DOE/OR/21949-305

ENVIRONMENTAL MONITORING PLAN
FOR THE HAZELWOOD INTERIM STORAGE SITE

HAZELWOOD, MISSOURI

NOVEMBER 1991

Prepared for

United States Department of Energy
Field Office, Oak Ridge
Under Contract No. DE-AC05-91OR21949

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CONTENTS

CONTENTS
(continued)

CONTENTS
(continued)

FIGURES

TABLES

Table	Title	Page

ACRONYMS

AEC	Atomic Energy Commission
ASER	annual site environmental report
ASME	American Society of Mechanical Engineers
BNI	Bechtel National, Inc.
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chain of custody
CWA	Clean Water Act
DOE	Department of Energy
DQO	data quality objective
EIS	environmental impact statement
EML	Environmental Measurements Laboratory
EMP	environmental monitoring plan
EPA	Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
HISS	Hazelwood Interim Storage Site
ID	identification
MAP	mitigation action plan
MED	Manhattan Engineer District
MEI	maximally exposed individual
NCR	nonconformance report
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants

ACRONYMS
(continued)

NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
PERALS	photon/electron-rejecting alpha liquid scintillation
PMC	project management contractor
PQAS	project quality assurance supervisor
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
SDL	sample detection limit
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
SRM	standard reference material
TETLD	tissue-equivalent thermoluminescent dosimeter
TMA/E	Thermo Analytical/Eberline

UNITS OF MEASURE

cm	centimeter
ft	foot
g	gram
gal	gallon
h	hour
ha	hectare
in.	inch
km	kilometer
L	liter
m	meter
mi	mile
ml	milliliter
μg	microgram
μR	microroentgen
mR	milliroentgen
mrem	millirem
pCi	picocurie
ppm	parts per million
yr	year

1.0 INTRODUCTION

This plan establishes the environmental monitoring program required to be conducted by the project management contractor (PMC) for the Hazelwood Interim Storage Site (HISS), effective January 1, 1992. HISS is assigned to the Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP), a program to decontaminate or otherwise control sites where residual radioactive materials remain from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. DOE maintains an environmental monitoring program for HISS to ensure that the public and environment are adequately protected from site contamination and to determine whether activities at the site are in compliance with applicable federal, state, and local standards and requirements. The program is designed to detect and quantify any unplanned releases and to provide high-quality data to enable the evaluation of potential contaminant migration pathways.

1.1 SCOPE OF PLAN

Under DOE Orders 5400.1 ["General Environmental Protection Program" (DOE 1988a)] and 5400.5 ["Radiation Protection of the Public and the Environment" (DOE 1990a)], all DOE-owned and -operated facilities are required to have an environmental monitoring plan (EMP) in place by November 9, 1991. EMPs provide the basis for identifying potential contaminant release pathways and document the rationale for the sampling frequency and program scope. This plan satisfies the requirements of the DOE orders.

The EMP fits into the overall environmental monitoring program as shown in Figure 1-1. The program is further implemented by the FUSRAP integrated environmental monitoring field activities instruction guide and the annual site environmental report (ASER) for HISS. These three elements of the program implement the requirements of DOE Orders 5400.1 and 5400.5 and the FUSRAP ALARA plan (BNI 1991c) and have been developed to meet quality assurance

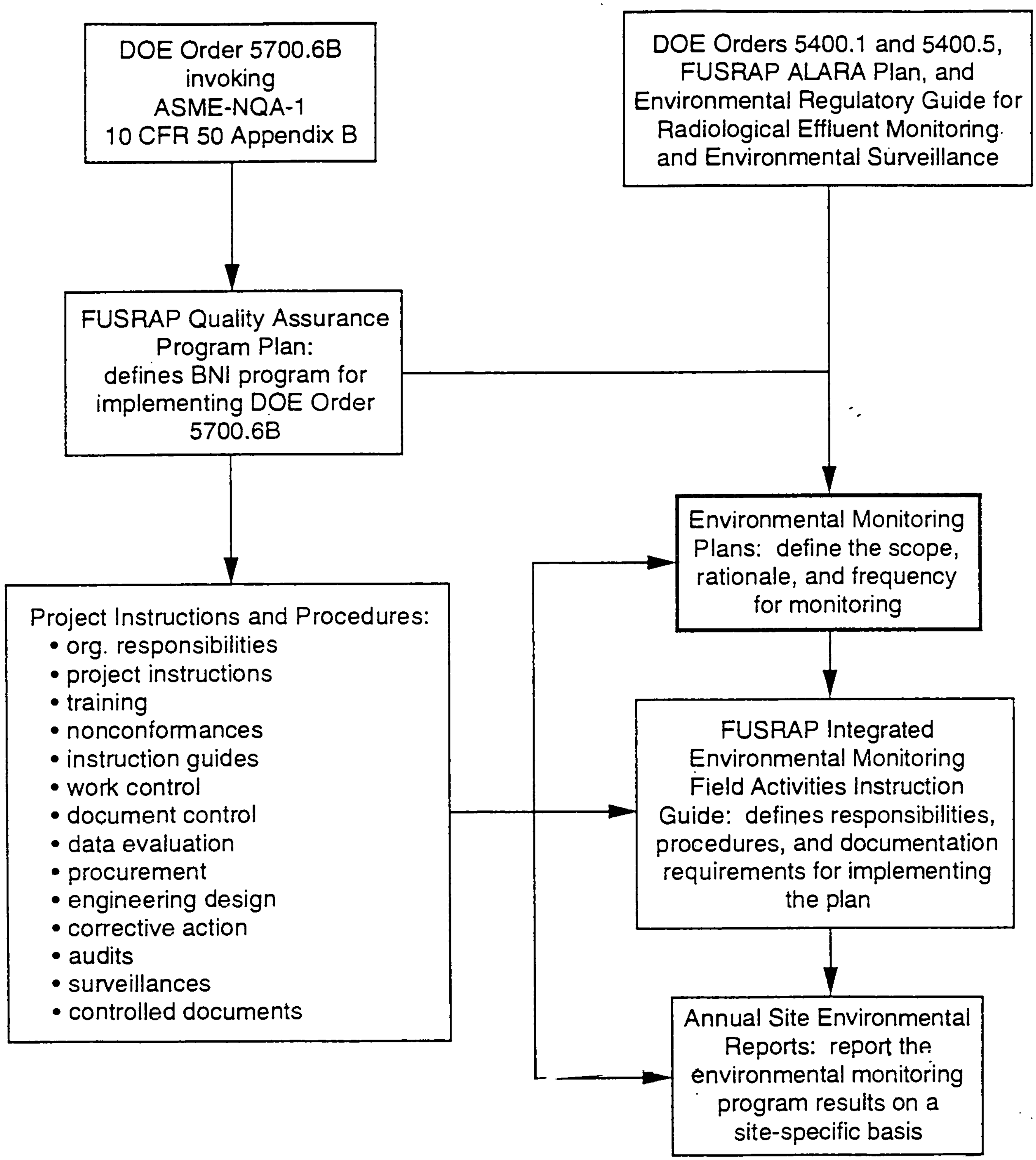

Figure 1-1
Relationship Among Environmental Monitoring Program Elements

program requirements of DOE Order 5700.6B ["Quality Assurance" (DOE 1989)], ASME-NQA-1 (ASME 1989), and 10 CFR 50 Appendix B, as defined in the FUSRAP quality assurance program plan (BNI 1990a). Specific quality criteria implementation requirements particular to the three program elements are either stated in these documents or are invoked by applying project instructions and procedures.

In support of DOE Orders 5400.1 and 5400.5, this EMP will address chemical and radioactive contaminants. However, chemicals associated with past Manhattan Engineer District (MED)/Atomic Energy Commission (AEC) activities are not currently a concern at HISS.

This EMP has also been written to comply with appropriate sections of the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE 1991) (hereafter referred to as the "regulatory guide"), which establishes the elements of a program that is acceptable to DOE. The regulatory guide addresses desirable procedures and activities that "should" be performed and prescribes specific high-priority procedures and activities (indicated in the regulatory guide by "should*"). A matrix that shows compliance with the "should*" requirements is provided in Appendix A.

The objective of this EMP is to establish monitoring and sampling strategies that will:

- Ensure compliance with applicable environmental regulations
- Adequately represent the HISS environment
- Establish background levels
- Detect contaminant migration and unplanned releases from the site to the environment
- Generate information to be made available to the public (e.g., distribution of the ASERs)

HISS has been monitored by DOE in some form since 1984. Based on the strategies outlined in this EMP and on existing data, the environmental monitoring program will be optimized. This plan establishes the components of the HISS environmental monitoring program, which are implemented and controlled by FUSRAP instruction guides and project instructions. (The terms "monitoring" and "surveillance" are used synonymously in this plan.)

The following subsections briefly describe HISS and the information known about the contaminants onsite. Sections 2.0 through 5.0 discuss the features of the environmental monitoring program needed to monitor HISS. Sections 6.0 through 10.0 describe the analysis of samples, the handling and reporting of the data generated from the sampling, and the quality assurance (QA)/quality control (QC) techniques that are used in the program for HISS.

1.2 SITE LOCATION AND DESCRIPTION

HISS occupies approximately 2.2 ha (5.5 acres) within the City of Hazelwood (St. Louis County) in eastern Missouri (Figure 1-2). The HISS property includes two office trailers, a decontamination pad, and two interim storage piles with surface areas of approximately 6,800 and 1,800 m^2 (73,000 and 19,000 ft^2) (Figure 1-3). HISS is currently used for storage of radioactively contaminated soil from vicinity properties. The site is entirely fenced, and public access is restricted (BNI 1987).

As shown in Figure 1-4, land use in the vicinity of HISS is predominantly industrial and commercial. The site is bordered by manufacturing companies to the north and west, a wooded area and Coldwater Creek to the south, and a warehouse to the east.

The principal source of potable water in the HISS area is treated water from the Mississippi River; nearly all of the City of Hazelwood uses this source (BNI 1991a). Water is taken from the Mississippi River approximately 32 km (20 mi) downstream of HISS and treated for public use at the Chain-of-Rocks Water Treatment Facility. Coldwater Creek (not used as a source of drinking water) empties into the Missouri River, which discharges into the Mississippi River. The nearest supply facilities for potable surface water are Central Plant and Howard Bend Plant on the Missouri River.

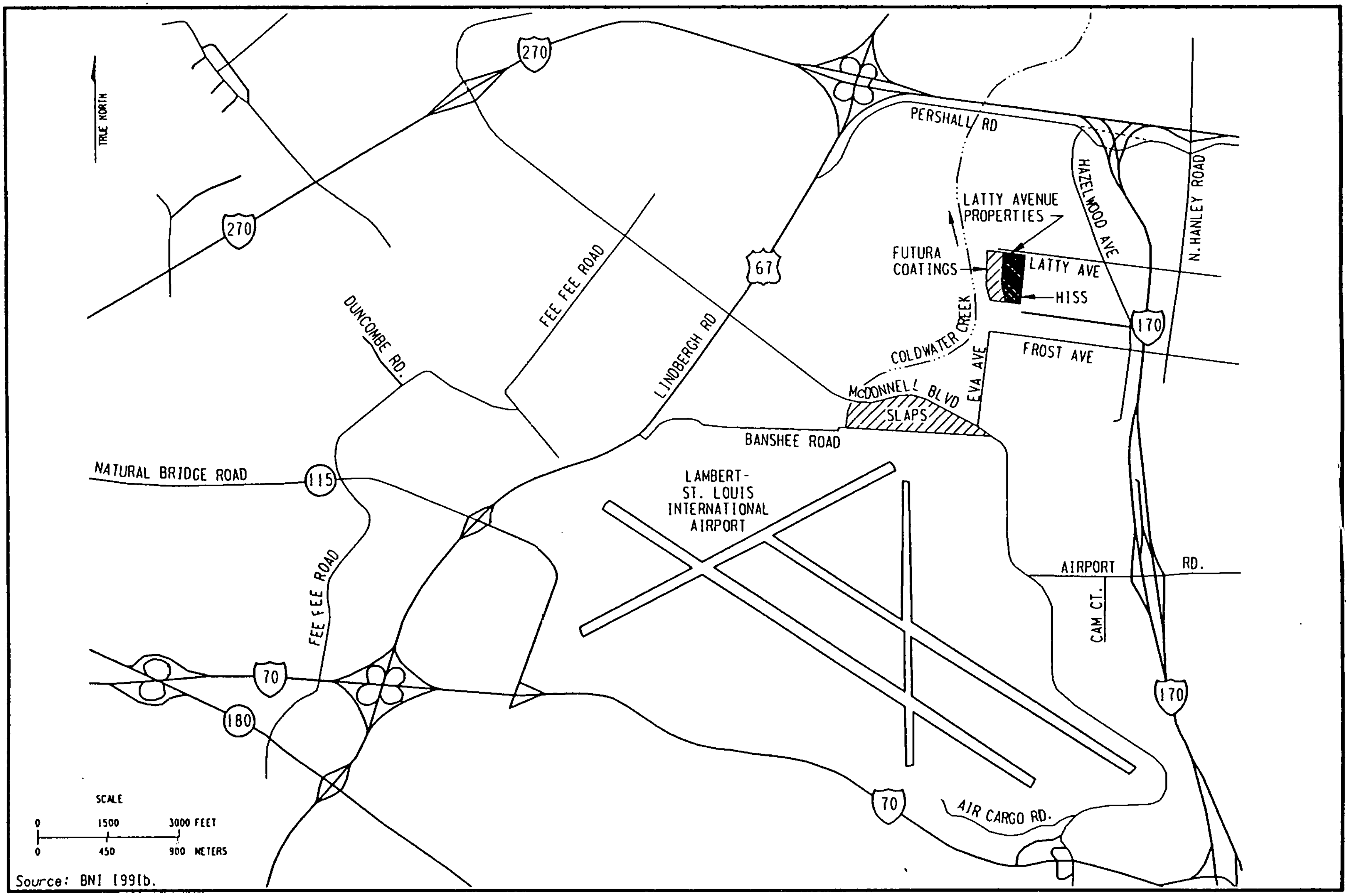

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Figure 1-2
Location of HISS

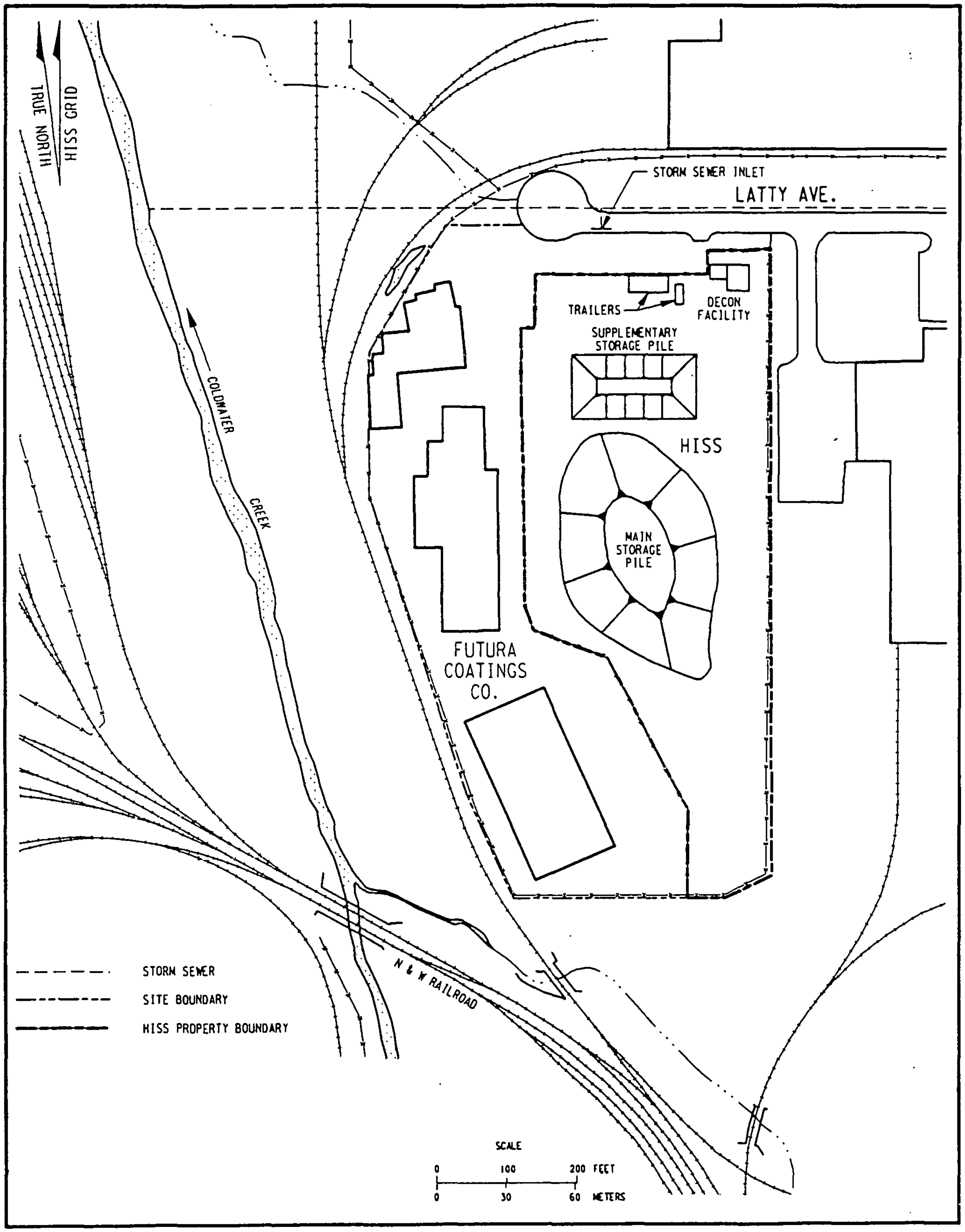

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Figure 1-3
Site Plan of HISS

