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USACE/OR/DACA62-1042

ENGINEERING EVALUATION/COST ANALYSIS FOR THE PAINESVILLE SITE

PAINESVILLE, OHIO

JUNE 1998

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U.S. Army Corps of Engineers
Buffalo District Office
Formerly Utilized Sites Remedial Action Program

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prepared by
U.S. Army Corps of Engineers, Buffalo District Office, Formerly Utilized Sites Remedial Action Program

with technical assistance from
Science Applications International Corporation ESC-FUSRAP
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ACRONYMS AND ABBREVIATIONS

Ac	Actinium
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
ANL	Argonne National Laboratory
ARAR	applicable or relevant and appropriate requirement
BNI	Bechtel National, Inc.
CAP	Clean Air Act Assessment Package
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminants of Concern
DAC	derived air concentration
dpm	disintegration per minute
DMC	Diamond Magnesium Company
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EE/CA	Engineering Evaluation/Cost Analysis
EM	electromagnetic
EPA	Environmental Protection Agency
F	Fahrenheit
ft	feet
FIDLER	field instrument for detecting low-energy radiation
FP&E	Fairport, Painesville, and Eastern
FUSRAP	Formerly Utilized Sites Remedial Action Program
GSA	General Services Administration
hr	hour
km	kilometer
l	liter
LTP	license termination plan
MDI	methylene di-para-phenylene isocyanate
MED	Manhattan Engineer District
m	meters
µCi/mL	microcuries per milliliter
µg	micrograms
mi	mile
mrem	millirem(s)
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
Pa	Protactinum
pCi	picocuries
pCi/g	picocuries per gram

ACRONYMS AND ABBREVIATIONS (continued)

pCi/l	picocuries/liter
PRG	preliminary remediation goals
Ra	radium
RAR	relevant and appropriate
RBC	risk based concentration
RCRA	Resource Conservation and Recovery Act
RESRAD	RESidual RADioactivity computer code
RME	reasonable maximum exposure
SAIC	Science Applications International Corporation
SOR	sum of ratios
SSL	soil screening level
SVOC	semivolatile organic compounds
TBC	to be considered
TCLP	toxicity characteristic leaching procedure
TDI	toluene diisocyanate
TEDE	total effective dose equivalent
Th	thorium
U	uranium
UMTRCA	Uranium Mill Tailings Radiation Control Act
US	United States
USGS	United States Geological Survey
VOC	volatile organic compound
WBS	Work Breakdown Structure
WL	working level
yr	year

1. INTRODUCTION

The United States (U.S.) Army Corps of Engineers (USACE) is preparing to conduct a cleanup action at the Painesville site in Painesville, Ohio under USACE's Formerly Utilized Sites Remedial Action Program (FUSRAP). The U.S. Atomic Energy Commission (AEC), a predecessor of the Department of Energy, established FUSRAP in 1974 to identify and remediate or control sites with residual radioactivity resulting from activities of the Manhattan Engineer District (MED) and early operations of the AEC. Congress transferred the FUSRAP program from the Department of Energy to USACE in October of 1997. This site was formerly known as the Diamond Magnesium Plant and is currently owned and operated by the Uniroyal Chemical Company (Uniroyal).

This engineering evaluation/cost analysis (EE/CA) report has been prepared to support cleanup measures for the Painesville site. The proposed removal action is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The analysis presented in this EE/CA demonstrates that the proposed action can be implemented in a manner that protects human health and the environment.

The proposed action is expected to be implemented after regulatory agencies, local government officials, and interested members of the public have had sufficient opportunity to review and comment on the proposal.

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2. SITE CHARACTERIZATION

2.1 SITE DESCRIPTION

The Painesville site is located at 720 Fairport-Nursery Road in Painesville, Ohio, approximately 35.4 kilometers (km) [22 miles (mi)] northeast of Cleveland (Figure 2-1). The site is located at approximately 41 degrees, 45 minutes north latitude, 81 degrees, 15 minutes east longitude, and is shown on the Perry Quadrangle, Ohio-Lake County, 7.5 minute series, United States Geological Survey (USGS) map.

The Painesville site is bounded on the north by the Fairport, Painesville, and Eastern (FP&E) Railroad, on the south and west by Fairport Nursery Road, and on the east by Hardy Road. Painesville Township Park lies north of the site, while industrial properties are located on the other sides of the site. The Diamond Alkali Waste Lake CERCLA site is located to the south of the site, and residential properties are to the northeast. An abandoned industrial site is located to the northwest. The Grand River is located approximately 0.2 km (0.1 mi) southwest of Fairport Nursery Road, and flows in a northwesterly direction towards Lake Erie.

The site contains as many as 35 buildings and structures. Available information on the construction and function of most of these buildings is limited. Information on the building locations is included on Figure 2-2.

2.2 SITE HISTORY

In the early 1940s, the Defense Plant Corporation constructed a magnesium reduction facility in Painesville, Ohio, on property owned by the Diamond Magnesium Company (DMC). In support of the war effort and later government operations, DMC operated this facility from the early 1940s to the early 1960s for the General Services Administration (GSA). The plant was sold by the GSA in two parts in 1963. At that time, Uniroyal purchased approximately 15.5 ha (38 acres) as commercial property, located at 720 Fairport-Nursery Road (ORNL 1990). Lonza purchased the second portion of the property (ORNL 1991).

Between 1951 and early 1953, DMC received approximately 1,650 tons of "slightly" contaminated ferrous metal scrap released through GSA. The ferrous metal scrap was generated from discarded iron drums and other items previously used to store uranium compounds involved with pitchblende operations. Since elevated levels of thorium-230 (Th-230) have been detected in the Painesville site soils, it is suspected the drums may have at one time contained waste from the Mallinckrodt Chemical Company of St. Louis, Missouri. The scrap metal was shipped to DMC from the Atomic Energy Commission's (AEC) Lake Ontario Storage Area. DMC utilized the scrap for its ferrous content; its radioactive contamination was incidental to this use. The scrap metal was delivered via railroad cars on the western side of the property. Conversations with former employees indicated an additional delivery route via the railroad on the eastern side of the buildings. From the eastern side, the scrap metal was either immediately added to the digester tanks of hydrochloric acid or stored on the ground on the north side of the building. The ferrous metal was used to scrub chlorine gas generated during the magnesium

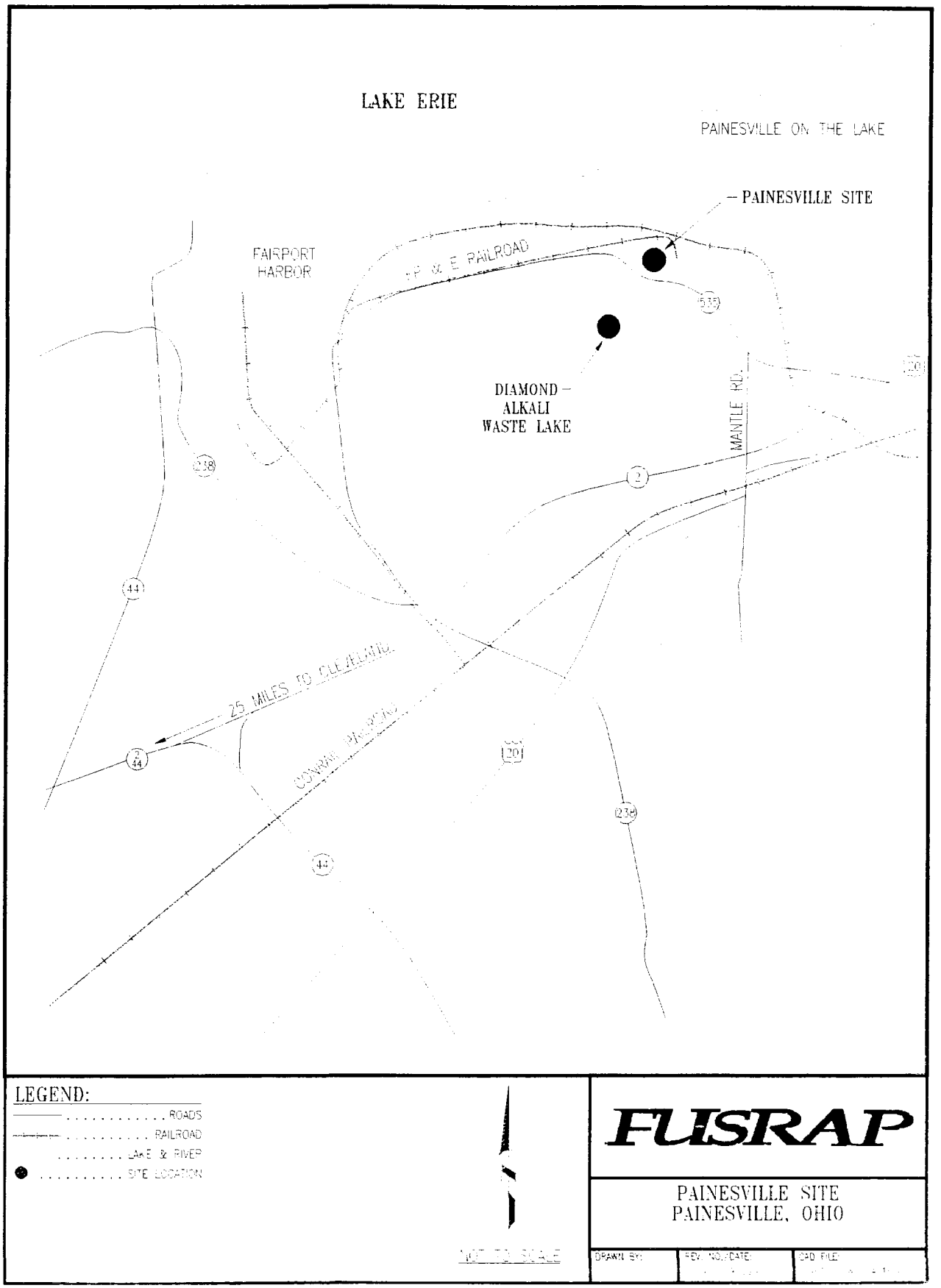


Figure 2-1. Painesville Site in Relation to the Surrounding Area

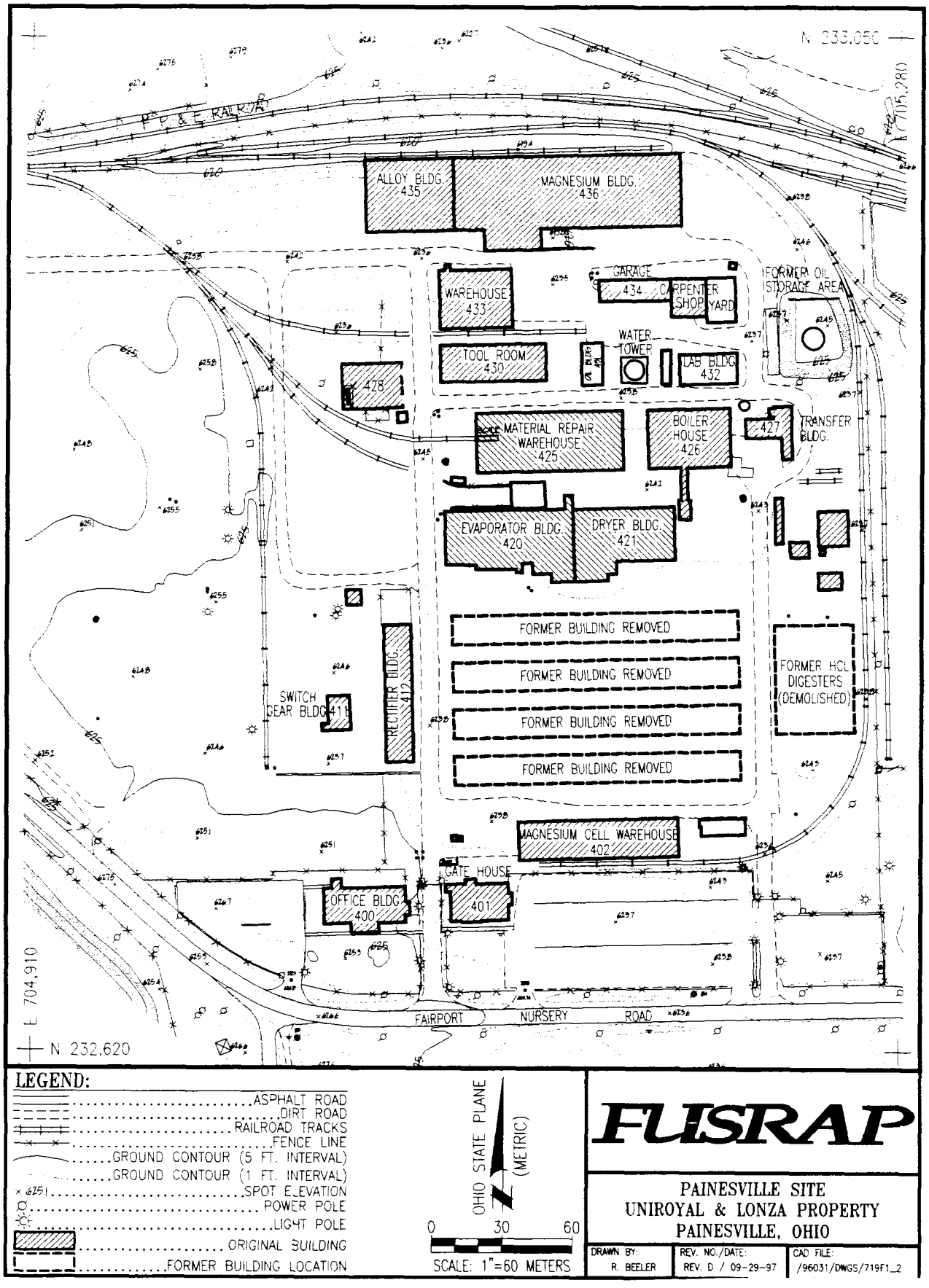


Figure 2-2. Historical Site Layout Map

production process. Hydrochloric acid oxidized the scrap metal to ferrous chloride. Chlorine gas released during magnesium reduction was bubbled through the ferrous chloride further oxidizing it to ferric chloride which was then discarded (ORNL 1990).

