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FUSRAP TECHNICAL MEMORANDUM

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From: James C. McCague, Project Engineering Manager - FUSRAP
Subject: Environmental Surveillance Results for 1995 for the Hazelwood Interim Storage Site

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SUMMARY

This memorandum presents and interprets analytical results and measurements obtained as part of the 1995 environmental surveillance program for the Hazelwood Interim Storage Site (HISS) under the Formerly Utilized Sites Remedial Action Program (FUSRAP). The discussion provides a comparative analysis of average historical background conditions and applicable regulatory criteria to the 1995 results reported for external gamma radiation and for samples from the media investigated (air, surface water, sediment, groundwater, and stormwater).

Results from the 1995 environmental surveillance program at HISS indicate that, with the exception of thorium-230 in streambed sediment, applicable U.S. Department of Energy (DOE) guidelines were not exceeded for any measured parameter or for any dose calculated for potentially exposed members of the general public.

In the absence of sediment guidelines, DOE soil guidelines serve as a standard of comparison for data obtained from streambed sediment; two samples from downstream locations contained concentrations of thorium-230 that exceeded DOE soil guidelines. All stormwater sample results were in compliance with permit-specified limits.

1.0 INTRODUCTION

HISS occupies the eastern half of the property located at 9150 to 9200 Latty Avenue in northern St. Louis County, within the city limits of Hazelwood, Missouri. The western half of the property is occupied by Futura Coatings, a private industry. Hazelwood is approximately 25 km northwest of downtown St. Louis, and 1.6 km north of the Lambert-St. Louis International Airport (Figure 1). HISS is situated on approximately 2.2 ha and currently includes access roads, two interim storage piles, a utility building, a vehicle decontamination facility, and three office trailers (DOE 1987). In addition, in October 1995 a mobile laboratory began operation at the site. The mobile laboratory consists of a sample preparation trailer and laboratory trailer and is used for performing gamma and alpha spectroscopic analysis of samples, facilitating FUSRAP characterization and remedial action being conducted in the St. Louis area.

At HISS, radioactively contaminated materials are present in below-grade soils (at depths of up to 1.8 m below ground surface) and in two interim storage piles: the main storage pile and the secondary storage pile (Figure 2). The predominant radioactive contaminant associated with this material is thorium-230, with lower concentrations of radium-226 and uranium (in natural isotopic abundance, neither depleted nor enriched) (DOE 1994).

The main storage pile was formed in 1977 when the property owner prepared the western half of the property for commercial use. Approximately 9,900 m^3 of contaminated material were generated during these activities and were placed in the main storage pile (Figure 2). In addition to this material, 10,700 m^3 of contaminated soil, generated during a cleanup of the north end of HISS and the western end of Latty Ave. in 1985, were incorporated into this pile (BNI 1991).

The secondary pile at HISS was created in 1986 as a result of an offsite drainage improvement project conducted by the city of Berkeley. Approximately 3,500 m^3 of radioactively contaminated soils were excavated during this project and placed at HISS, north of the main storage pile (Figure 2) (DOE 1994).

1.1 Measured Parameters

The key elements of the 1995 environmental surveillance program at HISS were:

- measurement of external gamma radiation;
- measurement of radon gas concentrations in air (combined contributions from radon-220 and radon-222; see note below);
- monitoring of radon-222 flux (rate of radon-222 emission from the storage piles);
- sampling and analysis of surface water and streambed sediment for total uranium, radium-226, thorium-230, and thorium-232 (hereafter referred to collectively as radioactive constituents);
- sampling and analysis of groundwater for radioactive constituents and water quality parameters;
- monitoring of stormwater discharge quality in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements as issued by the Missouri Department of Natural Resources.

[Note: radon gas consists of two isotopes, radon-220 and radon-222. Radon-220, traditionally referred to as "thoron," is the immediate decay product of radium-224, originating from thorium-232. Radon-222 is the immediate decay product of radium-226, originating from uranium-238. In this document, radon-220 and radon-222 will be referred to as radon gas, unless isotopic specificity is required. Based on known site conditions, radon-220 is not a contaminant of concern at HISS and is therefore not quantified separately.]

1.2 Unit Conversions

The following tables provide the units of measurement and appropriate abbreviations used in this document. Conventional units for radioactivity are used in all discussions because the applicable regulatory guidelines are generally provided in these terms; Système Internationale (SI) units of measurement are used in the discussion of all other parameters. Unit conversions will be provided in the text only for water level information.

Units of Measurement and Conversion Factors - Radioactivity

Parameter	Conventional Units	SI Units	Conversion Factor
Dose	millirem (mrem)	milliSievert (mSv)	1 mrem = 0.01 mSv
Activity	picocurie (pCi)	becquerel (Bq)	1 pCi = 0.037 Bq

Units of Measurement and Conversion Factors - Mass, Length, Area, and Volume

Parameter	SI Units	English Units	Conversion Factor
Mass	gram (g)	ounce (oz)	1 g = 0.035 oz
	kilogram (kg)	pound (lb)	1 kg = 2.2046 lb
Length	centimeter (cm)	inch (in)	1 cm = 0.394 in
	meter (m)	foot (ft)	1 m = 3.281 ft
	kilometer (km)	mile (mi)	1 km = 0.621 mi
Area	hectare (ha)	acre	1 ha = 2.47 acres
Volume	milliliter (mL)	fluid ounce (fl. oz.)	1 mL = 0.0338 fl. oz.
	liter (L)	gallon (gal)	1 L = 0.264 gal
	cubic meter (m^3)	cubic yard (yd^3)	1 m^3 = 1.307 yd^3

2.0 REGULATORY GUIDELINES

The primary regulatory guidelines that are applicable to activities at FUSRAP sites are found in DOE Orders, Federal statutes and regulations, and state regulations. DOE Orders (5400 series and 5820.2A) were applicable to all FUSRAP sites in 1995, while the applicability of other Federal and state regulations varied from site to site. For HISS, the State of Missouri has adopted Federal standards applicable to contaminants in the medium being monitored. Regulatory criteria that were used to evaluate the results of the 1995 environmental surveillance program at HISS are summarized below, categorized by applicable media and parameter.

External Gamma Radiation and Air (Radon Gas and Airborne Particulates)

Applicable regulatory criteria for evaluating the calculated maximum doses from external gamma radiation and inhalation of radioactive particulates, and the measured concentrations of radon gas are as follows:

- Clean Air Act

  Section 112 of the Clean Air Act authorized the Environmental Protection Agency (EPA) to promulgate the National Emission Standards for Hazardous Air Pollutants (NESHAPs), which is applicable at HISS under Subpart H (for nonradon, radioactive constituents) and Subpart Q (for radon emissions). Compliance with Subpart H is verified by applying the EPA-approved CAP88-PC model (EPA 1992a). Compliance with Subpart Q is verified by annual monitoring of the piles for radon-222 flux.

- DOE Order 5400.5

  Dose limits for members of the public are presented in this DOE Order. The primary dose limit is expressed as an effective dose equivalent of 100 mrem above background in a year from all sources. External gamma radiation dose and the calculated doses from airborne particulate releases are included in the calculation of the effective dose equivalent total.

  DOE limits for radon concentrations in air are also presented in this Order. The limits for radon-220 and radon-222 concentrations in air are both 3.0 pCi/L above background concentrations. Based on known site contaminants, radon-220 is not a contaminant of concern at HISS.

Summary of Radiological Standards and Guidelines
- External Gamma Radiation and Air -

Radioactive Parameter	DOE Order 5400.5 [a]	Federal Standard or Guideline
Radon-222 flux	---	20 $pCi/m^2/s$ [b]
Radon-222	3.0 pCi/L	4 pCi/L [c]
Radionuclide Emissions (airborne particulates and radioactive gases excluding radon-222 and radon-220)	10 mrem/yr	10 mrem/yr [b]
Effective Dose Equivalent (total contribution from all sources [d])	100 mrem/yr	---

[a] *Guidelines provided in the DOE Order are above background concentrations or exposure rates.*

[b] *Federal (EPA) Standard from 40 CFR, Part 61.*

[c] *EPA action level for radon concentration in homes (reference EPA 400-R-92-011).*

[d] *Contributing sources at HISS consist of external gamma radiation exposure, radionuclide emissions listed above, and ingested radionuclides in water and soil/sediment (listed in the following table).*

-- *No existing standard.*

Surface Water, Sediment, and Groundwater - Radioactive Parameters

Applicable regulatory criteria for evaluating the measured concentrations of radionuclides in sediment, surface water, and groundwater at HISS are as follows:

- DOE Order 5400.5

  DOE Order 5400.5 states that the guideline for residual concentrations of radium-226, radium-228, thorium-230, and thorium-232 in soil is 5 pCi/g above background for an individual isotope, averaged over the first 15 cm of soil below the surface. Because there are no cleanup standards for streambed sediment, the residual soil cleanup criterion of 5 pCi/g is used to provide a basis for evaluation of analytical results for sediment.

  The site-specific soil cleanup criterion for the St. Louis Sites for uranium-238 (50 pCi/g; DOE 1990) is used to evaluate analytical results for uranium in sediment. Because the uranium is present in natural isotopic abundance, uranium-238 represents approximately one-half of the radioactivity of total uranium (the other half of the activity resulting from uranium-234 and a very small percentage of uranium-235). Consequently, the total uranium concentration would be approximately double the uranium-238 concentration, and an equivalent soil guideline for total uranium would be double the uranium-238 guideline, or 100 pCi/g. Sediment samples are analyzed for total uranium, and they are subsequently compared to this 100 pCi/g guideline. The soil guidelines are health-based values that are established based on future use scenarios, such as farming and grazing livestock.

  For mixtures of radionuclides, the Order prescribes that the data be evaluated by the sum-of-the-ratios. By this method, the above-background concentration of each of the radioisotopes (radium-226 or thorium-230, whichever is greater; thorium-232 or radium-228, whichever is greater; and total uranium) is divided by the respective criterion, and the ratios are summed. If the result is greater than 1, the mixture of radionuclides fails the sum-of-the-ratios test and is considered to exceed the soil guidelines.

  DOE derived concentration guides (DCGs) for water are also presented in this Order and were used to evaluate historical and current analytical data at HISS. The DCG for each radionuclide represents the concentration that would result in a dose of 100 mrem during a year, conservatively calculated for continuous exposure conditions.

Summary of Radiological Standards and Guidelines - Water and Sediment

Radioactive Parameter	DOE DCG [a] for Water [b]	DOE Soil Cleanup Criterion [c,d]
Thorium-230	300 pCi/L	5 pCi/g
Thorium-232	50 pCi/L	5 pCi/g
Uranium-238	600 pCi/L	50 pCi/g
Total Uranium	600 pCi/L [e]	100 pCi/g [f]
Radium-226	100 pCi/L	5 pCi/g
Radium-228	100 pCi/L	5 pCi/g

[a] *DOE Derived Concentration Guide (DOE Order 5400.5).*

[b] *Surface water and groundwater (non-drinking water values); represent concentrations above background.*

[c] *Above background concentration in soil, averaged over the topmost 15 cm of soil.*

[d] *In the absence of standards for sediment, the DOE residual soil cleanup criteria for radium and thorium, and the site-specific criterion for uranium (DOE 1990) are used to provide a basis for evaluation of analytical results for sediment. If a mixture of the radionuclides is present, then the sum of the ratios of the concentration of each isotope (radium-226 or thorium-230, whichever is greater; radium-228 or thorium-232, whichever is greater; and uranium) to the allowable limit must be less than one.*

[e] *This guideline applies for total uranium in natural isotopic abundance (present at HISS).*

[f] *Total uranium concentration is approximated as two times the uranium-238 concentration when uranium is in natural isotopic abundance; consequently, the approximate soil guideline for total uranium is two times the guideline for uranium-238.*

Groundwater - Chemical Parameters

Applicable regulatory criteria for evaluating the measured concentrations of chemical parameters in groundwater at HISS are as follows:

- Safe Drinking Water Act (SDWA)

  SDWA is the primary Federal regulation applicable to the operation of a public water system and the development of drinking water quality standards. These regulations, found in 40 Code of Federal Regulations (CFR) Part 141, set maximum permissible levels of organic, inorganic, and microbial contaminants in drinking water by specifying the maximum contaminant level (MCL) for each. Although the groundwater in the vicinity of HISS is not used to provide a public drinking water supply, the SDWA MCLs were obtained from the EPA *Drinking Water Regulations and Health Advisories* (EPA 1994) and used to provide a basis of comparison for chemical (groundwater quality) analytical data at HISS. The MCLs are provided in the applicable data tables of this document.

Stormwater - Chemical and Radioactive Parameters

- Clean Water Act - National Pollutant Discharge Elimination System

  Effective April 28, 1995, the Missouri Department of Natural Resources, under its state implemented National Pollutant Discharge Elimination System (NPDES) program,

issued to DOE a revised stormwater permit for HISS which stipulates requirements for stormwater monitoring, effluent limitations, and sampling and reporting frequencies. The revised permit is essentially the same as the previous version, requiring daily monitoring of flow and rainfall, monthly sampling of stormwater runoff for settleable solids, and quarterly sampling of runoff for radioactive constituents, total organic halides, and total organic carbon. Quarterly sampling at the two HISS outfalls, as specified in the revised permit, is to be conducted in the months of March, June, September, and December. Samples are not collected during months lacking adequate rainfall to produce flow through either of the outfalls.

DOE evaluates stormwater quality by comparison of sample results to DOE DCGs for radioactive constituents and to permit effluent limitations for settleable solids (1.5 mL/L/h daily maximum and 1.0 mL/L/h monthly average) and pH (6.0 to 9.0).

3.0 SAMPLING LOCATIONS AND RATIONALE

At HISS, radioactive constituents are present in below-grade soils and in the two interim storage piles. Exposure of members of the public to radioactivity at HISS is unlikely due to site access restrictions (e.g., fences) and engineering controls; however, potential pathways include direct exposure to external gamma radiation; inhalation of air containing radon or radioactively contaminated particulates; and contact with, or ingestion of, contaminated surface water, streambed sediments, groundwater, or stormwater. The environmental surveillance program at HISS has been developed to provide surveillance of these potential exposure routes through periodic sampling and analysis of selected media for radioactive and chemical constituents. Figures 1, 2, 3 and 4 present the sampling locations and media included in the HISS environmental surveillance program. A summary of the program is provided in Table 1.

Measurement of external gamma radiation is conducted at fenceline locations surrounding HISS (Figure 2) to assess the maximum hypothetical exposure to the public. Measurement of radon concentrations in air is conducted at the same fenceline locations. Two offsite locations are used to determine the background external gamma radiation and radon concentration (Figure 1). Radon-222 flux results are obtained at discrete grid intersections on the surface of the main and secondary storage piles (Figure 4) to determine the rate at which radon is emitted from a specific area of the pile surface.

Surface water and streambed sediment samples are collected at sampling locations located both upstream and downstream of the site (Figures 1 and 3) and are analyzed for radioactive constituents.

Water level measurements and groundwater samples obtained from monitoring wells allow the assessment of groundwater flow patterns as well as groundwater quality in the immediate vicinity of the site. Groundwater monitoring wells are located inside the property boundary, along the fenceline, and at offsite locations north of Latty Avenue and south of Banshee Road (Figures 1 and 2). Water level data are collected from all 19 monitoring wells. Groundwater samples are obtained semiannually from a total of six monitoring wells situated radially about the area of contamination on the HISS/Futura property. Samples are analyzed semiannually for radioactive constituents and annually for water quality (chemical and physical) parameters.

Stormwater outfall sampling locations (Figure 2) are located on the northern and southern portions of HISS and aid in the evaluation of point source surface runoff.

4.0 SURVEILLANCE METHODOLOGY

Under the HISS environmental surveillance program, standard analytical methods approved and published by EPA and the American Society for Testing and Materials (ASTM) are used for chemical (i.e., all nonradiogical) analyses. The laboratories conducting the radiological analyses adhere to EPA-approved methods and to procedures developed by the Environmental Measurements Laboratory (EML) and ASTM. The specific analytical methods and the sampling locations at HISS are summarized in Table 2.

All 1995 environmental surveillance activities at HISS were conducted in accordance with the FUSRAP *Environmental Monitoring Plan* (BNI 1995a) and the instruction guides (IGs) listed in the following table. The IGs are based on guidelines provided in *RCRA Ground Water Monitoring: Draft Technical Guidance* (EPA 1992b), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846, EPA 1992c), and *A Compendium of Superfund Field Operations Methods* (EPA 1987).

FUSRAP Instruction Guides Used for Environmental Surveillance Activities

Document Number	Document Title
191-IG-007	IG for Meteorological and Water Level Measurements
191-IG-011	IG for Decontamination of Field Sampling Equipment at FUSRAP Sites
191-IG-028	IG for Surface Water and Sediment Sampling Activities
191-IG-029	IG for Radon/Thoron and TETLD Exchange
191-IG-033	IG for Groundwater Sampling Activities

5.0 ANALYTICAL DATA AND INTERPRETATION OF RESULTS

This section presents the data and interpretation of results for the environmental surveillance program at HISS. Data for 1995 are presented in Tables 3 through 12.

Note that in data tables containing analyses for radioactive constituents, some results may be expressed as negative numbers. This phenomenon occurs if the average background activity of the laboratory counting instrument exceeds the measured sample activity. In such cases, when this instrument background activity is subtracted from the sample activity, a negative number results. For the purposes of interpretation, all values below the baseline minimum detectable activity (MDA) are interpreted as having an unknown value between zero and the MDA. Such a value will be referred to as a nondetect in the text discussion.

For direct comparison of analytical results to the DOE DCGs, average background radioactivity in surface water, sediment, and groundwater is subtracted from the 1995 results. The reported results and the background corrected results are both presented in the data tables; however, for simplicity, discussion in the text presents the analytical result (background not subtracted) and calls out the above-background concentration only if the measured concentration is near the DCG. All figures displaying results present actual analytical data.

Average historical background concentration for each sampled analyte is determined from background sampling results from 1992 to 1995, unless otherwise noted. Subtracting the calculated average background from the sampling results for 1995 then gives an estimate of the above-background concentration of the measured constituent at each location. When background is subtracted from the sampling result, it is possible that a negative number will be obtained, much the same as a negative value may be obtained when the laboratory subtracts instrument background from a sample measurement. A negative number will be considered indistinguishable from background.

The most precise analytical method for analysis of total uranium yields results in µg/L and µg/g for water and sediment samples, respectively. To allow direct comparison of results to the DCGs and soil guidelines, the data must be converted to pCi/L and pCi/g, as appropriate. The specific activity for total uranium in its natural isotopic abundance (uranium that is neither depleted nor enriched) is 0.677 pCi/µg (BNI 1995b), which is used as the conversion factor to convert the data to pCi/L or pCi/g, as appropriate. Only the converted data are provided in the tables and text of this document.

5.1 External Gamma Radiation

External gamma radiation dose rates are measured using tissue-equivalent thermoluminescent dosimeters (TETLDs) in place at HISS continuously throughout the year. Each TETLD measures a

cumulative dose, which, when divided by the period of exposure, yields the external gamma radiation dose rate at that location. Typically, one set of TETLDs at each monitoring location is exposed for six months to provide an early indication of dose rates. Another set is exposed for the entire year, and these results are evaluated to determine the annual dose. Due to data quality concerns, the results for the TETLDs exposed at HISS for the entire calendar year are not being presented or used in the calculation of external gamma radiation dose rate. Instead, for this year only, the six month data has been presented and used. The site conditions during the first six months (during which the TETLDs were exposed) were not different from the conditions during the last six months, and consequently the six month TETLD results are representative of typical site conditions.

TETLD results for external gamma radiation dose rates in 1995 (both raw data and data corrected for shelter/absorption and background) are summarized in Table 3. TETLD surveillance locations are shown in Figures 1 and 2.

After the external gamma radiation dose data are corrected for shelter/absorption, normalized to one year's exposure, and corrected for background, these data are used to calculate the external gamma radiation dose rate to a hypothetical maximally exposed individual. The data from the side of the site displaying the highest radiation readings (i.e., locations 1, 2, 5, and 7) are averaged and the external gamma dose rates at the distances to individuals at the nearest commercial/industrial facility are then determined. This maximum dose rate was calculated assuming a maximally exposed individual working 40 hours per week at Futura Coatings to the west of the site, with an average distance of approximately 46 m between the fenceline and the individual. Results of this calculation are expressed as a maximum dose rate to the individual (mrem/yr).

Based on 1995 external gamma radiation results, the dose to a hypothetical maximally exposed individual (worker) 46 m west of the fenceline would be 0.13 mrem/yr. This value is consistent with the calculated dose rate for 1994 (0.13 mrem/yr, BNI 1995c) and is well below the DOE guideline of 100 mrem/yr.

5.2 Radon-220 and Radon-222

Quarterly radon concentrations for 1995 are presented in Table 4; the corresponding surveillance locations are shown in Figures 1 and 2. Concentrations of radon gas are measured using RadTrack® detectors, which are designed to measure alpha particle emissions from both isotopes of radon (radon-220 and radon-222) and to collect passive, integrated data throughout the period of exposure. At the end of each quarter, the exposed detectors were replaced with unexposed detectors so that the cumulative concentration of radon gas in air at the site was measured continuously throughout the year. Based on the contaminants known to exist at HISS, radon-220 is not a contaminant of concern.

Results of the 1995 radon surveillance program indicated that radon gas concentrations at the HISS fenceline were consistently low, ranging from 0.3 pCi/L (detection limit) to 0.6 pCi/L. In most cases, results were at or below the detection limit, consistent with results obtained in previous years (BNI 1995d). The maximum concentration of radon (1.6 pCi/L) occurred at one of the offsite background locations, a remote location which was unaffected by site activities and conditions. All 1995 radon concentrations at HISS were well below the DOE limit of 3.0 pCi/L.