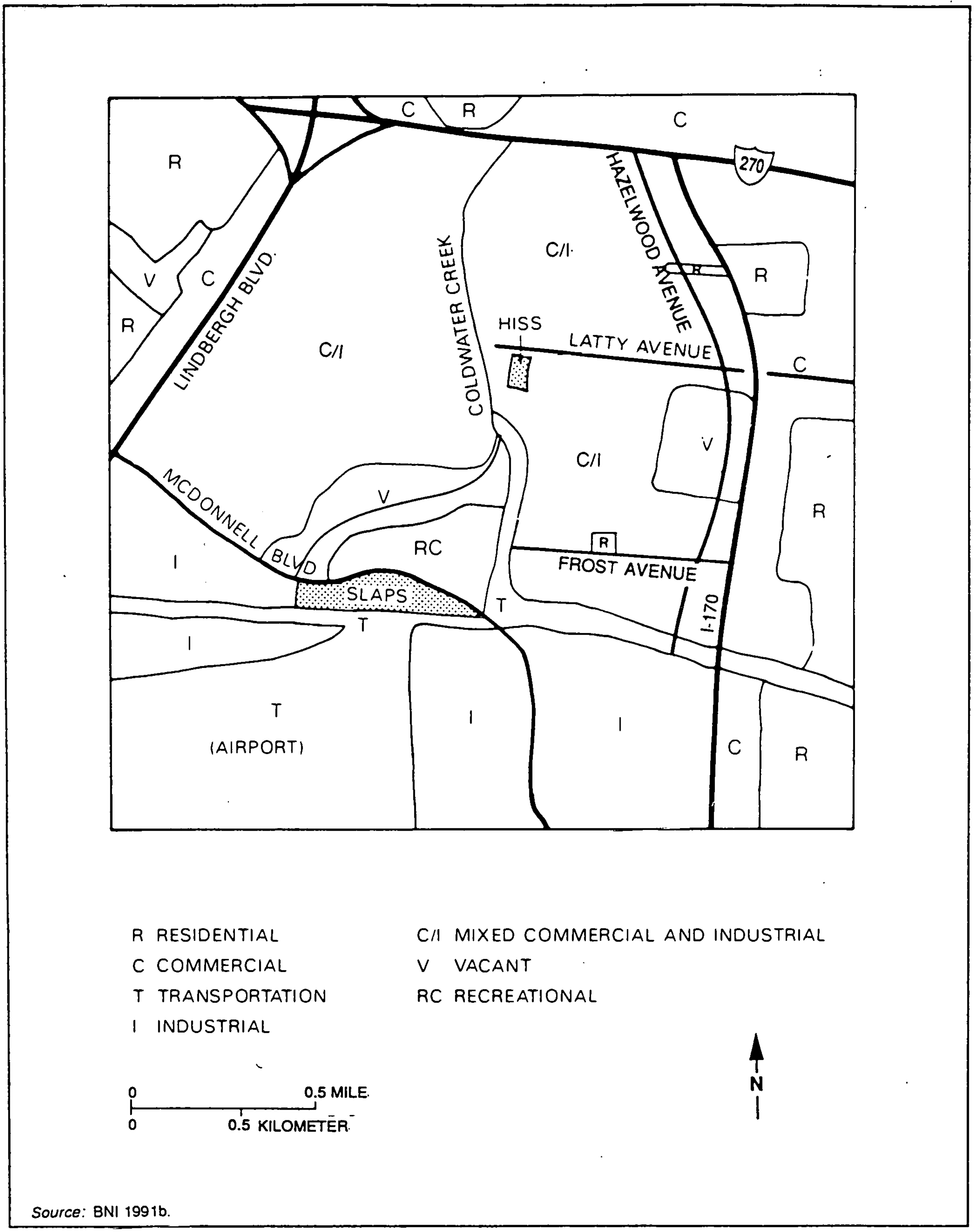


Figure 1-4
Generalized Land Use in the Vicinity of HISS

The nearest residential areas are approximately 0.5 km (0.3 mi) to the east in Hazelwood (population 12,800) and 0.8 km (0.5 mi) to the south in Berkeley (population 20,300). The residences are primarily single-family dwellings. The total population of the area within an 80-km (50-mi) radius of HISS is approximately 2.5 million (BNI 1991a).

1.3 SITE HISTORY

In early 1966, uranium ore residues and uranium- and radium-bearing process wastes that had been stored at the St. Louis Airport Site (SLAPS) (Figure 1-1) were purchased by the Continental Mining and Milling Company, Chicago, Illinois. The wastes had been generated at a facility now known as the St. Louis Downtown Site (SLDS) from 1942 through 1957 under contract with the Atomic Energy Commission (AEC) and its predecessor, the Manhattan Engineer District (MED). The wastes were moved to a storage site at 9200 Latty Avenue, a part of which is the present-day HISS. Between January 1967 and July 1973, the radioactive residues were dried and taken to facilities in Colorado. Much of the remaining material, classified as leached barium sulfate, and 30 to 46 cm (12 to 18 in.) of topsoil were removed and transported to a landfill in St. Louis County. Over the years, some contaminated material migrated from the site to areas along Latty Avenue. Between 1984 and 1987, these contaminated materials were excavated from certain areas along Latty Avenue and stored at HISS.

1.4 CONTAMINANTS OF CONCERN

Contamination at HISS resulted from storage, transport, and handling of residues and scrap materials containing radionuclides. Based on radiological characterization of the site (BNI 1987) and environmental monitoring performed to date (BNI 1991b), the onsite radioactive contaminants are known to be those associated with the natural uranium decay chain. Uranium-238 is in equilibrium with its daughters through uranium-234. The original processing disturbed the thorium-230 and radium-226 equilibrium; however, that equilibrium has been reestablished from polonium-218 through lead-206. The contaminants of concern at HISS and their measured concentrations are shown in Table 1-1.

Chemical characterization of soil at HISS (BNI 1990b) included an inductively coupled plasma atomic emission spectrophotometry scan for metals (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc). Analysis was conducted for metals because they are typically found in the uranium ores that were processed at SLDS. Barium was specifically targeted because barium carbonate was used during processing as a coprecipitator of sulfates and radium. Mobile ions, including sulfate, fluoride, and nitrate, were sampled because of their use in uranium processing and as indicators of contaminants that may have migrated beyond previously determined boundaries.

The guidelines used to determine whether soil samples contained unusual concentrations of metals and mobile ions were background concentrations and the average concentration ranges for metals in soils at various locations in the United States. These guidelines, which give the average range of concentrations of metals expected to be found in natural soils, were compared with the analytical results for metals at HISS. This comparison indicates that 16 metals are present in soil at HISS at concentrations exceeding background. Table 1-2 lists these contaminants and presents their mean, minimum, and maximum concentrations.

Antimony, cadmium, molybdenum, selenium, and thallium were found at above-background concentrations in all samples in which levels exceeded sample detection limits. Above-background concentrations of cobalt were detected in five samples, and levels of copper exceeded background in three samples. Barium was detected at above-background concentrations in only 2 of 11 samples; the maximum concentration of barium was 4,360 ppm.

With minor exceptions, most of the metals at HISS appear to be confined to depths of 0 to 1.9 m (0 to 6 ft). Magnesium occurred

Table 1-1

Radioactive Contaminants of Concern Identified at HISS

Radionuclide	Half-Life	Concentration[a] Average	Maximum
Uranium-238	4.51×10^9 yrs	15.7	800
Thorium-230	8.0×10^4 yrs	27.6	790
Radium-226	1602 yrs	9.4	700
Radon-220	3.823 days	0.4	1.1

Source: BNI 1987.

[a]Radionuclide concentrations, measured in soil samples, are given in units of pCi/g. Radon concentrations, monitored in the air, are given in units of pCi/L. Background values have not been subtracted.

Table 1-2

Summary Results for Metal Contaminants at HISS

Metal	Concentration (ppm)[a] Mean[b]	Min.	Max.	Number of Samples Analyzed	In Excess of Background	In Excess of Background And SDL[c]
Antimony	34.0	10.8	242	11	11[d]	1
Arsenic	120.0	18.0	1,010	11	2	2
Barium	930.0	83.3	4,360	11	2	2
Boron	120.0	21.9	1,010	11	1	1
Cadmium	3.7	1.1	26.6	11	11[d]	5
Cobalt	200.0	10.6	1,470	11	5	5
Copper	140.0	8.5	946	11	3	3
Lead	82.0	21.2	464	11	1	1
Magnesium	4,400.0	1,450	8,180	11	2	2
Molybdenum	120.0	19.1	1,100	11	11[d]	3
Nickel	240.0	9.3	1,780	11	1	1
Selenium	120.0	18.0	1,020	11	11[d]	11
Silver	3.8	1.8	18.3	11	1	2
Thallium	110.0	18.0	959	11	11	2
Vanadium	100.0	13.3	712	11	1	1
Zinc	67.0	22.7	308	11	1	1

Source: BNI 1990b.

[a]Maximum and minimum values include results reported as below background values.

[b]All values, including those reported as the sample detection limit, were used to calculate the mean.

[c]SDL - sample detection limit.

[d]Elevated SDLs were encountered in most samples as a result of matrix interference during analysis. All SDLs and measurable concentrations exceed background levels.

at low concentrations (maximum of 8,180 ppm) at maximum depths of 1.8 to 2.4 m (6 to 8 ft).

Only a few samples contained metals at concentrations above both background levels and sample detection limits. Furthermore, these samples were collected from locations throughout the site, not from one particular area. For these reasons, these metals will not be further investigated.

Although concentrations of several metal contaminants are elevated, the potential for exposure through inhalation is unlikely because HISS is covered with vegetation, the waste storage piles are covered with a synthetic membrane, and the potential for airborne particulate release is minimal. Therefore, routine monitoring of airborne particulates is not required (see Subsection 5.3). Monitoring for particulates will be conducted during any remedial action or other activity at the site that could release airborne particulates.

Chemical characterization also included analysis for volatile and semivolatile organic compounds; none of the volatiles or semivolatiles found at the site are believed to have been used during uranium processing. The presence of these compounds is probably the result of disposal of waste generated from activities unrelated to AEC/MED activities and HISS. No compounds on the Environmental Protection Agency (EPA) Target Compound List were detected.

Composite samples were taken to determine whether the material exhibited any hazardous waste characteristics as defined by the Resource Conservation and Recovery Act (RCRA). Samples were taken using a simple random sampling scheme based on EPA SW-846 methodology (EPA 1990). All samples were below RCRA criteria for reactivity, ignitability, corrosivity, and extraction procedure toxicity (BNI 1990b). Because none of the samples failed the RCRA extraction procedure toxicity test, there is little potential for the AEC/MED-related chemicals that are present onsite to migrate via groundwater or surface water. Therefore, chemicals are not considered a primary contaminant at HISS.

2.0 LIQUID EFFLUENT MONITORING

Liquid effluent monitoring is required to ensure compliance with DOE Orders 5400.1 and 5400.5. These orders also require surveillance of surface water, sediment, and stormwater, which is addressed in Subsection 5.5 of this plan. Because HISS is not an operating facility, the only "effluents" from the site are the rinseates resulting from decontamination of sampling equipment. The decontamination rinseates will be collected and stored in a 5000-gal tank. When the tank is filled to capacity, the liquid will be sampled and, if contaminated, will be disposed of by a commercial disposal service. No hazardous wastes as defined by RCRA are generated during decontamination of equipment; therefore, RCRA limitations on storage times and quantities are not applicable.

3.0 AIRBORNE EFFLUENT MONITORING

No airborne effluents are generated as a result of routine site operations. However, radionuclides could be released as particulates by wind erosion or as radon. These potential forms of release are addressed in Subsection 5.3.

4.0 METEOROLOGICAL MONITORING

Because HISS is not an operating facility, meteorological monitoring requirements differ from those required for an operating processing facility. Airborne contaminant levels and the calculated effective dose equivalent from HISS are low (Section 8.0) and even accidental releases would have minimal environmental impact; therefore, detailed onsite meteorological data are not required.

The Environmental Protection Agency (EPA) AIRDOS computer model will be used to show compliance with 40 CFR 61, Subpart H under the National Emission Standards for Hazardous Air Pollutants (NESHAPs). This computer model calculates doses from contaminant migration via the airborne pathway. Data will be collected by the National Oceanographic and Atmospheric Administration, National Weather Service at the Lambert - St. Louis International Airport, approximately 1.6 km (1 mi) south of the site.

Given the low concentrations of contaminants at the site and the similarity between climatological conditions at the site and data from observational stations that are included in the AIRDOS model, these data are considered sufficient to support any necessary modeling. Input to this model includes joint frequency distribution of wind direction and atmospheric stability, and an average wind speed for each combination of wind direction and stability. The model also uses an average mixing-layer and average temperature. Potential release modes, distances from release points to receptors and climatological conditions are considered in the model. Supplemental measurements will not be required.

Compliance techniques, which will be based on conservative assumptions and few climatological data, are outlined in Screening Techniques for Determining Compliance with Environmental Standards (NCRP 1986). QA/QC procedures will be followed in accordance with the requirements outlined in Section 10.0.

5.0 ENVIRONMENTAL SURVEILLANCE

Regulatory requirements for environmental monitoring of radioactive materials are found in DOE Orders 5400.1 and 5400.5. Site releases must comply with specific DOE orders [5400 series and DOE Order 5820.2A, "Radioactive Waste Management" (DOE 1988b)] that establish quantitative limits, derived concentration guidelines, and dose limits for radioactive releases from DOE facilities.

5.1 EVALUATION OF NEED

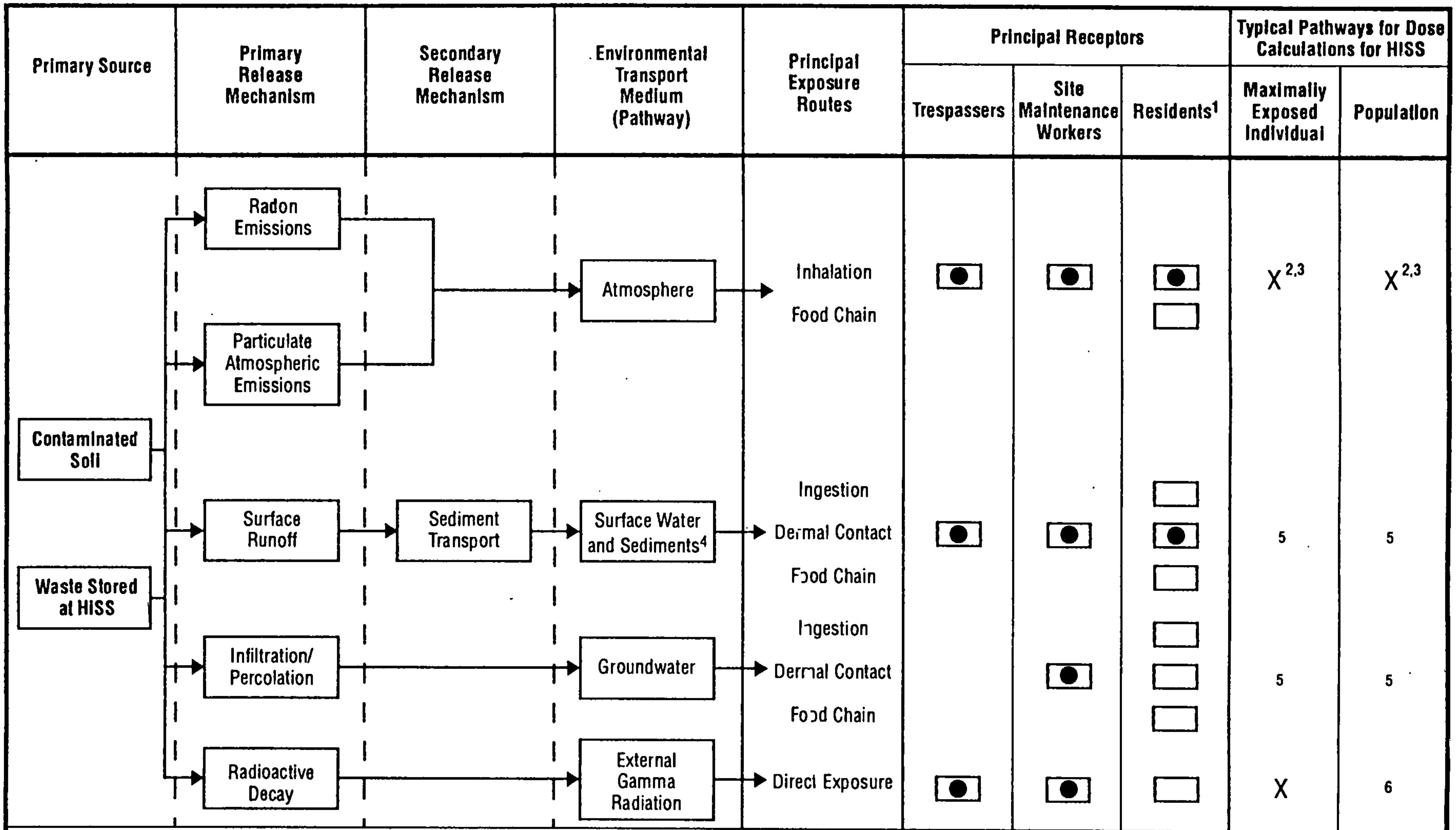
Environmental surveillance activities are necessary at HISS to ensure that the onsite waste is not posing a threat to human health and the environment. The overall goal of the environmental monitoring program at HISS is to determine whether contaminants are released and, if so, to determine the impact on human health and the environment. To achieve this goal, the program has been designed to meet the requirements of DOE Orders 5400.1 and 5400.5 and the applicable criteria outlined in the regulatory guide.