Since the contamination of the scrap metal was related to AEC activities, ORNL conducted a radiological survey of the facility to verify whether the site meets current radiological guidelines. The findings of this survey indicated the principal radionuclide of concern is radium-226 (Ra-226) and its naturally occurring decay products.

Previous Investigations

On October 10 and 11, 1988, the Oak Ridge National Laboratory (ORNL) performed a preliminary site evaluation of the Painesville site. This evaluation included a number of radiological surveys and radiological analyses of soil samples. The areas that were evaluated included the property west of the buildings from the west parking area to the fence south of the FP&E railroad tracks. During the survey, information was obtained concerning other portions of the property that would need to be addressed as part of future efforts (ORNL 1990).

ORNL returned to the site in September 1990 to examine the property to the east adjacent to the railroad tracks, owned by Lonza, and to investigate "stones" that showed elevated gamma readings during the 1988 survey. The survey results (ORNL 1991) indicated that elevated concentrations of radionuclides were found in surface and subsurface soil of both properties in excess of 40 CFR 192 guidelines. The major contaminants were radium-226 (Ra-226) and (Th-230).

In 1996, Bechtel National, Incorporated (BNI), Science Applications International Corporation (SAIC) and Argonne National Laboratory (ANL), under contract to DOE, performed a detailed investigation of the Painesville site area. This investigation included ambient air sampling, external gamma rate exposure measurements, building radiological surveys, gamma walkover surveys, groundwater sampling, surface geophysical surveys, surface water sampling, sediment sampling, ecological sampling, and soil sampling. The results of this study, documented in the Characterization Report for the Painesville Site (USACE 1998), are summarized in Section 2.4 and were used to support this EE/CA.

2.3 ENVIRONMENTAL SETTING

2.3.1 Topography/Structures

The Painesville site is approximately 21 hectares (52 acres) in size and has very little topographic relief. The maximum elevation change across the site is less than 3 meters (m) [10 feet (10 ft)]. The western two-thirds of the site is owned and operated by Uniroyal, while the eastern third of the site is owned and operated by Lonza.

The west side of the Uniroyal property is comprised primarily of open grass fields, a waste pond, an above-ground butadiene tank, and several railroad spurs. In contrast, the ground surface on the east side of the Uniroyal property is primarily covered with asphalt and contains

process buildings, warehouses, office buildings, a chemical transfer facility, several above-ground storage tanks, building rubble piles, and a railroad spur (see Figure 2-3). This property has three roads running in a north-south direction, and three roads running east-west. The main entrance is located at the south end of the property between Buildings 400 and 401. A second entrance is located in the north-west corner of the facility, north of the waste pond.

The Lonza property is covered with concrete except for the south and southeast portions of the site that are either covered by grass or have exposed soil. Other surface features include above-ground processing tanks on the far west side of the property, three railroad spurs, and a waste pond located on the east side of the property. The only entrance is located in the northeast corner of the property. Figures 2-2 and 2-3 present the historical and current layout of the Painesville site.

2.3.2 Geology

The Painesville site lies within the Eastern Lake Section of the Central Lowland Province, commonly referred to as the Lake Plain. The Lake Plain is a narrow strip of land, three to five miles wide, that parallels the shoreline of Lake Erie. This section consists of sedimentary rock sequences overlain by glacial deposits. The land surface slopes very gently downward to the present lake bluff (White 1980).

The uppermost bedrock unit underlying the site is the Chagrin Shale Formation (Schmidt 1988). The Chagrin Shale is a member of the Late Devonian-aged Ohio Shale Formation. Bedrock was not encountered in any of the boreholes, drilled to a maximum depth of 12 m (40 ft), during characterization; however, shale fragments were observed in the overlying soil. These shale fragments are a result of glacial erosion and presumably belong to the Chagrin Shale Formation.

The Ashtabula Till, a nonlithified till deposited in the late Woodfordian Age of the Wisconsinan glaciation during the Pleistocene Epoch, lies disconformably above the Chagrin Shale. Characteristically, the till is a dense, weakly jointed, compact unit with a gray color on fresh surfaces and a brown color where weathered (Schmidt 1988). The till was also observed to have a high clay and silt content with few sand- and gravel-sized, dark gray, shale fragments.

Located above the Ashtabula Till at the site is a layer of disturbed/fill material. Borings revealed a thickness ranging from 0.0 to 6.2 m (0.0 to 20.5 ft). This unit was found to be thickest in the western/northwestern part of the site over a large area that extends from the western side of Uniroyal's butadiene tank to their northwestern property boundary. Surface geophysical surveys conducted at the site also confirmed the location and approximate/relative depth of the fill. The fill consists of a wide variety of material: disturbed native till, black coal slag and fly ash, white granular polyvinyl chloride, red bricks, concrete, sand and gravel, plastic, cloth, glass, and metal of various origins.

2.3.3 Surface Water Hydrology

The primary surface water features on the Painesville site are the Uniroyal and Lonza waste ponds, which are approximately 1.0 and 0.3 acres in size, respectively. The UniRoyal

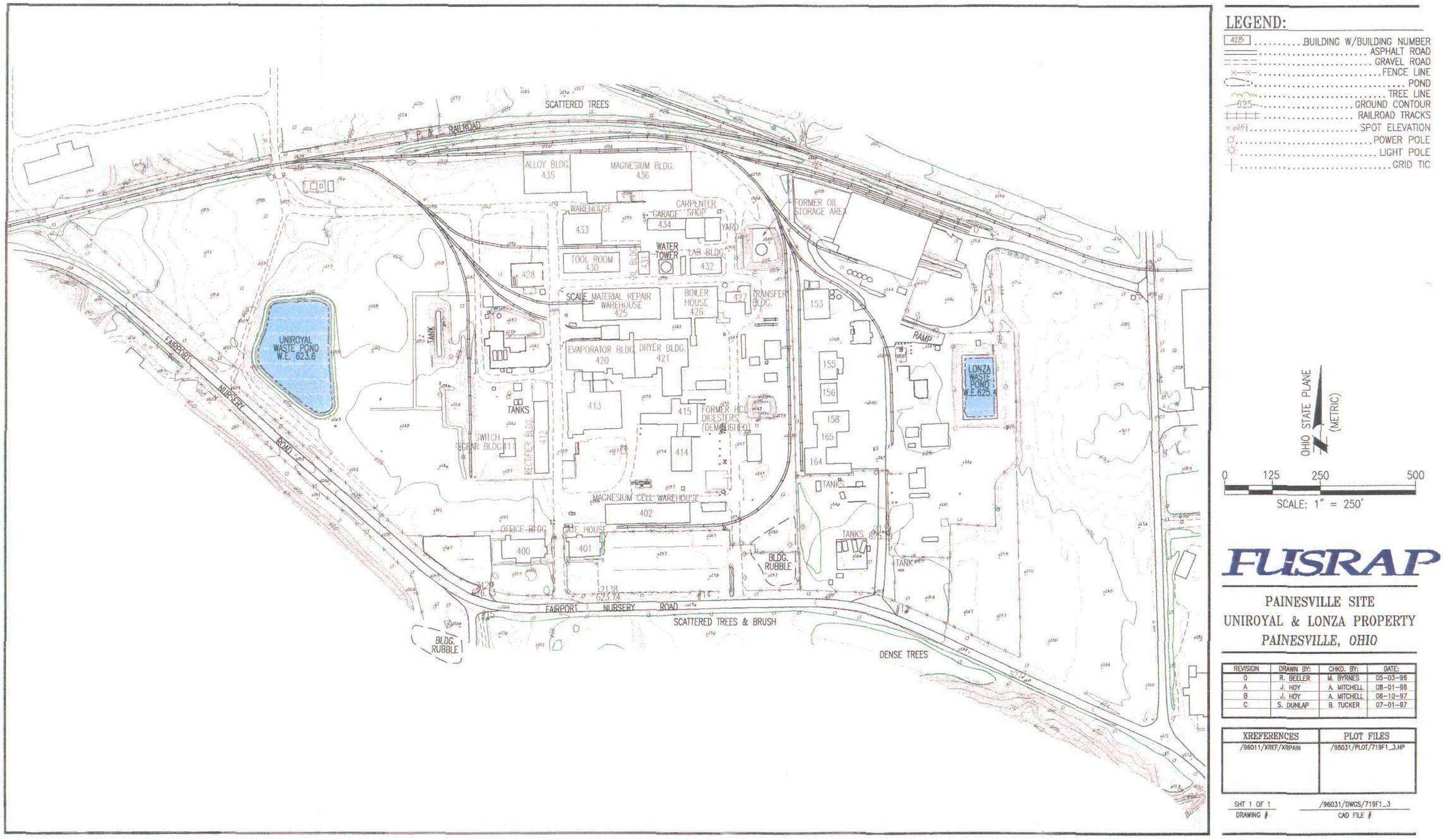


Figure 2-3. Current Site Location Map

waste pond was constructed in 1965 and has not received any wastes from MED activities. The only current recharge to this pond is through rainfall and snow-melt. Since the Lonza waste pond was built in recent years, it is unlikely that radiological contaminants of concern (COCs) are present in this pond.

Surface water features near the Painesville site include the Grand River, located approximately 0.16 kilometer (km) [0.1 mile (mi)] southwest of Fairport Nursery Road; a waste pond, located between Fairport Nursery Road and the Grand River; and Lake Erie, located approximately 1.6 km (1 mi) due north of the property. The Grand River empties into Lake Erie at Fairport Harbor, which is located approximately 1.5 miles northwest of the site.

An extensive storm sewer drainage system is present on the Lonza property and on the eastern half of the Uniroyal property where the ground surface is primarily covered by concrete or asphalt. In these areas, surface water from rain events is quickly captured by the drainage system and ultimately discharged to the Grand River. The western half of the Uniroyal property is covered primarily with grass and has a less extensive storm sewer system.

2.3.4 Groundwater

Elevation data collected from shallow piezometers and temporary monitoring wells suggest that perched groundwater occurs near the surface across much of the site, but is discontinuous and shallow. It appears that perched groundwater is pooling in topographic depressions in the natural clay formation. Observations made during drilling of the deep wells indicated that the materials immediately above the regional groundwater table were unsaturated over most of their vertical profile. The results from drilling activities determined that the regional water table is at a depth greater than 12 m (40 ft) below the ground surface.

The perched groundwater observed in the piezometers and temporary monitoring wells is very cloudy to turbid in nature and does not represent a potential drinking water aquifer. This determination was made jointly between DOE and the Ohio Environmental Protection Agency (EPA) based on the following information obtained during the characterization effort:

- Perched groundwater at the site is typically encountered within the first few feet below ground surface and is perched on top of natural formation soil, which has a high clay content.

- The perched groundwater is discontinuous across the site.

- The thickness of the saturation lens is, in most cases, less than 0.3 m (1 ft).

- Temporary wells installed during characterization activities produced water at very low rates (less than 1 gallon per minute).

According to Aller and Ballou (1991), groundwater yields from the glacial till deposits in Lake County are variable but typically low. Stout et al. (1943) reports that the Chagrin Formation underlying the Painesville area yields little or no water. Sulfur water or brine is often

(*Phragmites sp.*) was the only open water habitat identified. Two major water bodies adjacent to the site are Lake Erie and the Grand River; both possess major fishery resources used by the public.

The site potentially lies in a bald eagle (threatened species) migration route, with nesting pairs within a one county area, but no trees or large bodies of water exist on site to attract the bird. The site also lies within the range of the Indiana bat and piping plover, which are both endangered species (see Appendix A). Open grassland is a favored hunting habitat for the protected barn owl, which may be present. Intensely managed aquatic resources on the Grand River and Lake Erie include primarily walleye and steelhead trout.

Communications with the Fish and Wildlife Service (Appendix A-2) concluded that

> "Due to the project type, site, and location, the proposed project will have no affect on these (threatened and endangered) species. This precludes the need for further action on this project as required by the 1973 Endangered Species Act, as amended."

Communications with the Ohio Department of Natural Resources and the Ohio Historic Preservation Office concluded that there are no existing or proposed state nature preserves or scenic rivers in the vicinity of the study area, nor are there any unique ecological sites, geologic features, breeding or nonbreeding animal concentrations, champion trees, state parks, forest/wildlife areas, or any properties listed or eligible for the National Register of Historic Places.

2.3.7 Meteorology

The climate in the vicinity of the Painesville site is strongly influenced by Lake Erie. West-to-northerly winds blowing off Lake Erie tend to lower daily high temperatures in summer and raise temperatures in winter. The average annual temperature in the Painesville area is approximately 50° Fahrenheit (F) (DOC 1995).

Summers are moderately warm and humid with daytime temperatures occasionally exceeding 90°F. Winters are relatively cold and cloudy with an average of five days with sub-zero-degrees-F temperatures. Weather changes occur every few days from the passing cold fronts (DOC 1995).