5.3 Radon-222 flux

Measurement of radon-222 flux provides an indication of the rate of radon-222 emission from a surface. Radon-222 flux results and monitoring locations for 1995 are presented in Table 5 and Figure 4, respectively. Radon-222 flux at HISS is measured using activated charcoal canisters placed at 7.6 m intervals across the surface of each pile for a 24-hour exposure period. Measurements from the secondary pile ranged from 0.05 to 0.65 pCi/m^2/s and from the main storage pile ranged from 0.09 to 1.76 pCi/m^2/s. As in previous years (BNI 1995d), these measurements were significantly less than the radon-222 flux standard of 20 pCi/m^2/s as specified in 40 CFR Part 61, Subpart Q of NESHAPs.

5.4 Airborne Particulate Dose

To determine the dose from airborne particulates, airborne particulate release rates are calculated using historical data for site soil contamination and a limited reservoir surface wind erosion model (EPA 1985). Airborne particulate release rates are then entered into the CAP88-PC computer model (EPA 1992a) to perform two calculations. The first calculation estimates the resultant hypothetical doses from airborne particulates to individuals at the distances to the nearest residence and to the nearest commercial/industrial facility. Hypothetical doses are then corrected for the occupancy of the nearest residence (conservatively assumed to be 24 hour/day; 500 m southeast of the site) and the nearest commercial/industrial facility (40 hour/week for 50 weeks a year; 46 m west of the site). The higher of these two hypothetical doses then becomes the hypothetical airborne particulate dose to the maximally exposed individual for the site. The second calculation estimates the hypothetical airborne particulate collective dose to the population within 80 km of the site. The second calculation also uses a population file (generated from county population densities) to determine numbers of people in circular grid sections fanning out to 80 km from the center of the site.

The first of the calculations indicates that the 1995 hypothetical airborne particulate dose to the maximally exposed individual was 1.3 mrem/yr, to a worker 46 m west of HISS. Consistent with the results obtained in 1994 (1.00 mrem/yr), this value is well below the 10 mrem/yr standard specified in 40 CFR, Part 61, Subpart H. The second calculation indicates that the hypothetical airborne particulate collective dose to the population within 80 km of the site was

0.149 person-rem/yr (or 149 person-mrem/yr), comparing favorably with the 1994 hypothetical dose of 0.114 person-rem/yr, or 114 person-mrem/yr (BNI 1995c).

5.5 Surface Water and Sediment

In 1995 during April and October, surface water and sediment samples were collected at six offsite locations (Figures 1 and 3), including one upstream (background) location. Surface water and sediment samples were analyzed for radium-226, thorium-230, thorium-232, and total uranium. The 1995 environmental surveillance analytical results for surface water and sediment samples are presented in Tables 6 and 7, respectively. The tables refer to the surface water and sediment sampling locations by their formal identification numbers (for example, SWSD002); text and figures refer to the locations by the last digit of the formal identifiers (for example, location 2).

Surface Water

Consistent with results from previous years (BNI 1995d), sample results for all analyzed radionuclides in surface water were well below the applicable DOE DCGs. Analytical results (inclusive of background) for 1995 are discussed below.

- Radium-226 results were generally indistinguishable from background, ranging from nondetect to a maximum of 0.67 pCi/L at location 2, the background location upstream from the site. Historical average background for radium-226 is 0.3 pCi/L.

- All measured thorium-230 surface water concentrations were well below (less than 2 percent of) the DOE DCG of 300 pCi/L above background. Downstream thorium-230 concentrations ranged from nondetect to a maximum of 5.20 pCi/L at location 5 in April. This maximum concentration is not consistent with historical results for surface water (Figure 5; measured results, background not subtracted) and is likely the result of localized disruption of sediment during sample collection. As the figure shows, thorium-230 concentrations are routinely very low in surface water.

- Thorium-232 concentrations were all nondetects, with a maximum MDA of 0.17 pCi/L. The DOE DCG for thorium-232 is 50 pCi/L.

- The downstream total uranium results ranged from 1.73 pCi/L at location 6 to 3.25 pCi/L in April at location 4. The downstream results were generally only slightly higher than the historical average for total uranium, 0.8 pCi/L, and all detected total uranium concentrations were less than 1 percent of the DOE DCG of 600 pCi/L.

Sediment

Because there are no standards for concentrations of radioactive constituents in streambed sediment, the DOE soil cleanup criteria for residual radioactivity, 5 pCi/g above background, is used to provide the basis for evaluation of sediment analytical results for each analyzed radium and thorium isotope. Total uranium concentrations in sediment are compared to the HISS site-specific DOE soil cleanup criterion for total uranium of 100 pCi/g above background concentrations (DOE 1990).

For all radionuclides analyzed in sediment, results were less than the soil cleanup criteria, with the exception of thorium-230 at two downstream locations, as described in greater detail below:

- The historical average thorium-230 background concentration is 1 pCi/g. Measured downstream concentrations of thorium-230 in sediment ranged from 1.30 pCi/g at location 6 to 12.70 pCi/g at location 5, which is located immediately downstream from the site. Sediment results were greater than the DOE soil cleanup guideline for thorium-230 at two downstream sample locations: Location 3, with an analytical result of 6.20 pCi/g; and location 5 with an analytical result of 12.70 pCi/g. Both of these locations have exhibited elevated concentrations of thorium-230 in the past, as displayed in Figure 6 (background not subtracted).

- Reported analytical results for thorium-232 downstream of the site ranged from 0.40 pCi/g at location 3 to 1.68 pCi/g at location 6. Historical background is 0.73 pCi/g. All of the thorium-232 results were below the DOE soil cleanup guideline of 5 pCi/g above background.

- Reported results of analysis for radium-226 from downstream locations ranged from nondetect to a maximum of 2.77 pCi/g at location 5. Historical average background is 1 pCi/g. All of the radium-226 results were below the DOE soil cleanup guideline of 5 pCi/g above background. Figure 7 displays the historical analytical data (background not subtracted) for all locations from 1992 to present.

- Total uranium measured results downstream of the site ranged from 1.83 pCi/g at locations 5 and 6 to a maximum of 2.67 pCi/g at location 4 in October. Total uranium concentrations downstream of the site only slightly exceeded the average historical background concentration of 2.0 pCi/g and were well below the HISS site-specific DOE soil cleanup criterion for total uranium of 100 pCi/g above background. Figure 8 graphically depicts the historical and current results for total uranium in sediment (background not subtracted).

- The DOE criterion for mixtures of radionuclides (sum-of-the-ratios) was exceeded in only those samples that also exceeded the individual isotopic criteria. All other mixtures were present at concentrations that met the criterion.

The sediment sampling results from 1992 through 1995 for thorium-230, radium-226, and total uranium are shown in Figures 6, 7 and 8. Spotty contamination is known to exist in Coldwater Creek and its tributaries (DOE 1993). Consistent with characterization information, concentrations of radium and thorium radioisotopes measured under the environmental surveillance program have occasionally exceeded the DOE soil cleanup criterion of 5 pCi/g. Fluctuations from one sampling period to another occur, which is consistent with the localized nature of the contamination. No increasing trend in concentrations of any of these constituents is apparent.

5.6 Groundwater

The locations of groundwater monitoring wells at HISS are shown in Figures 1 and 2. Background information, descriptions of activities performed under the groundwater surveillance program, and surveillance results are discussed below.

5.6.1 Groundwater Flow System

Natural System

The overburden at HISS consists of topsoil and fill material generally less than 1.8 m (6 ft) thick. The topsoil and fill overlie loess material, which consists of yellowish-brown silty clay and clayey silt and extends to a depth of approximately 6.1 m to 7.6 m (20 to 25 ft) across the site. Greenish to olive-gray clayey silt and silty clay lacustrine deposits underlie the loess material. The monitoring wells used for water level measurement for HISS/Futura are screened at depths ranging from 4.6 to 9.2 m (15 to 30 ft) primarily in the loess layer (BNI 1994).

Groundwater occurs at approximately 2.1 m (7 ft) below ground surface. Hydraulic conductivity tests conducted in monitoring wells in 1992 indicate that the average hydraulic conductivity of the upper zone [extending from approximately 1.8 to 7.6 m (6 to 20 ft) below ground surface] is 4.85×10^{-4} cm/s (1.59×10^{-5} ft/s).

Water Level Measurements

A total of 19 groundwater monitoring wells are included in the groundwater surveillance program for HISS/Futura. There are 15 wells on the HISS/Futura property and 4 wells offsite. During 1995, groundwater levels were measured monthly from January through September. In October, quarterly groundwater level measurements were initiated. Wells HISS13, HISS15, HISS16, HISS17S, HISS20S, and B53W20S (background) were used for groundwater sampling and analyses.

Depths to groundwater range from approximately 0.60 to 4.0 m (2 to 13 ft) below ground surface. Groundwater elevations ranged from approximately 153 m (HISS-19S) to 158 m

(HISS01) above sea level (503 to 518 ft above sea level)]. A representative four-year hydrograph for monitoring wells at HISS is presented in Figure 9 (data for HISS16 were used in the construction of the hydrograph).

The potentiometric surface map for the May water level measurements is plotted in Figure 10. The general groundwater flow pattern was radial, moving away from the site, and the hydraulic gradient was approximately 0.01, consistent with monitoring events of previous years (BNI 1995c). The radial flow pattern is most likely the result of preferential recharge through the shallow drainage ditch located along the western portion of the southern storage pile combined with the presence of surface water courses located to the west (Coldwater Creek), north, and south of the site (BNI 1994). Assuming a porosity of 0.2, the average linear groundwater velocity is approximately 0.2 m/day (0.07 ft/day). This velocity is not necessarily the rate at which a contaminant migrates, because contaminant-dependent transport factors such as retardation (caused by phenomena such as binding to clay particles) can significantly slow the rate of transport.

5.6.2 Groundwater Quality

Field Parameters

Table 8 presents a summary of field parameters collected during the environmental surveillance sampling in 1995 at HISS. Field parameters include temperature, pH, oxidation/reduction potential (Eh), specific conductance, dissolved oxygen, and turbidity.

Water Quality Data

Groundwater samples from site monitoring wells HISS13, HISS15, and HISS17S and from background well B53W20S were analyzed for standard water quality parameters. These water quality parameters include sodium, potassium, calcium, magnesium, calcium carbonate, calcium bicarbonate, alkalinity, sulfate, total phosphate, chloride, nitrate, and total dissolved solids. Water quality data for 1995 are presented in Table 9.

The hydrochemical nature of the groundwater sampled during the environmental surveillance program at HISS is presented in the trilinear Piper diagram in Figure 11. This diagram provides a graphical presentation of inorganic water analyses and allows the determination of inorganic hydrochemical type. Recently recharged water in many aquifers is typically dominated by a calcium bicarbonate hydrochemical type. This condition plots in the upper left-hand field of the diagram. Natural softening of groundwater via ion exchange with the soil or rock matrix (sodium for calcium) to a sodium bicarbonate hydrochemical type generally occurs with extended residence time and/or distance traveled in the aquifer (upper right-hand field of the diagram). Oldest waters are generally dominated by the sodium chloride type and plot in the lower right-hand field of the diagram. These waters represent stagnant or connate groundwater type.

After a background water type has been established for a specific area, comparisons of hydrochemical type can be made. These comparisons can lead to determination of the presence and possible source areas of contaminants entering the local groundwater regime.

At HISS, the groundwater water quality parameters plot, for the most part, in the upper left-hand portion of the diagram, in the calcium bicarbonate field, indicating recently recharged groundwater. Background groundwater quality is substantially the same as that at the site, indicating that the site has not adversely affected groundwater quality.

5.6.3 Groundwater - Radioactive Constituents

Groundwater samples analyzed for radioactive constituents were collected from five wells arranged radially about the area of contamination at the site and from offsite background monitoring well, B53W20S. Samples were analyzed for radium-226, thorium-230, thorium-232, and total uranium (Table 10), and results were consistent with those of previous years (BNI, 1995d). Historical background concentrations for the analytes were determined from data from well B53W20S over the period of record (1993 - 1995).

All groundwater results were well below the applicable DCGs.

- Radium-226 concentrations at HISS ranged from 0.15 pCi/L (HISS17S) to 1.56 pCi/L (HISS16). The historical background concentration is 0.15 pCi/L. All sample concentrations were less than 2 percent of the radium-226 DOE DCG (100 pCi/L).

- Thorium-230 concentrations ranged from nondetect to 0.67 pCi/L (HISS16). The average historical thorium-230 concentration is 0.1 pCi/L. All detected thorium-230 concentrations were well below the DOE DCG of 300 pCi/L.

- Thorium-232 was not detected in any HISS well (MDA of 0.22 pCi/L or less). The DCG is 50 pCi/L for this constituent.

- Total uranium concentrations ranged from 1.23 pCi/L (HISS15) to 27.06 pCi/L (HISS16). All detected total uranium concentrations in groundwater were less than 7 percent of the DOE DCG of 600 pCi/L. A comparison of historical analytical results for total uranium (background not subtracted) in each well sampled in 1995 is presented in Figure 12. This figure shows that well HISS16, immediately north of the site, has consistently exhibited elevated concentrations of total uranium. However, although elevated, the concentrations are significantly less than the DOE DCGs. Groundwater underlying the site is not a drinking water source.

5.7 Stormwater

With the exception of the storage piles, topography at the site is relatively flat; therefore, precipitation often ponds in a few isolated low areas onsite but eventually infiltrates into the ground or drains offsite by way of overland flow. At outfall 001 the overland flow from the northern two-thirds of HISS is directed to the underground storm sewer system located to the north along Latty Avenue. At outfall 002 the runoff from the remaining one-third of HISS is directed to a ditch located to the south, both of which drain into Coldwater Creek (Figures 2 and 3).

Stormwater samples were collected and submitted for analysis for radioactive and chemical constituents in accordance with the site NPDES permit in effect at the time. Note that the revised permit was issued effective April 28, 1995; consequently, sampling prior to receipt of the revised permit (January 13 and April 20) was conducted in accordance with the previous version of the permit. Samples were collected for analysis for radioactive parameters, total organic halides, and total organic carbon during January, April, and December; insufficient runoff was generated during September to perform the third quarter sampling. Samples for settleable solids analysis were collected monthly, to the extent that meteorological and field conditions allowed.

Consistent with all previous years, all sampled discharges were in compliance with permit-specified effluent limitations and applicable DOE DCGs (provided in Tables 11 and 12). Field data for pH and specific conductance and analytical data for chemical constituents are presented in Table 11, and results for radioactive constituents are presented in Table 12.

- Radium-226 concentrations for stormwater ranged from nondetect to 1.01 pCi/L. The results are less than 1 percent of the DOE DCG of 100 pCi/L.

- Thorium-230 concentrations ranged from 3.34 to 17.36 pCi/L and were less than the DOE DCG of 300 pCi/L (less than 6 percent).

- Total uranium concentrations in stormwater ranged from 2.32 to 16.18 pCi/L and were less than 3 percent of the 600 pCi/L DOE DCG.

- Results of settleable solids analysis for 1995 were all nondetects, consistently less than the permit limits of 1.5 mL/L/h (daily maximum) and 1.0 mL/L/h (monthly average).

- Measurements for pH ranged from 6.57 to 6.85, well within the permit specified range of 6.0 to 9.0.

6.0 CONCLUSIONS

A. External Gamma Radiation

The 1995 dose from direct gamma exposure at HISS to a hypothetical maximally exposed individual (worker) 46 m west of the fenceline would be 0.13 mrem/yr above background. This value is consistent with the 1994 calculated maximum dose of 0.13 mrem/yr above background.

B. Radon-220 and Radon-222

Results of the 1995 radon surveillance program indicate that the combined radon-220 and radon-222 concentrations at the site were consistently low (0.3 pCi/L to 0.6 pCi/L throughout the year) and, in most cases, were at or below the detection limit. Based on known site conditions, radon-220 is not a contaminant of concern at the site. All radon concentrations at HISS were well below the DOE limit for radon-222 of 3.0 pCi/L above background.

C. Radon-222 Flux

Radon-222 flux results at HISS in 1995 ranged from 0.09 to 1.76 $pCi/m^2/s$ at the main storage pile and 0.05 to 0.65 $pCi/m^2/s$ at the secondary pile. These results were well below the standard of 20 $pCi/m^2/s$ as specified in 40 CFR Part 61, Subpart Q of the National Emission Standards for Hazardous Air Pollutants (NESHAPs).

D. Airborne Particulate Dose

The 1995 hypothetical dose from inhalation of radioactively contaminated airborne particulates to a worker situated 46 m west of the site is 1.3 mrem/yr. This value is below the 10 mrem/yr standard specified in 40 CFR, Part 61, Subpart H of NESHAPs.

E. Cumulative Dose from External Gamma Radiation and Airborne Particulates

The cumulative dose from external gamma radiation and airborne particulates to an individual 46 m west of the fenceline is 1.4 mrem/yr. This value is below the 100 mrem/yr standard (from all sources). The hypothetical airborne particulate collective dose to the population within 80 km of the site was 0.149 person-rem/yr.

F. Surface Water

All 1995 surface water results for radium-226, thorium-230, thorium-232, and total uranium were less than 2 percent of DOE DCGs. Radium-226 ranged from nondetect to 0.67 pCi/L at the background location; thorium-230 concentrations ranged from nondetect to a maximum of 5.20 pCi/L; thorium-232 concentrations were all nondetects, with a maximum MDA of 0.17 pCi/L; and total uranium results ranged from 1.02 pCi/L at location 6 to 3.25 pCi/L at location 4.

G. Sediment

Because there are no standards for concentrations of radioactive constituents in sediment, the DOE residual soil cleanup criteria were used to provide a basis for evaluation of sediment analytical results.

All radium-226 (ranged from nondetect to 2.77 pCi/g), thorium-232 (ranged from 0.40 pCi/g to 1.68 pCi/g), and total uranium (ranged from 1.83 pCi/g to 2.67 pCi/g) concentrations were less than the soil cleanup criteria of 5, 5, and 100 pCi/g, respectively. The 1995 results for one constituent, thorium-230, exceeded the DOE soil cleanup criterion of 5 pCi/g (above background) at two sampling locations downstream of HISS. The highest thorium-230 concentration, 12.70 pCi/g, occurred immediately downstream at sampling location 5, consistent with results obtained in previous years.

H. Groundwater

All 1995 results of groundwater analyses for radioactive constituents radium-226, thorium-230, and thorium-232 were less than 2 percent of the DOE DCGs. Well HISS16 continued to exhibit elevated concentrations of uranium; however, the concentrations were well below (less than 4 percent of) the DCGs. Groundwater quality analyses indicate that the groundwater at HISS/Futura is of calcium bicarbonate hydrochemical type, characteristic of recently recharged groundwater. Background groundwater quality is substantially the same as that at HISS/Futura, indicating that contamination at the site has not adversely affected groundwater quality.

I. Stormwater

All 1995 results of stormwater analyses for radioactive constituents were less than applicable DOE DCGs. Results of chemical analyses of stormwater for 1995 indicate that no concentrations of settleable solids exceeded the NPDES permit requirement of 1.5 mL/L/h (daily maximum) or 1.0 mL/L/h (monthly average). Field measurements confirmed that pH was within the permit-specified range of 6.0 to 9.0.

7.0 REFERENCES

Bechtel Environmental, Inc. (BNI), 1991. *Input to St. Louis Feasibility Study, St. Louis, Missouri,* (unnumbered), Oak Ridge, Tenn. (April).

BNI, 1994. *1993 Groundwater Technical Bulletin for the Hazelwood Interim Storage Site,* 140-94-003, Oak Ridge, Tenn. (June).

BNI, 1995a. *Environmental Monitoring Plan* Appendix A1 (Hazelwood Interim Storage Site). Oak Ridge, Tenn. (draft).

BNI, 1995b. Committed Calculation "Normal Uranium - Specific Activity," 191-CV-005, rev. 2. (April 18).

BNI, 1995c. *Environmental Surveillance Results for 1994 for the Hazelwood Interim Storage Site*, FUSRAP Technical Memorandum 140-95-011, Oak Ridge, Tenn. (June).

Department of Energy (DOE), 1987. *Characterization Report for the Hazelwood Interim Storage Site*, DOE/OR/20722-141, Oak Ridge, Tenn. (August).

DOE, 1990. Memorandum from J. J. Fiore (Acting Director, Division of Eastern Area Programs, Office of Environmental Restoration) to L. K. Price (FSRD), "Uranium Cleanup Guidelines for St. Louis, Missouri, FUSRAP Sites," BNI CCN 072892 (November 6).

DOE, 1993. *Remedial Investigation Addendum Report for the St. Louis Site, St. Louis, Missouri*, DOE/OR/21950-132, Oak Ridge, Tenn. (March).

DOE, 1994. *Remedial Investigation Report for the St. Louis Site*, DOE/OR/21949-280, Oak Ridge, Tenn. (January).

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

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

EPA, 1992a. *Users Guide for Version 1.0, CAP88-PC,* EPA 402-B-92-001 (March).

EPA, 1992b. *RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530/R-93/001, Office of Solid Waste (November).

EPA, 1992c. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846 (September).

EPA, 1994. *Drinking Water Regulations and Health Advisories,* Office of Water (November).

