and EPA will be invited to participate in this process.

Prior to selection of the remedial action for the SLDS, several properties were addressed under removal action authority. These properties include Plant 10 (City Block 1201, a.k.a. former Plant 4), the land east of the levee (Riverfront Trail), and several buildings at the Mallinckrodt Property. These areas are to be included in the post-remedial action risk assessment to reconfirm the protectiveness of the removal action.

SLDS Remedial Action Selection

Characterization activities conducted at the SLDS determined that contamination related to MED/AEC activities is present in accessible soil at the Mallinckrodt property and VPs at levels that require remedial action. The remedial action ultimately selected was identified as Selective Excavation and Disposal, although treatment to cost-effectively reduce the mobility and toxicity of the radioactivity to acceptable risk levels was initially retained as a conditional part of the remedy. Treatment was further evaluated during the design phase and was subsequently not identified as a cost-effective remedy that reduced the contaminant's volume, toxicity, or mobility. Therefore treatment was not included in the remedial action.

Implementation of a long-term ground-water monitoring strategy for the Mississippi Alluvial Aquifer (HU-B) is also being implemented under the SLDS ROD. The need for ground-water remediation is being investigated as part of Phase II of the Ground-water Remedial Action Alternatives Assessment (GRAAA).

Well sampling is conducted for two purposes: 1) to assure that protection of human health and the environment is being preserved; and, 2) to design and conduct the best management for treatment, if necessary, and disposition of excavation waters. Well sampling is conducted in both the shallow and deep water horizons. The deeper water (HU-B) needs to be protected and the GRAAA will evaluate any contaminants in the deeper water and determine if additional response actions are required. The protective sampling is to assure that the environment is not being degraded by the site's remedial action. The monitoring also provides information to determine issues that may influence the management / disposition of excavation water.

The remedial action objectives for the SLDS Accessible Soil and Ground-Water OU as set forth in the SLDS ROD (USACE 1998c) are to:

Soil

- prevent exposures from surface residual contamination in soil greater than the criteria prescribed in 40 CFR 192;
- eliminate or minimize the potential for humans or biota to contact, ingest, or inhale soil containing COCs;
- eliminate or minimize volume, toxicity, and mobility of affected soil;
- eliminate or minimize the potential for migration of radioactive materials off-site;
- comply with ARARs; and
- eliminate or minimize potential exposure to external gamma radiation.

Ground Water

- remove sources of COCs in the A Unit (HU-A); and
- continue to maintain low concentrations of OU COCs in the B Unit (HU-B).

The major components of the remedial action presented in the ROD include:

- excavation of accessible soil to composite criteria (ARAR based) on perimeter VPs and Mallinckrodt Plant 7;

- excavation of accessible soil on the Mallinckrodt Property (except Plant 7) to composite criteria (ARAR based) in the top 4 or 6 feet and to depth to deep-soil criteria (risk-based); and

- control of potential ground-water degradation by removal of sources of soil contamination; removal, treatment, and disposal of ground water from excavations within the A Unit (HU-A); implementing institutional controls, when applicable; and perimeter ground-water monitoring in the B Unit (HU-B) to assure post-remediation compliance.

The remediation goals for the SLDS Accessible Soil and Ground-Water OU as set forth in the SLDS ROD (USACE 1998c) consist of the following general components:

Soil

- Excavation of accessible surface soil according to the ARAR-based composite criteria of 5 picocuries per gram (pCi/g) above background for the greater of Ra-226 or Th-230, 5 pCi/g above background for the greater of Ra-228 or Th-232, and 50 pCi/g above background for U-238 in the uppermost 6 inches (in.) below ground surface (bgs) (5/5/50 criteria). To concurrently address each of the major radionuclides of interest, a sum of the ratios calculation is applied.

- Excavation of accessible subsurface soil (below 6 in. bgs) according to the ARAR-based subsurface criteria of 15 pCi/g above background for the greater of Ra-226 or Th-230, 15 pCi/g above background for for the greater of Ra-228 or Th-232, and 50 pCi/g above background for U-238 to a depth of 4 or 6 feet bgs of the SLDS (15/15/50 criteria). These criteria will be met to a depth of 6 feet bgs in areas of Mallinckrodt located west of the St. Louis Terminal Railroad Association tracks (DT-9) and at the former locations of Buildings 116 and 117 in Plant 6EH. These criteria will be met at the remaining areas of the SLDS to a depth of 4 feet bgs except at the Plant 7 area and VPs, where these criteria are applied to depth.

- Excavation of accessible deep subsurface soil [below 4 or 6 feet bgs] to the risk-based criteria of 50 pCi/g above background for Ra-226, 100 pCi/g above background for Th-230, and 150 pCi/g above background for U-238 in the Mallinckrodt property portion of the SLDS (50/100/150 criteria). To concurrently address each of the major radionuclides of interest, a sum of the ratios calculation is applied, subject to achieving the 25 mrem/yr ARAR (i.e., 10 CFR 20, Subpart E).

- For arsenic and cadmium: (1) excavation of accessible soil to the criteria of greater than 60 milligrams per kilogram (mg/kg) of arsenic and/or greater than 17 mg/kg of cadmium to a depth of 4 or 6 feet bgs and (2) excavation of accessible soil to the criteria of greater than 2,500 mg/kg of arsenic and/or greater than 400 mg/kg of cadmium from 4 or 6 feet bgs to depth. Arsenic and cadmium are COCs only in Plants 2, 6, 7N, 7S, and 7W and DT-10.

Ground Water

- Perimeter monitoring of the ground water in the HU-B during and after source-term removal will be implemented. The need for ground-water remediation will be evaluated as part of the periodic reviews performed for the SLDS. The ground-water monitoring will also establish the effectiveness of the source removal. The goal of the monitoring will be to determine if COCs are present above ILs and to provide sufficient sampling data to support an evaluation of the fate and transport of MED/AEC residual contaminants through and following the remedial action.

The remedial action for the SLDS includes the excavation and off-site disposal of accessible contaminated soil to remediation goals established in the SLDS ROD (USACE 1998c). Accessible contaminated sediment in sewers and drains considered to be accessible is removed along with the accessible soil. Only approved off-site borrow would be used to fill excavations at the perimeter VPs and in the top 4 to 6 feet across the Mallinckrodt Property. A post-remedial action risk assessment will be performed upon completion of excavation and restoration [i.e., backfilling and placement of cover (asphalt, concrete, crushed rock, etc.)] to describe the level of risk remaining from MED/AEC COCs following completion of remedial activities. Material that does not exceed the deep soil (risk-based) criteria and is not a characteristically hazardous waste may be used, with prior notification to MDNR, as backfill below 4 or 6 feet bgs, as appropriate, on the Mallinckrodt Property of the SLDS except in Plant 7.

Final determinations as to whether institutional controls and land-use restrictions are necessary at the remediated areas will be based on calculations of post-remedial action risk derived from actual residual conditions. Institutional controls may include land use restrictions for those areas having residual concentrations of contaminants unsuitable for unrestricted use. This determination will be made based on a risk analysis of the actual post-remedial action conditions. For residual conditions requiring land-use restrictions after the period of active remediation, coordination with property owners and local land use planning authorities will be necessary to implement deed restrictions or other mechanisms to maintain industrial/commercial land use.

Evaluation of the Mississippi River bed in the vicinity of the SLDS is a component of the SLDS remedial action. During the RI (BNI 1994) of the SLDS, sediments containing radioactivity were found in a small area of the Mississippi River bed. A subsequent investigation as part of the RI addendum (SAIC 1995) could not relocate radioactivity on the riverbed. Presumably it was carried downstream during high flows. The location of the riverbed where radiological contamination was detected during the RI will be revisited and characterized. If the remediation goals established in the SLDS ROD (USACE 1998c) are exceeded, the remediation of the riverbed will be addressed under a subsequent response action. If no contamination is present, the existing remedy will be considered the final remedy for this portion of the SLDS.

Because the removal action conducted along the Riverfront Trail on the strip of land east of the levee and west of the Mississippi River was subject to different exposure and land use assumptions than those used in the SLDS ROD (USACE 1998c), a post-remedial action risk assessment will be conducted as a component of the SLDS remedy to determine whether restrictions will be required on this portion of the SLDS.

Another component of the SLDS remedy is the performance of a post-remedial action risk assessment to reconfirm the protectiveness of the removal action conducted at Mallinckrodt Plant 10.

SLDS Remedial Action Implementation

As part of the remedial action implementation for the SLDS, pre-design investigations were conducted on the various SLDS properties to obtain the information necessary to develop the remedial design documents. Common to remedial action implementation at each Mallinckrodt Property or VP is the coordination with the property owner; establishment of a central support facility, water treatment facility, and soil storage and loading facility; implementation of air monitoring, access controls, and security measures; and sequencing of excavation, confirmation, and final status survey activities. Support facilities include personnel and equipment decontamination facilities.

The central support facility was established on the eastern portion of Plant 7N at the initiation of FUSRAP field activities. In order to accommodate characterization of Plant 7N, the support facility was moved to DT-7, Midwest Waste in 2002.

The purpose of the central wastewater treatment facility is to store and treat ground water removed during excavation activities. All potentially contaminated waters are processed through the wastewater treatment system and the treated water is discharged to the Metropolitan St. Louis Sewer District (MSD) sewer line in accordance with an MSD authorization letter, dated October 30, 1998. The discharge is directed to the Bissell Point Treatment Plant through underground mains. Each discharge is monitored, and the results reported to MSD.

Two soil storage and railroad car loading facilities are currently established at the SLDS: (1) the Plant 7S Loadout Area on the eastern edge of the Mallinckrodt Plant and (2) the Plant 6EH Loadout Area on the northern edge of the Mallinckrodt Plant. Although the physical loadout pad has switched from the south side of the rail spur (Plant 6EH) to the north side (PSC Metals), the name for this loadout area has not changed. Once loaded into the railcars, the excavated material is covered and sent out of state for disposal. Material is disposed, depending on the concentration of the contamination, at either U.S. Ecology Idaho, Inc. in Idaho or Envirocare in Utah, which are low-level radioactive waste disposal facilities.

Excavation perimeter air monitoring is conducted during excavation activities. Monitoring consists of both real-time (continuous readout) and time-integrated sampling. Real-time monitoring is conducted for lower exposure limit, oxygen level, particulates, and organic compounds. Time-integrated sampling consists of mid-volume and low-volume samplers for total alpha and total beta measurements. Radon monitoring is conducted to determine whether radon releases are occurring.

The primary means of access control is provided by security fencing surrounding each excavation area. Prior to the commencement of work, temporary chain-link fences, gates, and/or other barriers are installed around the remediation work area. Additional safety fencing is also installed at specific excavation locations as determined by site conditions. All non-remediation personnel pedestrian traffic is excluded from construction zones. Access exclusion is established through the use of temporary chain-link fences, barricades, orange construction fencing, and radiation rope. Appropriate warning signs are posted on or adjacent to contaminated areas.

Once verification sampling demonstrates that the contamination has been removed, final status survey confirmation sampling is conducted. The USACE evaluates the results to ensure that the residual concentrations in the excavation meet the SLDS ROD (USACE 1998c) remediation goals and the excavation can be backfilled. Following the completion of backfilling, the excavated areas are regraded, compacted, and resurfaced with the same type of material initially present (e.g., asphalt, concrete, gravel). Following resurfacing, a topographic survey of the excavation areas is completed to document backfill volumes and final conditions.

The required remedial action at the SLDS and VPs is not complete as of August 2003; however, remediation has been completed at a portion of the Mallinckrodt Property and VPs.

A summary of the remedial activities conducted at the SLDS through August 2003 is presented in the following Table IV-1 below.

Table IV-1. St. Louis Downtown Site Remedial Activities Summary

Loc.	Property	Start	Complete	CY Removed
DT-2	City Property VP	October 1998	July 1999	4,260
MP	Plant 2	October 1998	August 2000	9,660
MP	Plant 1	July 2000	March 2002	2,490
DT-7	Midwest Waste VP	May 2001	February 2003	3,910
MP	Plant 6 East Half (EH) and East (E)	November 2000	July 2003	18,880
DT-6	Heintz Steel VP	April 2003	In Progress	1,660
MP	Plant 7E	July 2003	In Progress	1,775
			Total Volume =	42,635

CY = cubic yards (In-Situ)

The specifics of these remedial activities are presented in the following sections.

City Property VP (DT-2)

The USACE completed remedial design activities for this VP between August and September 1998. The remedial design partitioned the City Property Work Area into six separate excavation areas, Areas A through F. Excavation of contaminated soil began on October 14, 1998 and site restoration activities (i.e., grading and revegetation) were completed on July 8, 1999. No unexpected events of note occurred during remedial activities at DT-2.

Contaminated soil was transported to the Plant 7S soil storage and loadout facility and loaded into lined railcars for transport to the Envirocare facility in Utah, a low-level radioactive waste disposal facility. Approximately 4,260 in situ yd^3 of contaminated material were removed from DT-2.

The remedial action summary and post-remedial action evaluation are presented in the *Final Post-Remedial Action Report for the St. Louis Downtown Site City-Owned Vicinity Property, St. Louis, Missouri* (USACE 1999b). The analytical results for the final status survey samples indicated that the residual radioactivity on DT-2 met the requirements of the remedial design and was below the SLDS ROD (USACE 1998c) remediation criteria. Thus, the remediated areas can be used without restriction. By definition, the area beneath the levee on DT-2 is considered to be an inaccessible soil area and therefore is not included in the scope of the SLDS ROD (USACE 1998c).

Mallinckrodt Plant 2

Prior to development of the remedial design for Plant 2, a pre-design investigation was implemented to gather additional subsurface data to support the design of the remedial action at Plant 2. During pre-design planning, the SAIC three-dimensional model (based on EarthVision Software) of radionuclide distribution was evaluated to determine whether the soil contamination boundaries in Plant 2 were adequately defined. In addition, the RI data were reviewed to determine whether sufficient data existed for evaluation of excavation support requirements. Several data gaps were identified, including a lack of soil geotechnical data; uncertainty in the vertical and horizontal contamination boundaries and shallow distribution of contamination; and lack of radiological and chemical waste characteristic data. To address the data gaps, two wells were completed in the fill material to measure hydraulic properties. In addition, sampling was conducted to further delineate three areas of radiological activity exceeding the SLDS ROD (USACE 1998c) remediation criteria identified during the Class 2 sampling in Plant 2. The pre-design investigation data showed that the radionuclide contamination was within the fill material. However, there were occurrences of radionuclide contamination within the underlying clay/silt layer (IT 1999a).

Remedial activities at Plant 2 (i.e., design through backfilling and site restoration) were conducted between October 1998 and August 2000.

Two changes to the initial design for Plant 2 occurred. The first change involved an alteration in the excavation limits based on newly acquired pre-design investigation data and a process change to allow the excavation to proceed incrementally once the gross excavation boundary was reached. The second change involved an update in the utility locations and the incorporation of fieldwork variances issued subsequent to the previous design change.

The following activities were major components of the remedial activities implemented at Plant 2. The foundations of Buildings 50, 51, 51A, 52, and 52A were demolished. Several water and fire suppression lines were temporarily capped and removed. Manholes and catch basins exposed during excavation were supported or replaced. On-site stockpiled crushed concrete, brick, and/or cinder block from previously demolished Mallinckrodt buildings, foundations, or other consolidated material having radionuclide concentrations below the composite criteria of the SLDS ROD (USACE 1998a) and exhibiting no hazardous characteristics, as determined by the Toxicity Characteristic Leaching Procedure, were used for backfilling excavations to levels below 6 feet bgs on Mallinckrodt property. Clean off-site borrow material was used to backfill excavations from 6 feet bgs to the surface.

A total of approximately 9,660 in-situ yd^3 of contaminated material was removed from Plant 2. Excavated soil was transported to a soil storage and loadout facility and loaded into lined railcars for transport to and disposal at Envirocare of Utah, a low-level radioactive waste disposal facility.

A few unexpected events of note occurred during remedial activities at Plant 2. These included the interception of previously unknown underground active and inactive utility lines, accumulation and required collection of greater-than-anticipated quantities of ground water, and the discovery of ordnance. During remediation of the main excavation area in Plant 2, multiple utility lines were encountered that were not previously identified by any Missouri utility company or Mallinckrodt, Inc. Leaking sewer lines as well as potable water and fire-suppression-system water line ruptures resulted in excessive water accumulation in the main excavation. During soil removal at the main excavation, ordnance was unexpectedly discovered within the excavation boundaries. Work was halted, and safety specialists from USACE and the St. Louis Police Department's Bomb and Arson Squad were called in to safely extract the nearly 150-year-old ordnance. Over a five-month period, 58 pieces of ordnance were eventually removed and disposed of by the Bomb and Arson Squad. A permanent brass marker was placed on the pavement surface to identify the location of the ordnance left in place beyond the excavation limits.

Portions of stockpiled crushed concrete, brick, and/or cinder block from previously demolished Mallinckrodt buildings, foundations, or other consolidated material were determined to meet the composite criteria stated in the SLDS ROD (USACE 1998a) and exhibit no hazardous characteristics, as determined by the Toxicity Characteristic Leaching Procedure. Approximately 5,700 yd^3 of crushate were placed as deep backfill in the Plant 2 main excavation from total depth to no higher than 6 feet bgs. Clean off-site borrow material or commercially available crushed aggregate was placed from 6 feet bgs to the level of the crushed aggregate base course for a new pavement. Commercially available crushed aggregate was also used as deep backfill material.

The remedial action summary and post-remedial action evaluation are presented in the *Post-Remedial Action Report for the Accessible Soils Within the St. Louis Downtown Site Plant 2 Property* (USACE 2002a). The analytical results for the final status survey samples indicated that the residual radioactivity in the accessible areas in Plant 2 met the requirements of the remedial design and was below the 15/15/50 SLDS ROD remediation criteria. In addition, analytical results for arsenic and cadmium were below the SLDS ROD remediation criteria. Thus, the accessible areas of Plant 2 were released for use without restriction. There are several areas of inaccessible soil present in Plant 2. These areas include soil beneath the buildings in Plant 2, a small area on the north end of the main excavation, and a small area on the south end of the main excavation.

Mallinckrodt Plant 1

The Plant 1 pre-design investigation activities described in the *Pre-Design Investigation Summary Report, Plant 1, FUSRAP St. Louis Downtown Site, St. Louis, Missouri* (IT 1999b) identified one large and 11 isolated locations of elevated radiological activity. The large area of contamination was located near the northwest corner of Plant 1 in the former Building K foundation (K-Pad) area. The 11 isolated locations, numbered 1 through 11, were located north and southeast of the K-Pad area.

The original Plant 1 design included the installation of sheet piling around the K-Pad area. However, the bids received to build/construct this design were significantly greater than the estimated costs. USACE, along with its remedial action contractor, IT, began to explore other means of shoring. It was determined that excavation of the K-Pad area in strips using a slide rail shoring system would be a more cost-effective approach. During the remediation, unexpected subsurface obstructions were encountered (e.g., remnants of building foundations and streets) that would not have allowed sheet piling to be driven to the desired depth. Use of the slide rail shoring system enabled the excavating subcontractor to work around these obstructions.

Plant 1 remedial activities began in July 2000 and were completed in September 2003. As remediation progressed, the 12 contamination locations (including the K-Pad) were further subdivided into individual excavation areas. This subdivision was implemented as an adjustment to changing field conditions and to facilitate remedial activities while allowing continuous Mallinckrodt operations. Approximately 2,490 in-situ yd^3 of contaminated material were removed. Ten areas of inaccessible soil have been identified in Plant 1, owned by Mallinckrodt, Inc. These areas could not be excavated without jeopardizing the integrity of nearby structures (e.g., building, substation) or impacting daily business operations of the owner.

The use of slide rail shoring at the K-Pad area excavation in lieu of the sheet pile system originally scoped was instrumental in controlling the volume of water accumulating in the excavation. Use of the slide rail shoring system facilitated the progress of excavation in a controlled manner by limiting the excavation area that was open at any given time. By using the slide rail shoring system, sheet-pile-driving vibrations which could have adversely affected Mallinckrodt operations in adjacent buildings were eliminated.

On-site stockpiled crushed concrete, brick, and/or cinder block from previously demolished Mallinckrodt buildings, foundations, or other consolidated material having radionuclide concentrations below the composite criteria of the SLDS ROD (USACE 1998a) and exhibiting no hazardous characteristics, as determined by the Toxicity Characteristic Leaching Procedure, were used for backfilling excavations to levels below 6 feet bgs on Mallinckrodt property. Approximately 450 yd^3 of crushate were placed as deep backfill in the K-Pad area from total depth to no deeper than 6 feet bgs. Clean off-site borrow material or commercially available crushed aggregate was placed from 6 feet bgs to the level of the crushed aggregate base course for the new pavement.

Many challenges were encountered during Plant 1 remedial activities because the work areas were in the most active part of an operating chemical plant complex. However, the only unexpected event of note was the encountering of subsurface remnants of a building foundation and brick street pavement. Use of the slide rail shoring system in the K-Pad area enabled the excavation subcontractor to work around these obstructions and therefore limit possible schedule delays.

The USACE most recently addressed contaminated soil near the former Buildings T, V, and W and the rail spur area south of Building X. Upon completion of remedial activities in these areas, a remedial action summary and post-remedial action evaluation will be presented in a post-remedial action report.

Midwest Waste VP (DT-7)

Prior to development of the remedial design for DT-7, a pre-design investigation was conducted to gather additional subsurface data to support the design of remedial action. The data collected during pre-design investigation activities identified 15 locations of shallow (less than 4 feet bgs) contamination [*Pre-Design Investigation Data Summary Report, Midwest Waste Vicinity Property (DT-7), St. Louis Downtown Site, St. Louis, Missouri* (IT 2001a)].

DT-7 remedial operations began in May 2001 and concluded in February 2003. After remediation activities began, it became apparent that more contamination was present than originally anticipated based on the pre-design investigation sampling. A geologic examination of the soil/fill horizons exposed by the excavations, along with further evaluation of historical land elevations and aerial photographs, indicated that the subsurface zone of contamination encountered appeared to coincide with the horizon that was the land surface at the time MED/AEC activities began (i.e., 1941). This horizon was present 4 to 5 feet bgs. The pre-design investigation sampling conducted on DT- 7 did not encounter this zone of contamination. A total of approximately 3,910 in-situ yd^3 of contaminated material was excavated from DT-7.

Other than the increased quantity of contaminated soil volumes discussed above, no unexpected events of note occurred during remedial activities at DT-7. The remedial action summary and post-remedial action evaluation will be presented in a post-remedial action report and will be submitted to MDNR and EPA for review and comment prior to finalization.

Mallinckrodt Plants 6 East (6E) and 6 East Half (6EH)

Prior to development of the remedial design for Plants 6E and 6EH, a pre-design investigation was conducted to gather additional subsurface data to support the design of remedial actions. The pre-design investigation data showed that radionuclide contamination was confined to two isolated areas in Plant 6E, but was extensive in Plant 6EH [*Pre-Design Investigation Data Summary Report, Plants 6 East Half and 6E* (IT 2000)]. The majority of the contamination appeared to be present within the fill material to a depth of 4 feet bgs. Contamination was present in two deep areas at 12 and 20 feet bgs.

Remedial activities consisting of the excavation of contaminated soils in Plant 6EH and Plant 6E began in November 2000 and were completed in July 2003. After remedial operations began, it became apparent that the contamination was more extensive, both vertically and horizontally, than originally anticipated based on the pre-design investigation sampling. Approximately 18,880 in-situ yd^3 of contaminated material were excavated from Plants 6EH and 6E. The post remedial action report for this area is being developed and will be submitted as part of the Post Remedial Action Report for Plant 6 to MDNR and EPA for review and comment prior to finalization. A more complete discussion of the remedial activities conducted at Plants 6EH and 6E will be provided in the next five-year review report.

Heintz Steel and Manufacturing VP (DT-6)

The Heintz Steel and Manufacturing VP (DT-6) was investigated to 2 feet bgs during pre-design investigation activities. The pre-design data indicated three areas of shallow (0.5 feet bgs) radiological contamination in the fill material [*Pre-Design Investigation Data Summary Report, Heintz Steel and Manufacturing Vicinity Property (DT-6)* (IT 2001b)]. The three areas of radiological contamination appeared to be randomly located, with no specifically identifiable source.

Due to the degree and extent of contaminated soil encountered at DT-7 during excavation activities, further evaluation of historical land elevations and aerial photographs was conducted for DT-6. The results of this evaluation indicated that the same subsurface zone of contamination present at DT-7, which coincides with the horizon that was the land surface at the time MED/AEC activities, which began in 1941, may be present at DT-6. This horizon is expected to be present 4 to 5 feet bgs. The pre-design investigation sampling conducted on DT-6 did not encounter this zone of contamination.

Remedial activities began in April 2003 and are ongoing. As part of these remediation activities, sampling of several trenches excavated to a depth of approximately four feet, was conducted to determine if the deeper zone of contamination encountered on DT-7 is present on DT-6, and to what extent. A more complete discussion of the remedial activities conducted at DT-6 will be provided in the next five-year review report.

Mallinckrodt Plant 7E

The Plant 7E property is located in the eastern portion of the SLDS, south of Destrehan Street and east of the Burlington Northern Railroad tracks (DT-12) and Plant 7 North (N). The northern portion of the Plant 7E property was previously remediated along with DT-2 because property ownership information available at that time indicated that it was part of DT-2 and not Plant 7E. The fenced portion of the Plant 7E property is surfaced with gravel placed over geotextile and was most recently used for storage of MI roll-offs and small FUSRAP stockpiles of miscellaneous materials. These stored items were removed.

The availability of data from Plant 7E obtained during remediation of DT-2 and the characterization of DT-1 precluded a pre-design investigation for the remedial design of Plant 7E. These data have been augmented by the sampling of several investigational trenches that delineated required areas of remediation in more detail. Data from samples collected during the digging of the trenches were used to aid in the determination of the proposed limits of gross excavation for Plant 7E and are presented in *Mallinckrodt Plant 7E Remediation Activity Work Description* (IT 2003).

Remedial activities began in July 2003 and are currently ongoing. A more complete discussion of the remedial activities conducted at Plant 7E will be provided in the next five-year review report.

General Remediation Matters

As stated previously, authority under the SLDS ROD (USACE 1998c) for the remediation of MED/AEC-related wastes is limited to those wastes in accessible soil and ground water. The SLDS ROD (USACE 1998c) defines accessible soil as soil that are not beneath buildings or other permanent structures. The SLDS ROD (USACE 1998c) also provides examples of soil considered to be inaccessible and excluded from remedial action under the SLDS ROD. Soil that is inaccessible due to the presence of buildings, active roads, active rail lines, and the levee is specifically excluded from remediation. Because the scope of the remedial action authorized by the SLDS ROD (USACE 1998c) is limited to accessible soil and ground water, the definition of accessible soil controls the determination of whether remediation of a particular area is authorized. The discussion of inaccessible soil in the SLDS ROD (USACE 1998c) provides examples of areas excluded, but not a complete list. Therefore, the determination of whether an area is accessible or inaccessible is made on a case-by-case basis by applying the SLDS ROD (USACE 1998c) definition of accessible soil. Because the determination of whether soil is accessible is directly related to the permanent nature of structures built upon soil, USACE has concluded that areas surrounding buildings or other permanent structures where the volume of soil underlying the areas is required for structural stability of the adjacent building or other permanent structure are also inaccessible. Each area excluded from remediation as inaccessible is documented, presented in the appropriate post-remedial action report, and will be included in the final site closeout report and will be submitted to MDNR and EPA for review and comment prior to finalization. A separate ROD will be developed for inaccessible areas at the SLDS. MDNR and EPA will be invited to participate in this process.

The SLDS remedy also includes implementation of a long-term ground-water monitoring strategy for the Mississippi Alluvial Aquifer (HU-B). As specified in the SLDS ROD (USACE 1998c), if long-term monitoring of HU-B shows significant exceedances of maximum contaminant levels (MCLs) or the thresholds established in 40 CFR 192 by the COCs specified in the SLDS ROD, then a GRAAA is to be initiated. The ROD-specified investigative levels (ILs) for each of the ground-water COCs are 50 micrograms per liter (μg/L) for arsenic, 5 μg/L for cadmium, and 20 μg/L for total uranium. Samples from three HU-B (Mississippi Alluvial Aquifer) monitoring wells exceeded the ILs for one or more of the COCs established in the SLDS ROD. Monitoring wells DW14 and DW15 exceeded the IL for arsenic. Significant exceedance of the total uranium IL in DW19 for an extended period initiated Phase 1 of the GRAAA. Therefore, a Phase I GRAAA was initiated in 2001 (USACE 2003a).

Final status surveys compatible with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) are performed subsequent to remediation at the SLDS. These surveys document achievement of remedial goals. Results of final status surveys are documented in Post-Remedial Action Reports (PRARs) for properties requiring remediation and in Final Status Survey Evaluation Reports (FSSERs) for those properties not requiring remedial action. Each of these reports includes a summary of the detailed documentation that confirms that the areas involved achieve remediation goals. This documentation specifically includes residual concentrations of contaminants of concern (e.g., exposure point concentrations) and assessment of residual site risks to confirm protectiveness.

System Operation/Operation and Maintenance

Thus far, the remedial activities completed for accessible soils have allowed for unlimited use and unrestricted exposure at the particular property. Therefore no operations and maintenance documents have been required. USACE is currently in the process of developing the CERCLA documentation necessary to address inaccessible soil at the SLDS. MDNR and EPA will be invited to participate in this process.

NORTH ST. LOUIS COUNTY SITES

During the period of this review (September 1998 through August 2003), North St. Louis County sites removal actions were conducted pursuant to the following EE/CAs and their corresponding Action Memoranda:

(1) *Engineering Evaluation/Cost Analysis – Environmental Assessment for the Proposed Decontamination of Properties in the Vicinity of the Hazelwood Interim Storage Site, Hazelwood, Missouri*, DOE/EA-0489, Rev. 1, March 1992 (DOE 1992) and *St. Louis Site Action Memorandum for Vicinity Property Cleanups*, June 1995 (DOE 1995).

(2) *St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA) St. Louis, Missouri*, DOE/OR-21950-1026, September 1997 (DOE 1997a) and *SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material*, September 1997 (DOE 1997b).

(3) *Engineering Evaluation/Cost Analysis for the Hazelwood Interim Storage Site (HISS), St. Louis, Missouri*, October 1998 (USACE 1998a) and *Action Memorandum for the Removal of Radioactively Contaminated Material at the Hazelwood Interim Storage Site and Latty Avenue Vicinity Properties*, June 1998 (USACE 1998b).

(4) *Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum, St. Louis, Missouri*, March 1999 (USACE 1999a).

North St. Louis County Sites Removal Action Selection

Up to August 2003, removal actions have been conducted pursuant to Action Memoranda adopting recommendations set forth in the EE/CAs while a ROD was being developed to identify the final remedial action.

Four separate EE/CAs govern the removal actions conducted at the North St. Louis County sites. As noted, two of these EE/CAs were developed by DOE and two were developed by the USACE.

The first EE/CA (DOE 1992) developed for the North St. Louis County sites addresses vicinity properties in the Hazelwood and Berkeley, Missouri, area that were affected by operations at the SLAPS and the HISS. The selected response action for these vicinity properties presented in the EE/CA is the excavation of affected materials and the transportation of the affected materials to an interim storage area, the HISS. Subsequently, a DOE memorandum, "*St. Louis Site – Action Memorandum for Vicinity Property Cleanups*, June 1995", authorized the removal actions recommended in the EE/CA and amended the original proposal to replace the interim storage of contaminated soil at the HISS with shipment to an out-of-state commercial disposal facility.

The second EE/CA (DOE 1997a) addresses the presence of residual radioactive material in the soil at the SLAPS. The objectives of the selected alternative are to remove fill material immediately adjacent to Coldwater Creek and to provide a buffer zone between the creek and the remainder of the SLAPS. Specifically, all excavated soil that exceeded the DOE standard referred to as the 5/15/50 guideline would be shipped out of state to a licensed disposal facility. This removal action was authorized in the *SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material* (DOE 1997b).

The third EE/CA (USACE 1998a) developed for the North St. Louis County sites addresses two interim storage piles at the HISS, two interim storage piles at Latty Avenue VP-2(L), accessible subsurface soil at two Latty Avenue VPs, and one contiguous property. The USACE determined that an expedited response action to address affected materials located on these properties was appropriate to ensure protection of human health and the environment. The approved removal action required soil from the four interim storage piles, and accessible subsurface soil from the two Latty Avenue VPs and the contiguous property that exceed the selected criteria of 5/15/50 pCi/g for Ra-226, Th-230, and U-238, respectively, to be excavated and disposed at a licensed or permitted disposal facility. This removal action was authorized in the *Action Memorandum for the Removal of Radioactively Contaminated Material at the Hazelwood Interim Storage Site and Latty Avenue Vicinity Properties* (USACE 1998b).

The fourth EE/CA and Action Memorandum (USACE 1999a) addresses the SLAPS and the Ballfields (a SLAPS-VP area) and identifies the excavation and disposal of affected fill materials from the SLAPS and the Ballfields as the selected removal action. Specifically, soil within the top 6-inch layer from the SLAPS and the Ballfields (excluding the north ditch) that exceeds the selected criteria of 5/5/50 pCi/g (Ra-226/Th-230/U-238, respectively) above background [as determined by sum of ratios (SOR)] is to be excavated and disposed at a licensed or permitted disposal facility. Soil below 6-inch bgs that exceeds 15/15/50 pCi/g (Ra-226/Th-230/U-238, respectively) above background (as determined by SOR) is also to be excavated and disposed at a licensed or permitted disposal facility. This EE/CA allows that, if an effective treatment is identified subsequent to approval of the EE/CA, the USACE will consider implementation of such treatment on any remaining soil.

North St. Louis County Sites Removal Action Implementation

As part of the removal actions for the North St. Louis County sites, pre-design investigations were conducted on the various North St. Louis County sites' properties in order to obtain the information necessary to develop the remedial design documents.

The pre-design investigations conducted to date have either refined information obtained during the RI and/or provided new information regarding the degree and extent of contamination on the North St. Louis County sites' properties.

The ground-water monitoring is to assure that the environment is not being degraded by the sites' response actions. The monitoring also provides information to determine issues that may influence the management / disposition of excavation water.

Presented below is the history of the removal action implementation at the North St. Louis County sites. Information regarding initial plans, implementation history, removal measures (including monitoring, fencing, and institutional controls), and current status of the removal actions is presented. Also presented are discussions regarding any changes to or problems with removal action components.

SLAPS

At the start of the five-year review reporting period in August 1998, the North Ditch Removal Action and Sedimentation Basin Installation were in progress at the SLAPS under a *Construction Work Plan* (CWP) (USACE 1998d) developed pursuant to the initial EE/CA at the SLAPS (DOE

1997) and the subsequent EE/CA and Action Memorandum (USACE 1999a). The CWP was implemented in three phases:

Phase 1: Excavation and disposal of radiologically affected soil from the North Ditch (the area between McDonnell Boulevard and the former ballfields).

Phase 2: Construction of a sedimentation basin on the western portion of the site.

Phase 3: Removal of radiologically affected soil from the East End Area of the site.

Each of these three phases was initiated as part of the site stabilization effort to prevent surface water run-off from carrying radioactive affected materials from the site. The SLAPS work areas and the status of the removal actions are shown in Figure IV-1.

Approximately 6,550 in-situ yd^3 of affected material were excavated from the North Ditch area. The soil excavated during each of the three phases that exceeded the removal action criteria was loaded into railcars, in accordance with governing transportation requirements, and shipped out of state to a licensed disposal facility.

In 1998, USACE performed additional characterization to provide data to support ongoing removal actions, to provide information on contaminant transport and limits of migration of contaminants, and to support contaminant boundary delineation (USACE 2001a). Soil samples from the investigation areas (IAs 1 to 13) were collected and analyzed for radionuclides and various chemicals. TCLP analyses were performed on selected soil samples. Some monitoring wells were added and some were abandoned as part of the characterization activities. Geophysical investigations were performed to determine the locations of subsurface features such as utilities, buried metal, and other objects that may be of concern during drilling and remediation activities. The USACE investigation reconfirmed the presence of the radionuclides of interest including Ra-226, Th-230, and U-238. The *SLAPS Implementation Report* documents the results of this investigation (USACE 2001a).

A pre-design investigation was conducted at the SLAPS East End and in the right-of-way (ROW) along McDonnell Boulevard in 2000 to supplement the historical data. The radiological sampling results of the pre-design investigation borings supported the historical data indicating the maximum depth of affected material to be 10 to 12 feet bgs in the East End. The radiological sampling results of the pre-design investigation borings along the McDonnell Boulevard ROW supported the historical data indicating the maximum depth of affected materials to be 3 to 4 feet bgs. In addition, the borings indicated no disturbed soil below this depth interval that may be affected as a result of past construction activities. The pre-design investigation results are presented in the *Pre-Design Investigation Summary Report, East End and Right of Way Work Areas* (Stone & Webster 2000).

In early 2000, a decision was made to temporarily suspend removal activities in the East End work area and to initiate removal of affected materials from the Radium Pits work area. The *Radium Pits Removal Action Work Plan* (USACE 2000a), developed pursuant to the EE/CA and Action Memorandum (USACE 1999a), implemented this removal action. Of note was that the Radium Pits area was believed to contain the highest radiological concentrations of affected material on the site. The Radium Pits work area was completed in November 2000.

Later in 2000, removal activities at the SLAPS resumed at the re-designated East End Extension/ROW work area (basically the area between the original East End and the Radium Pits, including the site drainage ditch along the ROW). The original work plan for this area included sheetpile shoring along portions of the ROW. However, field operations were conducted without the need for the sheetpile shoring, while still providing protection to workers and the public and stability to the roadway and shoulder area.

Current removal activities at the SLAPS are being implemented under the *Site Wide Removal Action Work Plan* (the SLAPS-RAWP)(USACE 2000b) and conducted pursuant to the EE/CA and Action Memorandum (USACE 1999a). The document includes or incorporates by reference the following:

- ARARs identified in the EE/CA (USACE 1999a);
- other related site-wide removal action plans (site safety and health plan, quality control plan, etc.);
- requirements for site-wide activities such as security, work zone access control, methods of excavation, decontamination, erosion and dust control, water management and treatment, final status surveys, backfill, site grading, and site restoration; and
- individual SLAPS area removal action work plans as appendices to the SLAPS-RAWP.

A 2.3-acre area located south of the Radium Pits, west of the East End, and north of the rail spur loadout facility has been designated as the Phase 1 Work Area. A pre-design investigation was performed during September–October 2000 in the Phase 1 Work Area. Results of historical RIs did not adequately cover the extent of the Phase 1 Work Area. Additional sampling resulted in the pre-design investigation borings supporting the historical data indicating the depth of contamination to be 12 feet bgs. The pre-dcsign investigation results are presented in the *Pre-Design Investigation Summary Report, Phase 1 Work Area* (Stone & Webster 2001a).

Excavation of the Phase 1 Work Area was implemented under the *Phase 1 Work Description* (USACE 2001b) developed pursuant to the EE/CA and Action Memorandum (USACE 1999a). Excavation of the Phase 1 Work Area was begun in December 2001 and completed in May 2003. Approximately 65,120 in-situ yd^3 of affected material were removed from the Phase 1 Work Area. A post-remedial action report will be developed and submitted to MDNR and EPA for review and comment prior to finalization. The report will include the Radium Pits, East End, East End Extension/ROW, and Phase 1 Work Area. A complete discussion of the removal activities conducted at the Phase 1 Work Area will be provided in the next five-year review report.

Currently, removal activities are in progress in the Phase 2 and 3 Work Areas, a 5.5-acre portion of the SLAPS located west of the Radium Pits and Phase 1 Work Area. Pre-design investigation activities were performed during June 2000 through January 2001 in the Phase 2 and Phase 3 Work Areas. The purpose of this investigation was to characterize the vertical extent of, and more accurately delineate, affected materials in the Phases 2 and 3 Work Areas prior to initiation of removal activities. The analytical results indicated that the deepest contamination was present

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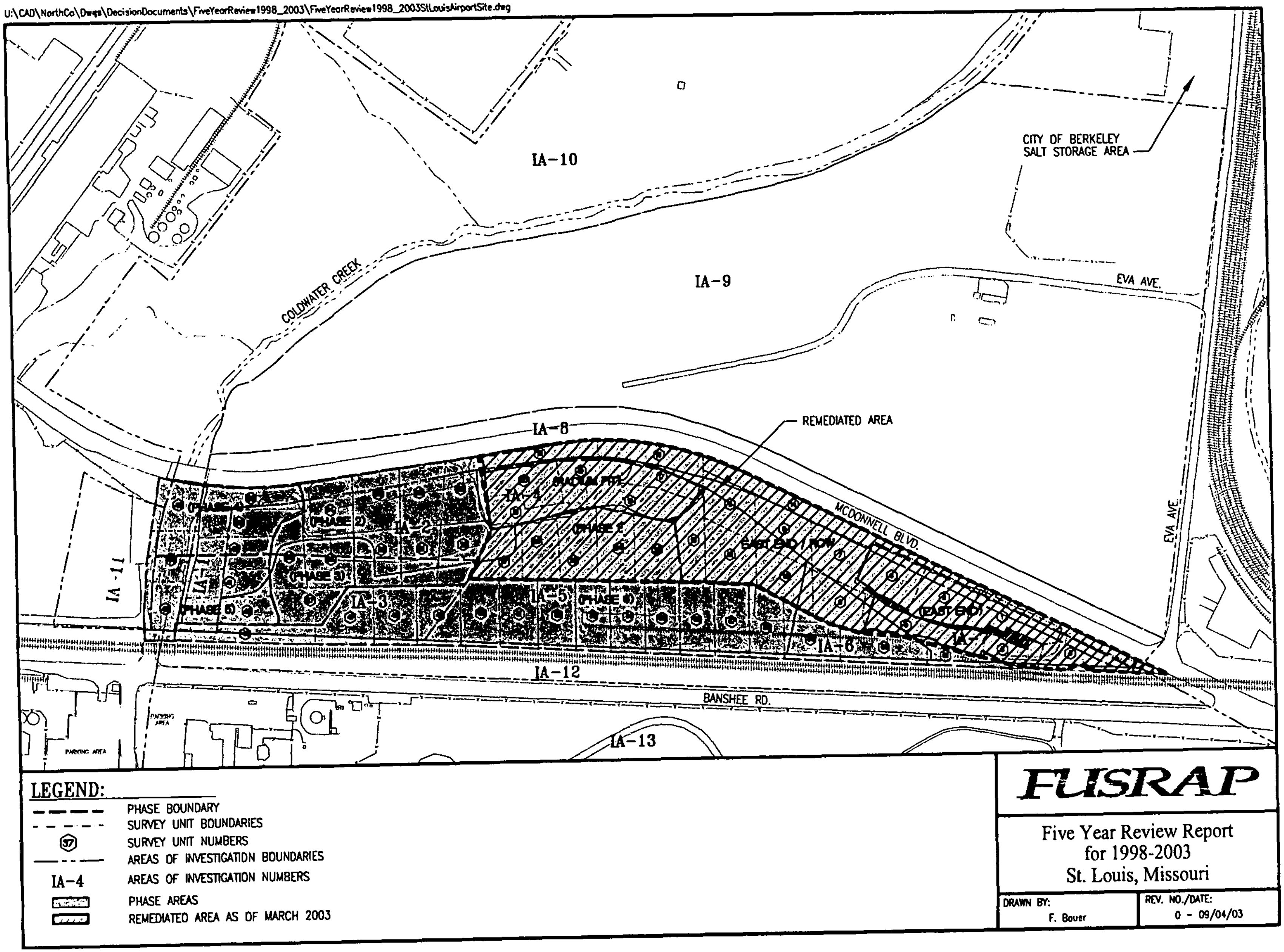


Figure IV-1. St. Louis Airport Site

at a depth of 18.4 feet bgs. The pre-design investigation results are presented in the *Pre-Design Investigation Summary Report, Phases 2 and 3 Work Areas* (Stone & Webster 2001b). The removal activity at the Phase 2 and 3 Work Areas was implemented in December 2002 under Appendix L to the SLAPS-RAWP, *Phase 2 and Phase 3 Work Description* (USACE 2001c). A complete discussion of the removal activities conducted at the Phase 2 and Phase 3 Work Areas will be provided in the next five-year review report.

At the SLAPS, the entire site is enclosed by chain-link fence, with vehicle access through a gated entrance. Non-work hour security is conducted site-wide. Environmental monitoring is conducted at the site boundaries. Thermoluminescent dosimeters (TLDs), radon alpha track detectors (ATDs) and particulate air filters are used in various combinations to monitor gamma exposure levels, radon emissions, and airborne radionuclide emissions. A ground-water monitoring well network is used to sample and evaluate ground-water constituent concentrations and potential effects on ground-water quality. Stormwater sampling and monitoring are conducted to meet National Pollutant Discharge Elimination System (NPDES)-equivalent and 120 CFR 20 Appendix B requirements for the site. In addition, monitoring to meet MSD discharge requirements is conducted.

Drainage and water control are integral to the removal actions conducted at the SLAPS during the period of this report (September 1998 through August 2003). Stabilized drainage ways have been constructed along the northern and southern boundaries of the site to convey run-off into the sedimentation basin located at the west end of the site. In 2000, monitoring of ground-water intrusion into active work areas indicated levels of selenium exceeding guidelines. A de-nitrification treatment is now utilized to lower selenium concentrations in the water removed from the excavations to levels below guidelines. A series of water storage tanks, having a capacity of over 600,000 gallons, are used to store water prior to treatment and/or discharge.

The removal action at the SLAPS is not complete as of August 2003; however, removal has been completed at a portion of the SLAPS.

Start and completion dates, as well as excavated (in-situ) volumes of the SLAPS removal actions performed during this reporting period, are summarized in the following table:

Table IV-2. SLAPS Removal Action Summary

Designation	Start	Complete	CY Removed
Sedimentation Basin	September 1998	May 1999	10,530
East End/East End Extension/ROW	October 1998	May 2003	65,120
Radium Pits	March 2000	November 2000	36,910
Phase 1	December 2001	May 2003	74,670
Phases 2 and 3	December 2002	In Progress	24,630
		Total Volume =	211,860

CY = cubic yards (In-Situ)

Latty Avenue Properties

For the Latty Avenue properties, the removal actions conducted during the five-year review period (September 1998 through August 2003) occurred primarily at the HISS/Futura site. The construction of the HISS railroad spur line and loading facility commenced in October 1998, pursuant to the EE/CA and Action Memorandum (USACE 1998a, b), and was completed by the spring of 1999. Two stockpiles of affected material were created from this construction and subsequently removed.

The HISS stockpile removal was implemented pursuant to the EE/CA and Action Memorandum (USACE 1998a, b), under several firm-fixed price service contracts. The stockpiled affected material at the HISS has been removed and shipped by railcar to out-of-state licensed disposal facilities. A Post-Remedial-Action Report for the HISS will be developed and submitted to MDNR and EPA for review and comment prior to finalization. The start and completion dates, as well as the excavated (in-situ) volumes for the HISS removal actions conducted during the five-year review period, are summarized in the following table:

Table IV-3. HISS Stockpiles Removal Summary

Stockpile Designation	Start	Complete	CY Removed
East Piles 1 and 2	April 2000	June 2000	6,880
Railroad Spur Spoil Piles A and B	March 2000	June 2000	5,590
Supplemental Pile	September 2000	October 2000	4,710
Main Pile – Northern Portion	November 2000	January 2001	4,440
Main Pile – Phase 1 – South Half	March 2001	May 2001	11,950
Main Pile – Phase 2 – North Half	September 2001	October 2001	5,905
		Total Volume =	39,475

CY = cubic yards

At the HISS, disturbed areas have been covered with topsoil and hydro-seeded, or covered with reinforced poly with granular ballast, pending final selection of a remedial action for the HISS subsurface contamination. Currently, the rail spur is not used but remains operational. The entire site is enclosed by chain-link fence, with vehicle access through a gated entrance. Environmental monitoring is conducted at the site boundaries for radioactive air particulates, external gamma radiation and radon levels. A ground-water monitoring well network is used to sample and evaluate ground-water constituent concentrations and potential effects on ground-water quality. Storm-water sampling and monitoring are conducted to meet NPDES permit requirements for the site.

SLAPS VPs

The first SLAPS VPs removal action performed during the five-year review period (September 1998 through August 2003) was in conjunction with the replacement of the St. Denis Street Bridge over Coldwater Creek located in Florissant, Missouri. The DOE, the predecessor of USACE, was contacted by the City of Florissant, Missouri regarding the planned bridge replacement and conducted sampling activities in the area of the pending construction. The results of the sampling activity identified levels exceeding DOE guidelines, and the area was designated for removal prior to construction in order to protect worker health and safety during construction. The removal action was conducted on the east and west banks of Coldwater Creek from October 21, 1998, through November 12, 1998, pursuant to the EE/CA and Action Memorandum (DOE 1992, DOE 1995). About 450 in-situ yd^3 of radioactively affected soil and sediment were excavated. The affected material was transported by dump truck to the Eva Road loading area, then transferred to railroad cars for shipment to Envirocare disposal facility in Utah. No portion of the removal action for this property required an on-going treatment of affected soil or water. The areas where removal of affected material had taken place were released to the City of Florissant to begin preparations for the bridge replacement. The excavated areas were released to the City of Florissant to begin preparations for the bridge replacement. On November 23, 1998, the USACE informed the City of Florissant that the soil with residual radioactive contamination above the EE/CA criteria (DOE 1992) in the areas impacted by the new bridge installation had been removed, as documented in the *Post-Remedial Action Report for the St. Denis Bridge Area* (USACE 1999c). Note that this document incorrectly cites the DOE 1997 as the governing document for the removal action. A correction will be issued to this document.

In March 2000, excavation of affected materials from a portion of the SLAPS VP-38 on SuperValu, Inc. property commenced pursuant to the EE/CA and Action Memorandum (DOE 1992, DOE 1995). Approximately 5,000 in-situ yd^3 of radioactively affected material were excavated and transported out of state for disposal at EnviroSafe in Idaho. The entire floor of the excavation was confirmed clean and released. However, only the west and northwest walls of the excavation were released. Residual soil concentrations in the other walls were in excess of the removal action goals and excluded from the removal area. Areas of the wall that were not included in the removal area were covered with geotextile material. Placement of clean backfill in the excavation and against the geotextile material was completed in June 2000. The VP-38 removal action is documented in the *Vicinity Property 38 Removal Action Summary*, Revision 0, dated April 9, 2001 (USACE 2001d). The post-remedial action report will be developed upon completion of the remaining response actions on this property and will be submitted to MDNR and EPA for review and comment prior to finalization. Currently, the USACE field project office complex and on-site laboratory facility are located on the remediated portion of VP-38.

Characterization activities consisting of gamma radiation walkovers and soil sampling were conducted across VP-24c in the Summer of 2002. Contaminated soil was identified on VP-24c. The contaminated soil was excavated in April 2002 and the area sampled in accordance with MARSSIM. The sample data showed that soil remaining on this parcel were below the criteria specified in the EE/CA and Action Memorandum (DOE 1992, DOE 1995).

Though no removal actions were required to be conducted on the property, a final status survey was performed on the northeast portion of the former ballfield area designated as the City of Berkeley Salt Storage Area. This area represents the first final status survey unit [Survey Unit (SU) 1] of IA-9. The final status survey and resulting conclusions are presented in *St. Louis Airport Site Investigation Area 9 Final Status Survey Evaluation, Berkeley Salt Storage Area (IA-9 Survey Unit 1)* (USACE 2000c).

Surface-water and sediment samples are collected from fixed locations along Coldwater Creek on a scheduled, periodic basis. Sample data are analyzed and evaluated against water quality criteria as part of the SLS environmental monitoring program.

Final status surveys compatible with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) are performed subsequent to removal at the North St. Louis County sites. These surveys document achievement of the removal action criteria identified in applicable Engineering Evaluations/ Cost Analyses (EE/CAs). Results of final status surveys are documented in Post-Remedial Action Reports (PRARs) for properties requiring a response action or in Final Status Survey Evaluation Reports (FSSERs) for those properties not requiring a response action. Each of these reports will include a summary of the detailed documentation that confirms that the areas involved achieve relevant criteria. This documentation will specifically include residual concentrations of COCs (e.g., exposure point concentrations) and assessment of residual site risks and doses to confirm protectiveness.

System Operation/Operation and Maintenance

Thus far, the removal actions completed at the North St. Louis County sites have allowed unlimited use and unrestricted exposure at the particular properties. Therefore, no O&M documents have been required.

V. PROGRESS SINCE THE LAST REVIEW

This is the first five-year review for the SLS.

VI. FIVE-YEAR REVIEW PROCESS

Administrative Components

The five-year review process for the St. Louis FUSRAP sites began in January 2003 and continued through August 2003. The five-year review process included notifying regulatory agencies, the community, and other interested parties of the start of the five-year review; establishing the five-year review team in consultation with the USEPA and MDNR; reviewing relevant documents and data pertaining to the removal and remedial actions conducted at the SLS over the past five years; conducting site inspections; conducting site interviews; and developing/reviewing this first Five-Year Review Report. Each of these elements is discussed below.

Although the USEPA and MDNR had been informally notified that the five-year review process had begun for the SLS in advance, they were formally notified in a letter from USACE dated February 13, 2003. A conference call was held with the three parties on February 20, 2003 to discuss the establishment of the five-year review team, details of the site inspections and site interviews, and document review procedures.

The Five-Year Review Team consisted of the following members: Jacque Mattingly, USACE; Deborah McKinley, USACE; Daniel Wall, USEPA; Jill Groboski, MDNR; and JoAnne Wade, MDNR. Ms. Mattingly led the team in the site visits and interviews while Ms. McKinley led the team in preparing the Five-Year Review Report. Additional USACE, USEPA, and MDNR staff assisted in review of the report.

Community Involvement

Activities to involve the community in the five-year review were initiated in March 2003. On March 14, 2003, St. Louis District USACE representatives presented the scope and schedule of the five-year review at the St. Louis Oversight Committee meeting, which is open to the public. Information identifying the purpose, scope, and components of the five-year review and soliciting public comment was posted on the St. Louis-District Web site (www.mvs.usace.army.mil/engr/fusrap/home2.htm). This information was also presented in the St. Louis FUSRAP Sites newsletter that was issued to the site mailing list.

On March 31, 2003, a news release was sent to local newspapers, radio stations, and television stations advising that a review of radiological response actions was underway for FUSRAP sites. On September 2, 2003, a public notice was published in the St. Louis Post-Dispatch announcing that the draft five-year review report for the St. Louis FUSRAP Sites was complete and available for 30-day public review and comment at the FUSRAP Project Office and the St. Louis Public Library (Main and Olive branch). A news release announcing this was sent to the local newspapers, radio stations, and television stations.

Document Review

The following sections list the documents assessed as part of this five-year review. The documents are categorized into the following:

Basis for Response Actions

The documents listed in Table VI-1 identify the background and goals of the remedies and any changes in laws and regulations that may affect the response action. These documents also provide background information on the sites, basis for action, and clean-up levels, and address community concerns and preferences.

Table VI-1. List of Response Action Documents

Document	Property	Purpose	Use for Review
Engineering Evaluation/Cost Analysis-Environmental Assessment for the Proposed Decontamination of the Vicinity Properties in the Vicinity of the Hazelwood Storage Site, March 1992 (DOE 1992).	HISS (VPs)	Propose removal action alternatives.	Goal of removal Background Basis for Action Clean-up levels Community Concerns
St. Louis Site Action Memorandum for Property Clean-ups, June 1995 (DOE 1995).	North St. Louis County sites VPs	Record selected response action.	Goal of remedy Basis for Action
St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA), September 1997 (DOE 1997a).	SLAPS	Propose removal action alternatives.	Goal of removal Background Basis for Action Clean-up levels Community Concerns
SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material, September (DOE 1997b).	SLAPS	Record selected removal action	Goal of Removal Basis for Action
Record of Decision for the St. Louis Downtown Site, October 1998 (USACE 1998c).	SLDS	Record selected remedial decision	Remediation Goals Background Basis for Action Community Concerns
Engineering Evaluation/Cost Analysis-Environmental Assessment for the Hazelwood Interim Storage Site (HISS), October 1998 (USACE 1998a).	HISS	Propose removal action alternatives	Goal of removal Background Basis for Action Clean-up levels Community Concerns
Action Memorandum for the Hazelwood Interim Storage Site (HISS), June 1998(USACE 1998b).	HISS	Record selected removal action	Goal of Removal Basis for Action
Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum, March 1999 (USACE 1999a).	SLAPS	Record removal decision	Goal of removal Background Basis for Action Clean-up levels Community Concerns

Table VI-1. List of Response Action Documents (Cont'd)

Document	Property	Purpose	Use for Review
Feasibility Study for the St. Louis North County Site, May 1, 2003 (USACE 2003b).	SLAPS, SLAPS VPs, HISS	Propose remedial action alternatives.	Remediation Goals Background Basis for Action Community Concerns
Proposed Plan for the St. Louis North County Site, St. Louis, Missouri, May 1, 2003 (USACE 2003c).	SLAPS, SLAPS VPs, HISS	Presents preferred remedial alternative	Remediation Goals Background Basis for Action Community Concerns

Implementation of the Response

The documents listed in Table VI-2 furnish information about design assumptions, design plans or modifications, and documentation of the response action at the sites.

Table VI-2. List of Implementation Documents

Document	Property	Purpose	Use for Review
Pre-Design Investigation Summary Report Plant I, St. Louis Downtown Site, December 9, 1999 (IT 1999b).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report Plants 6 East Half and 6E, St. Louis Downtown Site, August 18, 2000 (IT 2000).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report Midwest Waste – Vicinity Property (DT-7) FUSRAP St. Louis Downtown Site, May 3, 2001 (IT 2001a).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report: Heintz Steel and Manufacturing Vicinity Property (DT-6), FUSRAP St. Louis Downtown Site, July, 28, 2000 (IT 2001).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report: East End and Right-of-Way Work Areas, St. Louis Airport Site , July 2000 (Stone & Webster 2000).	SLAPS	Record investigation data	Check whether contaminant levels meet criteria.

Table VI-2. List of Implementation Documents (Cont'd)

Document	Property	Purpose	Use for Review
Pre-Design Investigation Summary Report: Phase 1 Work Area, January 10, 2001 (Stone & Webster 2001a).	SLAPS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Summary Report: Phases 2 and 3 Work Areas, June 26, 2001 (Stone & Webster 2001b).	SLAPS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Summary Report: Hazelwood Interim Storage Site (HISS)-Main Pile Removal Action, December 2000 (USACE 2000d).	HISS	Record investigation data	Check whether contaminant levels meet criteria.

Operations and Maintenance

O&M documents describe the ongoing measures at the site to ensure the remedy remains protective at the site. The removal or remedial actions completed to date have allowed for unlimited use and unrestricted exposure at the property. Therefore, no O&M documents have been required. If institutional controls are necessary for release of property, O&M documents will be completed and discussed in subsequent 5-year reviews.

Response Action Performance

Monitoring data, progress reports, and performance evaluation reports listed in Table VI-3 provide information that can be used to determine whether the response action continues to operate and function as designed.

