ST. LOUIS AIRPORT/HAZELWOOD INTERIM
STORAGE/FUTURA COATINGS COMPANY
ST. LOUIS, ST. LOUIS COUNTY, MISSOURI
CERCLIS NO. MOD980633176
MAY 10, 1991

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

Comment Period Ends:

JUNE 13, 1991

DEPARTMENT OF HEALTH & HUMAN SERVICES

077661

Public Health Service

SL-062

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

May 9, 1991

Mr. John Henry
Bechtel National, Inc.
9200 Latty Avenue
Hazelwood, Missouri 63042

Dear Mr. Henry:

Enclosed please find three copies of the Agency for Toxic Substances and Disease Registry (ATSDR) Preliminary Health Assessment - Public Comment Release for the St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Company Site. This Preliminary Health Assessment is ATSDR's evaluation of data and information on the release of radioactive substances into the environment from the St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Company, St. Louis, Missouri, CERCLIS NO. MOD980633176. The purpose of the Preliminary Health Assessment is to assess any current or future impact on public health.

On behalf of all concerned public/private agencies and citizens, ATSDR is requesting that the St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Company Site Preliminary Health Assessment be placed in the repository for this site. This will permit any interested party to review and comment on the Health Assessment. As indicated in the enclosed Public Notice, ATSDR will accept written comments from the public until June 13, 1991. Comments should be addressed to: Ms. Lydia Ogden-Askew, Community Involvement Liaison, Division of Health Assessment and Consultation, ATSDR, Mailstop E-32, 1600 Clifton Road, N.E., Atlanta, Georgia 30333.

ATSDR is responsible for coordinating all news releases and the publication of the Public Notice. We only request that you permit any interested party to review and/or copy the Preliminary Health Assessment. The enclosed Preliminary Health Assessment should not be removed from the repository.

If you have any questions, please do not hesitate to call Ms. Ogden-Askew, at 404/639-0610. Additionally, it is important that you acknowledge receipt of these documents so that we may have official notification of the repository status on record. Thank you for your cooperation and assistance.

Sincerely yours,

Max M. Howie, Jr.
Chief
Records and Information Management Branch
Division of Health Assessment
and Consultation

Enclosures

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THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXI LANATION

Section 104 (i) (7) (A) of the Comprehensive Environmental Response, Compensation, a id Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risk assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, ATSDR has conducted this preliminary health assessment on the data in the site summary form. Additional health assessments may be conducted for this site as more information becomes available to ATSDR.

The conclusion and recommendations presented in this Health Assessment are the result of site specific analyses and are not to be cited or quoted for other evaluations or Health Assessments.

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

Public Comment Release

PRELIMINARY HEALTH ASSESSMENT

FOR

ST. LOUIS AIRPORT
HAZELWOOD INTERIM STORAGE
FUTURA COATINGS COMPANY

ST. LOUIS, ST. LOUIS COUNTY, MISSOURI

CERCLIS NO. MOD980633176

ST. LOUIS AIRPORT
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May 9, 1991

SUMMARY

The St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Company, a National Priorities List site, is in St. Louis County, Missouri. The site, a U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP) activity, is near the St. Louis International Airport and the McDonnell Douglas Corporation. From 1946 to 1973, the site was used to store radioactive materials resulting from uranium processing. High levels of uranium, thorium, radium, and radon were detected in soil, groundwater, and air. The Agency for Toxic Substances and Disease Registry considers the St. Louis Airport site to be a potential public health concern because of the emission of radon and the presence of thorium in on-site air and off-site soils and the emission of radiation resulting from the presence of these materials.

BACKGROUND

A. SITE DESCRIPTION AND HISTORY

The St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Company site is in St. Louis County, Missouri. The site, which is composed of three smaller storage areas, was combined by the U.S. Environmental Protection Agency (EPA) into the present National Priorities List (NPL) site. These areas were the St. Louis Airport Storage Site (SLAPS), the Hazelwood Interim Storage Site (HISS) and the Futura Coatings Company site (FUTURA) (Figure 1). The HISS and FUTURA areas share common facilities. These three facilities were grouped together because of similarities of contaminants; proximity to each other; contaminated haul roads, including portions of Hazelwood Avenue, Pershall Road, and McDonnell Boulevard, between the areas; and air release of radon-222 (Rn-222). The sites also show the possibility of similar threats to public health (Mitre, 1988). The areas are also listed on the Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP).

The SLAPS is the largest of the three areas, covering 21.7 acres, and is approximately 15 miles northwest of downtown St. Louis. To the south is Banshee Road and a Norfolk and Western Railroad line, to the west is Coldwater Creek, and to the north and east is McDonnell Boulevard. Next to the SLAPS is the St. Louis International Airport on the south. The Berkeley Khoury League Park is to the north, and the McDonnell Douglas Corporation is to the west and southwest. The SLAPS slopes to the west toward the creek, which is about 20 feet below the site and 500 feet above mean sea level (Figure 2).

The HISS and FUTURA areas, which cover about 11 acres, are approximately 0.5 mile from SLAPS and approximately 2 miles northeast of the St. Louis Airport control tower. They are bounded on the north by Latty Avenue; on the east by the city of Berkeley; on the south by Hazelwood, the Norfolk and Western Railroad, and a tributary of the Coldwater Creek; and on the west by Coldwater Creek (Figure 3). The associated off-site locations collectively known as the Latty Avenue Properties are adjacent to the HIS and Furtura sites (Figure 4).

In 1946, the area was acquired by the Manhattan Engineering District of the U.S. Army and used to store uranium wastes generated by the Mallinckrodt operation in St. Louis. Wastes stored at these sites also included scrap metals, drums, covered piles, and unstabilized piles of waste generated during uranium-processing activities. At the SLAPS, the uranium-processing wastes were stored on open ground and once covered two-thirds of the area to an estimated height of 20 feet. In 1957, contaminated scrap metal and miscellaneous radioactive wastes were buried on the west portion of the SLAPS (USDOE, 1986a). In 1966, after the Continental Mining and Milling Company (CMM) purchased the property, the wastes were transferred from the SLAPS to the HISS. In 1967, CMM sold the property and wastes to the Commercial Discount Corporation of Chicago. The waste was then dried and shipped to the Cotter Corporation in Colorado. In December 1969, the Cotter Corporation purchased the remaining wastes at the HISS and shipped some material to Colorado. By late 1970, approximately 19,000 tons of uranium-processing waste (raffinate) and barium sulfate remained at the site. By 1973, most of the wastes were transferred to the Latty Avenue areas and the residual processing wastes had been removed to the Cotter Corporation in Canon City, Colorado.

Besides the wastes at the present NPL site, additional wastes were moved to either the Weldon Springs Quarry NPL site, also in Missouri, or to the West Lake Landfill in St. Louis County. During the latter part of the 1960's, the SLAPS land was transferred to the St. Louis Airport Authority, which partially remediated a portion of the area. The remediation included demolishing existing buildings and burying the wastes on-site. The area was covered with about 3 feet of clean fill during 1969. In 1977, the responsibility for the property, but not ownership, was returned to the DOE that was formed from the breakup of the Atomic Energy Commission (USDOE, 1986b).

Further remediation of the HISS and FUTURA area in 1977 generated 13,000 cubic yards of contaminated material that were placed in a pile at the HISS area. Later, the Nuclear Regulatory Commission (NRC) directed excavation of contaminated soils on the eastern portion of this area. In 1982, the HISS and FUTURA areas were placed on the DOE FUSRAP list. Also in 1982, ditches surrounding the SLAPS were sampled by Bechtel National, Inc. The results of this sampling delineated the limits of the uranium-238 (U-238) and radium-226 (Ra-226) contamination.

During 1984, additional remediation at Latty Avenue locations generated another 14,000 cubic yards that were stored in a second pile at HISS. Also during this time, a vehicle decontamination area was constructed, the area was fenced, and the waste piles were consolidated.

In 1985, the DOE was authorized to reacquire the SLAPS site (Public Law 98-360) and use it as a permanent disposal site for the waste existing on the site at that time. Also, contaminated soils from ditches surrounding the site and wastes stored at HISS were to be stored at the site. Erosion along the SLAPS was reduced by installing rock-filled structures along the western edge of the site. At Latty Avenue locations, monitoring wells were installed. The DOE also directed the Oak Ridge National Laboratories (ORNL) to survey the haul roads between these storage areas. On the basis of this survey, the major contaminant detected was thorium-230, (Th-230) and the portions of the haul roads to be remediated were determined. These areas included portions of Hazelwood Avenue, Pershall Road, and McDonnell Boulevard.

In 1986, the roads leading to these areas were improved and during this action, additional contaminated soils were removed from the area. Also, boreholes were drilled at the SLAPS to define the nature and extent of the contamination (USDOE, 1986a,b).