The goal will be achieved by implementing:

- Routine surveillance of all credible pathways
- Sample collection and analysis designed to obtain representative samples or measurements and high-quality data
- Monitoring capable of detecting unanticipated migration of contaminants from the site

One of the most critical objectives of the HISS environmental monitoring program is to identify the potential migration pathways. Four primary pathways exist at HISS: atmosphere, surface water and sediment, groundwater, and external gamma radiation. Each of these potential pathways is analyzed in Figure 5-1 and documented in the ASER.

Based on Figure 5-1, all of the transport pathways indicate a potential for exposure to the contaminants at the site.



[1] Includes future residents at SLAPS or HISS and recreational users of Coldwater Creek.

[2] Doses calculated for the atmospheric pathway do not include radon. Radon is controlled through concentration limits.

[3] The dose from the particulate transport through the atmospheric pathway is primarily calculated to meet the requirements of 40 CFR 61 Subpart H.

[4] Refers to Coldwater Creek.

[5] Typically the concentrations measured offsite in these media are at background levels.

[6] Direct gamma exposure only affects individuals near the site.

● Current Pathway

☐ Future Pathway

X Dose Calculated

Figure 5-1
Exposure Pathway Analysis

However, not all of the exposure routes are valid for HISS. The invalid exposure routes are direct contact by ingestion of contaminated livestock or foodstuffs (livestock and foodstuffs are not raised in the immediate area), direct contact by ingestion of contaminated fish (there is no fishing in Coldwater Creek), and overland migration of contaminants from the site to soils on adjacent properties (the adjacent properties contain low-level contaminants from previous operations and are scheduled for cleanup). Previous sampling results indicate that contaminant concentrations are at background levels in offsite groundwater and surface water, which supports the conclusion that ingestion is not a current exposure route. The following exposure routes currently contribute to the exposure of principal receptors:

- Inhalation of radon and contaminated particulates transported from the site via the atmospheric pathway
- Dermal contact with contaminated sediment
- Dermal contact with contaminated groundwater by workers collecting samples
- Direct exposure to gamma radiation for individuals near the site

Direct exposure to gamma radiation will be measured, and air, surface water, and groundwater samples will be collected and analyzed for the contaminants of concern (Subsection 1.4) to monitor the potential migration pathways from HISS. Surface water and groundwater modeling is not conducted because the environmental monitoring program includes groundwater and surface water sampling. Plant and biota samples will not be collected because there are no foodstuffs (i.e., gardens) livestock, or endangered species near the site.

Although this EMP was prepared in 1991, the environmental monitoring program at HISS has been evolving for some time. Appendix B is a table comparing the program as it existed in 1991 to the program described in this plan. The table references the specific sections of this plan that present the rationale for the changes made to the program. Upon any approval from DOE, deviations from routine environmental surveillance requirements, including the locations of sampling or measurement stations, will also be documented in the ASER and in future revisions of the appropriate project instruction guide and this EMP. Special studies at HISS are not covered in this EMP; they are reported in the ASER.

The following sections establish the plan for monitoring the pathways described above.

5.2 BASIS AND CRITERIA FOR EXTERNAL GAMMA RADIATION SURVEILLANCE

The primary objective of monitoring for external gamma radiation exposure is to estimate the potential radiation dose to members of the public from the radioactive contaminants at the site. Although the primary radioactive contaminants at the site are not gamma emitters, the daughters associated with the uranium-238 and thorium-230 decay chains have gamma energy emissions that could result in potential doses to the public.

The extent of the surveillance program is based on applicable regulations and the hazard potential, quantities, and concentrations of contaminants at the site. The program is designed to provide data to:

- Estimate potential dose to a hypothetical maximally exposed individual and to the general population within an 80-km (50-mi) radius
- Quantify maximum fenceline and onsite exposure levels
- Monitor for potential exposure to the environment and the public to determine whether near-term response actions will be required

5.2.1 Surveillance Requirements

The requirements for the external gamma radiation surveillance program are that timely information be received on exposures to the public from both stable site conditions and unexpected releases. The information obtained from this program should be adequate to estimate the potential dose to the hypothetical maximally exposed individual and to workers and the public in case of an accidental release.

5.2.2 Dosimeter Location Rationale

The dosimeter locations were selected based on a radiological characterization conducted at the site (BNI 1987). In this survey, gamma radiation exposure rates at 1 m (3 ft) above the ground were measured using a pressurized ionization chamber. Readings were made at 15 selected grid points; results are presented in Table 5-1. Based on these readings, dosimeters will be located in the areas of high gamma radiation along the fenceline to measure the maximum exposure levels (Figure 5-2). Locations of the dosimeters will be based on previous tissue-equivalent thermoluminescent dosimeter (TETLD) results (BNI 1991a) and on the occupancy of the adjacent property. The dosimeters will be placed 1 m (3 ft) above the ground (approximately at gonad level) to represent the exposure to the critical organ nearest the contamination. There will be 12 locations: 10 fenceline (Figure 5-2) and 2 offsite, one of which is a background location.

Based on the data collected from the external gamma radiation monitoring program, dosimeter locations may be added or deleted. When making these changes, the following factors will be considered:

- Proximity to naturally occurring radiation and geologic formations
- Proximity to buildings or structures that could alter measurement results

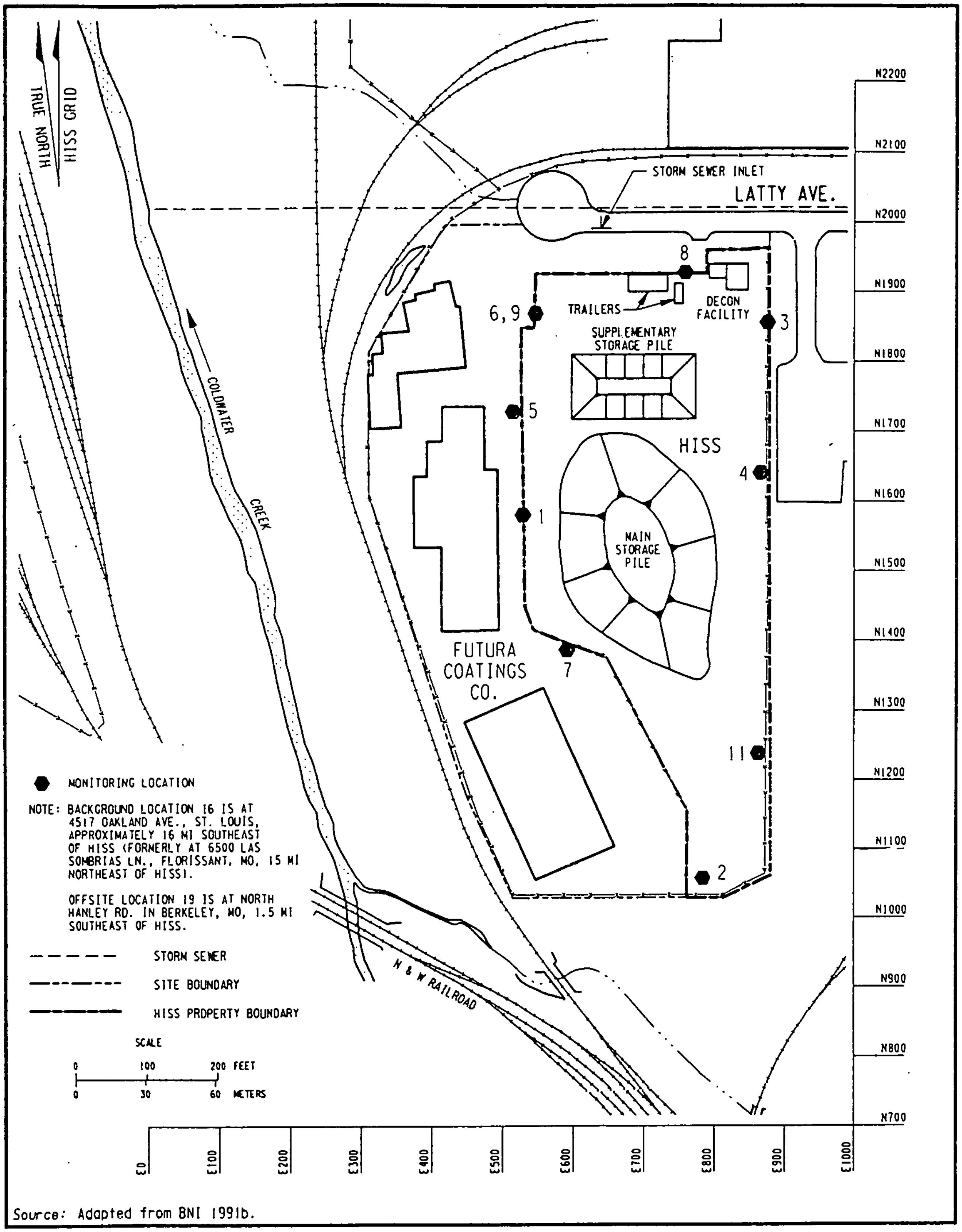
Table 5-1

Gamma Radiation Exposure Rates

at HISS

Coordinates		Rate
East	North	(μR/h)
550.0	1550.0	35
550.0	1800.0	55
600.0	1400.0	19
600.0	1700.0	47
600.0	1850.0	36
600.0	1925.0	14
700.0	1350.0	17
700.0	1700.0	23
700.0	1900.0	15
800.0	1300.0	16
800.0	1600.0	15
800.0	1750.0	16
850.0	1150.0	22
850.0	1450.0	22
850.0	1800.0	13

Source: BNI 1987.



Source: Adapted from BNI 1991b.

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Figure 5-2
Onsite Radon and External Gamma Radiation Monitoring Locations

- Differences in local topography that could shield the dosimeters from the possible passage of airborne effluents
- Meteorological conditions such as prevalent wind direction
- Security (vandalism or theft) for offsite dosimeters
- Access (legal) to offsite locations

The dosimeters located on the western boundary are positioned to detect maximum exposure levels to personnel working on the Futura Coatings property adjacent to HISS. Dosimeters on the eastern boundary of HISS supply data for calculating potential exposures at areas that are accessible to the public. Over the past five years, locations 6 and 8 (adjacent to the gravel area near the trailers and decontamination pad) and one dosimeter on the western boundary of the Futura property have not detected any exposures exceeding the DOE radiation protection standard of 100 mrem/yr. In fact, the levels have averaged between 10 and 11 mR/yr at these three locations, which can be attributed to remedial action performed in 1984 in the trailer area. Although locations 6 and 8 are not in areas of maximum exposure, they will be left in the monitoring program to provide continued surveillance at these locations. (The dosimeter on the western boundary has been removed from the program.)

The background location provides data for comparison with the levels measured at the fenceline. The background dosimeter will be approximately 26 km (16 mi) southeast of HISS at 4517 Oakland Avenue, St. Louis, at a distance where contributions from the site will not affect the readings. Another offsite dosimeter is 2.4 km (1.5 mi) southeast of HISS at North Hanley Road, Berkeley.

5.2.3 Sampling Frequency

The dosimeters will be retrieved and analyzed semiannually. The determination of sampling frequency was based on the following factors:

- There is little potential for exposures during routine site operations and maintenance activities.
- The site is inactive. Waste has been stored at the site since 1966, and environmental monitoring results since 1984 do not indicate an upward trend in levels of contaminants of concern.

Based on these factors, dosimeters that provide real-time measurements are not considered necessary. The dosimeter appropriate for the monitoring program is the TETLD, an integrating dosimeter, which will provide the total exposure at one location for the entire time (6 months or 1 year) the dosimeter is onsite.

Four dosimeters will be placed at each station in January. Two of the four dosimeters will be retrieved and analyzed in July to reveal changes that might have occurred at the site during the first six months of the year. The other two will be retrieved and analyzed the following January and will be used for dose calculations. The dosimeters will be removed in pairs to provide a duplicate measurement for each station. Additionally, the two extra dosimeters will be available for immediate analysis in case of an emergency without compromising the integrity of the monitoring network. Each January, a new set of four dosimeters will be placed in the station housing for monitoring in the subsequent year. This semiannual sampling frequency will also be applicable for any new sampling stations established around the site.

5.2.4 Sampling Methods and Dosimeters

Each TETLD station consists of a vertical support and a polyvinyl chloride holder assembly. An individual TETLD consists of a polyethylene sphere containing five individual lithium fluoride chips that were selected on the basis of having a reproducibility of ±4 percent across a series of laboratory exposures; this reproducibility is traceable to National Institute of Standards and Technology (NIST) criteria. Values are reported with a 95 percent confidence level. Attached to the TETLD is a chain leader, a snap swivel, and an aluminum identification tag. When exposed to penetrating radiation (such as gamma or cosmic), the lithium fluoride chips absorb and store a portion of the radiation energy. When the chips are heated, this stored energy is emitted as light, which can be measured and used to calculate an equivalent dose. The responses of the five chips are averaged to provide a single value, which is corrected for the shielding effect of the housing (approximately 8 percent); this corrected value is the radiation dose, expressed in mR/yr.

The procedures to be followed for exchanging dosimeters are documented in a FUSRAP instruction guide that provides information concerning identification of dosimeters and their removal and replacement during each sampling period.

5.2.5 Field Activities Quality Assurance

The specific QA requirements for external gamma radiation monitoring will be as follows:

- Chain-of-custody (COC) records for the dosimeters will be maintained, and COC seals will be placed on the shipping containers.

- A "ship" dosimeter will accompany each shipment of gamma radiation dosimeters to the site and to and from the laboratory to reveal any exposure incurred prior to installation or after dosimeter removal.

- Fresh dosimeters will be installed as soon as practicable after shipment and receipt at the site. Until installation, they will be stored in an area with a general gamma radiation field of less than 7 μR/h. Storage area radiation exposure rates will be verified by instrument surveys every six months, and a record of the surveys will be maintained in the site files.

- After dosimeters are removed from the monitoring station housing, they will be shipped immediately for analysis.

- By design, duplicate QC measurements will be taken at each sampling station, which will also protect against data losses due to faulty, damaged, or lost dosimeters.

- Dosimeter sampling locations will be inspected monthly for dosimeter loss, damage, proper housing height, signs of vandalism, theft, etc.

QA/QC procedures will be followed in accordance with the requirements outlined in Section 10.0. Details on procedures and documentation of field QA activities can be found in an instruction guide.

5.2.6 Emergency Provisions

During routine site operations and maintenance, unexpected releases will be unlikely. Trained site operations personnel and/or the site safety officer will notify appropriate personnel of Bechtel National, Inc. (BNI) (the PMC for FUSRAP) and DOE of any accidental release and will immediately take steps to minimize the potential for exposures, as specified in FUSRAP project instructions.

To provide immediate information on the magnitude of any accidental release, one of the TETLDs from each of the two stations nearest the release point may be removed and analyzed. Should conditions warrant, a health physics technician will evaluate site conditions with appropriate instrumentation.

5.3 BASIS AND CRITERIA FOR ATMOSPHERIC PATHWAY SURVEILLANCE

There are two exposure routes for the atmospheric pathway: particulate transport due to wind erosion, and radon emission.

Airborne particulate transport will not be monitored under the environmental surveillance program for the following reasons:

- The site is covered with vegetation or synthetic membrane material over the waste storage piles, and wind erosion, except under extreme circumstances, is unlikely.

- Other than the HISS pile upgrade, which will consist of preparatory work for the addition of soil to the pile, no work is planned for the site in the near future that would disturb existing surface conditions.

Therefore, radon is the only contaminant of concern for the atmospheric pathway.

DOE will also collect radon flux monitoring data from the two onsite storage piles to provide data to EPA Region VII to verify compliance with 40 CFR Part 61, Subpart Q. Radon flux monitoring will be conducted as agreed upon with EPA. Any major modifications to the pile will require a timely monitoring event to ensure compliance with the standard. DOE Orders 5400.1 and 5400.5 are the regulatory guidance applicable to the radon monitoring program.

5.3.1 Surveillance Requirements

One of the primary pathways for radiation exposure from the uranium-238 decay series is inhalation of short-lived radon (radon-222) and radon daughter products. Potential receptors of possible radon releases include members of the public who reside or work near the site (see Subsection 1.2). The radon monitoring program at HISS is designed to:

- Determine radon levels at the site boundary for comparison with regulatory limits
- Determine background radon levels
- Provide site-specific radon data to the public

5.3.2 Detector Location Rationale

The detector placement rationale was based primarily on the fact that the waste at the site is relatively stable and instantaneous releases are not expected. The site is considered stable because the waste is confined on the site in two covered storage piles, and monitoring to date has not shown significant contaminant migration from the site. Release of radon to the atmosphere is considered a diffuse source due to contaminant migration through the soil into the atmosphere.

The detector system should detect continuous releases of radon. The wind direction varies enough that several detectors along the property boundary would detect a continuous radon release. Therefore, detectors will be located on all sides of the site (Figure 5-2), which will detect radon even during changes in wind direction. The readings from the detectors will represent the average concentration along the fenceline.

A background station will be located at 4517 Oakland Avenue, St. Louis [26 km (16 mi) southeast of SLAPS], at a distance where contributions of radon from the site do not affect the readings. Another offsite location will be at North Hanley Road, Berkeley [2.4 km (1.5 mi) southeast of HISS].

All detectors will be placed 1.5 to 1.7 m (5.0 to 5.5 ft) above the ground surface to detect radon concentrations in the breathing zone for the average person.

To determine radon flux from the storage piles, 70 charcoal canisters will be placed on the large pile, and 20 will be placed on the small pile, at 7.6-m (25-ft) grid intersections. The canisters will remain on the piles for 24 hours.

5.3.3 Sampling Frequency

The primary factor that affects sampling frequency is whether the radon source is stable or if instantaneous releases can occur. As discussed in Subsection 5.3.2, the source of radon is considered stable. Therefore, the monitoring period can be relatively long, especially given the low occupancy of the site. Instruments such as radon gas monitors and pressurized ionization chambers that provide continuous data readouts are not necessary at HISS. Alpha track detectors provide the data needed to satisfy the requirements described in the DOE orders and regulatory guide. Sampling will be conducted quarterly; the detectors will remain at the sampling locations for the entire quarter to determine integrated average radon concentrations over the quarter.