Environmental Surveillance Results for 1995

Hazelwood Interim Storage Site

List of Figures

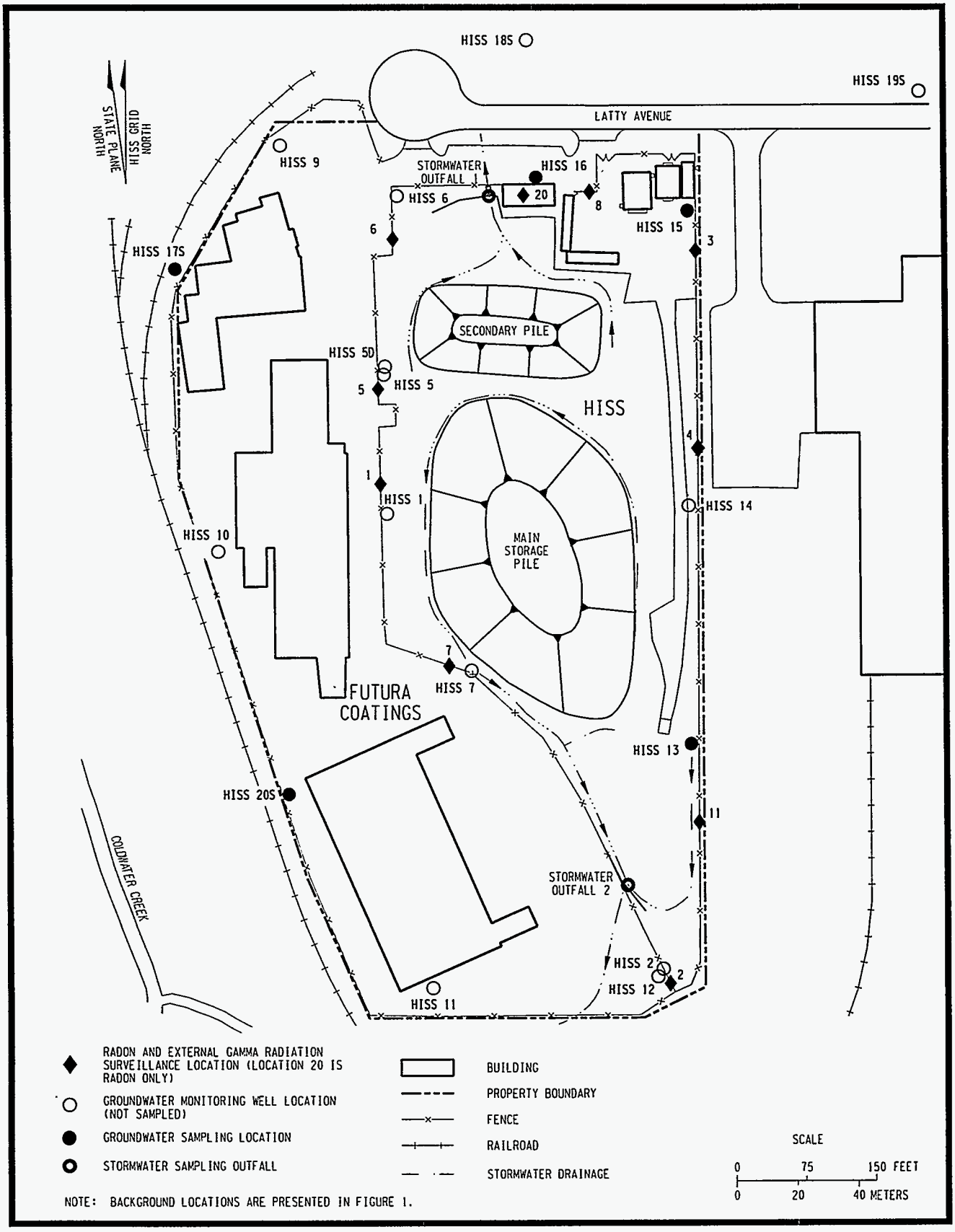

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Figure 2
Hazelwood Interim Storage Site Environmental Surveillance Locations External Gamma Radiation, Air (Radon), Groundwater, and Stormwater

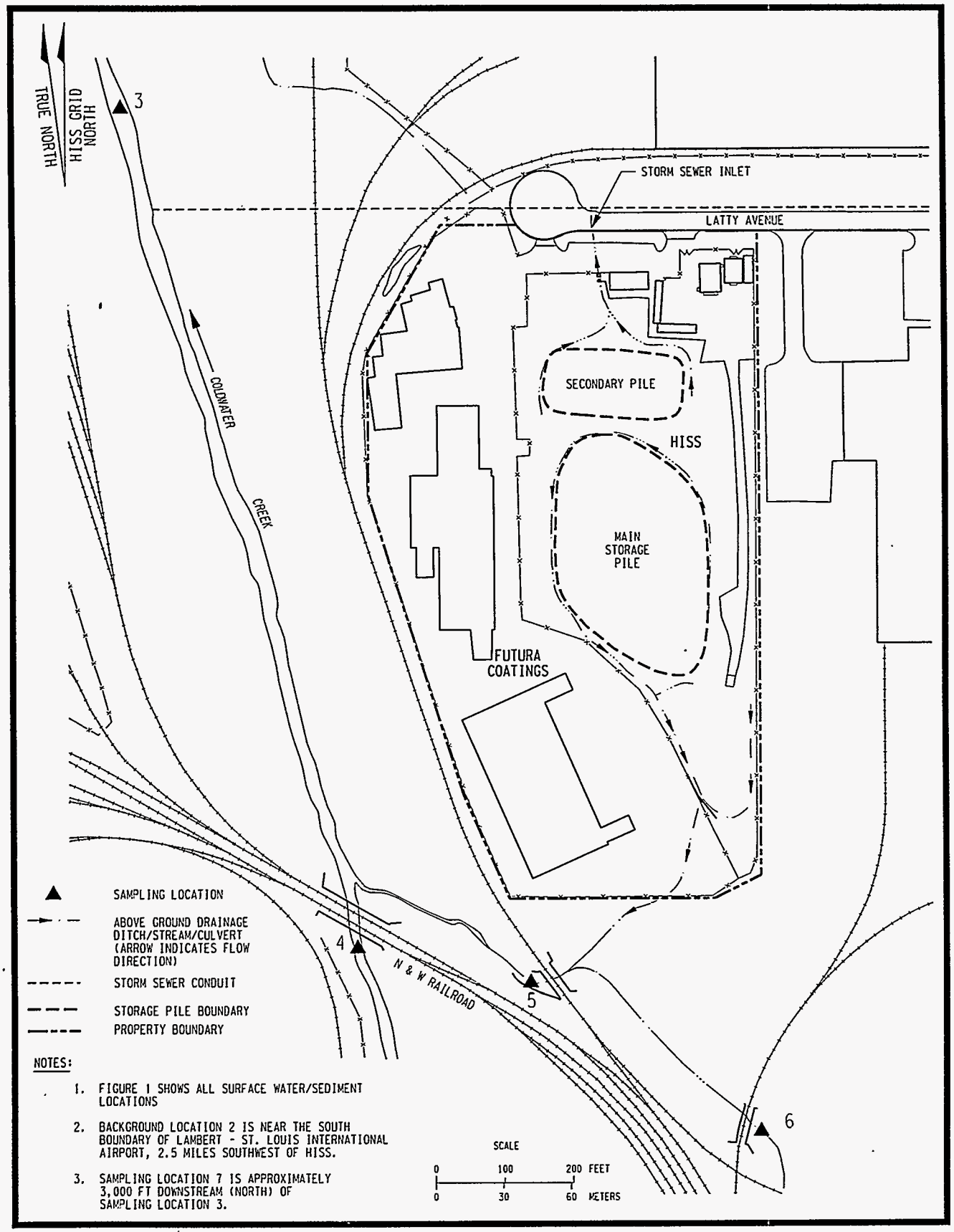

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Figure 3
Hazelwood Interim Storage Site Environmental Surveillance Locations
Surface Water and Sediment

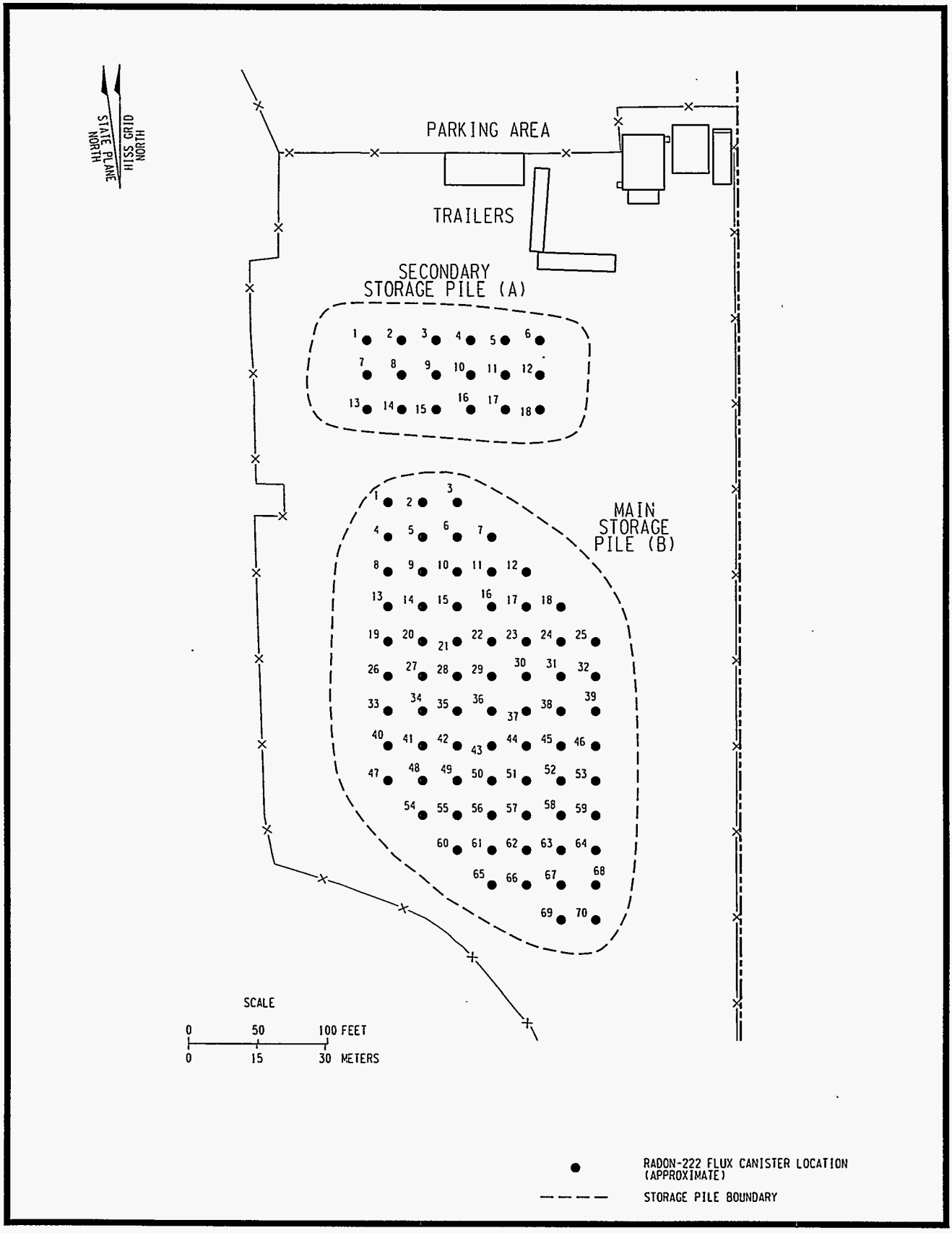

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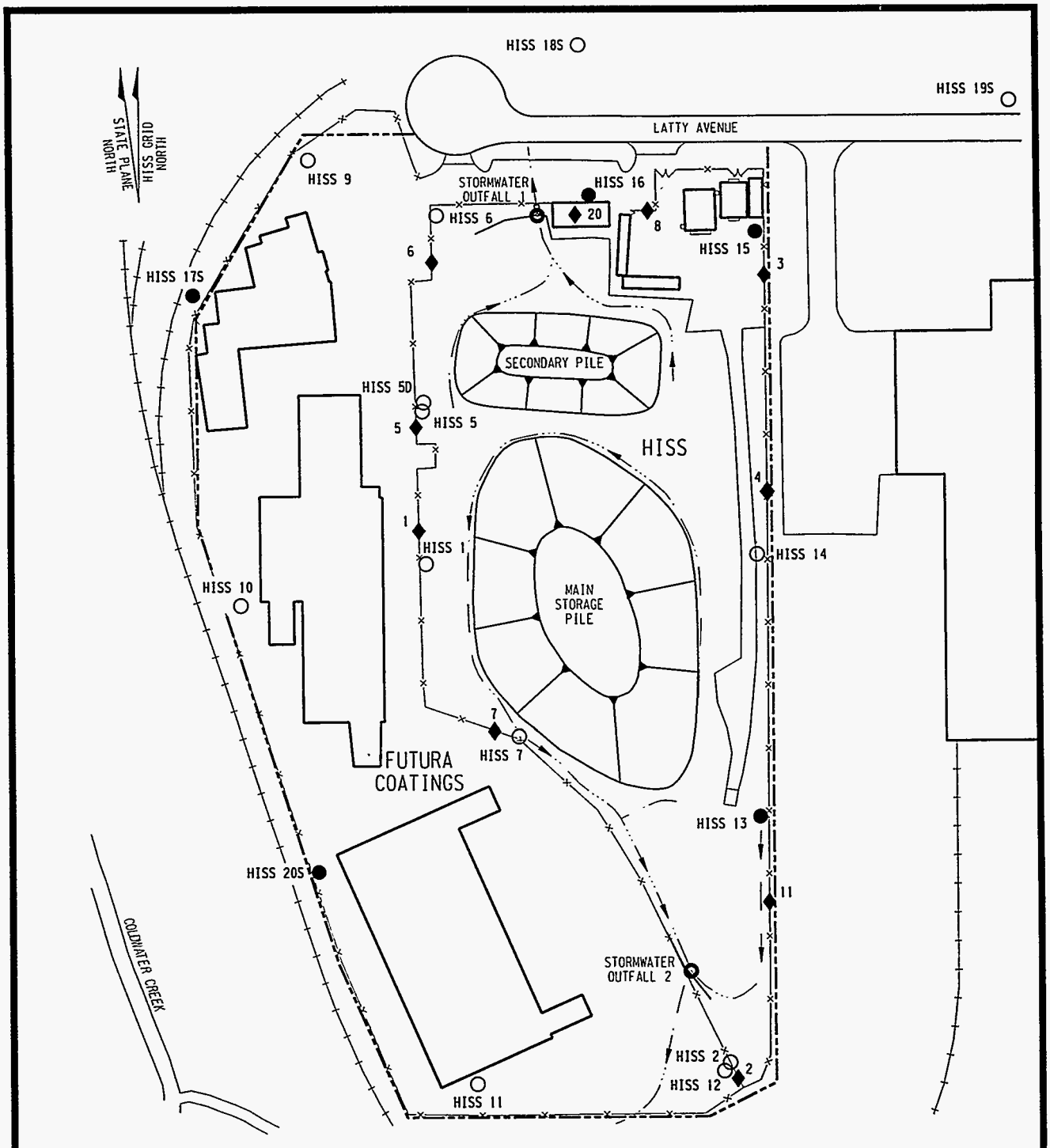
Figure 4
Hazelwood Interim Storage Site
Approximate Radon-222 Flux Monitoring Locations

Environmental Surveillance Results for 1995

Hazelwood Interim Storage Site

List of Figures


HISS 18S
HISS 19S
LATTY AVENUE
STATE PLANE NORTH
HISS GRID NORTH
HISS 9
STORMWATER OUTFALL 1
HISS 16
HISS 6
20
8
HISS 15
3
6
HISS 17S
SECONDARY PILE
HISS 5D
HISS 5
5
HISS
4
1
HISS 1
HISS 14
HISS 10
MAIN STORAGE PILE
7
HISS 7
FUTURA COATINGS
HISS 13
HISS 20S
11
COLDWATER CREEK
STORMWATER OUTFALL 2
HISS 2
2
HISS 12
HISS 11
RADON AND EXTERNAL GAMMA RADIATION SURVEILLANCE LOCATION (LOCATION 20 IS RADON ONLY)
GROUNDWATER MONITORING WELL LOCATION (NOT SAMPLED)
BUILDING
PROPERTY BOUNDARY
FENCE

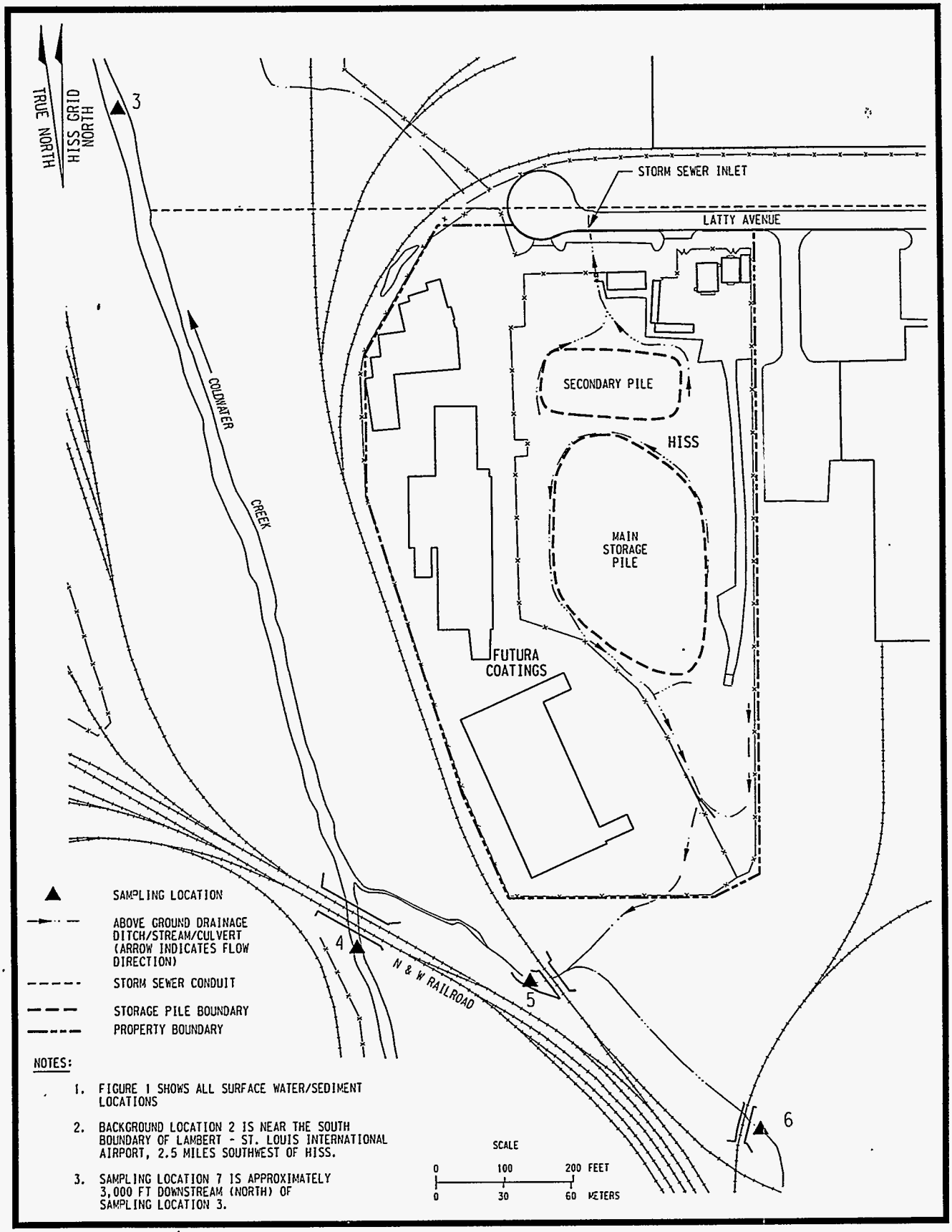


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Figure 3
Hazelwood Interim Storage Site Environmental Surveillance Locations
Surface Water and Sediment

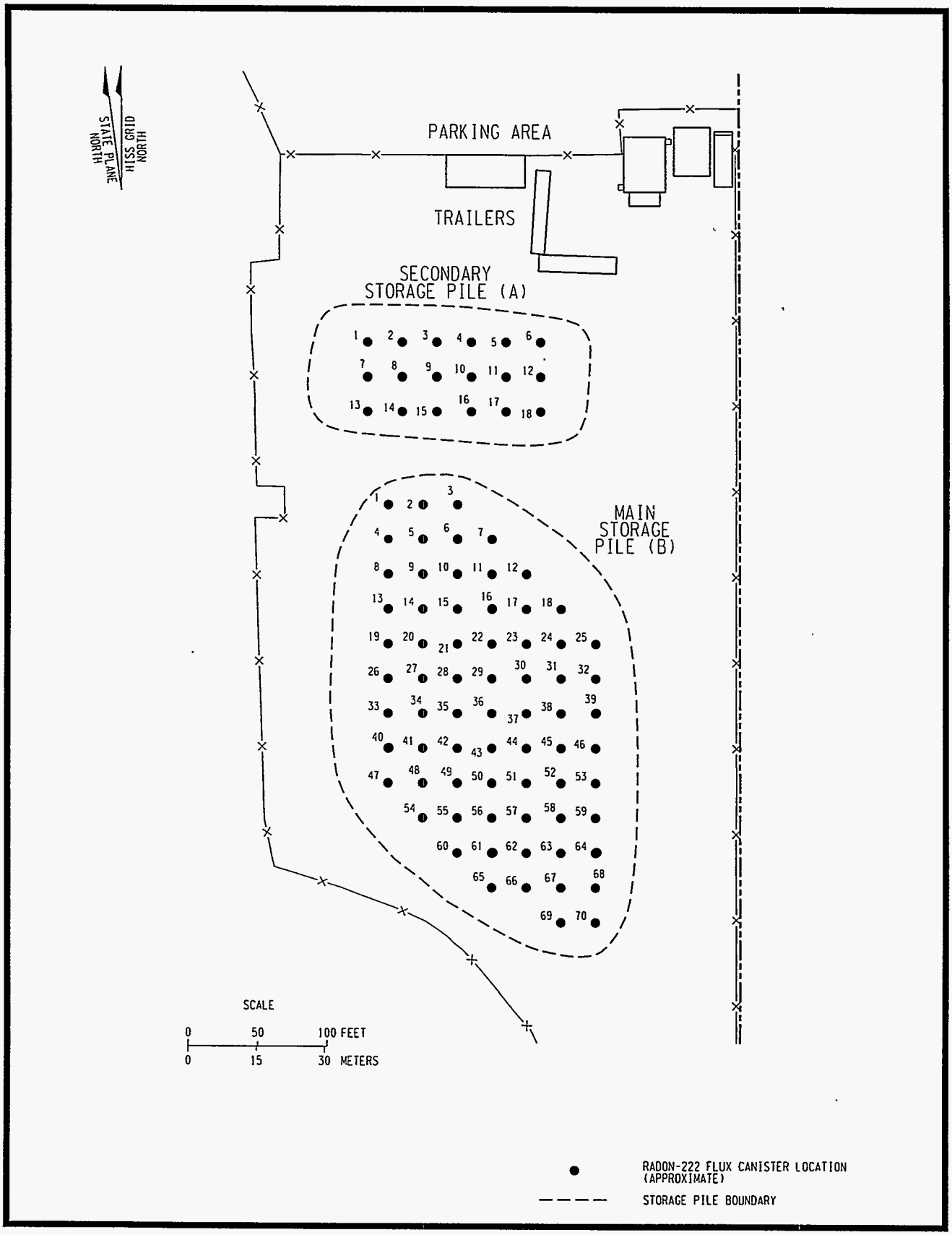

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Figure 4
Hazelwood Interim Storage Site
Approximate Radon-222 Flux Monitoring Locations