The total amount of the wastes believed to have been stored at the SLAPS is 125,150 tons, of which 241 tons were believed to be uranium, either naturally occurring (U-nat) or uranium-238 (U-238). Of this amount, the wastes perhaps consisted of 106,500 tons of raffinate, 10,200 tons of leached or unleached barium sulfate, 4,000 tons of dolomite and magnesium fluoride, 3,500 tons of scrap metal, 600 tons of U-containing sand and other contaminated materials in 2,400 drums, and 350 tons of miscellaneous wastes (Mitre, 1988).

In late 1989, the Army Corps of Engineers (COE) requested that DOE survey an additional portion of Coldwater Creek. The information garnered from this survey was used in preparing the COE's Coldwater Creek flood control project.

B. SITE VISIT

The Agency for Toxic Substances and Disease Registry (ATSDR) conducted a site visit on February 5, 1990. Participating in this visit were an ATSDR health physicist, a representative from the State of Missouri Department of Health, representatives from DOE and its contractor, Bechtel National, Inc., and a representative from EPA. During the site visit, a tour of the NPL site and off-site environs was given as well as a historical perspective of the operations resulting in the formation of the SLAPS.

C. DEMOGRAPHICS, LAND USE, AND NATURAL RESOURCE USE

The three areas comprising the NPL site are in a commercial and industrial area. The McDonnell Douglas Corporation is within 0.5 mile of the site and employs approximately 33,000 people. Runways from the St. Louis Airport terminate near the SLAPS boundary on the southwest edge of the site. The community closest to any one of the three areas is Hazelwood, Missouri, at a distance of less than 0.3 mile from HISS. The Hazelwood population in the 1980 census was 8,819 with most residents living north of Interstate-270, which is about 0.75 mile north of the property. The town of Berkeley (1980 population of 16,146) is to the south (Mitre, 1988).

A recreational area, Berkeley Khoury League Park, is to the north of the SLAPS and is contaminated with radioactive wastes previously stored at this site.

Coldwater Creek forms a site boundary and is not used for any recreational activities in the vicinity of SLAPS. However, since the creek is about 19 miles in length, some parks with recreational activities may occur along the creek. The nearest well is believed to be about 1.5 miles north of the SLAPS; however, no data are available to suggest if this well serves as a source of drinking water. There are no agricultural activities near the areas (Mitre, 1988).

COMMUNITY HEALTH CONCERNS

This site has posed many concerns for the health and safety of the residents in St. Louis. In 1987, the ATSDR released a health consultation, but could not adequately address the site then because of limited data. In that same year, a private citizen's letter to the U.S. Senators and Representatives of the region expressed concerns about the high concentrations of radioactive materials detected in soils, sediments, and the Coldwater Creek environs.

In 1988, the St. Louis Board of Aldermen passed a resolution stating their reluctance "that a permanent radioactive waste site near the airport would be in the best interest to area citizens or the local environment." The Board additionally remained opposed to releasing the title from the city to DOE for the purposes of site expansion (Resolution 146) unless specific conditions were met. In 1990, the Board of Aldermen voted to offer 81 acres near the airport to the DOE (St. Louis Post-Dispatch, February 5, 1990).

Concerns have been expressed about the nine cases of cancer reportedly found among the residents in the homes closest to the HISS. Citizens in this area of Hazelwood requested the Missouri Department of Health to investigate these cancer occurrences in the area and at other FUSRAP sites in the St. Louis area. This request has been referred to ATSDR. Members of the Division of Health Studies, ATSDR, have met with the State and investigated these complaints. As a result of this investigation, it was determined that a cancer cluster did not exist in the area surrounding the SLAPS. A cancer cluster is used to describe similarities between cancers, and in this location nine different cancers were found. Furthermore, the types of cancers in the Hazelwood area are not normally associated with exposure to alpha emitters found at this site but with exposure to gamma radiation.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. ON-SITE CONTAMINATION

Environmental monitoring locations for the SLAPS, HISS, and FUTURA areas are shown in Figures 5 and 6. Results of on-site sampling performed by the NRC, ORNL, and a DOE contractor found significant levels of radioactive materials in the groundwater, soils, and air. The contaminants detected were U-238, U-nat, Th-230 and Th-232, Ra-226, and radon (isotope not specified). The levels detected were in excess of the regional background (bkg) values for the St. Louis area as determined by the DOE. Although there is no surface water at the NPL site that could be contaminated, Coldwater Creek forms a boundary of the site (Figure 1) and contaminated surface runoff has entered the creek (Mitre, 1988).

Groundwater

Monitoring wells were located along the periphery of the site. Sampling results of these on-site groundwater monitoring locations at the SLAPS from 1981 to 1982 showed elevated levels of U-238. The yearly average during this time was approximately 439 picocuries per liter (pCi/L) (one picocurie equals 10^{-12} curies), with the highest well averaging an excess of 1,851 pCi/L during this time. Radium-226 and Th-230 were also detected in the groundwater. These monitoring results showed average concentrations for Ra-226 and Th-230 of 0.64 pCi/L and 0.8 pCi/L, respectively. The highest concentrations detected showed levels of 1 pCi/L for Ra-226 and 1.8 pCi/L for Th-230.

In 1988, groundwater monitoring at SLAPS showed the concentrations of total uranium ranged from bkg to over 5,500 pCi/L, for Ra-226 the concentrations ranged from bkg to about 1 pCi/L, and for Th-230 the concentrations ranged from bkg to over 50 pCi/L at on-site locations (Bechtel, 1989a). At HISS, groundwater samples from the site showed uranium concentrations ranging from bkg to 87 pCi/L, Th-230 from bkg to 64 pCi/L, and Ra-226 from bkg to 3.7 pCi/L (Tables 1, 2).

Surface Water

Surface water sampling in Coldwater Creek by the SLAPS showed the maximum concentration of total uranium, including background, was 4 pCi/L. The

concentrations of Th-230 and Ra-226 were at or below bkg (Bechtel, 1989a). Surface water measurements for radionuclides at the HISS showed the presence of total uranium ranging from bkg to 5 pCi/L, Th-230 ranging from 0.1 to 0.9 pCi/L, and Ra-226 ranging from 0.1 to 0.3 pCi/L (Tables 1, 2).

Sediment

Sediment sampling at the SLAPS for total uranium, Th-230, and Ra-226 showed maximum concentrations of 1.7 pCi/g, 4.1 pCi/g, and bkg, respectively (Bechtel, 1989a) (Table 1). Sediment sampling at the HISS for total uranium, Th-230, and Ra-226 showed average concentrations of 1.7 pCi/g, 4.8 pCi/g, and 1.2 pCi/g, respectively (Table 2) (Bechtel, 1989b).

Air

Airborne contamination at these areas consists of both gamma radiation and Rn-222. The amount, or intensity, of gamma rays depends on the type of radioactive material at the site, its concentration and depth from the surface, and physical distribution in the soil. This intensity results in an exposure rate. Measurements of the gamma ray exposure rate were made with a pressurized ionization chamber. The Rn-222 concentration is dependent on the amount of Ra-226 present, since Rn-222 is the first decay product produced during decay of the Ra-226. Airborne measurements for Rn-222 were the average of 25 stations determined by alpha track detectors. The bkg station was 5 miles from the areas.

At the SLAPS, the gamma exposure rate has been measured at 9 to 261 x 10^{-6} roentgens per hour (R/hr, a roentgen is a unit of radiation exposure), with an average of 84 x 10^{-6} R/hr taken along the northern boundary (Bechtel, 1987c). In 1988, gamma radiation measurements showed a radiation exposure rate ranging from 17 to 2,229 x 10^{-3} R/yr above a bkg average of 73x10^{-3} R/yr (Bechtel, 1989a).

At the HISS area, the exposure rate was 13 to 55 x 10^{-6} R/hr, with an average of 24 x 10^{-6} R/hr. The exposure rate at the FUTURA site was 8 to 27 x 10^{-6} R/hr outside existing structures. The bkg in the St. Louis area was 8 x 10^{-6} R/hr. Gamma radiation readings at the site during 1988 ranged from 13 to 55 x 10^{-6} R/hr with an average exposure rate of 24 x 10^{-6} R/hr with the bkg in the St. Louis area of 8 x 10^{-6} R/hr.

Rn-222 measurements at the SLAPS site, including the bkg of 0.3 pCi/L, ranged from bkg to 6.8 pCi/L with a maximum average of 3.4 pCi/L. Results from the HISS ranged from bkg to 3.4 pCi/L with a maximum average of 1.8 pCi/L. there were seasonal variations in the measurements as Because gas emanation is dependent on atmospheric temperature and pressure, there were seasonal variations in the measurements. Ra-222 at the SLAPS for 1988 ranged from 0.3 to 4.6 pCi/L, including a bkg reading ranging from 0.3 to 0.6 pCi/L. Background sampling locations were located a minimum of 0.5 mile from the site. The average Rn-222 concentration at the site from 1984 to 1988 has ranged from 0.1 pCi/L to 3.6 pCi/L (Bechtel, 1989a). The DOE limit for FUSRAP sites is 3 pCi/L.

values were above the DOE guidelines for FUSRAP locations. Surface soils from along the creek bank suggested the presence of U-238 (78 pCi/g), Th-232 (5 pCi/g), Th-230 (5,100 pCi/g), and Ra-226 (71 pCi/g) (Bechtel, 1990).