The daily range in temperature is usually greatest in late summer and least in winter. Annual extremes in temperature normally occur near the end of June and December. The lowest temperatures occur most often in December, January, and February. Temperatures of 100°F or higher are rare. On the average, freezing temperatures in fall are first recorded in October while the last freezing temperatures in spring normally occur in April (DOC 1995).

Precipitation varies widely from year to year. However, it is normally abundant and well distributed throughout the year. In Painesville, the average annual rainfall is approximately 91 cm (36 in). Showers and thunderstorms account for most of the rainfall during the growing season. Thunderstorms are most frequent from April through August (DOC 1995).

Soil

Preliminary remedial objectives for soil are derived from 40 CFR 192. Preliminary cleanup criteria for residual concentrations of Ra-226, when averaged over any 100 m^2 area, are:

- 5 picocuries per gram (pCi/g) above background, averaged over the first 15 cm (0.5 ft) of soil below the surface; and

- 15 pCi/g above background, averaged over 15 cm-thick layers of soil at greater than 15 cm below the surface (see Table 2-1).

An industrial scenario would set remedial objectives to a dose limit of 25 mrem/yr for affected workers. Appendix B shows how, using a model, this is translated into a remediation goal of 100 pCi/g for Ra-226 in soil.

The remedial objectives for uranium usually are established on a site-specific basis. The 17.5 pCi/g guideline calculated for a residential use scenario for the Alba Craft, Ohio, site has been used for the sum of ratios calculations and the dose assessment at the Painesville site. This value is considered conservative as it was derived to be protective for a more restrictive land use.

The soil sampling results were also compared against EPA Region III risk based concentrations (RBCs) for metals and organics, TCLP limits for samples analyzed for RCRA characteristics and the sum-of-the-ratios (SOR) guideline of 1.0 for radiological COCs. (EPA Region III RBCs were used because no similar risk-based guidelines have been established in EPA Region V where the Painesville site is located.) The SOR was calculated using the following formulas:

Soil Sampling Depths: 0.0 to 0.5 ft

$$SOR = \frac{\text{U-238 - background}}{17.5\ \text{pCi/g}} + \frac{\text{Max (Ra-226 or Th-230) - background}}{5\ \text{pCi/g}}$$

Soil Sampling Depths: > 0.5 ft

$$SOR = \frac{\text{U-238 - background}}{17.5\ \text{pCi/g}} + \frac{\text{Max (Ra-226 or Th-230) - background}}{15\ \text{pCi/g}}$$

Resource Conservation and Recovery Act (RCRA) toxicity characteristic leaching procedure (TCLP) levels were analyzed to determine if any additional waste handling requirements are necessary (i.e., if the radiological constituents are mixed with hazardous waste present at the site, the materials will require disposal as mixed waste). The RCRA TCLP limits are contained in 40 Code of Federal Regulations (CFR) 261.

Buildings/Structures

The remedial objectives for allowable radioactivity levels on structural surfaces are shown in Table 2-1.

2.4.3 External Gamma Exposure Measurements

External gamma exposure rate measurements were collected at the perimeter fenceline, at on-site areas where COCs are known to be present in soil, and from the interior of potentially impacted buildings.

Exposure rates inside three onsite buildings were not elevated above the background values measured onsite [14.1 microRoentgen (μR)/hr]. Even without the subtraction of background, the measurements of exposure rates in building interiors are well below the 40 CFR 192 guideline of 20 μR/hr for levels of gamma radiation inside a building.

Exposure rate measurements at the six perimeter fenceline locations averaged less than 1 μR/hr greater than off-site background rates. Two area locations were measured at Uniroyal at the methylene di-para-phenylene isocyanate/toluene diisocyanate (MDI/TDI) facility, in the southeastern portion of the site, and the butadiene tank, in the west central portion of the site. While exposure rates at the MDI/TDI facility (1.4 μR/hr above background) were well below the 40 CFR 192 guideline, the exposure rates at the butadiene tank were elevated at 74 μR/hr above background. At this exposure rate, a person would need to spend approximately four hours per work day for a full year at the butadiene tank to exceed the 10 CFR 20 guideline of 100 mrem/yr.

2.4.4 Building Radiological Survey Results

Gross alpha or beta-gamma surface release guidelines were not exceeded by either swipe or direct surface grid measurements. These grid measurements were calculated by averaging five point measurements within a 1 m^2 (10 ft^2) grid. One direct point surface beta-gamma measurement, out of 5 points measured, on the north wall of Building 428 exceeded the NRG Regulatory Guide 1.86 removable activity guideline of 1,000 dpm/100 cm^2. However, the removable activity at this location was well below the 1,000 dpm/100 cm^2 guideline. No average of 5 points in a grid for direct or removable measurements for any wall or floor surface in any building exceeded 1,000 dpm/100 cm^2.

NRC Reg. Guide 1.86 also provides some isotope-specific guidelines. For Ra-226 and Th-230 which are COCs at the Painesville site, these are much lower than 1,000 dpm/100 cm^2 gross alpha. A number of direct point surface alpha measurements exceed the 100 dpm/100 cm^2 fixed radiation guideline as well as the 20 dpm/100 cm^2 transferable guideline. Additional surface measurements taken in March and May indicate that only one area of Building 428, less than a square meter, exceeds 100 dpm/100 cm^2. Isotopic analysis is being done. Preliminary results indicate no COC's exceeding 1.5 pCi/g.

2.4.5 Gamma Walkover Survey Results

Bicron (a NaI detector) and field instrument for detecting low-energy radiation (FIDLER) surveys were performed to target the higher and lower energy gamma emitters respectively. Walkover surveys were conducted with a global positioning environmental radiological surveyor (GPERS) which provided continuous location coordinates, visual display of the track map, and instrument readings. The Bicron and FIDLER units were connected to the same GPERS unit, and the two surveys were performed simultaneously. A 100m × 100m grid was established over

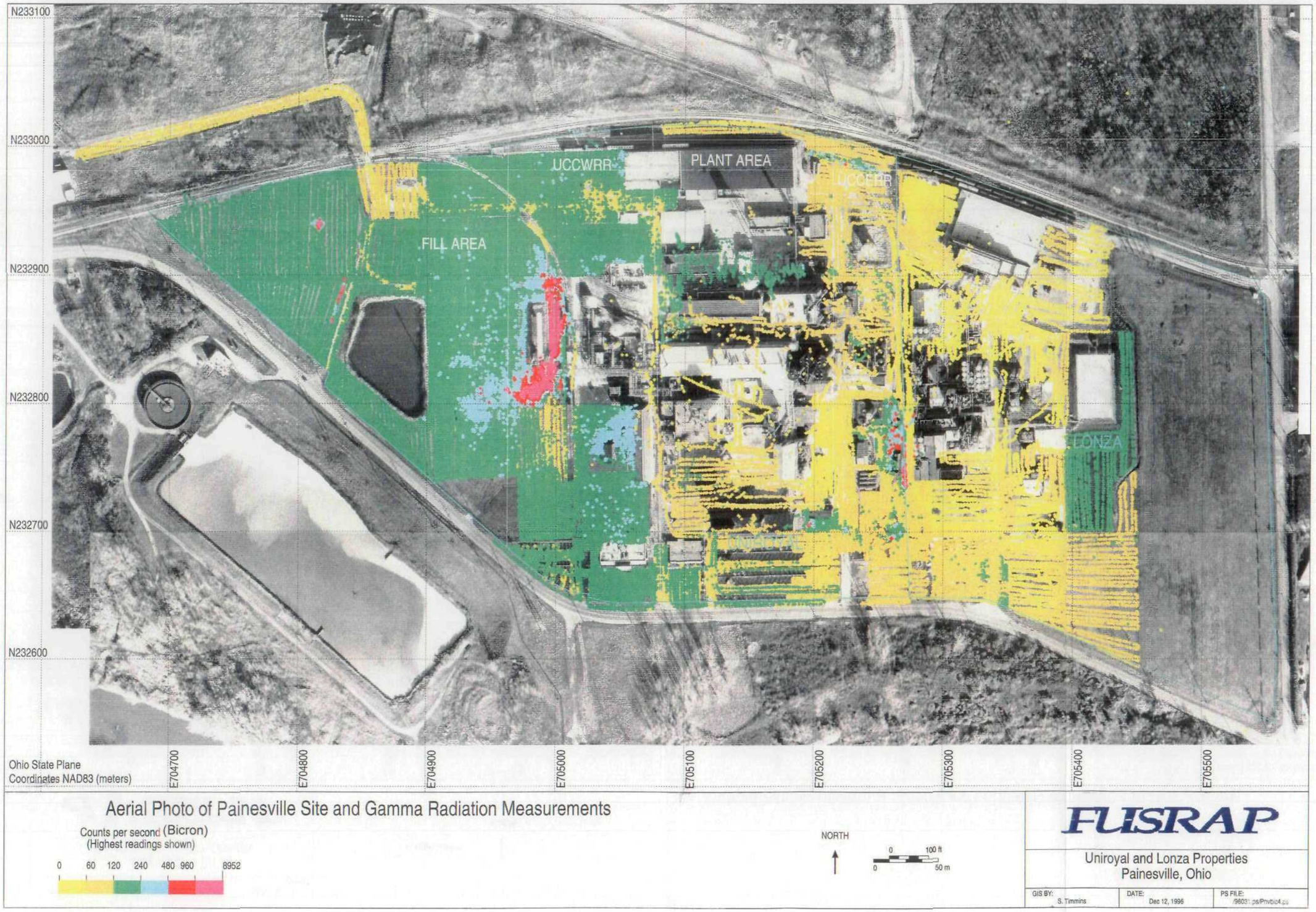


Figure 2-4. Bicron Results

Figure 2-5. FIDLER Results

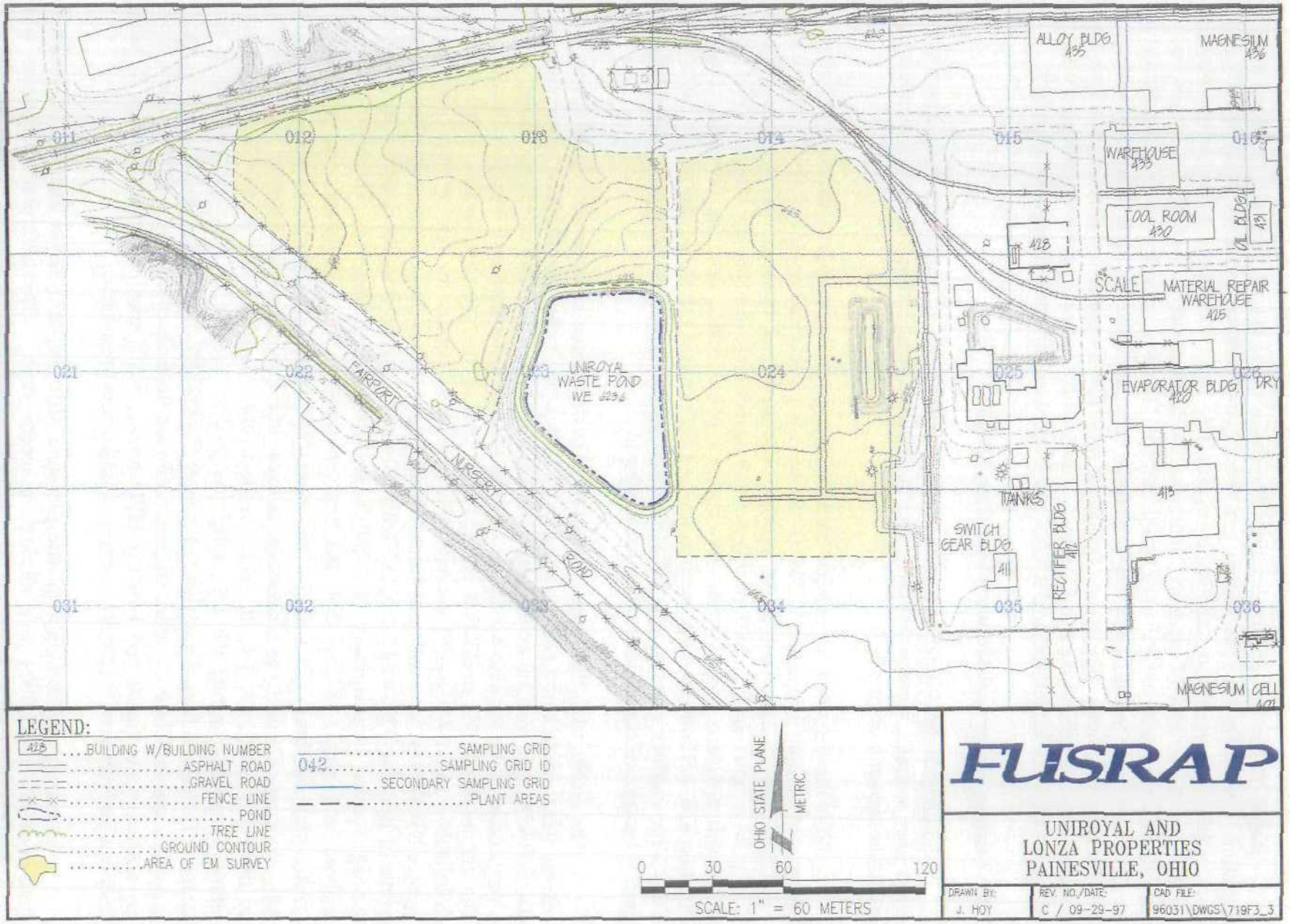


Figure 2-6. Areas Covered by the Electromagnetic Survey

Based on the EM results, locations for shallow and deeper borehole exploration were identified. The results from the shallow and deep borings indicated shallow metal debris at each point indicated by the EM-61 data at depths less than 1 m (3 ft), and a distinctive fill material associated with the EM-31 anomaly, intermixed with metal debris. At least two episodes of historical fill placement are indicated by this pattern. The first episode, which was indicated by the EM-31 anomaly region, is made up principally of nonmetallic, but more conductive materials, than the native site soils. The second episode of historical fill placement occurred at a later time based on superposition of the two fill areas. This second fill area is partly commingled with the earlier fill area, but extends beyond it to the north and west and contains more metal debris.