Environmental Surveillance Results for 1995

Hazelwood Interim Storage Site

List of Figures

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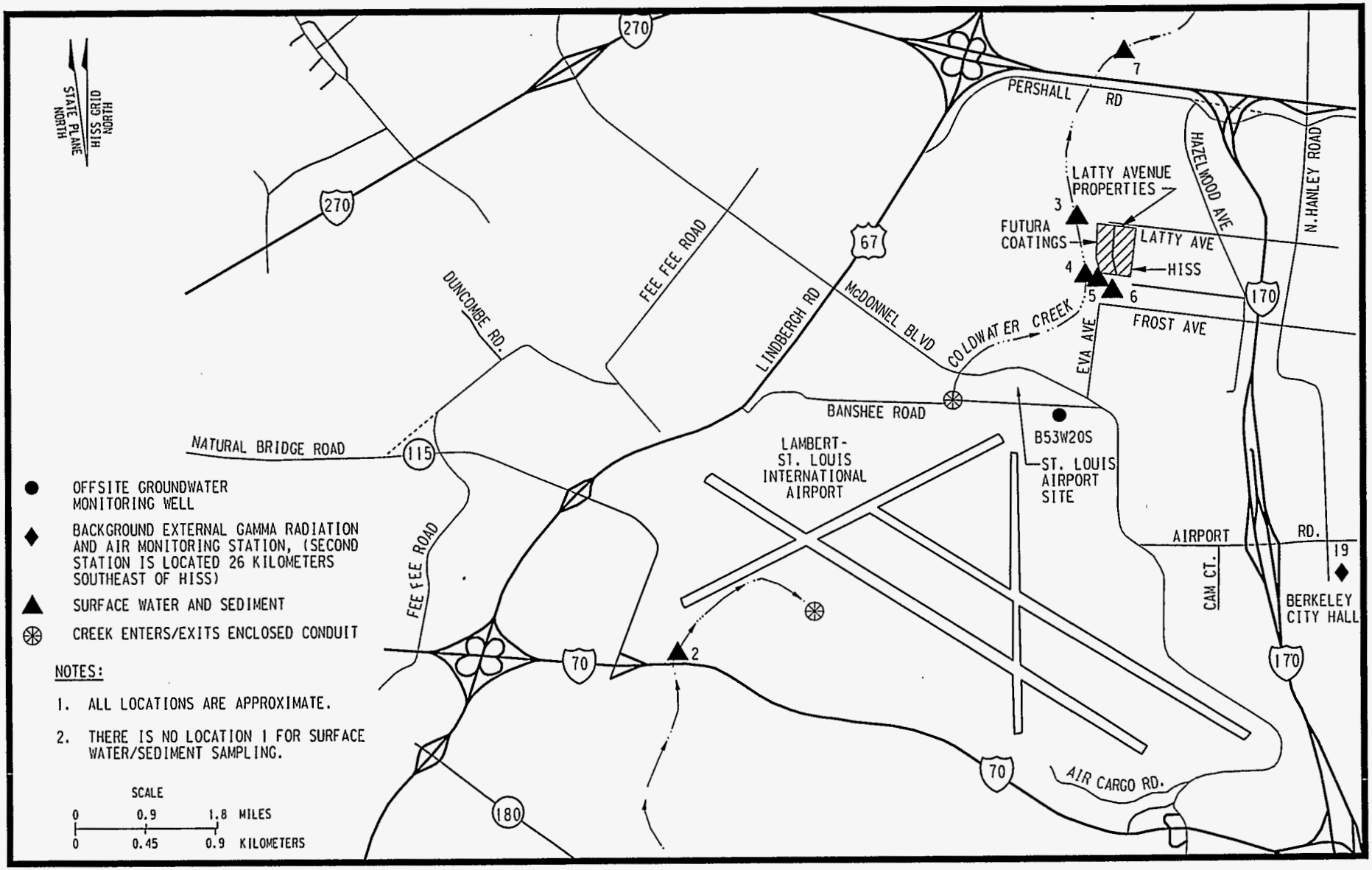

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Figure 1
Hazelwood Interim Storage Site Environmental Surveillance Locations
Offsite Air (Radon), External Gamma Radiation, Surface Water,
Sediment, and Groundwater

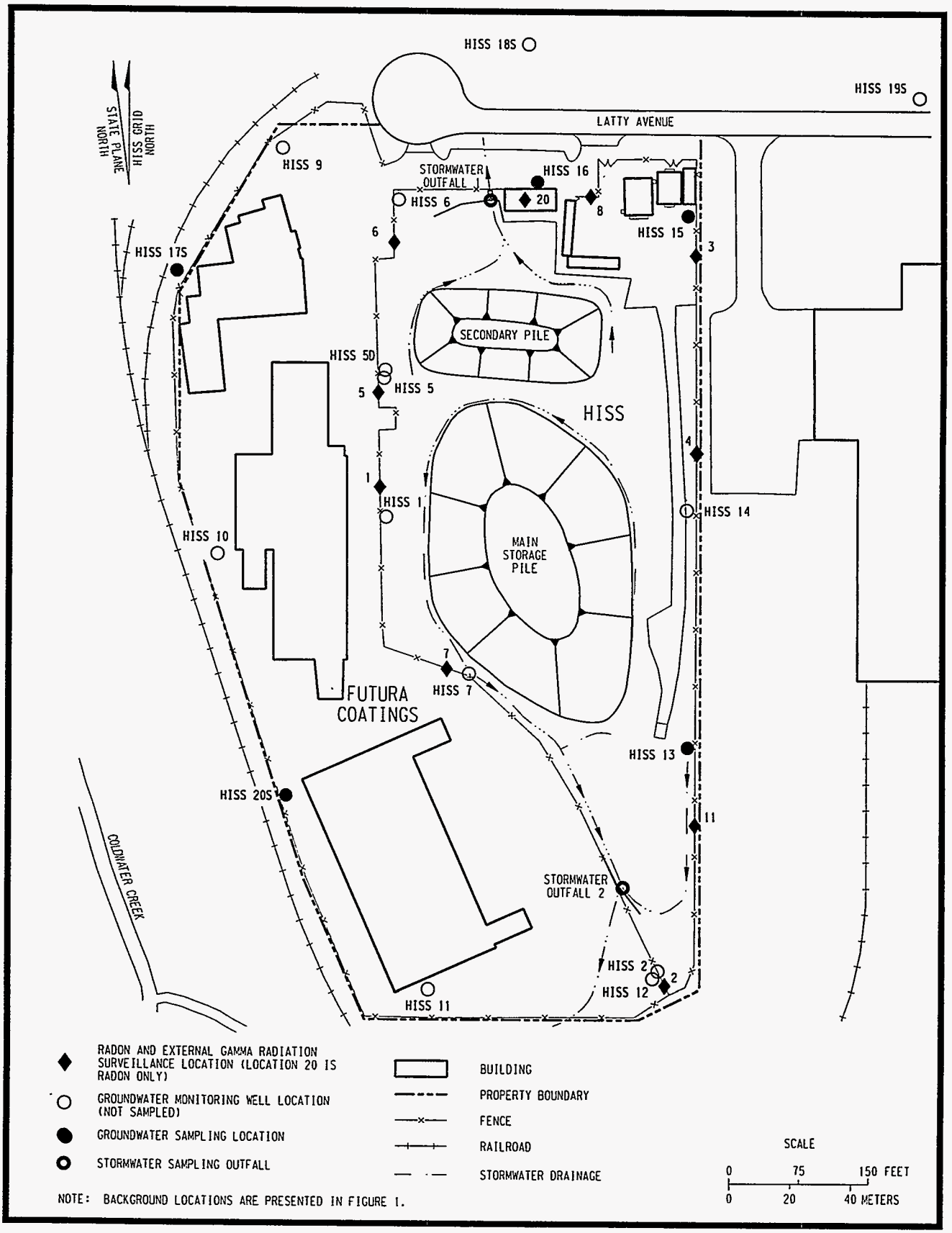

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Figure 2
Hazelwood Interim Storage Site Environmental Surveillance Locations
External Gamma Radiation, Air (Radon), Groundwater, and Stormwater

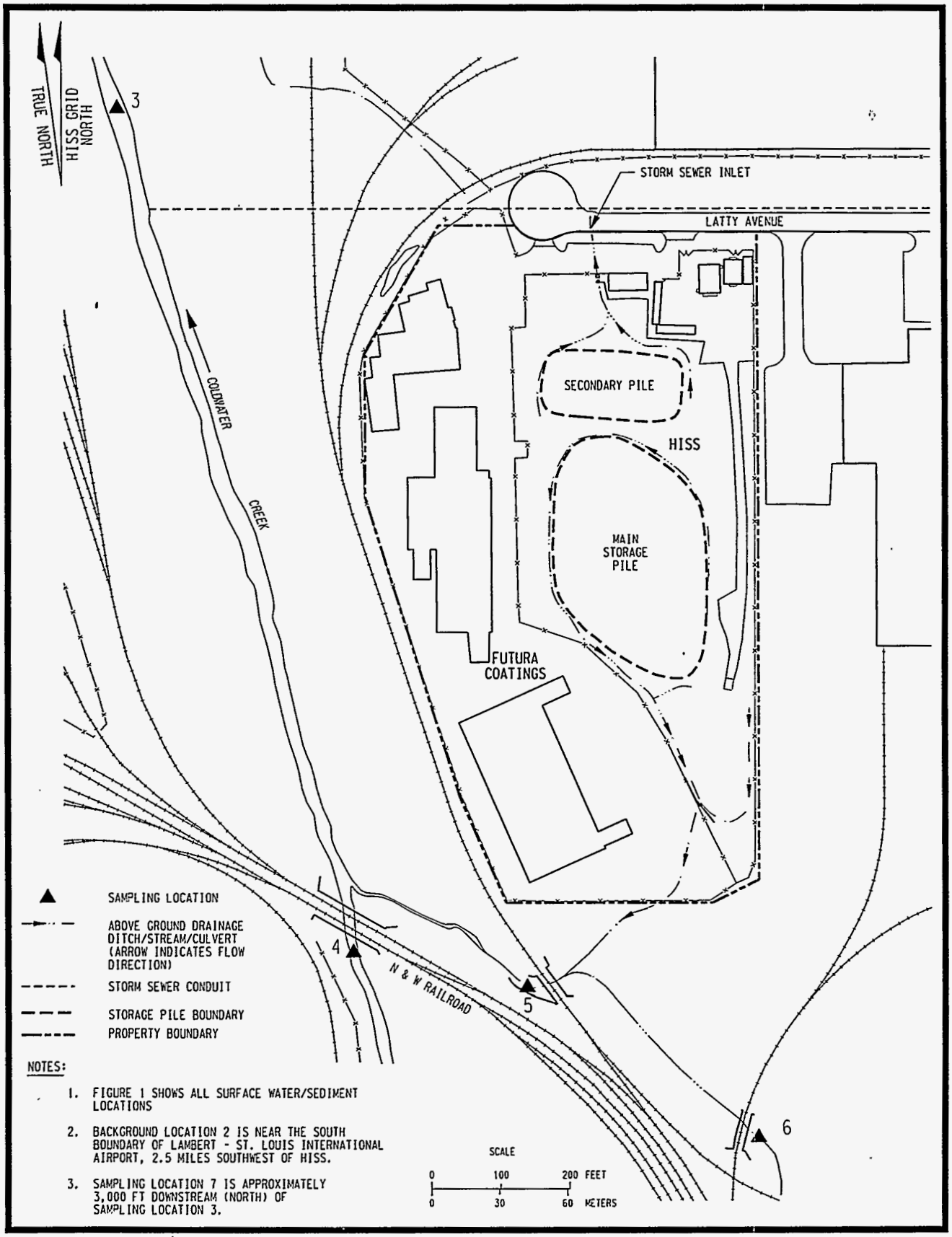

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Figure 3
Hazelwood Interim Storage Site Environmental Surveillance Locations
Surface Water and Sediment

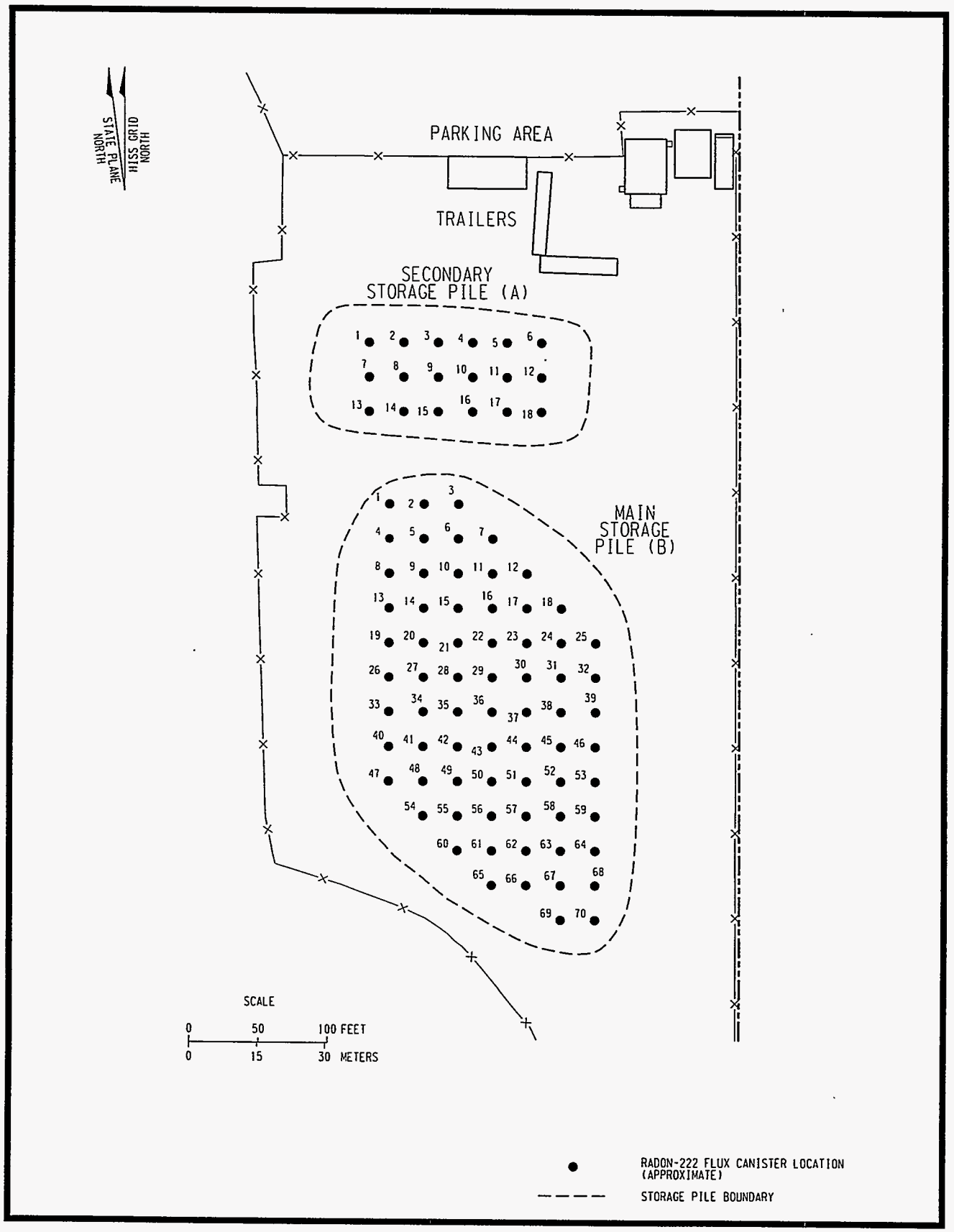

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Figure 4
Hazelwood Interim Storage Site
Approximate Radon-222 Flux Monitoring Locations

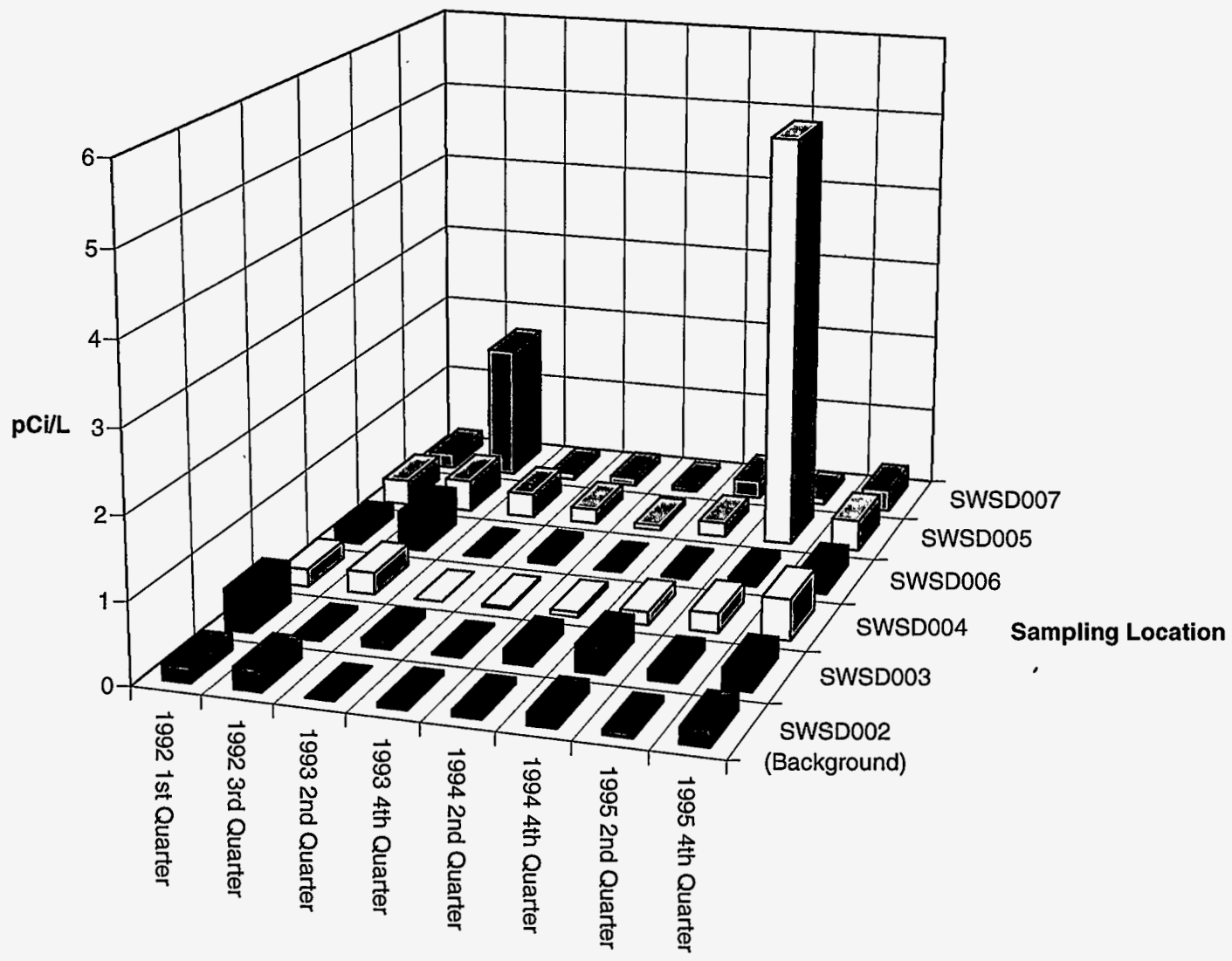

Figure 5. Historical and Current Results for Thorium-230 in Surface Water Hazelwood Interim Storage Site