During 1989, the COE collected additional soil plug samples along the banks of Coldwater Creek. These samples were collected beginning at the termination point of the Bechtel study and proceeded for an additional 4.8 miles along the banks at 500 foot intervals. The top 6 inches of the soil plug were also analyzed for U-238, Th-232, Th-230, and Ra-226. The results of these sampling activities showed the maximum concentrations (above background) of U-238, Th-232, Th-230, and Ra-226 were 12.9 pCi/g, 4 pCi/g, 27.7 pCi/g, and 2.4 pCi/g, respectively. Of these levels, Th-230 exceeded the DOE clean-up levels. It has not been determined if the concentration of uranium in this survey exceeds guidelines since the guidelines are still being formulated for the St. Louis area (FUSRAP, 1989).

The results of soil sampling from over 60 properties located along the haul roads have been reviewed and summarized. The maximum levels detected and the corresponding depths are given in Table 4 (Bechtel, 1990). The contamination was mostly confined to a depth of a foot over the haul roads. Along Latty Avenue, however, in one area, the contamination was found as deep as 7 feet. The survey along McDonnell Boulevard suggested the contamination in one location was at least 15 feet deep and over 1300 feet in length. In one isolated area near the intersection of Eva Avenue and McDonnell Boulevard, the contamination was found to a depth of 5 feet. Along Hazelwood Avenue, the contamination was spread from the intersection of Frost Road to Pershall Road. Contamination along Pershall Road was found at an average depth of 3 feet, with an isolated area contaminated to a depth of 13 feet (Bechtel, 1990).

The results of sampling supplied from the Latty Properties were for near surface (12 inches above the surface), borehole readings for gamma-emitting contamination, and soil sampling for radionuclides. These data are shown in Table 3 (Bechtel, 1988).

Results of sampling from the Berkeley Khoury League Park recreational area indicated that the concentrations, in soils, of U-238 were 10 pCi/g; Th-230, 20 pCi/g; and Ra-226, 2 pCi/g.

Railroad

The ditches running along the boundary of the SLAPS were sampled by measurements in boreholes for the presence of gamma-emitting radioactive materials and soil samples. The major contaminant in these areas was Th-230, present at a maximum concentration of 15,000 pCi/g. The U-238, Th-232, and Ra-226 concentrations were 94 pCi/g, 6 pCi/g, and 130 pCi/g, respectively. These maximum contaminant levels were found in surface soils (a maximum depth of 1 foot).

Banshee Road borders the SLAPS on the southern boundary. The sampling of this area included 48 boreholes and sampling of surface soils. Two areas showed elevated levels of Th-230 (34 pCi/g) with U-238 (<46 pCi/g), Th-232 (<7.1 pCi/g) and Ra-226 (<7.1 pCi/g) also present.

Airport Property

No off-site air sampling data for Rn-222 were supplied.

Results of general sampling of biota along ditches near the creek showed that Ra-226 ranged from 0.008 to 0.2 pCi/g, Th-232 ranged from 0.0004 to 0.003 pCi/g, and U-238 ranged from 0.02 to 0.16 pCi/g (Bechtel, 1983).

C. QUALITY ASSURANCE AND QUALITY CONTROL

In preparing this preliminary health assessment, the ATSDR relies on the information provided in the referenced documents. The ATSDR assumes that adequate quality assurance and quality control measures were followed with regard to chain-of-custody, laboratory procedures, and data reporting. The validity of the analyses and conclusions drawn for this preliminary health assessment is determined by the availability and reliability of the referenced information.

In order to identify other possible facilities that could contribute to the release of contaminants into the environment near the SLAP site, ATSDR searched the most recent data contained in the Toxic Chemical Release Inventory (TRI). TRI is developed by the EPA from the chemical release (air, water, and soil) information provided by specified industries. In searching the data base by zip code, there were no reporting facilities in the same zip code as the SLAP site that released either radioactive materials or heavy metals to the environment.

D. PHYSICAL AND OTHER HAZARDS

The three areas composing the NPL site are fenced and placarded as a radiation area. There are no physical hazards at these areas. The baseball field is not part of the NPL site, but the city of St. Louis has closed the field and placed signs stating the area is closed. The area is not fenced and access is not controlled.

PATHWAYS ANALYSES

A. ENVIRONMENTAL PATHWAYS (FATE AND TRANSPORT)

The Coldwater Creek flows through or forms the boundary of the SLAPS areas. There is no known use of the creek for recreational purposes or as a water source near the site. The creek, 19 miles in length, originates about 3.5 miles south of SLAPS, flows for about 500 feet along the western boundary of the site, and then flows into the Missouri River about 15 miles northeast of the SLAPS area (FUSRAP, 1989). The river serves as the area's source of potable water, with the nearest water treatment facility on the Missouri River above the confluence of the creek with the river. The SLAPS was used without liners or a leachate collection system, and runoff has entered the creek. Surface water runoff ultimately flows into Coldwater Creek by direct overland flow or by drainage ditches into the creek that flows north-northeast into the Missouri River.

There are two groundwater systems at the SLAPS. The upper zone is composed of a wind deposit or an eolian layer and a lacustrine or lake deposit. The lower zone is composed of the lake deposit material only. Separating the upper and lower zone is a deposit of legislature silty clay (Bechtel, 1986). The underlying aquifer is alluvial and approximately 25 feet below the surface, is estimated to be 100 feet thick, and includes clay, slit, and gravel deposits. The depth to the water table ranges from 25 to 35 feet. The water from the system is saline, and wells produce low volumes of water. There is no known use of the aquifer within a 3-mile radius of the site.

Leaching from the soil to the groundwater has occurred. It is unknown if the groundwater, which is believed to flow toward Coldwater Creek, discharges into the creek.

The air pathway includes ionizing radiation, Rn-222, and the possible exposure from airborne dusts contaminated with radioactive substances or heavy metals. The ionizing radiation can easily penetrate air and nominal thickness materials with no or very little attenuation. Rn-222 is an inert, radioactive gas and migrates easily through air. The decay products of radon are particulate and can electrostatically attach to the dust particules.

There are no identified pathways for exposure from potentially contaminated biota. No commercial or private crops are grown in the area and no hunting or fishing is likely to occur in these areas.

B. HUMAN EXPOSURE PATHWAYS

Apparently, the surface water and groundwater are not used for water sources in the area, therefore, these pathways are not considered viable routes for exposure. Furthermore, the EPA drinking water standards (40 CFR 141) for radioactive materials are not exceeded in Coldwater Creek.

The exposure to ionizing radiation in the areas, although elevated in some sites, is not of concern because of the small amount of time a member of the public would spend in the areas of higher radiation.

The concentrations of Ra-226 and Th-230 at on-site locations are above the EPA and DOE limits of 5 pCi/g from 0 to 15 cm and 15 pCi/g over any 15 cm of soil beneath the surface (40 CFR 190-192). Since these areas are now fenced and covered with clean fill, this potential exposure route is not of great concern. There is concern, however, with the soil concentrations at the off-site Latty Properties because access to these areas are possibly not as restricted as that of the SLAPS, HISS, and FUTURA areas.

The release of Rn-222 from the soils into the air at the SLAPS exceeds the regulations of DOE for FUSRAP sites (3.0 pCi/L). This also exceeds the NRC limit in unrestricted areas (10 CFR 20) and poses an inhalation hazard. The elevated levels of the heavy metals antimony, beryllium, cobalt, nickel, selenium, and lead at the SLAPS, although of some public health concern, are not considered an imminent threat since the contaminated area is fenced and there is no public access.

Inhalation or ingestion of airborne contaminants associated with dusts can result in radiation exposure to the respiratory system and, to a lesser degree, exposure to the gastrointestinal tract.

Additional inhalation and ingestion of soil contaminants may have occurred during the use of the recreational fields when fugitive dusts were generated during athletic events. Because the haul roads associated with these sites are known to be contaminated with radioactive materials, exposure to human populations may have occurred during remediation of the roads in 1986 and during use of the roads by commercial and private vehicular traffic.

PUBLIC HEALTH IMPLICATIONS

The contaminants of concern are Rn-222 (radiological halflife of 3.8 days) and Th-230 (radiological halflife 75,400 years). Because of the type of radiation these radionuclides emit--alpha particles and gamma rays--the greatest public health concern arises from inhalation or ingestion of the material.