5.3.4 Sampling Methods and Detectors

Radon concentrations will be measured using an integrating alpha track detector that contains a piece of alpha-sensitive film enclosed in a small, two-piece cup. Radon diffuses through a membrane of the cup until the concentrations inside the cup are in equilibrium with atmospheric concentrations. Alpha particles from the radioactive decay of radon and its daughters create tiny tracks when they collide with the film. After they are collected, the films are placed in a caustic etching solution to enlarge the tracks; under strong magnification, the tracks are counted. The number of tracks per unit area is related through calibration to the radon concentration in air.

5.3.5 Field Activities Quality Assurance

Various QA controls will be part of the radon surveillance program:

- Detectors will be shipped to the site in airtight Tedlar bags that will remain unopened until installation.
- Exposed (removed) detectors will be immediately sealed to halt the exposure.
- Detector COC will be maintained and documented; COC seals will be placed on shipping containers.
- Duplicate (QC) stations will be used at a frequency of 1 QC station for each 20 sampling stations.

- Stations will be inspected monthly for loss, damage, housing height, and signs of vandalism.

QA/QC procedures will be followed in accordance with the requirements outlined in Section 10.0.

5.3.6 Emergency Provisions

Unexpected releases of radon from the site would occur only when the site configuration is modified. During routine site operations and maintenance, an unexpected release is unlikely. However, if there is evidence of a release, trained site operations personnel and/or the site safety officer will notify appropriate BNI and DOE personnel and will immediately take steps to minimize the potential for contaminant migration, as specified in FUSRAP project instructions.

To provide immediate information on the magnitude of any accidental release, detectors from the two stations nearest the release point will be removed and analyzed.

5.4 BASIS AND CRITERIA FOR GROUNDWATER SURVEILLANCE

DOE Order 5400.1 requires that groundwater potentially affected by DOE operations be monitored to determine and document the effects of such operations on groundwater quality and to demonstrate compliance with applicable federal and state laws and regulations.

5.4.1 Surveillance Requirements

The goals established to provide effective groundwater surveillance will be to:

- Provide data to use in determining basic groundwater quality
- Demonstrate compliance with applicable regulations and DOE orders

- Provide data for early detection of groundwater contamination

5.4.2 Well Location Rationale

Groundwater monitoring at HISS will be conducted in accordance with DOE Order 5400.1. Requirements for groundwater monitoring programs are not typically included in DOE Order 5400.1 or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the only specific requirement is that the number of monitoring wells sampled be sufficient for adequate characterization of the site.

Groundwater flow in the uppermost water-bearing zone at HISS is strongly influenced by local surficial features. Groundwater flow at the site is radial, and centers on the western-central portion of the site (Figure 5-3). Radial flow is thought to be related to an area of preferential recharge located near well HISS-1, a well no longer monitored. Groundwater flowing to the west and to the south discharges into Coldwater Creek and a tributary to Coldwater Creek. Groundwater flow in deeper water-bearing zones at HISS has not been characterized.

Sampling locations were chosen using the following assumptions: 1) the subsurface is homogeneous in all directions, 2) the highest calculated average linear velocity is representative of flow rates in the subsurface, 3) contaminants are not bound to soils by any mechanism, and 4) mechanisms that enhance contaminant transport (i.e., complexing, chelation, etc.) are not occurring.

Groundwater sampling locations

The locations at which groundwater sampling at HISS will be conducted are shown in Figure 5-3. Because groundwater flow occurs in a radial pattern away from the HISS pile, groundwater samples will be collected at wells that encircle the pile. HISS-6 and HISS-16 are used to obtain data on groundwater quality to the north of HISS. HISS-13, HISS-14, and HISS-15 are used for surveillance

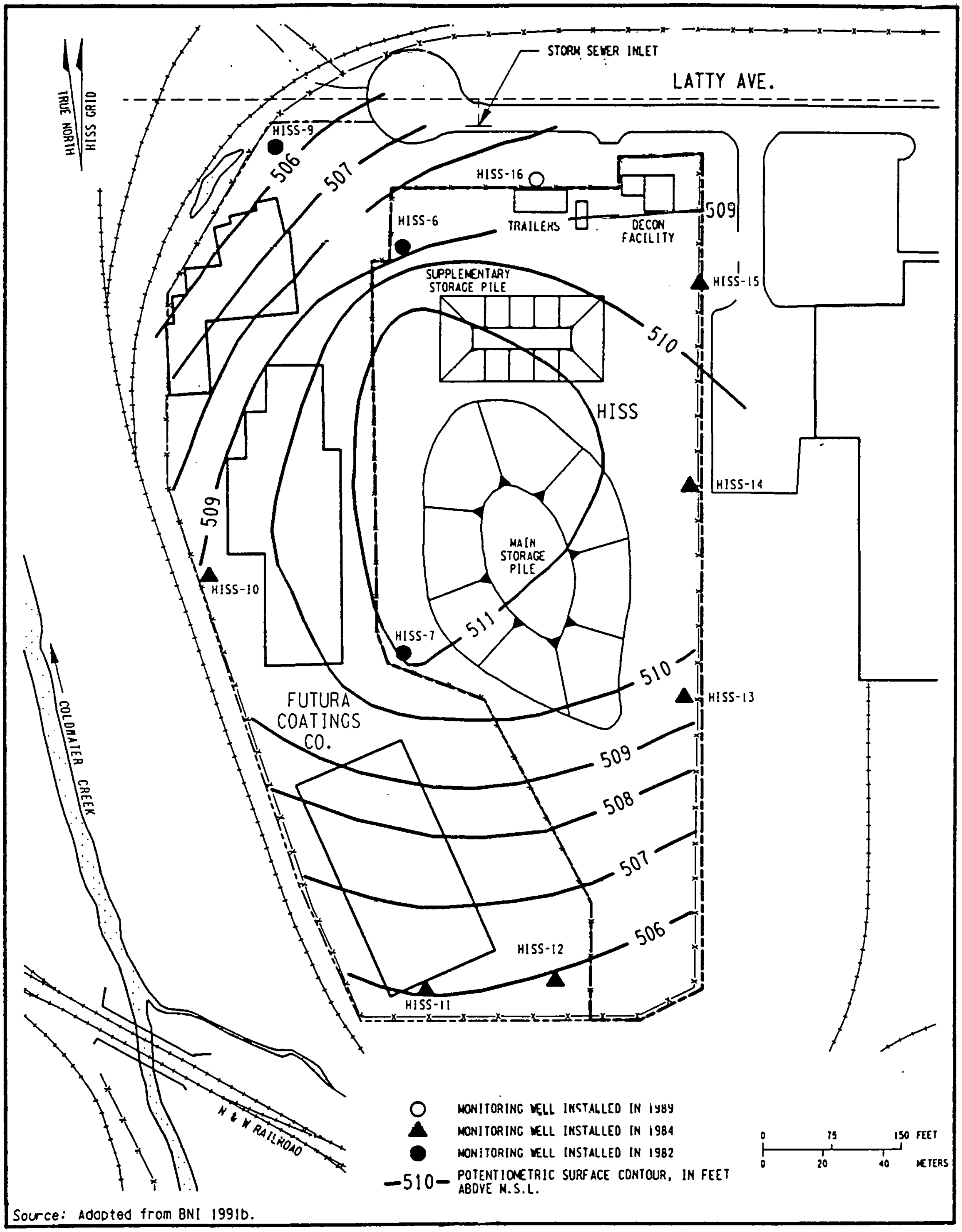

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Figure 5-3
Wells Used for Radiological Sampling

on the eastern edge of the site. HISS-11 and HISS-12 monitor the southern side of HISS, and groundwater on the western side of the site is sampled at HISS-9 and HISS-10.

Water level measurements

Continued monitoring of water levels at HISS will be conducted to detect changes in groundwater flow and to monitor potential contaminant migration pathways by following recharge or inflow/outflow patterns from the groundwater system. The wells in which water levels are monitored are shown in Figure 5-4 and Table 5-3. Water levels in three of these wells will be measured with an automatic recorder.

5.4.3 Sampling Frequency

Geologic and hydrogeologic parameters at HISS are summarized in Table 5-2. It is apparent from the values calculated for flow velocity that groundwater moves more rapidly at the northern end of the site. This agrees with what would be expected from the potentiometric contours shown in Figure 5-3. (Contours more closely spaced indicate a steeper gradient and therefore higher groundwater flow velocities.) The highest calculated flow velocity was 58.5 ft/yr. Because flow velocities are highest at the northern end of the pile, sampling will be conducted semiannually in wells HISS-6, HISS-9, and HISS-16. HISS-15 will also be monitored semiannually to provide surveillance on potential migration pathways to the east and west of the site. The highest flow velocity calculated for the southern end of the site is 10.6 ft/yr. Because contamination has not been detected in wells at the southern end of the site, HISS-7, HISS-10, HISS-11, HISS-12, HISS-13, and HISS-14 will be sampled annually. Annual samples will be collected in the spring so that fluctuations in the water table will have the least effect on contaminant concentrations. Automatic well recorders will measure water levels daily in three

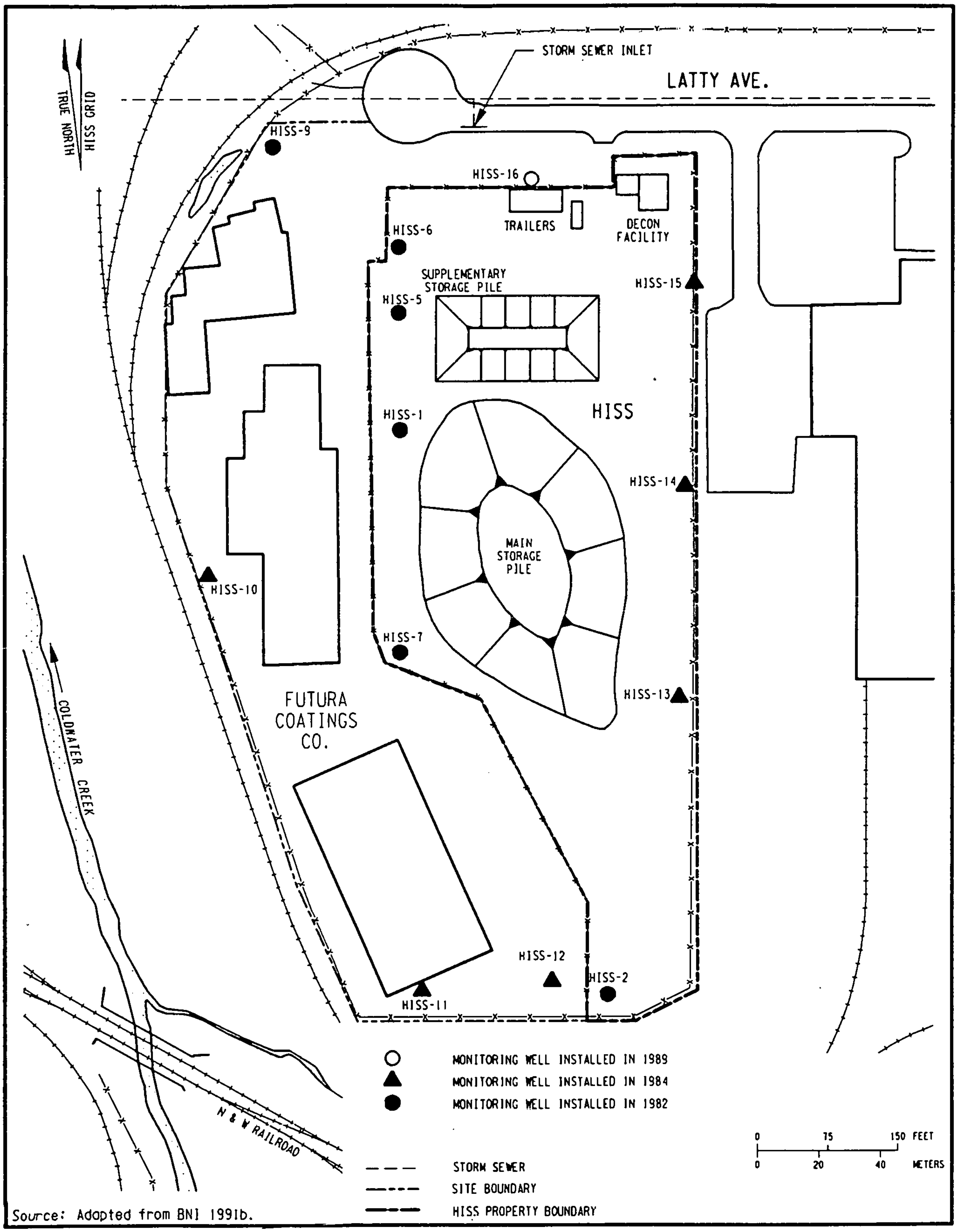

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Figure 5-4
Wells Used for Water Level Measurements

Table 5-2

Summary of Geologic and Hydrogeologic Parameters at HISS

Well No.[a]	Permeability (ft/yr)[b]	Hydraulic Gradient[c]	Porosity[d]	Groundwater Flow Velocity (ft/yr)[e]
HISS-9	186.3	0.017 - 0.023	0.20	21.4
HISS-10	275.9	0.0019 - 0.011	0.20	15.2
HISS-11	118.7	0.0092 - 0.014	0.20	8.3
HISS-12	141.0	0.0068 - 0.015	0.20	10.6
HISS-13	36.3	0.0043 - 0.013	0.20	2.4
HISS-14	11.2	0.0027 - 0.010	0.20	0.56
HISS-15	1063.8	0.0088 - 0.011	0.20	58.5

[a]Well locations are shown in Figures 5-3 and 5-4.

[b]Permeability values were determined in the field by rising-head permeability tests (BNI 1985).

[c]Range of values is from 1990, calculated from figures in BNI 1991a.

[d]Assumed.

[e]Calculated using permeability, the largest value for gradient, and porosity.

Table 5-3

Frequency of Sampling and Water Level Measurement in Wells at HISS

Well No.[a]	Sampling	Water Level Measurement
HISS-1	–[b]	Quarterly
HISS-2	–[b]	Quarterly
HISS-5	–[b]	Quarterly
HISS-6	Semiannually	Quarterly
HISS-7	Annually	Quarterly
HISS-9	Semiannually	Quarterly
HISS-10	Annually	Quarterly
HISS-11	Annually	Quarterly
HISS-12	Annually	Quarterly
HISS-13	Annually	Quarterly
HISS-14	Annually	Quarterly
HISS-15	Semiannually	Quarterly
HISS-16	Semiannually	Quarterly

[a]Well locations are shown in Figures 5-3 and 5-4.

[b](-) = well not sampled.

wells. Water levels will be measured manually in all wells every quarter. Frequency of sampling and water level measurement is given in Table 5-3.

5.4.4 Analytical Parameters and Sampling Methods

Based on the site characterization (BNI 1987), the contaminants of concern are radionuclides from uranium processing. Therefore, grab samples of groundwater will be analyzed for total radium, total thorium, and total uranium.

Groundwater will also be monitored for pH and specific conductance, which will be used as indicators to determine whether the groundwater has changed enough to affect the waste at the site and whether chemicals are migrating onto the site that could impact future remedial action activities. Specific conductance and pH measurements of groundwater will be taken during each sampling period.

Monitoring well sampling procedures (including equipment, techniques, and decontamination methods) are described in detail in an instruction guide that governs sampling activities at HISS. The instruction guide is based on protocols recommended in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) (EPA 1990) and A Compendium of Superfund Field Operations Methods (EPA 1987a). Analytical procedures will be in accordance with EPA-approved methods as described in Section 6.0. In accordance with best management practices, upgradient wells are sampled before downgradient wells.

5.4.5 Field Activities Quality Assurance

Sampling techniques, type of equipment, and decontamination procedures to be used for groundwater monitoring will be based on SW-846 (EPA 1990) and A Compendium of Superfund Field Operations Methods (EPA 1987a) and will be implemented through the use of FUSRAP instruction guides. Information on QC samples and data use is provided in Section 7.0 of this EMP.

A geologist will inspect all wells annually to ensure their integrity. Based on these inspections, damage or deterioration will be documented, and repairs will be made if necessary. Water level data will be entered into a database, and any irregularities will be noted and reported. QA/QC procedures will be followed in accordance with the requirements outlined in Section 10.0.

5.4.6 Emergency Provisions

In the event that a contaminated area is disturbed or a release occurs, site operations personnel and the site safety officer will notify appropriate BNI and DOE personnel in accordance with applicable FUSRAP project instructions. Any additional sampling required to investigate the extent of contamination will be initiated in accordance with these instructions.

5.5 BASIS AND CRITERIA FOR SURFACE WATER AND SEDIMENT SURVEILLANCE

This subsection describes the rationale and requirements for conducting surface water and sediment sampling as described in DOE Orders 5400.1 and 5400.5 and Subsections 5.10 and 5.12 of the regulatory guide. The primary surface water body that is monitored for impacts from the contaminants at HISS is Coldwater Creek. The sediments in the section of Coldwater Creek downstream of HISS receive low-level radioactive contaminants from both SLAPS and HISS. A gabion wall, constructed at the western end of SLAPS in 1985, helped alleviate erosion and therefore much contaminant migration.

5.5.1 Surveillance Requirements

The primary objective of the surface water and sediment surveillance program at HISS is to assess the potential radiation doses to members of the public from the site. To support this objective, surface water and sediment sampling will be conducted to provide data to:

- Determine conditions of background surface water and sediment quality
- Determine compliance with all applicable regulations and DOE orders
- Determine whether contamination that may pose a threat to human health or the environment is being transported offsite
- Estimate public doses of radiation from surface water sources

Additionally, stormwater runoff exiting the site is monitored at two locations, one on the northern side and the other on the southern side, in accordance with the HISS stormwater discharge permit acquired from the State of Missouri.