2.4.7 Surface Water and Sediment Sampling Results

Fourteen surface water and 13 sediment samples were collected from the primary storm sewer lines, outfalls, surface drainages, and the Uniroyal waste pond. Sampling locations and results are shown in Figure 2-7.

With the exception of sample SWSD0004, all of the surface water samples showed background activity levels for U-238 [(<0.1 to 1.6 picocuries/liter (pCi/L)], Th-230 (0.1 to 1.0 pCi/L), and Th-232 (<0.1 to 0.5 pCi/L). Elevated total uranium (223.8 pCi/L), Th-230 (25.7 pCi/L), and Th-232 (13.9 pCi/L) activity levels were detected in sample SWSD0004, which was collected from a storm sewer access point located near the northeast corner of Building 426. All surface water samples showed background activity levels for Ra-226 (0.1 to 0.9 pCi/L). Surface water sample SWSD004 was ultimately rejected during the data validation process because of excessive turbidity in the sample.

The results from the chemical analysis of surface water samples were compared against criteria, which were calculated assuming a 10^{-4} risk range under an industrial worker scenario (DOE 1995). This scenario assumes an incidental ingestion of 1 L/day of surface water. This is a very conservative scenario as surface water at the site is not used as a drinking water source. The results from this evaluation showed that two of the fourteen surface water samples (SWSD0004 and SWSD0007) exceeded the risk-based criteria for one or more parameters. Sample SWSD0004 was collected from a storm sewer access point located near the northeast corner of Building 426, while sample SWSD0007 was collected from the concrete-lined surface drainage located approximately 24 m (80 ft) southwest of Building 411. The results from the analysis of sample SWSD0004 detected antimony [281 micrograms (μg)/L], arsenic (2260 μg/L), beryllium (71.2 μg/L), cadmium (73.1 μg/L), manganese (13,000 μg/L), and benzo(a)pyrene (26 μg/L) at concentrations exceeding Preliminary Remediation Goals (PRGs) by factors of 7, 73, 11, 1.4, 26, and 7 respectively. Surface water sample SWSD004 was ultimately rejected during the data validation process because of excessive turbidity in the sample. The results from the analysis of sample SWSD0007 detected acrylonitrile (9,500 μg/L) at a concentration which exceeded the criteria for acrylonitrile of 48 μg/L. This sample is from the process waste trench and is not a MED related contaminant. The results from all other chemical analyses were well below corresponding risk based criteria.

It was reported by Uniroyal site personnel that the storm sewer drainage downstream from location SWSD0004 was blocked in recent years. This information explains why downstream surface water sampling locations SWSD0009 and SWSD0013 showed no elevated

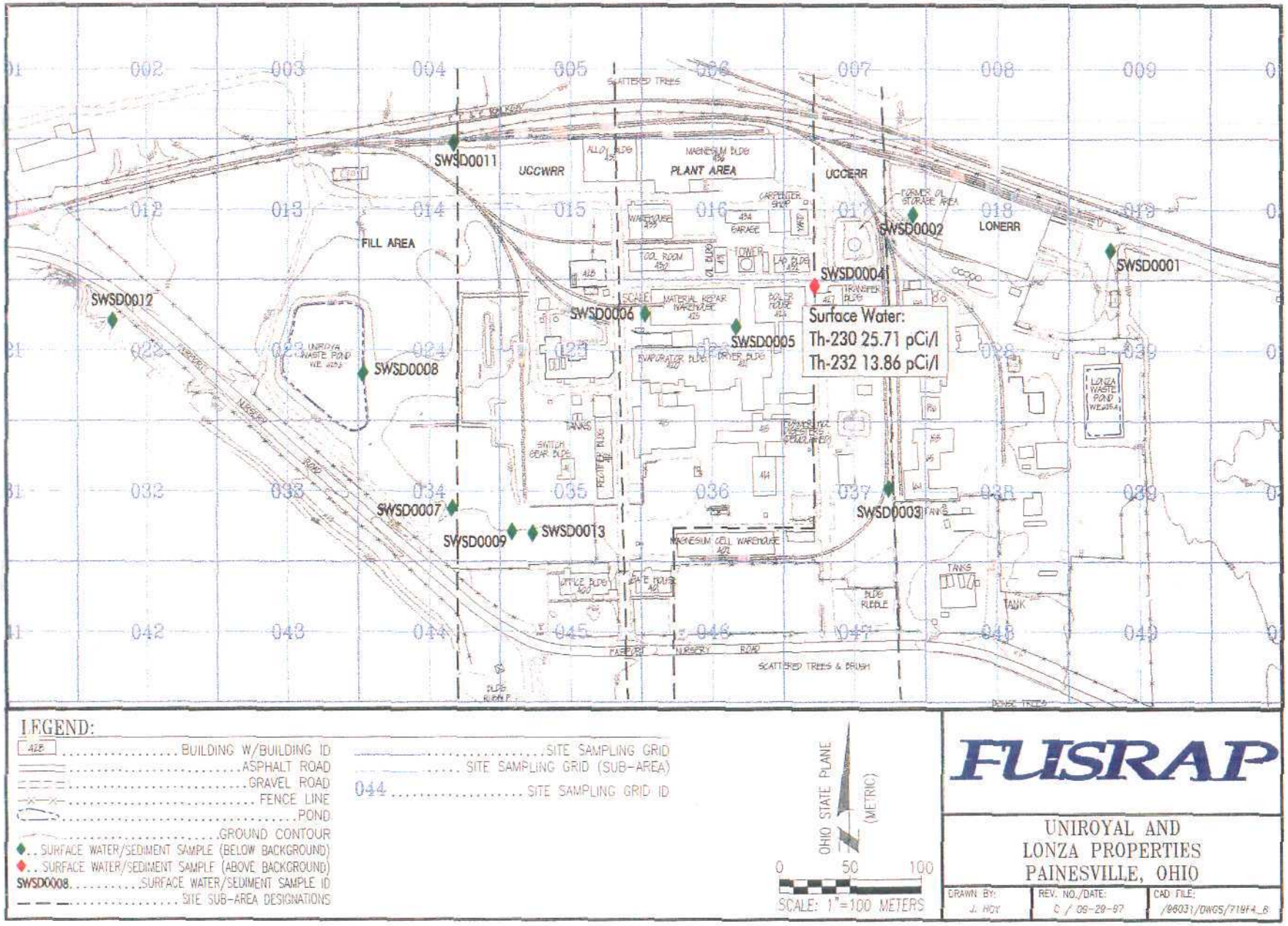


Figure 2-7. Surface Water and Sediment Sampling Results

radiological activity levels or chemical COCs exceeding corresponding risk based criteria. Only several inches of water were present in the storm sewer where sample SWSD0004 was collected. As a result, the surface water sample collected was turbid, since it was difficult not to disturb the underlying sediment during the sampling procedure.

All sediment samples showed background activity levels for Ra-226 (0.3 to 1.5 pCi/g), Th-230 (0.6 to 1.9 pCi/g), and Th-232 (0.2 to 1.1 pCi/g). With the exception of sample SWSD0007, all sediment samples also showed background activity levels for U-238 (0.4 to 2.6 pCi/g). A slightly elevated concentration of U-238 (8.1 pCi/g) was detected in sample SWSD0007.

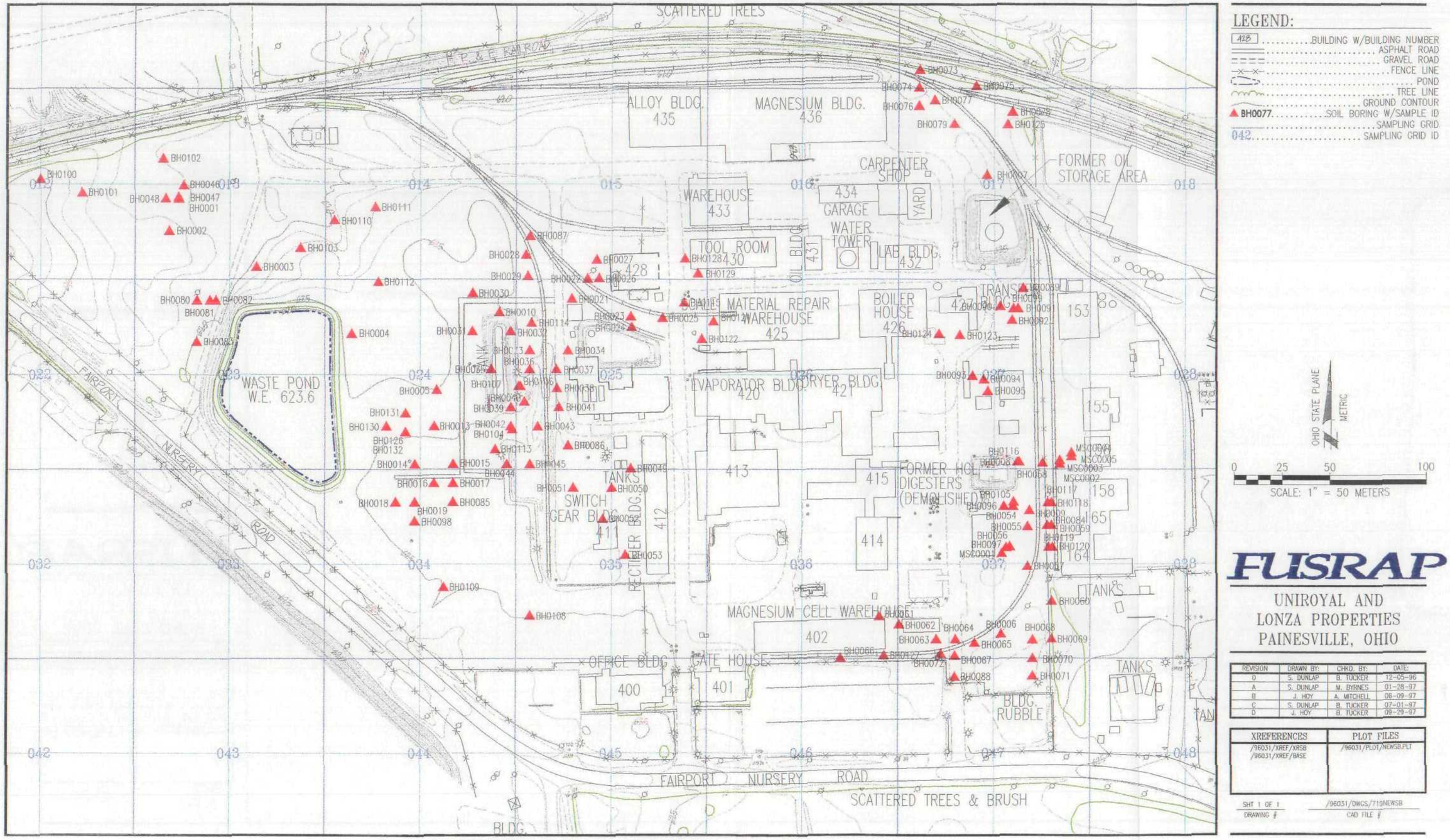
The results from the surface water and sediment samples collected from the Uniroyal and Lonza storm sewer systems, Uniroyal waste pond, and the Grand River showed background activity levels with the exception of the surface water sample collected from location SWSD0004 (sample PNV009), which showed elevated uranium and thorium activity levels.

2.4.8 Shallow and Deep Soil Sampling

A total of 667 soil samples were collected from 129 locations/boreholes using either a hand auger, split-spoon or Shelby Tube sampler (Figure 2-8). Of these samples a total of 356 were analyzed for radiological composition, 39 for chemical composition, 11 for geotechnical properties and 63 for quality control purposes (38 duplicates and 25 split samples). The soil sampling results were compared against the SOR guideline of 1.0 for radiological COCs. EPA Region III industrial guidelines were used as a basis of comparison for metals and organics. (EPA Region III guidelines were used because no similar risk-based guidelines have been established in EPA Region V where the Painesville site is located.) TCLP limits were used as the basis for evaluation of samples analyzed for RCRA characteristics.

Of the 356 soil samples analyzed for radiological composition, only 64 samples, collected from 30 boreholes, exceeded the SOR guideline (see Figures 2-9 and 2-10). Sample PNV0685, collected from the 0.5 to 1.5 ft interval of borehole BH0106, showed the highest activity levels at the site. This sample showed an adjusted U-238 and Ra-226 activity of 191 pCi/g and 1010 pCi/g respectively, and a SOR value of 78. The deepest soil sample found to exceed the SOR guideline was collected from the 3.5-ft to 4.5-ft depth interval within borehole BH0042. The next deepest soil sample exceeding the SOR guideline was collected from the 2.5-ft to 3.2-ft depth interval within borehole BH0054 (Fig. 2-8). As expected, the majority of the samples exceeding the SOR guideline were collected from the 0.0-ft to 0.5-ft depth interval. While the results from historical sampling identified radiological COCs as deep as 3.4 m (11 ft) below the ground surface, it is believed that this soil activity was carried to this depth by the drilling procedure. Figure 2-11 indicates the areas identified as exceeding a SOR of 1 as well as those exceeding 100 pCi/g Ra-226.