Rn-222 has been shown to be carcinogenic when inhaled, producing lung cancers. Most of these studies have involved uranium miners because radon is a primary member of a uranium decay chain. Although the gas itself is inert, some will be absorbed into the blood from the lungs and transported through the body (ATSDR, 1989a). However, the radon decay products are charged particulates in nature and will electrostatically deposit on lung surfaces. As these products decay further, many emit alpha particles that are completely absorbed in the structures containing the radon decay products. These particles are the major health hazard from exposure to radon gas. The National Council on Radiation Protection and Measurements (NCRP) estimates the annual dose from radon to the bronchial epithelium is 190 millirads for males and 10 year old children and 170 millirads for females (a rad is an estimate of the radiation exposure actually absorbed by a body). The lifetime risk of developing lung cancer from the inhalation of radon at a concentration of a picocurie per cubic meter is estimated at 0.21 per 100,000 population. It is estimated that the annual exposure to radon alone exceeds the exposure to all other naturally occurring sources of radioactivity (NCRP, 1984).

The concentration of Th-230 in soils is in the picocurie range and 1 picocurie of Th-230 has a mass of 48×10^{-12} grams (picograms). This amount of thorium is not considered a chemical hazard. Mice exposed to milligram amounts of thorium per cubic meter for 18 weeks showed no compound-related mortality. Similar types of studies with rats, guinea pigs, rabbits, and dogs resulted in similar findings. There have been no studies with humans concerning systemic exposures to thorium alone. A statistically significant excess of deaths resulting from pancreatic cancer has been reported in former thorium workers exposed to 0.13 milligrams/cubic meter (ATSDR, 1989b). Based on the amount of thorium present at these areas, the greatest hazard is the internal exposure to alpha particles and other radiations emitted from Th-230. The committed whole body dose equivalents (the radiation dose delivered over a 50-year period following intake of a specific radioactive substance) for this radioisotope are approximately 0.32×10^{-2} rem per picocurie inhaled and 0.54×10^{-2} rem per picocurie ingested (USEPA, 1988).

Appendix A gives the DOE calculations for individuals using the recreational fields. The ATSDR has reviewed these calculations, and its calculations were higher than those calculated by the DOE (ATSDR-15 mrem; DOE-6.5 mrem). ATSDR agrees with the initial calculation of the amount of contaminated dust inhaled. The difference in calculations appears to be in the amount of dust potentially ingested by a ball player. The DOE did not estimate the ingestion of soils by a person sliding into a base in the contaminated areas but used a value of 100 milligrams of soil ingested. The ATSDR used a value of 1 gram of soil being ingested which would account for the increase in the committed dose.

Available Health Outcome Data Bases

The Missouri Department of Health, State Center for Health Statistics, analyzes and consults on health related information collected from several sources. The Center's Bureau of Health Data Analysis has available statistical information, hospital discharge data and the Multi-Source Birth Defect Registry. The Multi-Source Birth Defect Registry consists of birth outcome data from the following sources: birth, death, hospital discharge Crippled Children's Services, and Neonatal Intensive Care Unit records.

For health assessments, cancer mortality rates by age, sex and cancer site are calculated to determine whether there is a significant difference between the area of concern and the rest of the state. Birth data include fetal deaths, low birth weight births, and frequency of malformations in the area of concern with comparison to the state rate.

For most of the state, the smallest geographic area that can be studied is defined by a zip code. In the St. Louis metropolitan area, census tract information is available that allows further refinement of the potentially exposed population. However, that may still represent a larger area than is actually affected by a site such as SLAPS and the additional people in the study group may well dilute and obscure any adverse health outcomes, if present.

CONCLUSIONS

Based on the information reviewed, the ATSDR considers the St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Company NPL site to be a potential public health concern. Emission of Rn-222 into the air and the presence of Th-230 in off-site soils are considered the primary contaminants of concern for their presence could result in humans inhaling and ingesting these contaminants.

RECOMMENDATIONS

- The ATSDR recommends that additional remediation and chemical characterization by the DOE be completed and submitted to ATSDR for evaluation. It is the Agency's understanding that the additional chemical characterization is presently being performed and that additional site remediation is continuing for these areas.

- Additional sampling data are required for ATSDR to complete its assessment of these areas. These data include more complete air monitoring data for off-site locations and sampling data for roads used to transport contaminated materials to and from these areas prior to remediation, and sampling of the baseball field.

- Based on the additional sampling of the baseball field, ATSDR will review these data and perhaps recommend that the baseball field and the recreational area be fenced and access restricted.

- During remediation of the haul roads, dust control measures should be implemented to reduce the generation of airborne dust, which would reduce the likelihood of internal deposition of radioactive materials.

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, the St. Louis Airport/Hazelwood Interim Storage/Futura Coatings Company NPL site has been evaluated for appropriate follow-up with respect to health effects studies. Since human exposure to on-site contaminants may have occurred in the past, this site is being considered for follow-up health effects studies. After consultation with Regional EPA staff and State and local health and environmental officials, the Division of Health Studies, ATSDR, has determined that follow-up public health actions or studies are appropriate for this site.

When indicated by public health needs, and as resources permit, the evaluation of additional relevant health outcome data and community health concerns, if available, is recommended.

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TABLES

Table 1

Environmental Sampling Data as reported in 1988 for the St. Louis Airport Storage Site[1]

	Groundwater	Surface Water	Sediment	Soils[2]
Uranium	5,500 pCi/L	0.4 pCi/L	1.7 pCi/g	1,600 pCi/g[3]
Th-232	ND[4]	ND	ND	63
Th-230	50	background	4.1	2,600
Ra-226	1	background	background	5,600

[1] The Maximum contaminant level for these radionuclides in drinking water is 5 pCi/L for radium and 15 pCi/L for gross alpha activity except for uranium.
[2] The concentration of thorium and radium in soils should not exceed 5 pCi/g above background over the first 15 cm of depth and 15 pCi/g averaged over 15 cm at depths greater than 15 cm (40 CFR 192). There are no standards for the concentration of uranium in soils.
[3] Value is for Uranium-238
[4] No Data

Table 2

Environmental Sampling Data as reported in 1988 for the Hazelwood Interim Storage Site[1]

	Groundwater	Surface Water	Sediment	Soils[2]
Uranium	87 pCi/L	5 pCi/L	1.7 pCi/g	800 pCi/g[3]
Th-232	ND[4]	ND	ND	5
Th-230	64	0.9	4.8	750
Ra-226	3.7	0.3	1.2	700

[1] The Maximum contaminant level for these radionuclides in drinking water is 5 pCi/L for radium and 15 pCi/L for gross alpha activity except for uranium.
[2] The concentration of thorium and radium in soils should not exceed 5 pCi/g above background over the first 15 cm of depth and 15 pCi/g averaged over 15 cm at depths greater than 15 cm (40 CFR 192). There are no standards for the concentration of uranium in soils.
[3] Value is for Uranium-238
[4] No Data

Table 3

Off-site Radionuclide Levels as reported in 1988 from the Latty Properties

Location	U-238	Th-232	Th-230	Ra-226
Wagner Electric Corporation	18 (1)	5 (1)	810 (0.5)	11 (0.5)
General Investment Fund	100 (0.5)	5 (5)	5,700 (0.5)	89 (0.5)
Crow-St. Louis	<20 (8)	4 (8)	460 (0.5)	10 (0.5)
SLT Warehouse Company	<39 (2)	5 (5)	15 (1)	4 (2)
Graham Engineering Corporation	<30 (8)	7 (8)	12 (0.5)	4 (8)

Values are expressed in pCi/g soil with the value in parenthesis the depth at which that level of contamination was found.

Table 4

Maximum Contamination Levels as reported in 1990 along the Haul Roads Associated with the SLAP NPL Site

Location	U-238	Th-232	Th-230	Ra-226
Latty Avenue	48.2 (1.5)	9.5 (2)	1,413	39.9 (1.5)
McDonnell Boulevard	59 (0.5)	9 (8)	2,900 (0.5)	64 (0.5)
Hazelwood Avenue	72 (0.5)	9 (2)	4,810 (0.5)	42 (0.5)
Pershall Road	73 (0.5)	8 (1)	4,900 (0.5)	92 (0.5)

Values are expressed in pCi/g soil with the value in parenthesis the depth, in feet, at which that level of contamination was found.