Table VI-3. List of Response Action Evaluation Documents

Document	Property	Purpose	Use for Review
VP-38 Removal Action Summary, Berkeley, Missouri, April 9, 2001 (USACE 2001d).	SLAPS VPs	Document that response actions are complete	History of VP-38 Status of VP-38 Chronology of activities
Annual Environmental Monitoring Data and Analysis Report for CY98, July 1999 (USACE 1999d).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
St. Louis Airport Site Investigation Area 9 Final Status Survey Evaluation, Berkeley Salt Storage Area (IA-9 Survey Unit 1), October 2000 (USACE 2000c).	SLAPS VP	Present final status survey data	Check whether contaminant levels meet criteria

Table VI-3. List of Response Action Evaluation Documents (Cont'd)

Document	Property	Purpose	Use for Review
Radium Pits Removal Action Summary Report: FUSRAP St. Louis Airport Site, November 1, 2001 (USACE 2001e).	SLAPS	Document that construction activities are complete	History of SLAPS Status of SLAPS Chronology of activities Lessons Learned
Final Post-Remedial Action Report for the St. Louis Downtown Site City-Owned Vicinity Property, St. Louis, Missouri, September 1999 (USACE 1999b).	SLDS VP	Document that construction activities are complete	History of DT-2 Status of DT-2 Chronology of activities Lessons Learned
Post-Remedial Action Report for the St. Denis Bridge Area, July 1999 (USACE 1999c).	SLAPS VPs	Document that construction activities are complete	History of St. Denis Bridge Status of St. Denis Bridge Chronology of activities Lessons Learned
Results of East Soil Piles and HISS Spoil Piles Characterization, St. Louis, Missouri, April 2000 (USACE 2000e).	HISS	Document that construction activities are complete	Characterization of soil
Final Post-Remedial Action Report for the Accessible Soils within the Downtown Site Plant 2 Property, January 2002 (USACE 2002a).	SLAPS	Document that construction activities are complete	Effectiveness of the remedial action at Plant 2
Final Status Survey Report Evaluation for the St. Louis Downtown Site City-Owned Property North (Metropolitan Sewer District (MSD) Salisbury Lift Station) Vicinity Property, February 2001 (USACE 2001f).	SLDS	Documents that Remediation Goals were met	Effectiveness of the remedial action at MSD Salisbury Lift Station VP
Final Status Survey Report Evaluation for the St. Louis Downtown Site Archer Daniels Midland Vicinity Property (DT-1), June 2002 (USACE 2002b).	SLDS	Documents that Remediation Goals were met	Effectiveness of the remedial action at St. Louis Downtown Site ADM VP (DT-1)
Annual Environmental Monitoring Data and Analysis Report for CY99, June 2000 (USACE 2000f).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
Annual Environmental Monitoring Data and Analysis Report for CY00, June 2001 (USACE 2001g).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
Annual Environmental Monitoring Data and Analysis Report for CY01, June 2002 (USACE 2002c).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
Annual Environmental Monitoring Data and Analysis Report for CY02, September 2003 (USACE 2003e).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values

Legal Documentation

In October 1998, Congress transferred responsibility for the administration and execution of FUSRAP from DOE to USACE in the Energy and Water Development Appropriations Act, Pub. L. 105-62. Provisions of the appropriations acts for fiscal years 1999 and 2000 clarified Congressional intent that USACE should conduct FUSRAP activities subject to CERCLA and the NCP. In March 1999, USACE and DOE executed a Memorandum of Understanding (MOU), which identifies program administrative and execution responsibilities for the two agencies. USACE is currently conducting FUSRAP response actions at the SLS under the legislative authority in the appropriations acts; subject to CERCLA, the NCP, and Executive Order 12580 implementing CERCLA; in accordance with the FFA, originally negotiated between USEPA and DOE; and in accordance with the MOU. The MOU designated DOE as responsible for long-term stewardship. A team of USACE, DOE, USEPA, MDNR, and stakeholder representatives are cooperatively developing a long-term stewardship plan for conducting response actions, implementing institutional and access controls, performing O&M activities, and preparing five-year reviews.

Community Involvement

The Community Relations Plan helps give an understanding of the history of the community involvement and other activities at the SLS. Current community involvement actions are being carried out under the *Community Relations Plan for the St. Louis FUSRAP Sites, Rev. 3, January* (USACE 2001h). This document will be updated prior to the next five-year review.

Data Review

The data review component of this five-year review consisted of examining environmental monitoring data collected as part of response actions conducted at the SLDS and the North St. Louis County sites. An environmental monitoring program was implemented at the SLS in calendar year (CY) 1998. This program is an integrated monitoring program with sampling locations and frequencies defined on the basis of site-specific permits/permit equivalents, decision documents, and a commitment to be protective of human health and the environment and demonstrate short-term effectiveness pursuant to CERCLA.

Air, soil, sediment, surface water, and ground water are sampled and analyzed as part of the environmental monitoring program. A discussion of the review of these data by site is presented in the following paragraphs.

Environmental monitoring data are collected quarterly pursuant to Section XIV of the FFA; these data are not evaluated as part of the quarterly reporting. Therefore, the environmental monitoring program includes the preparation of an annual Environmental Monitoring Data Analysis Report (EMDAR) that consolidates and evaluates the environmental monitoring data. The annual reports are prepared by calendar year and summarize the data obtained during the calendar year and provide trend analyses of the data.

The environmental monitoring program is evaluated at the end of each fiscal year (FY). The result of this evaluation is the development of an annual environmental monitoring implementation program for the following FY. Thc sampling locations and activities of the program are not static because of the evolving nature of the response actions being conducted at the St. Louis Sites.

Accordingly, sampling activities may be deleted in subsequent FYs because the monitoring is no longer pertinent (e.g., perimeter airborne particulate monitoring would not be pertinent once a property had been remediated and the site restored). Conversely, an increased sampling frequency may be incorporated into the program to address an elevated intensity of response actions at a site. Sampling frequencies are driven by the sampling data collected. For example, if data trends indicate short-term increasing concentrations, the sampling frequency may be increased.

The data reviewed included those data presented in the post-remedial action or final status survey reports prepared at the completion of response actions. Data generated by response actions that are not complete were not reviewed. These data will be reviewed for the next five-year review report. Only the conclusions presented in the post-remedial action or final status survey reports regarding compliance with response action goals and future use of the property evaluated are presented in this report. For the complete analysis of the data, please refer to the individual post-remedial action or final status survey reports.

The data presented in the annual environmental monitoring data and analysis reports from CY1998 through CY2002 were also reviewed [*Annual Environmental Monitoring Data and Analysis Report for CY98* (USACE 1999d), *Annual Environmental Monitoring Data and Analysis Report for CY99* (USACE 2000f), *Annual Environmental Monitoring Data and Analysis Report for CY00* (USACE 2001g), *Annual Environmental Monitoring Data and Analysis Report for CY01* (USACE 2002c), and *Draft Annual Environmental Monitoring Data and Analysis Report for CY02* (USACE 2003e)]. Only a summary of the data evaluations is presented here. For a complete presentation and evaluation of the data reviewed, please refer to the annual environmental monitoring data and analysis reports for each CY.

Ground-Water Monitoring

Ground-water monitoring is conducted at the SLS to meet several general objectives. These objectives are to:

- determine background-water quality at each of the SLS;
- identify potential effects on ground-water quality resulting from removal and remedial actions;
- obtain requisite data to evaluate response action performance; and
- ensure compliance with the SLDS ROD (USACE 1998c) requirements.

Pursuant to the above objectives, comparison values were established to evaluate ground-water data obtained under the ground-water monitoring program for the SLS. These comparison values are derived from the SLDS ROD (USACE 1998c), environmental regulatory programs, and from North St. Louis County sites background conditions for shallow and deep ground water presented in the Feasibility Study (FS).

The regulatory-based values considered for evaluation of HU-A ground-water data from the SLDS are the MCLs, secondary MCLs (SMCLs), and MCL goals of the Safe Drinking Water Act.

The regulatory-based values considered for evaluation of all ground-water data from the North St. Louis County sites are the MCLs, SMCLs, and MCL goals of the Safe Drinking Water Act.

North St. Louis County sites ground-water data are also compared to ground-water quality criteria promulgated by the MDNR under 10 CSR 20-7 and health-based advisories for ground-water quality included under 10 CSR 20-7 Table A Class I and VII.

Beginning in CY2000, North St. Louis County sites ground-water data were also compared to background values developed for the North St. Louis County sites FS (USACE 2003b). Background values for just the hydrostratigraphic zone of intrest (HZ-E or the protected aquifer) at the North St. Louis County sites were re-evaluated to fully consider additional available data. HZ-C overlies the jointed HZ-E bedrock, so that the HZ-C water represents the water quality of the HZ-E, whose water is difficult to extract. Thus, HZ-C is a surrogate for HZ-E. Additional monitoring wells and proper sampling protocols for all wells provided adequate basis for evaluation of the HZ-C/HZ-E water's background. The background was detailed and specified in the Environmental Monitoring Data and Analysis Report for CY 2002. As such, the background values were revised based on additional available data. The comparison values for North St. Louis County sites ground-water data will be revised when a final ROD is issued for the North St. Louis County sites. Ground-water data from HU-B at the SLDS are compared to the ILs established in the SLDS ROD (USACE 1998c) and to MCLs if an IL was not established. Prior to August 2003, both filtered and unfiltered samples were collected from St. Louis Sites ground-water wells. Currently only unfiltered samples are collected.

The following table summarizes those background values that have changed.

Table VI-4. Revised Background Values for North St. Louis County Sites HZ-C/HZ-E Hydrostratigraphic Zones

Chemical	Background	Revised Background	Units
Antimony		4	μg/L
Arsenic	82.7	180	μg/L
Barium	424	1,400	μg/L
Cadmium		2	μg/L
Chromium		13	μg/L
Molybdenum	0	68	μg/L
Nickel	1.1	18	μg/L
Radium-226	1.03	4	pCi/L
Radium-228		NR	pCi/L
Selenium		2	μg/L

Table VI-4. Revised Background Values for the North St. Louis County Sites HZ-C/HZ-E Hydrostratigraphic Zones (Cont'd)

Chemical	Background	Revised Background	Units
Thallium	0	7	µg/L
Thorium-228	0.62	2	pCi/L
Thorium-230	0.63	4	pCi/L
Thorium-232		2	pCi/L
Total Uranium		7	pCi/L
Uranium-234	0	~4	pCi/L
Uranium-235		NR	pCi/L
Uranium-238	0.11	~3	pCi/L
Vanadium		18	µg/L

NR = Not Reported – no detectable samples for that analyte

For those wells where sufficient data were available to evaluate a trend, the unfiltered groundwater data were evaluated using Mann-Kendall statistical testing. The Mann-Kendall trend analysis was performed at a 95% level of confidence. The complete results of the testing for the SLS are presented in EMDAR CY2002 (USACE 2003e). Statistically significant trends do not always reflect actual trends. The Mann-Kendall test does not consider the effects of measurement error and does not provide any information concerning the magnitude of the trends, so time-concentration plots were used to evaluate these factors.

HISS

Stratigraphy

The stratigraphy beneath the HISS is similar to that found at the SLAPS, with the exception that the shale unit (HZ-D) is absent at the HISS. Four HZs (HZ-A through HZ-C and HZ-E) are present at the HISS. These HZs are the shallow HZ-A, comprising the Unit 1 Fill, Unit 2 Loess, and Subunit 3T Silty Clay; the intermediate depth HZ-B, comprising the Subunit 3M Clay; the deep HZ-C, comprising the Subunit 3B silty clay and Unit 4 clayey to sandy gravel; and the protected deep HZ-E, comprising the Mississippian Limestone. HZ-A and HZ-B are often referred to as the upper zone, while HZ-C and HZ-E are referred to as the lower zone. With the exception of monitoring wells HISS-5D and HW23, which are screened in the HZ-C, all of the monitoring wells at the HISS are screened in the HZ-A. HW22 and HW23 are upgradient wells installed to assist in evaluating background conditions.

Sampling Program

Sampling was conducted at 17 ground-water monitoring wells in CY1998. Arsenic, cadmium, manganese, selenium, total U, and trichloroethene (TCE) were detected in HZ-A ground-water samples above their respective MCLs or SMCLs. No exceedences were noted in the HZ-C well samples. Although manganese and TCE were detected in HZ-A, they have been determined in the North St. Louis County sites FS not to be MED/AEC COCs. It should be noted that USACE screens for TCE and manganese as well as other metals to confirm that excavation water is properly treated and meets release requirements.

During CY1999, 15 ground-water monitoring wells were sampled at the HISS. Arsenic, cadmium, manganese, selenium, total U, and TCE were detected in HZ-A ground-water samples above their respective MCLs or SMCLs. No exceedences were noted in the HZ-C well samples.

Three monitoring wells (HW23, HW24, and HW25) were installed during CY2000. Therefore, 18 ground-water monitoring wells were sampled at the HISS for this calendar year. Arsenic, iron, manganese, selenium, Ra-226, Total U, TCE, and 1,2-dichloroethene (DCE) were detected at concentrations above their respective MCLs or SMCLs in samples from several HZ-A wells. Th-230 was detected in HZ-A ground-water samples above its background value. No exceedences were noted in the HZ-C well samples.

Sampling was also conducted at 18 ground-water monitoring wells at the HISS during CY2001. Arsenic, iron, manganese, selenium, Ra-226, Total U, TCE, and 1,2-DCE were detected at concentrations above their respective MCLs or SMCLs in samples from several HZ-A wells. Constituents exceeding their respective MCLs or SMCLs in samples collected from the two HZ-C wells included arsenic, manganese, and thallium. The maximum concentrations of arsenic also exceeded its expected background level.

During CY2002, 15 ground-water monitoring wells were sampled at the HISS. The locations of the ground-water monitoring wells are shown on Figure VI-1. The CY2002 data indicated localized effects on the HZ-A ground water from site-related constituents. Arsenic, manganese, selenium, Ra-226, and TCE were detected above their respective MCLs or SMCLs in samples from one or more HZ-A wells. The sampling results for HZ-C ground water indicate that arsenic and manganese had average concentrations that exceeded their respective MCLs or expected background concentrations for the HZ-C ground water.

Trend Analysis

A Mann-Kendall statistical trend analysis was conducted to determine if concentrations of arsenic, selenium, total uranium, and Th-230 are increasing or decreasing over time in samples from HZ-A wells. The test was performed on eight HZ-A wells (HISS-01, HISS-06, HISS-07, HISS-14, HISS-16, HISS-17S, HISS-20S, and HW21) that have yielded samples with selenium concentrations above its corresponding MCL at least once in the period from the winter of CY1997 through winter CY2002. Based on the trend analysis, a decreasing trend in selenium concentrations was observed at HISS-20S, primarily due to elevated concentrations of selenium during the 1999 sampling event. Samples from HISS-14 located near the eastern edge of the site exhibited increasing selenium concentrations. The cause of the increasing selenium concentrations is not known, but the increase appears to be of small magnitude, based on the time-concentration plot shown in Figure VI-2. The best fit trend lines for the selenium time-concentration plots are shown as dashed lines in Figure VI-2. Samples from the five remaining wells exhibited no concentration trends for selenium.

Arsenic has been detected at elevated levels in only a single well, HISS-19S. The concentrations of arsenic in samples from Well HISS-19S appear to be increasing over time based on the results of the Mann-Kendall test and the time-concentration plot shown in Figure VI-2. The cause of the increasing arsenic concentrations in this well is not known.

The Mann-Kendall trend analysis was conducted for total uranium on ground-water samples collected from HZ-A Wells HISS-01, HISS-06 and HW21. The complete analysis is presented in the EMDAR CY2002 (USACE 2003e). Samples from these wells have yielded total uranium concentrations above its corresponding MCL. The trend analysis was also conducted on seven wells (HISS-07, HISS-10, HISS-14, HISS-16, HISS-17S, HISS-20S, and HW22) that yielded samples with total uranium concentrations less than its corresponding MCL but with a greater than 80 percent detection rate and at least seven rounds of data. The Mann-Kendall test indicated a decreasing trend in total uranium concentrations for two HZ-A wells, HISS-01 and HISS-07. The Mann-Kendall test indicated a decreasing trend in total uranium concentrations for HISS-01 and HISS-07. However, this statistical test does not take into account the range of error inherent in the analytical measurements (the error bars are shown in Figure VI-2 are bracketed vertical lines). When the potential error in the measurement is taken into account, the ranges associated with the total uranium values in HISS-01 and HISS-07 are generally wider than the magnitude of the trend. This indidcates that the determination of an overall trend is inconclusive. A "no trend" line for these two wells is shown as a horizontal dashed line on the total uranium graphs in Figure VI-2. Due to the high percentage of non-detect (ND) values (greater than 20 percent ND), the Mann-Kendall trend analysis could only be performed on Th-230 for samples from wells HISS-10 and HISS-11. The results of the trend analysis indicated no statistically significant trends in Th-230 concentrations.

The Mann-Kendall trend analysis was conducted for HZ-C Wells HISS-05D and HW23 for the following constituents: arsenic, iron, and manganese. The results of the analysis indicate that there is a downward trend in manganese concentrations in HISS-05D.

Only wells with a greater than 80 percent detection rate and at least seven rounds of data are included in this report. Graphs of the trend analysis at the HISS are shown in Figure VI-2.

SLAPS and SLAPS VPs

Stratigraphy

There are five HZs recognized beneath the SLAPS and its adjacent VPs. These HZs are the shallow HZ-A, comprising the Unit 1 Fill, Unit 2 Loess, and Subunit 3T Silty Clay; the intermediate depth HZ-B, comprising the Subunit 3M Clay; the deep HZ-C, comprising the Subunit 3B silty clay and Unit 4 clayey to sandy gravel; HZ-D, comprising the Interbedded Pennsylvanian rock and shale; and the protected deep HZ-E, comprising the Mississippian Limestone. HZ-A and HZ-B are often referred to as the upper zone, while HZ-C, HZ-D, and HZ-E are referred to as the lower zone. Although the ground-water monitoring well network extends beyond the borders of the SLAPS to its associated VPs, the network is referred to as the SLAPS monitoring well network.

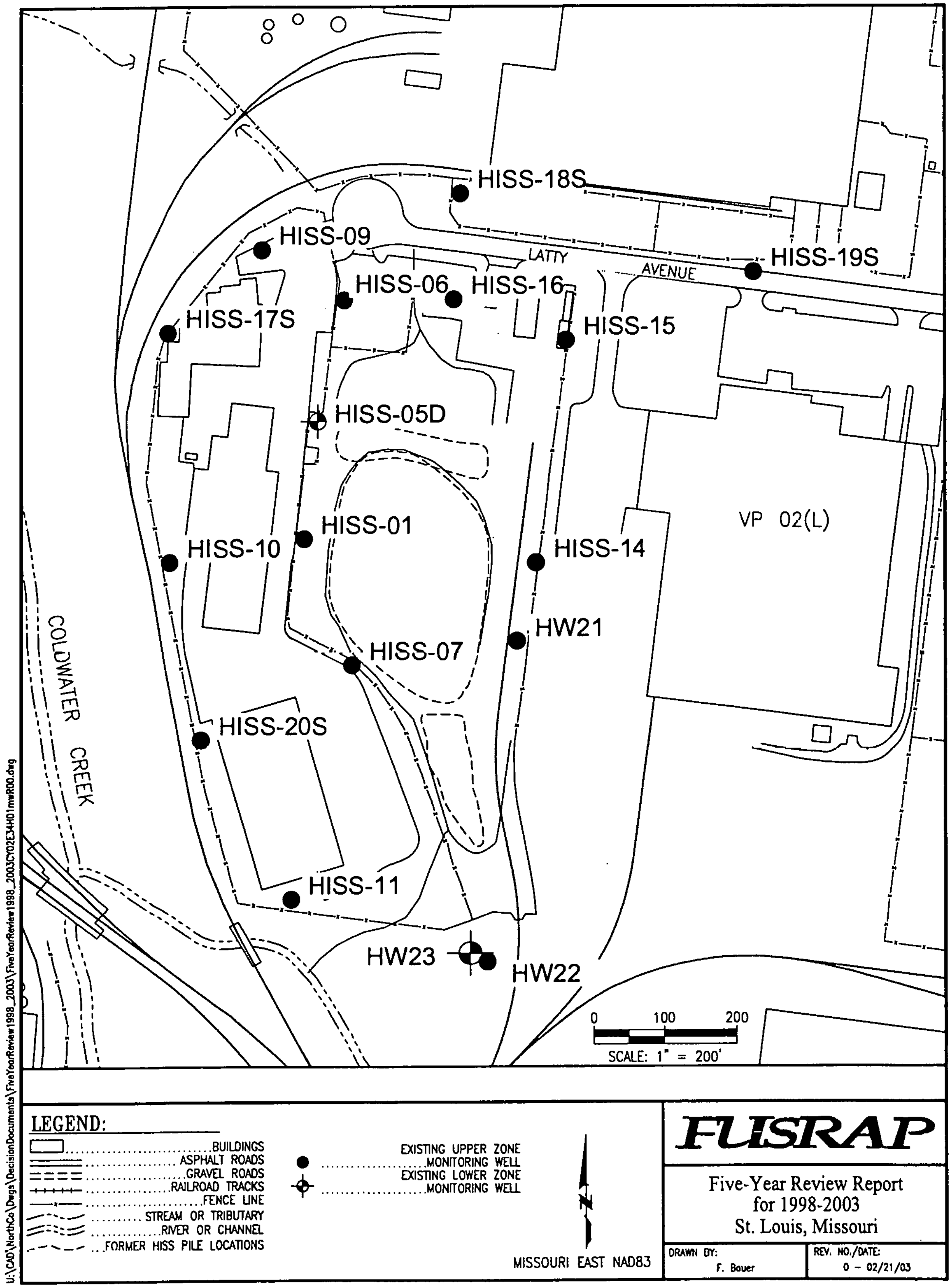
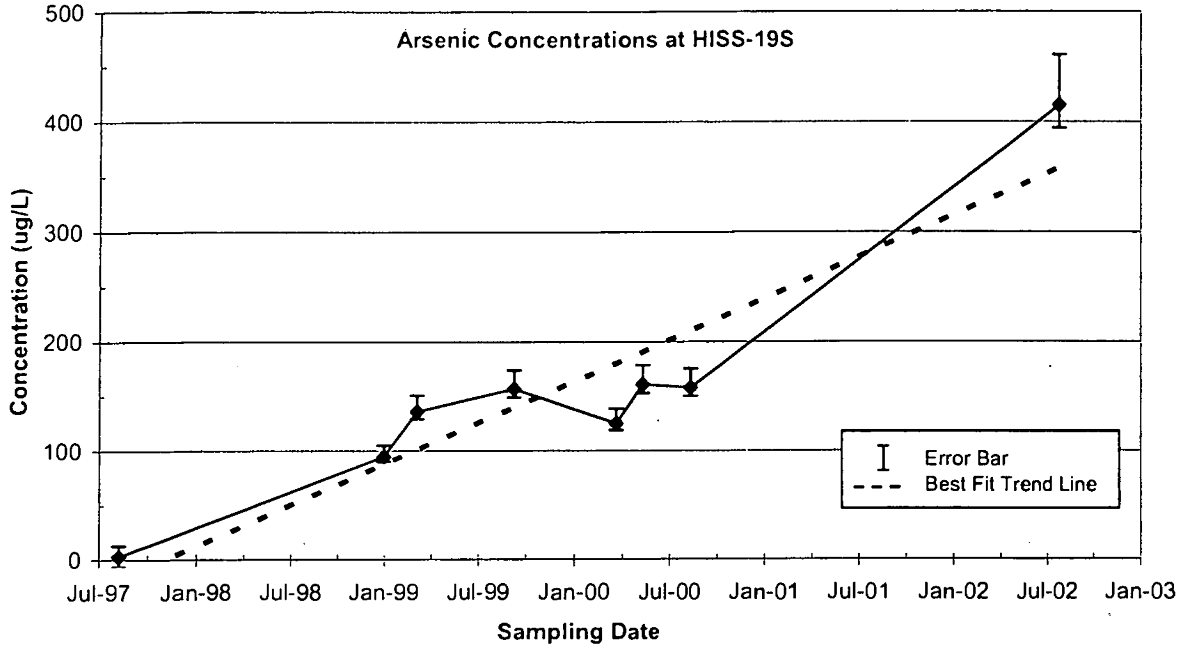
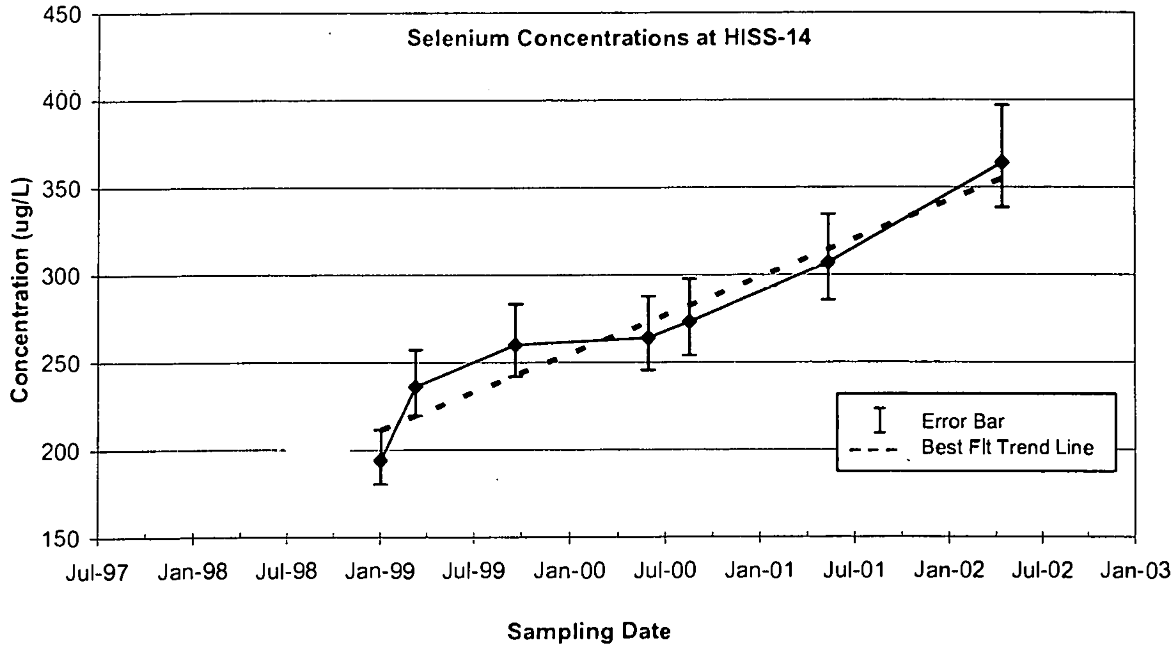


Figure VI-1. Ground-water Monitoring Well Locations at the HISS in CY 2002

Figure VI-2. Trend Analysis at the HISS



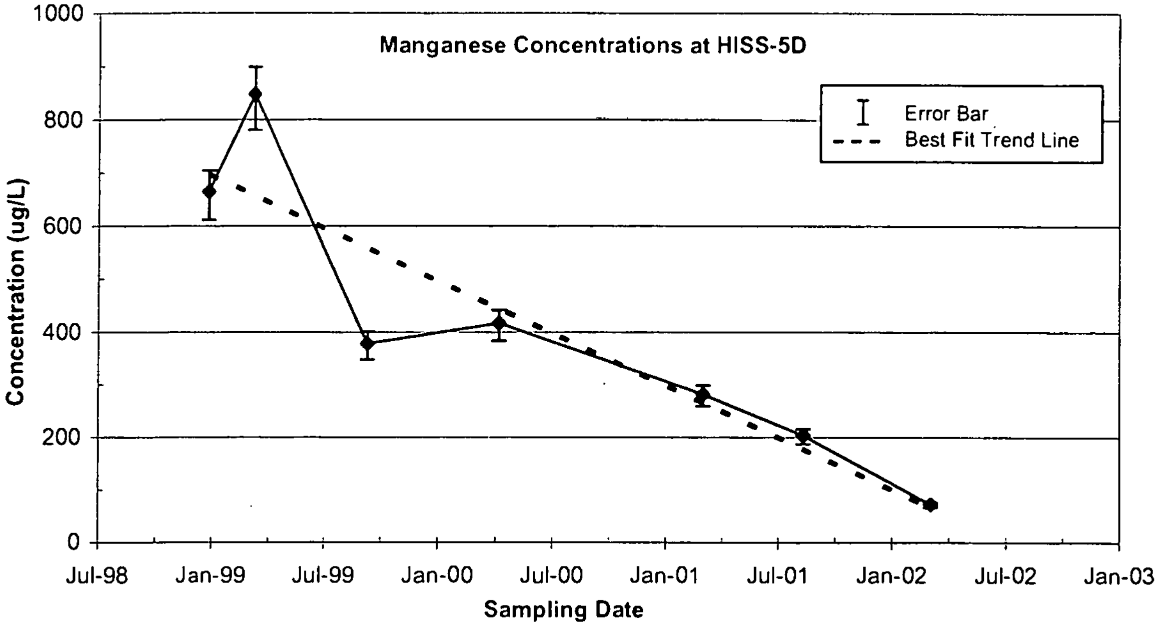


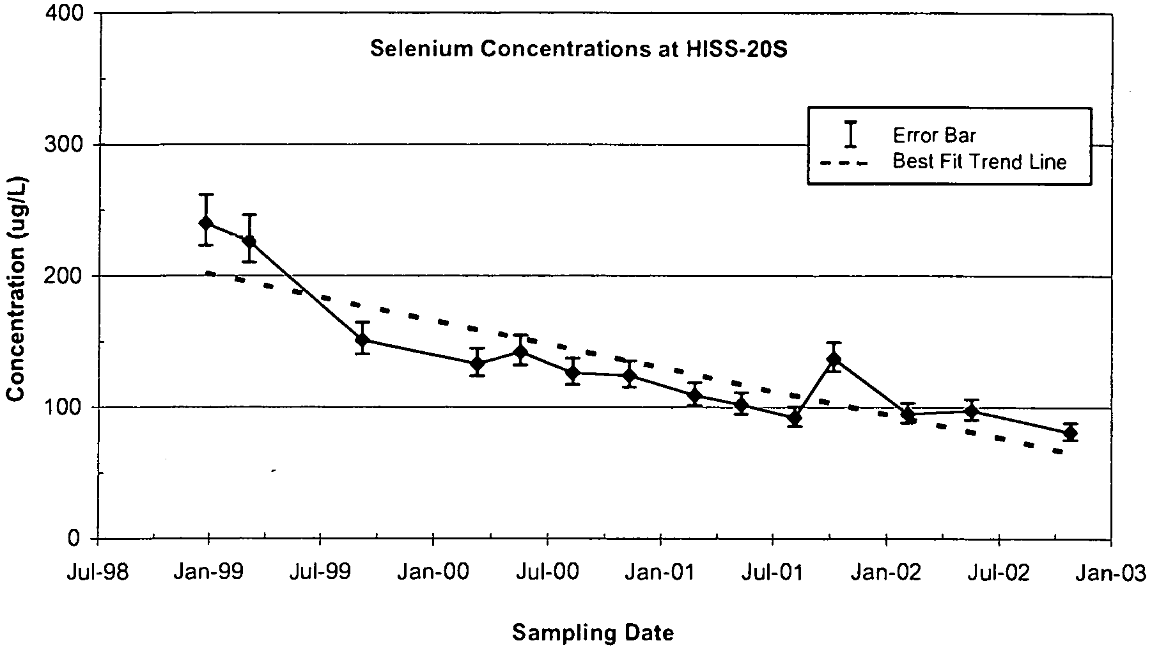
Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-2. Trend Analysis at the HISS (Continued)



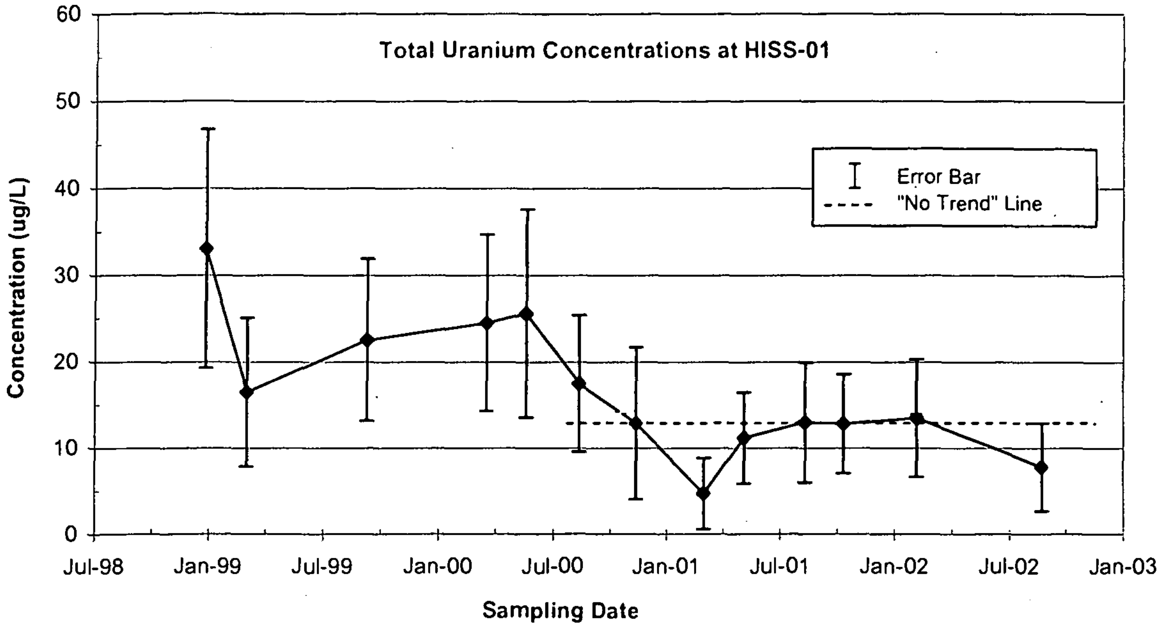


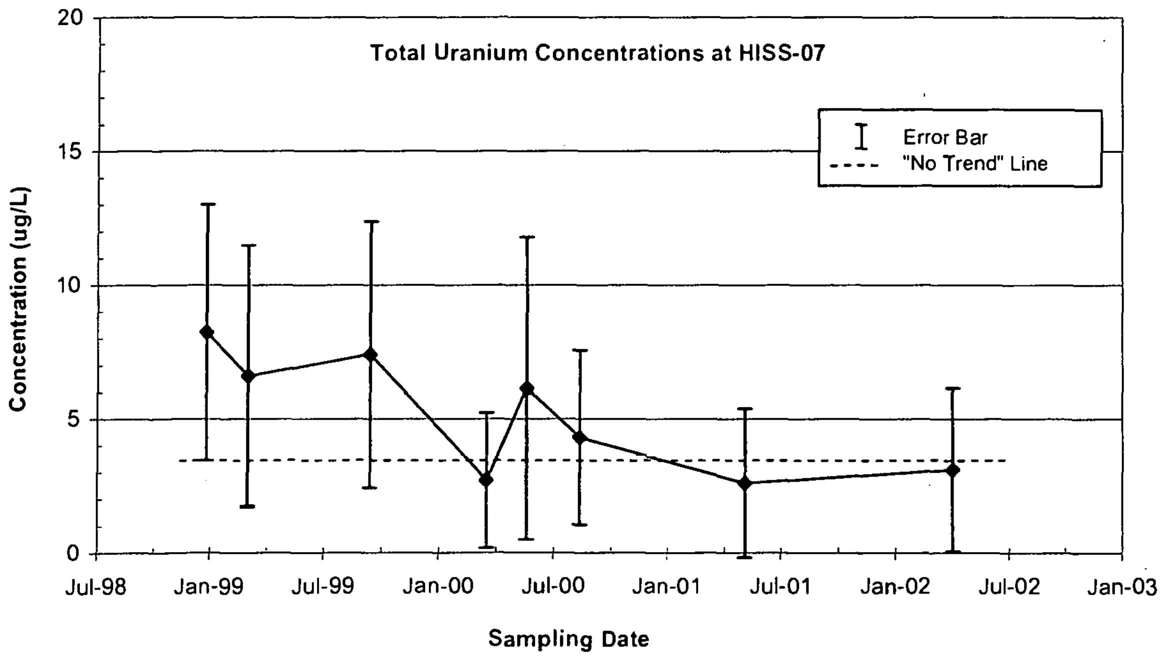
Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-2. Trend Analysis at the HISS (Continued)





Notes:

The error bar represents ± the sum of the measurement error for U-234, U-235, and U-238.

Sampling Program

In CY1998, the SLAPS monitoring well network consisted of 38 ground-water monitoring wells. Four monitoring wells were installed in CY1998 to fill data gaps pertaining to subsurface lithology, hydraulic gradient, and ground-water quality issues. Seven monitoring wells were concurrently abandoned due to their proximity to removal actions being conducted on the SLAPS proper. Twenty-eight wells were sampled in July and August of 1998, and 38 wells were sampled in the fourth quarter of 1998. Arsenic was detected above its corresponding MCL in several upper and lower zone well samples. Total uranium, selenium, and TCE were detected above their respective MCLs in several upper zone well samples.

The network consisted of 41 wells, but only 38 were sampled in CY1999. Five HZ-A wells yielded total uranium concentrations above the corresponding MCL in CY1999. Selenium and TCE were detected above their respective MCLs in the upper zone. Arsenic was present in lower zone samples above its corresponding MCL.

Forty-six ground-water wells were sampled in CY2000 at the SLAPS. Five of these wells (PW39 through PW43) were installed during CY2000, with sampling initiated in the third quarter of the calendar year. These wells were placed in areas where ground-water information was needed to provide insight into contaminant migration and surface water effects. Results of the ground-water sampling conducted during CY2000 indicate that metal, radionuclide, and organic constituents were present above MCLs or SMCLs in HZ-A ground-water samples collected at the SLAPS. These constituents included the metals arsenic, chromium, iron, manganese, nitrate,selenium, and thallium; the radionuclides Ra-226 and total uranium; and the organics 1,2-DCE and TCE. Additional radionuclides, in particular Th-230, U-234, U-235, and U-238, were detected in HZ-A ground water but have no designated MCLs or SMCLs. Arsenic, iron, and manganese were present above MCLs or SMCLs in ground-water samples from the lower zone. In addition, Ra-226 for CY2000 was detected at levels slightly exceeding the MCL in samples from four wells screened in HZ-C. None of these wells are on the SLAPS.

Forty-six ground-water wells were sampled in CY2001 at the SLAPS. Metal (arsenic, chromium, iron, manganese, nitrate, selenium, and thallium), radionuclide (Ra-226, Th-230, U-234, and U-238), and organic (TCE and 1,2-DCE) constituents were detected above MCLs, SMCLs, and/or background values in HZ-A ground-water samples. Arsenic, iron, and manganese were also present above MCLs or SMCLs in samples from the lower zone. In CY2001, total uranium and Ra-226 were not detected above their respective MCLs in samples from any wells screened exclusively across the lower zone. Th-228 and Th-230 were detected in samples from wells screened in the lower zone, but their maximum concentrations were only slightly above expected background levels.

Forty-six ground-water wells were also sampled in CY2002 at the SLAPS. The locations of the ground-water monitoring wells at the SLAPS are shown on Figure VI-3. The CY02 sampling results indicate that various metals, radionuclides, and organic compounds are present at elevated levels in HZ-A ground water at the SLAPS. Based on the CY2002 data, the principal inorganic contaminants in shallow HZ-A ground water at the site include arsenic, chromium, iron, manganese, nitrate, selenium, and thallium, which were detected above their respective MCLs, SMCLs, and/or background values in HZ-A ground-water samples. The radionuclides Ra-226, Th-230, U-234, and U-238 were also detected above their respective MCLs, SMCLs and/or background values in HZ-A ground-water samples. Additionally, the organic constituents TCE and 1,2-DCE were detected at concentrations above their respective MCLs in several shallow zone wells. Arsenic, iron, and manganese were present above their respective MCLs or SMCLs in samples from the lower zone. Total uranium was not detected in CY2002 above its MCL in any wells screened exclusively across the lower zone. Ra-226, Th-228 and Th-230 were detected in samples from wells screened in the lower zone, but their maximum concentrations were only slightly above expected background levels. The CY2002 data continue to support the determination that HZ-B, Subunit 3M, a relatively impermeable clay layer, is preventing the migration of constituents to lower ground-water zones. The localized constituent concentrations present in HZ-A ground water are not present in the deeper zones, indicating that mixing between HZ-A and HZ-C, HZ-D, and HZ-E ground-water zones is insignificant. In CY2003, two wells were installed in remediated areas of the SLAPS to verify the effectiveness of source removal. The results of sampling in these wells will be discussed in the next five-year review.

Trend Analysis

A Mann-Kendall statistical trend analysis was conducted to assess whether concentrations of arsenic, selenium, and total uranium are increasing (upward trending) or decreasing (downward trending) over time. The Mann-Kendall test does not consider the effects of measurement error, so time-concentration plots were used to evaluate the validity of the Mann-Kendall results. Because concentrations have been consistently low and the incidence of non-detection consistently high, a trend analysis was not performed for Ra-226 or Th-230. Although no organics were identified as COCs for the SLAPS, a statistical analysis was conducted for TCE because elevated concentrations have been consistently detected in several HZ-A wells.

A Mann-Kendall trend analysis was conducted for two HZ-A wells (B53W14S and M10-08S) and 15 HZ-C wells yielding samples showing arsenic concentrations consistently exceeding the MCL since July 1997. The Mann-Kendall results indicate that four HZ-C wells (B53W01D, M10-15D, PW36, and PW42) have statistically increasing trends. However, this statistical test does not take into account the range of error inherent in the analytical measurements. When the potential error in the measurements is taken into account, the errors associated with the arsenic values in B53W01D are generally wider than the magnitude of the trend (Figure VI-4). This indicates that the determination of an overall trend for this well is inconclusive. Two HZ-C wells (B53W12D and MW34-98) have decreasing trends based on the results of the Mann-Kendall test. This statistical test does not take into account the range of error inherent in the analytical measurements. When the potential error in the measurements is considered, the ranges associated with the arsenic values in B53WI2D are generally wider than the magnitude of the trend (see Figure VI-4). This indicates that the determination of the overall trend is inconclusive. For the remaining HZ-C wells, no trend in arsenic concentrations was observed. The lack of a correlation between the arsenic concentrations in the HZ-C ground-water samples and those reported for nearby HZ-A well samples indicates that the increasing arsenic trend in one HZ-C monitoring well on SLAPS cannot be related to FUSRAP-related activities at the SLAPS.

There are several wells screened in HZ-A that have consistently yielded samples from July 1997 through CY2002 with selenium levels above its MCL. A Mann-Kendall trend analysis was performed on the following eight HZ-A wells: B53W09S, B53W13S, B53W17S, M10-15S, MW31-98, MW33-98. PW38, and PW39. Two wells (M10-15S and PW41) showed increasing trends based on the Mann-Kendall test. The Mann-Kendall test does take into consideration the range of error inherent in analytical measurements. When the potential errors in the measurements are taken into account as shown in the time-concentration plots in Figure VI-5, the

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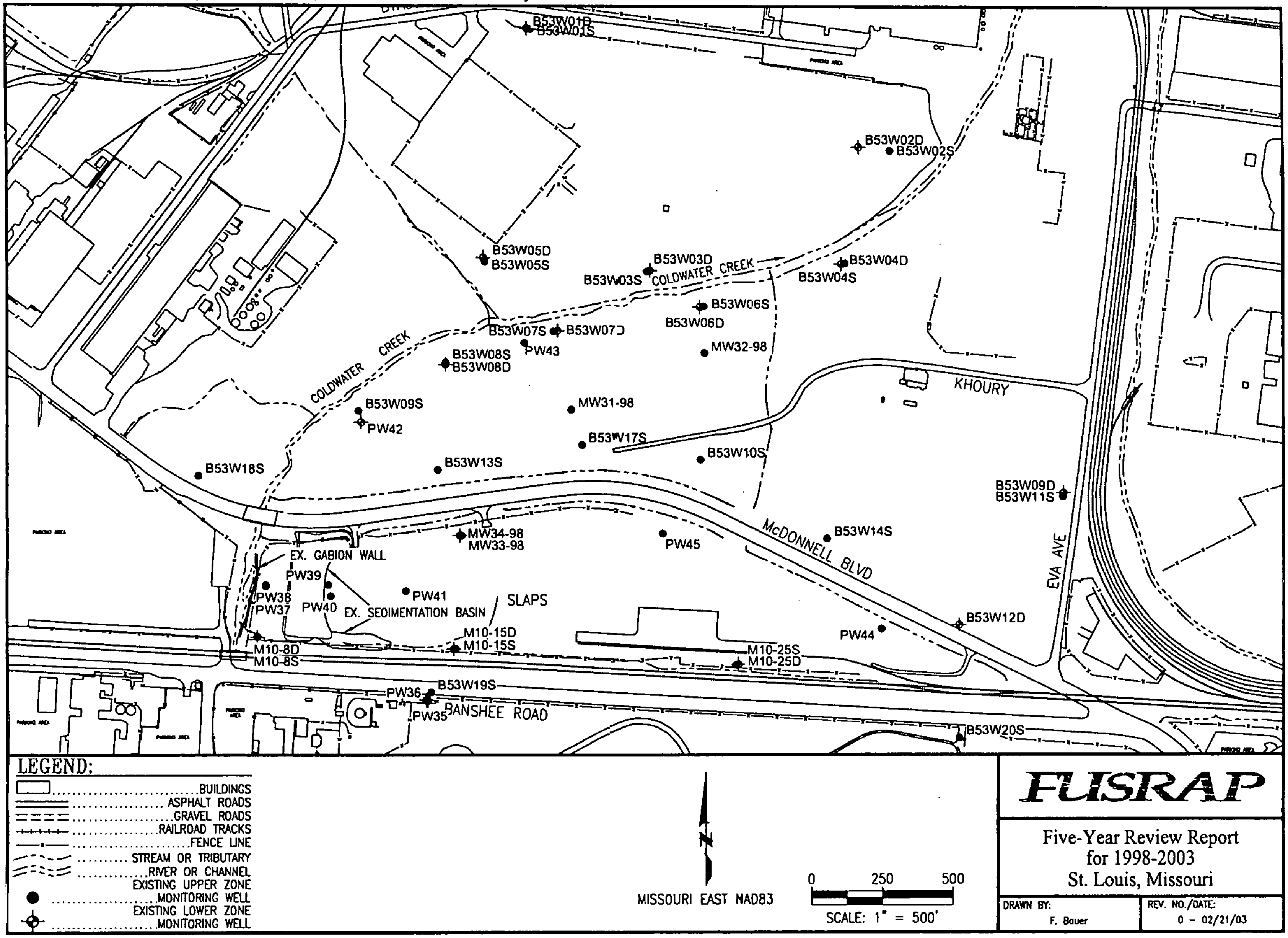


Figure VI-3. Ground-water Monitoring Well Locations at the SLAPS in CY 2002 ranges associated with the selenium values for PW41 and M10-15S show a no trend line which generally falls within the error bars. This indicates that an overall trend for these wells is inconclusive. If there is an increasing trend in these two wells, it may reflect a short-term increase resulting from removal activities being conducted at the SLAPS in the vicinity of the wells. However, continued monitoring will be necessary to determine the cause. Four wells showed decreasing selenium trends (B53W13S, B53W17S, MW33-98, and PW38) based on the Mann-Kendall test. The error measurements associated with the MW33-98 selenium values indicate there is no trend for the sampling data collected since August 2000.

Total uranium concentrations in samples from 16 HZ-A wells were subjected to the Mann-Kendall trend analysis. The analysis was performed on data collected from the fall of CY1998 through CY2002. An increasing trend was observed in two wells (MW33-98 and PW39). The Mann-Kendall statistical test does not take in to account the range of error inherent in the anaylitical measurements. The determination of an overall trend for PW39 is inconclusive, since the error associated with total uranium values is generally wider than the magnitude of the trend (see Figure VI-6). The remaining 14 wells displayed no trend. The increasing concentrations of total uranium in MW33-98, located adjacent to the Radium Pits area, may be related to removal activities that were being conducted in areas located immediately upgradient of the well. Total uranium concentrations remain at non-detect levels in MW34-98, located adjacent to MW33-98, indicating that HZ-C is not being impacted.

A Mann-Kendall trend analysis was performed for TCE on eight wells (B53W13S, B53W17S, MW31-98, MW33-98, PW38, PW39, PW40, and PW41). The results of the analysis indicate that one well (B53W13S) is showing an increasing trend in concentrations and one well (B53W17S) is showing a decreasing trend. As shown in Figure VI-7, the magnitude of the decreasing TCE trend for B53W17S is generally within the limits of the measurement error, indicating that the determination of an overall trend for this well is inconclusive. The magnitude of the increasing TCE trend for B53W13S is very small (i.e., an increase from 4 ug/L to 12 ug/L over the five-year period from July 1997 to September 2002). The sampling results may indicate that TCE is present due to a discrete release of TCE in the vicinity of B53W17S in the past. In addition to TCE, the TCE degradation product 1,2-DCE has been detected in the area. These detections suggest that some degradation of TCE is occurring in this area. The gradually increasing concentrations in downgradient well B53W13S may indicate that TCE is continuing to migrate slowly westward from the source area.

Only wells with a greater than 80 percent detection rate and at least seven rounds of data are included in this report. Graphs of the trend analysis at the SLAPS are shown in Figures VI-4 through VI-7.

SLDS

Stratigraphy

Ground water at the SLDS is found within three HUs. These HUs are the upper, HU-A unit, which consists of fill overlying clay and silt; the lower, Mississippi Alluvial Aquifer, referred to as HU-B; and the limestone bedrock, referred to as HU-C.

Sampling Program

The SLDS ROD (USACE 1998c) requires the implementation of a long-term ground-water monitoring program at the site. The selected remedy includes the installation and monitoring of perimeter ground-water monitoring wells on a long-term basis. The goal of the ground-water monitoring program is to monitor the protection of the potentially usable HU-B ground water and establish the effectiveness of the source removal action.

Regular monitoring of the SLDS HU-A and HU-B ground water was initiated in late CY1998 pursuant to issuance of the SLDS ROD (USACE 1998c). A baseline-sampling event had been conducted previously, in December 1997 and January 1998. Fifteen wells were sampled for radiological, metal, and organic parameters in late CY1998. Arsenic, magnesium, selenium, and total uranium were detected in HU-A ground-water samples above their respective regulatory-based values. No ILs or MCLs were exceeded in HU-B well samples.

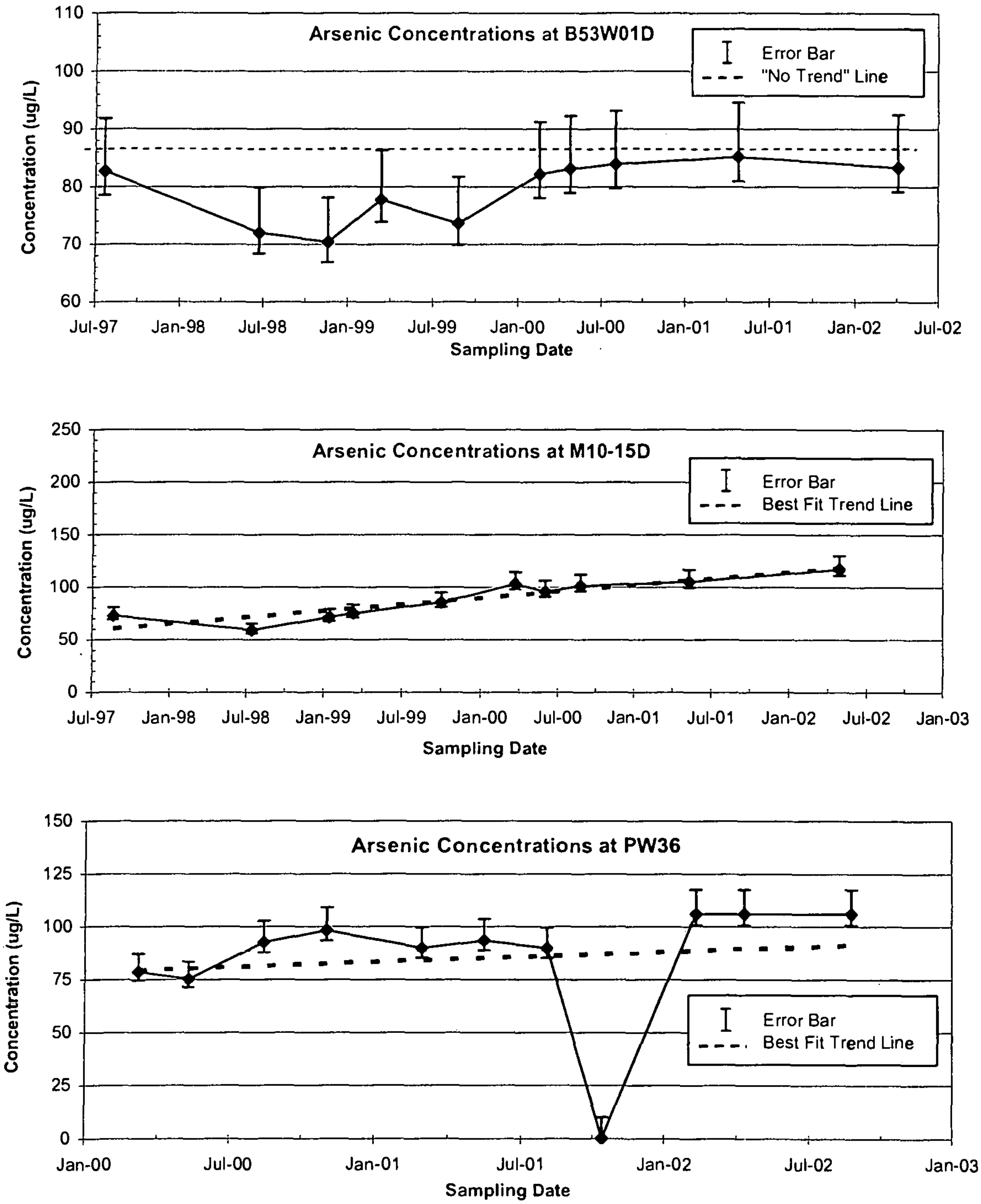
Eight new ground-water monitoring wells were installed prior to CY1999. These wells were identified as DW14, DW15, DW16, DW17, DW18, DW19, DW20, and DW21. Thus, 23 wells were sampled in CY1999. Ground-water samples from four HU-A wells and one HU-B well (DW19) exhibited total uranium concentrations above the MCL and IL of 20 µg/L, respectively. Ground-water samples from several HU-A and HU-B wells exhibited arsenic concentrations above its IL and the MCL. The only exceedence of the cadmium MCL was the HU-A Well B16W10S. Ra-226 exceeded its corresponding MCL in only one sample from one HU-A well, DW20. Samples from 22 of the 23 wells were collected in CY2000. Well DW20 was not sampled because the well rarely contained appreciable amounts of water. Ground-water samples from at least one HU-A and HU-B well exhibited arsenic and total uranium concentrations above their respective IL and MCL. Ra-226 concentrations exceeded its corresponding MCL in one HU-A well and one HU-B well.

One new ground-water monitoring well, DW22R, was installed at the SLDS in CY2001. This well is located on DT-8 and is intended to serve as an upgradient monitoring well for HU-B ground water at the SLDS. Data from this well will be used to determine background concentrations for the COCs in the HU-B ground water. Twenty-three wells were sampled in CY2001, including well DW22R. Well DW20 was not sampled in CY2001. Arsenic and total uranium exceeded their respective IL in more than one HU-A ground-water sample and more than one HU-B ground-water sample during CY2001. Ra-226 was detected only once above its MCL in one HU-A ground-water sample and more than once above its MCL in HU-B ground-water samples. Cadmium was detected only once above its IL in one HU-A well ground-water sample. Because significant exceedences of the ILs for arsenic and total uranium had been observed in the HU-B ground-water samples, the GRAAA was initiated in CY2001. Phase I of the GRAAA, the assessment phase, was completed in CY2002. Results of the Phase I indicate there is a need to conduct Phase II, the investigative phase.

Ground-water monitoring well DW20 was transferred to Mallinckrodt in the fourth quarter of CY2001 and is no longer included in the monitoring well network for the SLDS. Four monitoring wells (B16W05S, B16W05D, B16W11S, and DW22) were decommissioned in late CY2001.

The locations of the ground-water monitoring wells at the SLDS are shown in Figure IV-8. The CY2002 ground-water monitoring results indicated that ILs for arsenic and total uranium continued to be exceeded in both HU-A and HU-B ground-water samples. Monitoring wells DW14 and DW15 exceeded the IL for arsenic. Significant exceedance of the total uranium IL in DW19 occurred. Ra-226 was generally detected at low frequencies in both HU-A and HU-B ground-water samples. Cadmium was not detected in any samples from HU-A or HU-B wells.