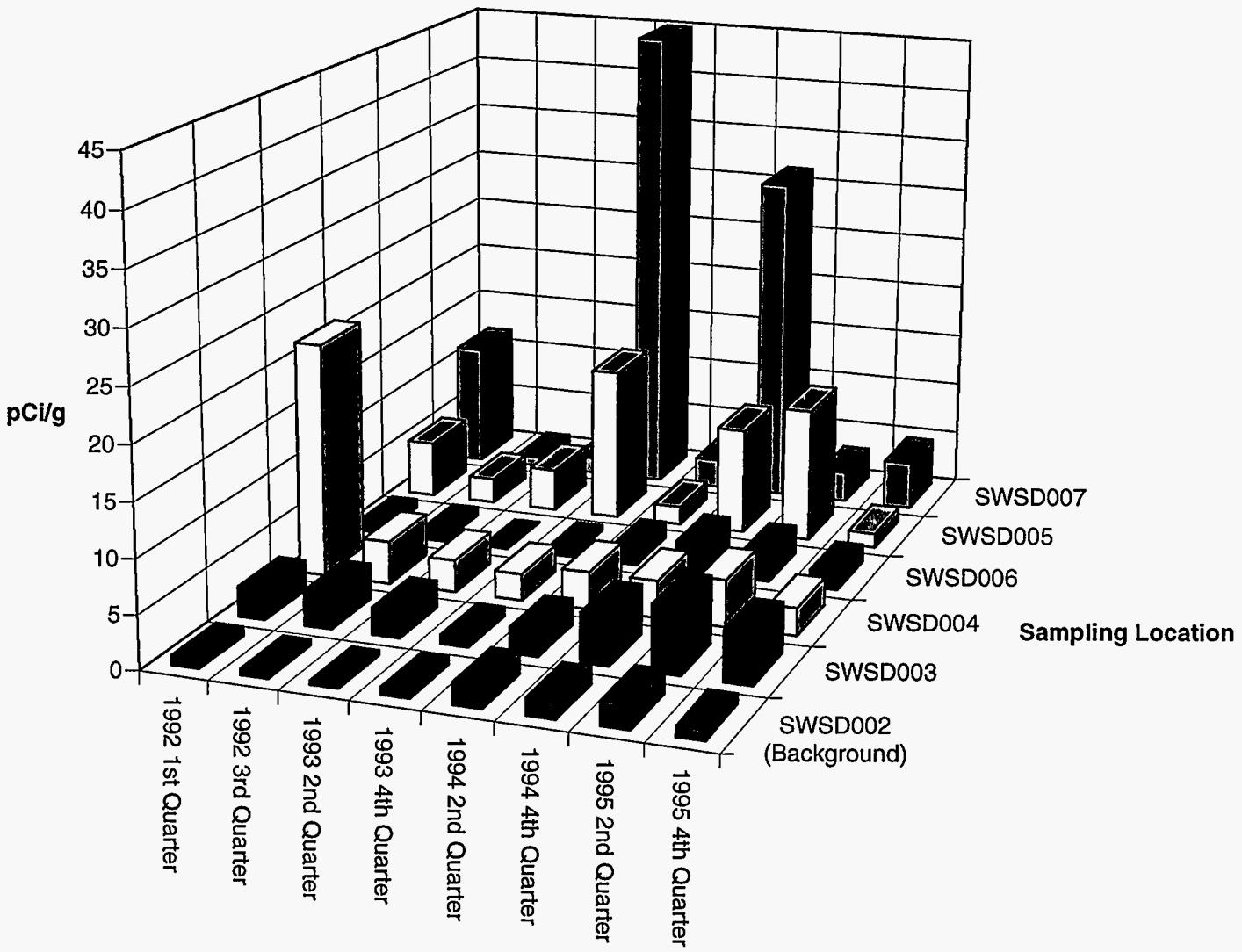

Figure 6. Historical and Current Results for Thorium-230 in Sediment Hazelwood Interim Storage Site

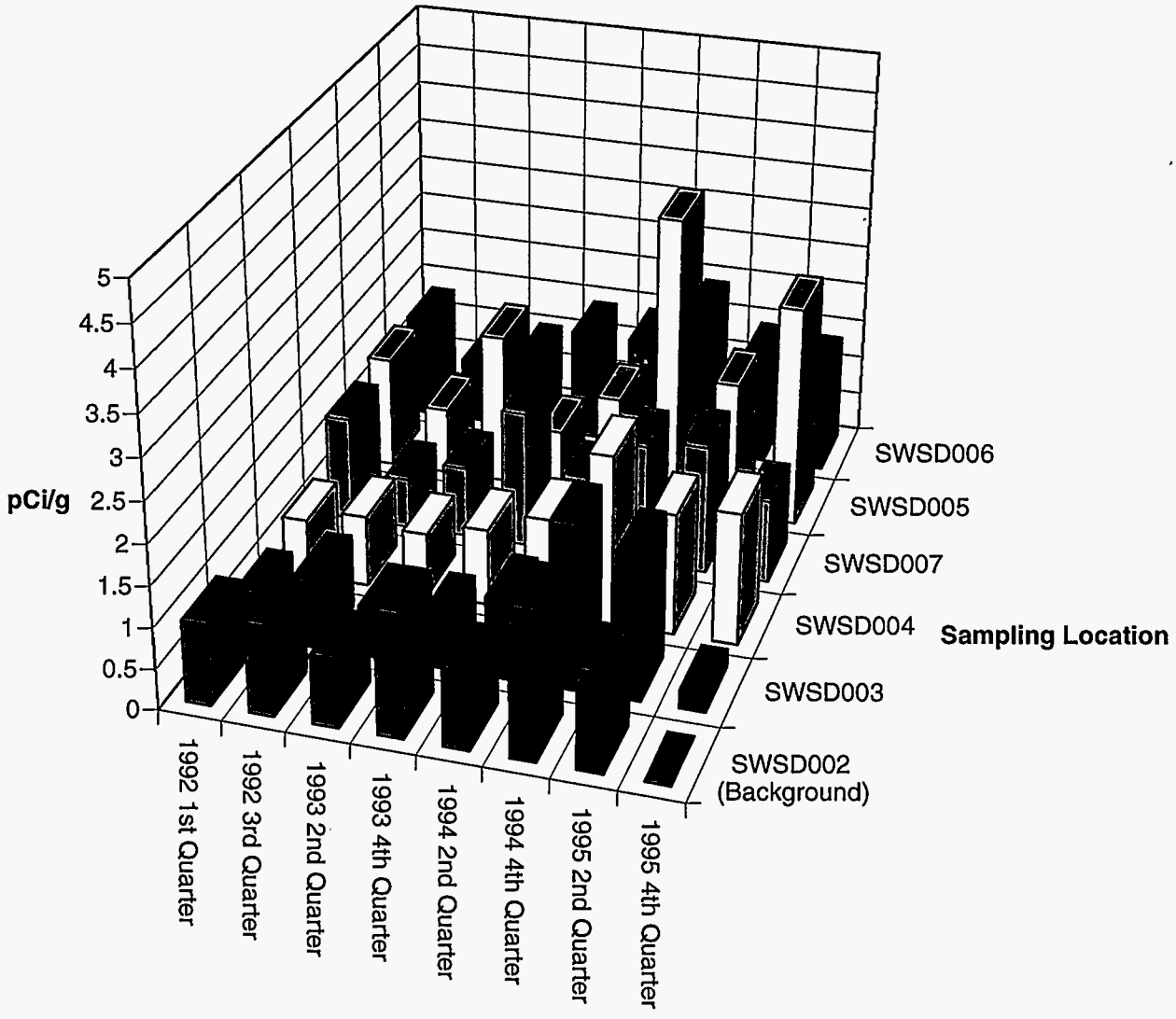

Figure 7. Historical and Current Results for Radium-226 in Sediment Hazelwood Interim Storage Site

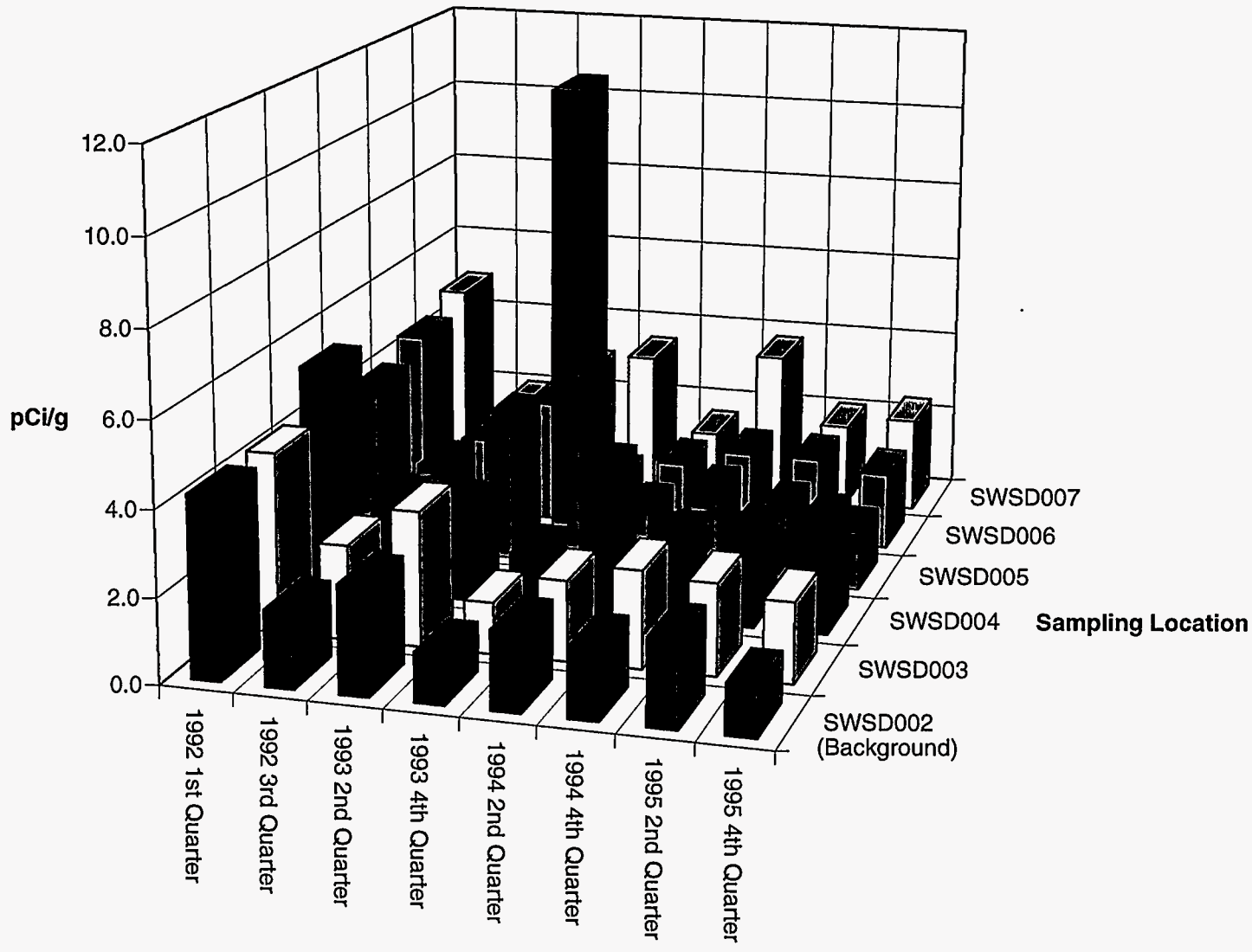

Figure 8. Historical and Current Results for Total Uranium in Sediment Hazelwood Interim Storage Site

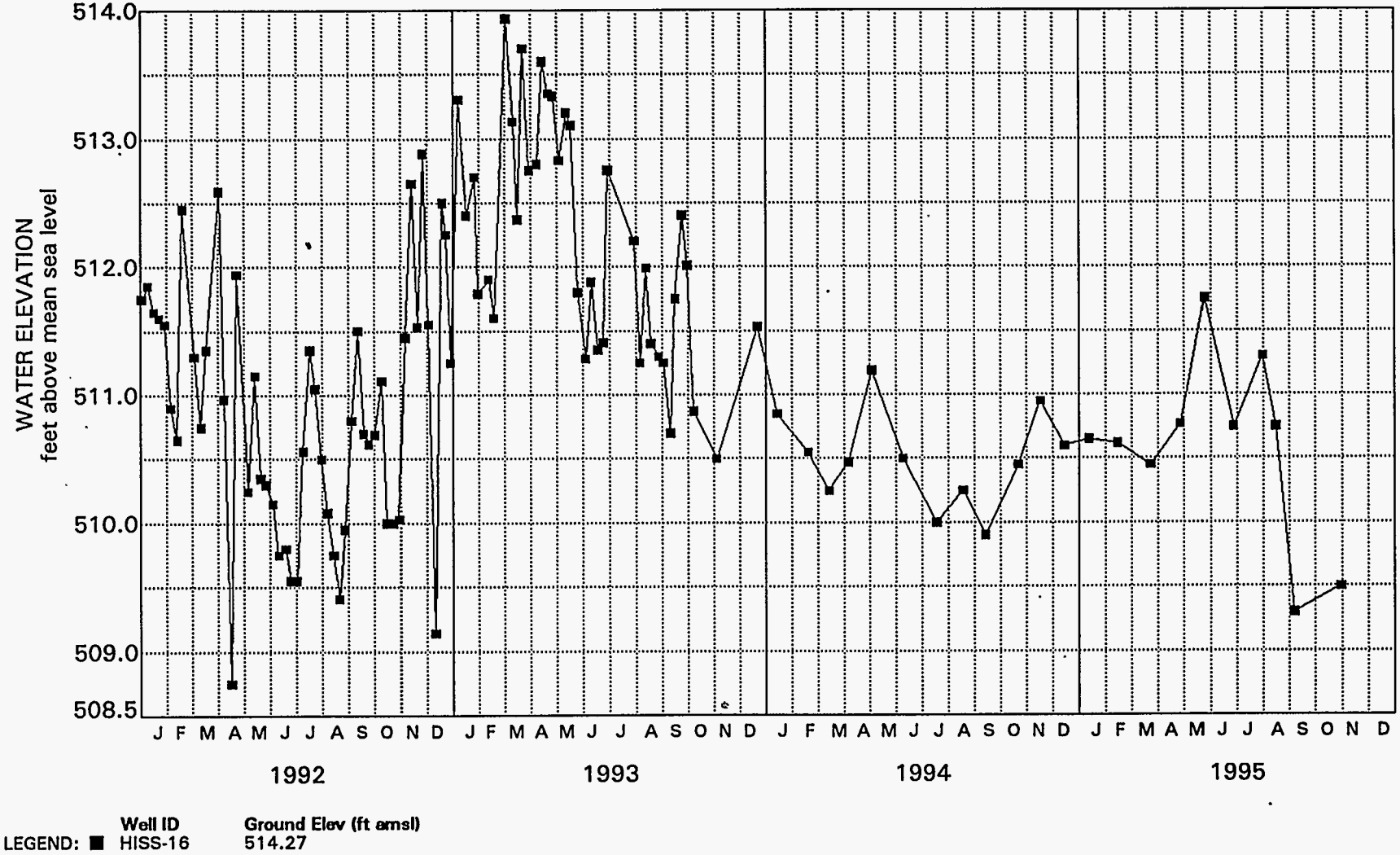

Figure 9
Four-Year Hydrograph for Hazelwood Interim Storage Site

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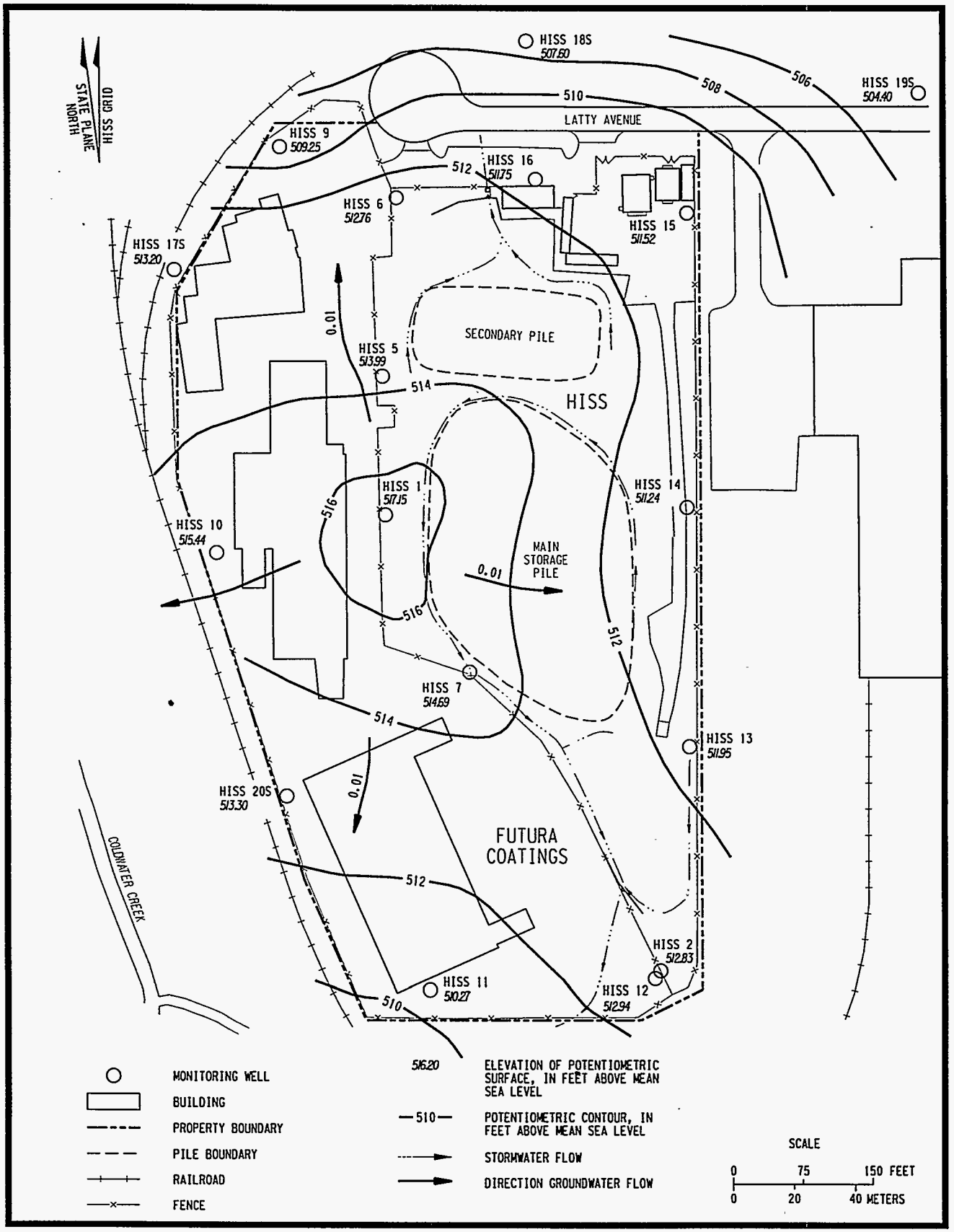

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Figure 10
Hazelwood Interim Storage Site
Potentiometric Surface Map (May 25, 1995)

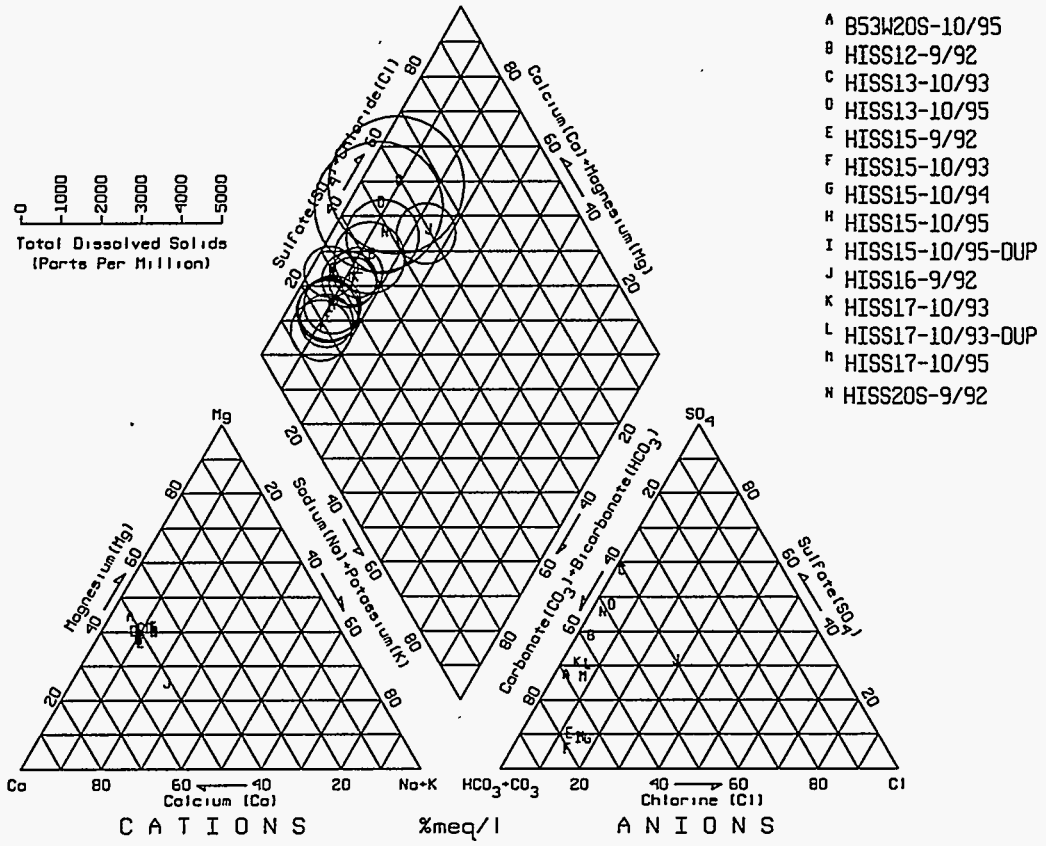

Figure 11
Trilinear Piper Diagram For Groundwater Quality
Hazelwood Interim Storage Site