FIGURES

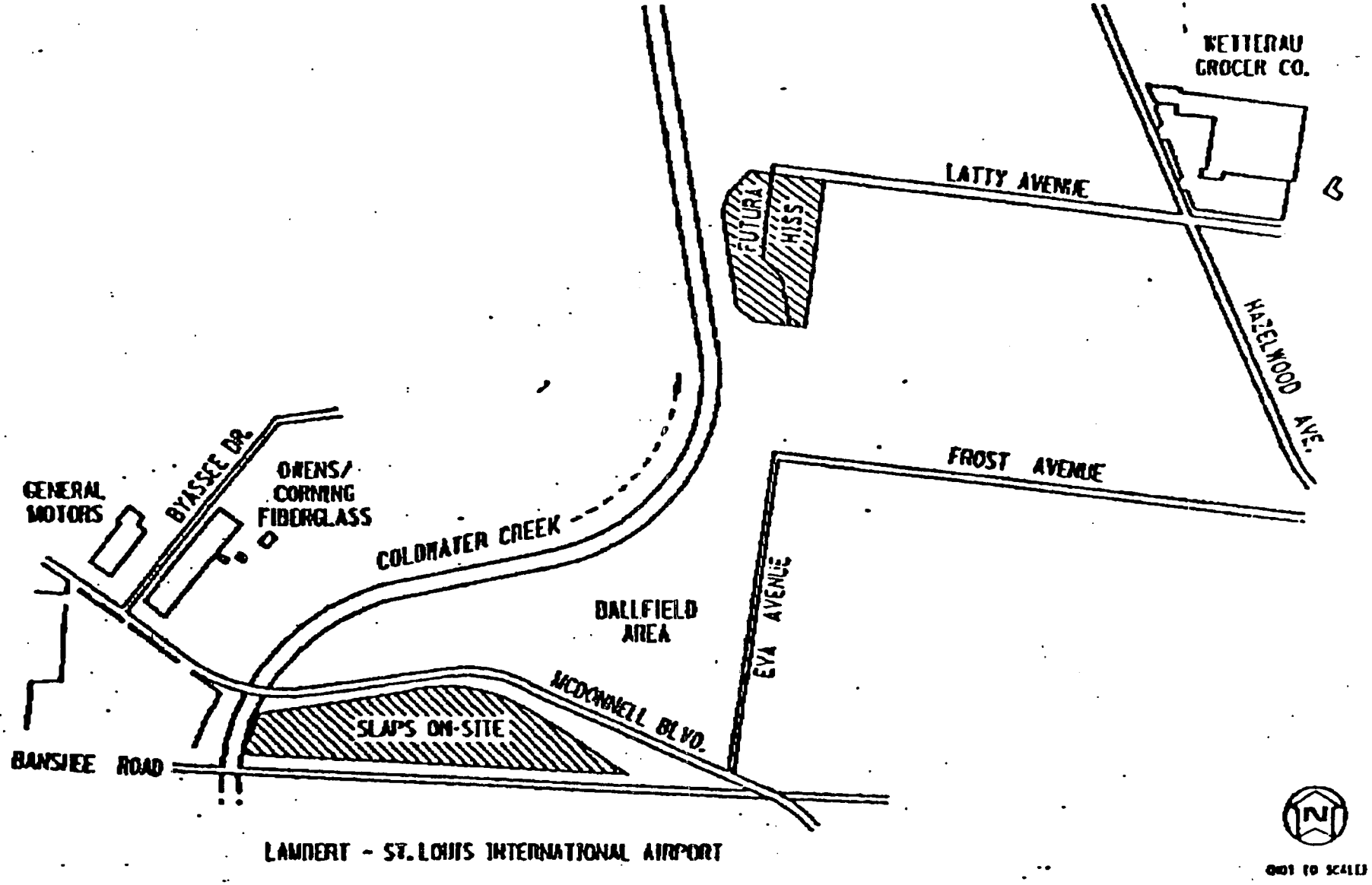

Figure 1. Location of the SLAP, HIS, and Futura sites

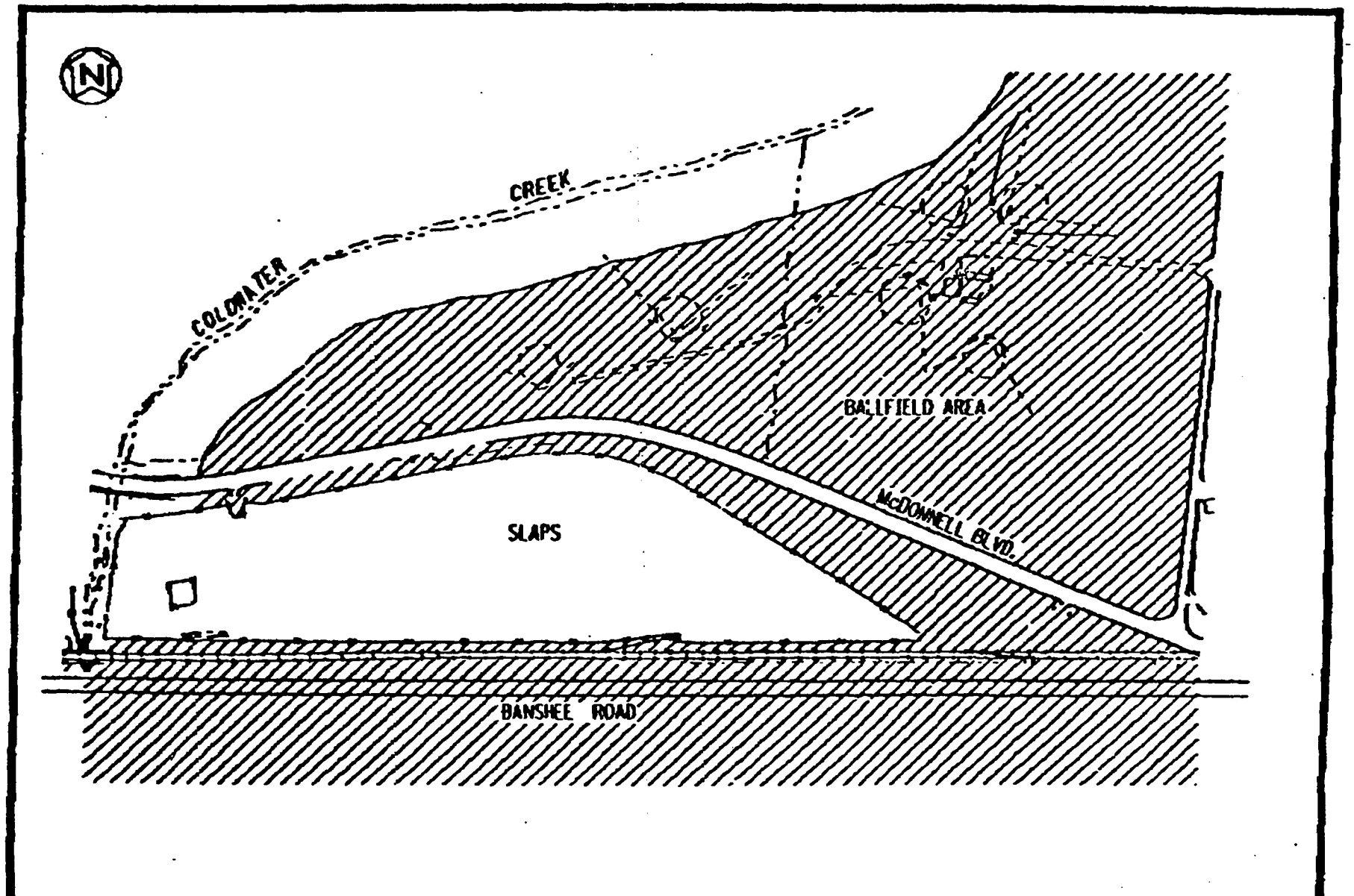

Figure 2. Location of the SLAP vicinity properties

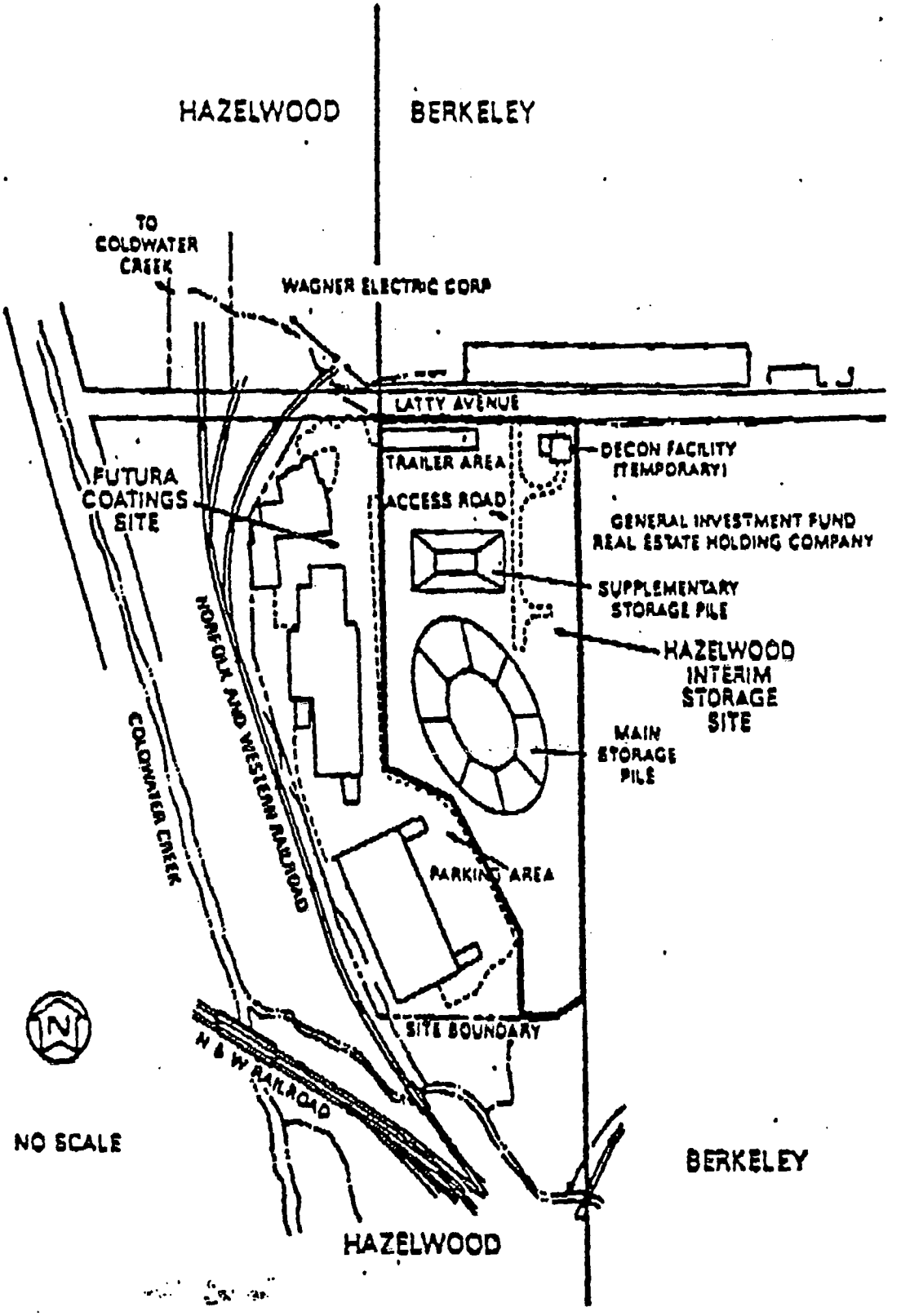

Figure 3. Boundaries of the HIS and Futura Sites

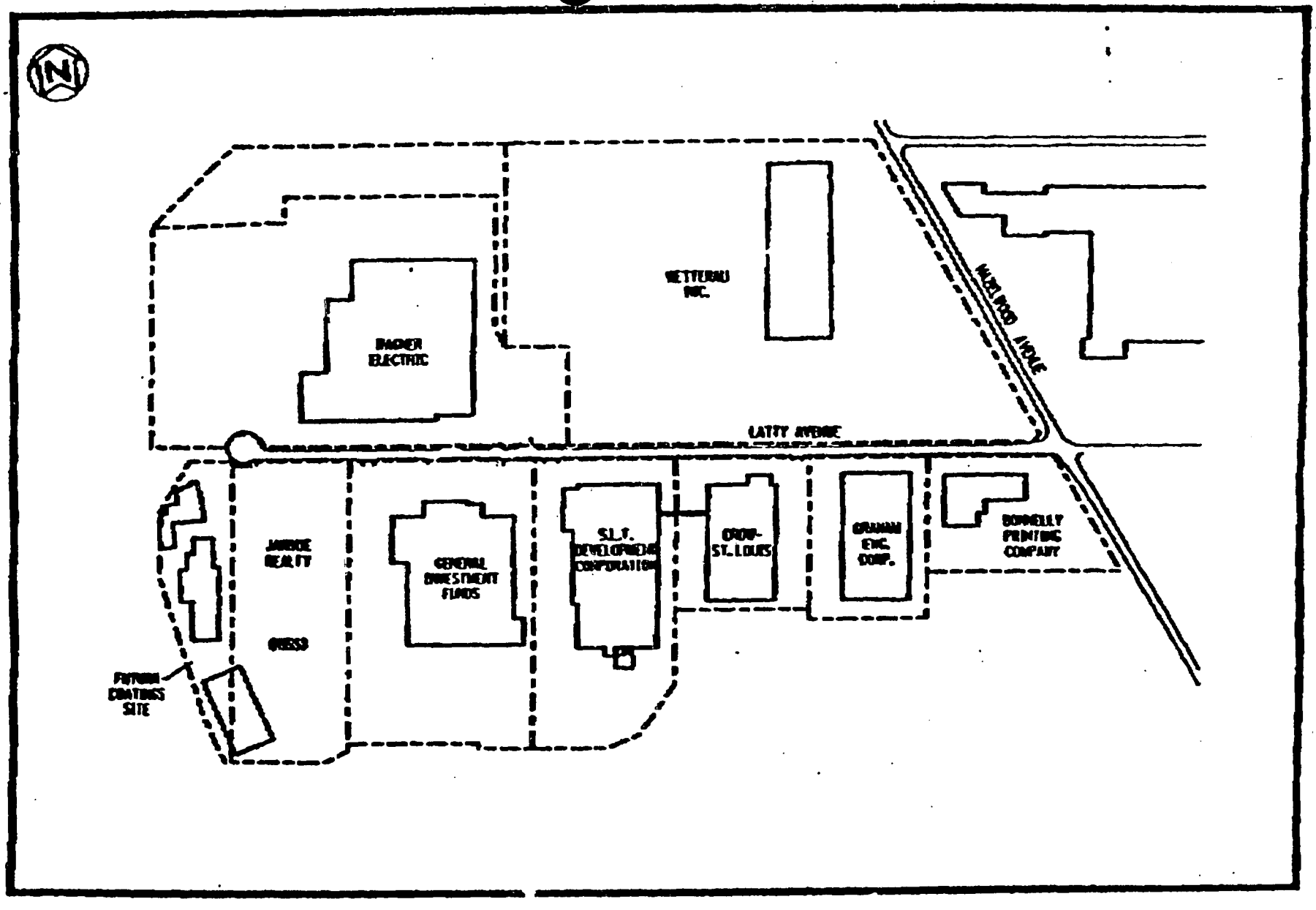

Figure 4. Location of the Latty Avenue vicinity properties

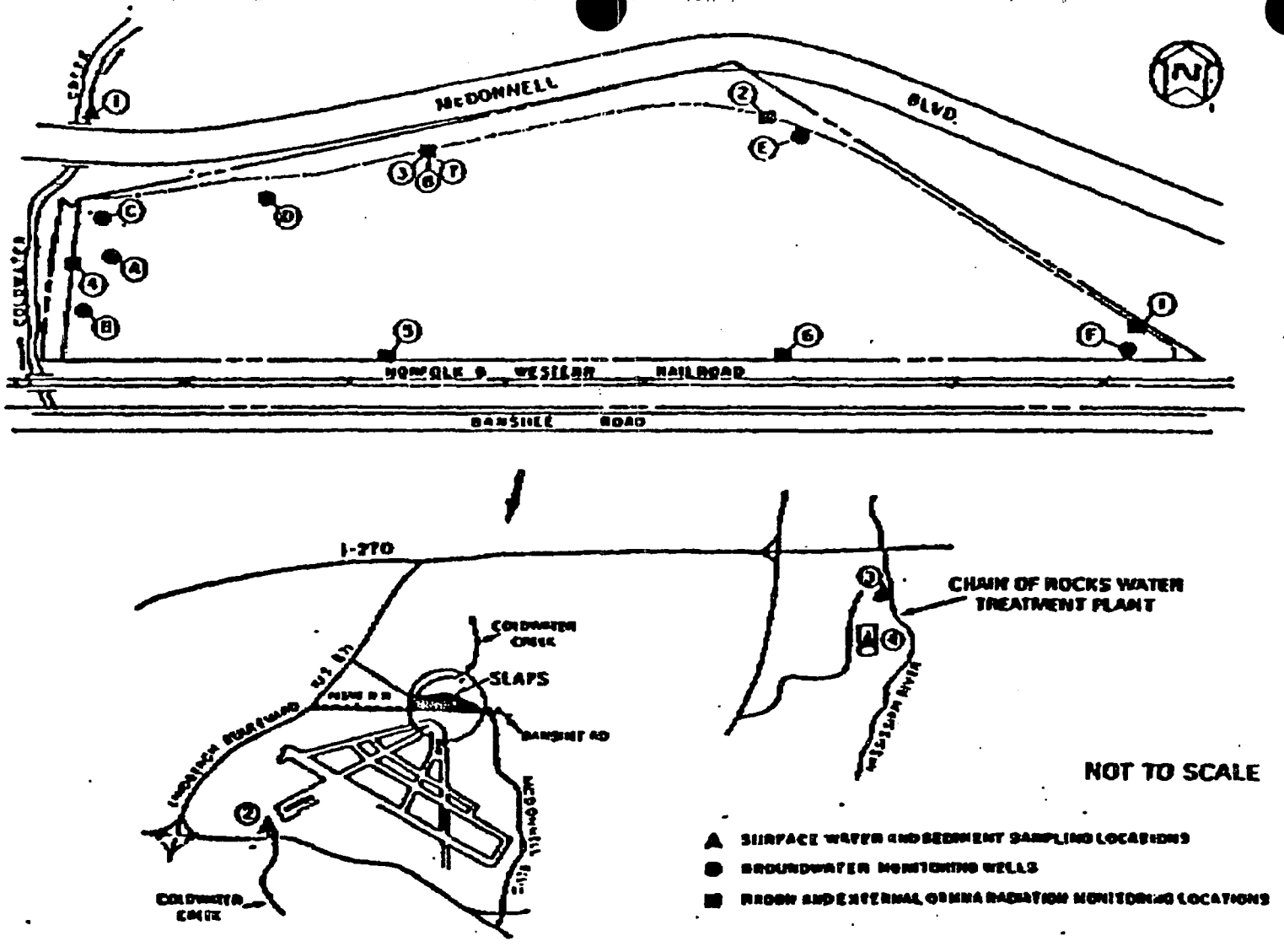

Figure 5. SLAPS environmental monitoring locations

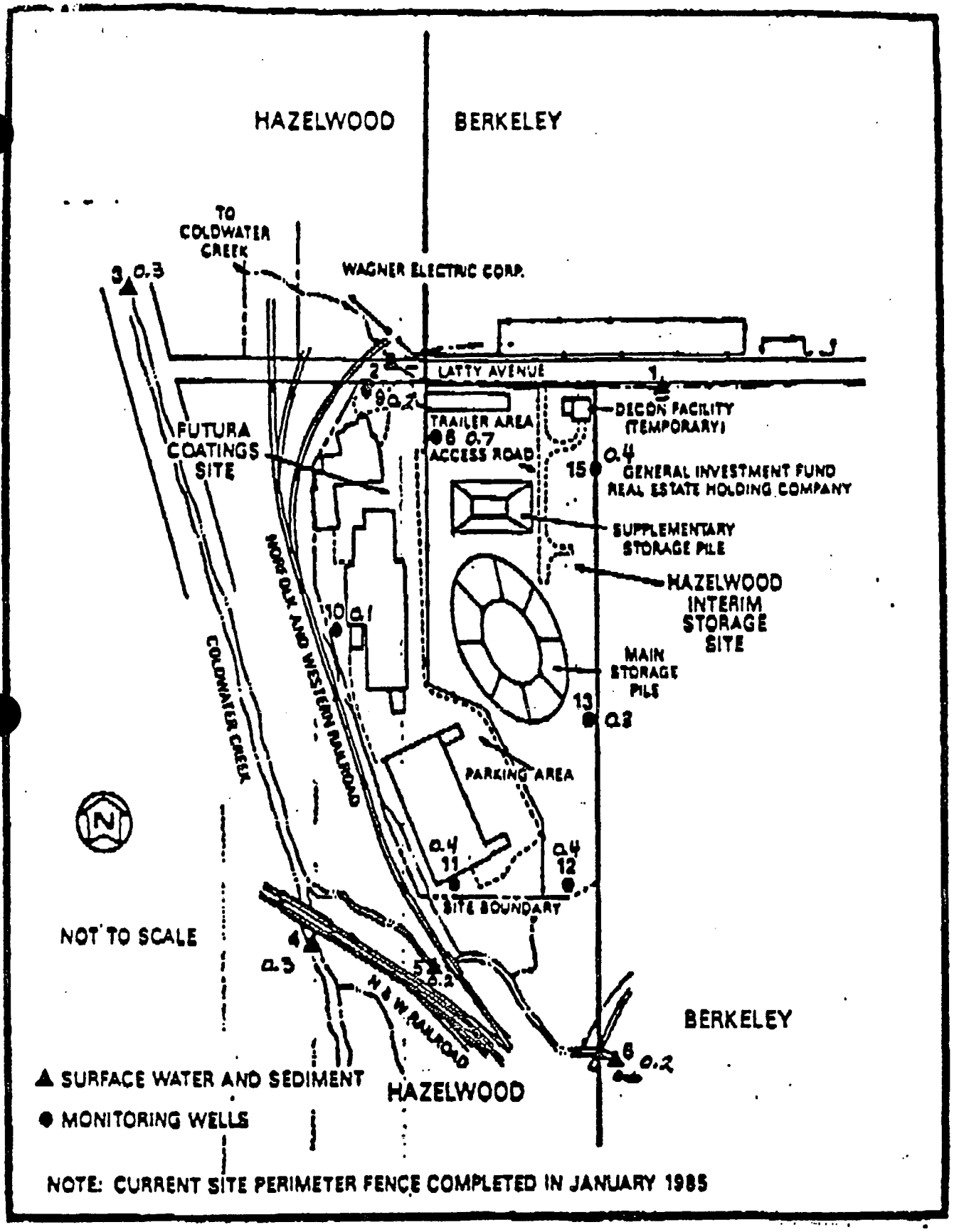

Figure 6. Surface water, groundwater, and sediment sampling locations at the HISS

Appendix A

Department of Energy Dose Calculations

Department of Energy
Oak Ridge Operations
P. O. Box E
Oak Ridge, Tennessee 37831

April 20, 1988

Mr. Larry Birkla, City Manager
City of Berkeley
6140 North Hanley Road
Berkeley, Missouri 63134

Dear Mr. Birkla:

RADIOLOGICAL STATUS OF RECREATION FIELDS

This letter is in response to your inquiry concerning the radiological status of recreation fields used by the City of Berkeley with regard to potential health risks to persons playing on the fields.

The Department of Energy (DOE) has "standards" or guidelines for radioactive contamination in soil that are adopted from Environmental Protection Agency (EPA) guidelines. If soil contamination exceeds these guidelines, remedial action is considered. On a site specific basis, contamination levels above DOE guidelines are reviewed to determine if there is any practicable way for the contamination to reach the human environment in sufficient quantity to represent a potential health hazard. If such a hazard exists then action is taken immediately. However, if it is determined that there are no significant health risks then site clean up is scheduled accordingly.