Figure VI-4. Trend Analysis at the SLAPS - Arsenic

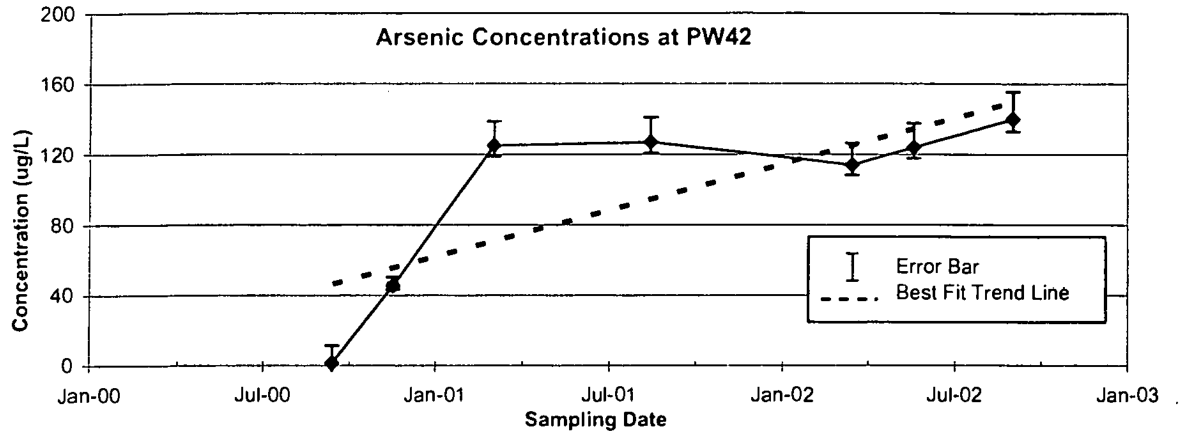


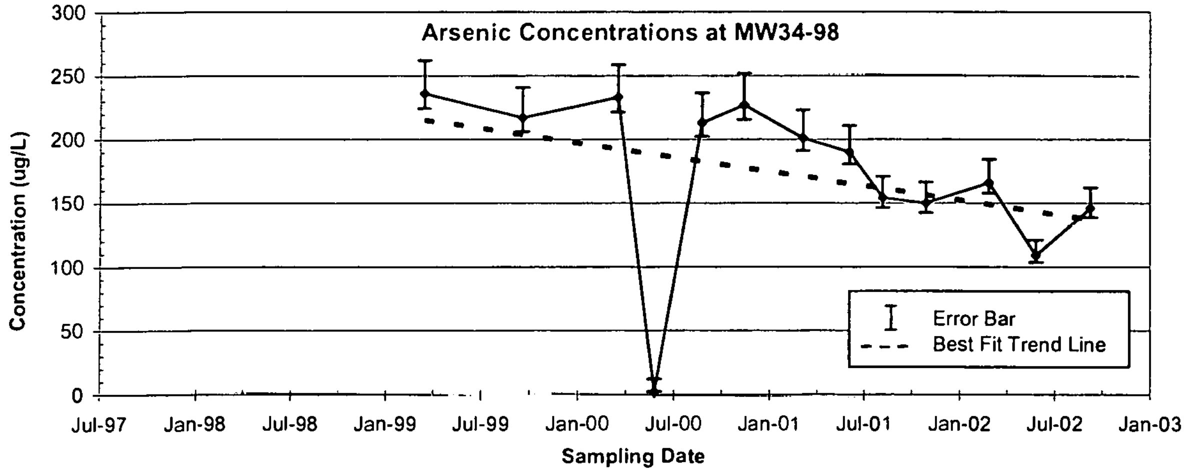
Notes:

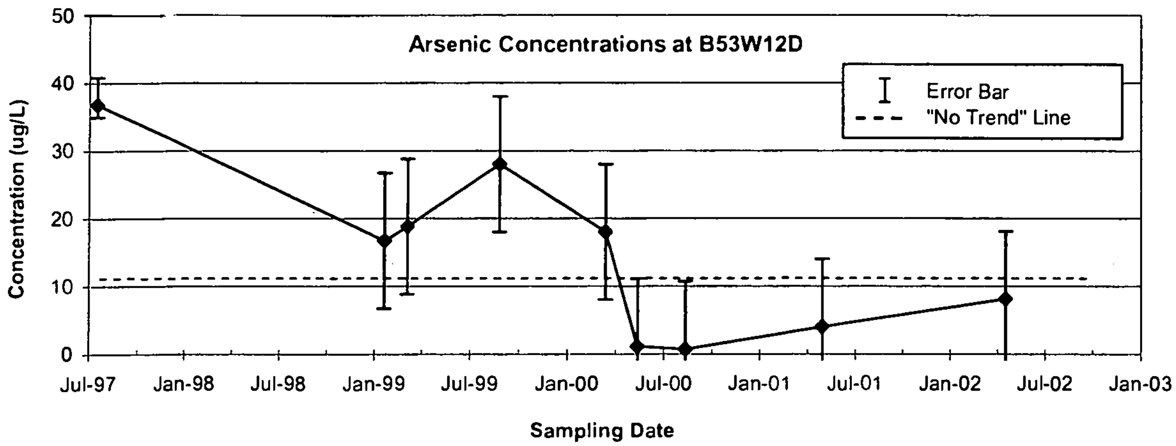
For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-4. Trend Analysis at the SLAPS - Arsenic (Continued)





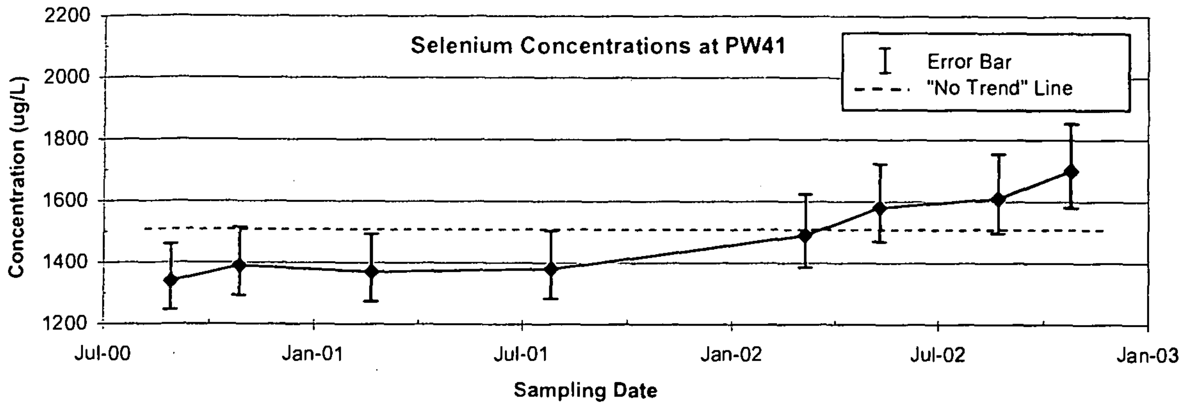


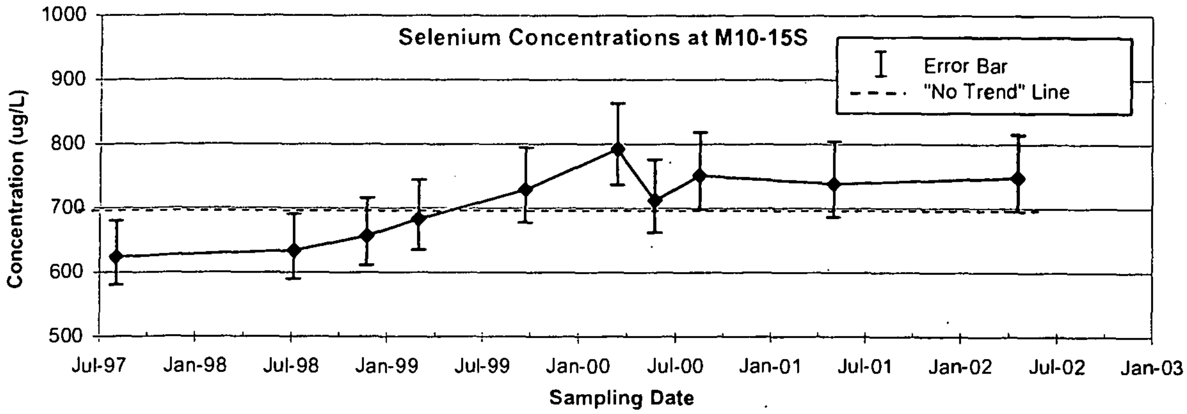
Notes:

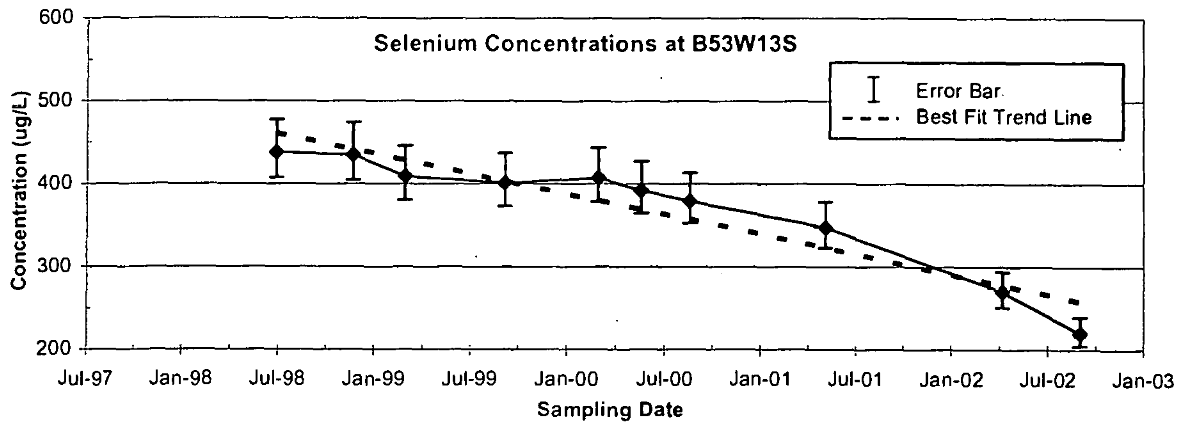
For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-5. Trend Analysis at the SLAPS - Selenium





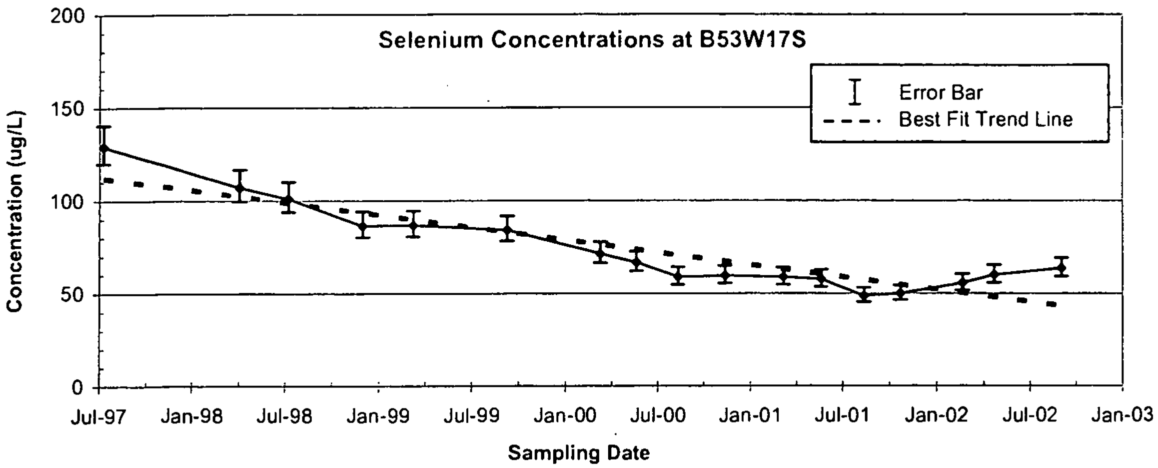


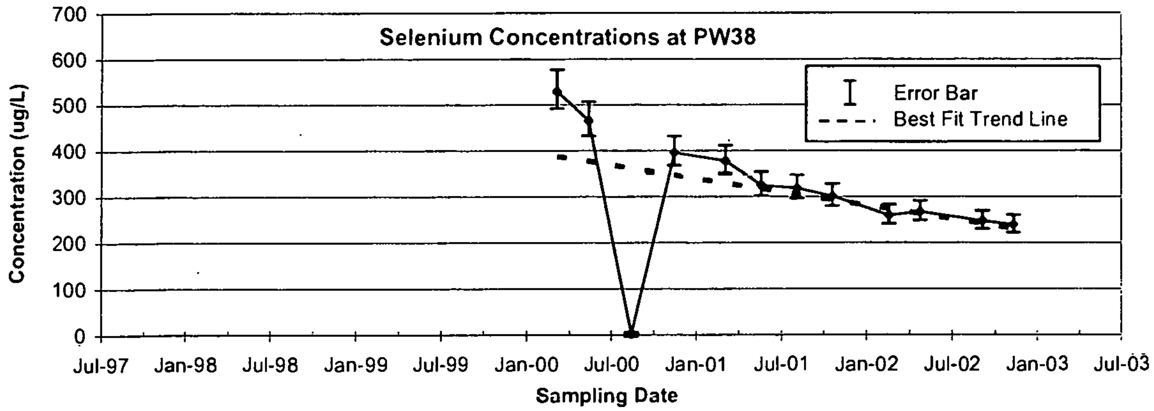
Notes:

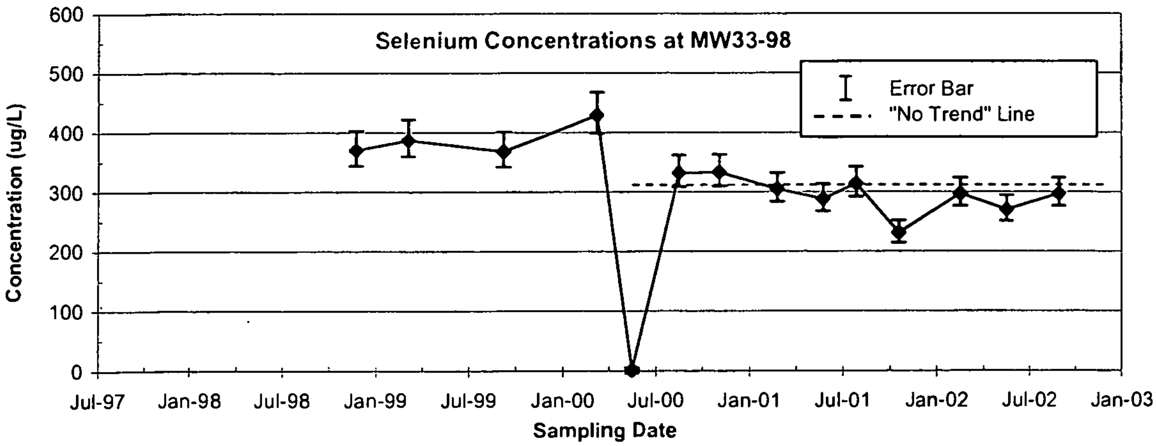
For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-5. Trend Analysis at the SLAPS - Selenium (Continued)





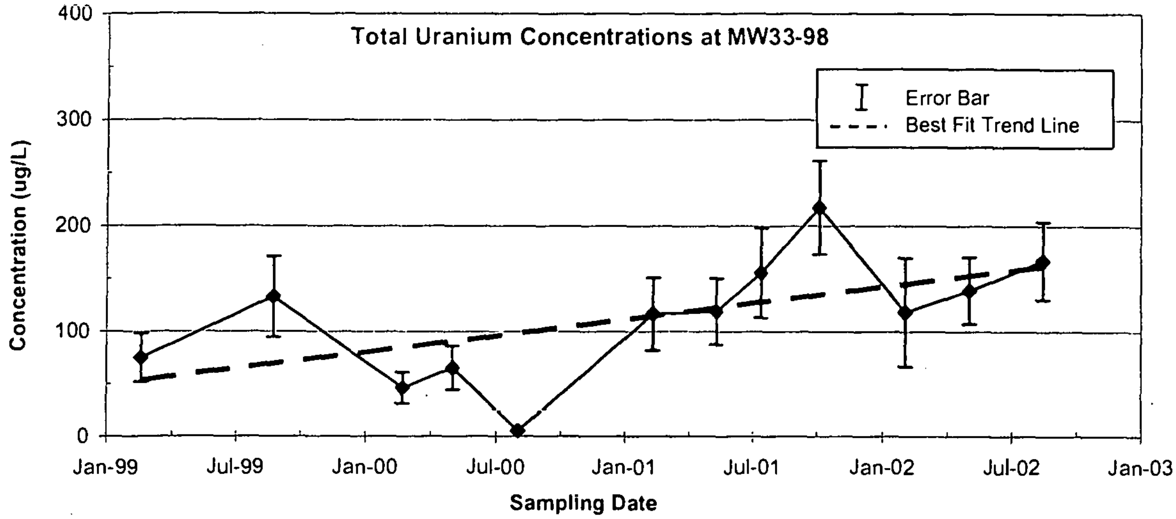


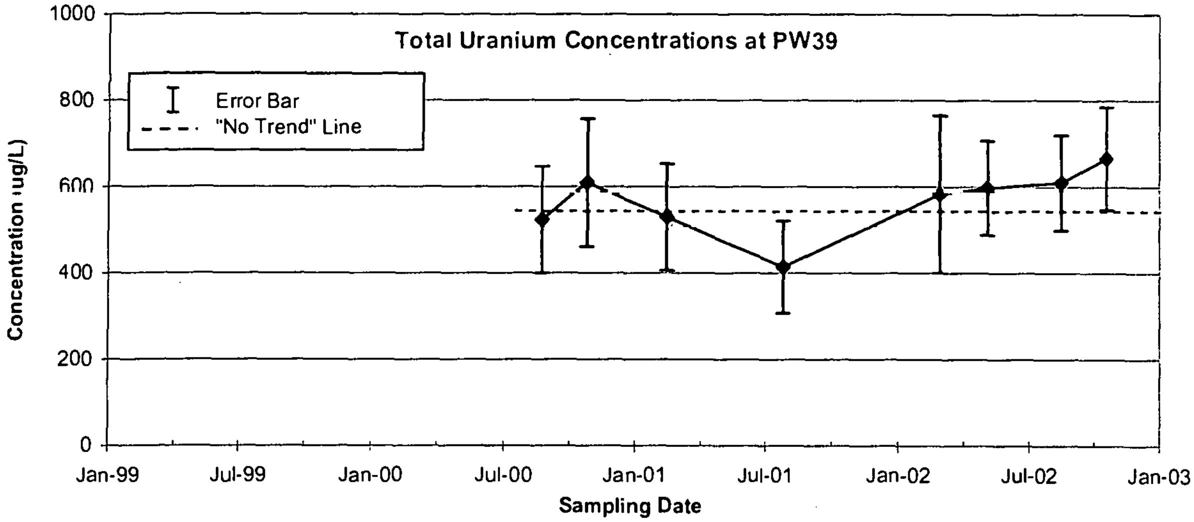
Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-6. Trend Analysis at the SLAPS - Total Uranium

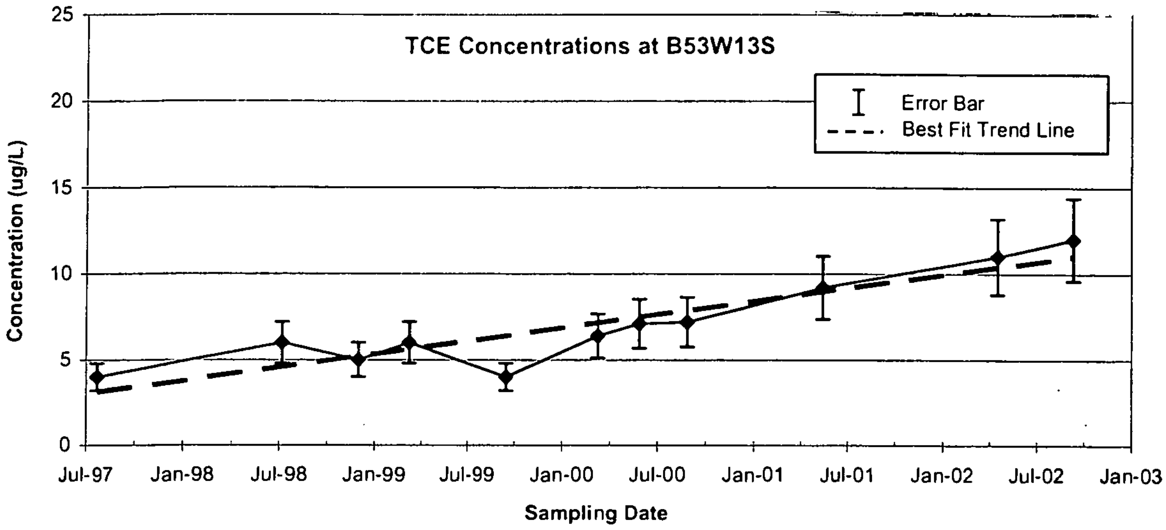


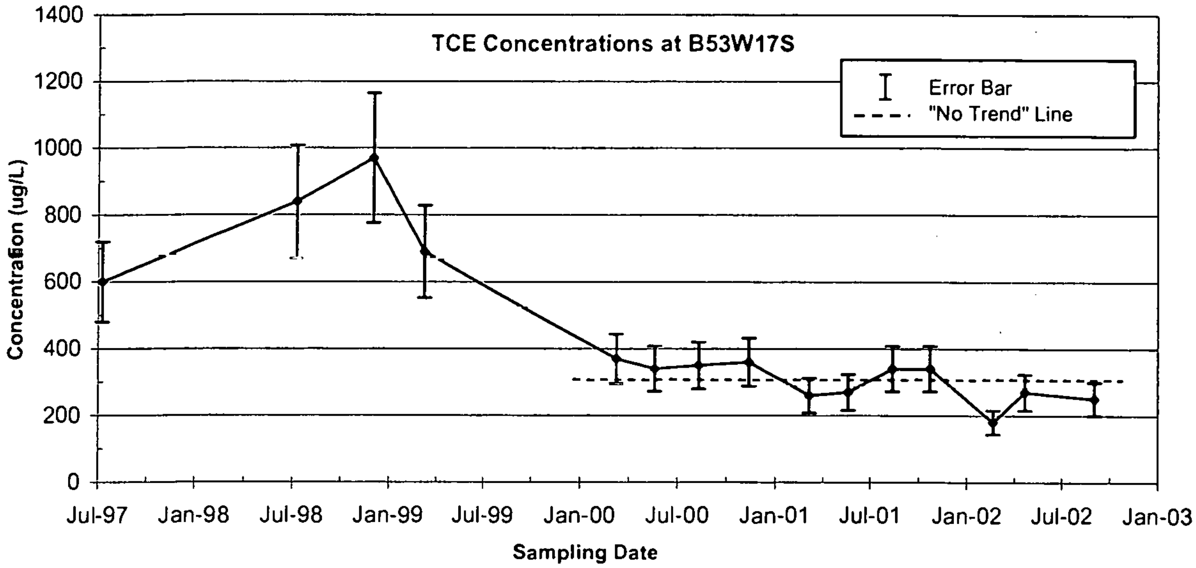


Notes:

For total uranium, the error bar represent ± the sum of the measurement error for U-234, U-235, and U-238.

Figure VI-7. Trend Analysis at the SLAPS - Trichloroethene





Notes:

For TCE, the measurement error was assumed to be ±20%

Trend Analysis

A quantitative evaluation of arsenic and total uranium concentration trends in both HU-A and HU-B unfiltered ground-water samples was conducted on available sampling data for the period from January 1999 through December 2002. The complete analysis is presented in USACE 2003d.

These trends were evaluated using Mann-Kendall testing. A Mann-Kendall trend analysis was conducted on those wells having at least seven sampling events and a greater than 80 percent detection frequency for the period January 1999 through December 2002. For arsenic, four HU-A wells (B16W04S, B16W06S, B16W07S and DW21) and seven HU-B wells (B16W07D, B16W08D, DW14, DW15, DW17, DW18, and DW19) were used. For total uranium, two HU-A wells (B16W12S, B16W13S) and three HU-B wells (DW16, DW17, and DW19) were used.

Mann-Kendall trend analysis indicated that only samples from HU-B well B16W07D are showing an upward trend for arsenic. The levels of arsenic in this well are below the investigative limit (50 μg/L). The Mann-Kendall statistical test does not take into consideration the range of error inherent in the analytical measurements. When the potential error in measurements is taken into account, the range associated with the arsenic values in B16W07D are generally wider than the magnitude of the trend as shown in Figure VI-9. This indicates that the determination of an overall trend for B16W07D is inconclusive.

The samples from the remaining HU-B wells show no arsenic trends. The Mann-Kendall test indicated a decreasing trend in total uranium concentrations for DW16. However, this test does not take into account the range of error associated in the analytical measurements. When the potential error in measurements is taken into account, the ranges associated with the total uranium values in DW16 are generally wider than the magnitude of the trend as shown in Figure VI-9. This indicates the overall trend for this well is inconclusive. The levels of total uranium in DW16 are below the IL (20 μg/L). It was determined that continued sampling would be necessary to determine if ongoing remedial actions will result in a decrease in uranium concentrations in HU-B ground-water samples (USACE 2003a).

Only wells with a greater than 80 percent detection rate and at least seven rounds of data are included in this report. Graphs of the trend analysis at the SLDS are shown in Figure VI-9. Graphs for those HU-B wells exceeding the ILs [DW19 (total uranium) and DW14 and DW15 (arsenic)] are provided in Figure VI-10. These wells do not show statistically significant trends based on the Mann-Kendall test.

Wastewater and Storm-Water Discharge Monitoring

This section provides a description of the wastewater and storm-water monitoring activities conducted at the SLS during the five-year review period. The monitoring results obtained from these activities are presented and compared with their respective permit or permit-equivalent requirements. The purpose of wastewater and storm-water discharge sampling at the SLS is to monitor compliance with the established discharge requirements. These requirements are established by the following: MSD discharge authorization letter dated October 30, 1998, and modified in a letter dated July 23, 2001, for the SLDS; MDNR NPDES-equivalent document dated October 2, 1998, and a discharge authorization letter dated July 23, 2001 for the SLAPS; and MDNR NPDES permit number MO-0111252 for the HISS. The storm-water sampling results for the SLAPS and the HISS are evaluated against the requirements in 10 CFR 20.1302, 10 Code of State Regulations (CSR) 20-7.031, and permit requirements and conditions. Wastewater sampling results for the SLAPS and the SLDS are evaluated against 10 CFR 20.2003 requirements and requirements listed in the MSD discharge authorization letters for the SLDS (October 30, 1998 and July 23, 2001).

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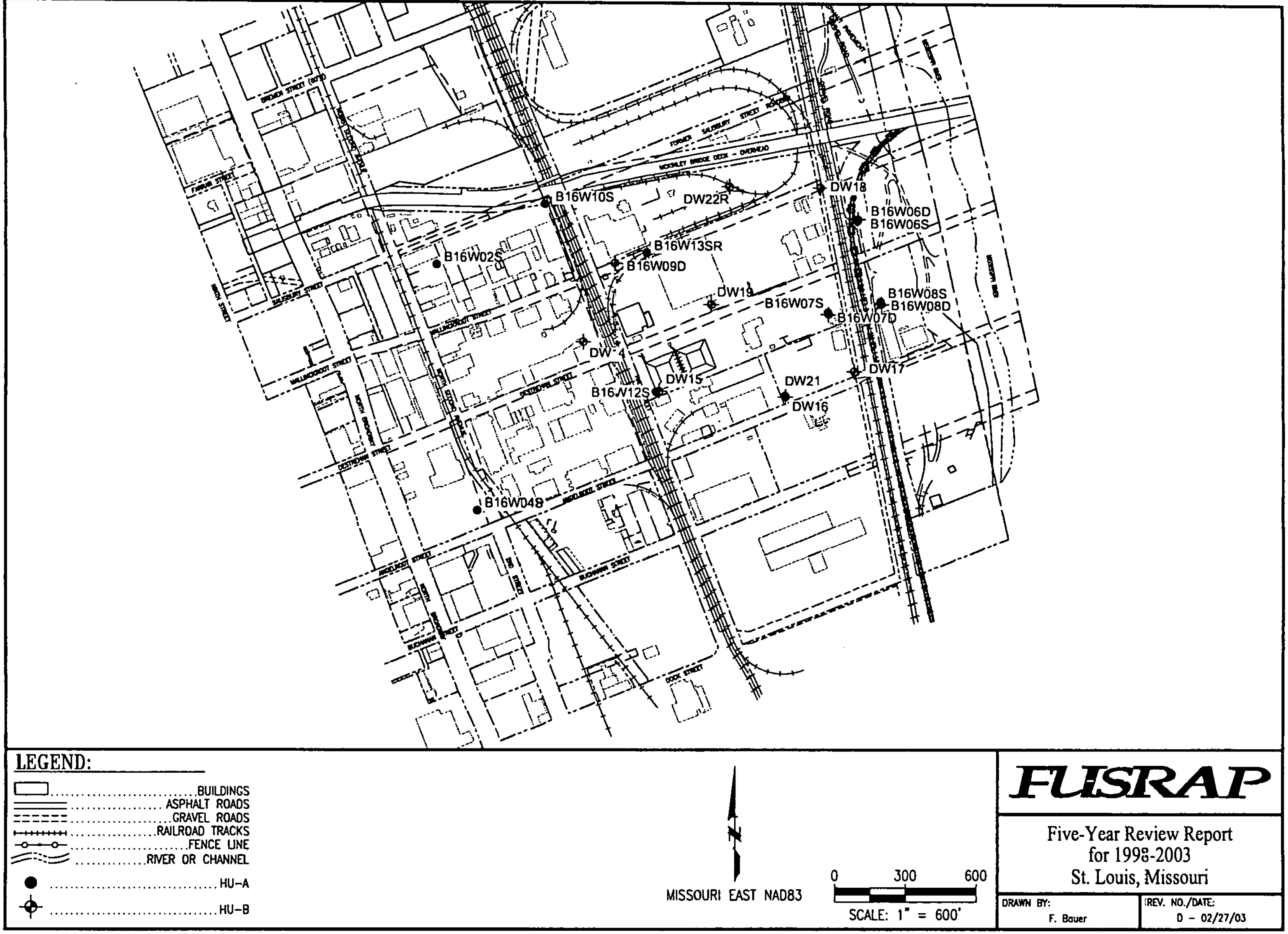


Figure VI-8. Ground-water Monitoring Well Locations at the SLDS in CY 2002

Wastewater Discharge Monitoring at the SLDS

Precipitation run-on and ground-water infiltration that collects in excavation areas of the SLDS are treated, if necessary, and discharged to the Bissell Point Sewage Treatment Plant under an authorization letter issued by the MSD.

There were no remedial-related discharges of storm water or ground water at the SLDS in CY1998. There were also no discharges during the first quarter of CY1999 due to the discovery of Civil War ordnance in the Plant 2 remediation area. Wastewater from the SLDS is discharged to MSD Base Map Inlet 17D3-022C. A summary of the wastewater discharges from the SLDS for the five-year review period is presented in Table VI-5. During three quarterly sampling events in 1999, gross beta values were observed at concentrations greater than the MSD authorization letter limit of 50 pCi/g. The elevated beta results were determined to be the result of the presence of naturally occurring K-40 in the water pumped from the excavations.

Table VI-5. Summary of Wastewater Discharges at the SLDS

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Activity Discharged	Total Volume Discharged
1998	No Discharge	No Discharge	No Discharge	No Discharge	0	0
1999	No Discharge	Exceeded MSD gross beta limit	Exceeded MSD gross beta limit	Exceeded MSD gross beta limit	Th – 1.65E-05 Ci U – 8.72E-06 Ci Ra – 2.75E-06 Ci	1,663,676 gallons
2000	No Exceedence	No Exceedence	No Exceedence	No Exceedence	Th – 1.15E-05 Ci U – 6.25E-06 Ci Ra – 3.07E-06 Ci	1,569,974 gallons
2001	No Exceedence	No Exceedence	No Exceedence	No Exceedence	Th –1.4E-05 Ci U – 4.5E-06 Ci Ra – 8.7E-06Ci	1,747,170 gallons
2002	No Exceedence	No Exceedence	No Exceedence	No Exceedence	Th – 1.1E-05 Ci U – 6.8E-06 Ci Ra – 1.8E-06 Ci	1,452,010 gallons

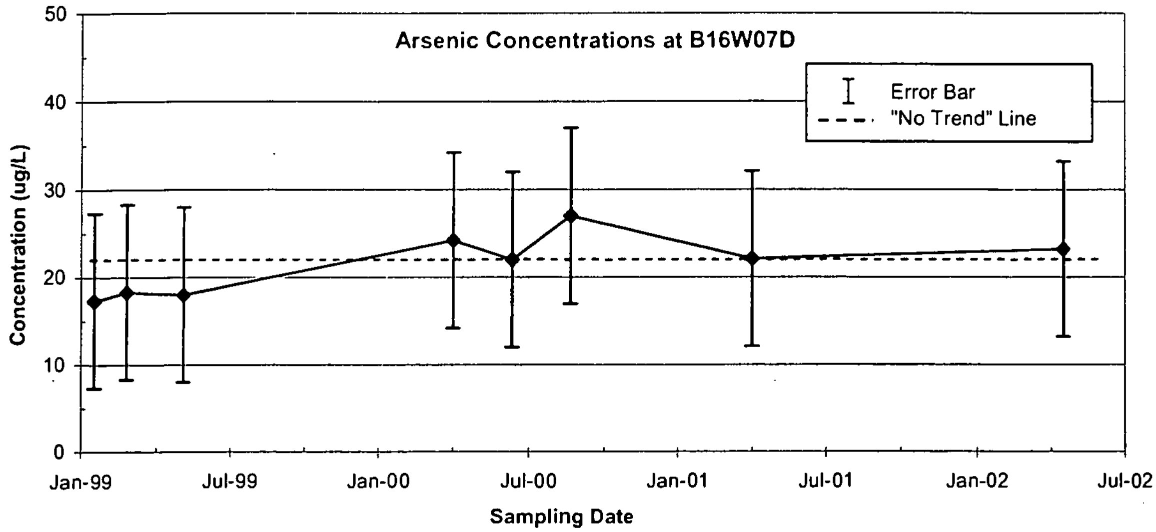
Wastewater Discharge Monitoring at the SLAPS

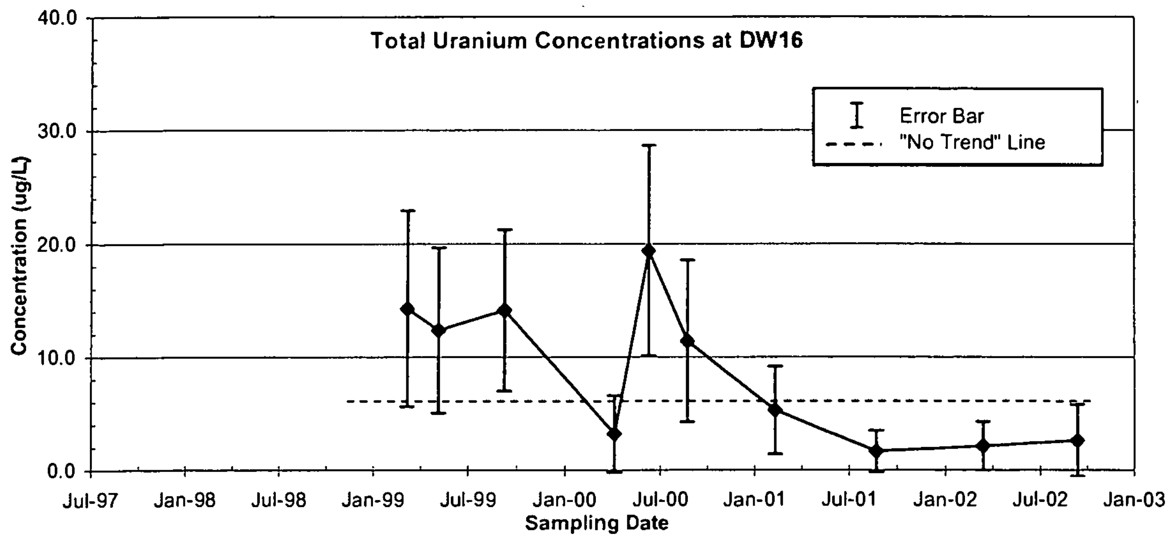
CY2002 was the first year that wastewater was discharged from the SLAPS to the sanitary sewer system. On July 23, 2001, the St. Louis MSD responded to a request by USACE to discharge treated wastewater to an MSD sanitary sewer located on-site by issuing a conditional approval for discharge of treated wastewater that resulted from USACE response actions at the SLAPS. The primary condition of the approval was that a treatment system be installed, maintained, and operated to produce an effluent meeting the standards contained in the following: MSD ordinance 8472, 10 CFR 20, and 19 CSR 20-10.

The MSD ordinance limits the annual allocation for radioactivity from the SLAPS to the MSD Coldwater Creek treatment plant, establishes the maximum volume of wastewater allowed to be discharged in a 24-hour period, and requires that the USACE show compliance of the treated wastewater with applicable standards and limits before MSD will allow the discharge.

During the second quarter of CY2002, a bench- and pilot-testing program of treating the wastewater by a bio-denitrification treatment system was initiated. A discharge line was installed from the wastewater treatment plant area to an MSD sewer line. During the third quarter, treatment of on-site stored wastewater was initiated. Four pilot-scale batches of wastewater were

Figure VI-9. Trend Analysis at the SLDS





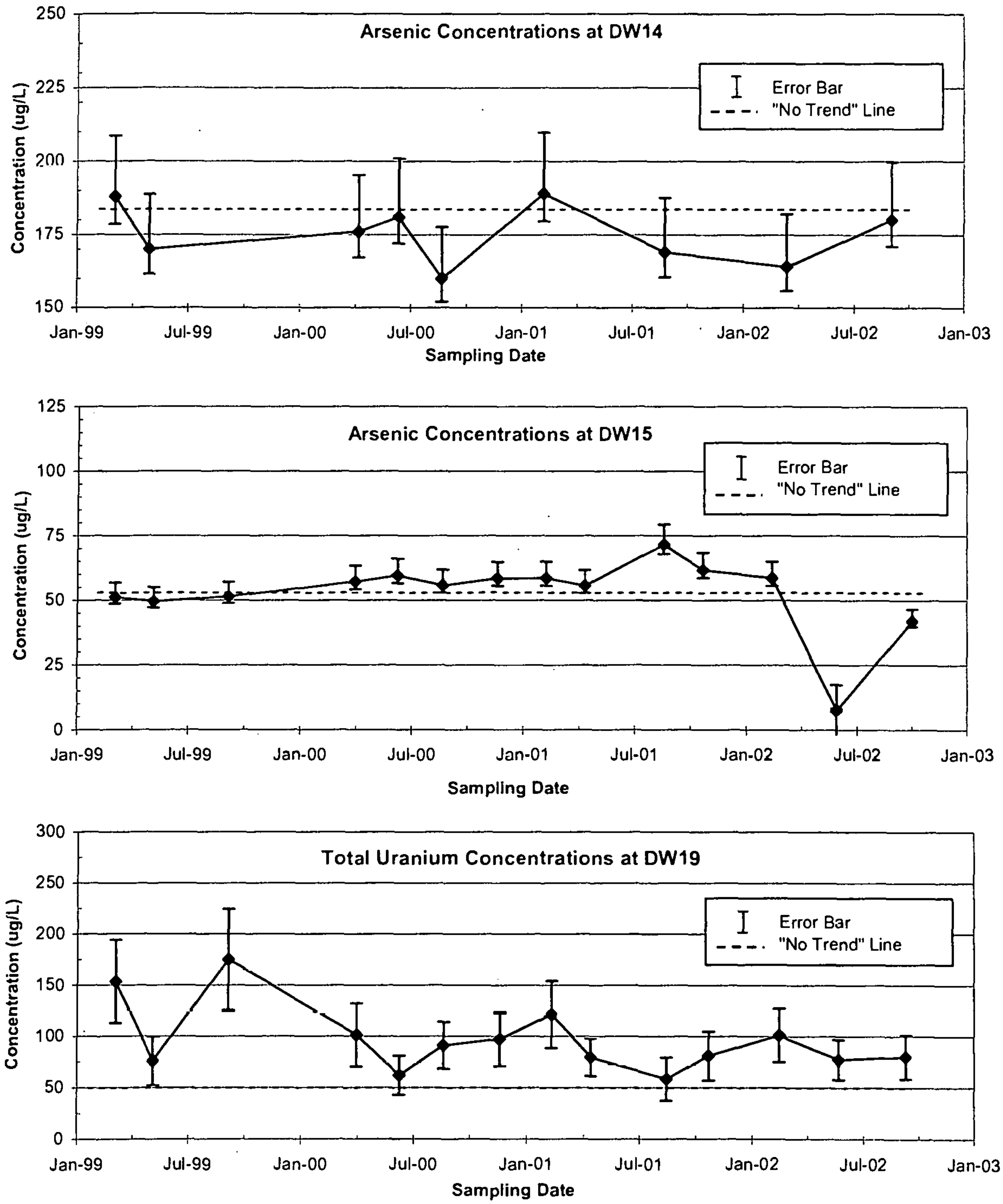
Notes:

For arsenic results less than 3 times the reporting limit (RL), the error bar represents ±RL

For arsenic results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

For total uranium, the error bar represent ± the sum of the measurement error for U-234, U-235, and U-238.

Figure VI-10. Trend Analysis for Wells Exceeding Investigative Limits (ILs) at the SLDS



Notes:

For arsenic results less than 3 times the reporting limit (RL), the error bar represents ±RL

For arsenic results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits of the Control Spike Samples

For total uranium, the error bar represent ± the sum of the measurement error for U-234, U-235, and U-238.

treated and one full-scale batch was treated. The treated wastewater consisted of a first batch of 12,000 gallons (gal) of pilot-treated wastewater and a second batch of 120,000 gal of treated wastewater. These batches of treated wastewater were sampled and analyzed for MSD influent criteria. The results indicated a total activity of 1.4E-06 curies (Ci) for Th, 2.9E-06 Ci for uranium (isotopic method), and 0.0E+00 Ci for Ra.

Storm-Water Monitoring at the HISS

The MDNR renewed NPDES operating permit MO-0111252 for the discharge of storm water from two outfalls at the HISS in 1995. These outfall locations are designated as HN01 and HN02.

Both total suspended solids and pH values were within the discharge limits at both outfalls for the sampling events in CY1998. However, the maximum and mean gross alpha activities for both outfalls exceeded the ambient water quality criteria (AWQC) of 15 picocuries per liter (pCi/L). Additionally, the mean and maximum concentrations of Ra isotopes in the HN02 effluent exceeded the AWQC for combined Ra-226 and Ra-228 of 5 pCi/L. None of the AWQC for the chemical pollutants was exceeded. Furthermore, the measured concentrations of the detected organic pollutants were below the health advisory levels for bromacil (90 grams per liter) and AWQC for the phthalate esters of 10 CSR 20-7 for a drinking water supply.

Outfall HN03 was constructed in July 1999 to monitor storm-water run-off from the soil piles. CY1999 storm-water discharge concentrations from the HISS complied with criteria contained in the permit and 10 CFR 20.1302. The permit expired in 2000 and negotiations between the USACE and MDNR as to future activity under the permit are ongoing.

In CY2000 through CY2002, storm-water discharge was monitored from three outfalls at the HISS: HN01, HN02, and HN03. No permit limits or 10 CFR 20.1302 criteria were exceeded at the HISS in these calendar years.

Storm-Water Discharge Monitoring at the SLAPS

Site-specific permits are in place for the discharge of storm water to Coldwater Creek at the SLAPS. Historical monitoring of storm-water discharges at the SLAPS involved semiannual sampling of the effluent from two outfalls. The first of the SLAPS historical outfalls (STW-001) was located at the northwest entrance to the site, and the second historical outfall (STW-002) was located in the southwest corner of the site. As a result of insufficient flow, storm-water effluent samples were not collected from Outfall STW-002 during CY1998.

In a NPDES-equivalent document dated October 2, 1998, MDNR established storm-water discharge requirements for three outfalls at the SLAPS in conjunction with the proposed construction of the sedimentation basin. These three storm-water discharge outfalls at the SLAPS replaced the historical outfalls and were designated as Outfall PN01, Outfall PN02, and Outfall PN03. Outfall PN01 actually consists of two separate outfalls. Outfall PN01a is the discharge point for the sedimentation basin, and Outfall PN01b is the discharge point for the emergency spillway. Outfall PN01b is located near historical Outfall STW-001. Th-230 concentrations exceeded the values specified in Table 2, Appendix B of 10 CFR 20 of 15 pCi/L at each outfall in CY1998 with concentrations ranging from 1.33 to 320.3 pCi/L. (Thorium is not in the permit, and is based on annual averages per 10 CFR 20.)

In CY1999, storm-water discharge parameters were detected below discharge requirements, with one exception. Analytical results for the July 1, 1999, sample for Outfall PN03 indicated total copper at 101 µg/L, which is above the discharge limit of 84 µg/L. The CY1999 storm-water discharges from the SLAPS also complied with criteria contained in 10 CFR 20.1302. The average annual concentration of radioactive material released in CY1999 storm-water discharges did not exceed the values specified in Table 2, Appendix B of 10 CFR 20 (i.e., for a mixture of radionuclides, the SOR is less than unity).

For CY2000, storm-water discharge results indicated an exceedence of the discharge limit of 84 µg/L for total recoverable copper at Outfall PN03 in February 2000. The result reported was 88.6 µg/L. The CY2000 storm-water discharges from the SLAPS complied with the criteria contained in 10 CFR 20.1302.

Chemical sample data results for CY2001 storm-water discharges indicated there were two exceedences at Outfall PN03 of the discharge limit of 1.0 microliters per liter per hour (µL/L/hr) for settleable solids. These exceedences occurred in September and October 2001. The respective results were 1.56 µL/L/hr and 4.0 µL/L/hr. Both exceedences were the result of an intense rainfall event. The October 2001 result for Outfall PN03 revealed that the sample also exceeded the total recoverable copper limit of 84 µg/L with a result of 160 µg/L. The average annual concentration of radioactive material released in CY2001 storm-water discharges did not exceed the values specified in Table 2 of Appendix B of 10 CFR 20.

Discharge limits were exceeded for copper at Outfall PN01a during the second quarter of CY2002. The concentration of total recoverable copper (100 µg/L) exceeded the daily maximum limit of 84 µg/L. Otherwise, discharge limits were not exceeded at the SLAPS for CY2002.

Exceedances at the outfalls were detected after rainfall events that corresponded with backfilling operations. In addition, the exceedances that occurred in 2001 occurred when PN03 was plugged and water was being diverted to PN01a.

In accordance with a letter dated February 19, 2002, from MDNR, sampling at Outfall PN02 was reduced to once a year, until the drainage area is affected by a soil disturbance. Outfall PN03 has been discontinued as a sampling location in accordance with a letter by MDNR dated February 19, 2002.

Site Radiological Monitoring

Program Overview (SLDS)

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, and radon data. The data were used to assess the magnitude of radiological exposures to the general public. Radon flux monitoring was not required at the SLDS.

Applicable Standards

10 CFR 20

The regulatory dose limit for members of the public is 100 millirem per year (mrem/yr) from all pathways, as stated in 10 CFR 20.1301. Compliance with the dose limit in 10 CFR 20.1301 can be demonstrated in one of the two following ways [§20.1302(b)(1) and (2)].

1. Demonstrating by measurement or calculation that the total effective dose equivalent (TEDE) to the individual likely to receive the highest dose from the SLDS operations does not exceed the annual dose limit (100 mrem/yr).
2. Demonstrating that (*i*) the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 and (*ii*) if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 2 millirem per hour (mrem/hr).

Gamma radiation, airborne particulate radionuclide, and radon data from the site were used to evaluate the cumulative dose to a hypothetically impacted individual (member of the public) from exposure to radiological contaminants at the SLDS in order to demonstrate compliance with 10 CFR 20.1301.

Radon was also compared to the regulatory criterion listed in 10 CFR 20, Table 2 of Appendix B, of 0.3 picocuries per liter (pCi/L) (at 30% equilibrium) average annual concentration above background.

40 CFR 61

Airborne particulate radionuclide data from the site were used to calculate the effective dose equivalent (EDE) to a critical receptor. The National Emission Standards for Hazardous Air Pollutant (NESHAP) standard of EDE to a critical receptor from radionuclide emissions is 10 mrem/yr as stated in 40 CFR 61, Subpart I (*National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H).*

Gamma Radiation Monitoring

Monitoring Overview

Gamma radiation was measured using thermoluminescent dosimeters (TLDs). TLDs at the SLDS were located at areas assumed to be representative of areas accessible to the public. At each monitoring station, the TLDs were placed approximately 3 feet above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at the SLDS at five locations during CY1999 through CY2001 and at four locations in CY2002. Gamma radiation was not monitored at the SLDS during CY1998. Station DA-5 was eliminated in October 2001 after it was determined to be a redundant location due to its proximity to DA-3.

Monitoring Program Results

The gamma radiation data collected from each location during CY1999 to CY2002 were corrected for background, shelter absorption, and fade and were normalized to exactly one year to calculate an annual dose. The corrected annual gamma radiation monitoring results are presented in Table VI-6.

Table VI-6. External Gamma Radiation Monitoring Results at the SLDS

Monitoring Location	Monitoring Station	CY1998 TLD Data	CY1999[a] TLD Data	CY2000 TLD Data	CY2001 TLD Data	CY2002 TLD Data
		(mrem/yr)				
SLDS	DA-1	NA	0	18	15	13
	DA-2	NA	0	2	9	13
	DA-3	NA	9	15	30	45
	DA-4	NA	0	6	18	18
	DA-5	NA	0	0	4	NA

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored or station eliminated

Data Analysis

Gamma radiation data from the SLDS were used to calculate an average dose rate, and an annual deep dose equivalent (DDE) to a hypothetically maximally exposed individual. The average dose rate was compared to the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr. A summary of calculated gamma radiation dose rates is presented in Table VI-7. The average dose rate during CY1999 to CY2002 was less than the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr.

Table VI-7. External Gamma Dose Rate at the SLDS

	Maximum Average Dose Rate above Background[a]	10 CFR 20 Limit (2 mrem/yr)	Annual Calendar Year Dose	10 CFR 20 Limit (100 mrem/yr)
	(mrem/hr)		(mrem/yr)	
1998	NA	2	NA	100
1999	<0.1	2	0.0	100
2000	<0.1	2	0.0	100
2001	<0.1	2	0.1	100
2002	<0.1	2	0.1	100

[a] Calculated by dividing the annual gamma radiation result by 8760 hours, the number of hours in a year, for each location.

NA Not available

The annual dose to a member of the public from gamma radiation was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20.1302(b)(1) limit of 100 mrem/yr during CY1999 to CY2002. The annual calendar year doses for CY1999 to CY2002 were less than the 100 mrem/year for all pathways.

Five-year Trend Analysis

The annual dose to a member of the public from gamma radiation at the SLDS was far below the 10 CFR 20.1302(b)(2)(ii) limit for all years with negligible variance from year to year. There was a minute upward trend over the time period; however, when compared to the regulatory limit, the trend was insignificant.

Airborne Particulate Monitoring

Monitoring Overview

Airborne radioactive particulates result from radioactive material in soil (or other sources) that becomes suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 feet above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in microcuries per milliliter (μCi/mL).

Perimeter air sampling for radiological particulates was not conducted at the SLDS during CY1998 to CY2002 due to the insignificant potential for material to become airborne at the site. Particulate air monitors were located at excavation perimeter locations on the SLDS. Air particulate samples are collected during active excavation at the SLDS and analyzed at the SLS radioanalytical laboratory. Airborne particulate data were not available for CY1998 and CY1999.

Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. For CY 1998 and CY1999, the annual dose was calculated by applying relevant modeling parameters given the size of known work areas, meteorological conditions, and potential exposure durations in lieu of available monitoring data. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table VI-8.

Table VI-8. Air Particulate Monitoring at the SLDS

Calendar Year	Average Annual Gross Alpha Concentration (μCi/mL)	Average Annual Gross Beta Concentration (μCi/mL)	Annual Dose Rate (mrem/yr)
1998	NA	NA	0.3
1999	NA	NA	0.8
2000	1.2E-14	1.3E-13	<0.1
2001	5.2E-15	6.0E-14	<0.7
2002	1.3E-15	2.3E-14	0.2

NA Not available

Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 CFR 61 standard of 10 mrem/yr. The estimated EDE was added to the radiological doses from other pathways to determine if the TEDE to a member of the public exceeded the 10 CFR 20 limit of 100 mrem/yr. A comparison of the EDE due to airborne particulate radionuclides at the SLDS and the regulatory limits is presented in Table VI-9.

Table VI-9. Airborne Particulate Dose Rate at the SLDS

Calendar Year	Annual Dose Rate	40 CFR 61 Standard (10 mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
	(mrem/yr)		
1998	*	10	100
1999	0.8	10	100
2000	<0.1	10	100
2001	<0.7	10	100
2002	0.2	10	100

* Value is less than 10 percent of the dose standard in 40 CFR 61.102.

As shown in Table VI-9, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 CFR 61 standard of 10 mrem/yr during CY1998 to CY2002.

Five-year Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at the SLDS was far below the 40 CFR 61 standard and did not really vary from year to year. There is a small downward trend over the time period; however, when compared to the regulatory standard, the trend is insignificant. The average annual gross alpha and gross beta results demonstrate a slight downward trend over the period as well.

Radon Monitoring

Monitoring Overview

Airborne radon monitoring was performed at the SLDS using alpha track decectors (ATDs) to measure radon emissions. The detectors were collocated with the TLDs at the site. The ATDs were collected semi-annually. Radon concentrations were used to calculate an EDE to a hypothetically maximally exposed individual and added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 dose limit of 100 mrem/yr. Recorded radon concentrations were also evaluated based on the regulatory criterion listed in 10 CFR 20, Appendix B of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. Radon monitoring was performed at the SLDS at five locations during CY1999 through CY2001 and at four locations in CY2002. Radon was not monitored at the SLDS during CY1998. Station DA-5 was eliminated in October 2001 after it was determined to be a redundant location due to its proximity to DA-3.

Monitoring Program Results

The radon data collected from each location during CY1999 to CY2002 were corrected for background and was normalized to exactly one year to calculate an annual dose rate. The calculated annual radon monitoring results are presented in Table VI-10.

Table VI-10. Radon Monitoring at the SLDS

Monitoring Location	Monitoring Station	CY1998 Radon Data	CY1999[a] Radon Data	CY2000 Radon Data	CY2001 Radon Data	CY2002 Radon Data
		(pCi/L)				
SLDS	DA-1	NA	0.0	0.0	0.1	0.0
	DA-2	NA	0.0	0.0	0.1	0.0
	DA-3	NA	0.0	0.0	0.0	0.1
	DA-4	NA	0.0	0.0	0.0	0.0
	DA-5	NA	0.2	0.0	0.0	NA

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored or station eliminated

Data Analysis

Radon data from the SLDS were used to calculate an average annual concentration and an annual EDE to a hypothetically maximally exposed individual. The average concentration was compared to the 10 CFR 20, Appendix B value of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. The annual dose was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 limit. A summary of the radon concentrations above background and calculated dose rates is presented in Table VI-11.

Table VI-11. Radon Concentration and Dose Rate at the SLDS

Calendar Year	Average Annual Concentration Above Background	10 CFR 20 App. B (0.3 pCi/L)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(pCi/L)		(mrem/yr)	
1998	NA	0.3	NA	100
1999	<0.1	0.3	0.0	100
2000	0.0	0.3	0.0	100
2001	<0.1	0.3	0.2	100
2002	<0.1	0.3	0.0	100

NA Not available

As shown in Table VI-11, the average annual concentrations above background during CY1999 to CY2002 were less than the 10 CFR 20 Appendix B value of 0.3 pCi/L.

Five-year Trend Analysis

The annual radon concentrations at the SLDS were far below the 10 CFR 20 limit with negligible variance from year to year. There was a minute upward trend for dose rates over the time period; however, when compared to the regulatory limit, the trend was insignificant. The average annual concentration of radon remained approximately the same for the period.

Site Radiological Monitoring

Program Overview (SLAPS)

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, and radon data. The data were used to assess the magnitude of radiological exposures to the general public. Radon flux monitoring was not required at the SLAPS.

Applicable Standards

10 CFR 20

The regulatory dose limit for members of the public is 100 mrem/yr from all pathways as stated in 10 CFR 20.1301. Compliance with the dose limit in 10 CFR 20.1301 can be demonstrated in one of the two following ways [§20.1302(b)(1) and (2)].

1. Demonstrating by measurement or calculation that the TEDE to the individual likely to receive the highest dose from the SLAPS operations does not exceed the annual dose limit (100 mrem/yr).

2. Demonstrating that (*i*) the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 and (*ii*) if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 2 mrem/hr.

Gamma radiation, airborne particulate radionuclide, and radon data from the site were used to evaluate the cumulative dose to a hypothetically impacted individual (member of the public) from exposure to radiological contaminants at the SLAPS in order to demonstrate compliance with 10 CFR 20.1301.

Radon was also compared to the regulatory criterion listed in 10 CFR 20, Appendix B, of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background.

40 CFR 61

Airborne particulate radionuclide data from the site were used to calculate the EDE to a critical receptor. The NESHAP standard of EDE to a critical receptor from radionuclide emissions is 10 mrem/yr as stated in 40 CFR 61, Subpart I (*National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H).*

Gamma Radiation Monitoring

Monitoring Overview

Gamma radiation was measured using TLDs. TLDs at the SLAPS were located at the site perimeter. At each monitoring station, the TLDs were placed approximately 3 feet above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at the SLAPS at four locations during CY1998 and at six locations during CY1999 through CY2002.

Monitoring Program Results

The gamma radiation data collected from each location during CY1998 to CY2002 were corrected for background, shelter absorption, and fade, and was normalized to exactly one year for the purpose of comparison to an annual dose. The calculated annual gamma radiation results are presented in Table VI-12.

Table VI-12. External Gamma Radiation Monitoring at the SLAPS

Monitoring Location	Monitoring Station	CY1998[a] TLD Data	CY1999[a] TLD Data	CY2000 TLD Data	CY2001 TLD Data	CY2002 TLD Data
		(mrem/yr)				
SLAPS	PA-1	NA	47	112	162	157
	PA-2	32	7	6	14	14
	PA-3	74	8	31	60	58
	PA-4	2450	330	142	58	45
	PA-5	47	30	27	13	7
	PA-6	NA	89	106	105	108

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored or station eliminated

Data Analysis

Gamma radiation data from the SLAPS was used to calculate an average dose rate and an annual DDE to a hypothetically maximally exposed individual. The average dose rate was compared to the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr. A summary of the calculated gamma radiation dose rates are presented in Table VI-13.

Table VI-13. External Gamma Dose Rate at the SLAPS

Calendar Year	Maximum Average Dose Rate above Background[a]	10 CFR 20 Limit (2 mrem/yr)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(mrem/hr)		(mrem/yr)	
1998	0.3	2	0.1	100
1999	<0.1	2	0.0	100
2000	<0.1	2	0.1	100
2001	<0.1	2	0.1	100
2002	<0.1	2	0.1	100

[a] Calculated by dividing the annual gamma radiation result by 8760 hours, the number of hours in a year, for each location.

The annual dose to a member of the public from gamma radiation was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 limit of 100 mrem/yr during CY1998 to CY2002. The average dose rate during CY1999 to CY2002 was less than the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr.

Five-year Trend Analysis

The annual dose to a member of the public from gamma radiation at the SLAPS was far below the 10 CFR 20 limit for all years with negligible variance from year to year.

Airborne Particulate Monitoring

Monitoring Overview

Airborne radioactive particulates result from radioactive material in soil (or other sources) that become suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 feet above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in μCi/mL.

Site perimeter air sampling for radiological particulates was conducted at the SLAPS during CY1999 to CY2002. Air particulate samples were collected weekly at the SLAPS and analyzed at the SLS radioanalytical laboratory. Airborne particulate data were not available for CY1998.

Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. For CY1998, the annual dose was calculated by applying relevant modeling parameters given the size of known work areas, meteorological conditions, and potential exposure durations in lieu of available monitoring data. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table VI-14.

Table VI-14. Air Particulate Monitoring at the SLAPS

Calendar Year	Average Annual Gross Alpha Concentration (μCi/mL)	Average Annual Gross Beta Concentration (μCi/mL)	Annual Dose (mrem/yr)
1998	NA	NA	7.6
1999	2.3E-15	3.5E-14	6.4
2000	3.5E-15	4.1E-14	6.4
2001	5.6E-15	6.3E-14	9.4
2002	3.1E-15	4.2E-14	4.8

NA Not available

Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 CFR 61 standard of 10 mrem/yr. The estimated EDE was added to the radiological doses from other pathways to determine if the TEDE to a member of the public exceeded the 10 CFR 20 limit of 100 mrem/yr. A comparison of the EDE due to airborne particulate radionuclides at the SLAPS to the regulatory standards is presented in Table VI-15.

Table VI-15. Airborne Particulate Dose Rate at the SLAPS

Calendar Year	Annual Dose Rate	40 CFR 61 Standard (10 mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
	(mrem/yr)		
1998	7.6	10	100
1999	6.4	10	100
2000	6.4	10	100
2001	9.4	10	100
2002	4.8	10	100

As shown in Table VI-15, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 CFR 61 standard of 10 mrem/yr CY1998 to CY2002.

Five-year Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at the SLAPS was below the 40 CFR 61 standard for all years. There is an overall slight downward trend during the time period. The average annual gross alpha and gross beta results have remained approximately the same over the period. This may be due to ongoing remediation at the SLAPS.

Radon Monitoring

Monitoring Overview

Airborne radon monitoring was performed at the SLAPS using ATDs to measure radon emissions. The detectors were collocated with the TLDs at the site. The ATDs were collected semi annually. Radon concentrations were used to calculate an EDE to a hypothetically maximally exposed individual and added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 dose limit of 100 mrem/yr. Recorded radon concentrations were also evaluated based on the regulatory criterion listed in 10 CFR 20, Appendix B of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. Radon monitoring was performed at the SLAPS at four locations during CY1998 and at six locations during CY1999 through CY2002.

Monitoring Program Results

The radon data collected from each location during CY1998 to CY2002 were corrected for background and was normalized to exactly one year to calculate an annual dose. The calculated annual radon monitoring results are presented in Table VI-16.

Table VI-16. Radon Monitoring at the SLAPS

Monitoring Location	Monitoring Station	CY1998[a] Radon Data	CY1999[a] Radon Data	CY2000 Radon Data	CY2001 Radon Data	CY2002 Radon Data
		(pCi/L)				
SLAPS	PA-1	NA	0.6	0.1	0.2	0.1
	PA-2	0.2	0.0	0.0	0.1	0.1
	PA-3	0.2	0.1	0.0	0.0	0.0
	PA-4	0.4	1.5	0.3	0.1	0.1
	PA-5	0.2	0.0	0.2	0.0	0.0
	PA-6	NA	0.0	0.0	0.2	0.0

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored

Data Analysis

Radon data from the SLAPS were used to calculate an average annual concentration and an annual EDE to a hypothetically maximally exposed individual. The average concentration was compared to the 10 CFR 20, Appendix B value of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. The annual dose was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20.1301 limit. A summary of the radon concentrations above background and calculated dose rates is presented in Table VI-17.