5.5.2 Sampling Location Rationale

The most likely occurrence of contaminant movement from HISS via the surface water and sediment pathway is during storm events, especially if site soil has been disturbed by construction or remedial action. During routine site operations and maintenance, there is little potential for exposure to the public via this pathway.

Surface water that travels offsite flows into Coldwater Creek, which runs along the western boundary of the site. The overall pattern of surface water/stormwater flow for HISS is shown in Figure 5-5. The six surface water and sediment sampling locations (Figure 5-6) include: two upstream of the site (locations 2 and 6) to establish background conditions; three downstream of the site (locations 3, 5, and 7) to monitor the effect of runoff from the site on Coldwater Creek; and one (location 4) to detect the upstream contaminant contribution from SLAPS to Coldwater Creek. Location 7 will serve to sample from accumulated sediments at an inside bend of Coldwater Creek about 909 m (3000 ft) downstream (north) of location 3.

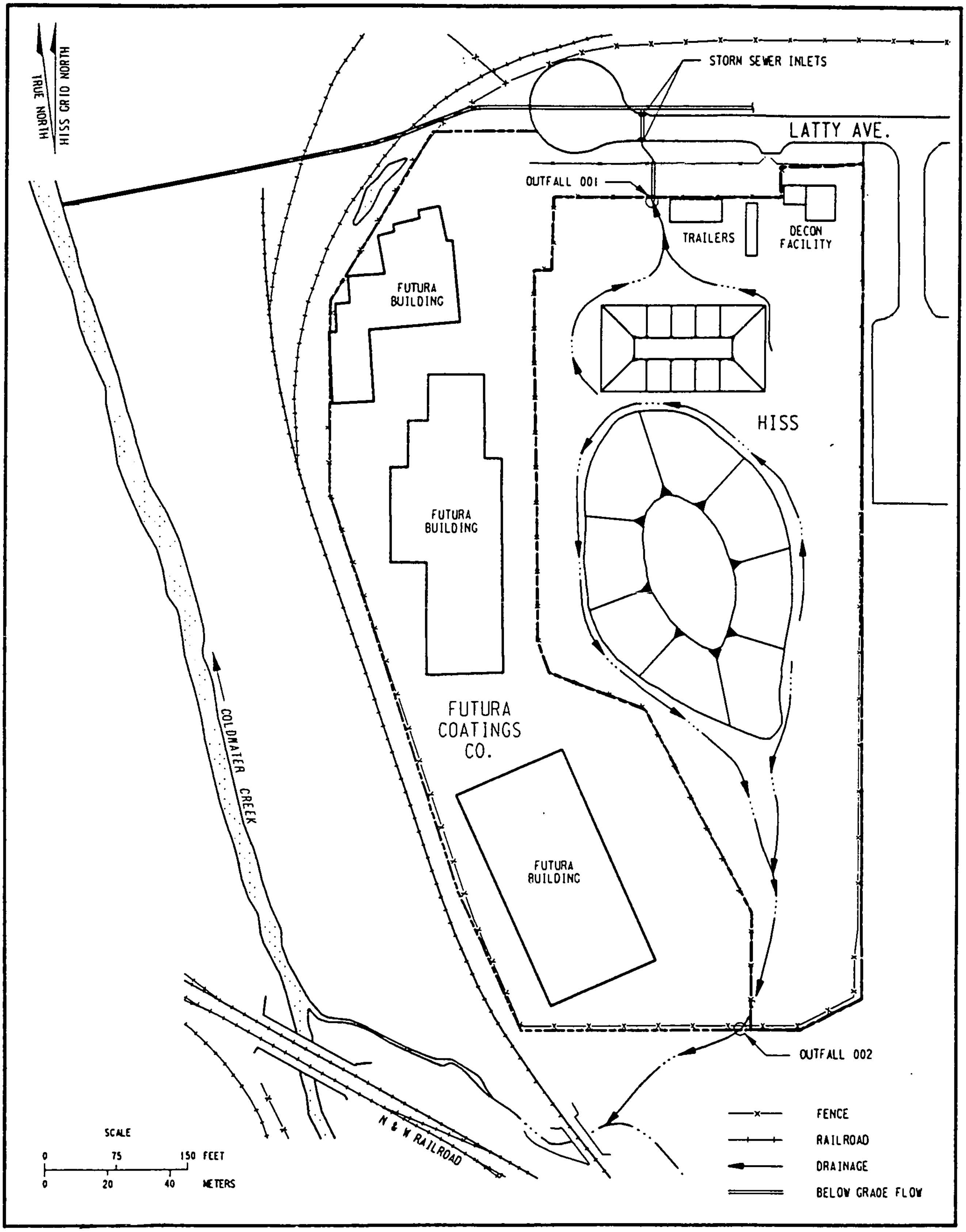

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Figure 5-5
Stormwater Drainage at HISS

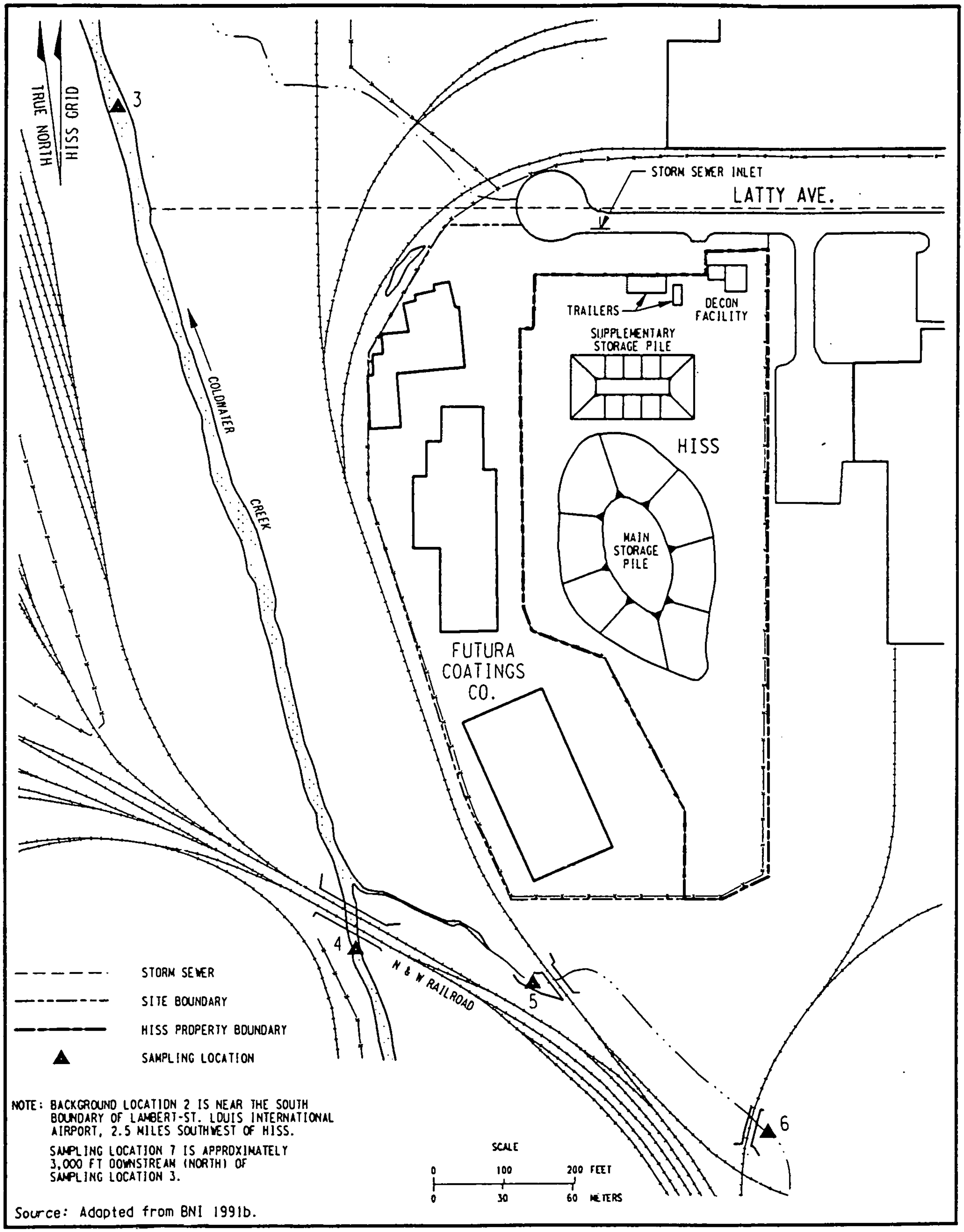

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Figure 5-6
Surface Water and Sediment Sampling Locations in the Vicinity of HISS

5.5.3 Sampling Frequency

The surface water and sediment sampling frequency was determined based on the following rationale. The contaminants at the site are the result of chemical processing of ores using acid digestion. Therefore, the wastes are relatively insoluble. Additionally, soluble contaminants would have probably already migrated from the site during the past 25 years. Because the waste is not soluble, the contaminants that would migrate from the site would be attached to particulates, which would tend to settle in the drainage ditches and in Coldwater Creek. Therefore, semiannual sampling should be sufficient to determine whether HISS is negatively impacting the public and the environment via the surface water and sediment pathway. Additionally, semiannual sampling will reveal typical seasonal concentrations of the contaminants of concern in Coldwater Creek.

This sampling frequency may be modified based on sampling requirements from EPA for stormwater discharge.

5.5.4 Analytical Parameters and Sampling Methods

Based on the site characterization, the contaminants of concern at the site are radionuclides from uranium processing operations. Therefore, grab samples of surface water and sediment will be analyzed for radium-226, thorium-230, and total uranium.

Surface water and sediment sampling procedures, including equipment, techniques, and decontamination methods, will be based on protocols recommended in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) (EPA 1990) and A Compendium of Superfund Field Operations Methods (EPA 1987a). Analytical procedures will be in accordance with EPA-approved methods as described in Section 6.0.

5.5.5 Field Activities Quality Assurance

Sampling techniques, type of equipment, and decontamination procedures to be used for surface water and sediment surveillance will be based on SW-846 (EPA 1990) and A Compendium of Superfund Field Operations Methods (EPA 1987a). Sample QA and QC are addressed in Section 7.0 of this EMP. QA/QC procedures will be followed in accordance with the requirements in Section 10.0.

5.5.6 Emergency Provisions

Because of the stability of site conditions, there is little probability that a release will occur that could affect surface water or sediment in the vicinity of HISS. However, in the event of a release, site operations personnel and/or the site safety officer will notify appropriate BNI and DOE personnel and will immediately take steps to minimize the potential for contaminant migration, as specified in FUSRAP project instructions. Conditions will be monitored until the release has been stabilized.

6.0 ANALYTICAL PROCEDURES

Radiological analyses will be performed by Thermo Analytical/ Eberline (TMA/E). Specifications of laboratory methods, analytical requirements, and reporting formats for analyses performed by TMA/E are given in the BNI radiological analytical services contract. Compliance with subcontract requirements will be verified through routine audits of the subcontractor's analytical data and facilities.

6.1 SUMMARY OF LABORATORY PROCEDURE REQUIREMENTS

The scope of this subsection is to identify acceptable laboratory analytical methods and protocols required for the environmental monitoring program at HISS. These methods were selected for their ability to detect the maximum number of analytes. This section also addresses specific laboratory procedures and practices used to maintain sample integrity and achieve consistently high-quality analytical results.

6.1.1 Sample Identification System

A standard sample identification (ID) system that tracks water, soil, and sediment samples will be used to maintain sample traceability and facilitate data retrieval. Sequentially numbered sample tags will be accountable documents after they are completed and attached to a sample or other physical evidence. The following information will be included on the sample tag:

- Site name
- Field ID or sampling station number
- Date and time of sample collection
- Designation of the sample as a grab or composite
- Type of sample (matrix)
- Signature of the sampler
- Type of preservative used, if applicable

The ID system used to label all samples taken for the program is provided in an instruction guide. This sample ID convention will also be used in the environmental monitoring database to track all pertinent information generated in the program.

TMA/E may use its own unique identifiers for in-house tracking of samples, but it will use the sample ID format described above to report the analytical results. All environmental monitoring data will be retrievable by this sample ID convention.

Samples collected for the program will be packaged, and the packages will be monitored for contamination and radiation levels and then shipped in a manner that meets applicable transportation regulations and requirements. COC forms will be used to track samples from collection locations to the laboratory.

6.1.2 Documentation of Methods

TMA/E will adhere to procedures developed by the Environmental Measurements Laboratory (EML) (DOE 1990b) and to EPA methods in analyzing groundwater and surface water samples. These requirements are listed in the radiological analytical services subcontract. Specific methods of radiological analysis and detection limits required for each method used in this program are given in Table 6-1. These methods have been selected to identify and determine the concentrations of potential environmental contaminants in the site area.

Analyses requested for HISS are based on previous site characterization studies and the history of chemical processes used at SLDS.

Surface water samples will be analyzed for radium-226, thorium-230, and total uranium. Radium-226 concentrations will be determined by radon emanation. This method for detecting radon consists of precipitating radium-226 as the sulfate and transferring the treated sulfate to a radon bubbler, where radon is allowed to come into equilibrium with its radium-226 parent. The radon is then withdrawn into a scintillation cell and counted by

Table 6-1

Analyses Performed on Samples from HISS

Parameter	Analytical Technique	Method	Detection Limit
Water Samples			
Total uranium	Fluorometric	U-01[a,b]	5.0 µg/L
Radium-226	Emanation/scintillation	Ra-03[a,b]	0.1 pCi/L
Thorium-230	PERALS[c]	TMA/E	0.1 pCi/L
Sediment Samples			
Total uranium	Fluorometric	U-01[a,b]	5.0 µg/L
Radium-226	Gamma spectroscopy	C-02[a]	0.5 pCi/g
Thorium-230	Alpha spectroscopy	Th-01[a,b]	0.5 pCi/g

[a]TMA/E utilizes laboratory procedures developed by Environmental Measurements Laboratory-300 (EML-300) (DOE 1990b).

[b]Modified EML procedure to accommodate the matrix.

[c]PERALS - photon/electron-rejecting alpha liquid scintillation.

the gross alpha technique. The quantity of radon detected in this manner is directly proportional to the quantity of radium-226 originally present in the sample.

Thorium-230 concentrations will be determined by the photon/electron-rejecting alpha liquid scintillation (PERALS) method. This method begins with the coprecipitation of radionuclides from a sample by using lead sulfate. Radium is separated onto barium sulfate and precipitated with diethylene-triamine-pentaacetate solution. Thorium is separated sequentially from the barium sulfate supernate by extraction into di(2-ethylhexyl)phosphoric acid and is then counted on the PERALS instrument. This method has a recovery rate of approximately 95 percent for thorium in samples.

Total uranium in surface water will be measured using the fluorometric method, which is very sensitive and dependable in determining trace concentrations of uranium. The first step is to dispense a measured aliquot (typically 0.1 ml) of sample onto a flux pellet made of sodium fluoride (98 percent) and lithium fluoride (2 percent). After the pellet is dried, the uranium is fused to the pellet by a rotary fusion burner. The fluorescence of the fused pellet after cooling is directly proportional to the concentration of total uranium in the sample as compared with spikes, standards, and blanks.

Sediment samples to be analyzed for thorium-230 will be eluted in solution, organically extracted, electroplated to a stainless steel disk, and counted by alpha spectrometry. Total uranium will be measured using the fluorometric method. Samples to be analyzed for radium-226 will be sealed to allow radon and its daughters (including bismuth-214) to come into secular equilibrium with radium-226. The sample will then be analyzed using gamma spectroscopy, which detects the radiation emitted by bismuth-214. Because the radon daughters (including bismuth-214) are in equilibrium with radium-226, the radium-226 concentration can be inferred.

TETLDs containing lithium fluoride chips will be used to measure external gamma radiation; these dosimeters have a lower detection limit of 20 mR.

6.1.3 Procedures to Prevent Cross-Contamination

TMA/E will establish and adhere to an internal laboratory QA plan to minimize the possibility of cross-contamination between samples. All samples will be preserved and shipped to the laboratory as soon as possible to maintain sample integrity from collection to analysis and to meet the "holding time" guidelines. In general, groundwater samples for radiological analysis will be preserved by lowering the sample pH to between 1 and 2 using concentrated nitric acid. Specific guidance on sample preservatives, holding times, and container sizes is provided in a FUSRAP instruction guide.

Samples will be segregated in the TMA/E laboratory according to predetermined radioactivity levels. These samples will be prepared and analyzed within their groups to minimize cross-contamination in the laboratory. Each sample will be monitored continuously during the analytical process to detect possible cross-contamination.

6.1.4 Calibration

Generally, laboratory equipment will be calibrated using the calibration frequency recommended by the manufacturers. The internal QA manual for the laboratory provides applicable equipment calibration procedures and specifies appropriate maintenance requirements for all equipment.

The QA procedures for performing radiological analyses will include routine calibration of counting instruments, source and background counts, routine yield determination of radiochemical procedures, and replicate analyses to check for precision.

Calibration standards for equipment used during radiological analysis will be compatible with NIST or other acceptable laboratory standards. Documentation supporting the validity of the calibration standards (e.g., calibration log books or calibration and maintenance files for all instruments used) will be maintained and accessible for auditing purposes. Field equipment calibration will be handled in accordance with TMA/E operational procedures.

6.2 QUALITY ASSURANCE

In addition to the general QA program provisions of Section 10.0 of this EMP, the subcontracted laboratory will maintain an internal QA program that will be audited annually by BNI to ensure that the analytical results for samples collected at HISS are valid and appropriate for use. Technical experts in radiological analyses may be invited to participate in these audits to fully evaluate the laboratory's performance.