Some of the samples collected for radiological evaluation were also analyzed for the presence of potentially hazardous chemicals. Of the 39 soil samples analyzed for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), 16 samples, collected from 15 boreholes, exceeded EPA Region III RBCs for one or more of the following compounds: benzo(a)anthracene, benzidine, benzo-(k)fluoranthene, benzo(a)pyrene, chrysene,



LEGEND:

- 428 ..... BUILDING W/BUILDING NUMBER
- ASPHALT ROAD
- GRAVEL ROAD
- FENCE LINE
- POND
- TREE LINE
- GROUND CONTOUR
- BH0077 ..... SOIL BORING W/SAMPLE ID
- SAMPLING GRID
- 042 ..... SAMPLING GRID ID

OHIO STATE PLANE
METRIC

0 25 50 100
SCALE: 1" = 50 METERS

FUSRAP

UNIROYAL AND
LONZA PROPERTIES
PAINESVILLE, OHIO

REVISION	DRAWN BY:	CHKD. BY:	DATE:
0	S. DUNLAP	B. TUCKER	12-05-96
A	S. DUNLAP	M. BYRNES	01-28-97
B	J. HOY	A. MITCHELL	08-09-97
C	S. DUNLAP	B. TUCKER	07-01-97
D	J. HOY	B. TUCKER	08-29-97

XREFERENCES	PLOT FILES
/96031/XREF/XRSB /96031/XREF/BASE	/96031/PLOT/NEWSB.PLT

SHT 1 OF 1
DRAWING #

/96031/DWGS/719NEWSB
CAD FILE #

Figure 2-8. Soil Sampling Locations

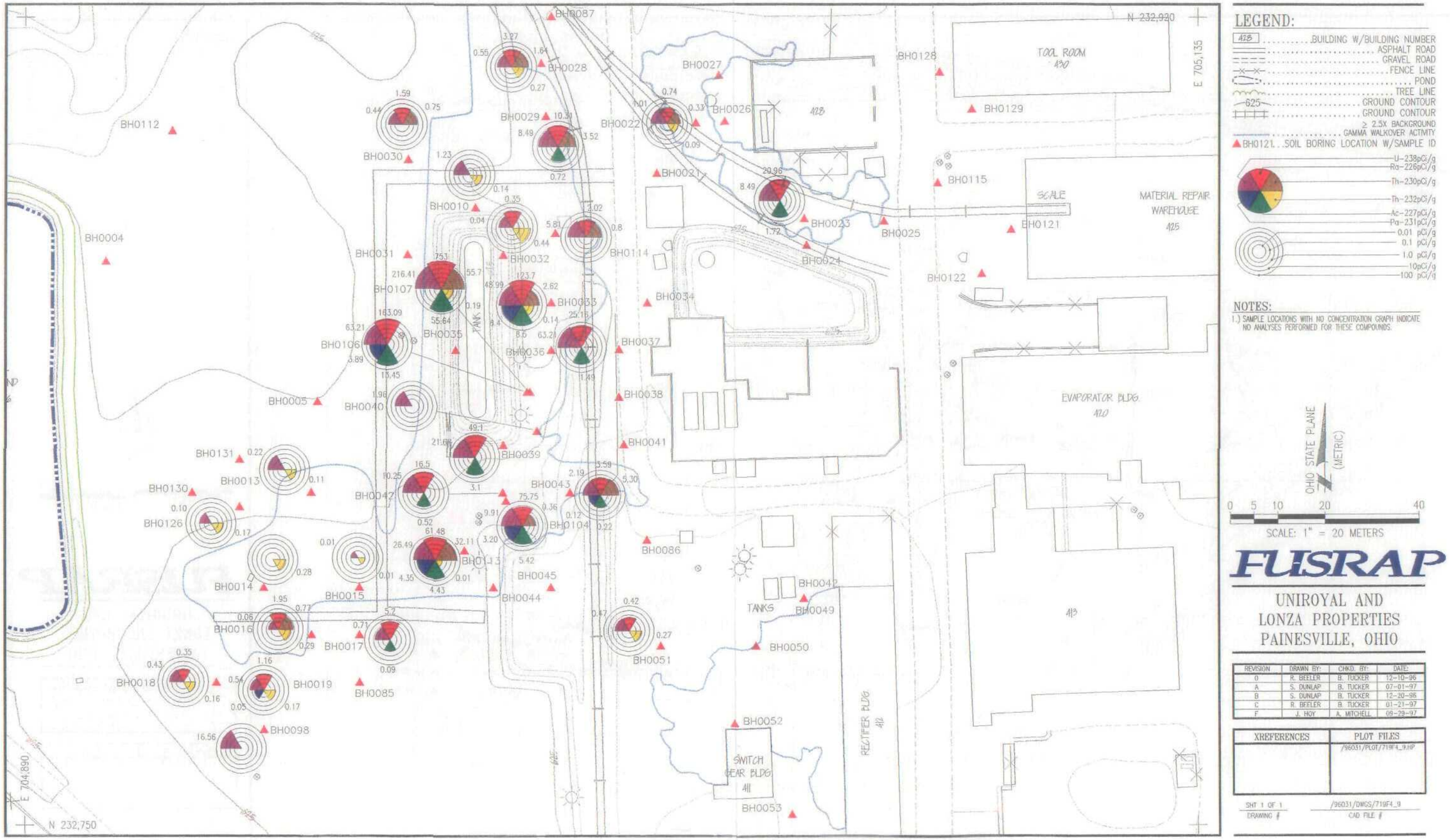


Figure 2-9. Concentrations of Radiological COCs in Surface Soils (0.0 to 0.5 ft)

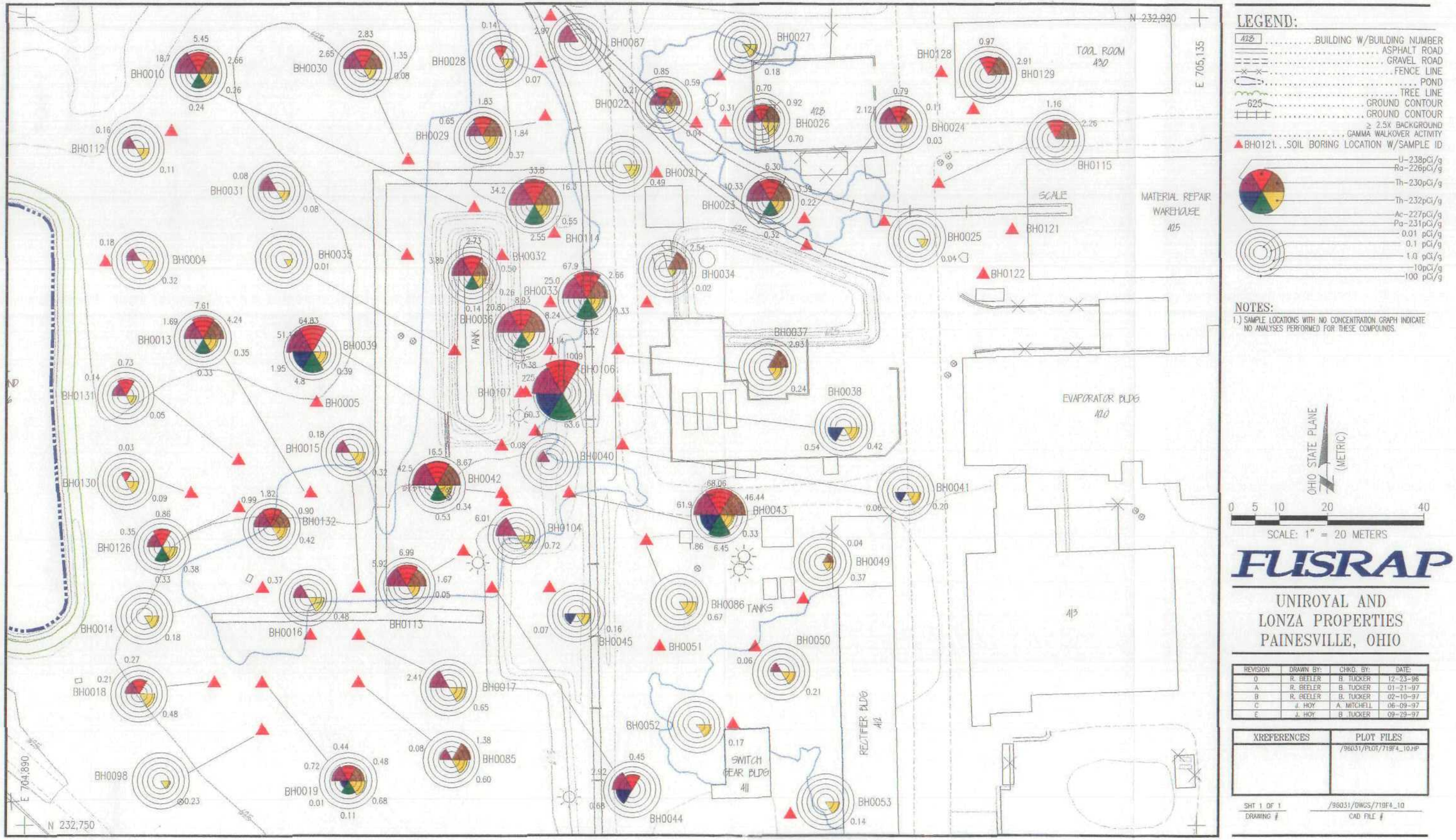


Figure 2-10. Maximum Radiological Soil Activity Levels Below 0.5 ft. Depth

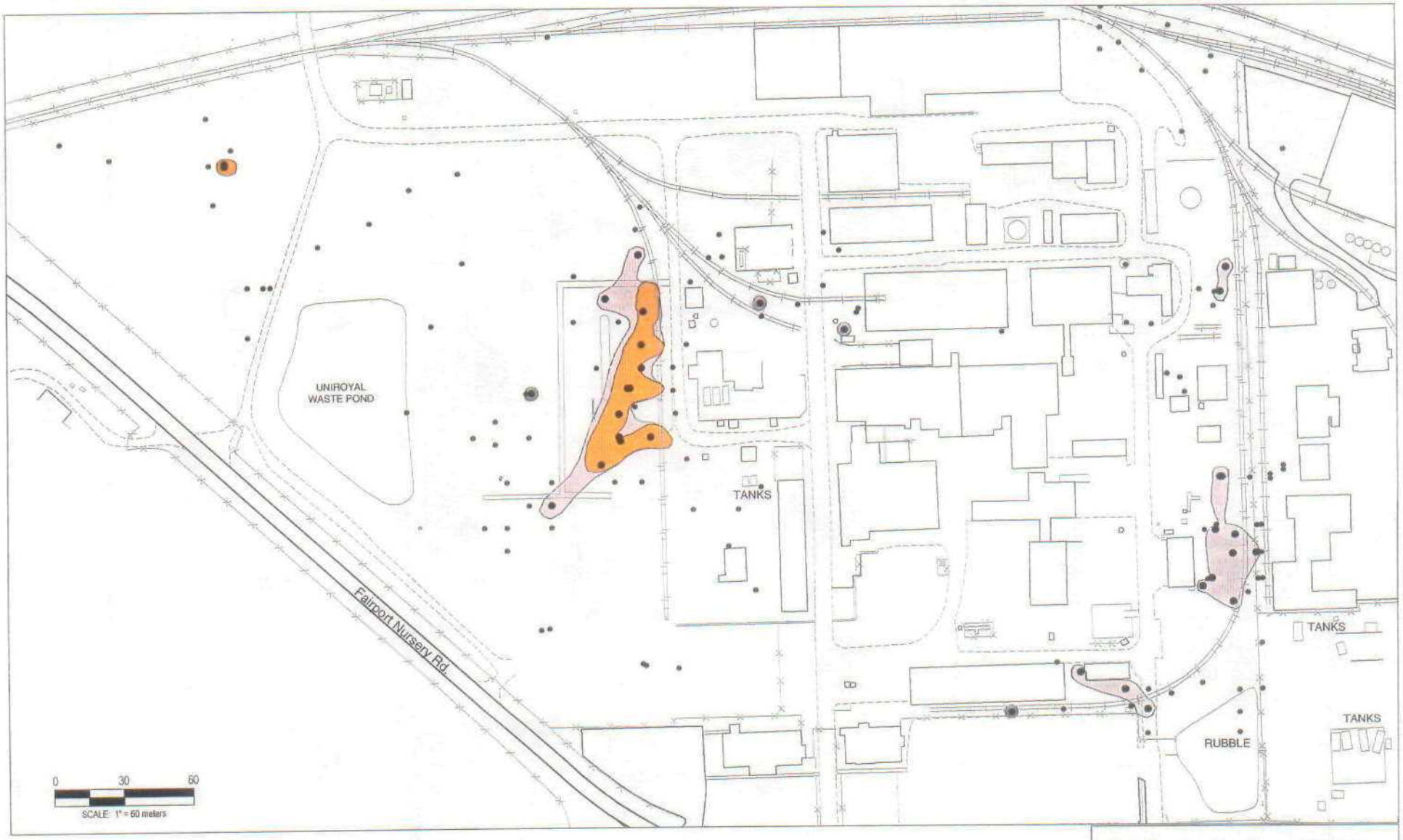


Figure 2-11. Areas of Contamination

- Sample locations
- SOR>1
- Ra-226>27pCi/g

dibenzo(a,h)anthracene, 1,1-dichloroethene, 1,2-dichloroethane, indeno(1,2,3-cd)pyrene, polychlorinated biphenyls, trichloroethene, 1,1,2-trichloroethane, and vinyl chloride. The chemical with the highest exceedance of its corresponding guideline was 1,1,2-trichloroethane, which was detected in sample PNV0581 at a concentration of 9,600 μg/kg, and exceeded its corresponding guideline by a factor of 960. Sample PNV0581 was collected from the 1.0-ft to 2.0-ft depth interval from borehole BH0004. The organic chemical showing the next highest exceedance was benzo(a)pyrene, which was detected in sample PNV0116 at a concentration of 15,000 μg/kg. This detection exceeded the guideline by a factor of 18.8. Sample PNV0116 was collected from the 2.5-ft to 3.5-ft depth interval from borehole BH0F03 and was the deepest sampling interval found to exceed EPA Region III guidelines for VOCs and SVOC.