In October of 1986 samples were taken from the recreation fields in the area extending about 300 feet north of McDonnell Douglas Boulevard. Analysis of these samples found that contamination exceeding DOE soil contamination guidelines was present. This is the same information that was provided to you and to the director of the Airport Authority in a letter dated March 11, 1987.

Utilizing these data, a conservative hazard analysis was performed on the recreation fields. This analysis made conservative assumptions on conditions which are not normally present, such as continuous high dust levels containing the radioactivity. Also, all of the contamination was found in grass covered areas which further reduces the risk of exposure to ball players by means of

Department of Energy
Oak Ridge Operations
P. O. Box E
Oak Ridge, Tennessee 37831

April 20, 1988

Mr. Larry Birkla, City Manager
City of Berkeley
6140 North Hanley Road
Berkeley, Missouri 63134

Dear Mr. Birkla:

RADIOLOGICAL STATUS OF RECREATION FIELDS

Please find enclosed a copy of the hazard assessment which was referenced in our letter of April 20, 1988. If there are any questions, please contact Mr. Andrew Avel at (615) 576-0844.

Sincerely,

Peter J. Gross, Director
Technical Services Division

Enclosure:
As stated

Calculations

I. Estimate of the 50 year committed effective dose from dust inhalation by the ball players at SLAPS ballfields.

Assumptions:

1. It is assumed that the playing season is 18 weeks per year. This is the normal season length.

2. The player is at the ballfields for 8 hours per week. This gives a total number of hours at the playing field for the season to be 144 hours. This amount of time would provide for one hour of practice each day and one two hour game each week.

3. The respiration rate is that for a standard man doing light work, 9600 liters per 8 hours. This respiration rate was chosen since baseball does not require great exertion.

4. All of the dust particles are assumed to be of respirable size, 1 micron.

5. The mass loading of soil in the air is assumed to be 5 mg/m^3. This is 50% of the ACGIH TLV for nuisance dusts. Since most of the ballfield area is covered with sod this should be very conservative.

Method for estimating the 50 year committed effective dose: The amount of dust inhaled per season is given by:

dust inhaled/season = (amount of dust in the air) X (respiration rate) X (time) substituting the assumed values gives:

dust inhaled/season = (5 mg/m^3) x (10^{-3} g/mg) x (10^{-3} m^3/liter) x (9600 liters/8 hr) x (144 hr/season)
= 0.864 g/season

From this the 50 year committed effective dose equivalent for one season's exposure is given by:

50 year committed effective dose = (dust inhaled/season) x (soil concentration) x (committed effective dose equivalent factor)

Table I gives the isotope, average soil concentration, committed dose equivalent factor, and the 50 year committed effective dose for the isotopes present at the SLAPS ballfields. The total 50 year committed effective dose from inhalation for one season of play is 9.3 mrem.