The scope of the auditing program will include specific step-by-step instructions to ensure that laboratory activities comply with calibration procedures set forth in the subcontract agreements, maintain sample integrity, and minimize possible cross-contamination that might have occurred in the laboratory during the analytical process. Discrepancies identified during these annual audits will be documented and tracked through corrective action requests.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT

FUSRAP has established acceptable data analysis and statistical treatment practices by using EPA guidance on data quality objectives (DQOs) to ensure that analytical results comply with DOE Orders 5400.1 and 5400.5.

The DQOs for radiological analysis will be designed to support data use comparable to EPA analytical level III, which is used for chemical analysis (EPA 1987b). Radiological analyses will be subject to the applicable requirements of Nuclear Regulatory Commission guidance (NRC 1979).

Data QC will be maintained to ensure defensibility and integrity of the analytical data to DOE, peer reviewers, and regulatory agencies.

Sampling techniques and sample-handling procedures are documented in a FUSRAP instruction guide that includes detailed instructions for sampling activities and provides guidance to reduce data variability. In addition, project instructions provide for consistency in environmental monitoring data analysis and management.

7.1 SUMMARY OF DATA ANALYSIS AND STATISTICAL TREATMENT REQUIREMENTS

The data analysis and statistical treatment procedures implemented in the HISS environmental monitoring program will be designed to comply with the DOE regulatory guide. The methods in the following subsections will be employed in the data validation process to ensure that analytical results are valid and appropriate for use.

7.1.1 Accuracy

Spikes and standard reference materials (SRMs) will be used to evaluate data accuracy. Analytical results for spiked samples will be reported in the QC reports from the laboratory.

The reported value will be an average of the number of spikes analyzed by the laboratory ±2 standard deviations of the mean.

7.1.2 Precision

Duplicate samples will be used to measure the precision of sample collection and analysis. The precision of duplicates will be reported in the monthly QC report from the laboratory. Environmental duplicates will be evaluated within 2 to 3 standard deviations of the mean for all duplicates analyzed by the laboratory. If the results are not within 3 standard deviations of the mean, a more detailed evaluation will be performed. As applicable, the precision of radiological analytical results will be reported ±2 standard deviations to provide a 95 percent confidence interval.

7.1.3 Comparability

Comparability expresses the confidence with which one data set can be compared with another. Comparability will be ensured through use of the EPA-designated reference or equivalent sampling procedures and analytical methods and certified calibration standards.

7.1.4 Data Evaluation

Raw data will be submitted to BNI in data transmittal packages and electronic data files. The transmittal packages will be subject to data verification by BNI. The verification process will consist of a review of data documentation, QC, and statistical information provided by the subcontracted laboratory. Checklists will be used during the review process in accordance with FUSRAP project instructions. The original packages and the reviewer comments will remain in the BNI Project Document Control Center.

Electronic data files received from the analytical contractor will be entered into the environmental monitoring database in a timely manner. The structure and detailed specifications applicable to the environmental monitoring database are included in the environmental monitoring data management project instruction guide.

Upon completion of the data review, BNI will either approve the data for inclusion in a final data report, declare the data unacceptable as is and then seek to resolve issues that render the data unacceptable, or include an explanation for data rejection. Nonconformance reports (NCRs) will be issued for rejected data.

Analytical results will be reported in the ASER after the data review is completed. All data will be compared with relevant and applicable standards and background concentrations to quantify levels of contaminants. Outliers will be excluded from the data only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process. If, by a process of probability plotting, time plotting or control charting, outliers and temporal irregularities cannot be identified, both results (i.e., possible outliers and the exclusion of possible outliers) will be reported if a significant difference between the two results is found. As each data point is collected, it will be compared with previous data to identify unusual results that require investigation.

Annual averages will be determined for all locations from the individual data points. Standard deviations of analytical results for samples collected at HISS over the past five years will also be calculated for trend analysis. The formula for standard deviation is as follows:

$$S = \sqrt{S^2} = \sqrt{\frac{\sum_{i=1}^{N} (x_i - x)^2}{N - 1}}$$

where:
- S = Standard deviation
- x = Average of values
- x_i = Individual values
- N = Number of values

(Note: When mean values rather than actual measurements are being evaluated, the standard deviation equals $S/\sqrt{\bar{N}}$.) Expected concentration ranges will be those values included within ±2 standard deviations using historic data from the past five years.

Current annual values will then be compared with the expected upper and lower ranges to identify possible trends. Seasonal variations (periodicities) and contaminant concentration averages will be examined when needed. If necessary, running averages will be conducted using data from previous years for comparative purposes. Where appropriate, regression analysis will be performed to support trend analysis. Results of the trend analysis will be used to determine whether investigation or further statistical evaluation is needed.

7.1.5 Less-Than-Detectable Values

Less-than-detectable values for radiological environmental monitoring data will be reported in accordance with Subsection 7.3.4 of the DOE regulatory guide. Additionally, all data will be reported as received from the laboratory; however, the reported averages, standard deviations, and expected ranges will be reported using the smallest number of significant figures from the data reported quarterly (e.g., 3.2 and 32 both have two significant figures). Some of the data will be reported using powers of ten (e.g., 1×10^{-9}).

7.2 QUALITY ASSURANCE

Calculations and independent data verifications will be performed and documented in accordance with FUSRAP project instructions. Discrepancies identified during the review process will be documented and tracked through NCRs.

In addition to the standard QA/QC criteria discussed in Section 10.0 of this document, a summary of results from participation in interlaboratory comparison programs is included in the HISS ASER to satisfy the requirements specified in DOE Order 5400.1.

QC samples will be analyzed to determine whether QA program objectives are being met. The four types of QC samples used in the environmental monitoring program for HISS are described below. If a QC sample is contaminated, all the samples associated with that QC sample will be reviewed by an independent reviewer to determine whether the sample results can be used with appropriate annotation.

A **laboratory duplicate** (a separate aliquot of a sample received for analysis) indicates the precision of an analytical procedure but not matrix interference or analytical accuracy.

An **SRM** is a standard reference material used to validate a particular analytical procedure. SRMs usually originate from EPA or NIST. To meet the QA objective of accuracy, SRMs will be used at a frequency of 5 percent of the samples or 1 for every 20 samples taken for all matrices.

A **field duplicate** indicates precision, reproducibility of the analytical results, and representativeness of the samples collected. Field duplicates, which should not be confused with splits or replicates, are duplicate samples collected by the same procedures used to collect the first sample. For groundwater samples, however, it will not be necessary to purge the well a second time because the duplicate will be collected immediately after the first sample.

A duplicate sample will be taken for every matrix sampled and will be analyzed for all the same analytes as the original sample. Duplicates will be taken at a frequency of at least 5 percent (1 for every 20 samples taken). Duplicate sample ID and location numbers will be designated by the environmental monitoring coordinator and conveyed to the sample teams via a memo before sampling begins.

A **"ship" dosimeter** will accompany radiation dosimeters during transport to and from monitoring locations to measure any exposure incurred before or after the monitoring period.

8.0 RADIOLOGICAL DOSE CALCULATIONS

Exposure pathways are discussed in Section 5.0 and shown on Figure 5-1. Radiological input data, dose calculations and modeling, assumptions, and comparisons with DOE guidelines are concisely reported in the ASER.

The following subsections outline the goals for calculating doses and the methodology that will be used.

8.1 PERFORMANCE STANDARDS FOR PUBLIC DOSE CALCULATIONS

The overall goal in calculating public doses is to verify that contamination at the site is not negatively impacting the residents or workers near the site. The calculated effective dose for a maximally exposed individual (MEI) will be determined using the distance that is closest to the site to obtain the most conservative dose estimate. DOE has established a basic dose limit of 100 mrem/yr above background (DOE 1990a) for the MEI. Additionally, 40 CFR 61 Subpart H requires that the dose to the MEI be less than 10 mrem/yr from radioactive particulates transported via the atmospheric pathway. This requirement currently does not apply to HISS; however, it is considered the best management practice for the site. The collective dose for the population within 80 km (50 mi) of the site will also be evaluated as required by DOE Order 5400.5.

Therefore, the goals of the public dose calculations are to:

- Calculate the dose to the MEI (both total dose and dose from radioactive particulates)
- Calculate the dose to the population within 80 km (50 mi) of the site

8.2 PATHWAYS

To estimate the dose to the general population and the hypothetical MEI at HISS, direct gamma radiation will be measured, and radionuclide concentrations will be determined for various environmental media: air, surface water and sediment, and groundwater. As stated in Section 5.0, the potential pathways at SLAPS are radioactive particulate transport via the atmospheric pathway, surface water and sediment, groundwater and direct exposure to external gamma radiation (Table 5-1). Under normal site conditions, atmospheric particulates do not constitute a viable pathway at HISS because the site is covered with vegetation and the waste is confined in covered piles. However, modeling will be conducted for this pathway to show compliance with 40 CFR 61 Subpart H.

The input data will be calculated for direct exposure and water transport and modeled for the atmospheric pathway. This procedure will be followed to determine the dose to a hypothetical MEI and a collective dose to the general population [within a 80-km (50-mi) radius].

The surface water and sediment that migrate offsite is stormwater that enters a storm sewer system and discharges at two outfalls. Surface water will be evaluated as a potential pathway, although no significant surface water bodies exist onsite or in the immediate vicinity.

The groundwater system at HISS will also be assessed as a potential exposure pathway. Previous groundwater studies indicate that 1 of 13 onsite monitoring wells may have had elevated radionuclide concentrations (BNI 1991b). Sampling and analysis will be conducted during routine monitoring; if radionuclide concentrations exceed background values, estimates will be made of dose exposure, even though onsite groundwater sources are not considered a viable exposure pathway because the site is fenced and wells are capped and locked.

Because HISS is in an industrial setting with no sources of livestock or cultivation of foodstuffs (i.e., gardens), the foodchain pathway is not an applicable exposure pathway. If future information indicates that livestock or foodstuffs are cultivated in the area, these exposure routes will be reconsidered.

The combined effects from all pathways will then be summed to produce an effective dose equivalent, which will be compared with the DOE guideline.

8.3 DOSE CALCULATION METHOD

Dose calculation methods are presented for the credible exposure routes: direct exposure from gamma radiation and inhalation of radioactive particulates. Dose calculation methodologies will be added for other exposure routes if the data indicate a potential for exposure. The combined exposures from all pathways will be summed to produce an effective dose equivalent and compared with the DOE guideline. A total population dose will be determined by summing the doses from all potential exposure pathways.

8.3.1 Direct Exposure

Direct exposure is considered in determining the dose to a hypothetical MEI near the site. Exposure data for this individual are collected through the TETLD program, which provides an average fenceline exposure rate at 1 m (3 ft) above the ground surface. The assumption that the individual works at this one location for an entire year provides a maximum dose value for this scenario. A dose equivalent is then calculated at a distance of 50 m (150 ft) from the fenceline using the following equation (Cember 1983):

$$Exposure\ at\ 50\ m = (Exposure\ at\ 1\ m)\ x\ \frac{h_1}{h_2}\ x\ \frac{\tan^{-1}(L/h_2)}{\tan^{-1}(L/h_1)}$$

where: h_1 = TETLD distance from the fenceline [1 m (3 ft)]

h_2 = Distance to the MEI [50 m (150 ft)]

L = Half the length of the site

The average exposure rate used in the model is the area of the site that presents the largest potential dose.

The collective dose by direct exposure to the general population living within an 80-km (50-mi) radius of HISS is assumed to be nondetectable. This determination is based on the location of HISS in an industrial setting, remote to the general population, with surrounding structural features that reduce direct gamma exposure.

8.3.2 Atmospheric Pathway

To estimate a maximum dose to a hypothetical MEI via an air pathway, it is assumed that the individual lives and works within 300 m (1000 ft) of the site. Environmental monitoring data are incorporated into the EPA AIRDOS model (current version) (ORNL 1989) to estimate the effective dose equivalent and are reported in the HISS ASER.

To determine the collective dose to the general population via the atmospheric pathway, the EPA AIRDOS model is applied at incremental distances from the site, to a maximum distance of 8 km (5 mi). Using the effective dose equivalents and the population density, a collective dose for the general population within 80 km (50 mi) is calculated.

Atmospheric particulate release rates, used in the AIRDOS model, are determined by using an unlimited wind erosion model (EPA 1985) for the site and radionuclide concentrations determined during soil characterization efforts. Other input parameters required by the model are size of the site, mixing height, and meteorological information. Default values are usually used for meteorological input parameters.

8.4 QUALITY ASSURANCE

Applicable QA standards (Section 10.0) are followed throughout the calculation procedure. All calculation procedures are documented in FUSRAP projcct instructions. Current practices include peer and supervisor review of all calculations. Additionally, benchmark problems are used to verify any computer modeling codes used.

9.0 RECORDS AND REPORTS

This section identifies and outlines the reporting and record-keeping requirements of the major federal regulations and DOE orders applicable to the environmental and effluent surveillance programs at HISS. Environmental statutes and regulations change frequently and are often amended or superseded; the monitoring program will be updated as necessary.

Proper record-keeping and reporting are essential to FUSRAP's overall compliance strategy. Appropriate FUSRAP, DOE, and other responsible authorities will be promptly notified of occurrences and information involving activities at HISS, as required. Records pertaining to in-house, DOE, EPA, or external agency audits of the monitoring program will be maintained; calculations, computer programs, and other data will be recorded and/or referenced.

9.1 APPLICABLE DOE ORDERS

Record-keeping and reporting requirements applicable to FUSRAP are listed below.

- **Order 1324.2:** Compliance with general DOE requirements for records disposition and retention

- **Order 5400.1:** Maintenance and retention of auditable records relating to the environmental surveillance and effluent monitoring programs; records of calculations, computer programs, and other information (e.g., raw data and procedures); protection of records against damage or loss, which generally entails assurance that a duplicate of records is stored in a separate location; description in the ASER of the status of the environmental monitoring program; preparation, annual review, and update (at least every three years) of the EMP

- **Order 5400.4:** Preparation of reports describing the extent and/or status of the CERCLA efforts; reporting of releases of radionuclides that exceed "reportable quantities" to the National Response Center

- **Order 5400.5:** Compliance with general requirements for record-keeping and reporting

- **Order 5484.1:** Preparation of reports on information having environmental protection, safety, or health protection significance

- **Order 5000.3A:** Preparation of occurrence reports, as required, on failure of effluent monitoring systems, inadvertent release of radionuclides, or discovery of significant radioactive contamination in the onsite or offsite environment attributable to current or past FUSRAP operations

- **Order 5700.6B:** Compliance with general QA requirements

- **Order 5820.2A:** Preparation of annual updates of the waste management plan

9.2 APPLICABLE ENVIRONMENTAL REGULATIONS

General reporting and record-keeping requirements for effluent and environmental surveillance activities at HISS are contained in numerous regulations. Applicable requirements under CERCLA, Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES), Clean Air Act (CAA), National Environmental Policy Act (NEPA), and NESHAPs are explained below.

- **CERCLA:** CERCLA is the primary statutory authority for response actions conducted at HISS. EPA record-keeping requirements under CERCLA are contained in Subpart I of the

National Oil and Hazardous Substances Contingency Plan. Subpart I requires that an administrative record be established and maintained at or near the site to contain documents that form the basis for selecting the response actions.

In general, any permits required by federal or state law must be kept onsite. However, CERCLA Section 121 provides an exception to the administrative requirement of obtaining a permit, with a few exceptions such as NPDES stormwater requirements. All substantive conditions required under a permit must still be met.

- **CWA:** Any site that acquires a permit pursuant to the provisions of the CWA should have a copy of the permit onsite. CWA permits issued under the NPDES program contain record-keeping and monitoring requirements. Records and monitoring data required in the permit should be kept onsite. Uncertainty as to inclusion of specific documents may be resolved by negotiations with the permit writer. Recent developments in the regulation of water discharges require stormwater discharge permits for sites associated with past industrial activities. Stormwater discharges are regulated by the NPDES and are administered and monitored by the applicable state.

- **NPDES:** Recent developments in the regulation of water discharges require stormwater discharge permits for sites associated with past industrial activities. Stormwater discharges are regulated by the NPDES under the CWA and are administrated and monitored by the state. Stormwater converges at two outfalls at HISS and is conveyed to Coldwater Creek. NPDES permit No. MO-0111252, issued for HISS on December 28, 1990, requires monthly effluent monitoring and quarterly reporting of the results.

The state regulations have not incorporated the provisions of the federal stormwater regulations promulgated on November 16, 1990. DOE and the Missouri Department of Natural Resources are evaluating the effects of these new federal requirements on existing state stormwater discharge requirements. However, because HISS has been issued a permit, an application for compliance with these new requirements will not have to be submitted until 180 days prior to the expiration of the current permit. A copy of the permit is kept by the PMC.

- **CAA:** HISS currently does not require an air permit per CERCLA Section 121; however, all applicable permit conditions will be met. No permit applications are pending.

- **NESHAPs:** Records are maintained for radon monitoring, data, monitoring system calibration checks, and the occurrence and duration of any period during which the monitoring system is malfunctioning or inoperative. Records must be stored at the site and maintained for two years (Subpart A, 40 CFR 61.14).

- **NEPA:** Project documents generated to comply with NEPA requirements are available in the administrative record, which is available for public review at the DOE Public Information office, St. Louis Public Library, and St. Louis County Library. For example, remedial investigation/ feasibility study (RI/FS) documents will be part of the administrative record, and FUSRAP prepares integrated CERCLA/NEPA documents such as the RI/FS-environmental impact statement (EIS). Mitigation action plans (MAPs) will be prepared when a finding of no significant impact for an action reviewed in an environmental assessment is based in significant part on a commitment to mitigate adverse environmental impact. An MAP is also prepared for implementation of commitments made in an EIS/record of decision.