Twenty-three metals onsite exceeded twice background. Most notably copper which exceeds background by a factor of 432 and exceeds twice background in a total of 18 samples. Metals onsite exceeding 10 times background are calcium, copper, lead, molybdenum, silver and zinc. Of the soil samples analyzed for metals, 42 samples collected from 32 boreholes exceeded EPA Region III soil screening levels (SSLs). Arsenic, barium, chromium, nickel, and thallium from onsite samples exceeded the Region III SSL values. The metal with the highest exceedance of its corresponding level was thallium, which was detected in sample PNV0571 at a concentration of 34.6 mg/kg, and exceeded its corresponding level by a factor of 87. Sample PNV0571 was collected from the 1.5 ft to 2.5 ft depth interval from borehole BH0107. The metal with the next highest exceedance was barium, which was detected in sample PNV0667 at a concenteration of 409 mg/kg. Sample PNV0667 was from the 0.0-ft to 0.5-ft depth interval from borehole BH0113. This detection exceeded its corresponding guideline by a factor of 13.

Analysis of background samples showed arsenic, barium, chromium, nickel, and thallium to exceed the Region III SSL for some samples. However, no metals had background averages above the Region III RBC values. Onsite, only beryllium exceeded the Region III RBC value. It had a maximum concentration of 2.6 mg/k in sample PNV091 from borehole BH0091.

Of the 17 soil samples run for TCLP analysis, no samples were found to exceed TCLP limits. A search of the Ohio EPA RCRA Branch records has revealed no evidence of a hazardous waste spill at the site. Since the samples for TCLP analysis were selected with bias from sampling intervals showing elevated activity levels, there is no concern over any mixed waste being present at the site.

Laboratory geotechnical testing was performed on 11 soil samples collected during characterization from sample locations BH0005, BH0006, and BH0007. These soil samples were obtained from both the undisturbed glacial till and the fill material at depths ranging from 0 to 14 ft below ground surface.

The results from the geotechnical testing showed that moisture content varied between 19 and 43 percent, and permeability ranged from 1.6×10^{-8} and 1.0×10^{-6} cm/sec. This range of hydraulic conductivity values is characteristic for glacial till (Freeze and Cherry 1979). No free liquids were identified as a result of any of the paint filter tests. The results from the soil gradation tests showed that the site soil and fill material was composed primarily of silt and clay (silt and clay content ranged from 71 to 91 percent; one fill sample showed 35 percent). The

liquid limit and plasticity index results ranged from 28 to 45 percent and 14 to 22 percent, respectively.

Soil samples were also evaluated to determine the distribution coefficient (k_d) for the COCs in the soil matrix. The K_d provides an indication of the degree to which the transfer of COCs from the solution to the soil matrix is retarded by absorption or other chemical processes. In general, the lack of a continuous groundwater flow regime limits the applicability of these results to the prediction of COC transport behavior at the Painesville site.

In summary, the results from soil sampling activities indicate limited areas of radioactive contamination and somewhat more extensive chemical contamination (organics and metals), with most of the contamination within the surface interval and almost all within 1 m of the surface. This sampling and a record search also confirmed that no mixed wastes are present on site since all sample results were below RCRA criteria and no record of hazardous waste spills was found. The soil samples collected from the shallow and deep boreholes positioned over geophysical anomalies confirmed that no radiological COCs are present in the vicinity of shallow ferromagnetic anomalies or deep fill material located north and west of the Uniroyal waste pond.

2.4.9 Groundwater Sampling Results

Groundwater characterization activities confirmed that the regional groundwater table is located more than 12 m (40 ft) below ground surface and is protected by a clay unit greater than 6 m (20 ft) in thickness. A discontinuous perched groundwater table was encountered near the ground surface, as shallow as 1-ft below grade. This perched saturated zone is typically less than 1-ft thick, and was absent in several of the boreholes during the sampling events. Due to the thickness of the silty clay layer which separates the perched zone from the regional water table, the potential for the vertical migration of COCs to the regional groundwater table is minimal.

For the unfiltered groundwater samples, concentrations of U-238 were found to range from as low as 13.2 pCi/L in well TW0010 to as high as 313 pCi/L in well TW0107. These detections of U-238 were well below the corresponding DCG of 600 pCi/L. The highest concentration of Ra-226 in the unfiltered samples was detected in well TW0008 at a concentration of 23.3 pCi/L. Unfiltered concentrations of Ra-226 in the remaining wells ranged from as low as 0.7 pCi/L in well TW0010 to 15.2 pCi/L in well TW0007. These detections of Ra-226 were well below the corresponding DCG of 100 pCi/L. The Ra-226 values do exceed maximum concentration limits (MCLs), but because the groundwater is not considered a potential drinking water source, application of MCL criteria is not applicable to this location. The concentrations of Th-230 in unfiltered samples were found to range from as low as 0.5 pCi/L in well TW0105 to as high as 50 pCi/L in well TW0008. These detections of Th-230 were well below the corresponding DCG of 300 pCi/L. The highest unfiltered concentration of Th-232 was detected in well TW0008 at a concentration of 39 pCi/L. Unfiltered concentrations of Th-232 in the remaining wells ranged from as low as 0.1 pCi/L in well TW0105 to 2.4 pCi/L in well TW0010. These detections of Th-232 were well below the corresponding DCG of 50 pCi/L. The unfiltered concentrations of Ac-227 ranged from 0.2 to 0.4 pCi/L. The Ac-227 concentrations were derived from Th-227 concentrations, which are in secular equilibrium. These detections of Ac-227 were well below the corresponding DCG of 10 pCi/L. The unfiltered concentrations of

Pa-231 were all below detection limits which ranged from 132 to 230 pCi/L. While these detection limits exceeded the 10 pCi/L DCG, lower detection limits were not attainable because the analysis had to be performed using gamma as opposed to alpha spectroscopy. A summary of groundwater sampling results is provided in Table 2-2.

Table 2-2. Summary of Groundwater Analytical Results

Station	Sample ID	Analyte Name	Result	Detection Limit		DOE Ingested Water DCG[a]	Method
TW0008	PNV0749	Actinium-227	34.80	34.80	pCi/l	10.00	Gammaspec
TW0008	PNV0749	Protactinium-231	145.00	145.00	pCi/l	10.00	Gammaspec
TW0008	PNV0749	Radium-226 (Filtered)	1.21		pCi/l	100.00	Alphaspec
TW0008	PNV0749	Radium-226	23.30	0.99	pCi/l	100.00	Alphaspec
TW0008	PNV0749	Thorium-230 (Filtered)	0.21		pCi/l	300.00	Alphaspec
TW0008	PNV0749	Thorium-230	50.37	2.26	pCi/l	300.00	Alphaspec
TW0008	PNV0749	Thorium-232 (Filtered)	0.32		pCi/l	50.00	Alphaspec
TW0008	PNV0749	Thorium-232	39.06	1.13	pCi/l	50.00	Alphaspec
TW0008	PNV0749	Uranium-238 (Filtered)	0.38		pCi/l	600.00	Alphaspec
TW0008	PNV0749	Uranium-238	14.40	0.45	pCi/l	600.00	Alphaspec
TW0010	PNV0748	Actinium-227	47.50	47.50	pCi/l	10.00	Gammaspec
TW0010	PNV0748	Protactinium-231	221.00	221.00	pCi/l	10.00	Gammaspec
TW0010	PNV0748	Radium-226	0.67	0.32	pCi/l	100.00	Alphaspec
TW0010	PNV0748	Thorium-230	3.80	0.57	PCi/l	300.00	Alphaspec
TW0010	PNV0748	Thorium-232	2.37	0.51	pCi/l	50.00	Alphaspec
TW0010	PNV0748	Uranium-238	13.16	0.76	pCi/l	600.00	Alphaspec
TW0105	PNV0750	Actinium-227	20.40	20.40	pCi/l	10.00	Gammaspec
TW0105	PNV0750	Protactinium-231	132.00	132.00	pCi/l	10.00	Gammaspec
TW0105	PNV0750	Radium-226	1.07	0.27	pCi/l	100.00	Alphaspec
TW0105	PNV0750	Thorium-230	0.45	0.27	pCi/l	300.00	Alphaspec
TW0105	PNV0750	Thorium-232	0.13	0.24	pCi/l	50.00	Alphaspec
TW0105	PNV0750	Uranium-238	24.87	0.36	pCi/l	600.00	Alphaspec
TW0107	PNV0570	Actinium-227	27.70	27.70	pCi/l	10.00	Gammaspec
TW0107	PNV0570	Protactinium-231	230.00	230.00	pCi/l	10.00	Gammaspec
TW0107	PNV0570	Radium-226	15.22	0.33	pCi/l	100.00	Alphaspec
TW0107	PNV0570	Thorium-230	5.93	0.25	pCi/l	300.00	Alphaspec
TW0107	PNV0570	Thorium-232	0.43	0.25	pCi/l	50.00	Alphaspec
TW0107	PNV0570	Uranium-238	312.80	0.64	pCi/l	600.00	Alphaspec

[a] DCG or Derived Concentration Guideline is a risk based guideline.

Unfiltered groundwater samples collected from the perched water table in areas of contamination showed elevated activity levels. The results from the filtered groundwater sample collected from well TW0008 (sample PNV0749) confirmed that the activity levels identified in the perched groundwater are the result of suspended soil particles in the water. After filtration, the activity levels of each isotope dropped a minimum of two orders of magnitude.

2.4.10 Ecological Sampling Results

The results from the gamma spectroscopy analysis of earthworm samples indicated a constant factor of four times in accumulation of Th-230 in tissue when compared to the concentrations in soil. U-238 was reported at a maximum concentration of 52 pCi/g in

earthworms near BH0036, which is approximately five times the concentration in soil. These earthworm samples were collected from locations showing elevated activity levels in soil.

2.5 STREAMLINED RISK EVALUATION

The radiological risk evaluation provided in Appendix B presents reasonable worst-case exposure scenarios at the Painesville site assuming the property remains an industrial facility. Under these conditions, it is assumed that the facility expands into areas found to contain elevated concentrations of radionuclides. Direct gamma exposure, soil ingestion, and dust inhalation (including radon decay products) pathways were considered. Consumption of livestock and homegrown produce were not considered for the industrial property. Groundwater was also not considered based on data collected during the 1996 characterization effort which showed that water which could be used for consumption is not in communication with impacted soil.

Currently, 10 CFR 20 limits doses to the public from all sources to no more than 100 mrem/yr to a maximum exposed individual. This regulation also requires application of the "as low as reasonably achievable" (ALARA) philosophy to reduce doses in most cases to a fraction of the 100 mrem/yr limit.

The estimated dose to the maximally exposed future site worker under worst case conditions is 99 mrem/yr, which equates to an excess lifetime cancer risk of 1.0E-3. This dose is based on conservative assumptions of future exposure conditions, which would allow much higher exposures than are possible under current site conditions. The potential dose is high enough that removal actions would be required under ALARA.

The threats posed by radioactive materials at the Painesville site are of a non-time-critical nature (i.e., no immediate risk to human health or the environment currently exist at this property that would require emergency cleanup within the next 6 months). However, because future radiation exposures could exceed the public dose limits, the site conditions do meet criteria listed in the National Contingency Plan (NCP) for conducting removal actions to prevent potential future exposures to nearby human populations. EPA considers a number of actions candidates for the EE/CA process (EPA, 1993). These include:

- prevention or abatement of actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances, pollutants or contaminants.

- mitigation or abatement of other situations or factors that may pose threats to public health, welfare or the environment.

3. IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

The results of the 1996 characterization activities confirmed the presence of radiological COCs exceeding current 40 CFR 192.12 guidelines. Although there is little potential for disturbance and spread of these materials at the Painesville site and no imminent risk to human health or the environment has been identified, the proposed removal action would further reduce the potential for human or environmental exposure by removing the impacted materials from the site.

This section identifies the statutory authority for the removal action, defines the scope and purpose of the removal action, and states the objectives to be achieved by the removal action.

3.1 STATUTORY LIMITS

Authority for responding to releases or threats of release from an impacted site is provided by Section 104 of CERCLA. In 1997, Congress authorized the USACE to manage FUSRAP under which it is authorized to undertake such investigations, surveys, testing, or other data gathering deemed necessary to identify the existence, extent, and nature of the COCs present at the Painesville site, including the extent of threats to human health and the environment. In addition, USACE is authorized to undertake planning, engineering, and other studies and investigations appropriate to direct response actions to prevent, limit, or mitigate potential risks associated with the site.