Table VI-17. Radon Concentration and Dose Rates at the SLAPS

Calendar Year	Average Annual Concentration Above Background	10 CFR 20 App. B (0.3 pCi/L)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(pCi/L)		(mrem/yr)	
1998	<0.2	0.3	NA	100
1999	0.37	0.3	0.0	100
2000	0.1	0.3	0.0	100
2001	0.1	0.3	0.2	100
2002	<0.1	0.3	0.0	100

NA Not available

As shown in Table VI-17, the average annual concentrations above background during CY1999 and CY2002 were less than the 10 CFR 20 Appendix B value of 0.3 pCi/L with the exception of 1999. Although the average annual radon concentration exceeded the Appendix B value in 1999, compliance with the 10 CFR 20 limit of 100 mrem/yr was demonstrated through calculation of the TEDE to the individual likely to receive the highest dose.

Five-year Trend Analysis

The annual radon concentrations at the SLAPS were below the 10 CFR 20 limit with negligible variance from year to year (with the exception of 1999). There was no apparent trend for annual dose over the time period. The average annual concentrations of radon had a slight downward trend for the period.

Site Radiological Monitoring

Program Overview (HISS)

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, radon, and radon flux data. The data were used to assess the magnitude of radiological exposures to the general public.

Applicable Standards

10 CFR 20

The regulatory dose limit for members of the public is 100 mrem/yr from all pathways as stated in 10 CFR 20.1301. Compliance with the dose limit in 10 CFR 20.1301 can be demonstrated in one of the two following ways [§20.1302(b)(1) and (2)].

1. Demonstrating by measurement or calculation that the TEDE to the individual likely to receive the highest dose from the HISS operations does not exceed the annual dose limit (100 mrem/yr).

2. Demonstrating that (*i*) the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 and (*ii*) if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 2 mrem/hr.

Gamma radiation, airborne particulate radionuclide, and radon data from the site were used to evaluate the cumulative dose to a hypothetically impacted individual (member of the public) from exposure to radiological contaminants at the HISS in order to demonstrate compliance with 10 CFR 20.1301.

Radon was also compared to the regulatory criterion listed in 10 CFR 20, Appendix B, of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background.

40 CFR 61

Airborne particulate radionuclide data from the site were used to calculate the EDE to a critical receptor. The NESHAP standard of EDE to a critical receptor from radionuclide emissions is 10 mrem/yr, as stated in 40 CFR 61, Subpart I (*National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H).*

40 CFR 192

40 CFR 192 requires control of residual radioactive materials to provide reasonable assurance that releases of radon-222 (Rn-222) will not exceed an average release rate of 20 picocuries per square meter per second ($pCi/m^2/s$). Radon flux data from the piles on the HISS were used to calculate an average radon release rate to compare to the 40 CFR 192 limit and to verify the liner over the piles was effectively intact.

Gamma Radiation Monitoring

Monitoring Overview

Gamma radiation was measured using TLDs. TLDs at the HISS were located at the site perimeter. At each monitoring station, the TLDs were placed approximately 3 feet above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at the HISS at eight locations during CY1998, at six locations during CY1999 through CY2001, and at five locations during CY2002.

Monitoring Program Results

The gamma radiation data collected from each location during CY1998 to CY2002 were corrected for background, shelter absorption, and fade and was normalized to exactly one year to calculate an annual dose. The corrected annual gamma radiation results are presented in Table VI-18.

Table VI-18. External Gamma Radiation Monitoring at the HISS

Monitoring Location	Monitoring Station	CY1998[a] TLD Data	CY1999[a] TLD Data	CY2000 TLD Data	CY2001 TLD Data	CY2002 TLD Data
		(mrem/yr)				
HISS	HA-1	0	0	11	110	90
	HA-2	59	52	51	66	49
	HA-3	101	37	42	76	20
	HA-4	43	47	59	94	NA
	HA-5	NA	NA	32	9	4
	HA-6	0	0	0	2	1
	1	27	NA	NA	NA	NA
	5	24	35	NA	NA	NA
	8	0	NA	NA	NA	NA

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.
NA Not monitored or station eliminated

Data Analysis

Gamma radiation data from the HISS were used to calculate an average dose rate and an annual EDE to a hypothetically maximally exposed individual. The average dose rate was compared to the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr. A summary of the calculated gamma radiation dose rates is presented in Table VI-19.

Table VI-19. External Gamma Dose Rate at the HISS

Calendar Year	Maximum Average Dose Rate above Background[a]	10 CFR 20 Limit (2 mrem/yr)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(mrem/hr)		(mrem/yr)	
1998	<0.1	2	0.3	100
1999	<0.1	2	0.2	100
2000	<0.1	2	0.2	100
2001	<0.1	2	0.2	100
2002	<0.1	2	0.1	100

[a] Calculated by dividing the annual gamma radiation result by 8760 hours for each location.

The annual dose to a member of the public from gamma radiation was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 limit of 100 mrem/yr during CY1998 to CY2002. The average dose rate during CY1999 to CY2002 was less than the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr.

Five-year Trend Analysis

The annual dose to a member of the public from gamma radiation at the HISS was far below the 10 CFR 20 limit for all years with negligible variance from year to year. The annual dose had a slight downward trend over the period.

Airborne Particulate Monitoring

Monitoring Overview

Airborne radioactive particulates result from radioactive material in soil (or other sources) that become suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 feet above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in µCi/mL.

Site perimeter air sampling for radiological particulates was conducted at the HISS during CY1999 to CY2002. Air particulate samples were collected weekly at the HISS and analyzed at the SLS radioanalytical laboratory. Airborne particulate data were not available for CY1998.

Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. For CY1998, the annual dose was calculated by applying relevant modeling parameters given the size of known work areas, meteorological conditions, and potential exposure durations in lieu of available monitoring data. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table VI-20.

Table VI-20. Air Particulate Monitoring at the HISS

Calendar Year	Average Annual Gross Alpha Concentration (µCi/mL)	Average Annual Gross Beta Concentration (µCi/mL)	Annual Dose (mrem/yr)
1998	NA	NA	0.1
1999	2.1E-15	3.5E-14	0.8
2000	2.0E-15	3.1E-14	2.1
2001	2.0E-15	2.9E-14	7.8
2002	1.7E-15	2.5E-14	7.8

NA Not available

Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 CFR 61 standard of 10 mrem/yr. The estimated EDE was added to the radiological doses from other pathways to determine if the TEDE to a member of the public exceeded the 10 CFR 20 limit of 100 mrem/yr. A comparison of the EDE due to airborne particulate radionuclides at the HISS and the regulatory limits is presented in Table VI-21.

Table VI-21. Airborne Particulate Dose Rate at the HISS

Calendar Year	Annual Dose Rate	40 CFR 61 Standard (10 mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
	(mrem/yr)		
1998	0.1	10	100
1999	0.8	10	100
2000	2.1	10	100
2001	7.8	10	100
2002	7.8	10	100

As shown in Table VI-21, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 CFR 61 standard of 10 mrem/yr during CY1998 to CY2002.

Five-year Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at the HISS was below both the 40 CFR 61 standard for all years. There is an overall upward trend during the time period. This may be due to active remediation in CY2000 and CY2001. The average annual gross alpha and gross beta results had a slight downward trend over the period. CY2002 gross alpha and gross beta results were less than the respective CY2001 results indicating that there may be lower airborne particulate emissions after the HISS piles had been removed in CY2000 and CY2001.

Radon Monitoring

Monitoring Overview

Airborne radon monitoring was performed at the HISS using ATDs to measure radon emissions. The detectors were collocated with the TLDs at the site. The ATDs were collected semi-annually. Radon concentrations were used to calculate an EDE to a hypothetically maximally exposed individual and added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 dose limit of 100 mrem/yr. Recorded radon concentrations were also evaluated based on the regulatory criterion listed in 10 CFR 20, Appendix B of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. Radon monitoring was performed at the HISS at eight locations during CY1998, at six locations during CY1999 through CY2001, and at five locations during CY2002.

Radon flux sampling was used to measure emission rates of radon from the surface of the contaminated soil piles. Radon flux monitoring was performed using 10-inch diameter activated charcoal canisters placed on a pre-determined grid. The canisters were attached to the storage pile's cover surface for 24 hours, and then the canisters were retrieved and sent to an off-site laboratory for analysis in accordance with Appendix B of 40 CFR 61. Radon flux monitoring was performed at the HISS piles during CY1998 through CY2000. The piles were remediated during CY2000 and CY2001 and radon flux monitoring was no longer required.

Perimeter Radon ATDs

Monitoring Program Results

The radon data collected from each location during CY1998 to CY2002 were corrected for background and were normalized to exactly one year to calculate an annual dose. The calculated annual radon monitoring results are presented in Table VI-22.

Table VI-22. Radon Monitoring at the HISS

Monitoring Location	Monitoring[a] Station	CY1998 ATD Data	CY1999 ATD Data	CY2000 ATD Data	CY2001 ATD Data	CY2002 ATD Data
		(mrem/yr)				
HISS	HA-1	0.2	0.0	0.2	0.2	0.0
	HA-2	0.2	0.0	0.0	0.1	0.0
	HA-3	0.2	0.1	0.0	0.0	0.1
	HA-4	0.2	0.0	0.1	0.1	NA
	HA-5	NA	NA	0.0	0.1	0.0
	HA-6	0.2	0.0	0.0	0.0	0.0
	1	0.2	NA	NA	NA	NA
	5	0.2	0.0	NA	NA	NA
	8	0.2	NA	NA	NA	NA

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored

Data Analysis

Radon data from the HISS were used to calculate an average annual concentration and an annual EDE to a hypothetically maximally exposed individual. The average concentration was compared to the 10 CFR 20, Appendix B value of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. The annual dose was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20.1301 limit. A summary of the radon concentrations above background and calculated dose rates are presented in Table VI-23.

Table VI-23. Radon Concentration and Dose Rate at the HISS

Calendar Year	Average Annual Concentration Above Background	10 CFR 20 App. B (0.3 pCi/L)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(pCi/L)		(mrem/yr)	
1998	0.2	0.3	NA	100
1999	<0.1	0.3	0.2	100
2000	<0.1	0.3	0.4	100
2001	0.1	0.3	0.2	100
2002	<0.1	0.3	0.1	100

NA Not available

As shown in Table VI-23, the average annual concentrations above background during CY1999 to CY2002 were less than the 10 CFR 20 Appendix B value of 0.3 pCi/L.

Five-year Trend Analysis

The annual radon concentration at the HISS was below the 10 CFR 20 limit with negligible variance from year to year. There was a slight downward trend for annual dose over the time period. The average annual concentration of radon also had a slight downward trend for the period.

Radon Flux

Monitoring Program Results

The radon flux data collected from each location on the HISS piles during CY1998 to CY2000 were used to calculate an average radon release rate for the site. The calculated average radon release rates are presented in Table VI-24. Removal of the HISS stockpiles was conducted during 2001.

Data Analysis

Radon release rate data from the HISS were compared to the 40 CFR 192 limit of 20 pCi/m^2/s. A summary of the radon flux monitoring is presented in Table VI-24.

Table VI-24. Radon Release Rate at the HISS

Calendar Year	Average Radon Release Rate	10 CFR 20 App. B (20 pCi/m^2/s)
	(pCi/m^2/s)	
1998	0.4	20
1999	1.3	20
2000	0.9	20

As shown in Table VI-24, the average radon release rate from the site did not exceed the 40 CFR 192 limit of 20 pCi/m^2/s during CY1998 to CY2000.

Five-year Trend Analysis

The average radon release rate at the HISS was far below the 40 CFR 192 limit with negligible variance from year to year. There was no apparent trend for the average radon release rate over the time period. These data indicate that the liner was effective at controlling the potential release of radon.

Confirmatory Soil Sampling Program

Final status survey confirmatory sampling has been conducted at properties where removal or remedial actions have taken place. The purpose of this confirmatory sampling is to demonstrate that the removal or remedial action has been completed and the residual contamination is below the removal or remedial goal. The USACE evaluates the results to ensure the residual concentrations in the excavation meet the SLDS ROD remediation criteria for the SLDS properties, and the removal action criteria in the applicable EE/CA for the North St. Louis County sites properties. The following table summarizes SLS completed actions:

Table VI-25. SLS Confirmatory Soil Sampling Program Completed Actions

Site	Location	Document	Completed Action
North St. Louis County	SLAPS-VP St. Denis St. Bridge	Post-Remedial Action Report for the St. Denis Bridge Area, July 1999 (USACE 1999c).	The USACE informed the City of Florissant that the soil with residual radioactive contamination above criteria in the areas impacted by the new bridge installation had been removed.
SLDS	DT-1 Archer Daniels Midland (ADM) VP	Final Status Survey Evaluation Report for the St. Louis Downtown Site Archer Daniels Midland Vicinity Property (DT-1)(USACE 2002b)	No removal action required; the property was released without radiological restrictions.
SLDS	DT-15 City Owned Metropolitan Sewer District (MSD) Salisbury Lift Station VP	Final Status Survey Evaluation Report for the St. Louis Downtown Site City- Owned Property North (MSD) Salisbury Lift Station Vicinity Property (USACE 2001f).	No removal action required; the property was released without radiological restrictions.
SLDS	Mallinckrodt Plant 2	Post-Remedial Action Report for the Accessible Soils Within the St. Louis Downtown Site Plant 2 Property (USACE 2002a).	Residual radioactivity in the accessible areas in Plant 2 met the requirements of the remedial design and was below the 15/15/50 SLDS ROD remediation criteria. In addition, analytical results for arsenic and cadmium were below the SLDS remediation criteria.
North St. Louis County	SLAPS-VP IA-9	St. Louis Airport Site Investigation Area 9 Final Status Survey Evaluation, Berkeley Salt Storage Area (IA-9 Survey Unit 1), (USACE 2000c).	

A complete discussion of confirmatory sampling conducted at the following locations will be included in the next five-year report. This will inlcude:

<u>SLDS</u>
Mallinckrodt Plant 1
Mallinckrodt Plant 6E and 6EH
Mallinckrodt Plant 7E
Midwest Waste Vicinity Property (DT-7)
Heintz Steel and Manufacturing Vicinity Property (DT-6)

<u>North St. Louis County Sites</u>
SLAPS Radium Pits, East End, East End Extension / ROW and Phase 1 work areas
SLAPS sedimentation basin
SLAPS North Ditch
HISS, including stockpiles
SLAPS VP-38

Surface-water and Sediment Monitoring Program

Monitoring Overview

The environmental monitoring plan of Coldwater Creek evaluates the physical, radiological, and chemical parameters present in Coldwater Creek's surface water and sediment. The radiological and chemical parameters to be monitored were based on the Environmental Monitoring Plan for the SLS and are not necessarily FUSRAP COCs. The monitoring programs are conducted at Coldwater Creek as a part of the SLS to meet several objectives. These objectives are:

- To assess the quality of surface water and sediment at Coldwater Creek
- To compare the sampling results with regulatory standards or background values
- To evaluate/determine whether run-off from the SLAPS, the HISS, and their vicinity properties contribute to the quality of surface water and sediment in the creek.

Sampling of Coldwater Creek's surface water and sediment is conducted semi-annually at six monitoring stations (C002 through C007).

Monitoring Program Results

The evaluation results for the surface water and sediment sampling data for Coldwater Creek from CY1998 to CY2002 are presented in the following section. The sampling locations along Coldwater Creek are shown on maps included in the Annual Environmental Data Analysis Reports.

CY1998 Coldwater Creek Sampling Event

One sampling event was conducted for both surface water and sediment at all six monitoring stations during CY1998. For surface water, the maximum concentrations of Ra-226 and Th-230 occurred at monitoring station C004 and C005, respectively. However, the results were below the corresponding background values. The maximum concentrations for uranium isotopes were detected at C004 (16.03 pCi/L).

For sediment, the concentrations of Ra-226, Th-230, and U-238 ranged from 0.96 pCi/g to 5.14 pCi/g, 1.61 pCi/g to 201.2 pCi/g, and 1.92 pCi/g to 7.16 pCi/g, respectively. The maximum concentrations for these radionuclides occurred at C005.

Ra-226 concentration exceeded its background criteria of 4.73 pCi/g at station C005. For Th-230, the background criteria (2.2 pCi/g) was exceeded at stations C003, C004, C005, and C007. However, U-238 concentrations did not exceed its background criteria of 4.3 pCi/g at any monitoring station.

CY1999 Coldwater Creek Sampling Event

One sampling event for surface water was conducted as part of the Ecological Risk Assessment for North St. Louis County sites during CY1999. Only two sampling stations (C002 and C003) were sampled. The maximum concentrations of Th-230 and uranium isotopes were detected at

C003. Among chemicals, the concentrations of iron and zinc were higher than respective background values at station C003.

One sediment sampling event was conducted at six monitoring stations during CY1999. Among radionuclides, Ra-226 was detected and exceeded its background criteria at station C007. The concentrations of Th-230 were above background at stations C003, C004, and C007, and the maximum concentration was detected at C007. However, the concentrations of uranium isotopes were less than their corresponding background levels. Among chemicals, background criteria for eight inorganic analytes (beryllium, boron, calcium, chromium, copper, lead, sodium, and thallium), and thirteen semi-volatile organic analytes were exceeded.

CY2000 Coldwater Creek Sampling Event

Two surface water and sediment sampling events were conducted in CY2000. Ra-226 was not detected during either surface water sampling event in CY2000. The maximum concentration of Th-230 was detected at C007 during the first sampling event, whereas the maximum concentrations of uranium isotopes were detected at C002, during the second sampling event. However, the maximum concentrations were below corresponding background values. No chemical exceeded its corresponding AWQC during the first surface water sampling event. During the second sampling event, aluminum and iron exceeded their corresponding AWQCs.

The maximum concentrations of Ra-226 and Th-230 were detected at C005 during the first CY2000 sediment sampling event. The results exceeded their corresponding background values. The maximum concentrations of uranium isotopes were below their corresponding background values.

CY2001 Coldwater Creek Sampling Event

Two surface water and sediment sampling events were conducted in CY2001. Ra-226 was not detected during either surface water sampling event of CY2001. Th-230 was detected only at C004 (1.39 pCi/L). The maximum concentrations for uranium isotopes occurred at sampling station C003 during the first sampling event. However, the maximum concentration was less than the background concentration. Zinc was the only chemical that exceeded the corresponding surface water background values during both sampling events. The concentration of zinc was below its AWQC.

The maximum concentrations of Ra-226, Th-230, and U-238 were detected at C005 during the CY2001 sediment sampling event. Except for Th-230, maximum concentrations did not exceed background values. Four inorganics, sixteen semi-volatile organics, and one volatile organic analyte (methylene chloride, a common laboratory contaminant) were detected during CY2001 sediment sampling events.

CY2002 Coldwater Creek Sampling Event

Two surface water sampling events were conducted in CY2002. Ra-226 was not detected during the CY2002 surface water sampling events. The maximum concentrations of Th-230 and uranium isotopes were detected at C007; however, their results are below their corresponding background levels. Manganese, nickel, and selenium exceeded their corresponding background values during the first sampling event. The concentrations of aluminum, arsenic, selenium, and zinc exceeded background values during the second sampling event.

Ra-226 only exceeded its background values at C007 during the first sediment sampling event. However, during the second sampling event, Ra-226 concentrations exceeded its background values at all downstream stations. Th-230 concentrations exceeded background values at four downgradient stations (C004, C005, C006, and C007) and three downstream stations (C003, C005, and C007) during the second sampling event. U-238 concentrations exceeded background values for all downstream stations and the maximum concentration was detected at C007 (1.19 pCi/g). Arsenic, manganese, and magnesium exceeded background values during both sampling events, whereas concentrations of thallium and cadmium exceeded background values during the first and second sampling event, respectively.

Five-Year Trend Analysis

Figure VI-11 represents the five-year concentration trend analysis for different radionuclides in surface water. Among different radionuclides, concentrations of Ra-226, Th-230, and total uranium at all monitoring stations were analyzed for the last five years. Figure VI-11 (Trend Analysis for Ra-226) showed that the concentrations of Ra-226 did not exceed its AWQC (5 pCi/L) during the last five years at any of the stations; however, the concentrations at each station were above its background criteria during different times within this five-year period. The maximum concentration of Ra-226 was detected at monitoring station C003 during the first sampling event of CY2000. The trend showed that Ra-226 concentrations have been decreasing at each of the monitoring stations during the last three years. Figure VI-11 (Trend Analysis for Th-230) presents the trend of Th-230 concentrations at each monitoring station during the last five years. Except for the CY1999 sampling event, the concentrations of Th-230 have not exceeded its background value during the last five years. The total uranium concentrations during the last three years has not exceeded its background value, as shown in Figure VI-11 (Trend Analysis Per Total Uranium). Negative bar graphs indicate that the concentrations were below background levels. Monitoring station bars are not shown in the graphs where data was not available for that station and sampling event.

Figure VI-12 represents the five-year concentration trend analysis for different radionuclides in sediment. Figure VI-12 (Trend Analysis for Ra-226) shows the trend of Ra-226 concentrations at each monitoring station during the last five years. However, the chart did not include the results of detected maximum concentrations of Ra-226 (March 2000 sampling event) in order to better present the trend of Ra-226 concentrations at other stations. The chart showed that the concentrations of Ra-226 are less than their background level at all stations except for C005. In addition, the recent concentrations of Ra-226 showed that the concentrations are around its background level at all monitoring stations. As in the first chart, the second chart of Figure VI-12 (Trend Analysis for Th-230) did not include the result of the detected maximum concentration of Th-230 at C005 (CY1998 sampling event) in order to better present the trend of Th-230 concentrations at other monitoring stations. The chart showed that Th-230 concentrations are consistently higher at station C007, with respect to other stations. An elevated concentration of Th-230 was detected at C005 during the CY2002 sampling event. Figure VI-12 (Trend Analysis of Total U) showed that the total uranium concentrations in the sediment at all monitoring stations have decreased during the last three years. Monitoring station bars are not shown in the graphs where data was not available for that station and sampling event.

In addition to the trend analysis, an analysis was performed to correlate the concentrations of the radionuclide COCs (Ra-226, Th-230, and Total U) in the surface water with the concentrations of the same in the sediments at the same location by using historic results. The non-parametric Mann-Whitney method was used to determine the correlation. Based on 95% confidence interval, a null hypothesis was assumed. According to the hypothesis,

$H_0 : \lambda 1 = \lambda 2$, versus $H1 : \lambda 1 \neq \lambda 2$, where λ is the population medium.

The results of the analysis showed that for Ra-226 and Th-230, a correlation exists between surface water and sediment concentrations at all monitoring stations. For total uranium, there is a correlation between surface water and sediment concentrations at monitoring stations C004, C005, and C007. This correlation indicates that concentrations of COCs in the sediment are impacting the surface water quality.

SITE INSPECTIONS

The purpose of the site inspections was to gather information about the SLS status and visually confirm and document the impact of the response actions on the site and the surrounding areas. Because of the size of the SLS and the distance between them, separate inspections were conducted for the North St. Louis County sites (the SLAPS, HISS, and SLAPS VPs) and the SLDS. The completed checklists are provided in Appendix C.

Hazelwood Interim Storage Site

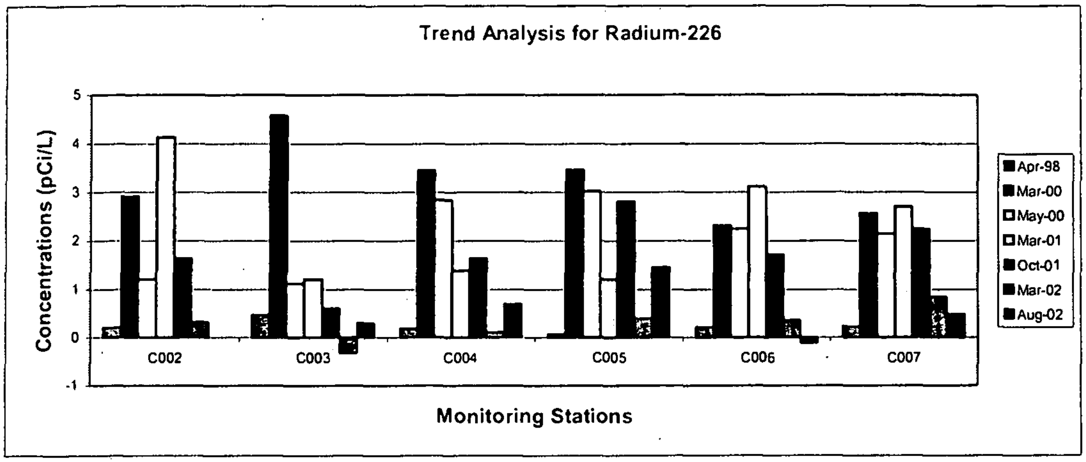
The HISS was inspected on April 8 - 10, 2003 by J. Mattingly (USACE), D. Wall (USEPA) and J. Groboski (MDNR). The team was met by Dave Mueller, the USACE-Area Engineer

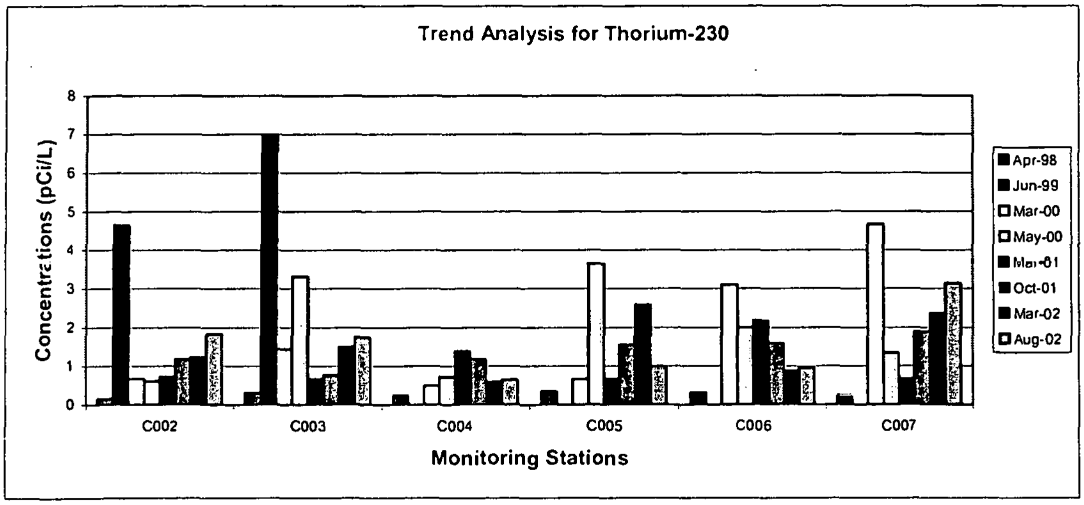
The inspection began with a discussion with Mr. Mueller about site activities and verification that key documents (Health and Safety Plan, training records, permits, as-built drawing, environmental reports) were on-site as required. Since the removal of the piles was completed in CY2002, maintenance and environmental monitoring were the only remedial activities taking place on the site.

During the physical inspection the team was escorted by Bob Wasitis (USACE), the site representative, chosen for safety and his knowledge of the HISS. The team inspected the perimeter of the site and the adjacent railroad spur. This inspection focused on general site conditions, access control facilities, and environmental monitoring equipment related to removal actions.

Although there were no significant issues identified by the team, the access control and monitoring stations for air and storm-water run-off were in place and appeared to be functioning properly. Most of the site was well covered with vegetative growth and geofabric covered by rock; however, the team noted a minor (potential) issue in that the vegetation in the northern area of the property was sparse and rock had been displaced, exposing the geofabric in some areas. The team also noted that the site drainage pattern impeded the growth of vegetation despite regular attempts at seeding the area; this could cause dust to become airborne and should be addressed to avoid potential fugitive dust emissions. It should be noted that there have been no emissions of fugitive dust to date, and ongoing air monitoring has not indicated fugitive dust to be an issue.

Figure VI-11. Trend Analysis for Radionuclides in Coldwater Creek Surface Water





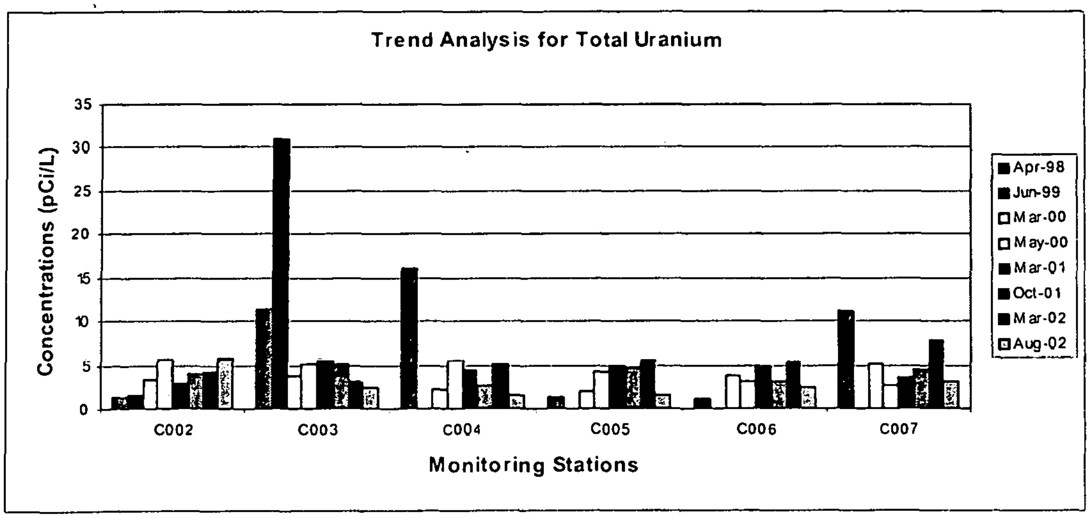
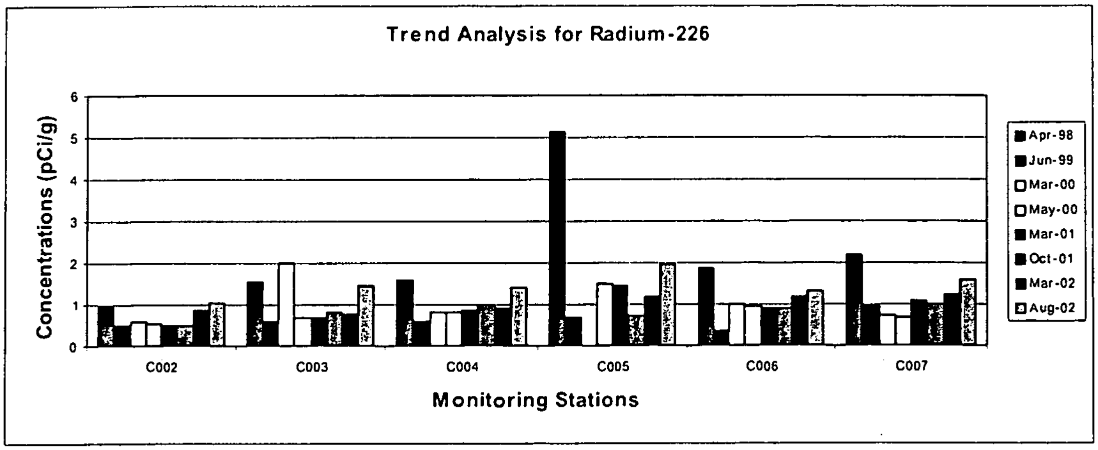
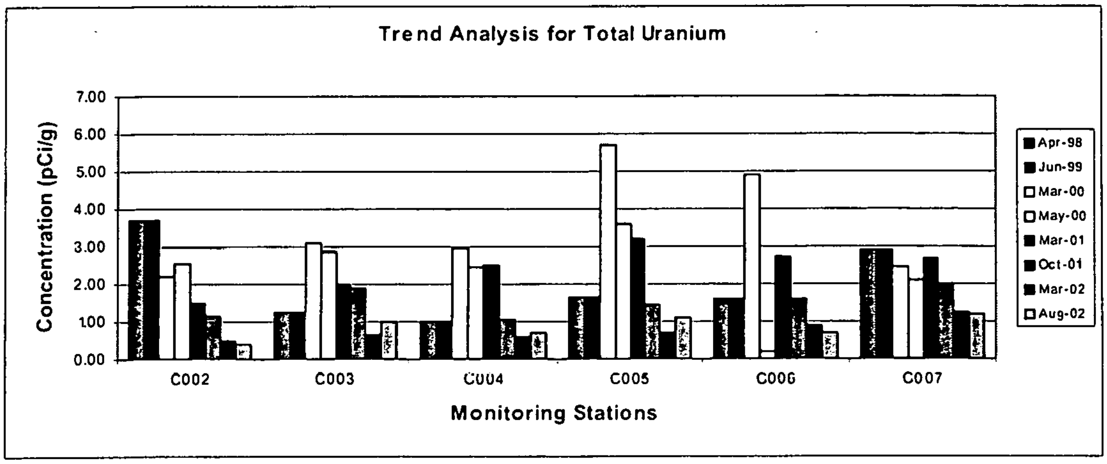
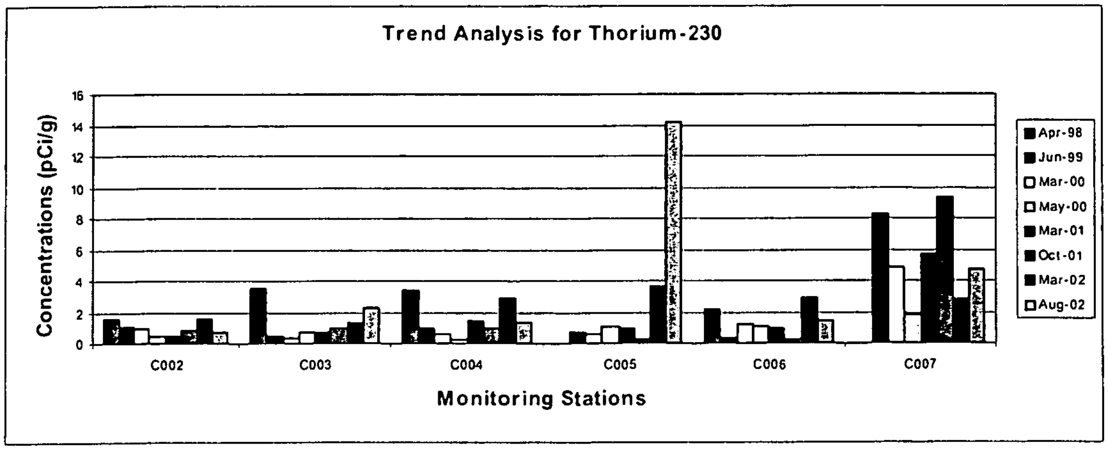


Figure VI-12. Trend Analysis for Radionuclides in Coldwater Creek Sediment







St. Louis Airport Site

The SLAPS was inspected on April 8 - 10, 2003 by J. Mattingly (USACE), D. McKinley, (USACE), D. Wall (USEPA) and J. Groboski (MDNR). The team was met by Sonny Roberts, the USACE-SLAPS Construction Manager.

The inspection began with a discussion with Mr. Roberts about site activities and verification that key documents (Health and Safety Plan, training records, permits, as-built drawing, environmental reports) were on-site as required. The following activities were underway on the days of the inspection:

- Excavation in the McDonnell Boulevard ROW
- Excavation in the Phase 1 area of the SLAPS
- Excavation in the Phase 2 area of the SLAPS
- Pumping of ponded water to holding basins for treatment
- Loading railroad cars with contaminated materials for shipment

During the physical inspection, the team was escorted by Corey Harris (SHAW) chosen for safety and his knowledge of the SLAPS. The site is an open area north of Lambert-St. Louis International Airport; the eastern portion is covered by facilities and parking areas for the remediation. The team inspected the perimeter of the site and the adjacent railroad spur. This inspection focused on access control facilities in areas impacted by remediation, environmental monitoring equipment related to the removal actions, and on-going removal work.

No significant issues were identified regarding the removal action being implemented at the SLAPS. Access control and environmental monitoring equipment were in place around the perimeter of the site and of the excavations, and the workers were observing appropriate health and safety measures. Dust-suppression procedures were being implemented to prevent the spread of airborne contamination, and water was being managed so run-off did not migrate to uncontaminated areas. Vegetative cover had been properly established as part of the final restoration for previously addressed areas and for areas not yet remediated.

North St. Louis County sites VPs

The SLAPS VPs were inspected on April 8 - 10, 2003 by J. Mattingly (USACE), D. Wall (USEPA) and J. Groboski (MDNR). The team was met by Dave Mueller, the USACE-Area Engineer, and the inspection began with a discussion with Mr. Mueller about site activities. The VPs are in a maintenance mode pending selection of the final remediation goals, so, aside from support to utilities and/or property development, no activities were taking place.

Because the VPs are privately owned and largely observable from public roads, the team performed its physical inspection of the properties unescorted. Affected properties were observed during a driving tour of the original haul routes, and the inspection was limited to general site conditions such as the presence of vegetative cover.

No significant issues were identified by the team regarding the response actions being implemented for the VPs. The primary activity for these properties is the communication regarding contaminant location and requests by the property owners for support during property improvements. Regular site inspections by USACE-CEMVS personnel and self-reporting by utility and property owners has helped assure that the properties are being properly addressed.

Building expansions were evident on properties VP-24 and VP-36; these construction activities had been supported by USACE-CEMVS. The inspection team also noted traffic ruts in shoulders of roadways and recommended continued monitoring and support as appropriate, since repairs could pose a health risk or move contamination to previously uncontaminated areas. The team also recommended updating VP contamination status maps so that cleared areas, contaminated areas, and questionable areas are clearly identified and land-use changes are recorded.

St. Louis Downtown Site

The SLDS was inspected on May 8 and 9, 2003 by J. Mattingly (USACE), D. Wall (USEPA) and J. Wade (MDNR). The team was met by Gerald Allen, the USACE-SLDS Construction Manager, who escorted them throughout the investigation for safety and knowledge of the SLDS.

The inspection began with a discussion with Mr. Allen about site activities and verification that key documents (Health and Safety Plan, training records, permits, as-built drawing, environmental reports) were on-site as required. The following activities were underway on the days of the inspection:

- Remedial excavation at Mallinckrodt Plant 6 East Half;
- Remedial excavation at Heintz Steel and Manufacturing VP (DT-6); and
- Construction activities underway on that portion of the property leased from PSC Metals. Construction activities were limited to the north side of the loadout facility to construct additional loadout capacity at the SLDS.

The physical inspection consisted of a tour of the site. Most of the VPs were visited. As would be expected in an area of mature industrialization, the SLDS is dominated by active manufacturing plants, warehouses, outdoor storage areas, roadways, and railways in various states of repair. This inspection focused on access control facilities in areas impacted by remediation, environmental monitoring equipment related to remediation, and on-going remedial work.

No significant issues were identified regarding the remedial action being implemented at the SLDS. Access control measures appeared to be appropriate for the excavations at Plant 6 and Heintz Steel. Monitoring devices were in place around the perimeter of the site, and the workers were observing appropriate health and safety measures. Dust-suppression procedures were being implemented to prevent the spread of airborne contamination, and water was being managed so run-off did not migrate to uncontaminated areas.

Interviews

In April and May 2003, the USACE conducted 30 St. Louis Sites community interviews. These interviews were conducted as a part of the FUSRAP five-year review. Respondents included property owners; business owners; city, county, state and federal elected officials; utility company representatives; citizen interest groups (e.g. St. Louis Oversight Committee, Gracehill); residents not otherwise affiliated with interest groups; local school officials; state and local government agency representatives; and community religious leaders.

Respondents generally reported feeling well informed of the site activities and progress. They reported they were satisfied with the current communication plan (means and frequency of information distribution through various meetings, newsletters, and news releases) and the USACE's responsiveness to community concerns. Currently, community concern about contamination from the St. Louis Sites is moderate, which does not mean that citizens are indifferent to the environmental problem posed by the sites. On the contrary, conversations with community members have revealed that many stakeholders are keenly interested in site response actions and regularly check the continued progress of cleanup activities.

Many of the people interviewed also expressed satisfaction with the progress of cleanup activities at the FUSRAP sites as well as USACE's openness in sharing information regarding site activities and efforts to build relationships with the various entities impacted the project. A summary of concerns and other related issues raised during the interviews follows.

Primary Concerns Raised During the Interviews

Contaminant Migration Issues: The public expressed concerns regarding the migration of contamination during cleanup activities. USACE should continue to take appropriate steps to minimize the potential for contaminant migration.

Inaccessible Soil and LTS Issues: Utility companies expressed concerns about whether the existing utility support agreements will be honored in the future after active remediation is complete. The current agreement provides utilities with a sense of security and reassurance that their people will be supported during work in impacted areas. State and local representatives wanted broader community involvement in the development of the final LTS plan for the various sites to ensure stewardship requirements fit the current and planned future land use.

Other Important Issues Raised by the Community

The CERCLA Cleanup Process: The community relations program at the St. Louis Sites should continue to educate area residents and local officials about the procedures, policies, and requirements of the Superfund program. The community expressed great satisfaction with past education efforts and encouraged continuation of this effort.

The Pace of the Community Relations Program: The pace of the community relations program will be set by the needs of the local stakeholders. Community relations activities will be set up to encourage community participation. Stakeholders have requested continuation of the following communication methods to relate information about progress and problems encountered during cleanup efforts: telephone contacts, letters, reports, newsletters, Internet resources, and regularly scheduled meetings with citizen groups.

VII. TECHNICAL ASSESSMENT

SLDS

Question A: Is the response action functioning as intended by the decision documents?

Answer A: Yes, the response action is functioning as intended by the decision documents.

The SLDS ROD (USACE 1998c) states:

"The main components of the selected remedial action include:

- Excavation and off-site disposal of approximately 65,000 cubic meters (85,000 cubic yards) (in-situ) contaminated soil; and
- No remedial action is required for ground water beneath the site. Perimeter monitoring of the ground water in the Mississippi River alluvial aquifer, designated as the HU-B, will be performed and the need for ground-water remediation will be evaluated as part of the periodic reviews performed for the site."

Response Action Performance

Response actions were completed at some properties of the SLDS (such as Plant 2, Archer Daniels Midland (DT-1), City Property (DT-2), and the MSD Lift Station (DT-15). Response actions are being conducted in some properties, such as Plant 1, Midwest Waste (DT-7), Plant 7E, Plant 6E, and Heintz Steel (DT-6). Response actions will be performed for Mallinckrodt and the remaining VPs. The past and present excavation and off-site disposal of accessible soil above the Remediation Goal (RG) at the SLDS are being performed as prescribed in the SLDS ROD. Completed activities have met the remediation goals [*Final Post-Remedial Action Report for the St. Louis Downtown Site City-Owned Vicinity Property, St. Louis, Missouri*, September 1999 (USACE1999b); *Post-Remedial Action Report for the Accessible Soils Within the Downtown Site Plant 2 Property*, January 2002 (USACE 2002a)]. However, in order to achieve the RGs, the volume of material excavated was greater than the volumes estimated in the ROD for the following reasons: indiscriminate dumping, air dispersion, unknown and abandoned utilities acting as preferred pathways, and surface and subsurface waterborne transport of particles all may have played a greater role in contaminant distribution than originally thought. The change in volumes did not affect the protectiveness of the response action.

The goal of the ground-water portion of the remedy was to monitor the usable aquifer (HU-B) to assure it was protected through the source removal; however, arsenic and uranium were detected in HU-B wells at levels exceeding MCLs or the ILs established in the SLDS ROD. A GRAAA was initiated as required by the ROD and is now in the second phase. The results of this assessment will be presented in the next five-year review.

Systems Operations/O&M

The past and current operating procedures maintain the effectiveness of the response actions. The only significant variance to costs is due to increased volumes of soil to be excavated and sent to off-site disposal.

Opportunities for Optimization

Optimization has occurred in three primary areas: pre-design investigations, system operations, and the environmental monitoring program. Rather than limiting investigations to a specific plant or VP, a study area approach using historical, geological, and gamma walkover survey data, and other existing information, has been implemented. The previous approach of limiting pre-design investigations to particular plants or VPs created difficulties when contamination extended beyond the study boundaries. The new approach results in a more efficient and effective investigation, design, and remedial action.

Systems operations have been optimized through construction of a second soil load out facility. This construction has facilitated efficient transport of contaminated soil and has resulted in a cost savings of approximately $1,000 per railcar.

The environmental monitoring system is optimized through an annual evaluation. Sampling locations, frequencies, and target constituents are modified on the basis of historical data, trends, and the evolving nature of the remedial action. Some monitoring locations have been deleted and sampling frequencies reduced as a result of these evaluations.

Early Indicators of Potential Issues

As discussed above, the only early indicators of potential issues were the larger volume of soil containing contaminants and the exceedance of ILs in the HU-B aquifer.

Implementation of Institutional Controls and Other Measures

To date, no institutional controls have been implemented at the SLDS. For accessible soil, areas remaining after remediation have been released without radiological restrictions. For inaccessible soil, access control and an excavation permit process are sufficient to prevent or minimize exposure.

Mallinckrodt provides the primary access controls on its property through badging and perimeter fencing. Prior to remedial activities at any property, temporary fences, gates, and/or barriers are installed around the work zone, warning signs are posted at designated intervals, and specific points are established for ingress and egress. Anyone not involved in the remediation is restricted from entry into the construction zone. As conditions change, controls are modified to restrict access. When it is necessary to close a road or sidewalk due to construction, alternate routes are provided. In addition, USACE is currently in the process of developing the CERCLA documentation necessary to address inaccessible soil at the SLDS. A long-term stewardship plan will be prepared to document processes and procedures with respect to requirements under CERCLA.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of response selection still valid?

Answer B: Yes, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of response selection are still valid and any changes in these values have no impact on the protectiveness of the remedy.

40 CFR 141

The change in this proposed standard (shown on Table VII-1) has had no impact on the protectiveness of the remedy. A GRAAA was initiated for the HU-B aquifer because the ROD standard was exceeded as it would have been for the new limits. The revised MCLs will be considered as part of the GRAAA evaluation. If a determination is made that further action is required, the revised MCLs will be considered during the ARARs evaluation.

Table VII-1. Changes in Standards and Investigative Limits

Citation	Contaminant	Medium	ROD IL	New Standard (MCL)
40 CFR 141	Arsenic	Ground water	50 µg/L	10 µg/L
	Uranium	Ground water	20 µg/L	30 µg/L
10 CFR 40; Appendix A, Criterion 6(6)	Non-Ra radionuclides	Soil	None	5/15 pCi/g, Ra-226 Benchmark dose

10 CFR 40 Appendix A: Criterion 6(6)

Title 10, Code of Federal Regulations, Part 40 (10 CFR 40), implements relevant standards for mill tailings. In April 1999, 10 CFR 40 was amended to include an approach for developing cleanup goals for tailings constituents other than radium in soil and for radiological contamination on building surfaces. Such constituents were previously addressed at CERCLA sites on a case-by-case basis by development of appropriate preliminary remediation goals (PRGs) and subsequent movement off the point of departure when appropriate rather than using a single, consistent, dose and risk-based approach. The amendment of 10 CFR 40 does not result in more restrictive remediation goals (RGs). Current RGs result in residual site risks within the CERCLA risk range and thus continue to be fully protective of human health and the environment. The 1998 SLDS ROD addressing accessible soil and ground water will not be revised as a result of the publication of Criterion 6(6). Changes in this standard are shown on Table VII-1.

Changes in Risk Assessment Methods

Standardized risk assessment methods have evolved into a more probabilistic approach since the ROD was signed. There have also been changes in determining risk-based PRGs for radionuclides. The changes include exposure parameters, chemical-specific parameters, and equations, and newer toxicity values. Adult-only ingestion slope factors for workers have been updated for Ra-226+D, U-235+D, and U-238+D. The soil-to-air volatilization factor replaces the particulate emission factor. The worker soil exposure PRGs have been separated into indoor and outdoor scenarios. The newer PRG equations include radionuclide decay correction. In January 2001, toxicity values for radionuclides in the *Health Effects Assessment Summary Table* were changed and USEPA revised its standard PRG calculation template. In addition, a newer version of the radiological assessment model has incorporated the new changes. These changes have had no impact on the remedy since post-remedial action risk assessments for the SLDS use the most recent risk assessment guidance and latest version of the model.

Expected Progress Towards Meeting RAOs

As stated above, excavation and off-site disposal of contaminated soil is being performed as prescribed in the ROD. Completed activities have met the RGs. A GRAAA has been initiated for the HU-B aquifer to address exceedance of the ILs as cited in the ROD.

Question C: Has any other information come to light that could call into question the protectiveness of the response action?

Answer C: No, there have been no newly identified ecological risks, impacts from natural disasters, or other information that has come to light that could affect the protectiveness of the remedy.

HISS / Latty Avenue VPs

Question A: Is the response action functioning as intended by the decision documents?

Answer A: Yes, the response action is functioning as intended by the decision documents.

"Soils from the four interim storage piles, and accessible subsurface soil from the two Latty Avenue VPs, and the contiguous property that exceed the selected criteria of 5/15/50 pCi/g for Ra-226, Th-230, and U-238 respectively would be excavated and disposed at a licensed or permitted disposal facility. As used herein the 5/15/50 criteria define contamination such that Ra-226 and Th-230 are each limited to 5 pCi/g in the top 6 inches of soil and 15 pCi/g below the top 6 inches of soil. U-238 is limited to 50 pCi/g at all depths."

Engineering Evaluation/Cost Analysis (EE/CA) for the Hazelwood Interim Storage Site (HISS), (USACE 1998a).

Action Memorandum for the Removal of Radioactively Contaminated Material at the Hazelwood Interim Storage Site and Latty Avenue Vicinity Properties, June 1998 (USACE 1998b).

Removal Action Performance

The excavation and off-site disposal of contaminated material from the interim storage piles at the HISS was performed as prescribed in the EE/CA. Additionally, removal actions performed on a portion of VP-2(L) and Futura property have met the EE/CA criteria.

Systems Operations

The current operating procedures, which include the environmental monitoring program, maintain the effectiveness of the response actions.

Opportunities for Optimization

Optimization has occurred in two primary areas: system operations and the environmental monitoring program. General process improvements, including equipment changes and efficiencies implemented through experience have, over time, optimized operations and reduced the cost per cubic yard of contaminated soil excavated. One specific operations improvement consisted of the construction of a new loadout facility at the HISS to replace the original facility on Eva Avenue.

The environmental monitoring system is optimized through an annual evaluation. Sampling locations, frequencies, and target constituents are modified on the basis of historical data, trends, and the evolving nature of the response action. Some monitoring locations have been deleted and sampling frequencies reduced as a result of these evaluations.

Early Indicators of Potential Issues

Thin vegetative cover was noted during the site inspection.

Implementation of Institutional Controls

At the HISS, the storage piles were removed and limited excavation on VPs was performed. The remaining contaminated soil will be addressed subsequent to signature of the North St. Louis County sites ROD. No institutional controls are required at this stage of the CERCLA process to prevent exposure. COCs remaining at the site will be addressed under the selected remedy identified in the North St. Louis County sites ROD. Until then, a fence and appropriate signage is maintained around the HISS proper.

Prior to response activities at any property, temporary fences, gates, and/or barriers are installed around the work zone, warning signs are posted at designated intervals, and specific points are established for ingress and egress. Anyone not involved in the remediation is restricted from entry into the construction zone. As conditions change, controls are modified to restrict access.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of response selection still valid?

Answer B: Yes, the exposure assumptions, toxicity data, cleanup levels, and response action objectives used at the time of response selection are still valid and any changes in these values have no impact on protectiveness.

Changes in Exposure Pathways

There have been no changes in land use, no change in the understanding of the physical site conditions, and no new contaminants of concern. There are no unanticipated toxic by-products from the remedy.

Changes in Toxicity or Contaminant Characteristics

There have been some changes in the toxicity factors in a way that affects the protectiveness of the remedy. RESRAD version 6.0 (2001) incorporates the factors from Federal Guidance Report (FGR)-11 and -12 and allows for the use of FGR-13 whereas the previous versions of RESRAD used data from older models.

In FGR-13, EPA includes newer toxicity values for each radionuclide based on age- and gender-dependence of radionuclide intake, metabolism, vital statistics and baseline cancer mortality data, and a revised dosimetric model.

Changes in Risk Assessment Methods

Standardized risk assessment methods have evolved into a more probabilistic approach since the EE/CA was finalized. There have also been changes in determining risk-based preliminary remediation goals for radionuclides. In January 2001, toxicity values for radionuclides in the

Health Effects Assessment Summary Table were changed and USEPA revised its standard preliminary remediation goal (PRG) calculation template. In addition, a newer version of the radiological assessment model has incorporated the new changes. These changes will have no impact on the remedy since post-remedial action risk assessments for the HISS will use the most recent risk assessment guidance documents and latest version of both chemical and radiological risk assessment models.

Expected Progress Towards Meeting RAOs

As stated above, excavation and off-site disposal of contaminated soil was performed as prescribed in the EE/CA. Completed activities have met the response action criteria.

Question C: Has any other information come to light that could call into question the protectiveness of the response?

Answer C: No, there have been no newly identified ecological risks, impacts from natural disasters, or other information that has come to light that could affect the protectiveness of the response action.

SLAPS (Including Associated VPs)

Question A: Is the response action functioning as intended by the decision documents?

Answer A: Yes, the response action is functioning as intended by the decision documents.

"Soils from the SLAPS and the Ballfields (cxcluding the north ditch) that exceed the selected criteria of 15/15/50 pCi/g (respectively for Ra-226/Th-230/U-238) above background (by SOR) would be excavated and disposed of at a licensed or permitted disposal facility. Soils within the top 6-inch layer that exceed the 5/5/50 pCi/g above background (by SOR) will be excavated."

St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA), (USACE 1997a).

SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material, September 1997 (DOE 1997b).

Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum, St. Louis, Missouri, March 1999 (USACE 1999a).

Response Action Performance

The excavation and off-site disposal of contaminated soil at the SLAPS is being performed as prescribed in the EE/CA. Complete activities have met the cleanup criteria as documented in (*Vicinity Property 38 Removal Action Summary, Berkeley, Missouri* (USACE 2001d); *Radium Pits Removal Action Summary Report FUSRAP St. Louis Airport Site* (USACE 2001e); *Post-Remedial Action Report for the St. Denis Bridge Area* (USACE 1999c); *St. Louis Airport Site Investigation Area 9; Final Status Survey Evaluation Berkeley Salt Storage Area (IA-9 Survey Unit 1)* (USACE 2000c).

The ground-water monitoring program at the SLAPS discovered levels of selenium in the shallow aquifer (HZ-A) above Clean Water Act default limits for Coldwater Creek and the MSD discharge limit of 200 μg/L for the Coldwater Creek treatment plant. The following treatment options were evaluated for the reduction of the selenium to acceptable levels: ion exchange, electro coagulation, reverse osmosis, iron-copper cementation, phytoremediation, chemical precipitation/ reduction, off-site disposal, and denitrification. Following bench- and full-scale testing which produced an effluent with less than allowable discharge limit, a bio-denitrification process was selected for pre-treatment of the water prior to treatment by the ion exchange system that was already in use. Existing excavations and on-site water storage tanks have been lined, filled, and inoculated with microbes obtained from MSD.

Systems Operations

The current operating procedures maintain the effectiveness of the response actions. The significant variances to costs are due to increased volumes of soil to be excavated and sent to off-site disposal and the bio-denitrification of the selenium contaminated water.

Opportunities for Optimization

Optimization has occurred in two primary areas: system operations and the environmental monitoring program. General process improvements, including equipment changes and efficiencies implemented through experience, have, over time, optimized operations and reduced the cost per cubic yard of contaminated soil excavated. A specific operations improvement was the construction of a new loadout facility at the SLAPS to replace the original facility on Eva Avenue.

The environmental monitoring system is optimized through an annual evaluation. Sampling locations, frequencies, and target constituents are modified on the basis of historical data, trends, and the evolving nature of the remedial action. Some monitoring locations have been deleted and sampling frequencies reduced as a result of these evaluations.

Early Indicators of Potential Issues

As discussed above, the only early indicator of a potential issue was the presence of elevated levels of selenium in the HU-A aquifer.

Implementation of Institutional Controls

No institutional controls are required at this stage of the CERCLA process to prevent exposure. In the future, institutional controls may be implemented if specified in new decision documents. COCs remaining at the site will be addressed under the selected remedy identified in the North St. Louis County sites ROD

Prior to response activities at any property, temporary fences, gates, and/or barriers are installed around the work zone, warning signs are posted at designated intervals, and specific points are established for ingress and egress. Anyone not involved in the response action is restricted from entry into the construction zone. As conditions change, controls are modified to restrict access.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of response selection still valid?

Answer B: Yes, the exposure assumptions, toxicity data, cleanup levels, and response action objectives used at the time of response selection are still valid and any changes in these values *have no impact on protectiveness.*

Changes in Exposure Pathways

There have been no changes in land use, no change in the understanding of the physical site conditions, and no new contaminants of concern. There are no unanticipated toxic by-products from the remedy.

Changes in Toxicity or Contaminant Characteristics

There have been some changes in the toxicity factors in a way that affects the protectiveness of the remedy. RESRAD version 6.0 (2001) incorporates the factors from Federal Guidance Report (FGR)-11 and -12 and allows for the use of FGR-13 whereas the previous versions of RESRAD used data from older models.

In FGR-13, EPA includes newer toxicity values for each radionuclide based on age- and gender-dependence of radionuclide intake, metabolism, vital statistics and baseline cancer mortality data, and a revised dosimetric model.

Changes in Risk Assessment Methods

Standardized risk assessment methods have evolved into a more probabilistic approach since the EE/CA was finalized. There have also been changes in determining risk-based preliminary remediation goals for radionuclides. In January 2001, toxicity values for radionuclides in the *Health Effects Assessment Summary Table* were changed and USEPA revised its standard PRG calculation template. In addition, a newer version of the radiological assessment model has incorporated the changes. These changes have had no impact on the remedy since post-remedial action risk assessments for the SLAPS use the most recent risk assessment guidance documents and the latest version of both chemical and radiological risk assessment models.

Expected Progress Towards Meeting RAOs

As stated above, excavation and off-site disposal of contaminated soil was/is being performed as prescribed in the EE/CA. Completed activities have met the removal criteria. However, the initial volume of soil to be excavated was underestimated and the remedy is progressing more slowly than anticipated.

Question C: Has any other information come to light that could call into question the protectiveness of the response?

Answer C: No, there have been no newly identified ecological risks, impacts from natural disasters, or other information that has come to light, which could affect the protectiveness of the response action.

VIII. ISSUES

SLDS

One issue was identified for the SLDS residual radioactivity concentrations in the SLDS inaccessible soil. This issue is discussed in the following paragraphs and summarized in Table VIII-1. SLDS Issue.

Residual radioactivity concentrations in the SLDS inaccessible soil:

As described in Section III, the SLDS has been separated into two operable units (OUs): 1) the Accessible Soil and Ground-Water OU and 2) the Inaccessible Soil OU. The Accessible Soil and Ground-Water OU consists of the accessible soil and ground water contaminated as the result of MED/AEC uranium processing activities at the Mallinckrodt plant. The Inaccessible OU consists of Mallinckrodt Buildings 25 and 101 and contaminated soil that is currently inaccessible due to the presence of buildings, active rail lines, roadways, the levee, and other permanent structures. The Inaccessible Soil OU was excluded from the scope of the 1998 SLDS ROD because the inaccessible soil did not present a significant threat in its current configuration and because activities critical to Mallinckrodt's continued operations prevented excavation beneath the encumbrances (e.g., roads, active railroads, Buildings 25 and 101). Contamination present within Building 25 also did not present an excessive risk under its current configuration. Because land use has remained the same at the SLDS since the 1998 SLDS ROD was signed, these determinations hold true today. Thus, while the presence of residual inaccessible soil exceeding remediation goals does not currently affect the protectiveness of the remedy, it could potentially affect the protectiveness of the remedy in the future if not addressed.