Neither hazardous waste nor radioactive mixed waste is present; therefore, HISS is not subject to regulation under RCRA. Because there are no polychlorinated biphenyls (PCBs) or asbestos onsite, HISS is not subject to the PCB or asbestos regulations in the Toxic Substances Control Act.

Applicable QA strategies (Section 10.0) will be followed throughout the reporting and record-keeping procedures, which are documented in FUSRAP project instructions.

10.0 QUALITY ASSURANCE

10.1 IMPLEMENTATION

The comprehensive QA program for HISS is based on the St. Louis quality assurance project plan (BNI 1991c) and the FUSRAP QA program. The basic QA requirements described in ASME-NQA-1 and the 18 QA criteria of 10 CFR Part 50 Appendix B are individually identified, addressed, and committed to in the QA program and satisfy the requirements of DOE Order 5700.6B. The requirements of the QA program are further detailed and implemented through project procedures, project instructions, specifications, drawings, plans, and work control documents. Adherence to the QA program will be required for all services in support of HISS. QA requirements will also be incorporated into contracts, work orders, and purchase orders issued for work and services at HISS by adherence to this QA program.

10.2 SOVEREIGNTY

The FUSRAP project quality assurance supervisor (PQAS) maintains organizational independence by functionally reporting to off-project QA management. The PQAS will be responsive, however, to the FUSRAP program manager for coordination of activities at HISS in the implementation of the QA program. The PQAS is responsible for:

- Assessing the adequacy and implementation of the QA program
- Contributing to the development of QA project plans
- Providing independent surveillances and audits of work activities, including environmental compliance assessments
- Review and approval, as required, of implementing procedures, instructions, and major reporting documents
- Identifying the need for corrective actions and verifying implementation of solutions

- Reporting on the effectiveness of the QA program implementation and providing recommendations to management
- Providing QA indoctrination and training to all project personnel
- Participating in the planning of all work to ensure that QA program requirements are addressed

10.3 SUBCONTRACTORS

Subcontractors to BNI will be an integral group in performing work on and for HISS. Sampling and sample analysis will be performed by TMA/E, the radiological analytical services subcontractor. Other subcontractors will perform labor, supply material, and assist in the many ongoing phases of the work.

10.3.1 Compliance with FUSRAP QA Program

Each BNI subcontractor's QA system will be implemented in a manner that is compatible with and equal to the FUSRAP QA program. Subcontractors not having their own QA program will work under the requirements of the FUSRAP QA program. TMA/E maintains its own internal QA program; its standard practices manuals have been reviewed and accepted by BNI. TMA/E will be audited at least annually by BNI to determine its compliance with QA requirements.

10.3.2 Participation in Laboratory QA Assessment Programs

TMA/E will participate in the collaborative testing and interlaboratory comparison program with EPA at Las Vegas, Nevada. In this program, samples of various environmental media (water, milk, air filters, soil, foodstuffs, and tissue ash) containing one or more radionuclides in known amounts will be prepared and distributed to participating laboratories. Results will be forwarded to EPA for comparison with known values and with the results from other laboratories. This program will enable the laboratory to regularly evaluate the accuracy of its analyses and take corrective action, if needed. TMA/E will also participate in the DOE EML interlaboratory QA program, which consists of receiving and analyzing environmental samples (air filters, vegetation, water, and soil) quarterly for specific radiochemical analyses. TMA/E has been approved for accreditation by the American Association for Laboratory Accreditation.

Interlaboratory comparison of the TMA/E TETLD results will be provided by participation in the International Environmental Dosimeter Project sponsored jointly by DOE, EPA, and the Nuclear Regulatory Commission.

10.4 AUDITS AND CORRECTIVE ACTIONS

Quality audits and surveillances, as defined in ASME-NQA-1, will be performed throughout the year on many areas of FUSRAP. Audits and surveillances will be scheduled so that performance-based assessments of project activities related to HISS are examined to review, evaluate, and report on the effectiveness and status of the project QA program. Audits will be led by an ASME-NQA-1 certified audit team leader appointed by the BNI QA manager. Audit team members will be selected based on technical expertise, qualification in the area being audited, and lack of direct responsibility for performing the activities being audited. These audits will be conducted, using checklists, in accordance with written procedures in the QA department standards. Surveillances, similar to audits, will be performed by QA personnel, with the use of checklists, and will focus on performance assessments for scope-specific QA program elements. Results of the QA audits and surveillances will be documented and reported to BNI management. Findings requiring corrective actions will be documented in accordance with QA department standards, clearly reported, assigned to a responsible individual, and tracked until effective solutions are implemented. The PQAS will verify the implementation of corrective actions and will report the results to project management and the BNI QA manager.

10.5 CONTROL OF SAMPLING

Control of field sampling and monitoring activities will be established through implementation of FUSRAP environmental health and safety procedures and instruction guides. The objective of sampling procedures will be to ensure that samples obtained are representative of the environment being investigated. Calculations will be performed in accordance with approved procedures. For sampling of air, water, sediments, soils, or wastes, the instruction guide for the sampling program includes:

- Techniques or guidelines used to select sampling sites
- Specific sampling procedures to be used
- Charts, flow diagrams, or tables delineating sampling program operations
- Containers, procedures, and reagents used for sample collection, preservation, transport, and storage (including holding times)
- Special preparation of sampling equipment and containers to avoid sample contamination
- Control of samples and COC
- Establishment of DQOs

Laboratory and instrument control will be established by implementation of field and laboratory procedures including:

- Preservation of samples
- Receipt and handling of samples
- Processing and analysis of samples
- Analytical equipment calibrations
- Data verification
- Data reporting
- Data and record retention
- Sample retention

10.6 RADIATION-MEASURING EQUIPMENT

Radiation-measuring equipment will be calibrated and operated in accordance with the QA program requirements implemented through project procedures. Included in the program will be laboratory and field instruments, sampling equipment, air monitoring equipment, and dosimeters. Calibration will be traceable to recognized national standards, using techniques recognized by the American Society for Testing and Materials, NIST, the nuclear industry, and EPA.

10.7 DATA MANAGEMENT

Data reviews will be performed and documented in accordance with FUSRAP project instructions. Discrepancies identified during the review process will be documented and tracked through an NCR.

10.8 CALCULATIONS AND MODELING

Applicable QA standards will be followed throughout the calculation and modeling procedure. All procedures will be documented in accordance with FUSRAP project instructions. Project calculations will be checked by a qualified person, reviewed by the group leader, and approved by project department supervisors. Additionally, benchmark problems will be used to verify any computer modeling codes.

REFERENCES

The American Society of Mechanical Engineers (ASME), 1989. Quality Assurance Program Requirements for Nuclear Facilities, ASME-NQA-1 (September 15).

Bechtel National, Inc. (BNI), 1985. Report on Drilling and Observation Well Installation at the Hazelwood Interim Storage Site, DOE/OR/20722-62, Oak Ridge, Tenn. (August).

BNI, 1987. Characterization Report for the Hazelwood Interim Storage Site, Hazelwood, Missouri, DOE/OR/20722-141, Oak Ridge, Tenn. (June).

BNI, 1990a. Quality Assurance Program Plan for U.S. DOE FUSRAP, Oak Ridge, Tenn. (December 11).

BNI, 1990b. Chemical Characterization Report for the St. Louis Airport Site and Latty Avenue Properties, DOE/OR/20722-206, Rev. 1, Oak Ridge, Tenn. (July).

BNI, 1991a. Work Plan for the Remedial Investigation/Feasibility Study-Environmental Impact Statement for the St. Louis Site, (Draft), DOE/OR/20722-271.1, Oak Ridge, Tenn. (July).

BNI, 1991b. Hazelwood Interim Storage Site Annual Environmental Report for Calendar Year 1990, DOE/OR/21949-283, Oak Ridge, Tenn. (June).

BNI 1991c. Quality Assurance Project Plan for the Remedial Investigation/Feasibility Study-Environmental Impact Statement for the St. Louis Site (Draft), DOE/OR/21949-271.3, Oak Ridge, Tenn. (August).

BNI, 1991d. Formerly Utilized Sites Remedial Action Program ALARA Plan, Oak Ridge, Tenn. (August).

Cember, H., 1983. Introduction to Health Physics, Pergamon Press, Oxford.

Department of Energy (DOE), 1988a. Order 5400.1, "General Environmental Protection Program" (January 9).

DOE, 1988b. Order 5820.2A, "Radioactive Waste Management" (September 26).

DOE, 1989. Order 5700.6B, "Quality Assurance" (November 22).

DOE, 1990a. Order 5400.5, "Radiation Protection of the Public and the Environment" (February 5).

DOE, 1990b. EML Procedures Manual, Environmental Measurements Laboratory, HASL-300-Ed. 27.

DOE, 1991. Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance, DOE/EH-0173T, Washington, D.C. (January).

Environmental Protection Agency (EPA), 1985. Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites, EPA/600/8-85/002 (February).

EPA, 1987a. A Compendium of Superfund Field Operations Methods, Vol. 2, EPA/540/P-87/001b (August).

EPA, 1987b. Data Quality Objectives for Remedial Response Activities, Office of Emergency and Remedial Response and Office of Waste Programs Enforcement, EPA/540/G-87/003, Washington, D.C. (March).

EPA, 1990. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, "Revision of Chapter 11 of SW-846, Ground-water Monitoring Design, Installation, and Operating Practices" (Draft) (November).

National Council on Radiation Protection and Measurements (NCRP), 1986. Screening Techniques for Determining Compliance with Environmental Standards (Commentary 3).

Nuclear Regulatory Commission (NRC), 1979. "Quality Assurance for Radiological Monitoring Programs - Effluent Streams and the Environment," Guide 415, Rev. 1 (February).

Oak Ridge National Laboratory (ORNL), 1989. AIRDOS-EPA: A Computerized Methodology for Estimating Environmental Concentrations and Dose to Man from Airborne Releases of Radionuclides, OCNL-5532, Oak Ridge, Tenn. (December).

APPENDIX A

Cross-Reference Showing EMP Compliance
With DOE Regulatory Guide

Appendix A is provided as a cross-reference to show how this environmental monitoring plan (EMP) complies with the specific "high-priority" elements listed in the "Summary of Effluent Monitoring and Environmental Surveillance Program Elements" section (pp. ix-xxvi) of the DOE regulatory guide. Where high-priority elements are judged to be not applicable to the scope of this EMP, the justification for not implementing them is shown by using a capital-letter code in the "EMP Section or Justification Code" column of this Appendix. These codes are explained in Table A-1 below.

Table A-1
Justification for Not Implementing High-Priority Elements

A. HISS is not an operating facility. No stack emissions or liquid effluents are generated.

B. Because HISS is an inactive facility, continuous monitoring will not be performed.

C. HISS is neither a new nor modified facility; therefore, a preoperational assessment is not required.

D. No radioiodides are present.

E. HISS is not a multi-facility site.

F. No endangered or protected species are known to occur in the site area.

G. There are no neutron sources.

H. Because HISS is located in an industrial area where no livestock is raised and there is no cultivation for producing foodstuffs, this requirement is not applicable.

HISS EMP Summary Matrix

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
Liquid Effluent Monitoring		
a. All liquid effluent streams **should*** be evaluated and their potential for release of radioactive material assessed. Based on this assessment, decisions **should*** be made regarding necessary effluent monitoring systems and the rationale **should*** be documented in the Environmental Monitoring Plan.	2.0	A 2.0
b. Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination **should*** be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.	2.0	A 2.0
c. Facility operators **should*** provide monitoring of liquid waste streams adequate to (1) demonstrate compliance with the requirements of DOE 5400.5, Chapter II, paragraphs 1a, 1d, 2a, and 3, (2) quantify radionuclides released from each discharge point, and (3) alert affected process supervisors of accidents in processes and emission controls.	2.1	A
d. When continuous monitoring or continuous sampling is provided, the overall accuracy of the results **should*** be determined (±% accuracy and the % confidence level) and documented in the Environmental Monitoring Plan.	2.1	B
e. Provisions for monitoring of liquid effluents during an emergency **should*** be considered when determining routine liquid effluent monitoring program needs.	2.1	5.5.6

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
f. The selection or modification of a liquid effluent monitoring system **should*** be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample-collection system(s), treatment system(s), and final release point(s) of the effluents.	2.2	A, B
g. For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of the monitoring or surveillance systems, a preoperational assessment **should*** be made and documented in the Environmental Monitoring Plan to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.	2.2	A, C
h. The performance of the effluent monitoring systems **should*** be sufficient for determining whether effluent releases of radioactive material are within the Derived Concentration Guides specified in DOE 5400.5 and to comply with the reporting requirements of Chapter II, paragraph 7, of that Order.	2.2	A
i. The required detection levels of the analysis and monitoring systems **should*** be sufficient to demonstrate compliance with all regulatory requirements consistent with the characteristics of the radionuclides that are present or expected to be present in the effluent.	2.2	A

HISS EMP Summary Matrix

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
j.	Sampling systems **should*** be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends, and to satisfy needs to quantify releases.	2.2.2	A, B
k.	Continuous monitoring and sampling systems **should*** be calibrated before use and recalibrated any time they are subject to maintenance, modification, or system changes that may affect equipment calibration.	2.2.3	B
l.	Sampling and monitoring systems **should*** be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.	2.2.3	B
m.	Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) **should*** be considered when locating effluent monitoring systems to avoid conditions that will influence the operation of the system.	2.2.4	A, B
n.	Off-line liquid transport lines **should*** be replaced if they become contaminated (to the point where the sensitivity of the system is affected) with radioactive materials or if they become ineffective in meeting the design basis within the established accuracy/confidence levels.	2.2.4	A, B
o.	If continuous monitoring/sampling and recording of the effluent quantity (stream flow) are not feasible for a specific effluent stream, the extenuating circumstances **should*** be documented in the Environmental Monitoring Plan.	2.3.2	A, B 2.0

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
p. Sampling/monitoring lines and components **should*** be designed to be compatible with the chemical and biological nature of the liquid effluent.	2.3.7	A, B
q. The output signal instrumentation, monitoring system recorders, and alarms **should*** be in a location that is continuously occupied by operations or security personnel.	2.4	B
r. To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems are required, they **should*** have alarms set to provide timely warnings.	2.5	B
s. As they apply to the monitoring/sampling of liquid effluents, the general quality assurance program provisions described in Chapter 10 of this guide **should*** be followed.	2.6	A
Airborne Effluent Monitoring		
a. All airborne emissions from each facility (DOE site) **should*** be evaluated and their potential for release of radionuclides assessed. Based on this assessment, decisions **should*** be made regarding necessary effluent monitoring systems and the rationale **should*** be documented in the site Environmental Monitoring Plan. The potential for emissions **should*** include consideration of the loss of emission controls while otherwise operating normally.	3.0	B 3.0 5.3, ¶ 1, 2, and 3

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
b. Airborne emissions from DOE-controlled facilities that have the potential for causing doses exceeding 0.1 mrem (effective dose equivalent) to a member of the public under realistic exposure conditions from emissions in a year **should*** be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.	3.0	5.3, ¶ 3
c. The criteria for monitoring listed in Chapter 3 of this guide **should*** be used to establish the airborne emission monitoring programs for DOE-controlled sites.	3.1	5.3.3
d. For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of monitoring or surveillance systems, a preoperational assessment **should*** be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of airborne emissions to be expected from the facility, and to establish the associated airborne emission monitoring needs of the facility.	3.3	C
e. The performance of the airborne emission monitoring systems **should*** be sufficient for determining whether the releases of radioactive materials are within the limits or requirements specified in DOE 5400.5.	3.3	5.1, ¶ 1 5.3, ¶ 3
f. Sampling and monitoring systems **should*** be calibrated before use and recalibrated any time they are subject to maintenance or modification that may affect equipment calibration.	3.3	A, B

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
g.	Sampling and monitoring systems **should*** be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.	3.3	A, B
h.	Provisions for monitoring of airborne emissions during accident situations **should*** be considered when determining routine airborne emission monitoring program needs.	3.3	5.3.6, ¶ 2
i.	Diffuse sources (i.e., area sources or multiple point sources in a limited area) **should*** be identified and assessed for their potential to contribute to public dose and **should*** be considered in designing the site emissions monitoring and environmental surveillance program. Diffuse sources that may contribute a significant fraction (e.g., 10%) of the dose to members of the public resulting from site operations **should*** be identified, assessed, documented, and verified annually.	3.3.2	5.3.2, ¶ 1
j.	Airborne emission sampling and monitoring systems **should*** demonstrate that quantification of airborne emissions is timely, representative, and adequately sensitive.	3.4	5.3.2, ¶ 1 and 2
k.	To the extent practicable, samples **should*** be extracted from the effluents from a location and in a manner that provides a representative sample, using multiport probes if necessary.	3.5.2	A, B
l.	Where a significant potential (greater than once per year exists for approaching or exceeding average fraction of the emission standard (e.g., 20%), continuous monitoring **should*** be required.	3.5.8	5.3.2, ¶ 1 and 2

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
m.	The design of radioiodine monitors will be such that replacement of sorbent and filter **should*** not disturb the geometry between the collector and detectors.	3.5.8.3	A, D
n.	To signal the need for corrective actions that may be necessary to prevent public or environmental exposures exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems (as required by the criteria in Chapter 3) are required, they **should*** have alarms set to provide timely warnings.	3.6	B
o.	As they apply to the monitoring of airborne emissions, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	3.7	5.3.5, ¶ 2
	Meteorological Monitoring		
a.	Each DOE site **should*** establish a meteorological monitoring program that is appropriate to the activities at the site, the topographical characteristics of the site, and the distance to critical receptors.	4.0	4.0, ¶ 1, 2, and 3
b.	The scope of the program **should*** be based on an evaluation of the regulatory requirements, the meteorological data needed for impact assessments, environmental surveillance activities, and emergency response, considering the mathematical procedures, models, and input data requirements necessary for computing atmospheric transport and diffusion computations and performing dose assessments.	4.0	4.0 entire section