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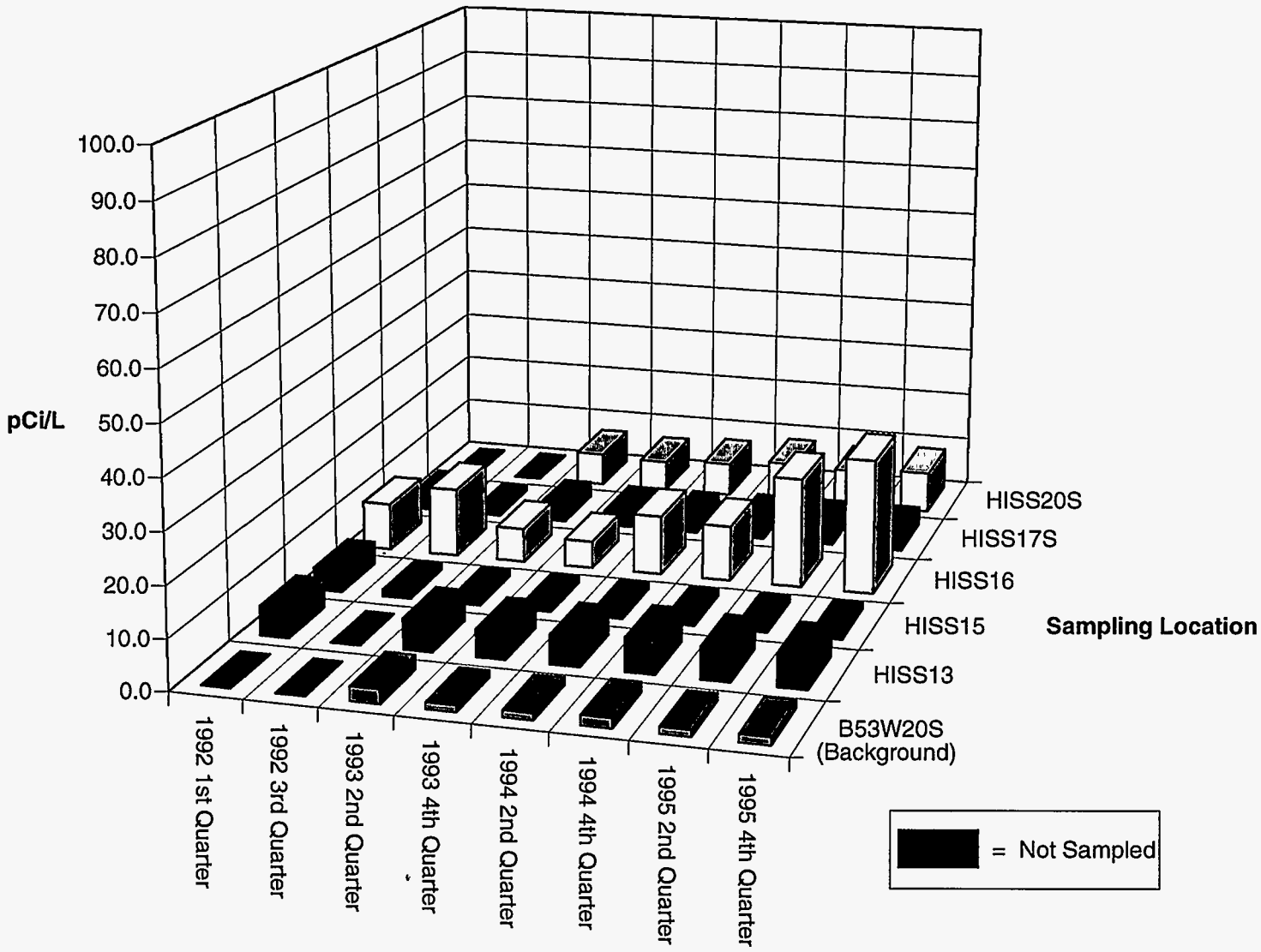

Figure 12. Historical and Current Results for Total Uranium in Groundwater Hazelwood Interim Storage Site

Environmental Surveillance Results for 1995

Hazelwood Interim Storage Site

List of Tables

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Table 1
1995 Sampling Summary
Hazelwood Interim Storage Site

Well ID / Sampling Location	Radioactive				Chemical				Water Quality			
	Q1[a]	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Groundwater												
HISS13		✓		✓								✓
HISS15		✓		✓								✓
HISS16		✓		✓								
HISS17S		✓		✓								✓
HISS20S		✓		✓								
B53W20S		✓		✓								
Surface Water												
SWSD002[b]		✓		✓								
SWSD003		✓		✓								
SWSD004		✓		✓								
SWSD005		✓		✓								
SWSD006		✓		✓								
SWSD007		✓		✓								
Sediment												
SWSD002[b]		✓		✓								
SWSD003		✓		✓								
SWSD004		✓		✓								
SWSD005		✓		✓								
SWSD006		✓		✓								
SWSD007		✓		✓								
Stormwater												
STW001	✓	✓	✓	✓	✓	✓	✓	✓				
STW002	✓	✓	✓	✓	✓	✓	✓	✓				
External Gamma Radiation												
1	✓		✓									
2	✓		✓									
3	✓		✓									
4	✓		✓									
5	✓		✓									
6	✓		✓									
7	✓		✓									
8	✓		✓									

Table 1
1995 Sampling Summary
Hazelwood Interim Storage Site

Well ID / Sampling Location	Radioactive Q1[a]	Q2	Q3	Q4	Chemical Q1	Q2	Q3	Q4	Water Quality Q1	Q2	Q3	Q4
External Gamma Radiation (continued)	✓		✓									
11	✓		✓									
16	✓		✓									
19	✓		✓									
Radon-220/Radon-222												
1	✓	✓	✓	✓								
2	✓	✓	✓	✓								
3	✓	✓	✓	✓								
4	✓	✓	✓	✓								
5	✓	✓	✓	✓								
6	✓	✓	✓	✓								
7	✓	✓	✓	✓								
8	✓	✓	✓	✓								
11	✓	✓	✓	✓								
16	✓	✓	✓	✓								
19	✓	✓	✓	✓								
20	✓	✓	✓	✓								

a. Q1 = first quarter 1995
Q2 = second quarter 1995
Q3 = third quarter 1995
Q4 = fourth quarter 1995

b. Text and figures refer to surface water and sediment sampling locations by the last nonzero digit of the formal identifier presented in the table (e.g., SWSD002 is Location 2)

Table 2
1995 Sampling Locations and Analytical Methods
Hazelwood Interim Storage Site
- External Gamma Radiation and Air (Radon Gas) -

Category	Analytical Parameter	Analytical Level	Analytical Technique	Analytical Method[a]	Sampling Locations
Laboratory Measurements					
Radiological	Radon-222 flux	V	LAACC[b] /γ-spec	N/A	Storage Pile (Figure 4)
Radiological	Radon-220 / Radon-222	V	Radtrack®	N/A	1, 2, 3, 4, 5, 6, 7, 8, 11, 16, 19 20 (Radon-220 / Radon-222 only) (Figures 1 and 2)
Radiation	External gamma radiation	V	Thermoluminescence - TETLD[c]	N/A	

Table 2
1995 Sampling Locations and Analytical Methods
Hazelwood Interim Storage Site
- Groundwater -

Category	Analytical Parameter	Analytical Level	Analytical Technique	Analytical Method [a]	Sampling Locations (Figures 1 and 2)
Field Measurements					
Chemical	Dissolved oxygen	II	Electrometric	EPA[d] 360.1	HISS13, HISS15, HISS16, HISS17S, HISS20S, B53W20S
	Eh	II	Electrometric	N/A	
	Turbidity	II	Nephelometric	EPA 180.1	
	Temperature	II	Electrometric	EPA 170.1	
	Specific conductivity	II	Electrometric	EPA 120.1	
	pH	II	Electrometric	EPA 150.1	
Laboratory Measurements					
Radiological	Total uranium	V	KPA[e]	ASTM[f] D-5174	HISS13, HISS15, HISS16, HISS17S, HISS20S, B53W20S
	Thorium-230 / Thorium-232	V	Alpha spec	EML[g] Th-01	
	Radium-226	V	Alpha spec	EPA 903.0	
Chemical	Sodium	III	ICPAES	EPA 6010A	HISS13, HISS15, HISS17S, B53W20S
	Potassium	III	ICPAES	EPA 6010A	
	Calcium	III	ICPAES	EPA 6010A	
	Magnesium	III	ICPAES	EPA 6010A	
	Bicarbonate	III	Titrimetric	EPA 310.1	
	Carbonate	III	Titrimetric	EPA 310.1	
	Sulfate	III	Turbidimetric	EPA 9038	
	Chloride	III	Colorimetric	EPA 325.2	
	Nitrate - N	III	Colorimetric	EPA 353.2	
	Phosphate-P	III	Colorimetric	EPA 365.2	
	Total dissolved solids	III	Gravimetric	EPA 160.1	
	Alkalinity	III	Titrimetric	EPA 310.1	

Table 2
1995 Sampling Locations and Analytical Methods
Hazelwood Interim Storage Site
- Stormwater -

Category	Analytical Parameter	Analytical Level	Analytical Technique	Analytical Method [a]	Sampling Locations (Figure 2)
Field Measurements					
Chemical	Specific conductivity	II	Electrometric	EPA 120.1	STW001, STW002
	pH	II	Electrometric	EPA 150.0	
Laboratory Measurements					
Radiological	Total uranium	V	KPA	ASTM D-5174	STW001, STW002
	Thorium-230 / Thorium-232	V	Alpha spec	EML Th-01	
	Radium-226	V	Alpha spec	EPA 903.0	
	Radium-228	V	Beta count of actinium-228	EPA 904.0	
	Lead-210	V	β proportional	EML Pb-01	
	Gross Alpha	III	α gas proportional counting	EPA 900.0	
	Gross Beta	III	β gas proportional counting	EPA 900.0	
Chemical	Total organic carbon	III	Persulfate oxidation	EPA 415.1	STW001, STW002
	Total organic halides	III	Colorimetric	EPA 9020	
	Settleable solids	III	Imhoff cone	EPA 160.5	

Table 2
1995 Sampling Locations and Analytical Methods
Hazelwood Interim Storage Site
- Surface Water and Sediment -

Category	Analytical Parameter	Analytical Level	Analytical Technique	Analytical Method[a]	Sampling Locations[h] (Figures 1 and 3)
Field Measurements					
Chemical, Surface water	Dissolved oxygen	II	Electrometric	EPA 360.1	SWSD002, SWSD003, SWSD004 SWSD005, SWSD006, SWSD007
	Eh	II	Electrometric	N/A	
	Turbidity	II	Electrometric	EPA 180.1	
	Temperature	II	Electrometric	EPA 170.1	
	Specific conductivity	II	Electrometric	EPA 120.1	
	pH	II	Electrometric	EPA 150.0	
Laboratory Measurements					
Radiological, Surface water	Total uranium	V	KPA	ASTM D-5174	SWSD002, SWSD003, SWSD004 SWSD005, SWSD006, SWSD007
	Thorium-230 / Thorium-232	V	Alpha spec	EML Th-01	
	Radium-226	V	Alpha spec	EPA 903.0	
Radiological, Sediment	Total uranium	V	KPA	ASTM D-5174	
	Thorium-232	V	Alpha spec	EML Th-01	
	Radium-226	V	Alpha spec	EPA 903.0	
	Thorium-230	V	Alpha spec	EML Th-01	

a. Analytical methods for radioactive constituents have been adapted from the referenced method as well as other methods.
b. Large area activated charcoal canister
c. Tissue-equivalent thermoluminescent dosimeter
d. Environmental Protection Agency
e. Kinetic phosphorescence analysis
f. American Society for Testing and Materials
g. Environmental Measurements Laboratory
h. Text and figures refer to surface water and sediment sampling locations by the last nonzero digit of the formal identifier presented in the table (e.g., SWSD002 is Location 2)

Table 3
1995 External Gamma Radiation Dose Rates
Hazelwood Interim Storage Site

Monitoring Location [b]		TETLD [a] Readings (mrem/yr)	TETLD [a] Corrected [c] (mrem/yr)
HISS Perimeter	1	41.6	-0.8
		42.4	0.8
	2	107.2	131.2
		106.6	130.0
	3	28.6	-27.0
		29.4	-25.3
	4	78.6	73.7
		75.2	66.8
	5	38.0	-8.0
		43.6	3.2
	6	38.2	-7.6
		37.2	-9.6
QC duplicate[d]	6	35.2	-13.7
		36.2	-11.7
	7	64.0	44.3
		53.6	23.4
	8	27.0	-30.2
		26.2	-31.8
	11	78.2	72.9
		73.4	63.2
Background	16	30.8	-22.5
		31.2	-21.7
	19	52.8	21.7
		53.2	22.5

TETLD Exposed Days..... 195

Calculated values:

Average Background [e]..... 42.0

Corrected Background / year [f]..... 84.5

1 mrem = 0.01mSv

a. TETLD = Tissue-equivalent thermoluminescent dosimeter. There are two TETLDs per station, each containing five chips. Reported values are an average chip reading per TETLD.

b. HISS perimeter monitoring locations are shown on Figure 2. The background locations are shown on Figure 1.

c. TETLD readings are corrected for shelter/absorption factor (s/a = 1.075), normalized to a one-year exposure (365 days), and corrected for corrected background/year.
Corrected exposure = (reading * 1.075 * days per year/exposed days) - (corrected background/year)
Example (Station 1): (41.6*1.075*365/195) - (84.5) = -0.8 mrem/yr

d. A quality control (QC) duplicate is collected at the same time and location and is analyzed by the same method for use in evaluation of precision in data collection method and analysis.

e. Average background is the average of reported values at locations 16 and 19.

f. Corrected background/year = (days per year/exposed days)*(average background)*1.075
Example: 365/195 * 42.0 * 1.075 = 84.5 mrem/yr

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Table 4
1995 Combined Radon-220 and Radon-222 Concentrations [a]
Hazelwood Interim Storage Site

Monitoring Location [b]		Average Concentration (pCi/L) 01/17/95 [c] 04/05/95	04/05/95 [c] 07/31/95	07/31/95 [c] 10/23/95	10/23/95 [c] 01/22/96
HISS Perimeter	1	0.4 *	0.3 *	0.6	0.3 *
	2	0.4 *	0.3 *	0.5	0.3 *
	3	0.4 *	0.3 *	0.5	0.3 *
	4	0.4	0.3 *	0.5	0.3 *
	5	0.4 *	0.3 *	0.4 *	0.3 *
	6	0.4 *	0.3 *	0.6	0.3 *
QC duplicate [d]	6	0.4 *	0.3 *	0.5	0.3 *
	7	0.4 *	0.3 *	0.4 *	0.3 *
	8	0.4 *	0.3 *	0.4	0.3 *
	11	0.4 *	0.3 *	0.6	0.3 *
Inside site trailer	20	-- [e]	0.3 *	0.4 *	0.3 *
Background	16 [f]	1.0	0.9	1.6	0.9
Background	19 [g]	0.4 *	0.3 *	0.4 *	0.3 *

a. 1995 radon gas concentrations were measured with RadTrack® detectors. These detectors measure the combined concentration of radon-220 and radon-222 in air. Historically, radon-220 has not been detected at HISS.
b. Monitoring locations are shown in Figures 1 and 2.
c. Detectors were installed and removed on the dates listed.
d. A quality control (QC) duplicate is collected at the same time and location and is analyzed by the same method for use in evaluation of precision in sampling and analysis.
e. Monitoring location 20 established inside site trailer during the second quarter of 1995.
f. Location 16 located at 3209 Delor Avenue, St. Louis, approximately 26 km southeast of HISS.
g. Location 19 located at North Hanley Road, Berkeley, Missouri, approximately 2.5 km east of HISS.

Note: The DOE limit for radon is 3.0 pCi/L.
(*) Indicates detection limit is reported. Actual result is less than this value.
1 pCi = 0.037 becquerel

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Table 5
1995 Radon-222 Flux Monitoring Results
Hazelwood Interim Storage Site

Sample ID	Radon-222 Flux ($pCi/m^2/s$)	Sample ID	Radon-222 Flux ($pCi/m^2/s$)	Sample ID	Radon-222 Flux ($pCi/m^2/s$)
140-RF-1A	0.27 ± 0.11	140-RF-23B	0.31 ± 0.13	140-RF-66B	0.17 ± 0.13
140-RF-2A	0.29 ± 0.11	140-RF-24B	0.13 ± 0.13	140-RF-67B	0.27 ± 0.14
140-RF-3A	0.18 ± 0.11	140-RF-25B	0.18 ± 0.13	140-RF-68B	0.37 ± 0.14
140-RF-4A	0.28 ± 0.11	140-RF-26B	0.99 ± 0.14	140-RF-69B	0.19 ± 0.14
140-RF-5A	0.25 ± 0.11	140-RF-27B	0.33 ± 0.13	140-RF-70B	0.29 ± 0.14
140-RF-6A	0.25 ± 0.11	140-RF-28B	0.25 ± 0.13	140-RF-71B	0.15 ± 0.13
140-RF-7A	0.14 ± 0.11	140-RF-29B	0.22 ± 0.13	140-RF-72B	0.15 ± 0.13
140-RF-8A	0.05 ± 0.11	140-RF-30B	0.23 ± 0.13	140-RF-73B	0.16 ± 0.13
140-RF-9A	0.18 ± 0.11	140-RF-31B	0.19 ± 0.13	140-RF-74B	1.57 ± 0.16
140-RF-10A	0.23 ± 0.11	140-RF-32B	0.12 ± 0.13		
140-RF-11A	0.25 ± 0.11	140-RF-33B	1.16 ± 0.14		
140-RF-12A	0.65 ± 0.12	140-RF-34B	0.34 ± 0.13	QC duplicates [a]	
140-RF-13A	0.19 ± 0.11	140-RF-35B	0.25 ± 0.13	140-RF-5B	0.32 ± 0.11
140-RF-14A	0.25 ± 0.11	140-RF-36B	0.19 ± 0.13	140-RF-10B	0.20 ± 0.15
140-RF-15A	0.16 ± 0.11	140-RF-37B	0.15 ± 0.13	140-RF-15B	0.41 ± 0.12
140-RF-16A	0.26 ± 0.11	140-RF-38B	0.42 ± 0.13	140-RF-20B	0.22 ± 0.13
140-RF-17A	0.21 ± 0.11	140-RF-39B	0.18 ± 0.13	118-RF-30B	0.15 ± 0.13
140-RF-18A	0.35 ± 0.12	140-RF-40B	0.18 ± 0.15	140-RF-40B	0.23 ± 0.16
140-RF-19A	0.22 ± 0.11	140-RF-41B	0.19 ± 0.13	140-RF-50B	0.23 ± 0.13
140-RF-20A	0.26 ± 0.12	140-RF-42B	0.42 ± 0.13	140-RF-60B	0.23 ± 0.16
		140-RF-43B	0.27 ± 0.13	140-RF-70B	0.21 ± 0.14
140-RF-1B	0.49 ± 0.11	140-RF-44B	0.14 ± 0.13		
140-RF-2B	0.57 ± 0.11	140-RF-45B	0.20 ± 0.13	Notes:	
140-RF-3B	0.29 ± 0.11	140-RF-46B	0.21 ± 0.13	'A' indicates secondary pile	
140-RF-4B	2.76 ± 0.15	140-RF-47B	0.17 ± 0.13	'B' indicates main pile	
140-RF-5B	0.21 ± 0.11	140-RF-48B	0.33 ± 0.13	The EPA standard for radon-222	
140-RF-6B	0.23 ± 0.11	140-RF-49B	0.20 ± 0.13	flux is 20 $pCi/m^2/s$.	
140-RF-7B	0.96 ± 0.12	140-RF-50B	0.27 ± 0.16		
140-RF-8B	0.79 ± 0.12	140-RF-51B	0.25 ± 0.13	a. The canisters are counted twice	
140-RF-9B	1.61 ± 0.13	140-RF-52B	0.21 ± 0.13	in the laboratory as quality control	
140-RF-10B	0.27 ± 0.15	140-RF-53B	0.22 ± 0.13	(QC) duplicates in order to	
140-RF-11B	1.08 ± 0.13	140-RF-54B	0.32 ± 0.13	evaluate analytical precision.	
140-RF-12B	0.26 ± 0.11	140-RF-55B	0.31 ± 0.13		
140-RF-13B	1.76 ± 0.14	140-RF-56B	1.06 ± 0.15		
140-RF-14B	1.42 ± 0.13	140-RF-57B	0.22 ± 0.13		
140-RF-15B	0.36 ± 0.12	140-RF-58B	0.53 ± 0.14		
140-RF-16B	0.69 ± 0.12	140-RF-59B	0.13 ± 0.13		
140-RF-17B	0.54 ± 0.12	140-RF-60B	0.09 ± 0.15		
140-RF-18B	0.33 ± 0.12	140-RF-61B	0.31 ± 0.13		
140-RF-19B	1.20 ± 0.13	140-RF-62B	0.14 ± 0.13		
140-RF-20B	0.45 ± 0.13	140-RF-63B	0.15 ± 0.13		
140-RF-21B	0.85 ± 0.14	140-RF-64B	0.38 ± 0.14		
140-RF-22B	0.11 ± 0.13	140-RF-65B	0.29 ± 0.14		