3.2 SCOPE AND PURPOSE

The scope of the proposed CERCLA cleanup action includes the removal, transportation, and permanent disposal of radioactively impacted materials from the Painesville site. The specific objectives of the action include the following:

- Remove soils with radioactive constituents that may impact public health from the Painseville site;
- Transport excavated materials to an appropriately licensed facility for permanent disposal;
- Minimize potential hazards to personnel performing the removal action, members of the public, and the environment;
- Allow future use of the site to be with minimal radiologic restrictions; and
- Restore the excavated areas.

The purpose of the proposed action is to reduce the potential for future exposures to the impacted materials. All activities would be conducted in a way to minimize the potential risks to on-site personnel performing the removal action, members of the public, and the environment.

3.3 SCHEDULE

The proposed removal action for the impacted materials at the Painesville site could begin in fiscal year 1998 and would require approximately six months for completion, depending on the availability of funding. If sufficient funding is not allocated to USACE for this activity during this period, the period for completion of the action could be extended; this schedule could also be delayed due to other factors such as unanticipated difficulties in waste transportation, coordination with property owners, or the availability of disposal capacity.

The schedule includes developing detailed work plans and health and safety plans, developing appropriate decontamination facilities, removing the impacted materials, transporting the materials for off-site disposal, and restoring the disturbed area.

3.4 COMPLIANCE WITH REGULATORY REQUIREMENTS

In a removal action under CERCLA, legally applicable or relevant and appropriate requirements (ARARs) need to be attained only to the extent practicable. The extent practicable is to be determined considering the urgency of the situation and the scope of the removal action.

An "applicable" requirement is a cleanup standard, standard of control, or other substantive environmental protection requirement, criterion, or limitation promulgated under federal or state law that specifically addresses a hazardous substance, pollutant, contaminant, removal action, location, or other circumstance at a CERCLA site.

A "relevant and appropriate" requirement is a cleanup standard, standard of control, or other substantive environmental protection requirement, criterion, or limitation promulgated under federal or state law that, while not "applicable" to the situation, addresses problems or situations sufficiently similar to those encountered at the CERCLA site that its use is well suited to the particular site. A requirement must be both relevant and appropriate to be an ARAR. A requirement is relevant if it addresses a problem similar to that at the site. A requirement is appropriate if it is well suited to the circumstances of the release and the site.

Also, for any hazardous substance that will remain on site, removal actions must attain requirements under Federal or State environmental or facility siting laws that are applicable or relevant and appropriate under the circumstances of the release at the completion of the removal action. State standards are potential ARARs for CERCLA removal actions when they are promulgated, more stringent than federal standards, and identified by the state in a timely manner.

When deciding what actions and standards to follow during a removal action, it may be necessary to use federal and state non-promulgated criteria, advisories, and guidance. These

standards are included in ARAR compilations as items "to be considered" or TBCs. Use of TBCs is discretionary. There is no legal requirement to comply with TBCs. The potential ARARs or TBCs at the site are 10 CFR 20 Subpart E and OAC 3701-39, which provide standards for determining the extent to which lands must be remediated before decommissioning of a site that is licensed by the NRC or the State of Ohio.

3.5 SITE SPECIFIC GUIDELINES

Ohio Administrative Code 3701-39-021, Standards for Handling Radioactive Material, contains criteria which determine if the handling, distribution, or processing or radioactive material is exempt from licensure. According to the Code, the following are exempt from licensure:

(a) Soil containing technologically enhanced radium-226 or radium-228 with a radon emanation rate less than 20 pCi/sq m/s provided that the concentrations of technologically enhanced radium-226 or radium-228 in the soil, averaged over any one hundred square meters, and averaged over the first fifteen centimeters of soil below the surface, does not exceed 27 pCi/g.

or

(b) Soil containing technologically enhanced radium-226 or radium-228 with a radon emanation rate equal to greater than 20 pCi/sq m/s provided that the concentration of technologically enhanced radium-226 or radium-228 in the soil, averaged over any one hundred square meters, and averaged over the first fifteen centimeters of soil below the surface, does not exceed 5 pCi/g.

Although this Code does not specify cleanup levels for soil, it does govern handling of radioactive material and based on radon emanation rate calculations, cost/benefit comparisons, and potential future site activities, could serve as a site-specific standard for the Painesville site.

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4. REMOVAL ACTION TECHNOLOGIES AND ALTERNATIVES

In this section the technologies potentially applicable to achieve the objectives described in this document are identified and evaluated for their usability. In Section 5.0, alternatives derived from these technologies are briefly discussed and evaluated as to their effectiveness, implementability, and cost.

4.1 TECHNOLOGY IDENTIFICATION AND SCREENING

The preliminary identification of technologies discussed in this section is not all inclusive, but provides a brief overview of relevant technologies that could be applied to protect human health and the environment. These technologies have been screened on the basis of site-specific conditions and the current understanding of radionuclide distribution at the Painesville site.

Institutional Controls

Institutional controls are measures that prevent or minimize public exposure by limiting access or use of impacted areas. They may include physical barriers (such as fences), use of deed restrictions, and environmental monitoring. Such controls are not effective in reducing the toxicity, mobility, or volume of COCs, but they may reduce the potential for exposure to impacted materials. Costs associated with institutional controls are generally low. However, the NCP specifies that institutional controls may not be used as a substitute for active response measures as the sole remedy unless active measures are determined not to be practicable. Therefore, institutional controls will not be considered further as a removal action alternative for the Painesville site but may be an element of other removal action alternatives (i.e., deed restrictions for contaminated materials left on site).

Containment

Containment technologies are designed to reduce the potential for migration of COCs into the surrounding environment through the in-place enclosure of impacted materials. Containment technologies do not typically reduce the toxicity or volume of contaminants, but they may be effective in reducing contaminant mobility. Costs associated with containment technologies are considered moderate.

Enclosure of the materials can occur through the use of surface and subsurface barriers. Surface barriers (caps) are used to cover the materials to prevent infiltration, erosion, and human exposure. Subsurface barriers can be created through the use of sheet piles, grout curtains, or other methods to prevent groundwater flow through the contaminated material. The ease of installation of these barriers is dependent upon the site geology.

Due to the thickness of the till separating the impacted soil from the regional aquifer and the "ponding nature" of the perched groundwater, the use of subsurface barriers has been eliminated from inclusion in the removal action alternatives.

Removal

Removal of impacted materials from a site can effectively reduce contaminant mobility and potential exposure. These technologies are reliable, can be easily implemented with standard construction procedures and conventional equipment, and have been used extensively for radioactive materials similar to those at the Painesville site. Therefore, removal technologies have been retained for inclusion in the removal action alternatives.

Treatment

Treatment includes a wide range of technologies, only a limited number of which are applicable to radioactive materials. Radioactive waste treatment technologies can be categorized as those that remove the radioactive material from the waste matrix, and those that change the form of the waste, thereby reducing the toxicity, mobility, or volume of the contaminants. Treatment costs are considered moderate to high.

Treatment technologies that immobilize the radioactive material would be inappropriate to apply to the low levels of radionuclides in the Painesville soils and will not be evaluated further in this document. Treatment technologies that remove the radioactive material from the matrix (such as soil washing or soil sorting) involve moderate to significant cost and time. Due to the relatively limited volume of impacted material at the Painesville site, these technologies were not considered to be cost effective and will also not be evaluated further in this document.

Interim Storage

Interim storage involves the temporary placement of impacted materials in a manner that effectively protects human health and the environment until the final treatment or disposal of the materials can be determined. Interim storage can be achieved by placing the impacted materials in an existing engineered facility or in a newly constructed facility. Costs range from low, if existing storage capacity is available, to moderately high, if construction of a new facility is required.

On-site interim storage capacity for the materials considered in this EE/CA is not available at the Painesville site, so on-site interim storage has been eliminated from inclusion in the removal action alternatives. Interim storage in a newly constructed facility has also been eliminated from further consideration on the basis of cost, implementation time, and lack of significant benefit.

Disposal

Disposal involves the permanent placement of impacted materials in a manner that reduces contaminant mobility and protects human health and the environment for the long term. There are several types of facilities that meet or could meet these requirements: a FUSRAP-exclusive facility, a commercial facility, and/or a government facility. Currently, no FUSRAP-exclusive facility exists and government facilities are very costly. Therefore, commercial disposal is the only permanent disposal option retained for the removal action alternatives.

4.2 IDENTIFICATION OF PRELIMINARY ALTERNATIVES

The preliminary screening of potentially applicable technologies resulted in the identification of the following removal action alternatives: no action, partial removal and commercial disposal, consolidation and placement of a permanent soil cover, and complete removal and commercial disposal. These removal action alternatives are described below.

Alternative 1: No action

Under Alternative 1, no additional action would be taken by USACE at the Painesville site. Uniroyal and Lonza would continue to maintain the current site controls to verify that no significant changes in site conditions occur.

The no-action alternative is included to provide a baseline for evaluation of other alternatives in accordance with CERCLA requirements. The acceptability of the no-action alternative will be judged in relation to the assessment of known site risks and by comparison to other removal alternatives.

Alternative 2: Partial removal and commercial disposal

Under Alternative 2, impacted materials would be removed sufficient to reduce doses to less than the regulation of 25 mrem/yr (10 CFR 20.1402), at the Painesville site and transported to an off-site permitted commercial disposal facility. Based on the dose assessment shown in Appendix B, Ra-226 concentrations are the primary contributor to the site dose. Removing impacted materials with Ra-226 concentrations exceeding 100 pCi/g would result in a site dose assessment of approximately 21 mrem/yr under a commercial/industrial use scenario. The volume of impacted material to be removed in this alternative would be approximately 190 m^3 (250 yd^3). Excavated areas would be backfilled, graded, and revegetated. Dust suppression measures would be implemented as needed during the removal action to protect workers and prevent airborne migration of radionuclides. Site access restrictions and environmental surveillance would be maintained throughout the removal action.

Alternative 3: Partial removal and commercial disposal

Under Alternative 3, impacted materials, sufficient to reduce maximum Ra-226 concentration to less than 65 pCi/g and doses to less than 25 mrem/yr (10 CFR 20.1402), would be removed at the Painesville site and transported to an off-site permitted commercial disposal facility. Based on the dose assessment shown in Appendix B, Ra-226 concentrations are the primary contributor to the site dose. Removing impacted materials with Ra-226 concentrations exceeding 65 pCi/g would result in a site dose assessment of less than the 21 mrem/yr evaluated under Alternative 2. This alternative was proposed as a cost comparison to Alternatives 2 and 4. The volume of impacted material to be removed in this alternative would be approximately 244 m^3 (320 yd^3). Excavated areas would be backfilled, graded, and revegetated. Dust suppression measures would be implemented as needed during the removal action to protect workers and prevent airborne migration of radionuclides. Site access restrictions and environmental surveillance would be maintained throughout the removal action.

Alternative 4: Partial removal and commercial disposal

Under Alternative 4, impacted materials, sufficient to reduce maximum Ra-226 concentration to less than 27 pCi/g and doses to less than the proposed regulation of 25 mrem/yr (10 CFR 20.1402), would be removed at the Painesville site and transported to an off-site permitted commercial disposal facility. The area that this represents is shown in Figure 2-11. Based on the dose assessment shown in Appendix B, Ra-226 concentrations are the primary contributor to the site dose. Removing impacted materials with Ra-226 concentrations exceeding 27 pCi/g would result in a site dose assessment of much less than 21 mrem/yr. This alternative is based on Ohio Administrative Code 3701-39-021 guidelines for handling of radioactive material. Modeling has shown that the material remaining onsite would meet the radon emanation rate limitations and the Ra-226 concentration guidelines set forth in the code. This would leave the current or future tenant with the ability to excavate and dispose soil without regard to radiological restrictions. The volume of impacted material to be removed in this alternative would be approximately 604 m^3 (790 yd^3). Excavated areas would be backfilled, graded, and revegetated. Dust suppression measures would be implemented as needed during the removal action to protect workers and prevent airborne migration of radionuclides. Site access restrictions and environmental surveillance would be maintained throughout the removal action.

Alternative 5: Consolidation and placement of a permanent soil cover

In Alternative 5, impacted material exceeding cleanup guidelines [approximately 3,100 m^3 (4,000 yd^3)] would be excavated and consolidated into a low lying area in the northwest corner of the Painesville site. A 1-ft thick permanent soil cover, which would reduce potential radiation exposure to site workers and the public, would be placed over the material. Dust suppression and erosion control measures would be implemented as needed during the removal action to protect the workers and prevent airborne migration of radionuclides. Site access restrictions and environmental surveillance would be maintained throughout the removal action. Maintenance of the soil cover and monitoring of the site would continue following the remediation.

Alternative 6: Complete removal and commercial disposal

In Alternative 6, impacted material exceeding cleanup guidelines for unrestricted use [approximately 3,100 m^3 (4,000 yd^3)] would be removed from the Painesville site and transported to an off-site permitted commercial disposal facility. The area that this represents is shown as the larger shaded area in Figure 2-11. Excavated areas would be backfilled, graded, and revegetated. Dust suppression and erosion control measures would be implemented as needed during the removal action to protect workers and prevent airborne migration of radionuclides. Site access restrictions and environmental surveillance would be maintained throughout the removal action.

5. EVALUATION OF ALTERNATIVES

The removal action alternatives identified in Section 4.2 are evaluated below with respect to effectiveness, implementability, and cost.