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
c. The program **should*** be documented in a meteorological monitoring section of the Environmental Monitoring Plan in compliance with DOE 5400.1.	4.0	4.0 entire section
d. For data from an offsite source to be acceptable, the data **should*** be representative of conditions at the DOE facility and provide statistically valid data consistent with onsite monitoring requirements.	4.0	4.0, ¶ 2
e. Specific meteorological information requirements for each facility **should*** be based on the magnitude of potential source terms, the nature of potential releases from the facility, possible pathways to the atmosphere, distances from release points to critical receptors, and the proximity of the site to other DOE facilities.	4.0	4.0, ¶ 3
f. Meteorological information requirements for facilities **should*** be sufficient to support environmental monitoring and surveillance programs.	4.0	4.0, ¶ 3
g. The meteorological monitoring program for each DOE site **should*** provide the data for use in atmospheric transport and diffusion computations that are appropriate for the site and application.	4.1.2	4.0, ¶ 2
h. Before any model is deemed appropriate for a specific application, the assumptions upon which the model is based **should*** be evaluated and the evaluation results documented.	4.1.2	4.0, ¶ 4

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
i.	Meteorological programs for sites where onsite meteorological measurements are not required **should*** include a description of climatology in the vicinity of the site and **should*** provide ready access to representative meteorological data.	4.1.2	4.0, ¶ 2 and 3
j.	Potential release modes, distances from release points to receptors, and meteorological conditions **should*** be considered in assessments for DOE facilities required to take onsite measurements.	4.1.3	4.0, ¶ 3
k.	Meteorological measurements **should*** be made in locations that, to the extent practicable, provide data representative of the atmospheric conditions into which material will be released and transported.	4.4	4.0, ¶ 3
l.	The instruments used in the monitoring program **should*** be capable of continuous operation in the normal range of atmospheric conditions at the facility.	4.4	B
m.	Wind measurements **should*** be made at a sufficient number of altitudes to adequately characterize the wind at potential release heights.	4.4.1	A, B 4.0, ¶ 3
n.	If instruments are mounted on booms extending to the side of a tower, the booms **should*** be oriented in directions that minimize the potential effects of the tower on the measurements. The instruments **should*** be at least two tower diameters from the tower, but **should** be three to four tower diameters from the tower.	4.4.2	A, B

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
o.	The meteorological monitoring program **should*** provide for routine inspection of the data and scheduled maintenance and calibration of the meteorological instrumentation and data-acquisition system at a minimum, based on the calibration frequency recommendations of the manufacturers.	4.6	A, B
p.	Inspections, maintenance, and calibrations **should*** be conducted in accordance with written procedures, and logs of the inspections, maintenance, and calibrations **should*** be kept and maintained as permanent records.	4.6	A, B
q.	The instrument system **should*** provide data recovery of at least 90% on an annual basis for wind direction, wind speed, those parameters necessary to classify atmospheric stability, and other meteorological elements required for dose assessment.	4.6	A, B
r.	The topographic setting of a facility and the distances from the facility to points of public access **should*** be considered when evaluating the need for supplementary instrumentation.	4.7	4.0, ¶ 3
s.	If meteorological measurements at a single location cannot adequately represent atmospheric condition for transport and diffusion computations, supplementary measurements **should*** be made.	4.7	4.0, ¶ 3
t.	A site-wide meteorological monitoring program **should*** be established at each multi-facility site to provide a comprehensive data base that can be used for all facilities located within the site.	4.8	E

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
u. As they apply to meteorological monitoring, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	4.11	4.0, ¶ 4
Environmental Surveillance		
a. An evaluation **should*** be conducted and used as the basis for establishirg an environmental surveillance program for all DOE-controlled sites. The purpose of the surveillance program is to characterize the radiological conditions of the offsite environs and, if appropriate, estimate public doses related to these conditions, confirm predictions of public doses based on effluent monitoring data, and, where appropriate, provide compliance data for all applicable regulations. The results of this evaluation **should*** be documented in the site Environmental Monitoring Plan.	5.0	1.0, ¶ 1 1.1, ¶ 1, 2, 3, 4, and 5
b. The environmental surveillance program for DOE-controlled sites **should*** be conducted in accordance with the requirements of DOE 5400.1 and DOE 5400.5.	5.0	5.0, ¶ 1 5.1, ¶ 1
c. The criteria for environmental surveillance programs listed in Chapter 5 **should*** be used for establishing the environmental surveillance program for DOE-controlled sites. Additional site-specific criteria **should*** be documented in the site Environmental Monitoring Plan.	5.1	1.1, ¶ 1, 2, 3, 4, and 5 5.1, ¶ 1

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
d.	The need for environmental sampling and analysis **should*** be evaluated, by exposure pathway analysis, for each site radionuclide effluent or emission (liquid or airborne). This analysis with appropriate data, references, and site-specific assumptions, along with site-specific criteria for selection of samples, measurements, instrumentation, equipment, and sampling or measurement locations **should*** be documented in the site Environmental Monitoring Plan.	5.1.1	5.1, entire section
e.	A critical pathway analysis (radionuclide/media) **should*** be performed, documented, and referenced in the Annual Site Environmental Report.	5.1.1	5.1, ¶ 3
f.	If the projected dose equivalent from inhalation of particulates exceeds the criteria of Chapter 5, particle-size analysis of the emission **should*** be conducted at least annually.	5.1.1	A
g.	Further provisions **should*** be made, as appropriate, for the detection and quantification of unplanned releases to the environment of radioactive material, including radionuclides that may be transported by stormwater runoff, flooding, or resuspension of ground-deposited material.	5.1.2	5.3.6, ¶ 2 5.5.6
h.	For all new or modified facilities coming on-line, a preoperational assessment **should*** be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of effluents to be expected from the facility and to establish the associated environmental surveillance program.	5.2	A, C
i.	Calibration of dosimeters and exposure-rate instruments **should*** be based on traceability to NIST standards.	5.2	5.2.4, ¶ 1

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
j.	Gross radioactivity analyses **should*** be used only as trend indicators, unless documented supporting analyses provide a reliable relationship to specific radionuclide concentrations or doses.	5.2	5.2, ¶ 1
k.	The overall accuracy (±% accuracy) **should*** be estimated, and the approximate Environmental Detection Limit at a specified % confidence level for environmental measurements of beta-gammas, alphas, and neutrons, as appropriate, **should*** be determined and documented.	5.2	5.2.4, ¶ 1
l.	Sample preservation methods **should*** be consistent with the analytical procedures used.	5.2	6.1.3, ¶ 1
m.	All environmental surveillance techniques **should*** be designed to take a representative sample or measurement of the important radiation exposure pathway media.	5.2	5.1, ¶ 2
n.	Sampling or measurement frequencies for each significant radionuclide or environmental medium combination (e.g., those contributing 10% or more to offsite dose greater than 0.1 mrem EDE from emissions in a year) **should*** take into account the half-life of the radionuclides to be measured and **should*** be documented in the site Environmental Monitoring Plan.	5.2.1	Table 1-1
o.	"Background" or "control" location measurements **should*** be made for every significant radionuclide and pathway combination (e.g., those contributing 10% or more to offsite dose greater than 0.1 mrem EDE from emissions in a year) for which environmental measurements are used in the dose calculations.	5.2.1	1.1, ¶ 5 5.3.2, ¶ 3 5.5.2, ¶ 2

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
p. An annual review of the radionuclide composition of effluents or emissions **should*** be made and compared with those used to establish the site Environmental Monitoring Plan. Any deviations from routine environmental surveillance requirements, including sampling or measurement station placement, **should*** be documented in an approved revised site Environmental Monitoring Plan.	5.2.1	5.1, ¶ 6 7.1.4, ¶ 6
q. The air sampling rate **should*** not vary by more than ±20% and total air flow or total running time **should*** be indicated; air sampling system **should*** be leak-tested, flow-calibrated, tested, and inspected on a routine basis at a minimum, using the calibration frequency recommendations of the equipment manufacturers.	5.2.2	A, B
r. State and local game officials **should*** be consulted when selecting appropriate protected species to sample.	5.2.3	F 5.1, ¶ 5
s. DOE Field Office and contractor staff **should*** ensure that groundwater monitoring plans are consistent with state and regional EPA groundwater monitoring requirements under RCRA and CERCLA to avoid unnecessary duplication. DOE Field Office and contractor staff **should*** consult with state and regional EPA offices, as needed, to ensure that the requirements are incorporated into the Radiological Monitoring Plan.	5.2.4	5.4, ¶ 1
t. Any changes in the site-specific or generic factors **should*** be noted in the Environmental Monitoring Plan and the retired or replaced values preserved for historical purposes.	5.3.2	5.1, ¶ 6

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
u.	When neutron monitoring is required, the method of measurement **should*** be based on the anticipated flux and energy spectrum.	5.6.2	G
v.	The sample exchange frequency for non-particulate sampling **should*** be determined on a site-specific basis and **should*** be documented in the environmental surveillance files.	5.7.5	5.3.3
w.	The analytical procedure to be used **should*** be considered when choosing a method for preserving milk samples.	5.8.2.1	H
x.	As they apply to environmental surveillance activities, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	5.10	5.2.5, ¶ 2 5.3.5, ¶ 2 5.4.5, ¶ 2 5.5.5
	Laboratory Procedures		
a.	Laboratory procedures and practices **should*** be documented in the site Environmental Monitoring Plan.	6.0	6.1, ¶ 1
b.	Each monitoring and surveillance organization **should*** have a sample identification system that provides positive identification of samples and aliquots of samples throughout the analytical process. The system **should*** incorporate a method for tracking all pertinent information obtained in the sampling process.	6.1.1	6.1.1, ¶ 1 and 2

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
c.	Each laboratory **should*** establish and adhere to written procedures to minimize the possibility of cross-contamination between samples. High-activity samples **should*** be kept separate from low-activity samples.	6.1.2	6.1.3, ¶ 1 and 2
d.	The integrity of samples **should*** be maintained (i.e., minimize degradation of samples by using proper preservation and handling practices that are compatible with analytical methods.	6.1.2	6.1.3, ¶ 1
e.	Specific analytical methods **should*** be identified, documented, and used to identify and quantify all radionuclides in the facility inventory or effluent that contribute 10% or more to the public dose or environmental contamination associated with the site.	6.1.3	6.1.2, ¶ 1
f.	Standard analytical methods **should*** be used for radionuclide analyses (when available). Any modification of standard methods **should*** be documented.	6.1.3	Table 6-1
g.	Methods, requirements, and necessary documentation **should*** be specified in analytical contracts.	6.1.3	6.0, ¶ 1
h.	All sites that release or could release gamma-emitting radionuclides **should*** have the capability (either in-house or outside) of having samples (routine, special, or emergency) analyzed by gamma-ray spectroscopy systems.	6.1.4	Table 6-1
i.	Counting equipment **should*** be calibrated using, at a minimum, the calibration frequency recommendations of the manufacturers to obtain accurate results.	6.1.5	6.1.4, ¶ 1 and 2

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
j. Check sources **should*** be counted periodically on all counters to verify that the counters are giving correct results.	6.1.5	6.1.4, ¶ 2
k. Samples that are sent offsite for analysis or for laboratory intercomparison **should*** be monitored for contamination and radiation levels and **should*** be packaged in a manner that meets applicable transportation regulations and requirements.	6.2.2	6.1.1, ¶ 4
l. As they apply to laboratory procedures, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	6.13	6.2, ¶ 1
Data Analysis and Statistical Treatment		
a. The statistical techniques used to support the concentration estimates, to determine their corresponding measures of reliability, and to compare radionuclide data between sampling and/or measurement points and times **should*** be designed with consideration of the characteristics of effluent and environmental data.	7.0	7.1, entire section
b. Documented and approved sampling, sample-handling, analysis, and data-management techniques **should*** be used to reduce the variability of results.	7.0	7.0, ¶ 4
c. The level of confidence in the data due to the radiological analyses **should*** be estimated by analyzing blanks and spiked pseudo-samples and by comparing the resulting concentration estimates to the known concentrations in those samples.	7.1	7.1.1, ¶ 1 and 2 7.1.2 7.1.3

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
d. The precision of radionuclide analytical results **should*** be reported as a range, a variance, a standard deviation, a standard error, and/or a confidence interval.	7.1	7.1.2
e. Data **should*** be examined and entered into the data base promptly after analysis.	7.1	7.1.4, ¶ 1 and 2
f. Outliers **should*** be excluded from the data only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process. As each data point is collected, it **should*** be compared to previous data, because such comparison can help identify unusual measurements that require investigation or further statistical evaluation.	7.1	7.1.4, ¶ 4
g. As they apply to data analysis and statistical treatment activities, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	7.7	7.2, ¶ 2
Dose Calculations		
a. Except where mandated otherwise (e.g., compliance with 40 CFR Part 61), the assessment models selected for all environmental dose assessments **should*** appropriately characterize the physical and environmental situation encountered. The information used in dose assessments **should*** be as accurate and realistic as possible.	8.1.1	4.0, ¶ 2 8.1, ¶ 1
b. Complete documentation of models, input data, and computer programs **should*** be provided in a manner that supports the annual site environmental report or other application.	8.1.1	8.3, entire section

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
c. Default values used in model applications **should*** be documented and evaluated to determine appropriateness to the specific modeling situation.	8.1.2	4.0, ¶ 3 8.3.2, ¶ 3
d. When performing human foodchain assessments, a complete set of human exposure pathways **should*** be considered, consistent with current methods, and **should*** be documented supporting the site Environmental Monitoring Plan.	8.1.2	H 5.1, ¶ 4 and 5 8.2, ¶ 5
e. Surface- and groundwater modeling **should*** be conducted as necessary to conform with the applicable requirements of the state government and the regional office of the EPA.	8.1.2	5.1, ¶ 5
f. The general quality assurance program provisions of Chapter 10 of this guide **should*** be followed as they apply to performing calculations that assess dose impacts.	8.7	8.4
Records and Reports		
a. DOE officials and DOE Management and Operating Contractors **should*** identify and comply with the relevant reporting requirements.	9.0	9.0, entire section
b. Timely notification of occurrences and information involving DOE and its contractors **should*** be made to the appropriate DOE officials and to other responsible authorities.	9.0	9.0, ¶ 2
c. Auditable records relating to environmental surveillance and effluent monitoring **should*** be maintained. Calculations, computer programs, or other data handling **should*** be recorded or referenced.	9.0	9.0, ¶ 2 9.1, bullet 2

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
d. As they apply to records and reporting activities, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	9.3	9.2, last ¶
Quality Assurance		
a. A QA Plan **should*** be prepared and included as a section of the Environmental Monitoring Plan and **should*** cover the monitoring activities at each site, consistent with applicable elements of the 18-element format in ANSI/ASME NQA-1.	10.0	10.1
b. Periodic audits **should*** be performed to verify compliance with operational procedures, QC procedures, and all aspects of the QA program.	10.1.2	10.3.1 10.4
c. Audits **should*** be performed independently in accordance with written procedures or checklists by personnel who do not have direct responsibility for performing the activities being audited (i.e., supervisors cannot audit their own facilities).	10.1.2	10.4
d. Audit results **should*** be documented and reported to and reviewed by responsible management. Follow-up action **should*** be taken where indicated.	10.1.2	10.4
e. The elements of a QA program **should*** be derived from the 18 criteria in ANSI/ASME NQA-1 and those stipulated in 10 CFR Part 50.	10.1.3	10.1

HISS EMP Summary Matrix

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
f.	Radiation measuring equipment, including portable instruments, environmental dosimeters, in situ monitoring equipment, and laboratory instruments, **should*** be calibrated with standards traceable to NIST calibration standards.	10.3.2	10.6

APPENDIX B

Comparison of the Scope of Environmental Monitoring at HISS (1991 Versus 1992)

APPENDIX B

HAZELWOOD ENVIRONMENTAL MONITORING

	1991 FREQUENCY	1991 LOCATIONS	1991 ANALYSES/YR* or MEASUREMENTS/YR	1992 FREQUENCY	1992 LOCATIONS	1992 ANALYSES/YR* or MEASUREMENTS/YR	RATIONALE (EMP SECTION)
GROUNDWATER SAMPLING							
RADIOLOGICAL PARAMETERS*		11	212		4/6	68	
Ra-226	Quarterly			Semiann/Annual			5.4.2
Th-230	Quarterly			Semiann/Annual			
Total uranium	Quarterly			Semiann/Annual			
CHEMICAL PARAMETERS		11	136		-	-	
TOX	Quarterly			-			5.4.3
TOC	Quarterly			-			
GEOLOGICAL PARAMETERS		13	676		13	52	
Water Level Measurements	Weekly			Quarterly	(Plus 3 automatic well records)		5.4.2
SURFACE WATER SAMPLING							
RADIOLOGICAL PARAMETERS		4	76		4	40	
Ra-226	Quarterly			Semiannually			5.5.2
Th-230	Quarterly			Semiannually			
Isotopic uranium	Quarterly			Semiannually			
SEDIMENT SAMPLING							
RADIOLOGICAL PARAMETERS		4	76		4	40	
Ra-226	Quarterly			Semiannually			5.5.2
Th-230	Quarterly			Semiannually			
Isotopic uranium	Quarterly			Semiannually			
FIELD MONITORING							
PARAMETERS		12	48		10 (2 each)	40	
Gamma radiation	Quarterly			Semiannually			5.2.3
RADON MONITORING							
PARAMETERS		12	48		11	44	
Radon + daughters	Quarterly			Quarterly			5.3.2

*Includes QC samples. Does not include 6 sampling locations shared by HISS and SLAPS. These are included in SLAPS EMP table.

DOE/OR/21949-305

Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-91OR21949

ENVIRONMENTAL MONITORING PLAN FOR THE HAZELWOOD INTERIM STORAGE SITE

Hazelwood, Missouri

November 1991

Bechtel National, Inc.

0189-0260.8