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Table 6
1995 Surface Water Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location [a]	Date Collected	Analyte	Result [b] (pCi/L)	BNI Flag [c]	MDA [d] (pCi/L)	Result Above Background [e] (pCi/L)	DCG [f] (pCi/L)
SWSD003	04/04/95	Radium-226	0.02 ± 0.11	UJ	0.39	-0.28 ± 0.14	100
	10/24/95	Radium-226	0.50 ± 0.31		0.32	0.20 ± 0.32	100
	04/04/95	Thorium-230	0.13 ± 0.12	J	0.12	0.03 ± 0.14	300
	10/24/95	Thorium-230	0.25 ± 0.22		0.20	0.15 ± 0.23	300
	04/04/95	Thorium-232	0.07 ± 0.09	UJ	0.12	0.02 ± 0.09	50
	10/24/95	Thorium-232	0.17 ± 0.17	UJ	0.23	0.12 ± 0.17	50
	04/04/95	Total uranium	2.50 ± 0.26		0.02	1.70 ± 0.26	600
	10/24/95	Total uranium	2.06 ± 0.02		0.02	1.26 ± 0.05	600
SWSD004	04/04/95	Radium-226	0.28 ± 0.23		0.13	-0.02 ± 0.25	100
	10/23/95	Radium-226	0.46 ± 0.54	UJ	0.72	0.16 ± 0.55	100
	04/04/95	Thorium-230	0.24 ± 0.17	J	0.07	0.14 ± 0.18	300
	10/23/95	Thorium-230	0.51 ± 0.33	J	0.12	0.41 ± 0.34	300
	04/04/95	Thorium-232	0.02 ± 0.05	UJ	0.12	-0.03 ± 0.06	50
	10/23/95	Thorium-232	0.05 ± 0.09	UJ	0.21	0.00 ± 0.09	50
	04/04/95	Total uranium	3.25 ± 0.33		0.02	2.45 ± 0.34	600
	10/23/95	Total uranium	2.53 ± 0.03		0.02	1.73 ± 0.06	600
SWSD005	04/04/95	Radium-226	0.17 ± 0.17	UJ	0.28	-0.13 ± 0.19	100
	10/23/95	Radium-226	0.35 ± 0.27		0.23	0.05 ± 0.28	100
	04/04/95	Thorium-230	5.20 ± 1.40		0.14	5.10 ± 1.40	300
	10/23/95	Thorium-230	0.39 ± 0.29		0.22	0.29 ± 0.30	300
	04/04/95	Thorium-232	0.07 ± 0.08	UJ	0.11	0.02 ± 0.09	50
	10/23/95	Thorium-232	0.14 ± 0.17	UJ	0.13	0.09 ± 0.17	50
	04/04/95	Total uranium	1.08 ± 0.13		0.02	0.28 ± 0.14	600
	10/23/95	Total uranium	1.68 ± 0.02		0.02	0.88 ± 0.05	600
SWSD006	04/04/95	Radium-226	0.10 ± 0.12	UJ	0.27	-0.20 ± 0.15	100
	10/23/95	Radium-226	0.64 ± 0.37		0.14	0.34 ± 0.38	100
	04/04/95	Thorium-230	0.09 ± 0.10	UJ	0.06	-0.01 ± 0.12	300
	10/23/95	Thorium-230	0.25 ± 0.23		0.14	0.15 ± 0.24	300
	04/04/95	Thorium-232	0.04 ± 0.07	UJ	0.11	-0.01 ± 0.08	50
	10/23/95	Thorium-232	0.10 ± 0.14	UJ	0.14	0.05 ± 0.14	50
	04/04/95	Total uranium	1.02 ± 0.13		0.02	0.22 ± 0.14	600
	10/23/95	Total uranium	1.73 ± 0.02		0.02	0.93 ± 0.05	600

Table 6
1995 Surface Water Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location [a]	Date Collected	Analyte	Result [b] (pCi/L)	BNI Flag [c]	MDA [d] (pCi/L)	Result Above Background [e] (pCi/L)	DCG [f] (pCi/L)
SWSD006	04/04/95	Radium-226	0.13 ± 0.15	UJ	0.24	-0.17 ± 0.18	100
QC duplicate [g]	10/23/95	Radium-226	0.51 ± 0.31		0.32	0.21 ± 0.32	100
	04/04/95	Thorium-230	0.16 ± 0.13	J	0.07	0.06 ± 0.15	300
	10/23/95	Thorium-230	0.52 ± 0.35		0.24	0.42 ± 0.36	300
	04/04/95	Thorium-232	0.05 ± 0.07	UJ	0.07	0.00 ± 0.08	50
	10/23/95	Thorium-232	0.10 ± 0.15	UJ	0.14	0.05 ± 0.15	50
	04/04/95	Total uranium	1.02 ± 0.13		0.02	0.22 ± 0.14	600
	10/23/95	Total uranium	1.67 ± 0.02		0.02	0.87 ± 0.05	600
SWSD007	04/04/95	Radium-226	0.10 ± 0.16	UJ	0.31	-0.20 ± 0.18	100
	10/23/95	Radium-226	0.42 ± 0.28		0.40	0.12 ± 0.29	100
	04/04/95	Thorium-230	0.08 ± 0.09	UJ	0.12	-0.02 ± 0.11	300
	10/23/95	Thorium-230	0.27 ± 0.22		0.24	0.17 ± 0.23	300
	04/04/95	Thorium-232	0.01 ± 0.06	UJ	0.17	-0.04 ± 0.07	50
	10/23/95	Thorium-232	0.04 ± 0.09	UJ	0.12	-0.01 ± 0.09	50
	04/04/95	Total uranium	1.90 ± 0.20		0.02	1.10 ± 0.20	600
	10/23/95	Total uranium	2.33 ± 0.03		0.02	1.53 ± 0.06	600
SWSD002	04/04/95	Radium-226	0.30 ± 0.28	UJ	0.34	0.00 ± 0.29	100
Background	10/24/95	Radium-226	0.67 ± 0.45	J	0.45	0.37 ± 0.46	100
	04/04/95	Thorium-230	0.06 ± 0.07	UJ	0.11	-0.04 ± 0.10	300
	10/24/95	Thorium-230	0.20 ± 0.21	UJ	0.23	0.10 ± 0.22	300
	04/04/95	Thorium-232	0.02 ± 0.04	UJ	0.06	-0.03 ± 0.05	50
	10/24/95	Thorium-232	0.14 ± 0.00	UJ	0.14	0.09 ± 0.03	50
	04/04/95	Total uranium	0.74 ± 0.08		0.02	-0.06 ± 0.10	600
	10/24/95	Total uranium	0.47 ± 0.01		0.02	-0.33 ± 0.05	600

a. Text and figures refer to sampling locations by the last non-zero digit of the formal identifier presented in the table (e.g., SWSD003 is location 3).

b. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level).

c. Bechtel National, Inc. data qualifier flags:
U = The analyte was not detected. The detection limit is reported.
J = Reported as an estimated value.
UJ = Analyte was undetected; estimated value reported. The result is below the MDA or less than the associated error term.

d. Minimum detectable activity

e. Historical (1992-1995) average background for surface water is 0.3±0.091, 0.1±0.07, 0.05±0.03, and 0.8±0.05 pCi/L for radium-226, thorium-230, thorium-232, and total uranium, respectively. Associated error term for result above background was calculated: $(error^2_{result} + error^2_{background})^{1/2}$

f. DOE derived concentration guide for water.

g. A quality control (QC) duplicate is collected at the same time and location and is analyzed by the same method for use in evaluation of precision in sampling and analysis.

Table 7
1995 Sediment Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location [a]	Date Collected	Analyte	Result [b] (pCi/g)	BNI Flag [c]	MDA [d] (pCi/g)	Result Above Background [e] (pCi/g)	Cleanup Criteria [f] (pCi/g)
SWSD003	04/04/95	Radium-226	1.80 ± 0.45	U	0.11	0.80 ± 0.46	5
	10/24/95	Radium-226	0.22 ± 0.00	UJ	0.22	-0.78 ± 0.10	5
	04/04/95	Thorium-230	6.20 ± 1.40	J	0.07	5.20 ± 1.41	5
	10/24/95	Thorium-230	4.61 ± 1.56	J	0.17	3.61 ± 1.57	5
	04/04/95	Thorium-232	0.74 ± 0.26		0.09	0.01 ± 0.31	5
	10/24/95	Thorium-232	0.40 ± 0.27	J	0.20	-0.33 ± 0.32	5
	04/04/95	Total uranium	2.17 ± 0.22		0.07	0.17 ± 0.24	100
	10/24/95	Total uranium	1.90 ± 0.06	U	0.07	-0.10 ± 0.12	100
SWSD004	04/04/95	Radium-226	1.50 ± 0.42	U	0.14	0.50 ± 0.43	5
	10/23/95	Radium-226	1.63 ± 0.51		0.17	0.63 ± 0.52	5
	04/04/95	Thorium-230	4.40 ± 1.20	J	0.12	3.40 ± 1.21	5
	10/23/95	Thorium-230	2.60 ± 1.09	J	0.12	1.60 ± 1.11	5
	04/04/95	Thorium-232	0.81 ± 0.32		0.06	0.08 ± 0.36	5
	10/23/95	Thorium-232	0.44 ± 0.31	J	0.12	-0.29 ± 0.35	5
	04/04/95	Total uranium	2.23 ± 0.22		0.07	0.23 ± 0.24	100
	10/23/95	Total uranium	2.67 ± 0.07		0.07	0.67 ± 0.12	100
SWSD005	04/04/95	Radium-226	1.70 ± 0.42	U	0.12	0.70 ± 0.43	5
	10/23/95	Radium-226	2.77 ± 0.58		0.17	1.77 ± 0.59	5
	04/04/95	Thorium-230	12.70 ± 3.10	J	0.13	11.70 ± 3.11	5
	10/23/95	Thorium-230	1.34 ± 0.47	J	0.07	0.34 ± 0.51	5
	04/04/95	Thorium-232	1.40 ± 0.48	J	0.06	0.67 ± 0.51	5
	10/23/95	Thorium-232	0.93 ± 0.37	J	0.07	0.20 ± 0.41	5
	04/04/95	Total uranium	1.83 ± 0.18		0.07	-0.17 ± 0.21	100
	10/23/95	Total uranium	1.34 ± 0.04	U	0.07	-0.66 ± 0.11	100
SWSD006	04/04/95	Radium-226	1.40 ± 0.35	U	0.13	0.40 ± 0.36	5
	10/23/95	Radium-226	1.34 ± 0.33		0.05	0.34 ± 0.34	5
	04/04/95	Thorium-230	2.70 ± 0.84	J	0.16	1.70 ± 0.86	5
	10/23/95	Thorium-230	1.65 ± 0.68	J	0.18	0.65 ± 0.71	5
	04/04/95	Thorium-232	1.50 ± 0.54	J	0.12	0.77 ± 0.57	5
	10/23/95	Thorium-232	0.96 ± 0.47	J	0.10	0.23 ± 0.50	5
	04/04/95	Total uranium	1.83 ± 0.18		0.07	-0.17 ± 0.21	100
	10/23/95	Total uranium	1.85 ± 0.03	U	0.07	-0.15 ± 0.10	100
SWSD006	04/04/95	Radium-226	1.70 ± 0.42	U	0.10	0.70 ± 0.43	5
QC duplicate [g]	10/23/95	Radium-226	1.01 ± 0.28		0.08	0.01 ± 0.30	5
	04/04/95	Thorium-230	1.30 ± 0.46	J	0.10	0.30 ± 0.50	5
	10/23/95	Thorium-230	1.58 ± 0.64	J	0.10	0.58 ± 0.67	5
	04/04/95	Thorium-232	1.20 ± 0.42		0.06	0.47 ± 0.45	5
	10/23/95	Thorium-232	1.68 ± 0.67	J	0.09	0.95 ± 0.69	5
	04/04/95	Total uranium	2.10 ± 0.21		0.07	0.10 ± 0.23	100
	10/23/95	Total uranium	1.96 ± 0.03	U	0.07	-0.04 ± 0.10	100

Table 7
1995 Sediment Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location [a]	Date Collected	Analyte	Result [b] (pCi/g)	BNI Flag [c]	MDA [d] (pCi/g)	Result Above Background [e] (pCi/g)	Cleanup Criteria [f] (pCi/g)
SWSD007	04/04/95	Radium-226	1.60 ± 0.44	U	0.15	0.60 ± 0.45	5
	10/23/95	Radium-226	1.03 ± 0.29		0.11	0.03 ± 0.31	5
	04/04/95	Thorium-230	2.90 ± 0.96	J	0.13	1.90 ± 0.98	5
	10/23/95	Thorium-230	4.53 ± 1.22		0.11	3.53 ± 1.23	5
	04/04/95	Thorium-232	0.86 ± 0.38	J	0.15	0.13 ± 0.42	5
	10/23/95	Thorium-232	0.82 ± 0.34		0.07	0.09 ± 0.38	5
	04/04/95	Total uranium	2.03 ± 0.20		0.07	0.03 ± 0.23	100
	10/23/95	Total uranium	2.32 ± 0.03	U	0.07	0.32 ± 0.11	100
SWSD002	04/04/95	Radium-226	1.20 ± 0.36	U	0.17	0.20 ± 0.37	5
Background	10/24/95	Radium-226	-0.01 ± 0.01	UJ	0.38	-1.01 ± 0.10	5
	04/04/95	Thorium-230	2.20 ± 0.78	J	0.15	1.20 ± 0.80	5
	10/24/95	Thorium-230	0.95 ± 0.46	J	0.17	-0.05 ± 0.50	5
	04/04/95	Thorium-232	0.96 ± 0.43	J	0.20	0.23 ± 0.46	5
	10/24/95	Thorium-232	0.37 ± 0.25	J	0.20	-0.36 ± 0.30	5
	04/04/95	Total uranium	2.03 ± 0.20		0.07	0.03 ± 0.23	100
	10/24/95	Total uranium	1.17 ± 0.05	U	0.07	-0.83 ± 0.11	100

a. Text and figures refer to sampling locations by the last non-zero digit of the formal identifier presented in the table (e.g., SWSD003 is location 3).

b. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level). Negative laboratory results occur when the average background activity of the laboratory counting instrument exceeds the measured sample activity.

c. Bechtel National, Inc. data qualifier flags:
   U = The analyte was not detected. Results for total uranium (10/23/95) and radium-226 (04/04/95) are 'U' flagged due to the presence of these analytes in the associated laboratory blank. If the sample result is less than 5 times the blank contamination the result is nondetect.
   J = Reported as an estimated value.
   UJ = Analyte was undetected; estimated value reported. The result is below the MDA or less than the associated error term.

d. Minimum detectable activity

e. Historical (1992-1995) average background for sediment is 1±0.1, 1±0.19, 0.73±0.17, and 3±0.1 pCi/g for radium-226, thorium-230, thorium-232, and total uranium, respectively. Associated error term for result above background was calculated: $(error^2_{result} + error^2_{background})^{1/2}$

f. DOE soil cleanup criteria, averaged over topmost 6 in. (15 cm) of soil. Because there are no standards for radioactive constituents in sediment, these soil values are used to provide a basis for comparison of sediment results. The site-specific criterion for uranium-238 is 50 pCi/g, which corresponds to 100 pCi/g total uranium.

g. A quality control (QC) duplicate is collected at the same time and location and is analyzed by the same method for use in evaluation of precision in sampling and analysis.

Table 8
1995 Field Parameter Summary
Hazelwood Interim Storage Site

Sampling Location	Date	Temp (°C)	pH	Spec. Cond.[a] (mS/cm)	DO[b] (mg/L)	Eh[c] (mV)	Turbidity (NTU)[d]	Purge Volume[e]	Discharge (GPM)[f]
GROUNDWATER									
HISS13	04/07/95	15.2	6.48	7.36	0.74	218	6	2.9	0.04
	10/24/95	18.0	6.57	6.21	0.49	248	20	1.0	0.12
HISS15	04/06/95	19.2	6.57	1.076	0.30	29	1	4.11	0.12
	10/25/95	17.3	6.63	0.918	0.32	0	2	1.25	0.06
HISS16	04/07/95	14.2	6.97	2.93	3.6	184	16	3.57	0.08
	10/24/95	16.6	6.92	2.17	2.16	305	62	2.0	0.08
HISS17S	04/07/95	19.8	6.92	1.134	1.25	140	11	1	0.10
	10/25/95	16.2	7.02	0.918	0.24	220	299	1.09	0.08
HISS20S	04/10/95	14.3	6.78	5.68	0.27	77	2	1.05	0.10
	10/26/95	16.6	6.70	4.62	0.31	273	13	1.0	0.10
B53W20S	04/06/95	16.6	6.93	0.774	4.07	182	47	1.08	0.12
	10/25/95	16.0	6.86	0.680	0.87	304	21	1.02	0.10
SURFACE WATER									
SWSD002	04/04/95	9.0	7.97	0.690	10.73	146	7	-[g]	-
	10/24/95	9.7	7.61	0.350	5.01	197	9	-	-
SWSD003	04/04/95	10.2	7.71	0.640	5.0	161	13	-	-
	10/24/95	13.2	6.64	0.582	5.83	86	9	-	-
SWSD004	04/04/95	7	7.42	0.76	5.39	65	6	-	-
	10/23/95	17	7.04	0.764	6.85	294	18	-	-
SWSD005	04/04/95	5.6	7.76	0.622	11.55	119	7	-	-
	10/24/95	17.2	8.04	0.598	8.69	252	3		
SWSD006	04/05/95	8.5	7.78	0.622	11.76	136	6	-	-
	10/23/95	16.9	7.94	0.592	8.62	264	3		
SWSD007	04/04/95	-	-	-	-	-	-	-	-
	10/23/95	15.0	7.85	0.658	2.33	193	64	-	-

a. Specific Conductance, measured in milliSiemens/centimeter (mS/cm)
b. Dissolved Oxygen
c. Oxidation reduction potential, measured in milliVolts (mV)
d. Nephelometric turbidity units
e. Purge volumes = gallons purged/one purge volume
f. Gallons per minute
g. (-) Parameter not applicable

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Table 9
1995 Groundwater Quality Analytical Results
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result (mg/L)	Data Qualifiers [a] BNI	Data Qualifiers [a] Lab	Detection Limit (mg/L)	Related Regulations [b] Federal [c] (mg/L)	Related Regulations [b] State [d] (mg/L)
HISS13	10/24/95	Alkalinity	300		=	2	NE	NE
	10/24/95	Bicarbonate	300		=	2	NE	NE
	10/24/95	Calcium	666		=	167	NE	NE
	10/24/95	Carbonate	2		U	2	NE	NE
	10/24/95	Chloride	15		=	1.2	250	250
	10/24/95	Magnesium	297	J	=	39.2	NE	NE
	10/24/95	Nitrate, as N	880		=	50	10	10
	10/24/95	Phosphate	0.058		=	0.05	NE	NE
	10/24/95	Potassium	1.77		=	0.714	NE	NE
	10/24/95	Sodium	115	J	=	32.3	NE	NE
	10/24/95	Sulfate	223		=	125	NE	NE
	10/24/95	Total dissolved solids	4,810		=	20	500	500
HISS15	10/25/95	Alkalinity	495		=	4	NE	NE
	10/25/95	Bicarbonate	495		=	4	NE	NE
	10/25/95	Calcium	111	J	=	16.7	NE	NE
	10/25/95	Carbonate	4		U	4	NE	NE
	10/25/95	Chloride	58.6		=	2.5	250	250
	10/25/95	Magnesium	46.0	J	=	39.2	NE	NE
	10/25/95	Nitrate, as N	0.02		U	0.02	10	10
	10/25/95	Phosphate	0.18		=	0.05	NE	NE
	10/25/95	Potassium	1.24		=	0.714	NE	NE
	10/25/95	Sodium	24.2	J	=	32.3	NE	NE
	10/25/95	Sulfate	41.2		=	10	NE	NE
	10/25/95	Total dissolved solids	697		=	5	500	500
HISS15	10/25/95	Alkalinity	496		=	4	NE	NE
QC duplicate[e]	10/25/95	Bicarbonate	496		=	4	NE	NE
	10/25/95	Calcium	113	J	=	16.7	NE	NE
	10/25/95	Carbonate	4		U	4	NE	NE
	10/25/95	Chloride	56.9		=	2.5	250	250
	10/25/95	Magnesium	47.5	J	=	39.2	NE	NE
	10/25/95	Nitrate, as N	0.02		U	0.02	10	10
	10/25/95	Phosphate	0.29		=	0.05	NE	NE
	10/25/95	Potassium	0.71		U	0.714	NE	NE
	10/25/95	Sodium	25.0	J	=	32.3	NE	NE
	10/25/95	Sulfate	38.9		=	5	NE	NE
	10/25/95	Total dissolved solids	701		=	5	500	500

Table 9
1995 Groundwater Quality Analytical Results
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result (mg/L)	Data Qualifiers [a] BNI	Data Qualifiers [a] Lab	Detection Limit (mg/L)	Related Regulations [b] Federal [c] (mg/L)	Related Regulations [b] State [d] (mg/L)
HISS17S	10/25/95	Alkalinity	351		=	2	NE	NE
	10/25/95	Bicarbonate	351		=	2	NE	NE
	10/25/95	Calcium	121	J	=	16.7	NE	NE
	10/25/95	Carbonate	2		U	2	NE	NE
	10/25/95	Chloride	23		=	1.2	250	250
	10/25/95	Magnesium	61.3	J	=	39.2	NE	NE
	10/25/95	Nitrate, as N	50.9		=	2	10	10
	10/25/95	Phosphate	0.05		U	0.05	NE	NE
	10/25/95	Potassium	0.71		U	0.714	NE	NE
	10/25/95	Sodium	32.2	J	=	32.3	NE	NE
	10/25/95	Sulfate	105		=	12.5	NE	NE
	10/25/95	Total dissolved solids	748		=	5	500	500
B53W20S	10/25/95	Alkalinity	362		=	4	NE	NE
background	10/25/95	Bicarbonate	362		=	4	NE	NE
	10/25/95	Calcium	97.6	J	=	16.7	NE	NE
	10/25/95	Carbonate	4		U	4	NE	NE
	10/25/95	Chloride	8.9		=	0.25	250	250
	10/25/95	Magnesium	49.6	J	=	39.2	NE	NE
	10/25/95	Nitrate, as N	1.1		=	0.04	10	10
	10/25/95	Phosphate	0.085		=	0.05	NE	NE
	10/25/95	Potassium	1.86		=	0.714	NE	NE
	10/25/95	Sodium	9.9	J	=	32.3	NE	NE
	10/25/95	Sulfate	105		=	12.5	NE	NE
	10/25/95	Total dissolved solids	565		=	5	500	500

a. Bechtel National, Inc. and laboratory data qualifier flags:
U = The analyte was not detected. The detection limit is reported.
J = Reported as an estimated value. Data quality evaluation indicates that the analytical result is an estimate of the actual value.
(=) = Analytical result reported; no flag also indicates actual value reported.

b. Regulations presented pertain to drinking water quality and are listed for comparison only. No drinking water supply is obtained from groundwater at HISS. NE = Not established.

c. Safe Drinking Water Act maximum contaminant levels from EPA Drinking Water Regulations and Health Advisories (May 1994).

d. Missouri state standards.

e. A quality control (QC) duplicate is collected at the same time and location and is analyzed by the same method for use in evaluation of precision in sampling and analysis.