Table VIII-1. SLDS Issue

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Residual radioactivity concentrations in the SLDS inaccessible soil: Radionuclides may remain in the SLDS inaccessible soil at concentrations above background values. USACE is currently developing the CERCLA documentation necessary to address inaccessible soil at the SLDS. A Long-Term Stewardship Plan will be prepared to document processes and procedures with respect to requirements under CERCLA.	No. Existing land use controls provide sufficient protectiveness.	Yes. Failure to develop a Long-Term Stewardship Plan may result in inadequate land use controls for inaccessible soil remaining after accessible soil remediation is complete.

North St. Louis County Sites

One issue was identified for the North St. Louis County sites: thin cover material at the HISS. This issue is discussed in the following paragraphs and summarized in Table VIII-2.

Table VIII-2. North St. Louis County Sites Issue

Issue	Currently Affects Protectiveness (Y/N)	Potentially Affects Future Protectiveness (Y/N)
Thin Cover Material at the HISS: The site inspection found vegetative cover on the northern area of the property inside the fence was thin. The cover material (soil) at the HISS is seeded several times per year; however, site drainage patterns appear to be impeding the establishment of vegetative cover. The USACE will reseed the cover material at the HISS to increase the vegetative cover present at the site. If unsuccessful through reseeding, other options will be considered to address the issue.	No. The rock in some areas had been displaced down to the geofabric. The geofabric cover remains and the underlying soil layer is not yet exposed.	Yes. Failure to establish adequate ground cover could result in exposure of the contaminated layer to surface water erosion and the movement of contaminated material.

Thin Cover Material at the HISS:

Although most of the site was well covered with vegetative growth and geofabric covered with rock, the site inspection found vegetative cover on the northern area of the property inside the fence was thin. The rock in some areas had been displaced down to the geofabric. Unforeseen delays in the selection of the final response action for the North St. Louis County sites led to the site's current state. The current site drainage pattern impeded the growth of vegetation despite regular attempts to seed the area. The condition of the vegetative cover does not currently affect the protectiveness of the response action. Even with total loss of the soil cover, the rock and plastic layers would prevent further erosion at the HISS. However, the protectiveness of the remedy in the future could be adversely affected if it resulted in exposure of the contaminated layer to surface water erosion.

IX. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Issue	Recommendations/Follow-up Actions	Lead Agency	Stakeholder Agencies	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Residual radioactivity concentrations in the SLDS inaccessible soil on vicinity properties	USACE is developing the CERCLA documentation necessary to address inaccessible soil at the SLDS. A Long-Term Stewardship Plan will be prepared to document processes and procedures with respect to requirements under CERCLA.	USACE	EPA DOE MDNR	Ongoing.	N	Y
Thin Cover Material at the HISS	USACE will continue to monitor the site to ensure that erosion does not result in an off-site discharge. USACE will reseed the cover material at the HISS to increase the vegetative cover present at the site. If unsuccessful through reseeding, other options (e.g., crushed rock, sod, geomembrane, clean soil) will be considered to address the issue.	USACE	EPA DOE MDNR	Ongoing.	N	Y

X. PROTECTIVENESS STATEMENT

Protectiveness Statement (St. Louis Downtown Site)

The remedy being implemented at the SLDS Operable unit is expected to be protective of human health and the environment upon attainment of the cleanup goals established in the ROD. In the interim, exposures that could result in unacceptable risks are being controlled through access controls and work place management practices. Some areas with soil contamination deeper than four feet and some areas with contamination under permanent structures will be managed in place using institutional controls to limit use. Long-term groundwater monitoring is being used to confirm that the remedy is protective of the alluvial aquifer.

Protectiveness Statement (North St. Louis County Sites)

The removal actions being implemented at the North St. Louis County Sites operable unit are expected to be protective of human health and the environment upon attainment of the soil cleanup goals established in the EE/CAs. In the interim, exposures that could result in unacceptable risks are being controlled through access controls, surveillances and maintenance, and coordination with property owners and utility companies. In May 2003, the USACE published a Proposed Plan for remedial action designed to address all remaining contamination at the North St. Louis County Sites. Public comment has been received. A ROD is currently under development and will be made available upon finalization.

XI. NEXT REVIEW

The next five-year review for the North St. Louis County sites and the SLDS is required by September 8, 2008, five years from the date of this review.

XII. REFERENCES

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be used without restriction. By definition, the area beneath the levee on DT-2 is considered to be an inaccessible soil area and therefore is not included in the scope of the SLDS ROD (USACE 1998c).

Mallinckrodt Plant 2

Prior to development of the remedial design for Plant 2, a pre-design investigation was implemented to gather additional subsurface data to support the design of the remedial action at Plant 2. During pre-design planning, the SAIC three-dimensional model (based on EarthVision Software) of radionuclide distribution was evaluated to determine whether the soil contamination boundaries in Plant 2 were adequately defined. In addition, the RI data were reviewed to determine whether sufficient data existed for evaluation of excavation support requirements. Several data gaps were identified, including a lack of soil geotechnical data; uncertainty in the vertical and horizontal contamination boundaries and shallow distribution of contamination; and lack of radiological and chemical waste characteristic data. To address the data gaps, two wells were completed in the fill material to measure hydraulic properties. In addition, sampling was conducted to further delineate three areas of radiological activity exceeding the SLDS ROD (USACE 1998c) remediation criteria identified during the Class 2 sampling in Plant 2. The pre-design investigation data showed that the radionuclide contamination was within the fill material. However, there were occurrences of radionuclide contamination within the underlying clay/silt layer (IT 1999a).

Remedial activities at Plant 2 (i.e., design through backfilling and site restoration) were conducted between October 1998 and August 2000.

Two changes to the initial design for Plant 2 occurred. The first change involved an alteration in the excavation limits based on newly acquired pre-design investigation data and a process change to allow the excavation to proceed incrementally once the gross excavation boundary was reached. The second change involved an update in the utility locations and the incorporation of fieldwork variances issued subsequent to the previous design change.

The following activities were major components of the remedial activities implemented at Plant 2. The foundations of Buildings 50, 51, 51A, 52, and 52A were demolished. Several water and fire suppression lines were temporarily capped and removed. Manholes and catch basins exposed during excavation were supported or replaced. On-site stockpiled crushed concrete, brick, and/or cinder block from previously demolished Mallinckrodt buildings, foundations, or other consolidated material having radionuclide concentrations below the composite criteria of the SLDS ROD (USACE 1998a) and exhibiting no hazardous characteristics, as determined by the Toxicity Characteristic Leaching Procedure, were used for backfilling excavations to levels below 6 feet bgs on Mallinckrodt property. Clean off-site borrow material was used to backfill excavations from 6 feet bgs to the surface.

A total of approximately 9,660 in-situ yd^3 of contaminated material was removed from Plant 2. Excavated soil was transported to a soil storage and loadout facility and loaded into lined railcars for transport to and disposal at Envirocare of Utah, a low-level radioactive waste disposal facility.

A few unexpected events of note occurred during remedial activities at Plant 2. These included the interception of previously unknown underground active and inactive utility lines, accumulation and required collection of greater-than-anticipated quantities of ground water, and the discovery of ordnance. During remediation of the main excavation area in Plant 2, multiple utility lines were encountered that were not previously identified by any Missouri utility company or Mallinckrodt, Inc. Leaking sewer lines as well as potable water and fire-suppression-system water line ruptures resulted in excessive water accumulation in the main excavation. During soil removal at the main excavation, ordnance was unexpectedly discovered within the excavation boundaries. Work was halted, and safety specialists from USACE and the St. Louis Police Department's Bomb and Arson Squad were called in to safely extract the nearly 150-year-old ordnance. Over a five-month period, 58 pieces of ordnance were eventually removed and disposed of by the Bomb and Arson Squad. A permanent brass marker was placed on the pavement surface to identify the location of the ordnance left in place beyond the excavation limits.

Portions of stockpiled crushed concrete, brick, and/or cinder block from previously demolished Mallinckrodt buildings, foundations, or other consolidated material were determined to meet the composite criteria stated in the SLDS ROD (USACE 1998a) and exhibit no hazardous characteristics, as determined by the Toxicity Characteristic Leaching Procedure. Approximately 5,700 yd^3 of crushate were placed as deep backfill in the Plant 2 main excavation from total depth to no higher than 6 feet bgs. Clean off-site borrow material or commercially available crushed aggregate was placed from 6 feet bgs to the level of the crushed aggregate base course for a new pavement. Commercially available crushed aggregate was also used as deep backfill material.

The remedial action summary and post-remedial action evaluation are presented in the *Post-Remedial Action Report for the Accessible Soils Within the St. Louis Downtown Site Plant 2 Property* (USACE 2002a). The analytical results for the final status survey samples indicated that the residual radioactivity in the accessible areas in Plant 2 met the requirements of the remedial design and was below the 15/15/50 SLDS ROD remediation criteria. In addition, analytical results for arsenic and cadmium were below the SLDS ROD remediation criteria. Thus, the accessible areas of Plant 2 were released for use without restriction. There are several areas of inaccessible soil present in Plant 2. These areas include soil beneath the buildings in Plant 2, a small area on the north end of the main excavation, and a small area on the south end of the main excavation.

Mallinckrodt Plant 1

The Plant 1 pre-design investigation activities described in the *Pre-Design Investigation Summary Report, Plant 1, FUSRAP St. Louis Downtown Site, St. Louis, Missouri* (IT 1999b) identified one large and 11 isolated locations of elevated radiological activity. The large area of contamination was located near the northwest corner of Plant 1 in the former Building K foundation (K-Pad) area. The 11 isolated locations, numbered 1 through 11, were located north and southeast of the K-Pad area.

The original Plant 1 design included the installation of sheet piling around the K-Pad area. However, the bids received to build/construct this design were significantly greater than the estimated costs. USACE, along with its remedial action contractor, IT, began to explore other means of shoring. It was determined that excavation of the K-Pad area in strips using a slide rail shoring system would be a more cost-effective approach. During the remediation, unexpected subsurface obstructions were encountered (e.g., remnants of building foundations and streets) that would not have allowed sheet piling to be driven to the desired depth. Use of the slide rail shoring system enabled the excavating subcontractor to work around these obstructions.

Plant 1 remedial activities began in July 2000 and were completed in September 2003. As remediation progressed, the 12 contamination locations (including the K-Pad) were further subdivided into individual excavation areas. This subdivision was implemented as an adjustment to changing field conditions and to facilitate remedial activities while allowing continuous Mallinckrodt operations. Approximately 2,490 in-situ yd^3 of contaminated material were removed. Ten areas of inaccessible soil have been identified in Plant 1, owned by Mallinckrodt, Inc. These areas could not be excavated without jeopardizing the integrity of nearby structures (e.g., building, substation) or impacting daily business operations of the owner.

The use of slide rail shoring at the K-Pad area excavation in lieu of the sheet pile system originally scoped was instrumental in controlling the volume of water accumulating in the excavation. Use of the slide rail shoring system facilitated the progress of excavation in a controlled manner by limiting the excavation area that was open at any given time. By using the slide rail shoring system, sheet-pile-driving vibrations which could have adversely affected Mallinckrodt operations in adjacent buildings were eliminated.

On-site stockpiled crushed concrete, brick, and/or cinder block from previously demolished Mallinckrodt buildings, foundations, or other consolidated material having radionuclide concentrations below the composite criteria of the SLDS ROD (USACE 1998a) and exhibiting no hazardous characteristics, as determined by the Toxicity Characteristic Leaching Procedure, were used for backfilling excavations to levels below 6 feet bgs on Mallinckrodt property. Approximately 450 yd^3 of crushate were placed as deep backfill in the K-Pad area from total depth to no deeper than 6 feet bgs. Clean off-site borrow material or commercially available crushed aggregate was placed from 6 feet bgs to the level of the crushed aggregate base course for the new pavement.

Many challenges were encountered during Plant 1 remedial activities because the work areas were in the most active part of an operating chemical plant complex. However, the only unexpected event of note was the encountering of subsurface remnants of a building foundation and brick street pavement. Use of the slide rail shoring system in the K-Pad area enabled the excavation subcontractor to work around these obstructions and therefore limit possible schedule delays.

The USACE most recently addressed contaminated soil near the former Buildings T, V, and W and the rail spur area south of Building X. Upon completion of remedial activities in these areas, a remedial action summary and post-remedial action evaluation will be presented in a post-remedial action report.

Midwest Waste VP (DT-7)

Prior to development of the remedial design for DT-7, a pre-design investigation was conducted to gather additional subsurface data to support the design of remedial action. The data collected during pre-design investigation activities identified 15 locations of shallow (less than 4 feet bgs) contamination [*Pre-Design Investigation Data Summary Report, Midwest Waste Vicinity Property (DT-7), St. Louis Downtown Site, St. Louis, Missouri* (IT 2001a)].

DT-7 remedial operations began in May 2001 and concluded in February 2003. After remediation activities began, it became apparent that more contamination was present than originally anticipated based on the pre-design investigation sampling. A geologic examination of the soil/fill horizons exposed by the excavations, along with further evaluation of historical land elevations and aerial photographs, indicated that the subsurface zone of contamination encountered appeared to coincide with the horizon that was the land surface at the time MED/AEC activities began (i.e., 1941). This horizon was present 4 to 5 feet bgs. The pre-design investigation sampling conducted on DT- 7 did not encounter this zone of contamination. A total of approximately 3,910 in-situ yd^3 of contaminated material was excavated from DT-7.

Other than the increased quantity of contaminated soil volumes discussed above, no unexpected events of note occurred during remedial activities at DT-7. The remedial action summary and post-remedial action evaluation will be presented in a post-remedial action report and will be submitted to MDNR and EPA for review and comment prior to finalization.

Mallinckrodt Plants 6 East (6E) and 6 East Half (6EH)

Prior to development of the remedial design for Plants 6E and 6EH, a pre-design investigation was conducted to gather additional subsurface data to support the design of remedial actions. The pre-design investigation data showed that radionuclide contamination was confined to two isolated areas in Plant 6E, but was extensive in Plant 6EH [*Pre-Design Investigation Data Summary Report, Plants 6 East Half and 6E* (IT 2000)]. The majority of the contamination appeared to be present within the fill material to a depth of 4 feet bgs. Contamination was present in two deep areas at 12 and 20 feet bgs.

Remedial activities consisting of the excavation of contaminated soils in Plant 6EH and Plant 6E began in November 2000 and were completed in July 2003. After remedial operations began, it became apparent that the contamination was more extensive, both vertically and horizontally, than originally anticipated based on the pre-design investigation sampling. Approximately 18,880 in-situ yd^3 of contaminated material were excavated from Plants 6EH and 6E. The post remedial action report for this area is being developed and will be submitted as part of the Post Remedial Action Report for Plant 6 to MDNR and EPA for review and comment prior to finalization. A more complete discussion of the remedial activities conducted at Plants 6EH and 6E will be provided in the next five-year review report.

Heintz Steel and Manufacturing VP (DT-6)

The Heintz Steel and Manufacturing VP (DT-6) was investigated to 2 feet bgs during pre-design investigation activities. The pre-design data indicated three areas of shallow (0.5 feet bgs) radiological contamination in the fill material [*Pre-Design Investigation Data Summary Report, Heintz Steel and Manufacturing Vicinity Property (DT-6)* (IT 2001b)]. The three areas of radiological contamination appeared to be randomly located, with no specifically identifiable source.

Due to the degree and extent of contaminated soil encountered at DT-7 during excavation activities, further evaluation of historical land elevations and aerial photographs was conducted for DT-6. The results of this evaluation indicated that the same subsurface zone of contamination present at DT-7, which coincides with the horizon that was the land surface at the time MED/AEC activities, which began in 1941, may be present at DT-6. This horizon is expected to be present 4 to 5 feet bgs. The pre-design investigation sampling conducted on DT-6 did not encounter this zone of contamination.

Remedial activities began in April 2003 and are ongoing. As part of these remediation activities, sampling of several trenches excavated to a depth of approximately four feet, was conducted to determine if the deeper zone of contamination encountered on DT-7 is present on DT-6, and to what extent. A more complete discussion of the remedial activities conducted at DT-6 will be provided in the next five-year review report.

Mallinckrodt Plant 7E

The Plant 7E property is located in the eastern portion of the SLDS, south of Destrehan Street and east of the Burlington Northern Railroad tracks (DT-12) and Plant 7 North (N). The northern portion of the Plant 7E property was previously remediated along with DT-2 because property ownership information available at that time indicated that it was part of DT-2 and not Plant 7E. The fenced portion of the Plant 7E property is surfaced with gravel placed over geotextile and was most recently used for storage of MI roll-offs and small FUSRAP stockpiles of miscellaneous materials. These stored items were removed.

The availability of data from Plant 7E obtained during remediation of DT-2 and the characterization of DT-1 precluded a pre-design investigation for the remedial design of Plant 7E. These data have been augmented by the sampling of several investigational trenches that delineated required areas of remediation in more detail. Data from samples collected during the digging of the trenches were used to aid in the determination of the proposed limits of gross excavation for Plant 7E and are presented in *Mallinckrodt Plant 7E Remediation Activity Work Description* (IT 2003).

Remedial activities began in July 2003 and are currently ongoing. A more complete discussion of the remedial activities conducted at Plant 7E will be provided in the next five-year review report.

General Remediation Matters

As stated previously, authority under the SLDS ROD (USACE 1998c) for the remediation of MED/AEC-related wastes is limited to those wastes in accessible soil and ground water. The SLDS ROD (USACE 1998c) defines accessible soil as soil that are not beneath buildings or other permanent structures. The SLDS ROD (USACE 1998c) also provides examples of soil considered to be inaccessible and excluded from remedial action under the SLDS ROD. Soil that is inaccessible due to the presence of buildings, active roads, active rail lines, and the levee is specifically excluded from remediation. Because the scope of the remedial action authorized by the SLDS ROD (USACE 1998c) is limited to accessible soil and ground water, the definition of accessible soil controls the determination of whether remediation of a particular area is authorized. The discussion of inaccessible soil in the SLDS ROD (USACE 1998c) provides examples of areas excluded, but not a complete list. Therefore, the determination of whether an area is accessible or inaccessible is made on a case-by-case basis by applying the SLDS ROD (USACE 1998c) definition of accessible soil. Because the determination of whether soil is accessible is directly related to the permanent nature of structures built upon soil, USACE has concluded that areas surrounding buildings or other permanent structures where the volume of soil underlying the areas is required for structural stability of the adjacent building or other permanent structure are also inaccessible. Each area excluded from remediation as inaccessible is documented, presented in the appropriate post-remedial action report, and will be included in the final site closeout report and will be submitted to MDNR and EPA for review and comment prior to finalization. A separate ROD will be developed for inaccessible areas at the SLDS. MDNR and EPA will be invited to participate in this process.

The SLDS remedy also includes implementation of a long-term ground-water monitoring strategy for the Mississippi Alluvial Aquifer (HU-B). As specified in the SLDS ROD (USACE 1998c), if long-term monitoring of HU-B shows significant exceedances of maximum contaminant levels (MCLs) or the thresholds established in 40 CFR 192 by the COCs specified in the SLDS ROD, then a GRAAA is to be initiated. The ROD-specified investigative levels (ILs) for each of the ground-water COCs are 50 micrograms per liter (μg/L) for arsenic, 5 μg/L for cadmium, and 20 μg/L for total uranium. Samples from three HU-B (Mississippi Alluvial Aquifer) monitoring wells exceeded the ILs for one or more of the COCs established in the SLDS ROD. Monitoring wells DW14 and DW15 exceeded the IL for arsenic. Significant exceedance of the total uranium IL in DW19 for an extended period initiated Phase 1 of the GRAAA. Therefore, a Phase I GRAAA was initiated in 2001 (USACE 2003a).

Final status surveys compatible with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) are performed subsequent to remediation at the SLDS. These surveys document achievement of remedial goals. Results of final status surveys are documented in Post-Remedial Action Reports (PRARs) for properties requiring remediation and in Final Status Survey Evaluation Reports (FSSERs) for those properties not requiring remedial action. Each of these reports includes a summary of the detailed documentation that confirms that the areas involved achieve remediation goals. This documentation specifically includes residual concentrations of contaminants of concern (e.g., exposure point concentrations) and assessment of residual site risks to confirm protectiveness.

System Operation/Operation and Maintenance

Thus far, the remedial activities completed for accessible soils have allowed for unlimited use and unrestricted exposure at the particular property. Therefore no operations and maintenance documents have been required. USACE is currently in the process of developing the CERCLA documentation necessary to address inaccessible soil at the SLDS. MDNR and EPA will be invited to participate in this process.

NORTH ST. LOUIS COUNTY SITES

During the period of this review (September 1998 through August 2003), North St. Louis County sites removal actions were conducted pursuant to the following EE/CAs and their corresponding Action Memoranda:

(1) *Engineering Evaluation/Cost Analysis – Environmental Assessment for the Proposed Decontamination of Properties in the Vicinity of the Hazelwood Interim Storage Site, Hazelwood, Missouri*, DOE/EA-0489, Rev. 1, March 1992 (DOE 1992) and *St. Louis Site Action Memorandum for Vicinity Property Cleanups*, June 1995 (DOE 1995).

(2) *St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA) St. Louis, Missouri*, DOE/OR-21950-1026, September 1997 (DOE 1997a) and *SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material*, September 1997 (DOE 1997b).

(3) *Engineering Evaluation/Cost Analysis for the Hazelwood Interim Storage Site (HISS), St. Louis, Missouri*, October 1998 (USACE 1998a) and *Action Memorandum for the Removal of Radioactively Contaminated Material at the Hazelwood Interim Storage Site and Latty Avenue Vicinity Properties*, June 1998 (USACE 1998b).

(4) *Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum, St. Louis, Missouri*, March 1999 (USACE 1999a).

North St. Louis County Sites Removal Action Selection

Up to August 2003, removal actions have been conducted pursuant to Action Memoranda adopting recommendations set forth in the EE/CAs while a ROD was being developed to identify the final remedial action.

Four separate EE/CAs govern the removal actions conducted at the North St. Louis County sites. As noted, two of these EE/CAs were developed by DOE and two were developed by the USACE.

The first EE/CA (DOE 1992) developed for the North St. Louis County sites addresses vicinity properties in the Hazelwood and Berkeley, Missouri, area that were affected by operations at the SLAPS and the HISS. The selected response action for these vicinity properties presented in the EE/CA is the excavation of affected materials and the transportation of the affected materials to an interim storage area, the HISS. Subsequently, a DOE memorandum, "*St. Louis Site – Action Memorandum for Vicinity Property Cleanups*, June 1995", authorized the removal actions recommended in the EE/CA and amended the original proposal to replace the interim storage of contaminated soil at the HISS with shipment to an out-of-state commercial disposal facility.

The second EE/CA (DOE 1997a) addresses the presence of residual radioactive material in the soil at the SLAPS. The objectives of the selected alternative are to remove fill material immediately adjacent to Coldwater Creek and to provide a buffer zone between the creek and the remainder of the SLAPS. Specifically, all excavated soil that exceeded the DOE standard referred to as the 5/15/50 guideline would be shipped out of state to a licensed disposal facility. This removal action was authorized in the *SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material* (DOE 1997b).

The third EE/CA (USACE 1998a) developed for the North St. Louis County sites addresses two interim storage piles at the HISS, two interim storage piles at Latty Avenue VP-2(L), accessible subsurface soil at two Latty Avenue VPs, and one contiguous property. The USACE determined that an expedited response action to address affected materials located on these properties was appropriate to ensure protection of human health and the environment. The approved removal action required soil from the four interim storage piles, and accessible subsurface soil from the two Latty Avenue VPs and the contiguous property that exceed the selected criteria of 5/15/50 pCi/g for Ra-226, Th-230, and U-238, respectively, to be excavated and disposed at a licensed or permitted disposal facility. This removal action was authorized in the *Action Memorandum for the Removal of Radioactively Contaminated Material at the Hazelwood Interim Storage Site and Latty Avenue Vicinity Properties* (USACE 1998b).

The fourth EE/CA and Action Memorandum (USACE 1999a) addresses the SLAPS and the Ballfields (a SLAPS-VP area) and identifies the excavation and disposal of affected fill materials from the SLAPS and the Ballfields as the selected removal action. Specifically, soil within the top 6-inch layer from the SLAPS and the Ballfields (excluding the north ditch) that exceeds the selected criteria of 5/5/50 pCi/g (Ra-226/Th-230/U-238, respectively) above background [as determined by sum of ratios (SOR)] is to be excavated and disposed at a licensed or permitted disposal facility. Soil below 6-inch bgs that exceeds 15/15/50 pCi/g (Ra-226/Th-230/U-238, respectively) above background (as determined by SOR) is also to be excavated and disposed at a licensed or permitted disposal facility. This EE/CA allows that, if an effective treatment is identified subsequent to approval of the EE/CA, the USACE will consider implementation of such treatment on any remaining soil.

North St. Louis County Sites Removal Action Implementation

As part of the removal actions for the North St. Louis County sites, pre-design investigations were conducted on the various North St. Louis County sites' properties in order to obtain the information necessary to develop the remedial design documents.

The pre-design investigations conducted to date have either refined information obtained during the RI and/or provided new information regarding the degree and extent of contamination on the North St. Louis County sites' properties.

The ground-water monitoring is to assure that the environment is not being degraded by the sites' response actions. The monitoring also provides information to determine issues that may influence the management / disposition of excavation water.

Presented below is the history of the removal action implementation at the North St. Louis County sites. Information regarding initial plans, implementation history, removal measures (including monitoring, fencing, and institutional controls), and current status of the removal actions is presented. Also presented are discussions regarding any changes to or problems with removal action components.

SLAPS

At the start of the five-year review reporting period in August 1998, the North Ditch Removal Action and Sedimentation Basin Installation were in progress at the SLAPS under a *Construction Work Plan* (CWP) (USACE 1998d) developed pursuant to the initial EE/CA at the SLAPS (DOE

1997) and the subsequent EE/CA and Action Memorandum (USACE 1999a). The CWP was implemented in three phases:

Phase 1: Excavation and disposal of radiologically affected soil from the North Ditch (the area between McDonnell Boulevard and the former ballfields).

Phase 2: Construction of a sedimentation basin on the western portion of the site.

Phase 3: Removal of radiologically affected soil from the East End Area of the site.

Each of these three phases was initiated as part of the site stabilization effort to prevent surface water run-off from carrying radioactive affected materials from the site. The SLAPS work areas and the status of the removal actions are shown in Figure IV-1.

Approximately 6,550 in-situ yd^3 of affected material were excavated from the North Ditch area. The soil excavated during each of the three phases that exceeded the removal action criteria was loaded into railcars, in accordance with governing transportation requirements, and shipped out of state to a licensed disposal facility.

In 1998, USACE performed additional characterization to provide data to support ongoing removal actions, to provide information on contaminant transport and limits of migration of contaminants, and to support contaminant boundary delineation (USACE 2001a). Soil samples from the investigation areas (IAs 1 to 13) were collected and analyzed for radionuclides and various chemicals. TCLP analyses were performed on selected soil samples. Some monitoring wells were added and some were abandoned as part of the characterization activities. Geophysical investigations were performed to determine the locations of subsurface features such as utilities, buried metal, and other objects that may be of concern during drilling and remediation activities. The USACE investigation reconfirmed the presence of the radionuclides of interest including Ra-226, Th-230, and U-238. The *SLAPS Implementation Report* documents the results of this investigation (USACE 2001a).

A pre-design investigation was conducted at the SLAPS East End and in the right-of-way (ROW) along McDonnell Boulevard in 2000 to supplement the historical data. The radiological sampling results of the pre-design investigation borings supported the historical data indicating the maximum depth of affected material to be 10 to 12 feet bgs in the East End. The radiological sampling results of the pre-design investigation borings along the McDonnell Boulevard ROW supported the historical data indicating the maximum depth of affected materials to be 3 to 4 feet bgs. In addition, the borings indicated no disturbed soil below this depth interval that may be affected as a result of past construction activities. The pre-design investigation results are presented in the *Pre-Design Investigation Summary Report, East End and Right of Way Work Areas* (Stone & Webster 2000).

In early 2000, a decision was made to temporarily suspend removal activities in the East End work area and to initiate removal of affected materials from the Radium Pits work area. The *Radium Pits Removal Action Work Plan* (USACE 2000a), developed pursuant to the EE/CA and Action Memorandum (USACE 1999a), implemented this removal action. Of note was that the Radium Pits area was believed to contain the highest radiological concentrations of affected material on the site. The Radium Pits work area was completed in November 2000.

Later in 2000, removal activities at the SLAPS resumed at the re-designated East End Extension/ROW work area (basically the area between the original East End and the Radium Pits, including the site drainage ditch along the ROW). The original work plan for this area included sheetpile shoring along portions of the ROW. However, field operations were conducted without the need for the sheetpile shoring, while still providing protection to workers and the public and stability to the roadway and shoulder area.

Current removal activities at the SLAPS are being implemented under the *Site Wide Removal Action Work Plan* (the SLAPS-RAWP)(USACE 2000b) and conducted pursuant to the EE/CA and Action Memorandum (USACE 1999a). The document includes or incorporates by reference the following:

- ARARs identified in the EE/CA (USACE 1999a);
- other related site-wide removal action plans (site safety and health plan, quality control plan, etc.);
- requirements for site-wide activities such as security, work zone access control, methods of excavation, decontamination, erosion and dust control, water management and treatment, final status surveys, backfill, site grading, and site restoration; and
- individual SLAPS area removal action work plans as appendices to the SLAPS-RAWP.

A 2.3-acre area located south of the Radium Pits, west of the East End, and north of the rail spur loadout facility has been designated as the Phase 1 Work Area. A pre-design investigation was performed during September–October 2000 in the Phase 1 Work Area. Results of historical RIs did not adequately cover the extent of the Phase 1 Work Area. Additional sampling resulted in the pre-design investigation borings supporting the historical data indicating the depth of contamination to be 12 feet bgs. The pre-design investigation results are presented in the *Pre-Design Investigation Summary Report, Phase 1 Work Area* (Stone & Webster 2001a).

Excavation of the Phase 1 Work Area was implemented under the *Phase 1 Work Description* (USACE 2001b) developed pursuant to the EE/CA and Action Memorandum (USACE 1999a). Excavation of the Phase 1 Work Area was begun in December 2001 and completed in May 2003. Approximately 65,120 in-situ yd^3 of affected material were removed from the Phase 1 Work Area. A post-remedial action report will be developed and submitted to MDNR and EPA for review and comment prior to finalization. The report will include the Radium Pits, East End, East End Extension/ROW, and Phase 1 Work Area. A complete discussion of the removal activities conducted at the Phase 1 Work Area will be provided in the next five-year review report.

Currently, removal activities are in progress in the Phase 2 and 3 Work Areas, a 5.5-acre portion of the SLAPS located west of the Radium Pits and Phase 1 Work Area. Pre-design investigation activities were performed during June 2000 through January 2001 in the Phase 2 and Phase 3 Work Areas. The purpose of this investigation was to characterize the vertical extent of, and more accurately delineate, affected materials in the Phases 2 and 3 Work Areas prior to initiation of removal activities. The analytical results indicated that the deepest contamination was present

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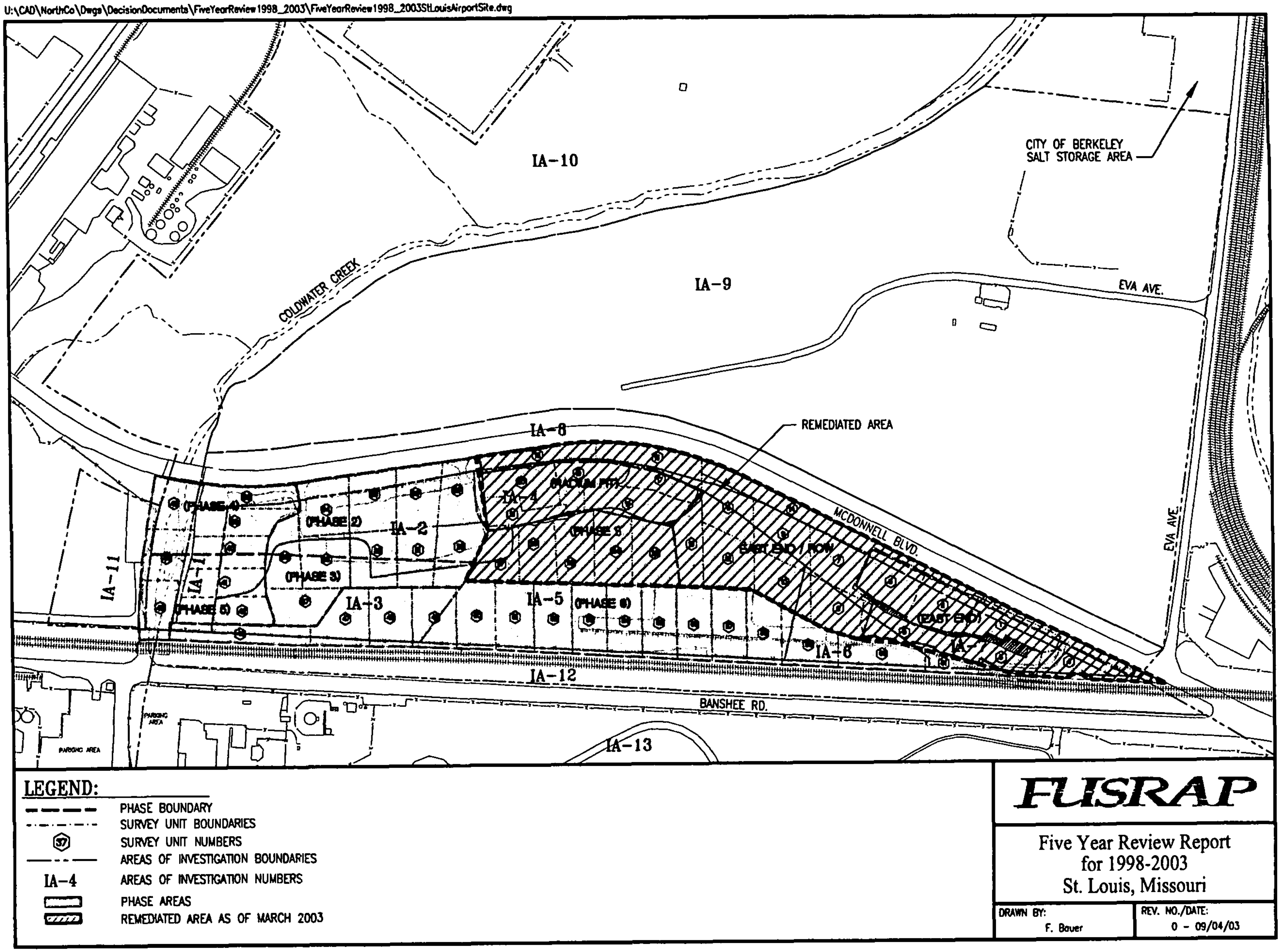


Figure IV-1. St. Louis Airport Site

at a depth of 18.4 feet bgs. The pre-design investigation results are presented in the *Pre-Design Investigation Summary Report, Phases 2 and 3 Work Areas* (Stone & Webster 2001b). The removal activity at the Phase 2 and 3 Work Areas was implemented in December 2002 under Appendix L to the SLAPS-RAWP, *Phase 2 and Phase 3 Work Description* (USACE 2001c). A complete discussion of the removal activities conducted at the Phase 2 and Phase 3 Work Areas will be provided in the next five-year review report.

At the SLAPS, the entire site is enclosed by chain-link fence, with vehicle access through a gated entrance. Non-work hour security is conducted site-wide. Environmental monitoring is conducted at the site boundaries. Thermoluminescent dosimeters (TLDs), radon alpha track detectors (ATDs) and particulate air filters are used in various combinations to monitor gamma exposure levels, radon emissions, and airborne radionuclide emissions. A ground-water monitoring well network is used to sample and evaluate ground-water constituent concentrations and potential effects on ground-water quality. Stormwater sampling and monitoring are conducted to meet National Pollutant Discharge Elimination System (NPDES)-equivalent and 120 CFR 20 Appendix B requirements for the site. In addition, monitoring to meet MSD discharge requirements is conducted.

Drainage and water control are integral to the removal actions conducted at the SLAPS during the period of this report (September 1998 through August 2003). Stabilized drainage ways have been constructed along the northern and southern boundaries of the site to convey run-off into the sedimentation basin located at the west end of the site. In 2000, monitoring of ground-water intrusion into active work areas indicated levels of selenium exceeding guidelines. A de-nitrification treatment is now utilized to lower selenium concentrations in the water removed from the excavations to levels below guidelines. A series of water storage tanks, having a capacity of over 600,000 gallons, are used to store water prior to treatment and/or discharge.

The removal action at the SLAPS is not complete as of August 2003; however, removal has been completed at a portion of the SLAPS.

Start and completion dates, as well as excavated (in-situ) volumes of the SLAPS removal actions performed during this reporting period, are summarized in the following table:

Table IV-2. SLAPS Removal Action Summary

Designation	Start	Complete	CY Removed
Sedimentation Basin	September 1998	May 1999	10,530
East End/East End Extension/ROW	October 1998	May 2003	65,120
Radium Pits	March 2000	November 2000	36,910
Phase 1	December 2001	May 2003	74,670
Phases 2 and 3	December 2002	In Progress	24,630
		Total Volume =	211,860

CY = cubic yards (In-Situ)

Latty Avenue Properties

For the Latty Avenue properties, the removal actions conducted during the five-year review period (September 1998 through August 2003) occurred primarily at the HISS/Futura site. The construction of the HISS railroad spur line and loading facility commenced in October 1998, pursuant to the EE/CA and Action Memorandum (USACE 1998a, b), and was completed by the spring of 1999. Two stockpiles of affected material were created from this construction and subsequently removed.

The HISS stockpile removal was implemented pursuant to the EE/CA and Action Memorandum (USACE 1998a, b), under several firm-fixed price service contracts. The stockpiled affected material at the HISS has been removed and shipped by railcar to out-of-state licensed disposal facilities. A Post-Remedial-Action Report for the HISS will be developed and submitted to MDNR and EPA for review and comment prior to finalization. The start and completion dates, as well as the excavated (in-situ) volumes for the HISS removal actions conducted during the five-year review period, are summarized in the following table:

Table IV-3. HISS Stockpiles Removal Summary

Stockpile Designation	Start	Complete	CY Removed
East Piles 1 and 2	April 2000	June 2000	6,880
Railroad Spur Spoil Piles A and B	March 2000	June 2000	5,590
Supplemental Pile	September 2000	October 2000	4,710
Main Pile – Northern Portion	November 2000	January 2001	4,440
Main Pile – Phase 1 – South Half	March 2001	May 2001	11,950
Main Pile – Phase 2 – North Half	September 2001	October 2001	5,905
		Total Volume =	39,475

CY = cubic yards

At the HISS, disturbed areas have been covered with topsoil and hydro-seeded, or covered with reinforced poly with granular ballast, pending final selection of a remedial action for the HISS subsurface contamination. Currently, the rail spur is not used but remains operational. The entire site is enclosed by chain-link fence, with vehicle access through a gated entrance. Environmental monitoring is conducted at the site boundaries for radioactive air particulates, external gamma radiation and radon levels. A ground-water monitoring well network is used to sample and evaluate ground-water constituent concentrations and potential effects on ground-water quality. Storm-water sampling and monitoring are conducted to meet NPDES permit requirements for the site.

SLAPS VPs

The first SLAPS VPs removal action performed during the five-year review period (September 1998 through August 2003) was in conjunction with the replacement of the St. Denis Street Bridge over Coldwater Creek located in Florissant, Missouri. The DOE, the predecessor of USACE, was contacted by the City of Florissant, Missouri regarding the planned bridge replacement and conducted sampling activities in the area of the pending construction. The results of the sampling activity identified levels exceeding DOE guidelines, and the area was designated for removal prior to construction in order to protect worker health and safety during construction. The removal action was conducted on the east and west banks of Coldwater Creek from October 21, 1998, through November 12, 1998, pursuant to the EE/CA and Action Memorandum (DOE 1992, DOE 1995). About 450 in-situ yd^3 of radioactively affected soil and sediment were excavated. The affected material was transported by dump truck to the Eva Road loading area, then transferred to railroad cars for shipment to Envirocare disposal facility in Utah. No portion of the removal action for this property required an on-going treatment of affected soil or water. The areas where removal of affected material had taken place were released to the City of Florissant to begin preparations for the bridge replacement. The excavated areas were released to the City of Florissant to begin preparations for the bridge replacement. On November 23, 1998, the USACE informed the City of Florissant that the soil with residual radioactive contamination above the EE/CA criteria (DOE 1992) in the areas impacted by the new bridge installation had been removed, as documented in the *Post-Remedial Action Report for the St. Denis Bridge Area* (USACE 1999c). Note that this document incorrectly cites the DOE 1997 as the governing document for the removal action. A correction will be issued to this document.

In March 2000, excavation of affected materials from a portion of the SLAPS VP-38 on SuperValu, Inc. property commenced pursuant to the EE/CA and Action Memorandum (DOE 1992, DOE 1995). Approximately 5,000 in-situ yd^3 of radioactively affected material were excavated and transported out of state for disposal at EnviroSafe in Idaho. The entire floor of the excavation was confirmed clean and released. However, only the west and northwest walls of the excavation were released. Residual soil concentrations in the other walls were in excess of the removal action goals and excluded from the removal area. Areas of the wall that were not included in the removal area were covered with geotextile material. Placement of clean backfill in the excavation and against the geotextile material was completed in June 2000. The VP-38 removal action is documented in the *Vicinity Property 38 Removal Action Summary*, Revision 0, dated April 9, 2001 (USACE 2001d). The post-remedial action report will be developed upon completion of the remaining response actions on this property and will be submitted to MDNR and EPA for review and comment prior to finalization. Currently, the USACE field project office complex and on-site laboratory facility are located on the remediated portion of VP-38.

Characterization activities consisting of gamma radiation walkovers and soil sampling were conducted across VP-24c in the Summer of 2002. Contaminated soil was identified on VP-24c. The contaminated soil was excavated in April 2002 and the area sampled in accordance with MARSSIM. The sample data showed that soil remaining on this parcel were below the criteria specified in the EE/CA and Action Memorandum (DOE 1992, DOE 1995).

Though no removal actions were required to be conducted on the property, a final status survey was performed on the northeast portion of the former ballfield area designated as the City of Berkeley Salt Storage Area. This area represents the first final status survey unit [Survey Unit (SU) 1] of IA-9. The final status survey and resulting conclusions are presented in *St. Louis Airport Site Investigation Area 9 Final Status Survey Evaluation, Berkeley Salt Storage Area (IA-9 Survey Unit 1)* (USACE 2000c).

Surface-water and sediment samples are collected from fixed locations along Coldwater Creek on a scheduled, periodic basis. Sample data are analyzed and evaluated against water quality criteria as part of the SLS environmental monitoring program.

Final status surveys compatible with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) are performed subsequent to removal at the North St. Louis County sites. These surveys document achievement of the removal action criteria identified in applicable Engineering Evaluations/ Cost Analyses (EE/CAs). Results of final status surveys are documented in Post-Remedial Action Reports (PRARs) for properties requiring a response action or in Final Status Survey Evaluation Reports (FSSERs) for those properties not requiring a response action. Each of these reports will include a summary of the detailed documentation that confirms that the areas involved achieve relevant criteria. This documentation will specifically include residual concentrations of COCs (e.g., exposure point concentrations) and assessment of residual site risks and doses to confirm protectiveness.

System Operation/Operation and Maintenance

Thus far, the removal actions completed at the North St. Louis County sites have allowed unlimited use and unrestricted exposure at the particular properties. Therefore, no O&M documents have been required.

V. PROGRESS SINCE THE LAST REVIEW

This is the first five-year review for the SLS.

VI. FIVE-YEAR REVIEW PROCESS

Administrative Components

The five-year review process for the St. Louis FUSRAP sites began in January 2003 and continued through August 2003. The five-year review process included notifying regulatory agencies, the community, and other interested parties of the start of the five-year review; establishing the five-year review team in consultation with the USEPA and MDNR; reviewing relevant documents and data pertaining to the removal and remedial actions conducted at the SLS over the past five years; conducting site inspections; conducting site interviews; and developing/reviewing this first Five-Year Review Report. Each of these elements is discussed below.

Although the USEPA and MDNR had been informally notified that the five-year review process had begun for the SLS in advance, they were formally notified in a letter from USACE dated February 13, 2003. A conference call was held with the three parties on February 20, 2003 to discuss the establishment of the five-year review team, details of the site inspections and site interviews, and document review procedures.

The Five-Year Review Team consisted of the following members: Jacque Mattingly, USACE; Deborah McKinley, USACE; Daniel Wall, USEPA; Jill Groboski, MDNR; and JoAnne Wade, MDNR. Ms. Mattingly led the team in the site visits and interviews while Ms. McKinley led the team in preparing the Five-Year Review Report. Additional USACE, USEPA, and MDNR staff assisted in review of the report.

Community Involvement

Activities to involve the community in the five-year review were initiated in March 2003. On March 14, 2003, St. Louis District USACE representatives presented the scope and schedule of the five-year review at the St. Louis Oversight Committee meeting, which is open to the public. Information identifying the purpose, scope, and components of the five-year review and soliciting public comment was posted on the St. Louis-District Web site (www.mvs.usace.army.mil/engr/fusrap/home2.htm). This information was also presented in the St. Louis FUSRAP Sites newsletter that was issued to the site mailing list.

On March 31, 2003, a news release was sent to local newspapers, radio stations, and television stations advising that a review of radiological response actions was underway for FUSRAP sites. On September 2, 2003, a public notice was published in the St. Louis Post-Dispatch announcing that the draft five-year review report for the St. Louis FUSRAP Sites was complete and available for 30-day public review and comment at the FUSRAP Project Office and the St. Louis Public Library (Main and Olive branch). A news release announcing this was sent to the local newspapers, radio stations, and television stations.

Document Review

The following sections list the documents assessed as part of this five-year review. The documents are categorized into the following:

Basis for Response Actions

The documents listed in Table VI-1 identify the background and goals of the remedies and any changes in laws and regulations that may affect the response action. These documents also provide background information on the sites, basis for action, and clean-up levels, and address community concerns and preferences.

Table VI-1. List of Response Action Documents

Document	Property	Purpose	Use for Review
Engineering Evaluation/Cost Analysis-Environmental Assessment for the Proposed Decontamination of the Vicinity Properties in the Vicinity of the Hazelwood Storage Site, March 1992 (DOE 1992).	HISS (VPs)	Propose removal action alternatives.	Goal of removal Background Basis for Action Clean-up levels Community Concerns
St. Louis Site Action Memorandum for Property Clean-ups, June 1995 (DOE 1995).	North St. Louis County sites VPs	Record selected response action.	Goal of remedy Basis for Action
St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA), September 1997 (DOE 1997a).	SLAPS	Propose removal action alternatives.	Goal of removal Background Basis for Action Clean-up levels Community Concerns
SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material, September (DOE 1997b).	SLAPS	Record selected removal action	Goal of Removal Basis for Action
Record of Decision for the St. Louis Downtown Site, October 1998 (USACE 1998c).	SLDS	Record selected remedial decision	Remediation Goals Background Basis for Action Community Concerns
Engineering Evaluation/Cost Analysis-Environmental Assessment for the Hazelwood Interim Storage Site (HISS), October 1998 (USACE 1998a).	HISS	Propose removal action alternatives	Goal of removal Background Basis for Action Clean-up levels Community Concerns
Action Memorandum for the Hazelwood Interim Storage Site (HISS), June 1998(USACE 1998b).	HISS	Record selected removal action	Goal of Removal Basis for Action
Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum, March 1999 (USACE 1999a).	SLAPS	Record removal decision	Goal of removal Background Basis for Action Clean-up levels Community Concerns

Table VI-1. List of Response Action Documents (Cont'd)

Document	Property	Purpose	Use for Review
Feasibility Study for the St. Louis North County Site, May 1, 2003 (USACE 2003b).	SLAPS, SLAPS VPs, HISS	Propose remedial action alternatives.	Remediation Goals Background Basis for Action Community Concerns
Proposed Plan for the St. Louis North County Site, St. Louis, Missouri, May 1, 2003 (USACE 2003c).	SLAPS, SLAPS VPs, HISS	Presents preferred remedial alternative	Remediation Goals Background Basis for Action Community Concerns

Implementation of the Response

The documents listed in Table VI-2 furnish information about design assumptions, design plans or modifications, and documentation of the response action at the sites.

Table VI-2. List of Implementation Documents

Document	Property	Purpose	Use for Review
Pre-Design Investigation Summary Report Plant 1, St. Louis Downtown Site, December 9, 1999 (IT 1999b).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report Plants 6 East Half and 6E, St. Louis Downtown Site, August 18, 2000 (IT 2000).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report Midwest Waste – Vicinity Property (DT-7) FUSRAP St. Louis Downtown Site, May 3, 2001 (IT 2001a).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report: Heintz Steel and Manufacturing Vicinity Property (DT-6), FUSRAP St. Louis Downtown Site, July, 28, 2000 (IT 2001).	SLDS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Data Summary Report: East End and Right-of-Way Work Areas, St. Louis Airport Site , July 2000 (Stone & Webster 2000).	SLAPS	Record investigation data	Check whether contaminant levels meet criteria.

Table VI-2. List of Implementation Documents (Cont'd)

Document	Property	Purpose	Use for Review
Pre-Design Investigation Summary Report: Phase 1 Work Area, January 10, 2001 (Stone & Webster 2001a).	SLAPS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Summary Report: Phases 2 and 3 Work Areas, June 26, 2001 (Stone & Webster 2001b).	SLAPS	Record investigation data	Check whether contaminant levels meet criteria.
Pre-Design Investigation Summary Report: Hazelwood Interim Storage Site (HISS)-Main Pile Removal Action, December 2000 (USACE 2000d).	HISS	Record investigation data	Check whether contaminant levels meet criteria.

Operations and Maintenance

O&M documents describe the ongoing measures at the site to ensure the remedy remains protective at the site. The removal or remedial actions completed to date have allowed for unlimited use and unrestricted exposure at the property. Therefore, no O&M documents have been required. If institutional controls are necessary for release of property, O&M documents will be completed and discussed in subsequent 5-year reviews.

Response Action Performance

Monitoring data, progress reports, and performance evaluation reports listed in Table VI-3 provide information that can be used to determine whether the response action continues to operate and function as designed.

Table VI-3. List of Response Action Evaluation Documents

Document	Property	Purpose	Use for Review
VP-38 Removal Action Summary, Berkeley, Missouri, April 9, 2001 (USACE 2001d).	SLAPS VPs	Document that response actions are complete	History of VP-38 Status of VP-38 Chronology of activities
Annual Environmental Monitoring Data and Analysis Report for CY98, July 1999 (USACE 1999d).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
St. Louis Airport Site Investigation Area 9 Final Status Survey Evaluation, Berkeley Salt Storage Area (IA-9 Survey Unit 1), October 2000 (USACE 2000c).	SLAPS VP	Present final status survey data	Check whether contaminant levels meet criteria

Table VI-3. List of Response Action Evaluation Documents (Cont'd)

Document	Property	Purpose	Use for Review
Radium Pits Removal Action Summary Report: FUSRAP St. Louis Airport Site, November 1, 2001 (USACE 2001e).	SLAPS	Document that construction activities are complete	• History of SLAPS Status of SLAPS Chronology of activities Lessons Learned
Final Post-Remedial Action Report for the St. Louis Downtown Site City-Owned Vicinity Property, St. Louis, Missouri, September 1999 (USACE 1999b).	SLDS VP	Document that construction activities are complete	History of DT-2 Status of DT-2 Chronology of activities Lessons Learned
Post-Remedial Action Report for the St. Denis Bridge Area, July 1999 (USACE 1999c).	SLAPS VPs	Document that construction activities are complete	History of St. Denis Bridge Status of St. Denis Bridge Chronology of activities Lessons Learned
Results of East Soil Piles and HISS Spoil Piles Characterization, St. Louis, Missouri, April 2000 (USACE 2000e).	HISS	Document that construction activities are complete	Characterization of soil
Final Post-Remedial Action Report for the Accessible Soils within the Downtown Site Plant 2 Property, January 2002 (USACE 2002a).	SLAPS	Document that construction activities are complete	Effectiveness of the remedial action at Plant 2
Final Status Survey Report Evaluation for the St. Louis Downtown Site City-Owned Property North (Metropolitan Sewer District (MSD) Salisbury Lift Station) Vicinity Property, February 2001 (USACE 2001f).	SLDS	Documents that Remediation Goals were met	Effectiveness of the remedial action at MSD Salisbury Lift Station VP
Final Status Survey Report Evaluation for the St. Louis Downtown Site Archer Daniels Midland Vicinity Property (DT-1), June 2002 (USACE 2002b).	SLDS	Documents that Remediation Goals were met	Effectiveness of the remedial action at St. Louis Downtown Site ADM VP (DT-1)
Annual Environmental Monitoring Data and Analysis Report for CY99, June 2000 (USACE 2000f).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
Annual Environmental Monitoring Data and Analysis Report for CY00, June 2001 (USACE 2001g).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
Annual Environmental Monitoring Data and Analysis Report for CY01, June 2002 (USACE 2002c).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values
Annual Environmental Monitoring Data and Analysis Report for CY02, September 2003 (USACE 2003e).	All	Records and evaluates monitoring data	Check whether contaminant levels meet comparison values

Legal Documentation

In October 1998, Congress transferred responsibility for the administration and execution of FUSRAP from DOE to USACE in the Energy and Water Development Appropriations Act, Pub. L. 105-62. Provisions of the appropriations acts for fiscal years 1999 and 2000 clarified Congressional intent that USACE should conduct FUSRAP activities subject to CERCLA and the NCP. In March 1999, USACE and DOE executed a Memorandum of Understanding (MOU), which identifies program administrative and execution responsibilities for the two agencies. USACE is currently conducting FUSRAP response actions at the SLS under the legislative authority in the appropriations acts; subject to CERCLA, the NCP, and Executive Order 12580 implementing CERCLA; in accordance with the FFA, originally negotiated between USEPA and DOE; and in accordance with the MOU. The MOU designated DOE as responsible for long-term stewardship. A team of USACE, DOE, USEPA, MDNR, and stakeholder representatives are cooperatively developing a long-term stewardship plan for conducting response actions, implementing institutional and access controls, performing O&M activities, and preparing five-year reviews.

Community Involvement

The Community Relations Plan helps give an understanding of the history of the community involvement and other activities at the SLS. Current community involvement actions are being carried out under the *Community Relations Plan for the St. Louis FUSRAP Sites, Rev. 3, January* (USACE 2001h). This document will be updated prior to the next five-year review.

Data Review

The data review component of this five-year review consisted of examining environmental monitoring data collected as part of response actions conducted at the SLDS and the North St. Louis County sites. An environmental monitoring program was implemented at the SLS in calendar year (CY) 1998. This program is an integrated monitoring program with sampling locations and frequencies defined on the basis of site-specific permits/permit equivalents, decision documents, and a commitment to be protective of human health and the environment and demonstrate short-term effectiveness pursuant to CERCLA.

Air, soil, sediment, surface water, and ground water are sampled and analyzed as part of the environmental monitoring program. A discussion of the review of these data by site is presented in the following paragraphs.

Environmental monitoring data are collected quarterly pursuant to Section XIV of the FFA; these data are not evaluated as part of the quarterly reporting. Therefore, the environmental monitoring program includes the preparation of an annual Environmental Monitoring Data Analysis Report (EMDAR) that consolidates and evaluates the environmental monitoring data. The annual reports are prepared by calendar year and summarize the data obtained during the calendar year and provide trend analyses of the data.

The environmental monitoring program is evaluated at the end of each fiscal year (FY). The result of this evaluation is the development of an annual environmental monitoring implementation program for the following FY. The sampling locations and activities of the program are not static because of the evolving nature of the response actions being conducted at the St. Louis Sites.

Accordingly, sampling activities may be deleted in subsequent FYs because the monitoring is no longer pertinent (e.g., perimeter airborne particulate monitoring would not be pertinent once a property had been remediated and the site restored). Conversely, an increased sampling frequency may be incorporated into the program to address an elevated intensity of response actions at a site. Sampling frequencies are driven by the sampling data collected. For example, if data trends indicate short-term increasing concentrations, the sampling frequency may be increased.

The data reviewed included those data presented in the post-remedial action or final status survey reports prepared at the completion of response actions. Data generated by response actions that are not complete were not reviewed. These data will be reviewed for the next five-year review report. Only the conclusions presented in the post-remedial action or final status survey reports regarding compliance with response action goals and future use of the property evaluated are presented in this report. For the complete analysis of the data, please refer to the individual post-remedial action or final status survey reports.

The data presented in the annual environmental monitoring data and analysis reports from CY1998 through CY2002 were also reviewed [*Annual Environmental Monitoring Data and Analysis Report for CY98* (USACE 1999d), *Annual Environmental Monitoring Data and Analysis Report for CY99* (USACE 2000f), *Annual Environmental Monitoring Data and Analysis Report for CY00* (USACE 2001g), *Annual Environmental Monitoring Data and Analysis Report for CY01* (USACE 2002c), and *Draft Annual Environmental Monitoring Data and Analysis Report for CY02* (USACE 2003e)]. Only a summary of the data evaluations is presented here. For a complete presentation and evaluation of the data reviewed, please refer to the annual environmental monitoring data and analysis reports for each CY.

Ground-Water Monitoring

Ground-water monitoring is conducted at the SLS to meet several general objectives. These objectives are to:

- determine background-water quality at each of the SLS;
- identify potential effects on ground-water quality resulting from removal and remedial actions;
- obtain requisite data to evaluate response action performance; and
- ensure compliance with the SLDS ROD (USACE 1998c) requirements.

Pursuant to the above objectives, comparison values were established to evaluate ground-water data obtained under the ground-water monitoring program for the SLS. These comparison values are derived from the SLDS ROD (USACE 1998c), environmental regulatory programs, and from North St. Louis County sites background conditions for shallow and deep ground water presented in the Feasibility Study (FS).

The regulatory-based values considered for evaluation of HU-A ground-water data from the SLDS are the MCLs, secondary MCLs (SMCLs), and MCL goals of the Safe Drinking Water Act.

The regulatory-based values considered for evaluation of all ground-water data from the North St. Louis County sites are the MCLs, SMCLs, and MCL goals of the Safe Drinking Water Act.

North St. Louis County sites ground-water data are also compared to ground-water quality criteria promulgated by the MDNR under 10 CSR 20-7 and health-based advisories for ground-water quality included under 10 CSR 20-7 Table A Class I and VII.

Beginning in CY2000, North St. Louis County sites ground-water data were also compared to background values developed for the North St. Louis County sites FS (USACE 2003b). Background values for just the hydrostratigraphic zone of intrest (HZ-E or the protected aquifer) at the North St. Louis County sites were re-evaluated to fully consider additional available data. HZ-C overlies the jointed HZ-E bedrock, so that the HZ-C water represents the water quality of the HZ-E, whose water is difficult to extract. Thus, HZ-C is a surrogate for HZ-E. Additional monitoring wells and proper sampling protocols for all wells provided adequate basis for evaluation of the HZ-C/HZ-E water's background. The background was detailed and specified in the Environmental Monitoring Data and Analysis Report for CY 2002. As such, the background values were revised based on additional available data. The comparison values for North St. Louis County sites ground-water data will be revised when a final ROD is issued for the North St. Louis County sites. Ground-water data from HU-B at the SLDS are compared to the ILs established in the SLDS ROD (USACE 1998c) and to MCLs if an IL was not established. Prior to August 2003, both filtered and unfiltered samples were collected from St. Louis Sites ground-water wells. Currently only unfiltered samples are collected.