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II. Estimates of the external dose equivalent from the soil at the SLAPS ballfields.

Assumptions:

1. It is assumed that the playing season is 18 weeks per year. This is the normal season length.

2. The player is at the ballfields for 8 hours per week. This gives the total number of hours at the playing field to be 144 hours per season.

3. Soil is assumed to have a density of 2 g/cm^3.

4. All of the contamination contained in the top 15 cm of soil is assumed to be an infinitely thin layer at the surface. Incorporated in this assumption is the fact that there is no contamination below 15 cm.

5. All short-lived daughters are assumed to be in secular equilibrium with their long-lived parent or be present at the relative abundance found naturally.

Method for estimating the external dose equivalent:

For this estimate it is assumed that all of the contamination in the 15 cm of the soil is located at the surface: this concentration will be called the effective contamination/cm^2. The effective contamination/cm^2 is given by:

effective contamination/cm^2 = (soil concentration of contaminant) x (soil density) x (15 cm)

The estimate of the external dose equivalent is then given by:

external dose equivalent = (effective contamination/cm^2) x (external dose rate conversion factor) x (time spent in contaminated area)

Table 2 gives the isotope, average soil concentration, external dose rate conversion factor, and the external dose equivalent for the isotopes presented the SLAPS ballfields. The total external dose equivalence from all isotopes is a 3.9 mrem.

III. Estimate of the external dose equivalent from immersion in a dust cloud at the SLAPS ballfields.

Assumptions:

1. It is assumed that the playing season is 18 weeks per year.

2. The player is at the ballfields for 8 hours per week.

3. The mass loading of the soil in the air is assumed to be 5 mg/m^3.

4. All short-lived daughters are assumed to be in secular equilibrium with their long-lived parents or be present at the relative abundance found naturally.

Method of estimating the external dose equivalent from immersion in a dust cloud.

The external dose equivalent from immersion in a dust cloud is given by:

external dose equivalent = (soil concentration) x
(mass loading factor) x
(dose rate conversion factor) x
(time spent in dust cloud)

Table 3 gives the isotopes, average soil concentration, external dose rate conversion factor, and the external dose equivalent for the isotopes present at the SLAPS ballfields. The total estimated external dose equivalent from immersion in a dust cloud is 3.8×10^{-6}.

All of the information for these calculations were taken from "Models and Parameters for Environmental Radiological Assessments", DOE/TIC-11468, 1984

Table 1: Data for the calculations of the 50 year committed dose equivalent

Isotope	Average Soil Concentration (PCi/g)	Committed Effective Dose Equivalent (mrem/uCi)	50 Year Committed Dose Equivalent (mrem)
U-238	10	1.0×10^{6} (Y)	8.6×10^{-1}
Th-234	10	3.0×10^{1} (W)	2.6×10^{-4}
Pa-234m	10	3.7×10^{-3} (W)	3.2×10^{-8}
Pa-234	0.013	9.6 (Y)	1.1×10^{-7}
U-234	10	1.1×10^{5} (Y)	9.5×10^{-1}
Th-230	20	3.7×10^{5} (W)	6.5
Ra-226	2	8.5×10^{3} (W)	1.5×10^{-2}
Rn-222	2	2.8×10^{-1} (-)	4.8×10^{-7}
Po-218	2	3.1 (W)	5.4×10^{-6}
Pb-214	2	1.5×10^{1} (W)	2.6×10^{-5}
Bi-214	2	1.2×10^{1} (W)	2.1×10^{-5}
Po-214	2	1.7×10^{-6} (W)	2.9×10^{-12}
Pb-210	2	2.6×10^{3} (W)	4.5×10^{-3}
Bi-210	2	2.0×10^{2} (W)	3.5×10^{-4}
Po-210	2	1.0×10^{4} (D)	1.7×10^{-2}
Th-232	2	4.1×10^{5} (W)	7.1×10^{-1}
Ra-228	2	1.7×10^{3} (W)	2.9×10^{-3}
Ac-228	2	4.4×10^{1} (Y)	7.6×10^{-5}
Th-228	2	1.3×10^{5} (Y)	2.3×10^{-1}
Ra-224	2	1.2×10^{3} (W)	2.1×10^{-3}
Rn-220	2	2.6×10^{-1} (-)	4.5×10^{-7}
Po-216	2	2.3×10^{-3} (Y)	4.0×10^{-9}
Pb-212	2	2.3×10^{2} (W)	4.0×10^{-4}
Bi-212	2	3.5×10^{1} (W)	6.1×10^{-5}
Po-212	1.3	3.6×10^{-9} (W)	4.0×10^{-15}
Tl-208	0.7	1.0×10^{-2} (W)	6.0×10^{-9}

Table 2: Data for the calculations of the estimated external dose equivalence from the soil.

Isotope	Average Soil Concentration (pCi/g)	External Dose Rate (Ground Surface) Conversion Factor (rem/yr per uCi/cm^2)	External Dose Equivalent (mrem)
U-238	10	5.7×10^{2}	2.8×10^{-3}
Th-234	10	8.9×10^{3}	4.4×10^{-2}
Pa-234m	10	1.1×10^{4}	5.4×10^{-2}
Pa-234	0.013	1.8×10^{6}	1.2×10^{-2}
U-234	10	7.1×10^{2}	3.5×10^{-3}
Th-230	10	7.8×10^{2}	7.7×10^{-3}
Ra-226	2	6.8×10^{3}	6.7×10^{-3}
Rn-222	2	3.7×10^{3}	3.7×10^{-3}
Po-218	2	0.0	0.0
Pb-214	2	2.5×10^{5}	2.5×10^{-1}
Bi-214	2	1.3×10^{6}	1.3
Po-214	2	7.9×10^{1}	7.8×10^{-5}
Pb-210	2	2.6×10^{3}	2.6×10^{-3}
Bi-210	2	0.0	0.0
Po-210	2	8.1	8.0×10^{-6}
Th-232	2	5.7×10^{2}	5.6×10^{-4}
Ra-228	2	4.8×10^{4}	4.8×10^{-2}
Ac-228	2	8.5×10^{5}	8.4×10^{-1}
Th-228	2	2.4×10^{3}	2.4×10^{-3}
Ra-224	2	1.0×10^{4}	9.9×10^{-3}
Rn-220	2	5.0×10^{2}	5.0×10^{-4}
Po-216	2	0.0	0.0
Pb-212	2	1.5×10^{5}	1.5×10^{-1}
Bi-212	2	1.7×10^{5}	$1.7\ 10^{-1}$
Po-212	1.3	0.0	0.0
Tl-208	0.7	2.8×10^{6}	1.0

Table 3: Data for the calculations of the estimated external dose equivalence from the immersion in a dust cloud.

	Average Soil Concentration (pCi/g)	External Dose Rate Conversion Factor (mrem/yr per uCi/cm^3 (Immersion)	External Dose Equivalent (mrem)
U-238	10	4.6×10^{5}	3.8×10^{-10}
Th-234	10	3.4×10^{7}	2.8×10^{-8}
Pa-234	10	5.6×10^{7}	4.6×10^{-8}
Pa-234	0.013	9.60×10^{9}	1.0×10^{-8}
U-234	10	6.70×10^{5}	5.5×10^{-10}
Th-230	20	1.7×10^{6}	2.8×10^{-9}
Ra-226	2	3.7×10^{7}	6.1×10^{-9}
Rn-222	2	1.8×10^{6}	3.0×10^{-10}
Po-218	2	0.0	0.0
Pb-214	2	1.1×10^{9}	1.8×10^{-7}
Bi-214	2	7.7×10^{9}	1.3×10^{-6}
Po-214	2	4.1×10^{5}	6.8×10^{-11}
Pb-210	2	5.9×10^{6}	9.7×10^{-10}
Bi-210	2	0.0	0.0
Po-210	2	4.2×10^{4}	6.9×10^{-12}
Th-232	2	8.2×10^{5}	1.4×10^{-10}
Ra-228	2	2.3×10^{1}	3.8×10^{-15}
Ac-228	2	4.5×10^{9}	7.4×10^{-7}
Th-228	2	8.8×10^{6}	1.5×10^{-9}
Ra-224	2	4.6×10^{7}	7.6×10^{-9}
Rn-220	2	2.5×10^{6}	4.1×10^{-10}
Po-216	2	0.0	0.0
Pb-212	2	6.7×10^{8}	1.1×10^{-7}
Bi-212	2	9.0×10^{8}	1.5×10^{-7}
Po-212	1.3	0.0	0.0
Tl-208	0.7	1.9×10^{10}	1.1×10^{-6}

Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the St. Louis Airport and Latty Avenue Sites, Missouri

U.S. Department of Energy