Table 10
1995 Groundwater Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/L)	BNI Flag [b]	MDA [c] (pCi/L)	Result Above Background [d] (pCi/L)	DCG [e] (pCi/L)
B53W20S	04/06/95	Radium-226	0.11 ± 0.10	UJ	0.12	-0.04 ± 0.11	100
background	10/25/95	Radium-226	0.31 ± 0.16		0.14	0.16 ± 0.16	100
	04/06/95	Thorium-230	0.12 ± 0.11	U	0.11	0.02 ± 0.12	300
	10/25/95	Thorium-230	0.26 ± 0.21	U	0.17	0.16 ± 0.22	300
	04/06/95	Thorium-232	0.07 ± 0.00	UJ	0.07	0.02 ± 0.02	50
	10/25/95	Thorium-232	0.10 ± 0.00	UJ	0.10	0.05 ± 0.02	50
	04/06/95	Total uranium	1.90 ± 0.14		0.02	0.20 ± 0.17	600
	10/25/95	Total uranium	2.18 ± 0.01		0.02	0.48 ± 0.10	600
HISS13	04/07/95	Radium-226	0.18 ± 0.19	UJ	0.22	0.03 ± 0.19	100
	10/24/95	Radium-226	0.19 ± 0.16	UJ	0.21	0.04 ± 0.16	100
	04/07/95	Thorium-230	0.05 ± 0.07	UJ	0.07	-0.05 ± 0.09	300
	10/24/95	Thorium-230	0.64 ± 0.30	J	0.16	0.54 ± 0.30	300
	04/07/95	Thorium-232	0.07 ± 0.00	UJ	0.07	0.02 ± 0.02	50
	10/24/95	Thorium-232	0.06 ± 0.09	UJ	0.08	0.01 ± 0.09	50
	04/07/95	Total uranium	6.30 ± 0.64		0.02	4.60 ± 0.65	600
	10/24/95	Total uranium	6.24 ± 0.07		0.02	4.54 ± 0.12	600
HISS15	04/06/95	Radium-226	0.41 ± 0.28		0.28	0.26 ± 0.28	100
	10/25/95	Radium-226	0.54 ± 0.32		0.21	0.39 ± 0.32	100
	04/06/95	Thorium-230	0.19 ± 0.15	U	0.14	0.09 ± 0.16	300
	10/25/95	Thorium-230	0.26 ± 0.19	J	0.15	0.16 ± 0.20	300
	04/06/95	Thorium-232	-0.01 ± 0.01	UJ	0.11	-0.06 ± 0.02	50
	10/25/95	Thorium-232	0.15 ± 0.00	UJ	0.15	0.10 ± 0.02	50
	04/06/95	Total uranium	1.35 ± 0.14		0.02	-0.35 ± 0.17	600
	10/25/95	Total uranium	1.23 ± 0.01		0.02	-0.47 ± 0.10	600
HISS15	04/06/95	Radium-226	0.44 ± 0.30		0.27	0.29 ± 0.30	100
QC duplicate [f]	10/25/95	Radium-226	0.36 ± 0.27		0.28	0.21 ± 0.27	100
	04/06/95	Thorium-230	0.15 ± 0.11	U	0.06	0.05 ± 0.12	300
	10/25/95	Thorium-230	0.17 ± 0.16	UJ	0.18	0.07 ± 0.17	300
	04/06/95	Thorium-232	0.10 ± 0.10	U	0.10	0.05 ± 0.10	50
	10/25/95	Thorium-232	0.03 ± 0.07	UJ	0.22	-0.02 ± 0.07	50
	04/06/95	Total uranium	1.35 ± 0.14		0.02	-0.35 ± 0.17	600
	10/25/95	Total uranium	1.22 ± 0.01		0.02	-0.48 ± 0.10	600

Table 10
1995 Groundwater Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/L)	BNI Flag [b]	MDA [c] (pCi/L)	Result Above Background [d] (pCi/L)	DCG [e] (pCi/L)
B53W20S	04/06/95	Radium-226	0.11 ± 0.10	UJ	0.12	-0.04 ± 0.11	100
background	10/25/95	Radium-226	0.31 ± 0.16		0.14	0.16 ± 0.16	100
	04/06/95	Thorium-230	0.12 ± 0.11	U	0.11	0.02 ± 0.12	300
	10/25/95	Thorium-230	0.26 ± 0.21	U	0.17	0.16 ± 0.22	300
	04/06/95	Thorium-232	0.07 ± 0.00	UJ	0.07	0.02 ± 0.02	50
	10/25/95	Thorium-232	0.10 ± 0.00	UJ	0.10	0.05 ± 0.02	50
	04/06/95	Total uranium	1.90 ± 0.14		0.02	0.20 ± 0.17	600
	10/25/95	Total uranium	2.18 ± 0.01		0.02	0.48 ± 0.10	600
HISS13	04/07/95	Radium-226	0.18 ± 0.19	UJ	0.22	0.03 ± 0.19	100
	10/24/95	Radium-226	0.19 ± 0.16	UJ	0.21	0.04 ± 0.16	100
	04/07/95	Thorium-230	0.05 ± 0.07	UJ	0.07	-0.05 ± 0.09	300
	10/24/95	Thorium-230	0.64 ± 0.30	J	0.16	0.54 ± 0.30	300
	04/07/95	Thorium-232	0.07 ± 0.00	UJ	0.07	0.02 ± 0.02	50
	10/24/95	Thorium-232	0.06 ± 0.09	UJ	0.08	0.01 ± 0.09	50
	04/07/95	Total uranium	6.30 ± 0.64		0.02	4.60 ± 0.65	600
	10/24/95	Total uranium	6.24 ± 0.07		0.02	4.54 ± 0.12	600
HISS15	04/06/95	Radium-226	0.41 ± 0.28		0.28	0.26 ± 0.28	100
	10/25/95	Radium-226	0.54 ± 0.32		0.21	0.39 ± 0.32	100
	04/06/95	Thorium-230	0.19 ± 0.15	U	0.14	0.09 ± 0.16	300
	10/25/95	Thorium-230	0.26 ± 0.19	J	0.15	0.16 ± 0.20	300
	04/06/95	Thorium-232	-0.01 ± 0.01	UJ	0.11	-0.06 ± 0.02	50
	10/25/95	Thorium-232	0.15 ± 0.00	UJ	0.15	0.10 ± 0.02	50
	04/06/95	Total uranium	1.35 ± 0.14		0.02	-0.35 ± 0.17	600
	10/25/95	Total uranium	1.23 ± 0.01		0.02	-0.47 ± 0.10	600
HISS15	04/06/95	Radium-226	0.44 ± 0.30		0.27	0.29 ± 0.30	100
QC duplicate [f]	10/25/95	Radium-226	0.36 ± 0.27		0.28	0.21 ± 0.27	100
	04/06/95	Thorium-230	0.15 ± 0.11	U	0.06	0.05 ± 0.12	300
	10/25/95	Thorium-230	0.17 ± 0.16	UJ	0.18	0.07 ± 0.17	300
	04/06/95	Thorium-232	0.10 ± 0.10	U	0.10	0.05 ± 0.10	50
	10/25/95	Thorium-232	0.03 ± 0.07	UJ	0.22	-0.02 ± 0.07	50
	04/06/95	Total uranium	1.35 ± 0.14		0.02	-0.35 ± 0.17	600
	10/25/95	Total uranium	1.22 ± 0.01		0.02	-0.48 ± 0.10	600

Table 10
1995 Groundwater Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/L)	BNI Flag [b]	MDA [c] (pCi/L)	Result Above Background [d] (pCi/L)	DCG [e] (pCi/L)
HISS16	04/07/95	Radium-226	1.00 ± 0.61		0.53	0.85 ± 0.61	100
	10/24/95	Radium-226	1.56 ± 0.43		0.08	1.41 ± 0.43	100
	04/07/95	Thorium-230	0.67 ± 0.29		0.06	0.57 ± 0.29	300
	10/24/95	Thorium-230	0.28 ± 0.22	J	0.22	0.18 ± 0.23	300
	04/07/95	Thorium-232	0.02 ± 0.05	UJ	0.06	-0.03 ± 0.05	50
	10/24/95	Thorium-232	0.04 ± 0.08	UJ	0.11	-0.01 ± 0.08	50
	04/07/95	Total uranium	22.07 ± 2.64		0.02	20.37 ± 2.64	600
	10/24/95	Total uranium	27.06 ± 0.86		0.02	25.36 ± 0.87	600
HISS17S	04/07/95	Radium-226	0.15 ± 0.19	UJ	0.29	0.00 ± 0.19	100
	10/25/95	Radium-226	0.28 ± 0.28	UJ	0.32	0.13 ± 0.28	100
	04/07/95	Thorium-230	0.09 ± 0.09	UJ	0.11	-0.01 ± 0.10	300
	10/25/95	Thorium-230	0.07 ± 0.10	UJ	0.17	-0.03 ± 0.11	300
	04/07/95	Thorium-232	0.02 ± 0.05	UJ	0.11	-0.03 ± 0.05	50
	10/25/95	Thorium-232	0.04 ± 0.07	UJ	0.10	-0.01 ± 0.07	50
	04/07/95	Total uranium	3.66 ± 0.37		0.02	1.96 ± 0.39	600
	10/25/95	Total uranium	3.67 ± 0.04		0.02	1.97 ± 0.11	600
HISS20S	04/10/95	Radium-226	0.49 ± 0.32		0.33	0.34 ± 0.32	100
	10/26/95	Radium-226	0.61 ± 0.25		0.13	0.46 ± 0.25	100
	04/10/95	Thorium-230	0.07 ± 0.09	UJ	0.12	-0.03 ± 0.10	300
	10/26/95	Thorium-230	0.46 ± 0.27	J	0.10	0.36 ± 0.27	300
	04/10/95	Thorium-232	-0.02 ± 0.02	UJ	0.17	-0.07 ± 0.03	50
	10/26/95	Thorium-232	0.04 ± 0.07	UJ	0.21	-0.01 ± 0.07	50
	04/10/95	Total uranium	7.58 ± 0.88		0.02	5.88 ± 0.89	600
	10/26/95	Total uranium	8.43 ± 0.27		0.02	6.73 ± 0.29	600

a. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level). Negative laboratory results occur when the average background activity of the laboratory counting instrument exceeds the measured sample activity.

b. Bechtel National, Inc. data qualifier flags:
   U = The analyte was not detected. Trace concentrations of thorium-230 were detected in the associated laboratory blanks. If sample results are less than 5 times the blank contamination the result is nondetect.
   J = Reported as an estimated value.
   UJ = Analyte was undetected; estimated value reported. The result is below the MDA or less than the associated error term.

c. Minimum detectable activity

d. Historical (1993-1995) average background for groundwater is 0.15±0.04, 0.1±0.05, 0.05±0.02, and 1.7±0.10 pCi/L for radium-226, thorium-230, thorium-232, and total uranium, respectively. Associated error term for result above background was calculated: $(error^2_{result} + error^2_{background})^{1/2}$

e. DOE derived concentration guide for water.

f. A quality control (QC) duplicate is collected at the same time and location and is analyzed by the same method for use in evaluation of precision in sampling and analysis.

Table 11
1995 Stormwater Analytical Results and Field Parameters - Chemical Constituents
Hazelwood Interim Storage Site

Sampling Location [a]	Date Collected	Analyte	Result	Result Units	Data Qualifiers [b] BNI	Data Qualifiers [b] Lab	Detection Limit	NPDES Permit Limitations [c]
STW001	01/13/95	Settleable solids	0.5	mL/L/h	UJ	U	0.5	1.0 mL/L/h [d]
	02/03/95	Settleable solids	0.5	mL/L/h	UJ	U	0.5	1.0 mL/L/h
	03/22/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	04/20/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	05/19/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	06/30/95	Settleable solids	no sample [e]					
	07/20/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	08/07/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	09/30/95	Settleable solids	no sample [e]					
	10/03/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	11/13/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	12/18/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	01/13/95	Total organic carbon	4.6	mg/L		=	0.5	NE
	04/20/95	Total organic carbon	13	mg/L	J	=	0.5	NE
	09/30/95	Total organic carbon	no sample [e]					
	12/18/95	Total organic carbon	9.8	mg/L		=	0.5	NE
	01/13/95	Total organic halides	9	ug/L		=	5	NE
	04/20/95	Total organic halides	12.5	ug/L			5	NE
	09/30/95	Total organic halides	no sample [e]					
	12/18/95	Total organic halides	19.8	ug/L	J	=	5	NE
	01/13/95	pH	6.57	pH units			NA [f]	6 - 9
	04/20/95	pH	no sample [e]					
	09/30/95	pH	no sample [e]					
	12/18/95	pH	6.78	pH units			NA [f]	6 - 9
	01/13/95	Specific conductivity	178	µmhos/cm			NA [f]	NE
	04/20/95	Specific conductivity	no sample [e]					
	09/30/95	Specific conductivity	no sample [e]					
	12/18/95	Specific conductivity	40	µmhos/cm			NA [f]	NE

Table 11
1995 Stormwater Analytical Results and Field Parameters - Chemical Constituents
Hazelwood Interim Storage Site

Sampling Location [a]	Date Collected	Analyte	Result	Result Units	Data Qualifiers [b] BNI	Data Qualifiers [b] Lab	Detection Limit	NPDES Permit Limitations [c]
STW002	01/13/95	Settleable solids	0.5	mL/L/h	UJ	U	0.5	1.0 mL/L/h [d]
	02/03/95	Settleable solids	0.5	mL/L/h	UJ	U	0.5	1.0 mL/L/h
	03/22/95	Settleable solids	no sample [e]					
	04/20/95	Settleable solids	no sample [e]					
	05/19/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	06/30/95	Settleable solids	no sample [e]					
	07/20/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	08/07/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	09/30/95	Settleable solids	no sample [e]					
	10/03/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	11/13/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	12/18/95	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	01/13/95	Total organic carbon	4.7	mg/L		=	0.5	NE
	04/20/95	Total organic carbon	no sample [e]					
	09/30/95	Total organic carbon	no sample [e]					
	12/18/95	Total organic carbon	6.4	mg/L		=	0.5	NE
	01/13/95	Total organic halides	32.9	ug/L		=	10	NE
	04/20/95	Total organic halides	no sample [e]					
	09/30/95	Total organic halides	no sample [e]					
	12/18/95	Total organic halides	19.7	ug/L	J	=	6.2	NE
	01/13/95	pH	6.69	pH units			NA [f]	6 - 9
	04/20/95	pH	no sample [e]					
	09/30/95	pH	no sample [e]					
	12/18/95	pH	6.85	pH units			NA [f]	6 - 9
	01/13/95	Specific conductivity	153	µmhos/cm			NA [f]	NE
	04/20/95	Specific conductivity	no sample [e]					
	09/30/95	Specific conductivity	no sample [e]					
	12/18/95	Specific conductivity	40	µmhos/cm			NA [f]	NE

a. Text and figures refer to sampling locations as Outfall 001 and Outfall 002. This table presents the sampling locations as STW001 and STW002, respectively.

b. Bechtel National, Inc. and laboratory data qualifier flags:
U = The analyte was not detected. The detection limit is reported.
J = Reported as an estimated value. Data quality evaluation indicates that the analytical result is an estimate of the actual value.
UJ = Analyte was undetected; estimated value reported.
(=) = Analytical result reported; no flag also indicates actual value reported.

c. National Pollutant Discharge Elimination System Permit requirements. NE = Not established.

d. 1.0 mL/L/h is the monthly average limit; the daily maximum limit is 1.5 mL/L/h.

e. No sample collected due to constraints imposed by meteorological or field conditions.

f. pH and specific conductivity are field measurements; detection limits are not applicable.

Table 12
1995 Stormwater Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location [a]	Date Collected	Analyte	Result [b] (pCi/L)	BNI Flag [c]	MDA [d] (pCi/L)	DCG [e] (pCi/L)
STW001	01/13/95	Gross alpha	12.50 ± 2.70	J	1.20	NE
	04/20/95	Gross alpha	25.20 ± 2.30	J	0.37	NE
	09/30/95	Gross alpha	no sample [f]			
	12/18/95	Gross alpha	8.82 ± 2.42		2.14	NE
	01/13/95	Gross beta	7.70 ± 2.80		1.00	NE
	04/20/95	Gross beta	9.40 ± 2.00		0.44	NE
	09/30/95	Gross beta	no sample			
	12/18/95	Gross beta	10.90 ± 2.98		3.96	NE
	01/13/95	Lead-210	no sample			
	04/20/95	Lead-210	1.40 ± 1.50	UJ	0.46	30
	09/30/95	Lead-210	no sample			
	12/18/95	Lead-210	7.50 ± 2.70		0.69	30
	01/13/95	Radium-226	0.38 ± 0.31	UJ	0.41	100
	04/20/95	Radium-226	0.58 ± 0.37		0.36	100
	09/30/95	Radium-226	no sample			
	12/18/95	Radium-226	1.01 ± 0.61		0.43	100
	01/13/95	Radium-228	no sample			
	04/20/95	Radium-228	1.90 ± 2.30	UJ	1.60	100
	09/30/95	Radium-228	no sample			
	12/18/95	Radium-228	0.00 ± 1.48	UJ	3.83	100
	01/13/95	Thorium-230	5.00 ± 1.60	J	0.35	300
	04/20/95	Thorium-230	15.50 ± 4.20	J	0.15	300
	09/30/95	Thorium-230	no sample			
	12/18/95	Thorium-230	3.34 ± 0.87		0.14	300
	01/13/95	Thorium-232	0.11 ± 0.17	UJ	0.27	50
	04/20/95	Thorium-232	0.06 ± 0.11	UJ	0.15	50
	09/30/95	Thorium-232	no sample			
	12/18/95	Thorium-232	0.26 ± 0.17		0.07	50
	01/13/95	Total uranium	7.45 ± 0.88		0.02	600
	04/20/95	Total uranium	6.03 ± 0.62		0.02	600
	09/30/95	Total uranium	no sample			
	12/18/95	Total uranium	6.04 ± 0.07		0.02	600
STW002	01/13/95	Gross alpha	32.40 ± 3.40	J	0.96	NE
	04/20/95	Gross alpha	no sample			
	09/30/95	Gross alpha	no sample			
	12/18/95	Gross alpha	17.50 ± 3.92		3.00	NE
	01/13/95	Gross beta	13.60 ± 2.80		0.76	NE
	04/20/95	Gross beta	no sample			
	09/30/95	Gross beta	no sample			
	12/18/95	Gross beta	11.38 ± 4.17		5.98	NE

Table 12
1995 Stormwater Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location [a]	Date Collected	Analyte	Result [b] (pCi/L)	BNI Flag [c]	MDA [d] (pCi/L)	DCG [e] (pCi/L)
STW002	01/13/95	Lead-210	no sample [f]			
continued	04/20/95	Lead-210	no sample			
	09/30/95	Lead-210	no sample			
	12/18/95	Lead-210	7.30 ± 1.60		0.46	30
	01/13/95	Radium-226	0.90 ± 0.49		0.17	100
	04/20/95	Radium-226	no sample			
	09/30/95	Radium-226	no sample			
	12/18/95	Radium-226	0.83 ± 0.53		0.38	100
	01/13/95	Radium-228	no sample			
	04/20/95	Radium-228	no sample			
	09/30/95	Radium-228	no sample			
	12/18/95	Radium-228	0.41 ± 1.59	UJ	3.95	100
	01/13/95	Thorium-230	13.80 ± 3.40		0.20	300
	04/20/95	Thorium-230	no sample			
	09/30/95	Thorium-230	no sample			
	12/18/95	Thorium-230	17.36 ± 3.90		0.18	300
	01/13/95	Thorium-232	0.04 ± 0.09	UJ	0.12	50
	04/20/95	Thorium-232	no sample			
	09/30/95	Thorium-232	no sample			
	12/18/95	Thorium-232	0.12 ± 0.14	UJ	0.11	50
	01/13/95	Total uranium	16.18 ± 1.90		0.02	600
	04/20/95	Total uranium	no sample			
	09/30/95	Total uranium	no sample			
	12/18/95	Total uranium	2.32 ± 0.03		0.02	600

a. Text and figures refer to sampling locations as Outfall 001 and Outfall 002. This table presents the sampling locations as STW001 and STW002, respectively.
b. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level).
c. Bechtel National, Inc. data qualifier flags:
J = Reported as an estimated value.
UJ = Analyte was undetected; estimated value reported. The result is below the MDA or less than the associated error term.
d. Minimum detectable activity
e. DOE derived concentration guide for water. NE = Not established.
f. No sample collected due to constraints imposed by meteorological or field conditions.