The following table summarizes those background values that have changed.

Table VI-4. Revised Background Values for North St. Louis County Sites HZ-C/HZ-E Hydrostratigraphic Zones

Chemical	Background	Revised Background	Units
Antimony		4	µg/L
Arsenic	82.7	180	µg/L
Barium	424	1,400	µg/L
Cadmium		2	µg/L
Chromium		13	µg/L
Molybdenum	0	68	µg/L
Nickel	1.1	18	µg/L
Radium-226	1.03	4	pCi/L
Radium-228		NR	pCi/L
Selenium		2	µg/L

Table VI-4. Revised Background Values for the North St. Louis County Sites HZ-C/HZ-E Hydrostratigraphic Zones (Cont'd)

Chemical	Background	Revised Background	Units
Thallium	0	7	μg/L
Thorium-228	0.62	2	pCi/L
Thorium-230	0.63	4	pCi/L
Thorium-232		2	pCi/L
Total Uranium		7	pCi/L
Uranium-234	0	~4	pCi/L
Uranium-235		NR	pCi/L
Uranium-238	0.11	~3	pCi/L
Vanadium		18	μg/L

NR = Not Reported – no detectable samples for that analyte

For those wells where sufficient data were available to evaluate a trend, the unfiltered groundwater data were evaluated using Mann-Kendall statistical testing. The Mann-Kendall trend analysis was performed at a 95% level of confidence. The complete results of the testing for the SLS are presented in EMDAR CY2002 (USACE 2003e). Statistically significant trends do not always reflect actual trends. The Mann-Kendall test does not consider the effects of measurement error and does not provide any information concerning the magnitude of the trends, so time-concentration plots were used to evaluate these factors.

HISS

Stratigraphy

The stratigraphy beneath the HISS is similar to that found at the SLAPS, with the exception that the shale unit (HZ-D) is absent at the HISS. Four HZs (HZ-A through HZ-C and HZ-E) are present at the HISS. These HZs are the shallow HZ-A, comprising the Unit 1 Fill, Unit 2 Loess, and Subunit 3T Silty Clay; the intermediate depth HZ-B, comprising the Subunit 3M Clay; the deep HZ-C, comprising the Subunit 3B silty clay and Unit 4 clayey to sandy gravel; and the protected deep HZ-E, comprising the Mississippian Limestone. HZ-A and HZ-B are often referred to as the upper zone, while HZ-C and HZ-E are referred to as the lower zone. With the exception of monitoring wells HISS-5D and HW23, which are screened in the HZ-C, all of the monitoring wells at the HISS are screened in the HZ-A. HW22 and HW23 are upgradient wells installed to assist in evaluating background conditions.

Sampling Program

Sampling was conducted at 17 ground-water monitoring wells in CY1998. Arsenic, cadmium, manganese, selenium, total U, and trichloroethene (TCE) were detected in HZ-A ground-water samples above their respective MCLs or SMCLs. No exceedences were noted in the HZ-C well samples. Although manganese and TCE were detected in HZ-A, they have been determined in the North St. Louis County sites FS not to be MED/AEC COCs. It should be noted that USACE screens for TCE and manganese as well as other metals to confirm that excavation water is properly treated and meets release requirements.

During CY1999, 15 ground-water monitoring wells were sampled at the HISS. Arsenic, cadmium, manganese, selenium, total U, and TCE were detected in HZ-A ground-water samples above their respective MCLs or SMCLs. No exceedences were noted in the HZ-C well samples.

Three monitoring wells (HW23, HW24, and HW25) were installed during CY2000. Therefore, 18 ground-water monitoring wells were sampled at the HISS for this calendar year. Arsenic, iron, manganese, selenium, Ra-226, Total U, TCE, and 1,2-dichloroethene (DCE) were detected at concentrations above their respective MCLs or SMCLs in samples from several HZ-A wells. Th-230 was detected in HZ-A ground-water samples above its background value. No exceedences were noted in the HZ-C well samples.

Sampling was also conducted at 18 ground-water monitoring wells at the HISS during CY2001. Arsenic, iron, manganese, selenium, Ra-226, Total U, TCE, and 1,2-DCE were detected at concentrations above their respective MCLs or SMCLs in samples from several HZ-A wells. Constituents exceeding their respective MCLs or SMCLs in samples collected from the two HZ-C wells included arsenic, manganese, and thallium. The maximum concentrations of arsenic also exceeded its expected background level.

During CY2002, 15 ground-water monitoring wells were sampled at thc HISS. The locations of the ground-water monitoring wells are shown on Figure VI-1. The CY2002 data indicated localized effects on the HZ-A ground water from site-related constituents. Arsenic, manganese, selenium, Ra-226, and TCE were detected above their respective MCLs or SMCLs in samples from one or more HZ-A wells. The sampling results for HZ-C ground water indicate that arsenic and manganese had average concentrations that exceeded their respective MCLs or expected background concentrations for the HZ-C ground water.

Trend Analysis

A Mann-Kendall statistical trend analysis was conducted to determine if concentrations of arsenic, selenium, total uranium, and Th-230 are increasing or decreasing over time in samples from HZ-A wells. The test was performed on eight HZ-A wells (HISS-01, HISS-06, HISS-07, HISS-14, HISS-16, HISS-17S, HISS-20S, and HW21) that have yielded samples with selenium concentrations above its corresponding MCL at least once in the period from the winter of CY1997 through winter CY2002. Based on the trend analysis, a decreasing trend in selenium concentrations was observed at HISS-20S, primarily due to elevated concentrations of selenium during the 1999 sampling event. Samples from HISS-14 located near the eastern edge of the site exhibited increasing selenium concentrations. The cause of the increasing selenium concentrations is not known, but the increase appears to be of small magnitude, based on the time-concentration plot shown in Figure VI-2. The best fit trend lines for the selenium time-concentration plots are shown as dashed lines in Figure VI-2. Samples from the five remaining wells exhibited no concentration trends for selenium.

Arsenic has been detected at elevated levels in only a single well, HISS-19S. The concentrations of arsenic in samples from Well HISS-19S appear to be increasing over time based on the results of the Mann-Kendall test and the time-concentration plot shown in Figure VI-2. The cause of the increasing arsenic concentrations in this well is not known.

The Mann-Kendall trend analysis was conducted for total uranium on ground-water samples collected from HZ-A Wells HISS-01, HISS-06 and HW21. The complete analysis is presented in the EMDAR CY2002 (USACE 2003e). Samples from these wells have yielded total uranium concentrations above its corresponding MCL. The trend analysis was also conducted on seven wells (HISS-07, HISS-10, HISS-14, HISS-16, HISS-17S, HISS-20S, and HW22) that yielded samples with total uranium concentrations less than its corresponding MCL but with a greater than 80 percent detection rate and at least seven rounds of data. The Mann-Kendall test indicated a decreasing trend in total uranium concentrations for two HZ-A wells, HISS-01 and HISS-07. The Mann-Kendall test indicated a decreasing trend in total uranium concentrations for HISS-01 and HISS-07. However, this statistical test does not take into account the range of error inherent in the analytical measurements (the error bars are shown in Figure VI-2 are bracketed vertical lines). When the potential error in the measurement is taken into account, the ranges associated with the total uranium values in HISS-01 and HISS-07 are generally wider than the magnitude of the trend. This indidcates that the determination of an overall trend is inconclusive. A "no trend" line for these two wells is shown as a horizontal dashed line on the total uranium graphs in Figure VI-2. Due to the high percentage of non-detect (ND) values (greater than 20 percent ND), the Mann-Kendall trend analysis could only be performed on Th-230 for samples from wells HISS-10 and HISS-11. The results of the trend analysis indicated no statistically significant trends in Th-230 concentrations.

The Mann-Kendall trend analysis was conducted for HZ-C Wells HISS-05D and HW23 for the following constituents: arsenic, iron, and manganese. The results of the analysis indicate that there is a downward trend in manganese concentrations in HISS-05D.

Only wells with a greater than 80 percent detection rate and at least seven rounds of data are included in this report. Graphs of the trend analysis at the HISS are shown in Figure VI-2.

SLAPS and SLAPS VPs

Stratigraphy

There are five HZs recognized beneath the SLAPS and its adjacent VPs. These HZs are the shallow HZ-A, comprising the Unit 1 Fill, Unit 2 Loess, and Subunit 3T Silty Clay; the intermediate depth HZ-B, comprising the Subunit 3M Clay; the deep HZ-C, comprising the Subunit 3B silty clay and Unit 4 clayey to sandy gravel; HZ-D, comprising the Interbedded Pennsylvanian rock and shale; and the protected deep HZ-E, comprising the Mississippian Limestone. HZ-A and HZ-B are often referred to as the upper zone, while HZ-C, HZ-D, and HZ-E are referred to as the lower zone. Although the ground-water monitoring well network extends beyond the borders of the SLAPS to its associated VPs, the network is referred to as the SLAPS monitoring well network.

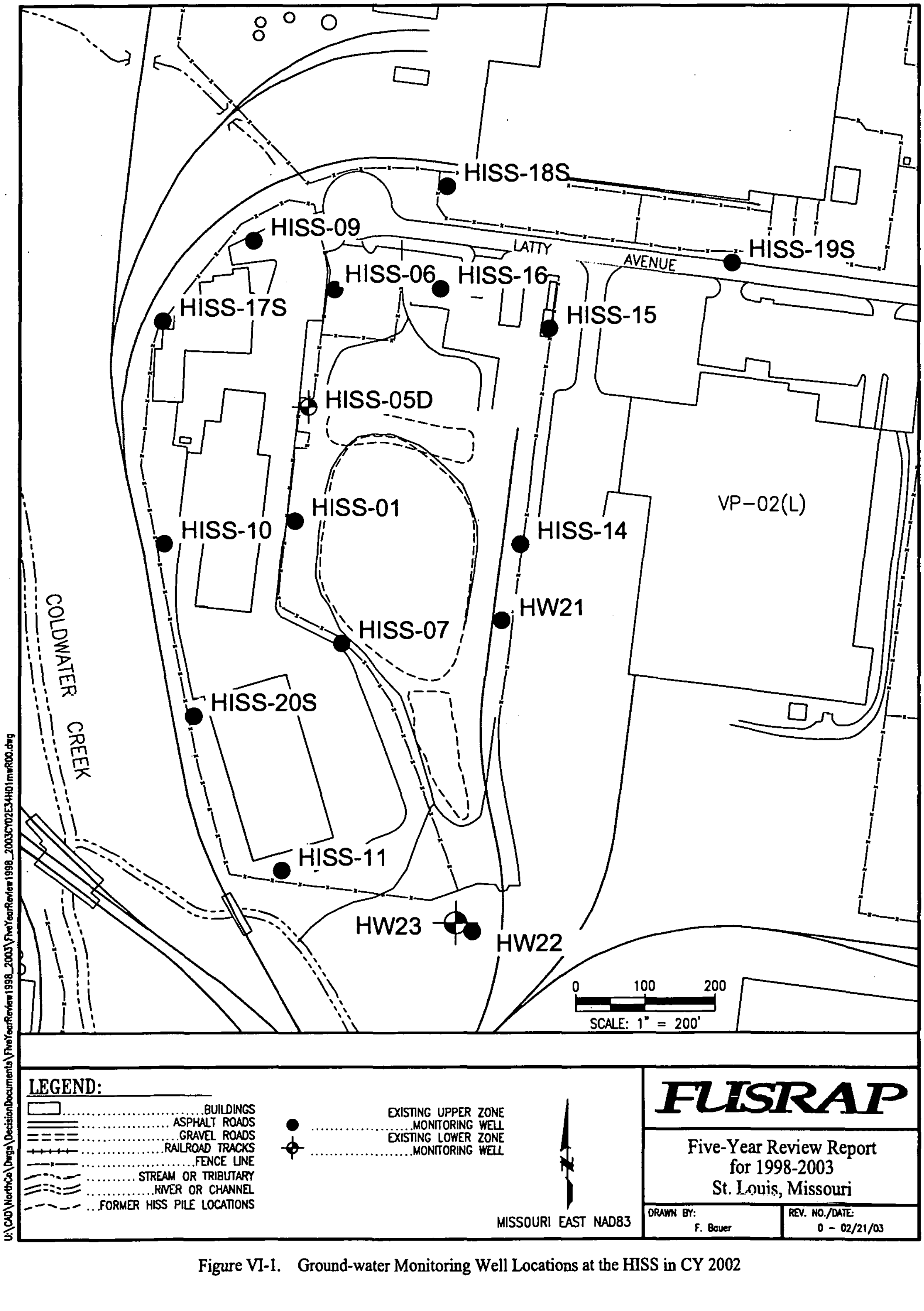
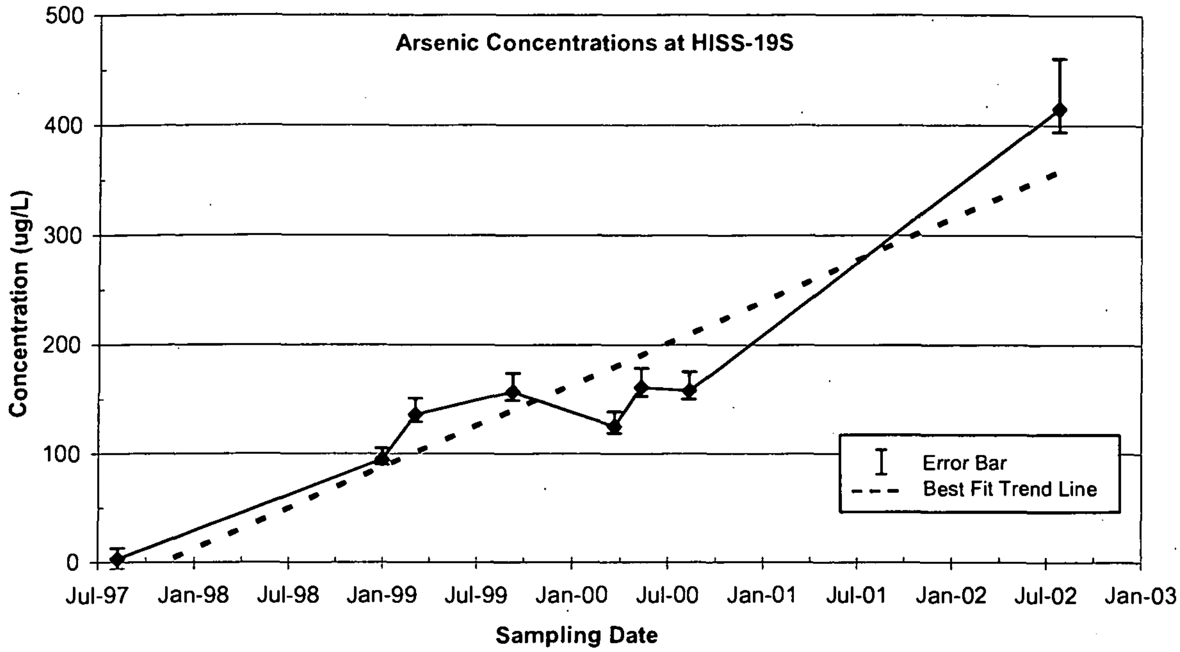
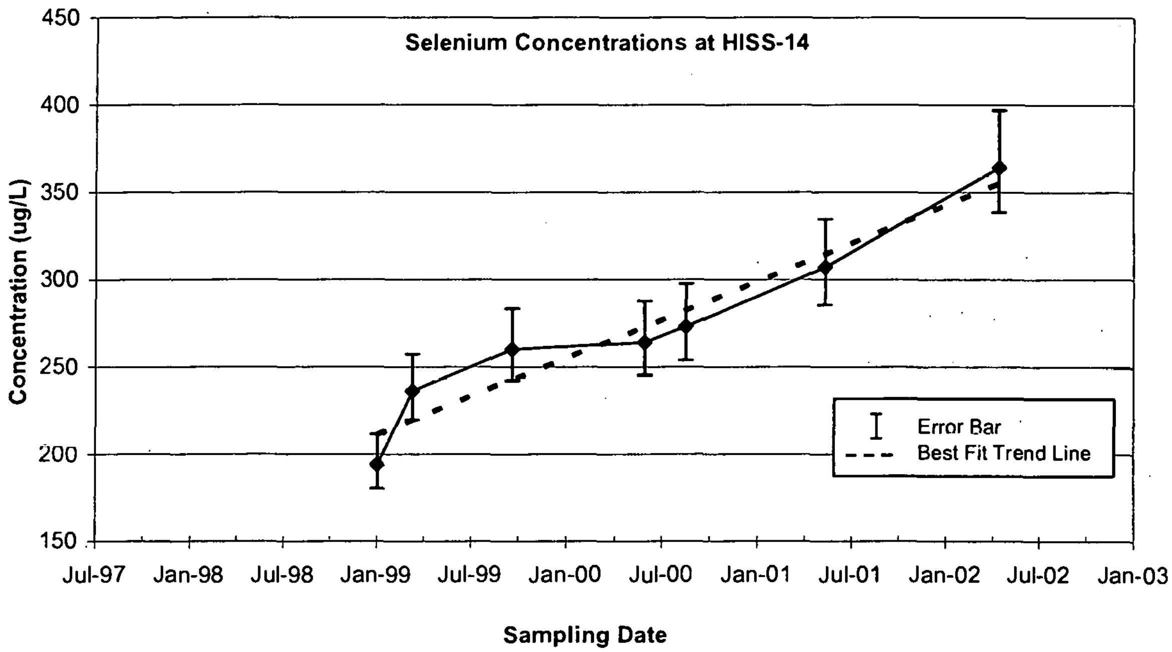


Figure VI-1. Ground-water Monitoring Well Locations at the HISS in CY 2002

Figure VI-2. Trend Analysis at the HISS



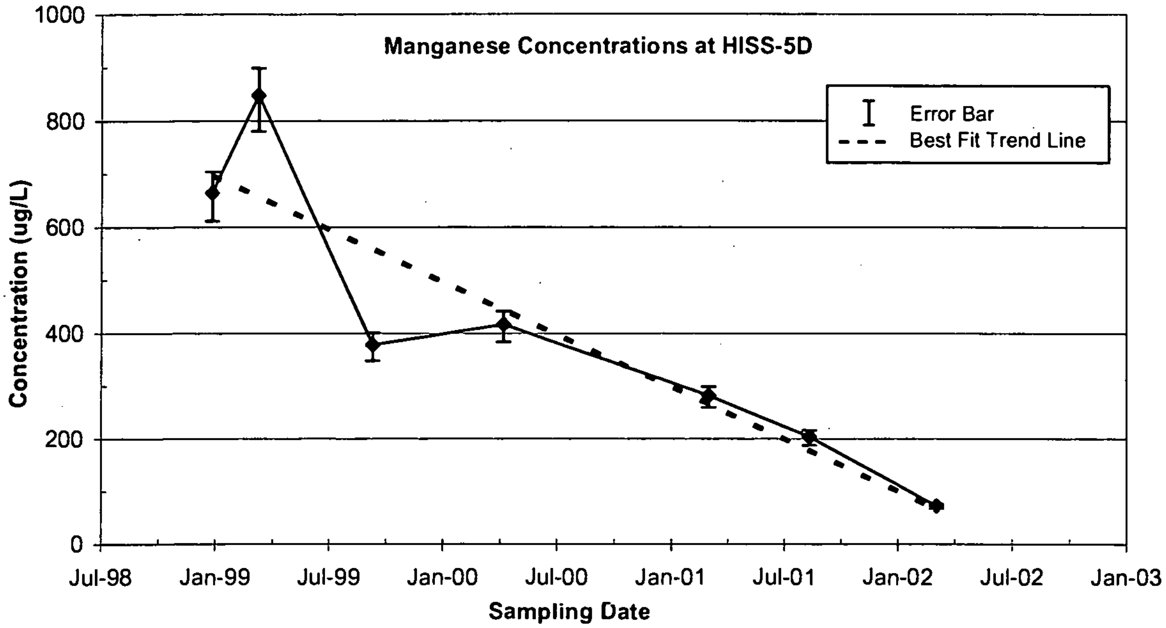


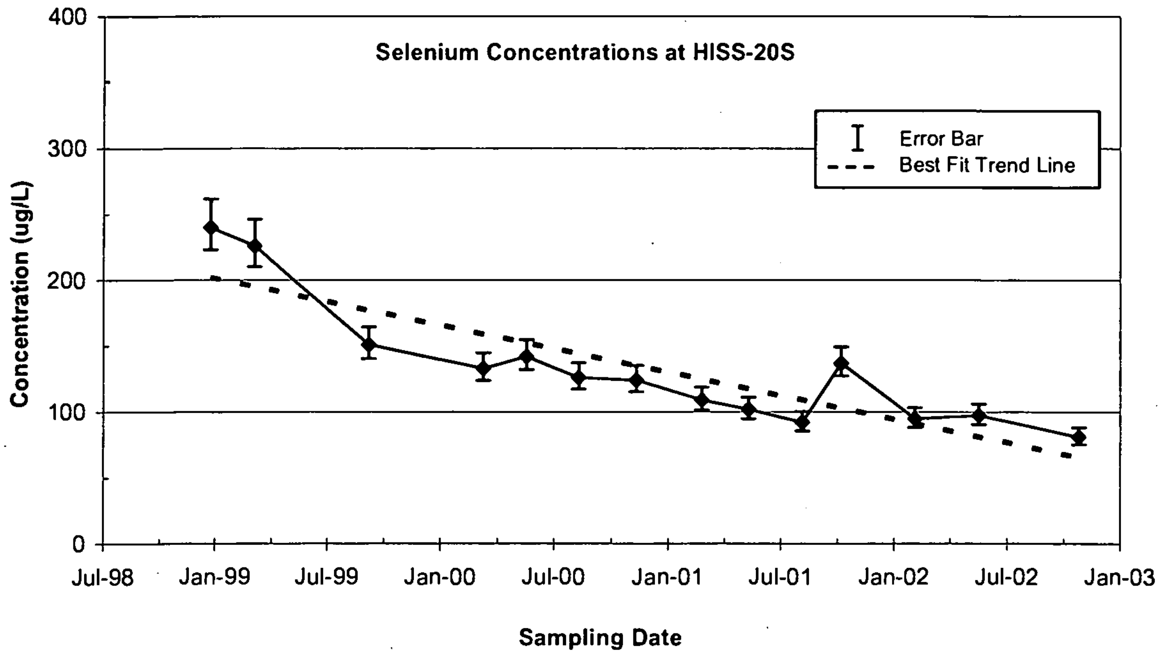
Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-2. Trend Analysis at the HISS (Continued)



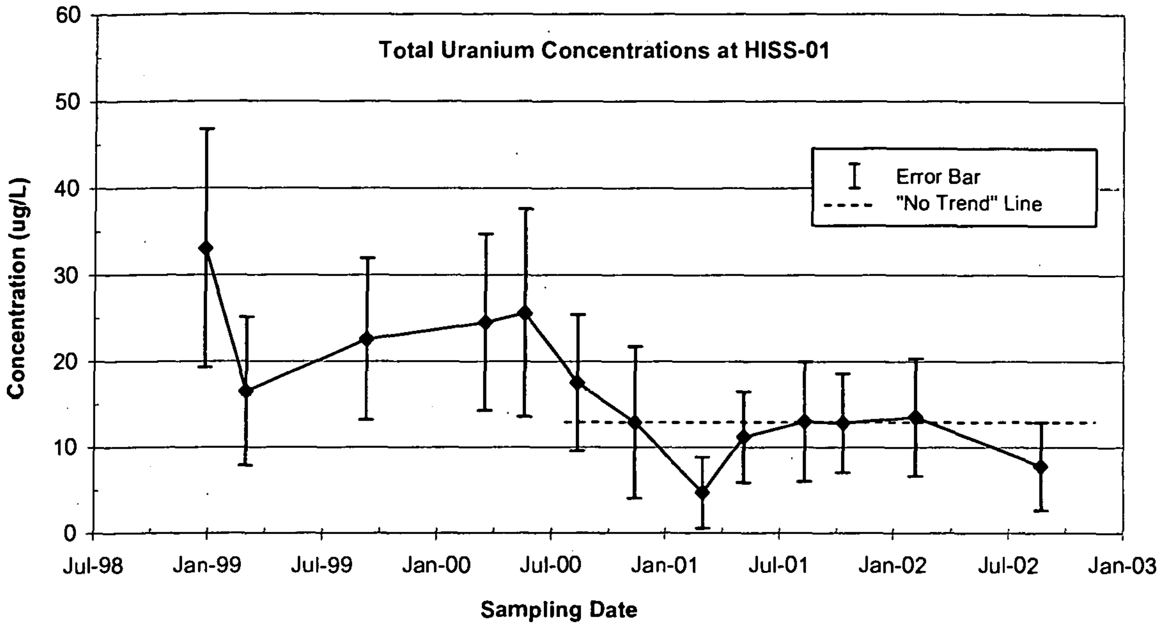


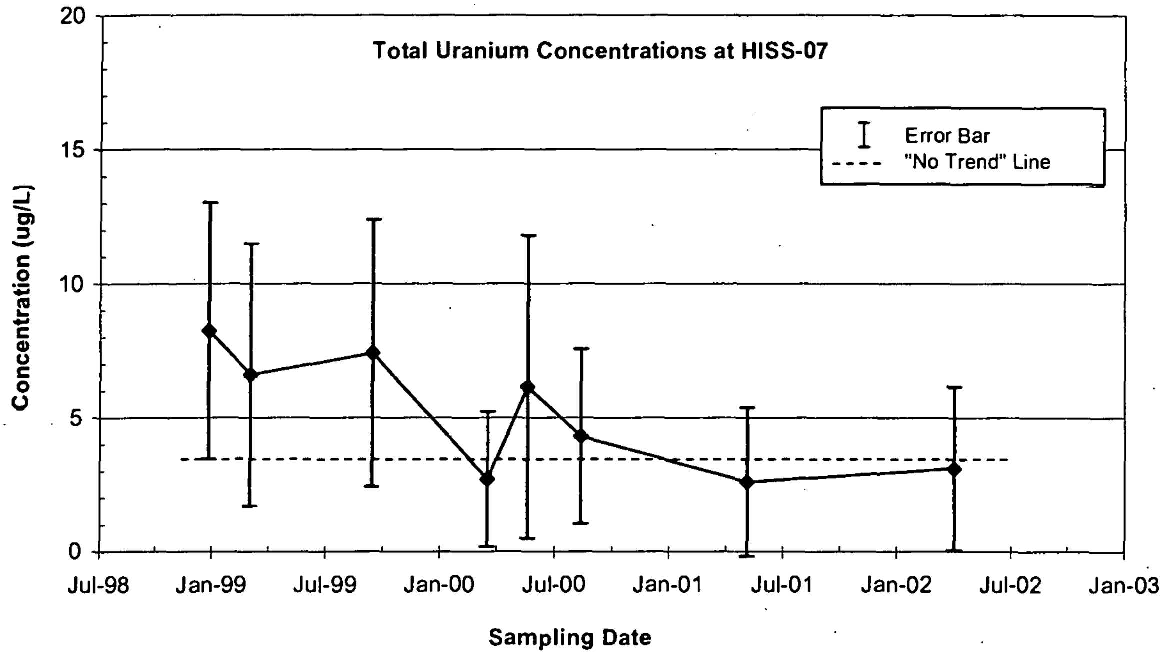
Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-2. Trend Analysis at the HISS (Continued)





Notes:

The error bar represents ± the sum of the measurement error for U-234, U-235, and U-238.

Sampling Program

In CY1998, the SLAPS monitoring well network consisted of 38 ground-water monitoring wells. Four monitoring wells were installed in CY1998 to fill data gaps pertaining to subsurface lithology, hydraulic gradient, and ground-water quality issues. Seven monitoring wells were concurrently abandoned due to their proximity to removal actions being conducted on the SLAPS proper. Twenty-eight wells were sampled in July and August of 1998, and 38 wells were sampled in the fourth quarter of 1998. Arsenic was detected above its corresponding MCL in several upper and lower zone well samples. Total uranium, selenium, and TCE were detected above their respective MCLs in several upper zone well samples.

The network consisted of 41 wells, but only 38 were sampled in CY1999. Five HZ-A wells yielded total uranium concentrations above the corresponding MCL in CY1999. Selenium and TCE were detected above their respective MCLs in the upper zone. Arsenic was present in lower zone samples above its corresponding MCL.

Forty-six ground-water wells were sampled in CY2000 at the SLAPS. Five of these wells (PW39 through PW43) were installed during CY2000, with sampling initiated in the third quarter of the calendar year. These wells were placed in areas where ground-water information was needed to provide insight into contaminant migration and surface water effects. Results of the ground-water sampling conducted during CY2000 indicate that metal, radionuclide, and organic constituents were present above MCLs or SMCLs in HZ-A ground-water samples collected at the SLAPS. These constituents included the metals arsenic, chromium, iron, manganese, nitrate,selenium, and thallium; the radionuclides Ra-226 and total uranium; and the organics 1,2-DCE and TCE. Additional radionuclides, in particular Th-230, U-234, U-235, and U-238, were detected in HZ-A ground water but have no designated MCLs or SMCLs. Arsenic, iron, and manganese were present above MCLs or SMCLs in ground-water samples from the lower zone. In addition, Ra-226 for CY2000 was detected at levels slightly exceeding the MCL in samples from four wells screened in HZ-C. None of these wells are on the SLAPS.

Forty-six ground-water wells were sampled in CY2001 at the SLAPS. Metal (arsenic, chromium, iron, manganese, nitrate, selenium, and thallium), radionuclide (Ra-226, Th-230, U-234, and U-238), and organic (TCE and 1,2-DCE) constituents were detected above MCLs, SMCLs, and/or background values in HZ-A ground-water samples. Arsenic, iron, and manganese were also present above MCLs or SMCLs in samples from the lower zone. In CY2001, total uranium and Ra-226 were not detected above their respective MCLs in samples from any wells screened exclusively across the lower zone. Th-228 and Th-230 were detected in samples from wells screened in the lower zone, but their maximum concentrations were only slightly above expected background levels.

Forty-six ground-water wells were also sampled in CY2002 at the SLAPS. The locations of the ground-water monitoring wells at the SLAPS are shown on Figure VI-3. The CY02 sampling results indicate that various metals, radionuclides, and organic compounds are present at elevated levels in HZ-A ground water at the SLAPS. Based on the CY2002 data, the principal inorganic contaminants in shallow HZ-A ground water at the site include arsenic, chromium, iron, manganese, nitrate, selenium, and thallium, which were detected above their respective MCLs, SMCLs, and/or background values in HZ-A ground-water samples. The radionuclides Ra-226, Th-230, U-234, and U-238 were also detected above their respective MCLs, SMCLs and/or background values in HZ-A ground-water samples. Additionally, the organic constituents TCE and 1,2-DCE were detected at concentrations above their respective MCLs in several shallow zone wells. Arsenic, iron, and manganese were present above their respective MCLs or SMCLs in samples from the lower zone. Total uranium was not detected in CY2002 above its MCL in any wells screened exclusively across the lower zone. Ra-226, Th-228 and Th-230 were detected in samples from wells screened in the lower zone, but their maximum concentrations were only slightly above expected background levels. The CY2002 data continue to support the determination that HZ-B, Subunit 3M, a relatively impermeable clay layer, is preventing the migration of constituents to lower ground-water zones. The localized constituent concentrations present in HZ-A ground water are not present in the deeper zones, indicating that mixing between HZ-A and HZ-C, HZ-D, and HZ-E ground-water zones is insignificant. In CY2003, two wells were installed in remediated areas of the SLAPS to verify the effectiveness of source removal. The results of sampling in these wells will be discussed in the next five-year review.

Trend Analysis

A Mann-Kendall statistical trend analysis was conducted to assess whether concentrations of arsenic, selenium, and total uranium are increasing (upward trending) or decreasing (downward trending) over time. The Mann-Kendall test does not consider the effects of measurement error, so time-concentration plots were used to evaluate the validity of the Mann-Kendall results. Because concentrations have been consistently low and the incidence of non-detection consistently high, a trend analysis was not performed for Ra-226 or Th-230. Although no organics were identified as COCs for the SLAPS, a statistical analysis was conducted for TCE because elevated concentrations have been consistently detected in several HZ-A wells.

A Mann-Kendall trend analysis was conducted for two HZ-A wells (B53W14S and M10-08S) and 15 HZ-C wells yielding samples showing arsenic concentrations consistently exceeding the MCL since July 1997. The Mann-Kendall results indicate that four HZ-C wells (B53W01D, M10-15D, PW36, and PW42) have statistically increasing trends. However, this statistical test does not take into account the range of error inherent in the analytical measurements. When the potential error in the measurements is taken into account, the errors associated with the arsenic values in B53W01D are generally wider than the magnitude of the trend (Figure VI-4). This indicates that the determination of an overall trend for this well is inconclusive. Two HZ-C wells (B53W12D and MW34-98) have decreasing trends based on the results of the Mann-Kendall test. This statistical test does not take into account the range of error inherent in the analytical measurements. When the potential error in the measurements is considered, the ranges associated with the arsenic values in B53WI2D are generally wider than the magnitude of the trend (see Figure VI-4). This indicates that the determination of the overall trend is inconclusive. For the remaining HZ-C wells, no trend in arsenic concentrations was observed. The lack of a correlation between the arsenic concentrations in the HZ-C ground-water samples and those reported for nearby HZ-A well samples indicates that the increasing arsenic trend in one HZ-C monitoring well on SLAPS cannot be related to FUSRAP-related activities at the SLAPS.

There are several wells screened in HZ-A that have consistently yielded samples from July 1997 through CY2002 with selenium levels above its MCL. A Mann-Kendall trend analysis was performed on the following eight HZ-A wells: B53W09S, B53W13S, B53W17S, M10-15S, MW31-98, MW33-98. PW38, and PW39. Two wells (M10-15S and PW41) showed increasing trends based on the Mann-Kendall test. The Mann-Kendall test does take into consideration the range of error inherent in analytical measurements. When the potential errors in the measurements are taken into account as shown in the time-concentration plots in Figure VI-5, the

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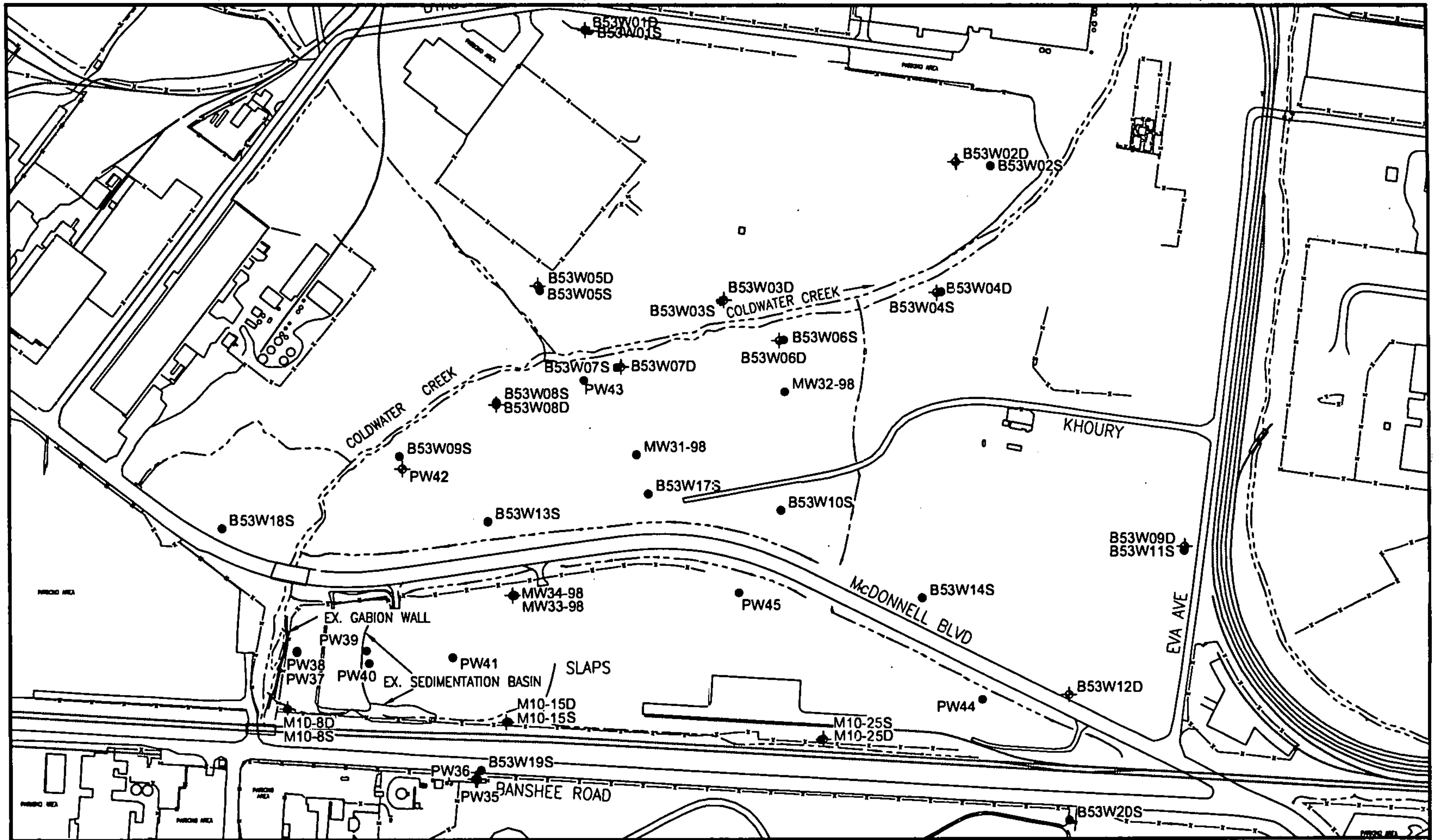


LEGEND:
BUILDINGS
ASPHALT ROADS
GRAVEL ROADS
RAILROAD TRACKS
FENCE LINE
STREAM OR TRIBUTARY
RIVER OR CHANNEL
EXISTING UPPER ZONE MONITORING WELL
EXISTING LOWER ZONE MONITORING WELL

FUSRAP

Five-Year Review Report
for 1998-2003
St. Louis, Missouri

DRAWN BY: F. Bauer
REV. NO./DATE: 0 - 02/21/03

Figure VI-3. Ground-water Monitoring Well Locations at the SLAPS in CY 2002 ranges associated with the selenium values for PW41 and M10-15S show a no trend line which generally falls within the error bars. This indicates that an overall trend for these wells is inconclusive. If there is an increasing trend in these two wells, it may reflect a short-term increase resulting from removal activities being conducted at the SLAPS in the vicinity of the wells. However, continued monitoring will be necessary to determine the cause. Four wells showed decreasing selenium trends (B53W13S, B53W17S, MW33-98, and PW38) based on the Mann-Kendall test. The error measurements associated with the MW33-98 selenium values indicate there is no trend for the sampling data collected since August 2000.

Total uranium concentrations in samples from 16 HZ-A wells were subjected to the Mann-Kendall trend analysis. The analysis was performed on data collected from the fall of CY1998 through CY2002. An increasing trend was observed in two wells (MW33-98 and PW39). The Mann-Kendall statistical test does not take in to account the range of error inherent in the anaylitical measurements. The determination of an overall trend for PW39 is inconclusive, since the error associated with total uranium values is generally wider than the magnitude of the trend (see Figure VI-6). The remaining 14 wells displayed no trend. The increasing concentrations of total uranium in MW33-98, located adjacent to the Radium Pits area, may be related to removal activities that were being conducted in areas located immediately upgradient of the well. Total uranium concentrations remain at non-detect levels in MW34-98, located adjacent to MW33-98, indicating that HZ-C is not being impacted.

A Mann-Kendall trend analysis was performed for TCE on eight wells (B53W13S, B53W17S, MW31-98, MW33-98, PW38, PW39, PW40, and PW41). The results of the analysis indicate that one well (B53W13S) is showing an increasing trend in concentrations and one well (B53W17S) is showing a decreasing trend. As shown in Figure VI-7, the magnitude of the decreasing TCE trend for B53W17S is generally within the limits of the measurement error, indicating that the determination of an overall trend for this well is inconclusive. The magnitude of the increasing TCE trend for B53W13S is very small (i.e., an increase from 4 ug/L to 12 ug/L over the five-year period from July 1997 to September 2002). The sampling results may indicate that TCE is present due to a discrete release of TCE in the vicinity of B53W17S in the past. In addition to TCE, the TCE degradation product 1,2-DCE has been detected in the area. These detections suggest that some degradation of TCE is occurring in this area. The gradually increasing concentrations in downgradient well B53W13S may indicate that TCE is continuing to migrate slowly westward from the source area.

Only wells with a greater than 80 percent detection rate and at least seven rounds of data are included in this report. Graphs of the trend analysis at the SLAPS are shown in Figures VI-4 through VI-7.

SLDS

Stratigraphy

Ground water at the SLDS is found within three HUs. These HUs are the upper, HU-A unit, which consists of fill overlying clay and silt; the lower, Mississippi Alluvial Aquifer, referred to as HU-B; and the limestone bedrock, referred to as HU-C.

Sampling Program

The SLDS ROD (USACE 1998c) requires the implementation of a long-term ground-water monitoring program at the site. The selected remedy includes the installation and monitoring of perimeter ground-water monitoring wells on a long-term basis. The goal of the ground-water monitoring program is to monitor the protection of the potentially usable HU-B ground water and establish the effectiveness of the source removal action.

Regular monitoring of the SLDS HU-A and HU-B ground water was initiated in late CY1998 pursuant to issuance of the SLDS ROD (USACE 1998c). A baseline-sampling event had been conducted previously, in December 1997 and January 1998. Fifteen wells were sampled for radiological, metal, and organic parameters in late CY1998. Arsenic, magnesium, selenium, and total uranium were detected in HU-A ground-water samples above their respective regulatory-based values. No ILs or MCLs were exceeded in HU-B well samples.

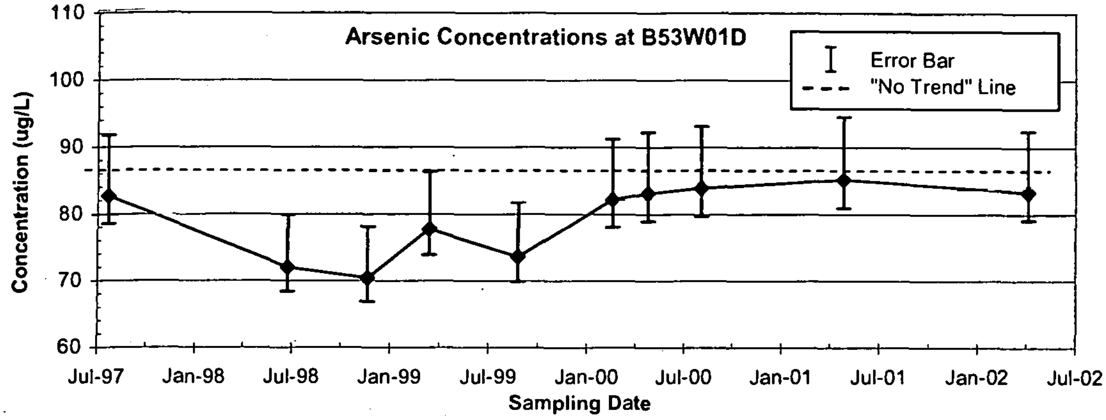
Eight new ground-water monitoring wells were installed prior to CY1999. These wells were identified as DW14, DW15, DW16, DW17, DW18, DW19, DW20, and DW21. Thus, 23 wells were sampled in CY1999. Ground-water samples from four HU-A wells and one HU-B well (DW19) exhibited total uranium concentrations above the MCL and IL of 20 μg/L, respectively. Ground-water samples from several HU-A and HU-B wells exhibited arsenic concentrations above its IL and the MCL. The only exceedence of the cadmium MCL was the HU-A Well B16W10S. Ra-226 exceeded its corresponding MCL in only one sample from one HU-A well, DW20. Samples from 22 of the 23 wells were collected in CY2000. Well DW20 was not sampled because the well rarely contained appreciable amounts of water. Ground-water samples from at least one HU-A and HU-B well exhibited arsenic and total uranium concentrations above their respective IL and MCL. Ra-226 concentrations exceeded its corresponding MCL in one HU-A well and one HU-B well.

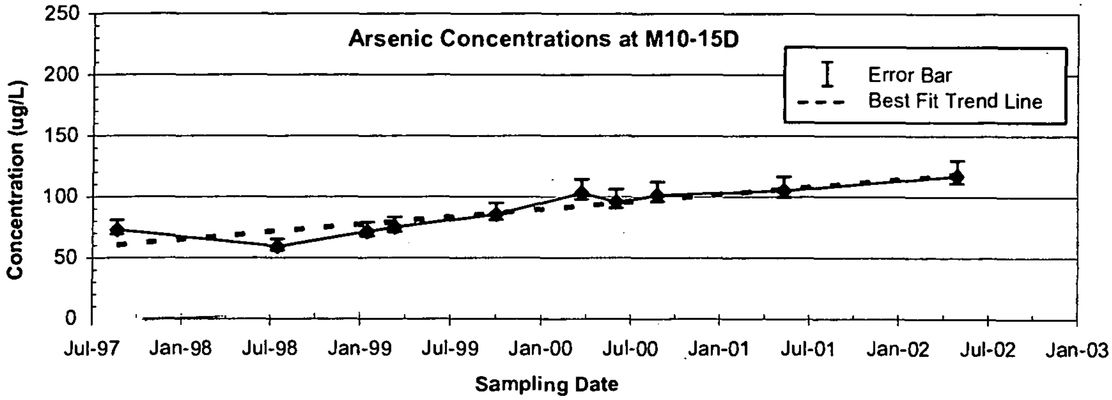
One new ground-water monitoring well, DW22R, was installed at the SLDS in CY2001. This well is located on DT-8 and is intended to serve as an upgradient monitoring well for HU-B ground water at the SLDS. Data from this well will be used to determine background concentrations for the COCs in the HU-B ground water. Twenty-three wells were sampled in CY2001, including well DW22R. Well DW20 was not sampled in CY2001. Arsenic and total uranium exceeded their respective IL in more than one HU-A ground-water sample and more than one HU-B ground-water sample during CY2001. Ra-226 was detected only once above its MCL in one HU-A ground-water sample and more than once above its MCL in HU-B ground-water samples. Cadmium was detected only once above its IL in one HU-A well ground-water sample. Because significant exceedences of the ILs for arsenic and total uranium had been observed in the HU-B ground-water samples, the GRAAA was initiated in CY2001. Phase I of the GRAAA, the assessment phase, was completed in CY2002. Results of the Phase I indicate there is a need to conduct Phase II, the investigative phase.

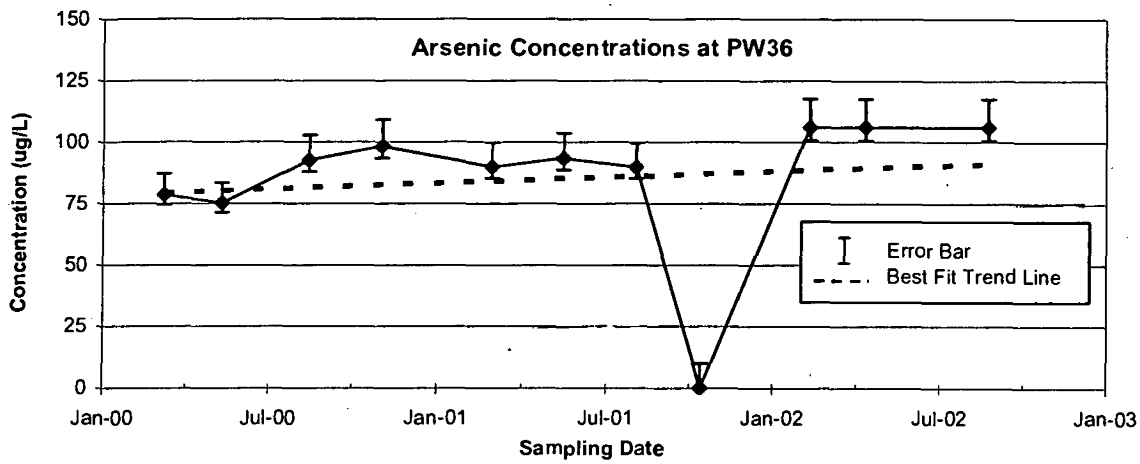
Ground-water monitoring well DW20 was transferred to Mallinckrodt in the fourth quarter of CY2001 and is no longer included in the monitoring well network for the SLDS. Four monitoring wells (B16W05S, B16W05D, B16W11S, and DW22) were decommissioned in late CY2001.

The locations of the ground-water monitoring wells at the SLDS are shown in Figure IV-8. The CY2002 ground-water monitoring results indicated that ILs for arsenic and total uranium continued to be exceeded in both HU-A and HU-B ground-water samples. Monitoring wells DW14 and DW15 exceeded the IL for arsenic. Significant exceedance of the total uranium IL in DW19 occurred. Ra-226 was generally detected at low frequencies in both HU-A and HU-B ground-water samples. Cadmium was not detected in any samples from HU-A or HU-B wells.

Figure VI-4. Trend Analysis at the SLAPS - Arsenic





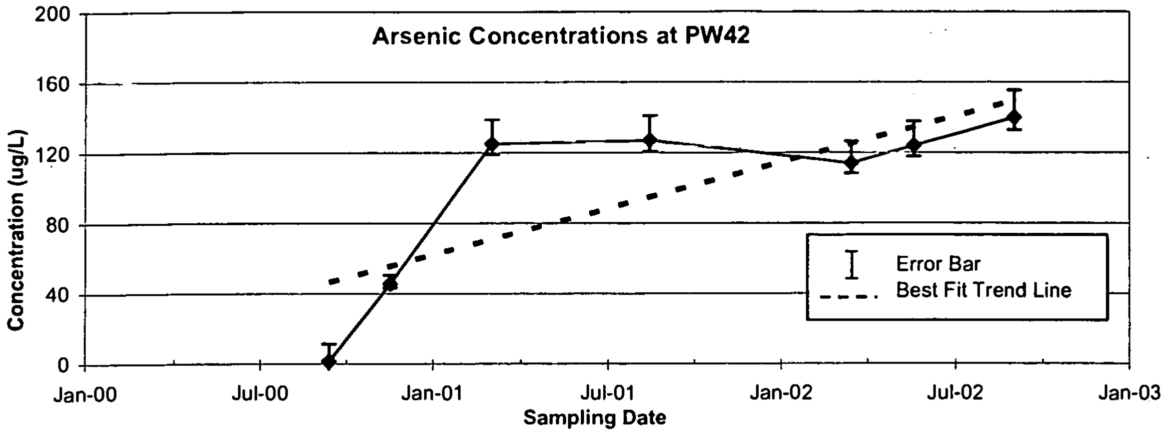


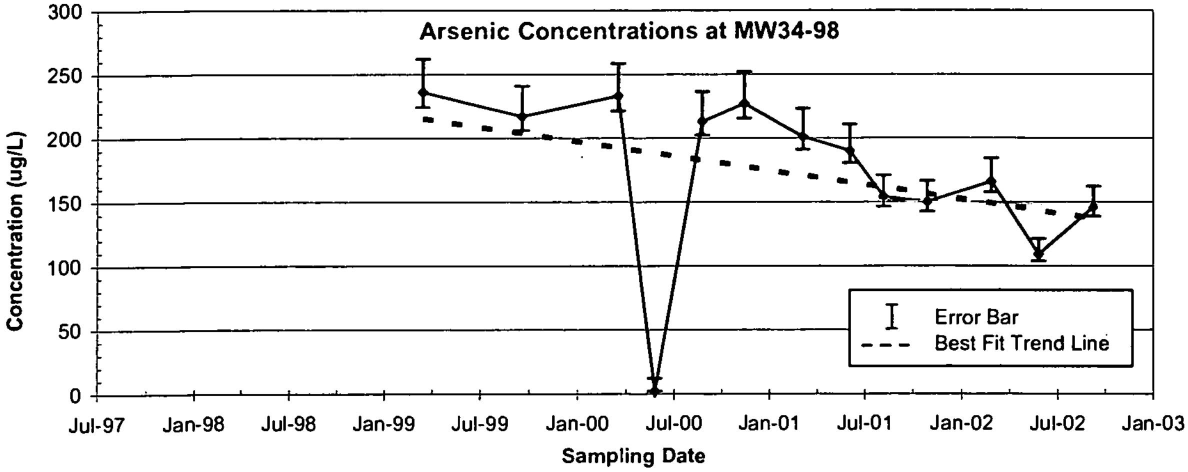
Notes:

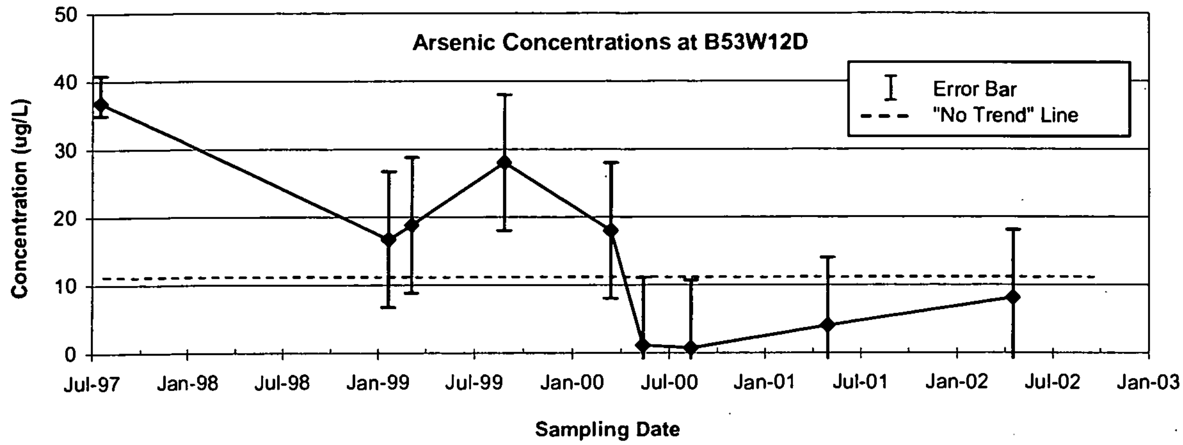
For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-4. Trend Analysis at the SLAPS - Arsenic (Continued)





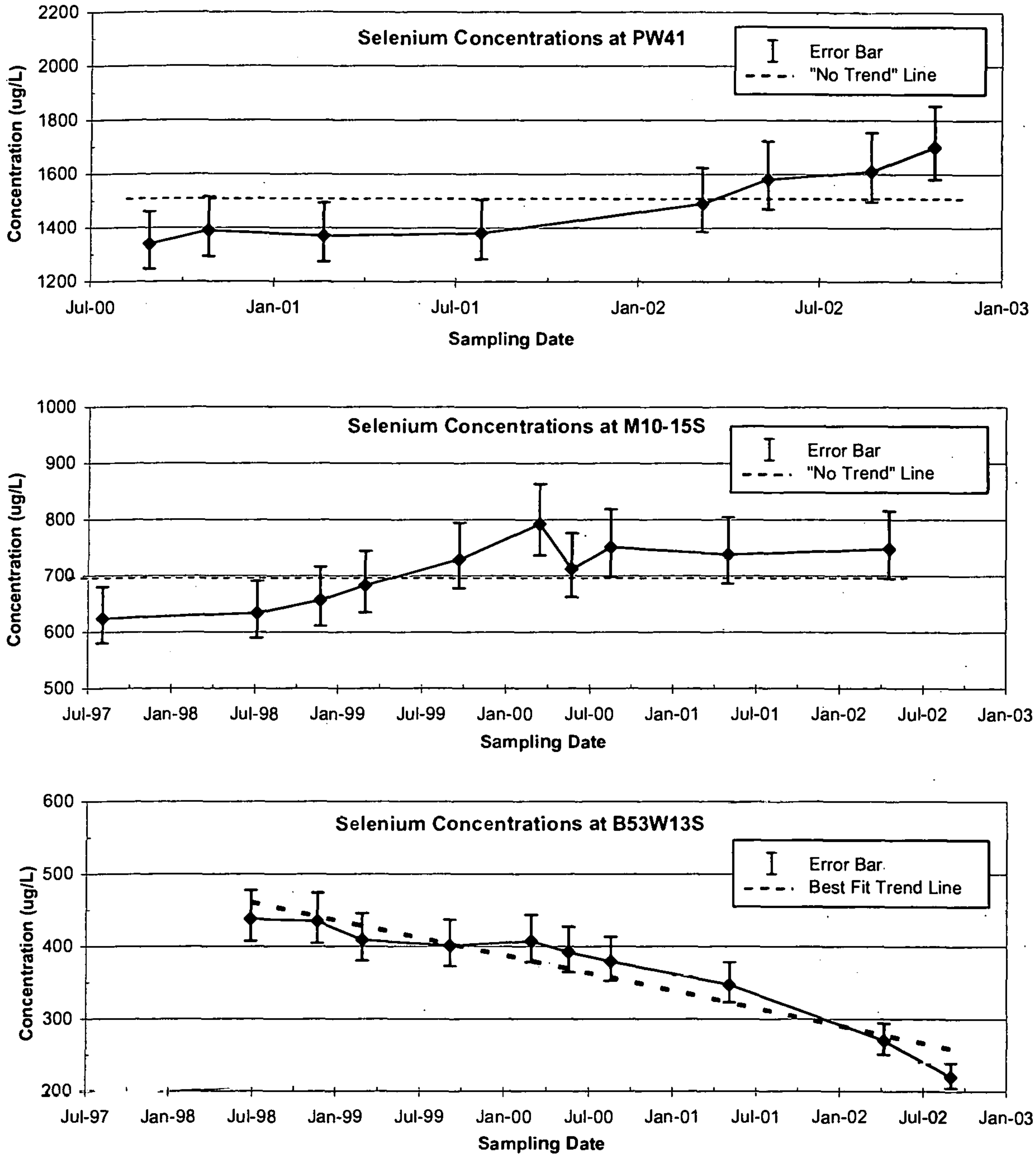


Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-5. Trend Analysis at the SLAPS - Selenium

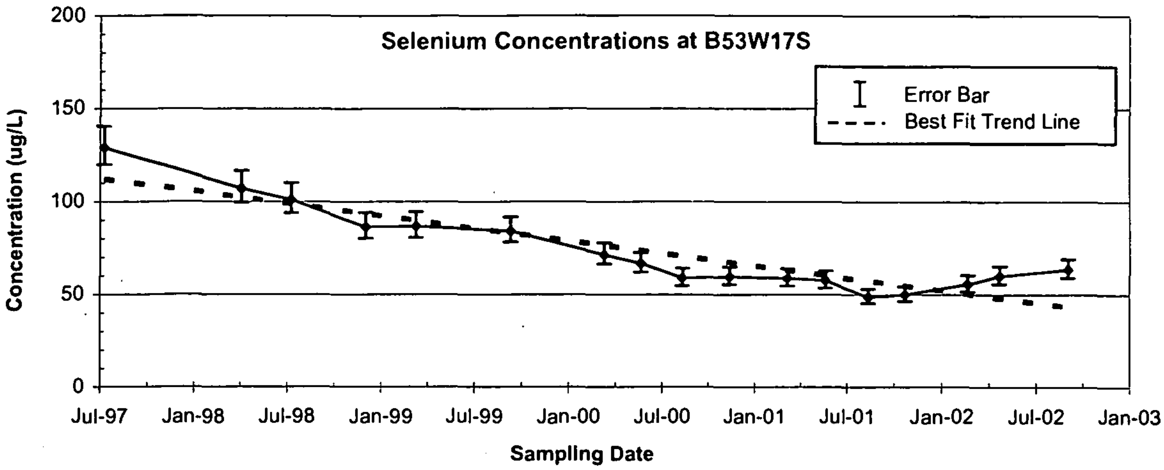


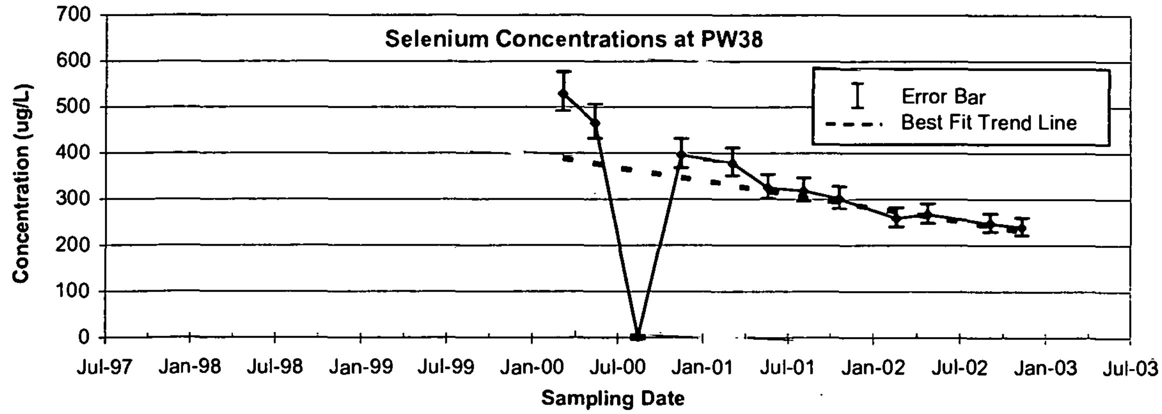
Notes:

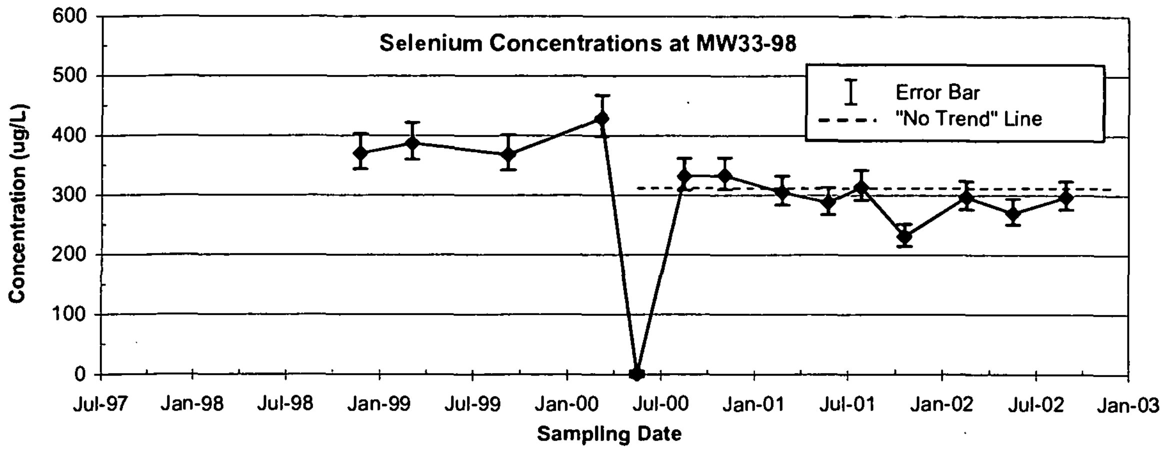
For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-5. Trend Analysis at the SLAPS - Selenium (Continued)





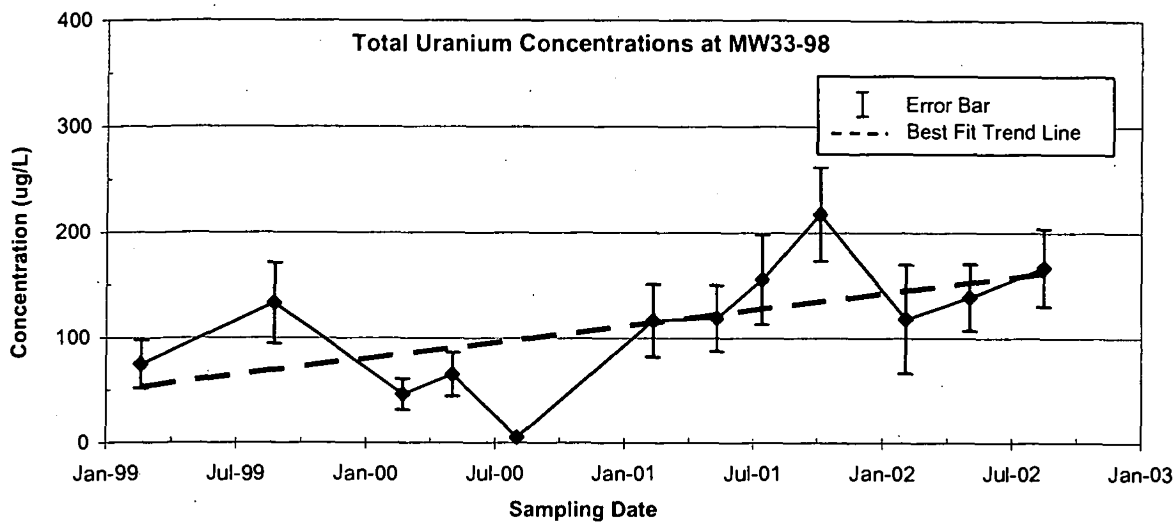


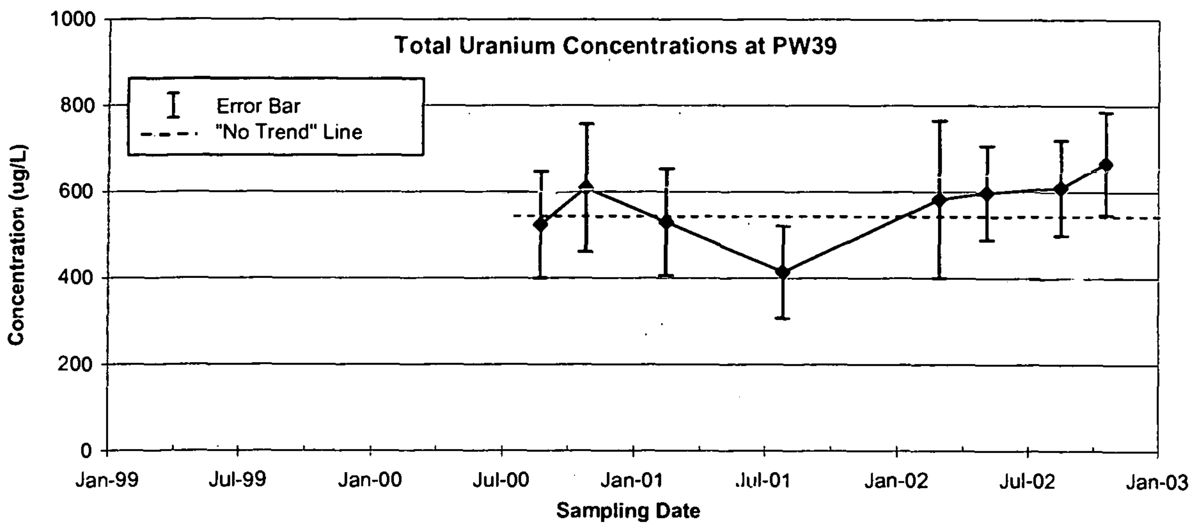
Notes:

For results less than 3 times the reporting limit (RL), the error bar represents ±RL

For results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

Figure VI-6. Trend Analysis at the SLAPS - Total Uranium

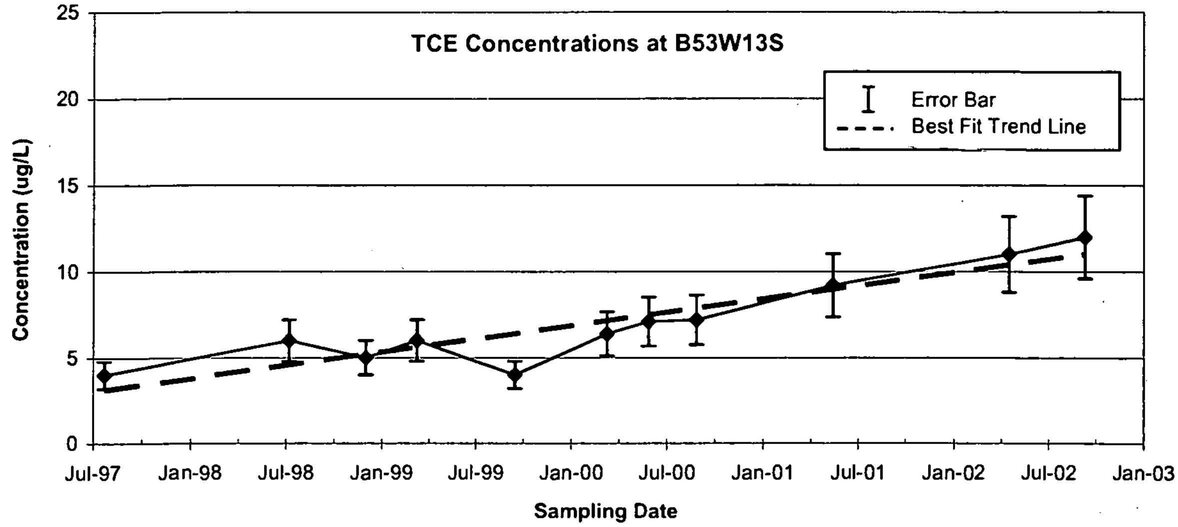


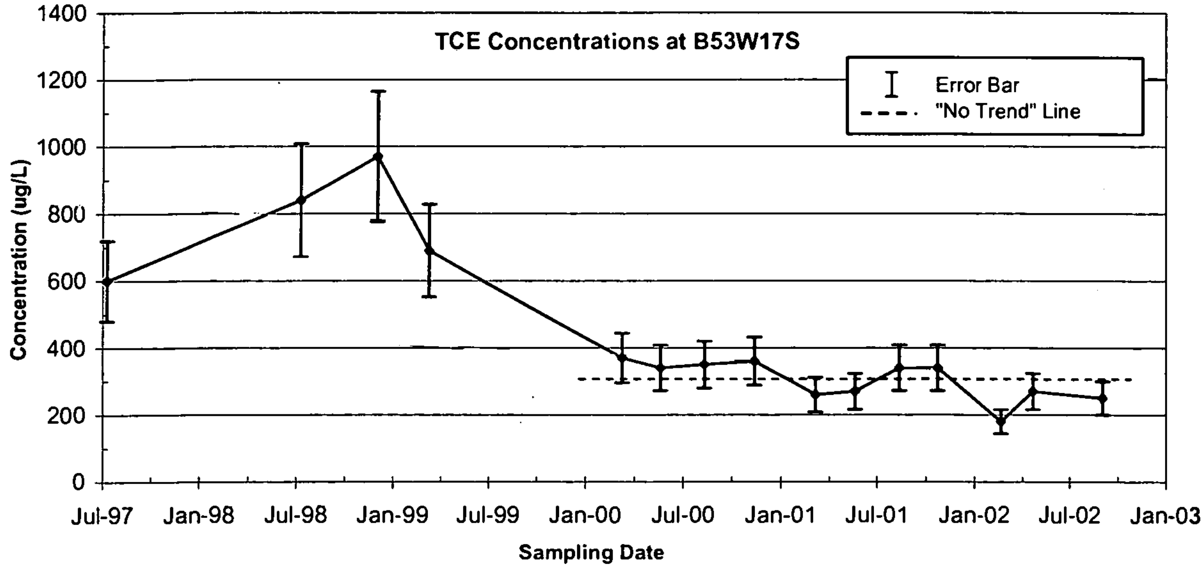


Notes:

For total uranium, the error bar represent ± the sum of the measurement error for U-234, U-235, and U-238.

Figure VI-7. Trend Analysis at the SLAPS - Trichloroethene





Notes:

For TCE, the measurement error was assumed to be ±20%

Trend Analysis

A quantitative evaluation of arsenic and total uranium concentration trends in both HU-A and HU-B unfiltered ground-water samples was conducted on available sampling data for the period from January 1999 through December 2002. The complete analysis is presented in USACE 2003d.

These trends were evaluated using Mann-Kendall testing. A Mann-Kendall trend analysis was conducted on those wells having at least seven sampling events and a greater than 80 percent detection frequency for the period January 1999 through December 2002. For arsenic, four HU-A wells (B16W04S, B16W06S, B16W07S and DW21) and seven HU-B wells (B16W07D, B16W08D, DW14, DW15, DW17, DW18, and DW19) were used. For total uranium, two HU-A wells (B16W12S, B16W13S) and three HU-B wells (DW16, DW17, and DW19) were used.

Mann-Kendall trend analysis indicated that only samples from HU-B well B16W07D are showing an upward trend for arsenic. The levels of arsenic in this well are below the investigative limit (50 µg/L). The Mann-Kendall statistical test does not take into consideration the range of error inherent in the analytical measurements. When the potential error in measurements is taken into account, the range associated with the arsenic values in B16W07D are generally wider than the magnitude of the trend as shown in Figure VI-9. This indicates that the determination of an overall trend for B16W07D is inconclusive.

The samples from the remaining HU-B wells show no arsenic trends. The Mann-Kendall test indicated a decreasing trend in total uranium concentrations for DW16. However, this test does not take into account the range of error associated in the analytical measurements. When the potential error in measurements is taken into account, the ranges associated with the total uranium values in DW16 are generally wider than the magnitude of the trend as shown in Figure VI-9. This indicates the overall trend for this well is inconclusive. The levels of total uranium in DW16 are below the IL (20 µg/L). It was determined that continued sampling would be necessary to determine if ongoing remedial actions will result in a decrease in uranium concentrations in HU-B ground-water samples (USACE 2003a).

Only wells with a greater than 80 percent detection rate and at least seven rounds of data are included in this report. Graphs of the trend analysis at the SLDS are shown in Figure VI-9. Graphs for those HU-B wells exceeding the ILs [DW19 (total uranium) and DW14 and DW15 (arsenic)] are provided in Figure VI-10. These wells do not show statistically significant trends based on the Mann-Kendall test.

Wastewater and Storm-Water Discharge Monitoring

This section provides a description of the wastewater and storm-water monitoring activities conducted at the SLS during the five-year review period. The monitoring results obtained from these activities are presented and compared with their respective permit or permit-equivalent requirements. The purpose of wastewater and storm-water discharge sampling at the SLS is to monitor compliance with the established discharge requirements. These requirements are established by the following: MSD discharge authorization letter dated October 30, 1998, and modified in a letter dated July 23, 2001, for the SLDS; MDNR NPDES-equivalent document dated October 2, 1998, and a discharge authorization letter dated July 23, 2001 for the SLAPS; and MDNR NPDES permit number MO-0111252 for the HISS. The storm-water sampling results for the SLAPS and the HISS are evaluated against the requirements in 10 CFR 20.1302, 10 Code of State Regulations (CSR) 20-7.031, and permit requirements and conditions. Wastewater sampling results for the SLAPS and the SLDS are evaluated against 10 CFR 20.2003 requirements and requirements listed in the MSD discharge authorization letters for the SLDS (October 30, 1998 and July 23, 2001).

U:\CAD\SLDS\Dwgs\DecisionDocuments\FiveYearReview1998_2003\FiveYearReview1998_2003CY02E34D01mw01.dwg

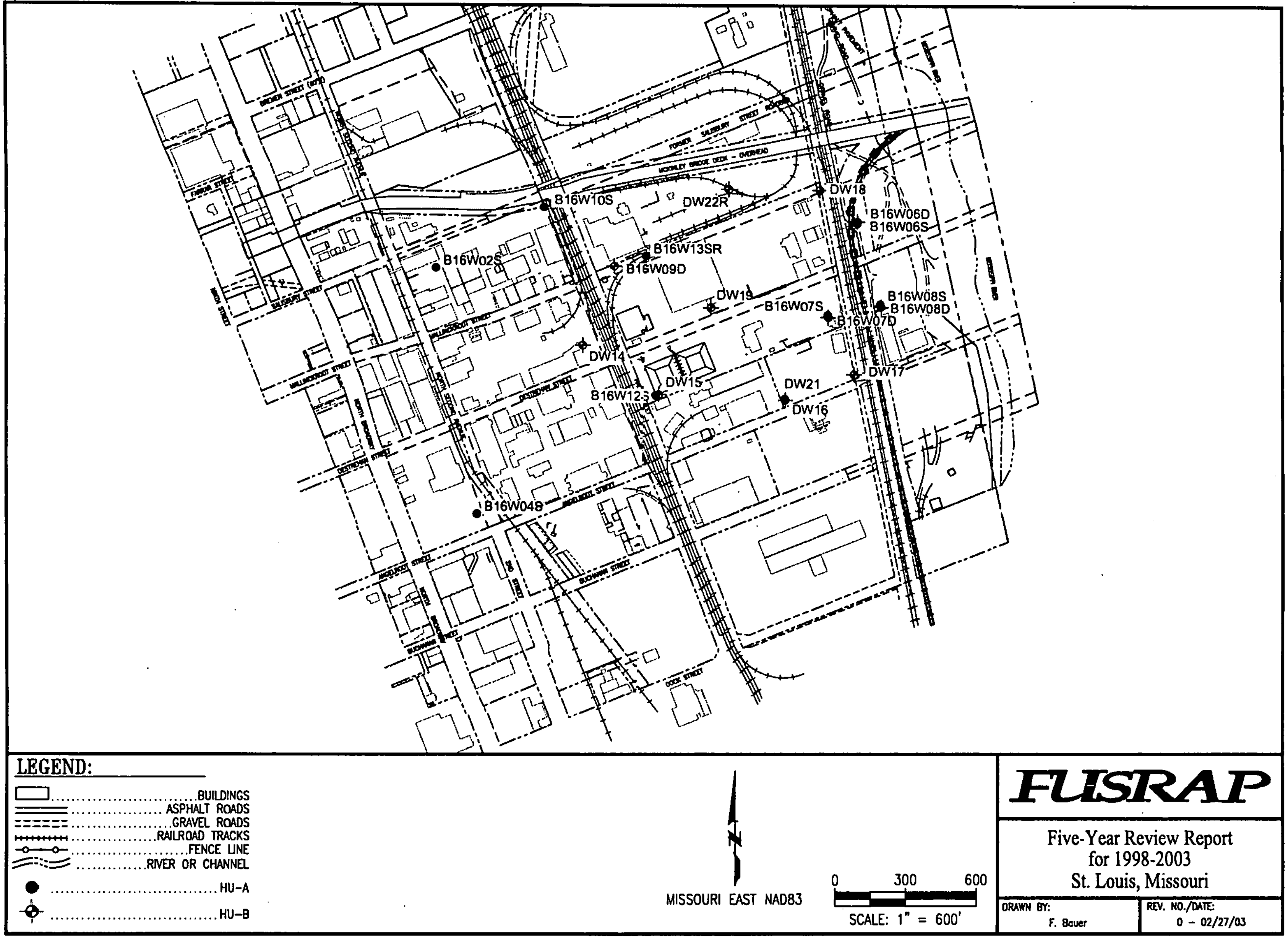


Figure VI-8. Ground-water Monitoring Well Locations at the SLDS in CY 2002

Wastewater Discharge Monitoring at the SLDS

Precipitation run-on and ground-water infiltration that collects in excavation areas of the SLDS are treated, if necessary, and discharged to the Bissell Point Sewage Treatment Plant under an authorization letter issued by the MSD.

There were no remedial-related discharges of storm water or ground water at the SLDS in CY1998. There were also no discharges during the first quarter of CY1999 due to the discovery of Civil War ordnance in the Plant 2 remediation area. Wastewater from the SLDS is discharged to MSD Base Map Inlet 17D3-022C. A summary of the wastewater discharges from the SLDS for the five-year review period is presented in Table VI-5. During three quarterly sampling events in 1999, gross beta values were observed at concentrations greater than the MSD authorization letter limit of 50 pCi/g. The elevated beta results were determined to be the result of the presence of naturally occurring K-40 in the water pumped from the excavations.

Table VI-5. Summary of Wastewater Discharges at the SLDS

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Activity Discharged	Total Volume Discharged
1998	No Discharge	No Discharge	No Discharge	No Discharge	0	0
1999	No Discharge	Exceeded MSD gross beta limit	Exceeded MSD gross beta limit	Exceeded MSD gross beta limit	Th – 1.65E-05 Ci U – 8.72E-06 Ci Ra – 2.75E-06 Ci	1,663,676 gallons
2000	No Exceedence	No Exceedence	No Exceedence	No Exceedence	Th – 1.15E-05 Ci U – 6.25E-06 Ci Ra – 3.07E-06 Ci	1,569,974 gallons
2001	No Exceedence	No Exceedence	No Exceedence	No Exceedence	Th –1.4E-05 Ci U – 4.5E-06 Ci Ra – 8.7E-06Ci	1,747,170 gallons
2002	No Exceedence	No Exceedence	No Exceedence	No Exceedence	Th – 1.1E-05 Ci U – 6.8E-06 Ci Ra – 1.8E-06 Ci	1,452,010 gallons

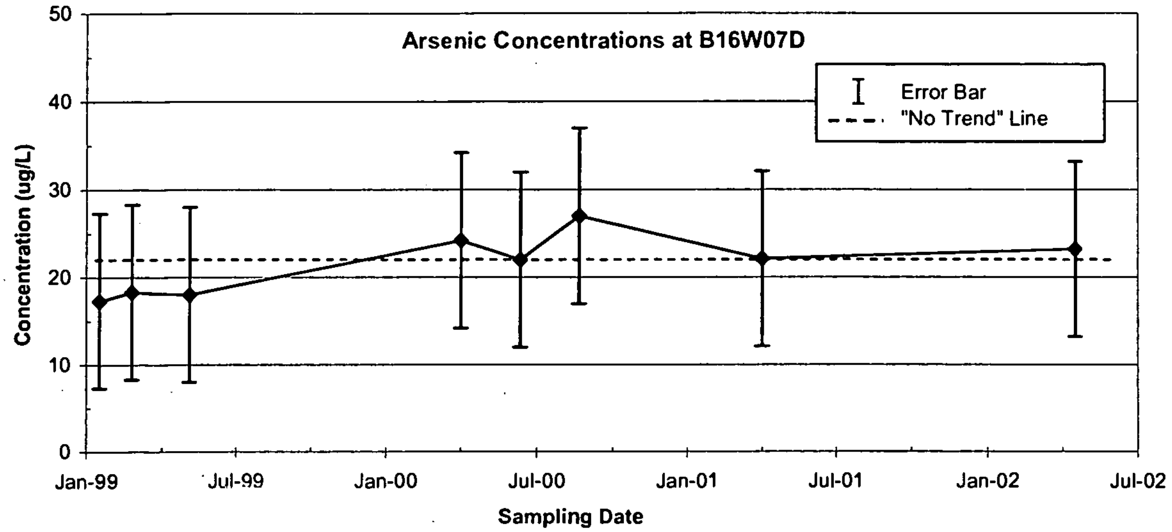
Wastewater Discharge Monitoring at the SLAPS

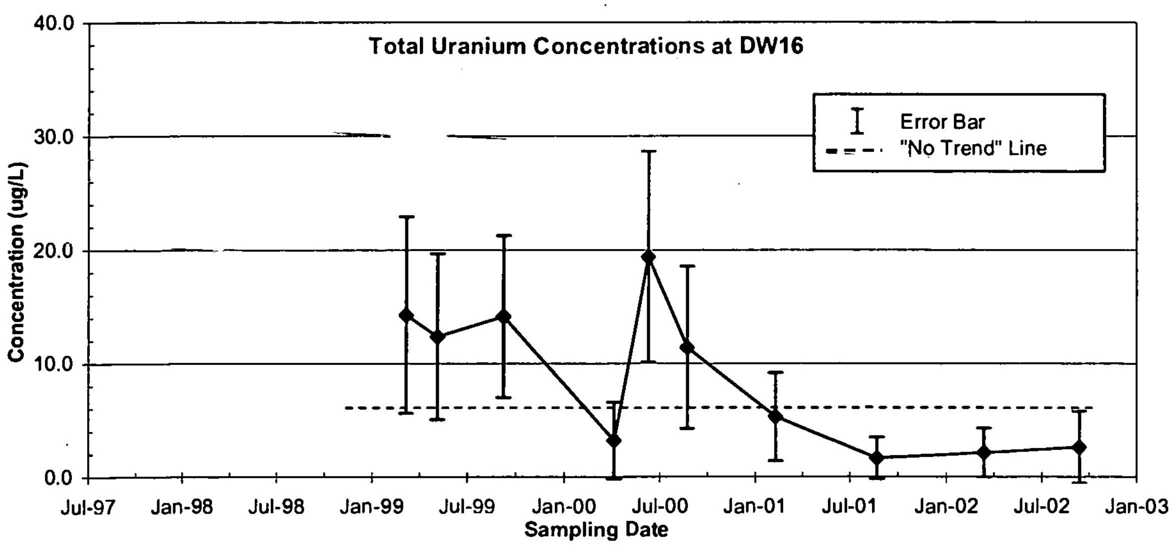
CY2002 was the first year that wastewater was discharged from the SLAPS to the sanitary sewer system. On July 23, 2001, the St. Louis MSD responded to a request by USACE to discharge treated wastewater to an MSD sanitary sewer located on-site by issuing a conditional approval for discharge of treated wastewater that resulted from USACE response actions at the SLAPS. The primary condition of the approval was that a treatment system be installed, maintained, and operated to produce an effluent meeting the standards contained in the following: MSD ordinance 8472, 10 CFR 20, and 19 CSR 20-10.

The MSD ordinance limits the annual allocation for radioactivity from the SLAPS to the MSD Coldwater Creek treatment plant, establishes the maximum volume of wastewater allowed to be discharged in a 24-hour period, and requires that the USACE show compliance of the treated wastewater with applicable standards and limits before MSD will allow the discharge.

During the second quarter of CY2002, a bench- and pilot-testing program of treating the wastewater by a bio-denitrification treatment system was initiated. A discharge line was installed from the wastewater treatment plant area to an MSD sewer line. During the third quarter, treatment of on-site stored wastewater was initiated. Four pilot-scale batches of wastewater were

Figure VI-9. Trend Analysis at the SLDS





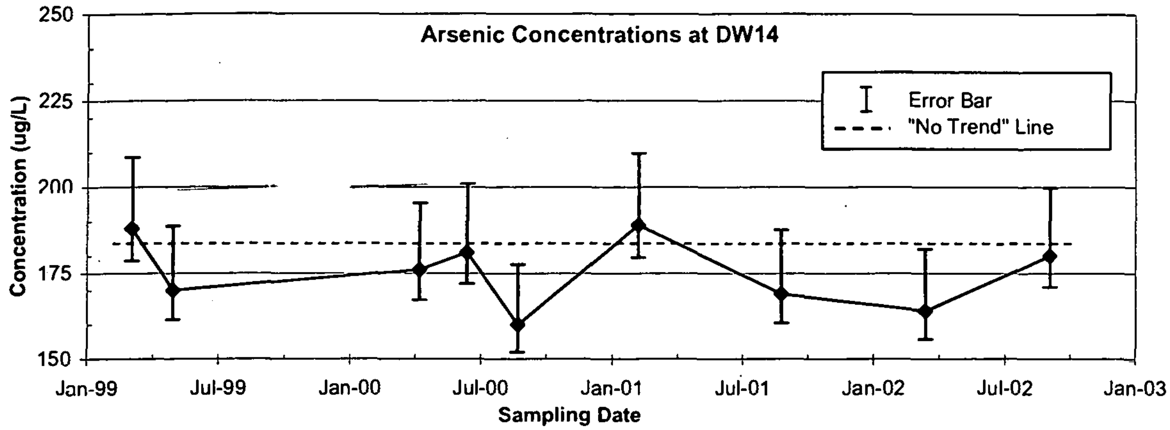
Notes:

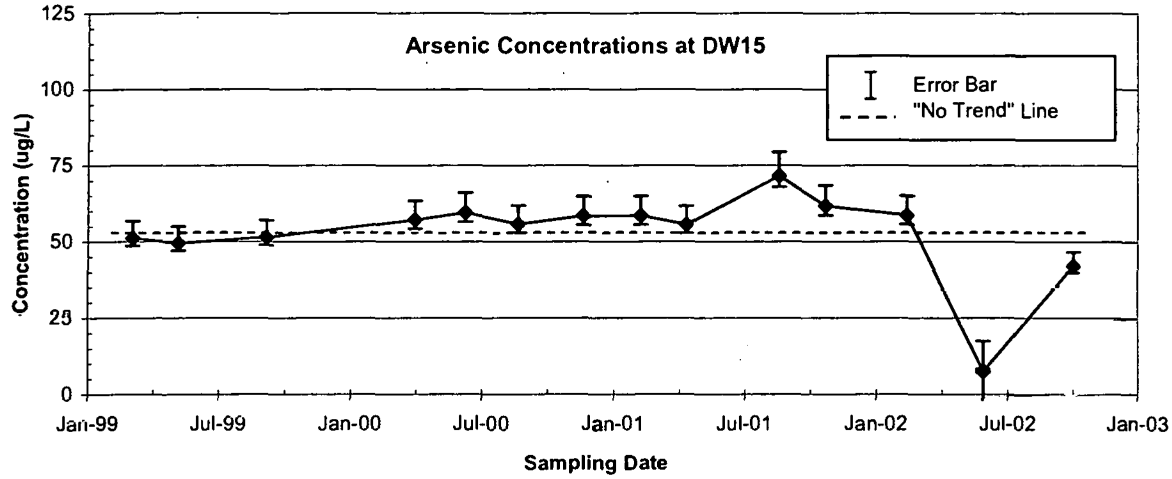
For arsenic results less than 3 times the reporting limit (RL), the error bar represents ±RL

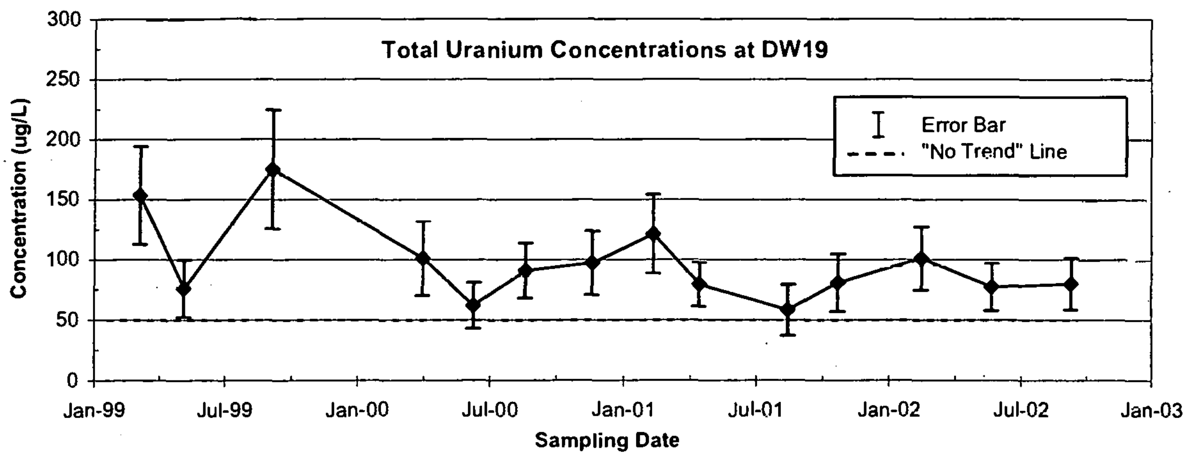
For arsenic results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits on the Control Spike Samples

For total uranium, the error bar represent ± the sum of the measurement error for U-234, U-235, and U-238.

Figure VI-10. Trend Analysis for Wells Exceeding Investigative Limits (ILs) at the SLDS







Notes:

For arsenic results less than 3 times the reporting limit (RL), the error bar represents ±RL

For arsenic results exceeding 3 times the RL, the error bar represents the Upper and Lower Control Limits of the Control Spike Samples

For total uranium, the error bar represent ± the sum of the measurement error for U-234, U-235, and U-238.

treated and one full-scale batch was treated. The treated wastewater consisted of a first batch of 12,000 gallons (gal) of pilot-treated wastewater and a second batch of 120,000 gal of treated wastewater. These batches of treated wastewater were sampled and analyzed for MSD influent criteria. The results indicated a total activity of 1.4E-06 curies (Ci) for Th, 2.9E-06 Ci for uranium (isotopic method), and 0.0E+00 Ci for Ra.

Storm-Water Monitoring at the HISS

The MDNR renewed NPDES operating permit MO-0111252 for the discharge of storm water from two outfalls at the HISS in 1995. These outfall locations are designated as HN01 and HN02.

Both total suspended solids and pH values were within the discharge limits at both outfalls for the sampling events in CY1998. However, the maximum and mean gross alpha activities for both outfalls exceeded the ambient water quality criteria (AWQC) of 15 picocuries per liter (pCi/L). Additionally, the mean and maximum concentrations of Ra isotopes in the HN02 effluent exceeded the AWQC for combined Ra-226 and Ra-228 of 5 pCi/L. None of the AWQC for the chemical pollutants was exceeded. Furthermore, the measured concentrations of the detected organic pollutants were below the health advisory levels for bromacil (90 grams per liter) and AWQC for the phthalate esters of 10 CSR 20-7 for a drinking water supply.

Outfall HN03 was constructed in July 1999 to monitor storm-water run-off from the soil piles. CY1999 storm-water discharge concentrations from the HISS complied with criteria contained in the permit and 10 CFR 20.1302. The permit expired in 2000 and negotiations between the USACE and MDNR as to future activity under the permit are ongoing.

In CY2000 through CY2002, storm-water discharge was monitored from three outfalls at the HISS: HN01, HN02, and HN03. No permit limits or 10 CFR 20.1302 criteria were exceeded at the HISS in these calendar years.

Storm-Water Discharge Monitoring at the SLAPS

Site-specific permits are in place for the discharge of storm water to Coldwater Creek at the SLAPS. Historical monitoring of storm-water discharges at the SLAPS involved semiannual sampling of the effluent from two outfalls. The first of the SLAPS historical outfalls (STW-001) was located at the northwest entrance to the site, and the second historical outfall (STW-002) was located in the southwest corner of the site. As a result of insufficient flow, storm-water effluent samples were not collected from Outfall STW-002 during CY1998.

In a NPDES-equivalent document dated October 2, 1998, MDNR established storm-water discharge requirements for three outfalls at the SLAPS in conjunction with the proposed construction of the sedimentation basin. These three storm-water discharge outfalls at the SLAPS replaced the historical outfalls and were designated as Outfall PN01, Outfall PN02, and Outfall PN03. Outfall PN01 actually consists of two separate outfalls. Outfall PN01a is the discharge point for the sedimentation basin, and Outfall PN01b is the discharge point for the emergency spillway. Outfall PN01b is located near historical Outfall STW-001. Th-230 concentrations exceeded the values specified in Table 2, Appendix B of 10 CFR 20 of 15 pCi/L at each outfall in CY1998 with concentrations ranging from 1.33 to 320.3 pCi/L. (Thorium is not in the permit, and is based on annual averages per 10 CFR 20.)

In CY1999, storm-water discharge parameters were detected below discharge requirements, with one exception. Analytical results for the July 1, 1999, sample for Outfall PN03 indicated total copper at 101 µg/L, which is above the discharge limit of 84 µg/L. The CY1999 storm-water discharges from the SLAPS also complied with criteria contained in 10 CFR 20.1302. The average annual concentration of radioactive material released in CY1999 storm-water discharges did not exceed the values specified in Table 2, Appendix B of 10 CFR 20 (i.e., for a mixture of radionuclides, the SOR is less than unity).

For CY2000, storm-water discharge results indicated an exceedence of the discharge limit of 84 µg/L for total recoverable copper at Outfall PN03 in February 2000. The result reported was 88.6 µg/L. The CY2000 storm-water discharges from the SLAPS complied with the criteria contained in 10 CFR 20.1302.

Chemical sample data results for CY2001 storm-water discharges indicated there were two exceedences at Outfall PN03 of the discharge limit of 1.0 microliters per liter per hour (µL/L/hr) for settleable solids. These exceedences occurred in September and October 2001. The respective results were 1.56 µL/L/hr and 4.0 µL/L/hr. Both exceedences were the result of an intense rainfall event. The October 2001 result for Outfall PN03 revealed that the sample also exceeded the total recoverable copper limit of 84 µg/L with a result of 160 µg/L. The average annual concentration of radioactive material released in CY2001 storm-water discharges did not exceed the values specified in Table 2 of Appendix B of 10 CFR 20.

Discharge limits were exceeded for copper at Outfall PN01a during the second quarter of CY2002. The concentration of total recoverable copper (100 µg/L) exceeded the daily maximum limit of 84 µg/L. Otherwise, discharge limits were not exceeded at the SLAPS for CY2002.

Exceedances at the outfalls were detected after rainfall events that corresponded with backfilling operations. In addition, the exceedances that occurred in 2001 occurred when PN03 was plugged and water was being diverted to PN01a.

In accordance with a letter dated February 19, 2002, from MDNR, sampling at Outfall PN02 was reduced to once a year, until the drainage area is affected by a soil disturbance. Outfall PN03 has been discontinued as a sampling location in accordance with a letter by MDNR dated February 19, 2002.

Site Radiological Monitoring

Program Overview (SLDS)

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, and radon data. The data were used to assess the magnitude of radiological exposures to the general public. Radon flux monitoring was not required at the SLDS.

Applicable Standards

10 CFR 20

The regulatory dose limit for members of the public is 100 millirem per year (mrem/yr) from all pathways, as stated in 10 CFR 20.1301. Compliance with the dose limit in 10 CFR 20.1301 can be demonstrated in one of the two following ways [§20.1302(b)(1) and (2)].

1. Demonstrating by measurement or calculation that the total effective dose equivalent (TEDE) to the individual likely to receive the highest dose from the SLDS operations does not exceed the annual dose limit (100 mrem/yr).
2. Demonstrating that (*i*) the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 and (*ii*) if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 2 millirem per hour (mrem/hr).

Gamma radiation, airborne particulate radionuclide, and radon data from the site were used to evaluate the cumulative dose to a hypothetically impacted individual (member of the public) from exposure to radiological contaminants at the SLDS in order to demonstrate compliance with 10 CFR 20.1301.

Radon was also compared to the regulatory criterion listed in 10 CFR 20, Table 2 of Appendix B, of 0.3 picocuries per liter (pCi/L) (at 30% equilibrium) average annual concentration above background.

40 CFR 61

Airborne particulate radionuclide data from the site were used to calculate the effective dose equivalent (EDE) to a critical receptor. The National Emission Standards for Hazardous Air Pollutant (NESHAP) standard of EDE to a critical receptor from radionuclide emissions is 10 mrem/yr as stated in 40 CFR 61, Subpart I (*National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H).*

Gamma Radiation Monitoring

Monitoring Overview

Gamma radiation was measured using thermoluminescent dosimeters (TLDs). TLDs at the SLDS were located at areas assumed to be representative of areas accessible to the public. At each monitoring station, the TLDs were placed approximately 3 feet above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at the SLDS at five locations during CY1999 through CY2001 and at four locations in CY2002. Gamma radiation was not monitored at the SLDS during CY1998. Station DA-5 was eliminated in October 2001 after it was determined to be a redundant location due to its proximity to DA-3.

Monitoring Program Results

The gamma radiation data collected from each location during CY1999 to CY2002 were corrected for background, shelter absorption, and fade and were normalized to exactly one year to calculate an annual dose. The corrected annual gamma radiation monitoring results are presented in Table VI-6.

Table VI-6. External Gamma Radiation Monitoring Results at the SLDS

Monitoring Location	Monitoring Station	CY1998 TLD Data	CY1999[a] TLD Data	CY2000 TLD Data	CY2001 TLD Data	CY2002 TLD Data
		(mrem/yr)				
SLDS	DA-1	NA	0	18	15	13
	DA-2	NA	0	2	9	13
	DA-3	NA	9	15	30	45
	DA-4	NA	0	6	18	18
	DA-5	NA	0	0	4	NA

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.
NA Not monitored or station eliminated

Data Analysis

Gamma radiation data from the SLDS were used to calculate an average dose rate, and an annual deep dose equivalent (DDE) to a hypothetically maximally exposed individual. The average dose rate was compared to the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr. A summary of calculated gamma radiation dose rates is presented in Table VI-7. The average dose rate during CY1999 to CY2002 was less than the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr.

Table VI-7. External Gamma Dose Rate at the SLDS

	Maximum Average Dose Rate above Background[a]	10 CFR 20 Limit (2 mrem/yr)	Annual Calendar Year Dose	10 CFR 20 Limit (100 mrem/yr)
	(mrem/hr)		(mrem/yr)	
1998	NA	2	NA	100
1999	<0.1	2	0.0	100
2000	<0.1	2	0.0	100
2001	<0.1	2	0.1	100
2002	<0.1	2	0.1	100

[a] Calculated by dividing the annual gamma radiation result by 8760 hours, the number of hours in a year, for each location.
NA Not available

The annual dose to a member of the public from gamma radiation was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20.1302(b)(1) limit of 100 mrem/yr during CY1999 to CY2002. The annual calendar year doses for CY1999 to CY2002 were less than the 100 mrem/year for all pathways.

Five-year Trend Analysis

The annual dose to a member of the public from gamma radiation at the SLDS was far below the 10 CFR 20.1302(b)(2)(ii) limit for all years with negligible variance from year to year. There was a minute upward trend over the time period; however, when compared to the regulatory limit, the trend was insignificant.

Airborne Particulate Monitoring

Monitoring Overview

Airborne radioactive particulates result from radioactive material in soil (or other sources) that becomes suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 feet above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in microcuries per milliliter (µCi/mL).

Perimeter air sampling for radiological particulates was not conducted at the SLDS during CY1998 to CY2002 due to the insignificant potential for material to become airborne at the site. Particulate air monitors were located at excavation perimeter locations on the SLDS. Air particulate samples are collected during active excavation at the SLDS and analyzed at the SLS radioanalytical laboratory. Airborne particulate data were not available for CY1998 and CY1999.

Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. For CY 1998 and CY1999, the annual dose was calculated by applying relevant modeling parameters given the size of known work areas, meteorological conditions, and potential exposure durations in lieu of available monitoring data. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table VI-8.

Table VI-8. Air Particulate Monitoring at the SLDS

Calendar Year	Average Annual Gross Alpha Concentration (µCi/mL)	Average Annual Gross Beta Concentration (µCi/mL)	Annual Dose Rate (mrem/yr)
1998	NA	NA	0.3
1999	NA	NA	0.8
2000	1.2E-14	1.3E-13	<0.1
2001	5.2E-15	6.0E-14	<0.7
2002	1.3E-15	2.3E-14	0.2

NA Not available

Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 CFR 61 standard of 10 mrem/yr. The estimated EDE was added to the radiological doses from other pathways to determine if the TEDE to a member of the public exceeded the 10 CFR 20 limit of 100 mrem/yr. A comparison of the EDE due to airborne particulate radionuclides at the SLDS and the regulatory limits is presented in Table VI-9.

Table VI-9. Airborne Particulate Dose Rate at the SLDS

Calendar Year	Annual Dose Rate	40 CFR 61 Standard (10 mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
	(mrem/yr)		
1998	*	10	100
1999	0.8	10	100
2000	<0.1	10	100
2001	<0.7	10	100
2002	0.2	10	100

* Value is less than 10 percent of the dose standard in 40 CFR 61.102.

As shown in Table VI-9, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 CFR 61 standard of 10 mrem/yr during CY1998 to CY2002.

Five-year Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at the SLDS was far below the 40 CFR 61 standard and did not really vary from year to year. There is a small downward trend over the time period; however, when compared to the regulatory standard, the trend is insignificant. The average annual gross alpha and gross beta results demonstrate a slight downward trend over the period as well.

Radon Monitoring

Monitoring Overview

Airborne radon monitoring was performed at the SLDS using alpha track decectors (ATDs) to measure radon emissions. The detectors were collocated with the TLDs at the site. The ATDs were collected semi-annually. Radon concentrations were used to calculate an EDE to a hypothetically maximally exposed individual and added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 dose limit of 100 mrem/yr. Recorded radon concentrations were also evaluated based on the regulatory criterion listed in 10 CFR 20, Appendix B of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. Radon monitoring was performed at the SLDS at five locations during CY1999 through CY2001 and at four locations in CY2002. Radon was not monitored at the SLDS during CY1998. Station DA-5 was eliminated in October 2001 after it was determined to be a redundant location due to its proximity to DA-3.

Monitoring Program Results

The radon data collected from each location during CY1999 to CY2002 were corrected for background and was normalized to exactly one year to calculate an annual dose rate. The calculated annual radon monitoring results are presented in Table VI-10.

Table VI-10. Radon Monitoring at the SLDS

Monitoring Location	Monitoring Station	CY1998 Radon Data	CY1999[a] Radon Data	CY2000 Radon Data	CY2001 Radon Data	CY2002 Radon Data
		(pCi/L)				
SLDS	DA-1	NA	0.0	0.0	0.1	0.0
	DA-2	NA	0.0	0.0	0.1	0.0
	DA-3	NA	0.0	0.0	0.0	0.1
	DA-4	NA	0.0	0.0	0.0	0.0
	DA-5	NA	0.2	0.0	0.0	NA

a Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored or station eliminated

Data Analysis

Radon data from the SLDS were used to calculate an average annual concentration and an annual EDE to a hypothetically maximally exposed individual. The average concentration was compared to the 10 CFR 20, Appendix B value of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. The annual dose was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 limit. A summary of the radon concentrations above background and calculated dose rates is presented in Table VI-11.

Table VI-11. Radon Concentration and Dose Rate at the SLDS

Calendar Year	Average Annual Concentration Above Background	10 CFR 20 App. B (0.3 pCi/L)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(pCi/L)		(mrem/yr)	
1998	NA	0.3	NA	100
1999	<0.1	0.3	0.0	100
2000	0.0	0.3	0.0	100
2001	<0.1	0.3	0.2	100
2002	<0.1	0.3	0.0	100

NA Not available

As shown in Table VI-11, the average annual concentrations above background during CY1999 to CY2002 were less than the 10 CFR 20 Appendix B value of 0.3 pCi/L.

Five-year Trend Analysis

The annual radon concentrations at the SLDS were far below the 10 CFR 20 limit with negligible variance from year to year. There was a minute upward trend for dose rates over the time period; however, when compared to the regulatory limit, the trend was insignificant. The average annual concentration of radon remained approximately the same for the period.

Site Radiological Monitoring

Program Overview (SLAPS)

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, and radon data. The data were used to assess the magnitude of radiological exposures to the general public. Radon flux monitoring was not required at the SLAPS.

Applicable Standards

10 CFR 20

The regulatory dose limit for members of the public is 100 mrem/yr from all pathways as stated in 10 CFR 20.1301. Compliance with the dose limit in 10 CFR 20.1301 can be demonstrated in one of the two following ways [§20.1302(b)(1) and (2)].

1. Demonstrating by measurement or calculation that the TEDE to the individual likely to receive the highest dose from the SLAPS operations does not exceed the annual dose limit (100 mrem/yr).

2. Demonstrating that (*i*) the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 and (*ii*) if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 2 mrem/hr.

Gamma radiation, airborne particulate radionuclide, and radon data from the site were used to evaluate the cumulative dose to a hypothetically impacted individual (member of the public) from exposure to radiological contaminants at the SLAPS in order to demonstrate compliance with 10 CFR 20.1301.

Radon was also compared to the regulatory criterion listed in 10 CFR 20, Appendix B, of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background.

40 CFR 61

Airborne particulate radionuclide data from the site were used to calculate the EDE to a critical receptor. The NESHAP standard of EDE to a critical receptor from radionuclide emissions is 10 mrem/yr as stated in 40 CFR 61, Subpart I (*National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H).*

Gamma Radiation Monitoring

Monitoring Overview

Gamma radiation was measured using TLDs. TLDs at the SLAPS were located at the site perimeter. At each monitoring station, the TLDs were placed approximately 3 feet above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at the SLAPS at four locations during CY1998 and at six locations during CY1999 through CY2002.

Monitoring Program Results

The gamma radiation data collected from each location during CY1998 to CY2002 were corrected for background, shelter absorption, and fade, and was normalized to exactly one year for the purpose of comparison to an annual dose. The calculated annual gamma radiation results are presented in Table VI-12.

Table VI-12. External Gamma Radiation Monitoring at the SLAPS

Monitoring Location	Monitoring Station	CY1998[a] TLD Data	CY1999[a] TLD Data	CY2000 TLD Data	CY2001 TLD Data	CY2002 TLD Data
		(mrem/yr)				
SLAPS	PA-1	NA	47	112	162	157
	PA-2	32	7	6	14	14
	PA-3	74	8	31	60	58
	PA-4	2450	330	142	58	45
	PA-5	47	30	27	13	7
	PA-6	NA	89	106	105	108

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored or station eliminated

Data Analysis

Gamma radiation data from the SLAPS was used to calculate an average dose rate and an annual DDE to a hypothetically maximally exposed individual. The average dose ratc was compared to the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr. A summary of the calculated gamma radiation dose rates are presented in Table VI-13.

Table VI-13. External Gamma Dose Rate at the SLAPS

Calendar Year	Maximum Average Dose Rate above Background[a]	10 CFR 20 Limit (2 mrem/yr)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(mrem/hr)		(mrem/yr)	
1998	0.3	2	0.1	100
1999	<0.1	2	0.0	100
2000	<0.1	2	0.1	100
2001	<0.1	2	0.1	100
2002	<0.1	2	0.1	100

[a] Calculated by dividing the annual gamma radiation result by 8760 hours, the number of hours in a year, for each location.

The annual dose to a member of the public from gamma radiation was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 limit of 100 mrem/yr during CY1998 to CY2002. The average dose rate during CY1999 to CY2002 was less than the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr.

Five-year Trend Analysis

The annual dose to a member of the public from gamma radiation at the SLAPS was far below the 10 CFR 20 limit for all years with negligible variance from year to year.

Airborne Particulate Monitoring

Monitoring Overview

Airborne radioactive particulates result from radioactive material in soil (or other sources) that become suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 feet above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in μCi/mL.

Site perimeter air sampling for radiological particulates was conducted at the SLAPS during CY1999 to CY2002. Air particulate samples were collected weekly at the SLAPS and analyzed at the SLS radioanalytical laboratory. Airborne particulate data were not available for CY1998.

Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. For CY1998, the annual dose was calculated by applying relevant modeling parameters given the size of known work areas, meteorological conditions, and potential exposure durations in lieu of available monitoring data. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table VI-14.

Table VI-14. Air Particulate Monitoring at the SLAPS

Calendar Year	Average Annual Gross Alpha Concentration (μCi/mL)	Average Annual Gross Beta Concentration (μCi/mL)	Annual Dose (mrem/yr)
1998	NA	NA	7.6
1999	2.3E-15	3.5E-14	6.4
2000	3.5E-15	4.1E-14	6.4
2001	5.6E-15	6.3E-14	9.4
2002	3.1E-15	4.2E-14	4.8

NA Not available

Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 CFR 61 standard of 10 mrem/yr. The estimated EDE was added to the radiological doses from other pathways to determine if the TEDE to a member of the public exceeded the 10 CFR 20 limit of 100 mrem/yr. A comparison of the EDE due to airborne particulate radionuclides at the SLAPS to the regulatory standards is presented in Table VI-15.

Table VI-15. Airborne Particulate Dose Rate at the SLAPS

Calendar Year	Annual Dose Rate	40 CFR 61 Standard (10 mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
	(mrem/yr)		
1998	7.6	10	100
1999	6.4	10	100
2000	6.4	10	100
2001	9.4	10	100
2002	4.8	10	100

As shown in Table VI-15, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 CFR 61 standard of 10 mrem/yr CY1998 to CY2002.

Five-year Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at the SLAPS was below the 40 CFR 61 standard for all years. There is an overall slight downward trend during the time period. The average annual gross alpha and gross beta results have remained approximately the same over the period. This may be due to ongoing remediation at the SLAPS.

Radon Monitoring

Monitoring Overview

Airborne radon monitoring was performed at the SLAPS using ATDs to measure radon emissions. The detectors were collocated with the TLDs at the site. The ATDs were collected semi-annually. Radon concentrations were used to calculate an EDE to a hypothetically maximally exposed individual and added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 dose limit of 100 mrem/yr. Recorded radon concentrations were also evaluated based on the regulatory criterion listed in 10 CFR 20, Appendix B of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. Radon monitoring was performed at the SLAPS at four locations during CY1998 and at six locations during CY1999 through CY2002.

Monitoring Program Results

The radon data collected from each location during CY1998 to CY2002 were corrected for background and was normalized to exactly one year to calculate an annual dose. The calculated annual radon monitoring results are presented in Table VI-16.

Table VI-16. Radon Monitoring at the SLAPS

Monitoring Location	Monitoring Station	CY1998[a] Radon Data	CY1999[a] Radon Data	CY2000 Radon Data	CY2001 Radon Data	CY2002 Radon Data
		(pCi/L)				
SLAPS	PA-1	NA	0.6	0.1	0.2	0.1
	PA-2	0.2	0.0	0.0	0.1	0.1
	PA-3	0.2	0.1	0.0	0.0	0.0
	PA-4	0.4	1.5	0.3	0.1	0.1
	PA-5	0.2	0.0	0.2	0.0	0.0
	PA-6	NA	0.0	0.0	0.2	0.0

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.

NA Not monitored

Data Analysis

Radon data from the SLAPS were used to calculate an average annual concentration and an annual EDE to a hypothetically maximally exposed individual. The average concentration was compared to the 10 CFR 20, Appendix B value of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. The annual dose was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20.1301 limit. A summary of the radon concentrations above background and calculated dose rates is presented in Table VI-17.

Table VI-17. Radon Concentration and Dose Rates at the SLAPS

Calendar Year	Average Annual Concentration Above Background	10 CFR 20 App. B (0.3 pCi/L)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(pCi/L)		(mrem/yr)	
1998	<0.2	0.3	NA	100
1999	0.37	0.3	0.0	100
2000	0.1	0.3	0.0	100
2001	0.1	0.3	0.2	100
2002	<0.1	0.3	0.0	100

NA Not available

As shown in Table VI-17, the average annual concentrations above background during CY1999 and CY2002 were less than the 10 CFR 20 Appendix B value of 0.3 pCi/L with the exception of 1999. Although the average annual radon concentration exceeded the Appendix B value in 1999, compliance with the 10 CFR 20 limit of 100 mrem/yr was demonstrated through calculation of the TEDE to the individual likely to receive the highest dose.

Five-year Trend Analysis

The annual radon concentrations at the SLAPS were below the 10 CFR 20 limit with negligible variance from year to year (with the exception of 1999). There was no apparent trend for annual dose over the time period. The average annual concentrations of radon had a slight downward trend for the period.

Site Radiological Monitoring

Program Overview (HISS)

Site radiological monitoring consisted of collecting gamma radiation, airborne particulate radionuclide, radon, and radon flux data. The data were used to assess the magnitude of radiological exposures to the general public.

Applicable Standards

10 CFR 20

The regulatory dose limit for members of the public is 100 mrem/yr from all pathways as stated in 10 CFR 20.1301. Compliance with the dose limit in 10 CFR 20.1301 can be demonstrated in one of the two following ways [§20.1302(b)(1) and (2)].

1. Demonstrating by measurement or calculation that the TEDE to the individual likely to receive the highest dose from the HISS operations does not exceed the annual dose limit (100 mrem/yr).

2. Demonstrating that (*i*) the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area does not exceed the values specified in Table 2 of Appendix B to Part 20 and (*ii*) if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 2 mrem/hr.

Gamma radiation, airborne particulate radionuclide, and radon data from the site were used to evaluate the cumulative dose to a hypothetically impacted individual (member of the public) from exposure to radiological contaminants at the HISS in order to demonstrate compliance with 10 CFR 20.1301.

Radon was also compared to the regulatory criterion listed in 10 CFR 20, Appendix B, of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background.

40 CFR 61

Airborne particulate radionuclide data from the site were used to calculate the EDE to a critical receptor. The NESHAP standard of EDE to a critical receptor from radionuclide emissions is 10 mrem/yr, as stated in 40 CFR 61, Subpart I (*National Emission Standards for Emissions of Radionuclides Other Than Radon From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered By Subpart H).*

40 CFR 192

40 CFR 192 requires control of residual radioactive materials to provide reasonable assurance that releases of radon-222 (Rn-222) will not exceed an average release rate of 20 picocuries per square meter per second ($pCi/m^2/s$). Radon flux data from the piles on the HISS were used to calculate an average radon release rate to compare to the 40 CFR 192 limit and to verify the liner over the piles was effectively intact.

Gamma Radiation Monitoring

Monitoring Overview

Gamma radiation was measured using TLDs. TLDs at the HISS were located at the site perimeter. At each monitoring station, the TLDs were placed approximately 3 feet above the ground surface inside a housing shelter. The TLDs were collected quarterly and sent to an off-site vendor for analysis. Gamma radiation monitoring was performed at the HISS at eight locations during CY1998, at six locations during CY1999 through CY2001, and at five locations during CY2002.

Monitoring Program Results

The gamma radiation data collected from each location during CY1998 to CY2002 were corrected for background, shelter absorption, and fade and was normalized to exactly one year to calculate an annual dose. The corrected annual gamma radiation results are presented in Table VI-18.

Table VI-18. External Gamma Radiation Monitoring at the HISS

Monitoring Location	Monitoring Station	CY1998[a] TLD Data	CY1999[a] TLD Data	CY2000 TLD Data	CY2001 TLD Data	CY2002 TLD Data
		(mrem/yr)				
HISS	HA-1	0	0	11	110	90
	HA-2	59	52	51	66	49
	HA-3	101	37	42	76	20
	HA-4	43	47	59	94	NA
	HA-5	NA	NA	32	9	4
	HA-6	0	0	0	2	1
	1	27	NA	NA	NA	NA
	5	24	35	NA	NA	NA
	8	0	NA	NA	NA	NA

a Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.
NA Not monitored or station eliminated

Data Analysis

Gamma radiation data from the HISS were used to calculate an average dose rate and an annual EDE to a hypothetically maximally exposed individual. The average dose rate was compared to the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr. A summary of the calculated gamma radiation dose rates is presented in Table VI-19.

Table VI-19. External Gamma Dose Rate at the HISS

Calendar Year	Maximum Average Dose Rate above Background[a]	10 CFR 20 Limit (2 mrem/yr)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(mrem/hr)		(mrem/yr)	
1998	<0.1	2	0.3	100
1999	<0.1	2	0.2	100
2000	<0.1	2	0.2	100
2001	<0.1	2	0.2	100
2002	<0.1	2	0.1	100

a Calculated by dividing the annual gamma radiation result by 8760 hours for each location.

The annual dose to a member of the public from gamma radiation was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 limit of 100 mrem/yr during CY1998 to CY2002. The average dose rate during CY1999 to CY2002 was less than the 10 CFR 20.1302(b)(2)(ii) limit of 2 mrem/hr.

Five-year Trend Analysis

The annual dose to a member of the public from gamma radiation at the HISS was far below the 10 CFR 20 limit for all years with negligible variance from year to year. The annual dose had a slight downward trend over the period.

Airborne Particulate Monitoring

Monitoring Overview

Airborne radioactive particulates result from radioactive material in soil (or other sources) that become suspended in the air. Airborne radioactive particulates were measured by drawing air through a filter membrane with an air sampling pump placed approximately 3 feet above the ground and then analyzing the material contained on the filter. The results of the analysis, when compared to the amount of air drawn through the filter, were reported as radioactive contaminant concentrations in µCi/mL.

Site perimeter air sampling for radiological particulates was conducted at the HISS during CY1999 to CY2002. Air particulate samples were collected weekly at the HISS and analyzed at the SLS radioanalytical laboratory. Airborne particulate data were not available for CY1998.

Monitoring Program Results

The annual dose was calculated for a hypothetically maximally exposed individual. For CY1998, the annual dose was calculated by applying relevant modeling parameters given the size of known work areas, meteorological conditions, and potential exposure durations in lieu of available monitoring data. The average annual gross alpha and gross beta concentrations and the annual dose rate to a hypothetically maximally exposed individual are presented in Table VI-20.

Table VI-20. Air Particulate Monitoring at the HISS

Calendar Year	Average Annual Gross Alpha Concentration (µCi/mL)	Average Annual Gross Beta Concentration (µCi/mL)	Annual Dose (mrem/yr)
1998	NA	NA	0.1
1999	2.1E-15	3.5E-14	0.8
2000	2.0E-15	3.1E-14	2.1
2001	2.0E-15	2.9E-14	7.8
2002	1.7E-15	2.5E-14	7.8

NA Not available

Data Analysis

Airborne particulate data were used to calculate radionuclide emission rates to determine if the EDE to a member of the public exceeded the 40 CFR 61 standard of 10 mrem/yr. The estimated EDE was added to the radiological doses from other pathways to determine if the TEDE to a member of the public exceeded the 10 CFR 20 limit of 100 mrem/yr. A comparison of the EDE due to airborne particulate radionuclides at the HISS and the regulatory limits is presented in Table VI-21.

Table VI-21. Airborne Particulate Dose Rate at the HISS

Calendar Year	Annual Dose Rate	40 CFR 61 Standard (10 mrem/yr)	10 CFR 20 Limit (100 mrem/yr)
	(mrem/yr)		
1998	0.1	10	100
1999	0.8	10	100
2000	2.1	10	100
2001	7.8	10	100
2002	7.8	10	100

As shown in Table VI-21, the annual dose to a member of the public from air particulate radionuclides did not exceed the 40 CFR 61 standard of 10 mrem/yr during CY1998 to CY2002.

Five-year Trend Analysis

The annual dose to a member of the public from airborne particulate radionuclides at the HISS was below both the 40 CFR 61 standard for all years. There is an overall upward trend during the time period. This may be due to active remediation in CY2000 and CY2001. The average annual gross alpha and gross beta results had a slight downward trend over the period. CY2002 gross alpha and gross beta results were less than the respective CY2001 results indicating that there may be lower airborne particulate emissions after the HISS piles had been removed in CY2000 and CY2001.

Radon Monitoring

Monitoring Overview

Airborne radon monitoring was performed at the HISS using ATDs to measure radon emissions. The detectors were collocated with the TLDs at the site. The ATDs were collected semi-annually. Radon concentrations were used to calculate an EDE to a hypothetically maximally exposed individual and added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20 dose limit of 100 mrem/yr. Recorded radon concentrations were also evaluated based on the regulatory criterion listed in 10 CFR 20, Appendix B of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. Radon monitoring was performed at the HISS at eight locations during CY1998, at six locations during CY1999 through CY2001, and at five locations during CY2002.

Radon flux sampling was used to measure emission rates of radon from the surface of the contaminated soil piles. Radon flux monitoring was performed using 10-inch diameter activated charcoal canisters placed on a pre-determined grid. The canisters were attached to the storage pile's cover surface for 24 hours, and then the canisters were retrieved and sent to an off-site laboratory for analysis in accordance with Appendix B of 40 CFR 61. Radon flux monitoring was performed at the HISS piles during CY1998 through CY2000. The piles were remediated during CY2000 and CY2001 and radon flux monitoring was no longer required.

Perimeter Radon ATDs

Monitoring Program Results

The radon data collected from each location during CY1998 to CY2002 were corrected for background and were normalized to exactly one year to calculate an annual dose. The calculated annual radon monitoring results are presented in Table VI-22.

Table VI-22. Radon Monitoring at the HISS

Monitoring Location	Monitoring[a] Station	CY1998 ATD Data	CY1999 ATD Data	CY2000 ATD Data	CY2001 ATD Data	CY2002 ATD Data
		(mrem/yr)				
HISS	HA-1	0.2	0.0	0.2	0.2	0.0
	HA-2	0.2	0.0	0.0	0.1	0.0
	HA-3	0.2	0.1	0.0	0.0	0.1
	HA-4	0.2	0.0	0.1	0.1	NA
	HA-5	NA	NA	0.0	0.1	0.0
	HA-6	0.2	0.0	0.0	0.0	0.0
	1	0.2	NA	NA	NA	NA
	5	0.2	0.0	NA	NA	NA
	8	0.2	NA	NA	NA	NA

[a] Station names and locations may have varied slightly from year to year. The exact location of each station can be found in the Annual Environmental Monitoring Data and Analysis Report for the respective year.
NA Not monitored

Data Analysis

Radon data from the HISS were used to calculate an average annual concentration and an annual EDE to a hypothetically maximally exposed individual. The average concentration was compared to the 10 CFR 20, Appendix B value of 0.3 pCi/L (at 30% equilibrium) average annual concentration above background. The annual dose was added to dose rates from other pathways to demonstrate compliance with the 10 CFR 20.1301 limit. A summary of the radon concentrations above background and calculated dose rates are presented in Table VI-23.

Table VI-23. Radon Concentration and Dose Rate at the HISS

Calendar Year	Average Annual Concentration Above Background	10 CFR 20 App. B (0.3 pCi/L)	Annual Dose Rate	10 CFR 20 Limit (100 mrem/yr)
	(pCi/L)		(mrem/yr)	
1998	0.2	0.3	NA	100
1999	<0.1	0.3	0.2	100
2000	<0.1	0.3	0.4	100
2001	0.1	0.3	0.2	100
2002	<0.1	0.3	0.1	100

NA Not available

As shown in Table VI-23, the average annual concentrations above background during CY1999 to CY2002 were less than the 10 CFR 20 Appendix B value of 0.3 pCi/L.

Five-year Trend Analysis

The annual radon concentration at the HISS was below the 10 CFR 20 limit with negligible variance from year to year. There was a slight downward trend for annual dose over the time period. The average annual concentration of radon also had a slight downward trend for the period.

Radon Flux

Monitoring Program Results

The radon flux data collected from each location on the HISS piles during CY1998 to CY2000 were used to calculate an average radon release rate for the site. The calculated average radon release rates are presented in Table VI-24. Removal of the HISS stockpiles was conducted during 2001.

Data Analysis

Radon release rate data from the HISS were compared to the 40 CFR 192 limit of 20 pCi/m^2/s. A summary of the radon flux monitoring is presented in Table VI-24.

Table VI-24. Radon Release Rate at the HISS

Calendar Year	Average Radon Release Rate	10 CFR 20 App. B (20 pCi/m^2/s)
	(pCi/m^2/s)	
1998	0.4	20
1999	1.3	20
2000	0.9	20

As shown in Table VI-24, the average radon release rate from the site did not exceed the 40 CFR 192 limit of 20 pCi/m^2/s during CY1998 to CY2000.

Five-year Trend Analysis

The average radon release rate at the HISS was far below the 40 CFR 192 limit with negligible variance from year to year. There was no apparent trend for the average radon release rate over the time period. These data indicate that the liner was effective at controlling the potential release of radon.

Confirmatory Soil Sampling Program

Final status survey confirmatory sampling has been conducted at properties where removal or remedial actions have taken place. The purpose of this confirmatory sampling is to demonstrate that the removal or remedial action has been completed and the residual contamination is below the removal or remedial goal. The USACE evaluates the results to ensure the residual concentrations in the excavation meet the SLDS ROD remediation criteria for the SLDS properties, and the removal action criteria in the applicable EE/CA for the North St. Louis County sites properties. The following table summarizes SLS completed actions:

Table VI-25. SLS Confirmatory Soil Sampling Program Completed Actions

Site	Location	Document	Completed Action
North St. Louis County	SLAPS-VP St. Denis St. Bridge	Post-Remedial Action Report for the St. Denis Bridge Area, July 1999 (USACE 1999c).	The USACE informed the City of Florissant that the soil with residual radioactive contamination above criteria in the areas impacted by the new bridge installation had been removed.
SLDS	DT-1 Archer Daniels Midland (ADM) VP	Final Status Survey Evaluation Report for the St. Louis Downtown Site Archer Daniels Midland Vicinity Property (DT-1)(USACE 2002b)	No removal action required; the property was released without radiological restrictions.
SLDS	DT-15 City Owned Metropolitan Sewer District (MSD) Salisbury Lift Station VP	Final Status Survey Evaluation Report for the St. Louis Downtown Site City- Owned Property North (MSD) Salisbury Lift Station Vicinity Property (USACE 2001f).	No removal action required; the property was released without radiological restrictions.
SLDS	Mallinckrodt Plant 2	Post-Remedial Action Report for the Accessible Soils Within the St. Louis Downtown Site Plant 2 Property (USACE 2002a).	Residual radioactivity in the accessible areas in Plant 2 met the requirements of the remedial design and was below the 15/15/50 SLDS ROD remediation criteria. In addition, analytical results for arsenic and cadmium were below the SLDS remediation criteria.
North St. Louis County	SLAPS-VP IA-9	St. Louis Airport Site Investigation Area 9 Final Status Survey Evaluation, Berkeley Salt Storage Area (IA-9 Survey Unit 1), (USACE 2000c).	

A complete discussion of confirmatory sampling conducted at the following locations will be included in the next five-year report. This will inlcude:

<u>SLDS</u>
Mallinckrodt Plant 1
Mallinckrodt Plant 6E and 6EH
Mallinckrodt Plant 7E
Midwest Waste Vicinity Property (DT-7)
Heintz Steel and Manufacturing Vicinity Property (DT-6)

<u>North St. Louis County Sites</u>
SLAPS Radium Pits, East End, East End Extension / ROW and Phase 1 work areas
SLAPS sedimentation basin
SLAPS North Ditch
HISS, including stockpiles
SLAPS VP-38

Surface-water and Sediment Monitoring Program

Monitoring Overview

The environmental monitoring plan of Coldwater Creek evaluates the physical, radiological, and chemical parameters present in Coldwater Creek's surface water and sediment. The radiological and chemical parameters to be monitored were based on the Environmental Monitoring Plan for the SLS and are not necessarily FUSRAP COCs. The monitoring programs are conducted at Coldwater Creek as a part of the SLS to meet several objectives. These objectives are:

- To assess the quality of surface water and sediment at Coldwater Creek
- To compare the sampling results with regulatory standards or background values
- To evaluate/determine whether run-off from the SLAPS, the HISS, and their vicinity properties contribute to the quality of surface water and sediment in the creek.

Sampling of Coldwater Creek's surface water and sediment is conducted semi-annually at six monitoring stations (C002 through C007).

Monitoring Program Results

The evaluation results for the surface water and sediment sampling data for Coldwater Creek from CY1998 to CY2002 are presented in the following section. The sampling locations along Coldwater Creek are shown on maps included in the Annual Environmental Data Analysis Reports.

CY1998 Coldwater Creek Sampling Event

One sampling event was conducted for both surface water and sediment at all six monitoring stations during CY1998. For surface water, the maximum concentrations of Ra-226 and Th-230 occurred at monitoring station C004 and C005, respectively. However, the results were below the corresponding background values. The maximum concentrations for uranium isotopes were detected at C004 (16.03 pCi/L).

For sediment, the concentrations of Ra-226, Th-230, and U-238 ranged from 0.96 pCi/g to 5.14 pCi/g, 1.61 pCi/g to 201.2 pCi/g, and 1.92 pCi/g to 7.16 pCi/g, respectively. The maximum concentrations for these radionuclides occurred at C005.

Ra-226 concentration exceeded its background criteria of 4.73 pCi/g at station C005. For Th-230, the background criteria (2.2 pCi/g) was exceeded at stations C003, C004, C005, and C007. However, U-238 concentrations did not exceed its background criteria of 4.3 pCi/g at any monitoring station.

CY1999 Coldwater Creek Sampling Event

One sampling event for surface water was conducted as part of the Ecological Risk Assessment for North St. Louis County sites during CY1999. Only two sampling stations (C002 and C003) were sampled. The maximum concentrations of Th-230 and uranium isotopes were detected at

C003. Among chemicals, the concentrations of iron and zinc were higher than respective background values at station C003.

One sediment sampling event was conducted at six monitoring stations during CY1999. Among radionuclides, Ra-226 was detected and exceeded its background criteria at station C007. The concentrations of Th-230 were above background at stations C003, C004, and C007, and the maximum concentration was detected at C007. However, the concentrations of uranium isotopes were less than their corresponding background levels. Among chemicals, background criteria for eight inorganic analytes (beryllium, boron, calcium, chromium, copper, lead, sodium, and thallium), and thirteen semi-volatile organic analytes were exceeded.

CY2000 Coldwater Creek Sampling Event

Two surface water and sediment sampling events were conducted in CY2000. Ra-226 was not detected during either surface water sampling event in CY2000. The maximum concentration of Th-230 was detected at C007 during the first sampling event, whereas the maximum concentrations of uranium isotopes were detected at C002, during the second sampling event. However, the maximum concentrations were below corresponding background values. No chemical exceeded its corresponding AWQC during the first surface water sampling event. During the second sampling event, aluminum and iron exceeded their corresponding AWQCs.

The maximum concentrations of Ra-226 and Th-230 were detected at C005 during the first CY2000 sediment sampling event. The results exceeded their corresponding background values. The maximum concentrations of uranium isotopes were below their corresponding background values.

CY2001 Coldwater Creek Sampling Event

Two surface water and sediment sampling events were conducted in CY2001. Ra-226 was not detected during either surface water sampling event of CY2001. Th-230 was detected only at C004 (1.39 pCi/L). The maximum concentrations for uranium isotopes occurred at sampling station C003 during the first sampling event. However, the maximum concentration was less than the background concentration. Zinc was the only chemical that exceeded the corresponding surface water background values during both sampling events. The concentration of zinc was below its AWQC.

The maximum concentrations of Ra-226, Th-230, and U-238 were detected at C005 during the CY2001 sediment sampling event. Except for Th-230, maximum concentrations did not exceed background values. Four inorganics, sixteen semi-volatile organics, and one volatile organic analyte (methylene chloride, a common laboratory contaminant) were detected during CY2001 sediment sampling events.

CY2002 Coldwater Creek Sampling Event

Two surface water sampling events were conducted in CY2002. Ra-226 was not detected during the CY2002 surface water sampling events. The maximum concentrations of Th-230 and uranium isotopes were detected at C007; however, their results are below their corresponding background levels. Manganese, nickel, and selenium exceeded their corresponding background values during the first sampling event. The concentrations of aluminum, arsenic, selenium, and zinc exceeded background values during the second sampling event.

Ra-226 only exceeded its background values at C007 during the first sediment sampling event. However, during the second sampling event, Ra-226 concentrations exceeded its background values at all downstream stations. Th-230 concentrations exceeded background values at four downgradient stations (C004, C005, C006, and C007) and three downstream stations (C003, C005, and C007) during the second sampling event. U-238 concentrations exceeded background values for all downstream stations and the maximum concentration was detected at C007 (1.19 pCi/g). Arsenic, manganese, and magnesium exceeded background values during both sampling events, whereas concentrations of thallium and cadmium exceeded background values during the first and second sampling event, respectively.

Five-Year Trend Analysis

Figure VI-11 represents the five-year concentration trend analysis for different radionuclides in surface water. Among different radionuclides, concentrations of Ra-226, Th-230, and total uranium at all monitoring stations were analyzed for the last five years. Figure VI-11 (Trend Analysis for Ra-226) showed that the concentrations of Ra-226 did not exceed its AWQC (5 pCi/L) during the last five years at any of the stations; however, the concentrations at each station were above its background criteria during different times within this five-year period. The maximum concentration of Ra-226 was detected at monitoring station C003 during the first sampling event of CY2000. The trend showed that Ra-226 concentrations have been decreasing at each of the monitoring stations during the last three years. Figure VI-11 (Trend Analysis for Th-230) presents the trend of Th-230 concentrations at each monitoring station during the last five years. Except for the CY1999 sampling event, the concentrations of Th-230 have not exceeded its background value during the last five years. The total uranium concentrations during the last three years has not exceeded its background value, as shown in Figure VI-11 (Trend Analysis Per Total Uranium). Negative bar graphs indicate that the concentrations were below background levels. Monitoring station bars are not shown in the graphs where data was not available for that station and sampling event.

Figure VI-12 represents the five-year concentration trend analysis for different radionuclides in sediment. Figure VI-12 (Trend Analysis for Ra-226) shows the trend of Ra-226 concentrations at each monitoring station during the last five years. However, the chart did not include the results of detected maximum concentrations of Ra-226 (March 2000 sampling event) in order to better present the trend of Ra-226 concentrations at other stations. The chart showed that the concentrations of Ra-226 are less than their background level at all stations except for C005. In addition, the recent concentrations of Ra-226 showed that the concentrations are around its background level at all monitoring stations. As in the first chart, the second chart of Figure VI-12 (Trend Analysis for Th-230) did not include the result of the detected maximum concentration of Th-230 at C005 (CY1998 sampling event) in order to better present the trend of Th-230 concentrations at other monitoring stations. The chart showed that Th-230 concentrations are consistently higher at station C007, with respect to other stations. An elevated concentration of Th-230 was detected at C005 during the CY2002 sampling event. Figure VI-12 (Trend Analysis of Total U) showed that the total uranium concentrations in the sediment at all monitoring stations have decreased during the last three years. Monitoring station bars are not shown in the graphs where data was not available for that station and sampling event.

In addition to the trend analysis, an analysis was performed to correlate the concentrations of the radionuclide COCs (Ra-226, Th-230, and Total U) in the surface water with the concentrations of the same in the sediments at the same location by using historic results. The non-parametric Mann-Whitney method was used to determine the correlation. Based on 95% confidence interval, a null hypothesis was assumed. According to the hypothesis,

$H_0 : \lambda 1 = \lambda 2$, versus $H1 : \lambda 1 \neq \lambda 2$, where λ is the population medium.

The results of the analysis showed that for Ra-226 and Th-230, a correlation exists between surface water and sediment concentrations at all monitoring stations. For total uranium, there is a correlation between surface water and sediment concentrations at monitoring stations C004, C005, and C007. This correlation indicates that concentrations of COCs in the sediment are impacting the surface water quality.

SITE INSPECTIONS

The purpose of the site inspections was to gather information about the SLS status and visually confirm and document the impact of the response actions on the site and the surrounding areas. Because of the size of the SLS and the distance between them, separate inspections were conducted for the North St. Louis County sites (the SLAPS, HISS, and SLAPS VPs) and the SLDS. The completed checklists are provided in Appendix C.

Hazelwood Interim Storage Site

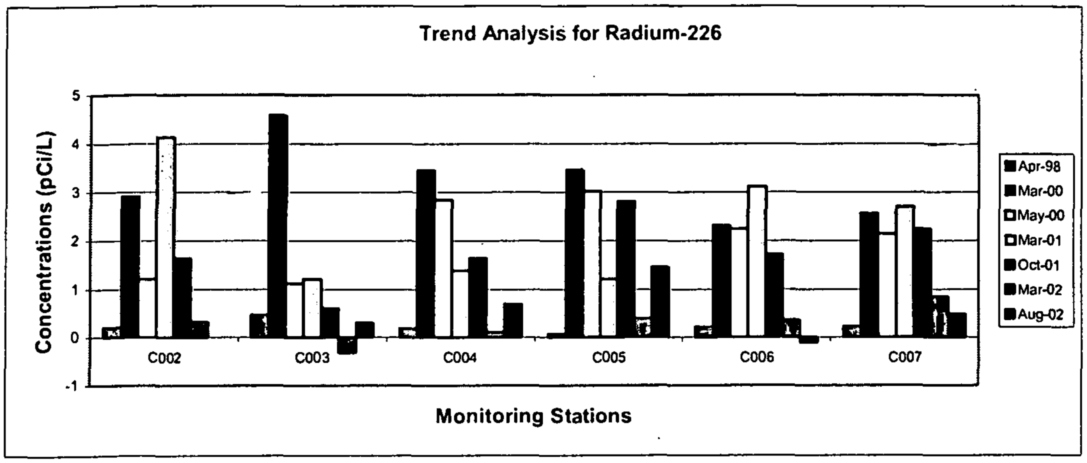
The HISS was inspected on April 8 - 10, 2003 by J. Mattingly (USACE), D. Wall (USEPA) and J. Groboski (MDNR). The team was met by Davc Mueller, the USACE-Area Engineer.

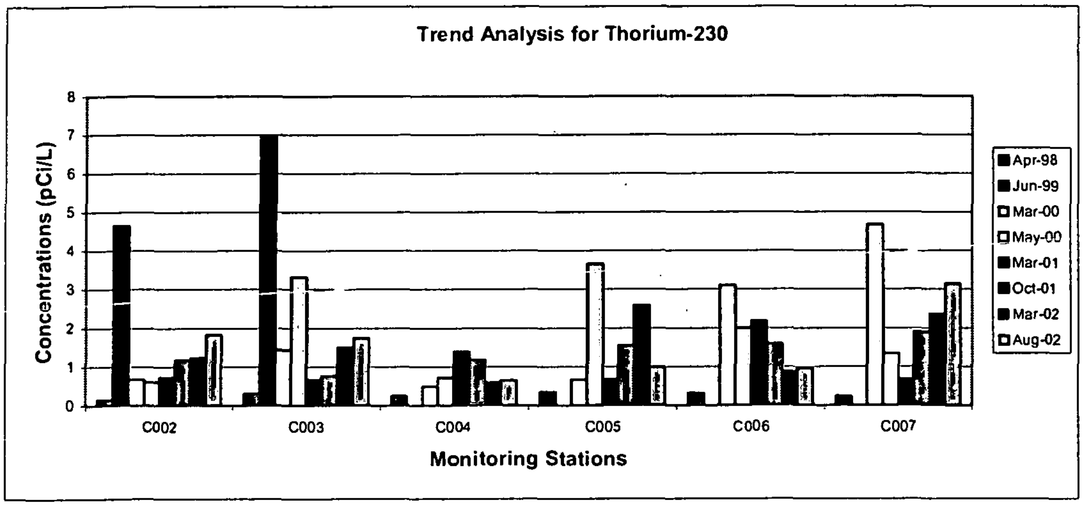
The inspection began with a discussion with Mr. Mueller about site activities and verification that key documents (Health and Safety Plan, training records, permits, as-built drawing, environmental reports) were on-site as required. Since the removal of the piles was completed in CY2002, maintenance and environmental monitoring were the only remedial activities taking place on the site.

During the physical inspection the team was escorted by Bob Wasitis (USACE), the site representative, chosen for safety and his knowledge of the HISS. The team inspected the perimeter of the site and the adjacent railroad spur. This inspection focused on general site conditions, access control facilities, and environmental monitoring equipment related to removal actions.

Although there were no significant issues identified by the team, the access control and monitoring stations for air and storm-water run-off were in place and appeared to be functioning properly. Most of the site was well covered with vegetative growth and geofabric covered by rock; however, the team noted a minor (potential) issue in that the vegetation in the northern area of the property was sparse and rock had been displaced, exposing the geofabric in some areas. The team also noted that the site drainage pattern impeded the growth of vegetation despite regular attempts at seeding the area; this could cause dust to become airborne and should be addressed to avoid potential fugitive dust emissions. It should be noted that there have been no emissions of fugitive dust to date, and ongoing air monitoring has not indicated fugitive dust to be an issue.

Figure VI-11. Trend Analysis for Radionuclides in Coldwater Creek Surface Water





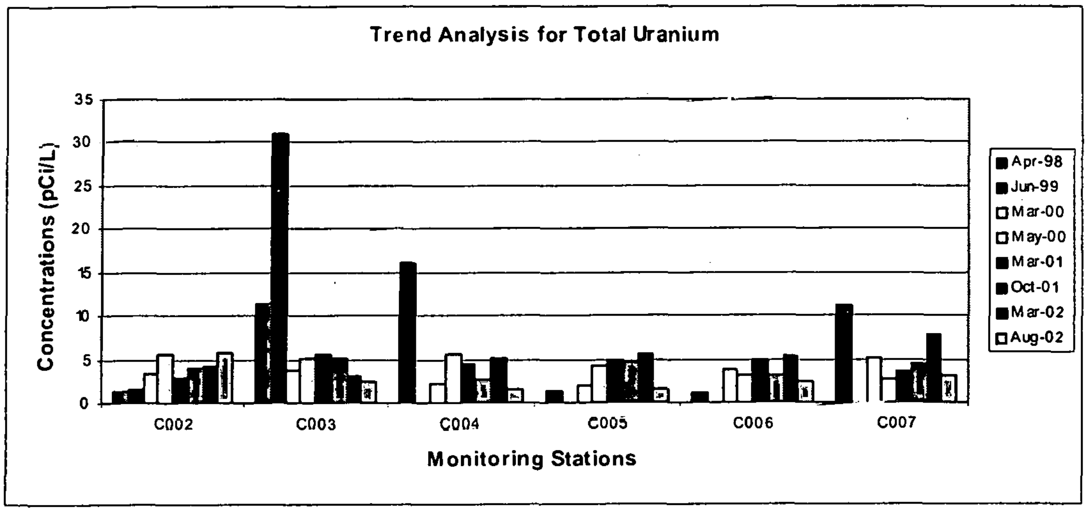
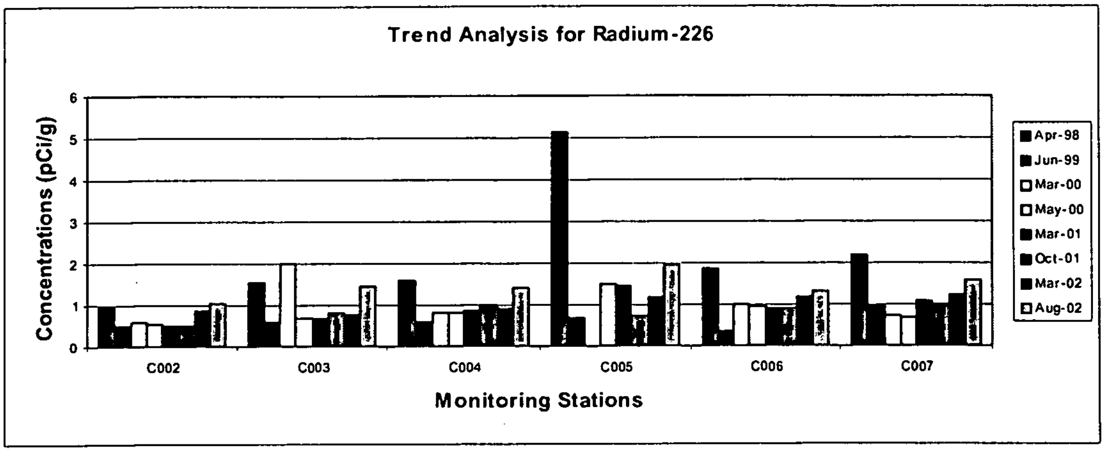
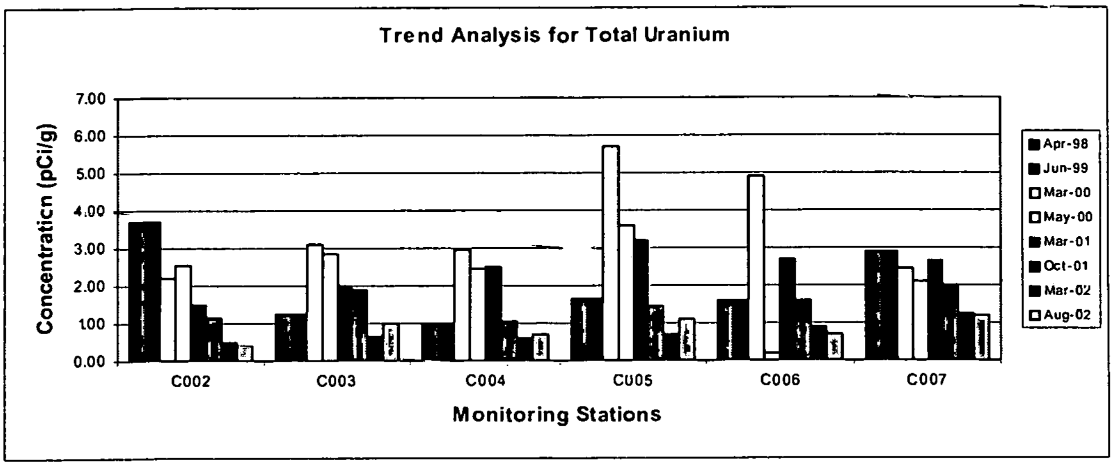
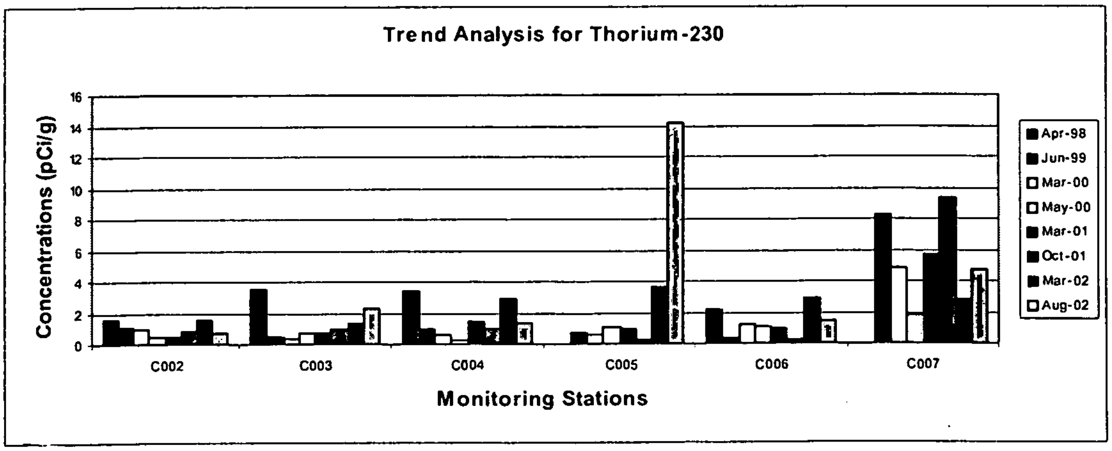


Figure VI-12. Trend Analysis for Radionuclides in Coldwater Creek Sediment







St. Louis Airport Site

The SLAPS was inspected on April 8 - 10, 2003 by J. Mattingly (USACE), D. McKinley, (USACE), D. Wall (USEPA) and J. Groboski (MDNR). The team was met by Sonny Roberts, the USACE-SLAPS Construction Manager.

The inspection began with a discussion with Mr. Roberts about site activities and verification that key documents (Health and Safety Plan, training records, permits, as-built drawing, environmental reports) were on-site as required. The following activities were underway on the days of the inspection:

- Excavation in the McDonnell Boulevard ROW
- Excavation in the Phase 1 area of the SLAPS
- Excavation in the Phase 2 area of the SLAPS
- Pumping of ponded water to holding basins for treatment
- Loading railroad cars with contaminated materials for shipment

During the physical inspection, the team was escorted by Corey Harris (SHAW) chosen for safety and his knowledge of the SLAPS. The site is an open area north of Lambert-St. Louis International Airport; the eastern portion is covered by facilities and parking areas for the remediation. The team inspected the perimeter of the site and the adjacent railroad spur. This inspection focused on access control facilities in areas impacted by remediation, environmental monitoring equipment related to the removal actions, and on-going removal work.

No significant issues were identified regarding the removal action being implemented at the SLAPS. Access control and environmental monitoring equipment were in place around the perimeter of the site and of the excavations, and the workers were observing appropriate health and safety measures. Dust-suppression procedures were being implemented to prevent the spread of airborne contamination, and water was being managed so run-off did not migrate to uncontaminated areas. Vegetative cover had been properly established as part of the final restoration for previously addressed areas and for areas not yet remediated.

North St. Louis County sites VPs

The SLAPS VPs were inspected on April 8 - 10, 2003 by J. Mattingly (USACE), D. Wall (USEPA) and J. Groboski (MDNR). The team was met by Dave Mueller, the USACE-Area Engineer, and the inspection began with a discussion with Mr. Mueller about site activities. The VPs are in a maintenance mode pending selection of the final remediation goals, so, aside from support to utilities and/or property development, no activities were taking place.

Because the VPs are privately owned and largely observable from public roads, the team performed its physical inspection of the properties unescorted. Affected properties were observed during a driving tour of the original haul routes, and the inspection was limited to general site conditions such as the presence of vegetative cover.

No significant issues were identified by the team regarding the response actions being implemented for the VPs. The primary activity for these properties is the communication regarding contaminant location and requests by the property owners for support during property improvements. Regular site inspections by USACE-CEMVS personnel and self-reporting by utility and property owners has helped assure that the properties are being properly addressed.

Building expansions were evident on properties VP-24 and VP-36; these construction activities had been supported by USACE-CEMVS. The inspection team also noted traffic ruts in shoulders of roadways and recommended continued monitoring and support as appropriate, since repairs could pose a health risk or move contamination to previously uncontaminated areas. The team also recommended updating VP contamination status maps so that cleared areas, contaminated areas, and questionable areas are clearly identified and land-use changes are recorded.

St. Louis Downtown Site

The SLDS was inspected on May 8 and 9, 2003 by J. Mattingly (USACE), D. Wall (USEPA) and J. Wade (MDNR). The team was met by Gerald Allen, the USACE-SLDS Construction Manager, who escorted them throughout the investigation for safety and knowledge of the SLDS.

The inspection began with a discussion with Mr. Allen about site activities and verification that key documents (Health and Safety Plan, training records, permits, as-built drawing, environmental reports) were on-site as required. The following activities were underway on the days of the inspection:

- Remedial excavation at Mallinckrodt Plant 6 East Half;
- Remedial excavation at Heintz Steel and Manufacturing VP (DT-6); and
- Construction activities underway on that portion of the property leased from PSC Metals. Construction activities were limited to the north side of the loadout facility to construct additional loadout capacity at the SLDS.

The physical inspection consisted of a tour of the site. Most of the VPs were visited. As would be expected in an area of mature industrialization, the SLDS is dominated by active manufacturing plants, warehouses, outdoor storage areas, roadways, and railways in various states of repair. This inspection focused on access control facilities in areas impacted by remediation, environmental monitoring equipment related to remediation, and on-going remedial work.

No significant issues were identified regarding the remedial action being implemented at the SLDS. Access control measures appeared to be appropriate for the excavations at Plant 6 and Heintz Steel. Monitoring devices were in place around the perimeter of the site, and the workers were observing appropriate health and safety measures. Dust-suppression procedures were being implemented to prevent the spread of airborne contamination, and water was being managed so run-off did not migrate to uncontaminated areas.

Interviews

In April and May 2003, the USACE conducted 30 St. Louis Sites community interviews. These interviews were conducted as a part of the FUSRAP five-year review. Respondents included property owners; business owners; city, county, state and federal elected officials; utility company representatives; citizen interest groups (e.g. St. Louis Oversight Committee, Gracehill); residents not otherwise affiliated with interest groups; local school officials; state and local government agency representatives; and community religious leaders.

Respondents generally reported feeling well informed of the site activities and progress. They reported they were satisfied with the current communication plan (means and frequency of information distribution through various meetings, newsletters, and news releases) and the USACE's responsiveness to community concerns. Currently, community concern about contamination from the St. Louis Sites is moderate, which does not mean that citizens are indifferent to the environmental problem posed by the sites. On the contrary, conversations with community members have revealed that many stakeholders are keenly interested in site response actions and regularly check the continued progress of cleanup activities.

Many of the people interviewed also expressed satisfaction with the progress of cleanup activities at the FUSRAP sites as well as USACE's openness in sharing information regarding site activities and efforts to build relationships with the various entities impacted the project. A summary of concerns and other related issues raised during the interviews follows.

Primary Concerns Raised During the Interviews

Contaminant Migration Issues: The public expressed concerns regarding the migration of contamination during cleanup activities. USACE should continue to take appropriate steps to minimize the potential for contaminant migration.

Inaccessible Soil and LTS Issues: Utility companies expressed concerns about whether the existing utility support agreements will be honored in the future after active remediation is complete. The current agreement provides utilities with a sense of security and reassurance that their people will be supported during work in impacted areas. State and local representatives wanted broader community involvement in the development of the final LTS plan for the various sites to ensure stewardship requirements fit the current and planned future land use.

Other Important Issues Raised by the Community

The CERCLA Cleanup Process: The community relations program at the St. Louis Sites should continue to educate area residents and local officials about the procedures, policies, and requirements of the Superfund program. The community expressed great satisfaction with past education efforts and encouraged continuation of this effort.

The Pace of the Community Relations Program: The pace of the community relations program will be set by the needs of the local stakeholders. Community relations activities will be set up to encourage community participation. Stakeholders have requested continuation of the following communication methods to relate information about progress and problems encountered during cleanup efforts: telephone contacts, letters, reports, newsletters, Internet resources, and regularly scheduled meetings with citizen groups.

VII. TECHNICAL ASSESSMENT

SLDS

Question A: Is the response action functioning as intended by the decision documents?

Answer A: Yes, the response action is functioning as intended by the decision documents.

The SLDS ROD (USACE 1998c) states:

"The main components of the selected remedial action include:

- Excavation and off-site disposal of approximately 65,000 cubic meters (85,000 cubic yards) (in-situ) contaminated soil; and
- No remedial action is required for ground water beneath the site. Perimeter monitoring of the ground water in the Mississippi River alluvial aquifer, designated as the HU-B, will be performed and the need for ground-water remediation will be evaluated as part of the periodic reviews performed for the site."

Response Action Performance

Response actions were completed at some properties of the SLDS (such as Plant 2, Archer Daniels Midland (DT-1), City Property (DT-2), and the MSD Lift Station (DT-15). Response actions are being conducted in some properties, such as Plant 1, Midwest Waste (DT-7), Plant 7E, Plant 6E, and Heintz Steel (DT-6). Response actions will be performed for Mallinckrodt and the remaining VPs. The past and present excavation and off-site disposal of accessible soil above the Remediation Goal (RG) at the SLDS are being performed as prescribed in the SLDS ROD. Completed activities have met the remediation goals [*Final Post-Remedial Action Report for the St. Louis Downtown Site City-Owned Vicinity Property, St. Louis, Missouri*, September 1999 (USACE1999b); *Post-Remedial Action Report for the Accessible Soils Within the Downtown Site Plant 2 Property*, January 2002 (USACE 2002a)]. However, in order to achieve the RGs, the volume of material excavated was greater than the volumes estimated in the ROD for the following reasons: indiscriminate dumping, air dispersion, unknown and abandoned utilities acting as preferred pathways, and surface and subsurface waterborne transport of particles all may have played a greater role in contaminant distribution than originally thought. The change in volumes did not affect the protectiveness of the response action.

The goal of the ground-water portion of the remedy was to monitor the usable aquifer (HU-B) to assure it was protected through the source removal; however, arsenic and uranium were detected in HU-B wells at levels exceeding MCLs or the ILs established in the SLDS ROD. A GRAAA was initiated as required by the ROD and is now in the second phase. The results of this assessment will be presented in the next five-year review.

Systems Operations/O&M

The past and current operating procedures maintain the effectiveness of the response actions. The only significant variance to costs is due to increased volumes of soil to be excavated and sent to off-site disposal.

Opportunities for Optimization

Optimization has occurred in three primary areas: pre-design investigations, system operations, and the environmental monitoring program. Rather than limiting investigations to a specific plant or VP, a study area approach using historical, geological, and gamma walkover survey data, and other existing information, has been implemented. The previous approach of limiting pre-design investigations to particular plants or VPs created difficulties when contamination extended beyond the study boundaries. The new approach results in a more efficient and effective investigation, design, and remedial action.

Systems operations have been optimized through construction of a second soil load out facility. This construction has facilitated efficient transport of contaminated soil and has resulted in a cost savings of approximately $1,000 per railcar.

The environmental monitoring system is optimized through an annual evaluation. Sampling locations, frequencies, and target constituents are modified on the basis of historical data, trends, and the evolving nature of the remedial action. Some monitoring locations have been deleted and sampling frequencies reduced as a result of these evaluations.

Early Indicators of Potential Issues

As discussed above, the only early indicators of potential issues were the larger volume of soil containing contaminants and the exceedance of ILs in the HU-B aquifer.

Implementation of Institutional Controls and Other Measures

To date, no institutional controls have been implemented at the SLDS. For accessible soil, areas remaining after remediation have been released without radiological restrictions. For inaccessible soil, access control and an excavation permit process are sufficient to prevent or minimize exposure.

Mallinckrodt provides the primary access controls on its property through badging and perimeter fencing. Prior to remedial activities at any property, temporary fences, gates, and/or barriers are installed around the work zone, warning signs are posted at designated intervals, and specific points are established for ingress and egress. Anyone not involved in the remediation is restricted from entry into the construction zone. As conditions change, controls are modified to restrict access. When it is necessary to close a road or sidewalk due to construction, alternate routes are provided. In addition, USACE is currently in the process of developing the CERCLA documentation necessary to address inaccessible soil at the SLDS. A long-term stewardship plan will be prepared to document processes and procedures with respect to requirements under CERCLA.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of response selection still valid?

Answer B: Yes, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of response selection are still valid and any changes in these values have no impact on the protectiveness of the remedy.

40 CFR 141

The change in this proposed standard (shown on Table VII-1) has had no impact on the protectiveness of the remedy. A GRAAA was initiated for the HU-B aquifer because the ROD standard was exceeded as it would have been for the new limits. The revised MCLs will be considered as part of the GRAAA evaluation. If a determination is made that further action is required, the revised MCLs will be considered during the ARARs evaluation.

Table VII-1. Changes in Standards and Investigative Limits

Citation	Contaminant	Medium	ROD IL	New Standard (MCL)
40 CFR 141	Arsenic	Ground water	50 μg/L	10 μg/L
	Uranium	Ground water	20 μg/L	30 μg/L
10 CFR 40; Appendix A, Criterion 6(6)	Non-Ra radionuclides	Soil	None	5/15 pCi/g, Ra-226 Benchmark dose

10 CFR 40 Appendix A: Criterion 6(6)

Title 10, Code of Federal Regulations, Part 40 (10 CFR 40), implements relevant standards for mill tailings. In April 1999, 10 CFR 40 was amended to include an approach for developing cleanup goals for tailings constituents other than radium in soil and for radiological contamination on building surfaces. Such constituents were previously addressed at CERCLA sites on a case-by-case basis by development of appropriate preliminary remediation goals (PRGs) and subsequent movement off the point of departure when appropriate rather than using a single, consistent, dose and risk-based approach. The amendment of 10 CFR 40 does not result in more restrictive remediation goals (RGs). Current RGs result in residual site risks within the CERCLA risk range and thus continue to be fully protective of human health and the environment. The 1998 SLDS ROD addressing accessible soil and ground water will not be revised as a result of the publication of Criterion 6(6). Changes in this standard are shown on Table VII-1.

Changes in Risk Assessment Methods

Standardized risk assessment methods have evolved into a more probabilistic approach since the ROD was signed. There have also been changes in determining risk-based PRGs for radionuclides. The changes include exposure parameters, chemical-specific parameters, and equations, and newer toxicity values. Adult-only ingestion slope factors for workers have been updated for Ra-226+D, U-235+D, and U-238+D. The soil-to-air volatilization factor replaces the particulate emission factor. The worker soil exposure PRGs have been separated into indoor and outdoor scenarios. The newer PRG equations include radionuclide decay correction. In January 2001, toxicity values for radionuclides in the *Health Effects Assessment Summary Table* were changed and USEPA revised its standard PRG calculation template. In addition, a newer version of the radiological assessment model has incorporated the new changes. These changes have had no impact on the remedy since post-remedial action risk assessments for the SLDS use the most recent risk assessment guidance and latest version of the model.

Expected Progress Towards Meeting RAOs

As stated above, excavation and off-site disposal of contaminated soil is being performed as prescribed in the ROD. Completed activities have met the RGs. A GRAAA has been initiated for the HU-B aquifer to address exceedance of the ILs as cited in the ROD.

Question C: Has any other information come to light that could call into question the protectiveness of the response action?

Answer C: No, there have been no newly identified ecological risks, impacts from natural disasters, or other information that has come to light that could affect the protectiveness of the remedy.

HISS / Latty Avenue VPs

Question A: Is the response action functioning as intended by the decision documents?

Answer A: Yes, the response action is functioning as intended by the decision documents.

"Soils from the four interim storage piles, and accessible subsurface soil from the two Latty Avenue VPs, and the contiguous property that exceed the selected criteria of 5/15/50 pCi/g for Ra-226, Th-230, and U-238 respectively would be excavated and disposed at a licensed or permitted disposal facility. As used herein the 5/15/50 criteria define contamination such that Ra-226 and Th-230 are each limited to 5 pCi/g in the top 6 inches of soil and 15 pCi/g below the top 6 inches of soil. U-238 is limited to 50 pCi/g at all depths."

Engineering Evaluation/Cost Analysis (EE/CA) for the Hazelwood Interim Storage Site (HISS), (USACE 1998a).

Action Memorandum for the Removal of Radioactively Contaminated Material at the Hazelwood Interim Storage Site and Latty Avenue Vicinity Properties, June 1998 (USACE 1998b).

Removal Action Performance

The excavation and off-site disposal of contaminated material from the interim storage piles at the HISS was performed as prescribed in the EE/CA. Additionally, removal actions performed on a portion of VP-2(L) and Futura property have met the EE/CA criteria.

Systems Operations

The current operating procedures, which include the environmental monitoring program, maintain the effectiveness of the response actions.

Opportunities for Optimization

Optimization has occurred in two primary areas: system operations and the environmental monitoring program. General process improvements, including equipment changes and efficiencies implemented through experience have, over time, optimized operations and reduced the cost per cubic yard of contaminated soil excavated. One specific operations improvement consisted of the construction of a new loadout facility at the HISS to replace the original facility on Eva Avenue.

The environmental monitoring system is optimized through an annual evaluation. Sampling locations, frequencies, and target constituents are modified on the basis of historical data, trends, and the evolving nature of the response action. Some monitoring locations have been deleted and sampling frequencies reduced as a result of these evaluations.

Early Indicators of Potential Issues

Thin vegetative cover was noted during the site inspection.

Implementation of Institutional Controls

At the HISS, the storage piles were removed and limited excavation on VPs was performed. The remaining contaminated soil will be addressed subsequent to signature of the North St. Louis County sites ROD. No institutional controls are required at this stage of the CERCLA process to prevent exposure. COCs remaining at the site will be addressed under the selected remedy identified in the North St. Louis County sites ROD. Until then, a fence and appropriate signage is maintained around the HISS proper.

Prior to response activities at any property, temporary fences, gates, and/or barriers are installed around the work zone, warning signs are posted at designated intervals, and specific points are established for ingress and egress. Anyone not involved in the remediation is restricted from entry into the construction zone. As conditions change, controls are modified to restrict access.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of response selection still valid?

Answer B: Yes, the exposure assumptions, toxicity data, cleanup levels, and response action objectives used at the time of response selection are still valid and any changes in these values have no impact on protectiveness.

Changes in Exposure Pathways

There have been no changes in land use, no change in the understanding of the physical site conditions, and no new contaminants of concern. There are no unanticipated toxic by-products from the remedy.

Changes in Toxicity or Contaminant Characteristics

There have been some changes in the toxicity factors in a way that affects the protectiveness of the remedy. RESRAD version 6.0 (2001) incorporates the factors from Federal Guidance Report (FGR)-11 and -12 and allows for the use of FGR-13 whereas the previous versions of RESRAD used data from older models.

In FGR-13, EPA includes newer toxicity values for each radionuclide based on age- and gender-dependence of radionuclide intake, metabolism, vital statistics and baseline cancer mortality data, and a revised dosimetric model.

Changes in Risk Assessment Methods

Standardized risk assessment methods have evolved into a more probabilistic approach since the EE/CA was finalized. There have also been changes in determining risk-based preliminary remediation goals for radionuclides. In January 2001, toxicity values for radionuclides in the

Health Effects Assessment Summary Table were changed and USEPA revised its standard preliminary remediation goal (PRG) calculation template. In addition, a newer version of the radiological assessment model has incorporated the new changes. These changes will have no impact on the remedy since post-remedial action risk assessments for the HISS will use the most recent risk assessment guidance documents and latest version of both chemical and radiological risk assessment models.

Expected Progress Towards Meeting RAOs

As stated above, excavation and off-site disposal of contaminated soil was performed as prescribed in the EE/CA. Completed activities have met the response action criteria.

Question C: Has any other information come to light that could call into question the protectiveness of the response?

Answer C: No, there have been no newly identified ecological risks, impacts from natural disasters, or other information that has come to light that could affect the protectiveness of the response action.

SLAPS (Including Associated VPs)

Question A: Is the response action functioning as intended by the decision documents?

Answer A: Yes, the response action is functioning as intended by the decision documents.

"Soils from the SLAPS and the Ballfields (excluding the north ditch) that exceed the selected criteria of 15/15/50 pCi/g (respectively for Ra-226/Th-230/U-238) above background (by SOR) would be excavated and disposed of at a licensed or permitted disposal facility. Soils within the top 6-inch layer that exceed the 5/5/50 pCi/g above background (by SOR) will be excavated."

St. Louis Airport Site (SLAPS) Interim Action Engineering Evaluation/Cost Analysis (EE/CA), (USACE 1997a).

SLAPS Action Memorandum for the Removal of Radioactively Contaminated Material, September 1997 (DOE 1997b).

Engineering Evaluation/Cost Analysis (EE/CA) and Responsiveness Summary for the St. Louis Airport Site (SLAPS) and Action Memorandum, St. Louis, Missouri, March 1999 (USACE 1999a).

Response Action Performance

The excavation and off-site disposal of contaminated soil at the SLAPS is being performed as prescribed in the EE/CA. Complete activities have met the cleanup criteria as documented in (*Vicinity Property 38 Removal Action Summary, Berkeley, Missouri* (USACE 2001d); *Radium Pits Removal Action Summary Report FUSRAP St. Louis Airport Site* (USACE 2001e); *Post-Remedial Action Report for the St. Denis Bridge Area* (USACE 1999c); *St. Louis Airport Site Investigation Area 9; Final Status Survey Evaluation Berkeley Salt Storage Area (IA-9 Survey Unit 1)* (USACE 2000c).

The ground-water monitoring program at the SLAPS discovered levels of selenium in the shallow aquifer (HZ-A) above Clean Water Act default limits for Coldwater Creek and the MSD discharge limit of 200 µg/L for the Coldwater Creek treatment plant. The following treatment options were evaluated for the reduction of the selenium to acceptable levels: ion exchange, electro coagulation, reverse osmosis, iron-copper cementation, phytoremediation, chemical precipitation/ reduction, off-site disposal, and denitrification. Following bench- and full-scale testing which produced an effluent with less than allowable discharge limit, a bio-denitrification process was selected for pre-treatment of the water prior to treatment by the ion exchange system that was already in use. Existing excavations and on-site water storage tanks have been lined, filled, and inoculated with microbes obtained from MSD.

Systems Operations

The current operating procedures maintain the effectiveness of the response actions. The significant variances to costs are due to increased volumes of soil to be excavated and sent to off-site disposal and the bio-denitrification of the selenium contaminated water.

Opportunities for Optimization

Optimization has occurred in two primary areas: system operations and the environmental monitoring program. General process improvements, including equipment changes and efficiencies implemented through experience, have, over time, optimized operations and reduced the cost per cubic yard of contaminated soil excavated. A specific operations improvement was the construction of a new loadout facility at the SLAPS to replace the original facility on Eva Avenue.

The environmental monitoring system is optimized through an annual evaluation. Sampling locations, frequencies, and target constituents are modified on the basis of historical data, trends, and the evolving nature of the remedial action. Some monitoring locations have been deleted and sampling frequencies reduced as a result of these evaluations.

Early Indicators of Potential Issues

As discussed above, the only early indicator of a potential issue was the presence of elevated levels of selenium in the HU-A aquifer.

Implementation of Institutional Controls

No institutional controls are required at this stage of the CERCLA process to prevent exposure. In the future, institutional controls may be implemented if specified in new decision documents. COCs remaining at the site will be addressed under the selected remedy identified in the North St. Louis County sites ROD

Prior to response activities at any property, temporary fences, gates, and/or barriers are installed around the work zone, warning signs are posted at designated intervals, and specific points are established for ingress and egress. Anyone not involved in the response action is restricted from entry into the construction zone. As conditions change, controls are modified to restrict access.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of response selection still valid?

Answer B: Yes, the exposure assumptions, toxicity data, cleanup levels, and response action objectives used at the time of response selection are still valid and any changes in these values *have no impact on protectiveness.*

Changes in Exposure Pathways

There have been no changes in land use, no change in the understanding of the physical site conditions, and no new contaminants of concern. There are no unanticipated toxic by-products from the remedy.

Changes in Toxicity or Contaminant Characteristics

There have been some changes in the toxicity factors in a way that affects the protectiveness of the remedy. RESRAD version 6.0 (2001) incorporates the factors from Federal Guidance Report (FGR)-11 and -12 and allows for the use of FGR-13 whereas the previous versions of RESRAD used data from older models.

In FGR-13, EPA includes newer toxicity values for each radionuclide based on age- and gender-dependence of radionuclide intake, metabolism, vital statistics and baseline cancer mortality data, and a revised dosimetric model.

Changes in Risk Assessment Methods

Standardized risk assessment methods have evolved into a more probabilistic approach since the EE/CA was finalized. There have also been changes in determining risk-based preliminary remediation goals for radionuclides. In January 2001, toxicity values for radionuclides in the *Health Effects Assessment Summary Table* were changed and USEPA revised its standard PRG calculation template. In addition, a newer version of the radiological assessment model has incorporated the changes. These changes have had no impact on the remedy since post-remedial action risk assessments for the SLAPS use the most recent risk assessment guidance documents and the latest version of both chemical and radiological risk assessment models.

Expected Progress Towards Meeting RAOs

As stated above, excavation and off-site disposal of contaminated soil was/is being performed as prescribed in the EE/CA. Completed activities have met the removal criteria. However, the initial volume of soil to be excavated was underestimated and the remedy is progressing more slowly than anticipated.

Question C: Has any other information come to light that could call into question the protectiveness of the response?

Answer C: No, there have been no newly identified ecological risks, impacts from natural disasters, or other information that has come to light, which could affect the protectiveness of the response action.

VIII. ISSUES

SLDS

One issue was identified for the SLDS residual radioactivity concentrations in the SLDS inaccessible soil. This issue is discussed in the following paragraphs and summarized in Table VIII-1. SLDS Issue.

Residual radioactivity concentrations in the SLDS inaccessible soil:

As described in Section III, the SLDS has been separated into two operable units (OUs): 1) the Accessible Soil and Ground-Water OU and 2) the Inaccessible Soil OU. The Accessible Soil and Ground-Water OU consists of the accessible soil and ground water contaminated as the result of MED/AEC uranium processing activities at the Mallinckrodt plant. The Inaccessible OU consists of Mallinckrodt Buildings 25 and 101 and contaminated soil that is currently inaccessible due to the presence of buildings, active rail lines, roadways, the levee, and other permanent structures. The Inaccessible Soil OU was excluded from the scope of the 1998 SLDS ROD because the inaccessible soil did not present a significant threat in its current configuration and because activities critical to Mallinckrodt's continued operations prevented excavation beneath the encumbrances (e.g., roads, active railroads, Buildings 25 and 101). Contamination present within Building 25 also did not present an excessive risk under its current configuration. Because land use has remained the same at the SLDS since the 1998 SLDS ROD was signed, these determinations hold true today. Thus, while the presence of residual inaccessible soil exceeding remediation goals does not currently affect the protectiveness of the remedy, it could potentially affect the protectiveness of the remedy in the future if not addressed.

Table VIII-1. SLDS Issue

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Residual radioactivity concentrations in the SLDS inaccessible soil: Radionuclides may remain in the SLDS inaccessible soil at concentrations above background values. USACE is currently developing the CERCLA documentation necessary to address inaccessible soil at the SLDS. A Long-Term Stewardship Plan will be prepared to document processes and procedures with respect to requirements under CERCLA.	No. Existing land use controls provide sufficient protectiveness.	Yes. Failure to develop a Long-Term Stewardship Plan may result in inadequate land use controls for inaccessible soil remaining after accessible soil remediation is complete.

North St. Louis County Sites

One issue was identified for the North St. Louis County sites: thin cover material at the HISS. This issue is discussed in the following paragraphs and summarized in Table VIII-2.

Table VIII-2. North St. Louis County Sites Issue

Issue	Currently Affects Protectiveness (Y/N)	Potentially Affects Future Protectiveness (Y/N)
<u>Thin Cover Material at the HISS</u>: The site inspection found vegetative cover on the northern area of the property inside the fence was thin. The cover material (soil) at the HISS is seeded several times per year; however, site drainage patterns appear to be impeding the establishment of vegetative cover. The USACE will reseed the cover material at the HISS to increase the vegetative cover present at the site. If unsuccessful through reseeding, other options will be considered to address the issue.	No. The rock in some areas had been displaced down to the geofabric. The geofabric cover remains and the underlying soil layer is not yet exposed.	Yes. Failure to establish adequate ground cover could result in exposure of the contaminated layer to surface water erosion and the movement of contaminated material.

<u>Thin Cover Material at the HISS</u>:

Although most of the site was well covered with vegetative growth and geofabric covered with rock, the site inspection found vegetative cover on the northern area of the property inside the fence was thin. The rock in some areas had been displaced down to the geofabric. Unforeseen delays in the selection of the final response action for the North St. Louis County sites led to the site's current state. The current site drainage pattern impeded the growth of vegetation despite regular attempts to seed the area. The condition of the vegetative cover does not currently affect the protectiveness of the response action. Even with total loss of the soil cover, the rock and plastic layers would prevent further erosion at the HISS. However, the protectiveness of the remedy in the future could be adversely affected if it resulted in exposure of the contaminated layer to surface water erosion.

IX. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Issue	Recommendations/Follow-up Actions	Lead Agency	Stakeholder Agencies	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Residual radioactivity concentrations in the SLDS inaccessible soil on vicinity properties	USACE is developing the CERCLA documentation necessary to address inaccessible soil at the SLDS. A Long-Term Stewardship Plan will be prepared to document processes and procedures with respect to requirements under CERCLA.	USACE	EPA DOE MDNR	Ongoing.	N	Y
Thin Cover Material at the HISS	USACE will continue to monitor the site to ensure that erosion does not result in an off-site discharge. USACE will reseed the cover material at the HISS to increase the vegetative cover present at the site. If unsuccessful through reseeding, other options (e.g., crushed rock, sod, geomembrane, clean soil) will be considered to address the issue.	USACE	EPA DOE MDNR	Ongoing.	N	Y

X. PROTECTIVENESS STATEMENT

Protectiveness Statement (St. Louis Downtown Site)

The remedy being implemented at the SLDS Operable unit is expected to be protective of human health and the environment upon attainment of the cleanup goals established in the ROD. In the interim, exposures that could result in unacceptable risks are being controlled through access controls and work place management practices. Some areas with soil contamination deeper than four feet and some areas with contamination under permanent structures will be managed in place using institutional controls to limit use. Long-term groundwater monitoring is being used to confirm that the remedy is protective of the alluvial aquifer.

Protectiveness Statement (North St. Louis County Sites)

The removal actions being implemented at the North St. Louis County Sites operable unit are expected to be protective of human health and the environment upon attainment of the soil cleanup goals established in the EE/CAs. In the interim, exposures that could result in unacceptable risks are being controlled through access controls, surveillances and maintenance, and coordination with property owners and utility companies. In May 2003, the USACE published a Proposed Plan for remedial action designed to address all remaining contamination at the North St. Louis County Sites. Public comment has been received. A ROD is currently under development and will be made available upon finalization.

XI. NEXT REVIEW

The next five-year review for the North St. Louis County sites and the SLDS is required by September 8, 2008, five years from the date of this review.

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