5.1 EFFECTIVENESS

The effectiveness of an alternative is defined by its ability to protect human health and the environment from risks associated with the radionuclides in both the short term and the long term. Measures of effectiveness include (1) reduction of potential risks to human health and the environment; (2) compliance with regulatory requirements; (3) timeliness; and (4) reduction of contaminant toxicity, mobility, and volume through treatment.

5.1.1 Potential Human Health and Environmental Impacts

Radiological dose and risk assessments have been performed to provide a basis for comparison of removal action alternatives, using the RESidual RADioactivity (RESRAD) computer code (Yu et al. 1993). These estimates include numerous conservative assumptions (i.e., assumptions likely to overestimate actual exposure conditions) using industrial use scenarios.

Because Uniroyal and Lonza have been in operation for over 30 years and other land-use scenarios are not expected in the foreseeable future, it is expected that the future use of the Painesville site will remain commercial/industrial. Thus, a possible sequence of events for the site includes possible construction of new chemical processing, general office, or warehouse structures. To assess potential exposures, it was assumed that new structures would be constructed directly over a large area known to contain elevated radionuclide concentrations. The butadiene tank area to the west of all current site structures was selected to provide a reasonable worst case scenario. The exposure scenarios evaluated included a construction worker involved in the erection of new site structures, an industrial worker located in the newly constructed building, a maintenance worker involved in the upkeep of the containment area cover, and a remediation worker involved in the excavation and movement of impacted materials.

Estimates of the radiation dose to the construction, industrial and maintenance workers for each removal action alternative are summarized in Table 5-1. Alternatives 2 and 6 represent the endpoints of the partial-complete excavation alternatives. Since the risks for these alternatives would also represent the endpoints, and both are within EPA's risk range, no separate risk calculations were done for the other partial excavation alternatives (3 and 4). (Because the remediation worker exposure would be comparable to but less than the construction worker, and because doses would be a small fraction of the applicable limit (5,000 mrem/yr from 10 CFR 20), separate dose and risk calculations were not performed for the remediation worker). Additional information about the dose estimates for each alternative and their respective exposure assumptions are summarized below and presented in more detail in Appendix B.

Table 5-1. Maximum Estimated Radiation Dose and Risk Estimates to Workers After Implementation of Removal Action Alternatives for the Painesville Site

Scenario	Receptor	Total Dose (mrem/yr)	Lifetime Risk (yr^{-1})
Alternative 1: No Action	Construction Worker Industrial Worker	15 99	6.E-06 1.E-03
Alternative 2: Partial Removal	Construction Worker Industrial Worker	4.1 22	1.E-06 3.E-04
Alternative 3: Partial Removal	Construction Worker Industrial Worker	>0.25 to <4.1 >1.5 to <22	<1.E-06 <3.E-04
Alternative 4: Partial Removal	Construction Worker Industrial Worker	>0.25 to <<4.1 >1.5 to <<22	<1.E-06 <3.E-04
Alternative 5: On-Site Consolidation	Maintenance Worker (1-ft cover)	< 1	3.E-06
Alternative 6: Complete Removal[a]	Construction Worker Industrial Worker	0.25 1.5	1.E-07 2.E-05

[a] Removal of soil concentrations > SOR = 1

Gamma exposure rate and ambient air sampling results were collected to assess potential dose to an individual located just outside the Painesville site perimeter fence line. Gamma exposure rate measurements taken at six fence line locations were indistinguishable from background. Ambient air measurements also indicate results indistinguishable from background. Because these data were collected under current site conditions (equivalent to the no action alternative), no further evaluation of fence line exposure was necessary.

Alternative 1: No action

Under Alternative 1, no action would be taken to address the impacted material contained on the Painesville site and the site would remain an industrial (nonresidential) facility. Based on current environmental surveillance data, the maximum potential radiation dose to a hypothetical industrial worker was at the butadiene tank spill containment area. The maximum potential radiation dose would be approximately 99 mrem/yr (industrial worker) with an excess lifetime risk of 1×10^{-3}. This dose estimate would not meet the limit of 25 mrem/yr (10 CFR 20) and exceeds the CERCLA lifetime risk criteria of 10^{-4}.

This alternative would not be effective in either the long term or short term in protecting the public health and the environment.

Alternative 2: Partial removal and commercial disposal

Under Alternative 2, potential risks to construction and industrial workers and the environment at the site would be reduced in the long term, because all of the impacted material (approximately 250 yd^3) containing Ra-226 >100 pCi/g would be removed from its present location and placed in an off-site engineered facility designed for permanent disposal. Impacted material with lower concentrations of radionuclides would remain onsite.

Under Alternative 2, the dose to the industrial and construction worker (22 mrem/yr and 4.1 mrem/yr, respectively) are below the limit of 25 mrem/yr. The maximum lifetime risk is 3×10^{-4}, and generally falls within the range of risk determined by EPA to be acceptable at other sites. Included in the risk calculation is the fact that the result of removing the Ra-226 to these levels also removes U-238 such that the maximum U-238 activity left would be 65 pCi/g and the maximum Th-230 activity would be 304 pCi/g.

This alternative complies with all potential ARARs except OAC 3701-39-021. Because this alternative does reduce the risk to future workers to within EPA's risk range, it does achieve long term effectiveness.

As Table 5-1 shows, this alternative also achieves short term effectiveness by protecting the remediation worker from risks exceeding EPA's risk range. Because of the low volume of material, there would be minimal disruption of the local community due to transportation of the material. Impacts to the air and water, and environment in general would be mitigated using good construction practices. This alternative could be implemented quickly thus reducing the time until remedial objectives are achieved.

Alternative 3: Partial removal and commercial disposal

In Alternative 3, potential risks to construction and industrial workers and the environment at the site would be reduced in the long term, because all of the impacted material containing Ra-226 >65 pCi/g (approximately 320 yd^3) would be removed from its present location and placed in an off-site engineered facility designed for permanent disposal. Impacted material with lower concentrations of radionuclides would remain onsite.

Under Alternative 3, the dose to the industrial and construction worker is less than in Alternative 2 and is below the limit of 25 mrem/yr. The maximum lifetime risk is less than 3×10^{-4}, and generally falls within the range of risk determined by EPA to be acceptable at other sites. For the entire site the result of removing the Ra-226 also removes U-238 such that the maximum U-238 activity left would be 64 pCi/g and the maximum Th-230 activity would be 304 pCi/g.

This alternative complies with all potential ARARs except OAC 3701-39-021. Because this alternative does reduce the risk to future workers to within EPA's risk range it does achieve long term effectiveness.

As Table 5-1 shows, this alternative also achieves short term effectiveness by protecting the remediation worker from risks exceeding EPAs risk range. Because of the low volume of material there would be minimal disruption of the local community due to transportation of the material. Impacts to the air and water, and environment in general would be mitigated using good construction practices. This alternative could be implemented quickly thus reducing the time until remedial objectives are achieved.

Alternative 4: Partial removal and commercial disposal

Under Alternative 4, potential risks to construction and industrial workers and the environment at the site would be reduced in the long term, because all of the impacted material containing Ra-226 >27 pCi/g (approximately 790 yd^3) would be removed from its present location and placed in an off-site engineered facility designed for permanent disposal. Impacted material with lower concentrations of radionuclides would remain onsite.

Under Alternative 4, the dose to the industrial and construction worker is less than that for Alternatives 2 and 3 and is below the limit of 25 mrem/yr. The maximum lifetime risk is less than 3×10^{-4} but greater than 2×10^{-5}, and generally falls within the range of risk determined by EPA to be acceptable at other sites. For the entire site the result of removing the Ra-226 to this level also removes U-238 such that the maximum U-238 activity left would be 50 pCi/g and the maximum Th-230 activity would be 30 pCi/g. This alternative also meets the standards set in Ohio Administrative Code 3701-39-021.

This alternative complies with all potential ARARs. Because this alternative does reduce the risk to future workers to within EPA's risk range it does achieve long term effectiveness.

As Table 5-1 shows, this alternative also achieves short-term effectiveness by protecting the remediation worker from risks exceeding EPA's risk range. Because of the low volume of material there would be minimal disruption of the local community due to transportation of the material. Impacts to the air and water, and environment in general would be mitigated using good construction practices. This alternative could be implemented quickly thus reducing the time until remedial objectives are achieved.

Alternative 5: Consolidation and placement of a permanent soil cover

Under Alternative 5, contaminated material exceeding 5/15 criteria would be excavated and consolidated on site and a 1-ft thick permanent clean soil cover would be placed over the material. This cover would provide shielding to reduce radiation exposures, so that potential risks to human health and the environment at the Painesville site would be reduced in the near-term.

The dose assessment for this alternative shows that the onsite maintenance worker would receive less than 1 mrem/yr assuming the impacted materials are consolidated and covered with 1-ft of clean soil. The lifetime risk for the maintenance worker is estimated at 3×10^{-6}. Therefore, CERCLA risk criteria will likely be achieved by this alternative.

This alternative complies with all potential ARARs. Because this alternative does reduce the risk to future workers to within EPA's risk range it does achieve some long-term effectiveness. There is some uncertainty over the long-term reliability of the cover. Deed restriction would be required to prevent future land owners from breaching the containment or allowing the containment to degrade. Therefore, the goal of long term effectiveness can only be achieved through deed restrictions and long term maintenance and monitoring.

As Table 5-1 shows, this alternative achieves short-term effectiveness by protecting the maintenance worker from risks exceeding EPA's risk range. Because no contaminated material would be removed from the site, there would be minimal disruption to the local community. Impacts to the air and water, and environment in general would be mitigated using good construction practices. This alternative could be implemented relatively quickly thus reducing the time until remedial objectives are achieved.

Alternative 6: Complete removal and commercial disposal

In Alternative 6, potential risks to human health and the environment at the site would be reduced in the long term because the contaminated material would be removed from its present location and placed in an off-site engineered facility designed for permanent disposal.

If all soil exceeding the 5/15 criteria were removed, the doses to the construction worker and industrial workers (0.25 mrem/yr and 1.5 mrem/yr, respectively) are estimated to be well below the 40 CFR 192 limits. Risks are less than the CERCLA risk criterion of 10^{-4} with estimated risks of 1×10^{-7} for the construction worker and 2×10^{-5} for the industrial worker.

The dose estimates presented above for each of the removal alternatives assume reasonable worst case industrial use scenarios. Therefore, actual exposures and doses would likely be significantly lower than the estimates presented here.

This alternative complies with all potential ARARs. Because this alternative reduces the risk to future workers to within EPA's risk range it achieves long term effectiveness. There would be no restrictions of future land use.

As Table 5-1 shows, this alternative also achieves short-term effectiveness by protecting both the maintenance and remediation worker from risks exceeding EPA's risk range. Because of the volume of material to be excavated there would be some short-term disruption of the local community due to transportation of the material. Impacts to the air and water, and environment in general would be mitigated using good construction practices. This alternative could be begun quickly thus reducing the time until remedial objectives are achieved.

5.1.2 Potential Environmental Impacts

Soil and Water Resources

Under Alternative 1, no direct impacts to soil or water resources would occur.

Localized short-term impacts to soil would occur under Alternatives 2, 3, and 4 due to the operation of heavy equipment and on-site excavation and construction activities. Disturbed areas would be more likely to experience wind and water erosion. These temporary effects could be minimized by limiting the area disturbed at any time during excavation operations, and by employing good engineering practices (e.g., sediment barriers to minimize the amount of sediment leaving the work area, containment of surface water runoff during storms). The impacts under Alternative 2, 3, and 4 would be minimal due to the small area that would be disturbed.

Consolidation and placement of a soil cover under Alternative 5 would alter the surface soil and surface water drainage contours, however, this would not create any negative impacts. Alternative 6, and Alternative 2, 3 and 4 to a lesser extent, would have a net beneficial effect on site soil and water resources as contaminated soil would be removed. For all alternatives, no long-term impacts to soil or water resources would be expected.

Air Quality

Environmental surveillance activities at the site indicate no significant adverse air impacts from normal site operations (USACE 1998).

Alternative 1 would result in no incremental impacts on air quality. Re-suspension and dispersion of contaminated particulates during construction, materials handling, and transportation activities under Alternatives 2, 3, 4, 5, and 6 could impact air quality in the immediate vicinity of the site during the short-term. The impacts associated with Alternative 2, 3, and 4 would be minimal due to the small area that would be disturbed. These impacts, however, would be very minor and localized, and would be eliminated upon completion of the removal action.

Good engineering practices, such as wetting and/or covering exposed surfaces, would be used to minimize dust generation during removal activities, as appropriate. Monitoring of airborne particulates and radon would be conducted throughout the removal action to ensure compliance with requirements to protect workers and the public.

Ecological Resources

None of the alternatives would have significant impacts on ecological resources. The Painesville site does not currently provide substantial wildlife habitat because of its small size and industrial development. No threatened or endangered species would be affected by implementing any of the alternatives. Critical habitats for listed species are not present at the Painesville site. and no threatened or endangered species are known to inhabit the site (Appendix A). Because the Painesville site supports only a few common species, the proposed removal action would have no significant harmful effect on ecological resources.

Wetlands and Floodplains

The Painesville site addressed in this EE/CA is not located within 100-year floodplain or wetlands areas, and no wetlands or floodplains would be impacted by any of the removal action alternatives.

Historical, Archaeological, and Cultural Resources

No archaeological sites or historic structures listed in (or eligible for listing in) the National Register of Historic Places would be affected by implementing any of the removal action alternatives. A Stage IA Survey of the Painesville site has been completed and filed with the State Historic Preservation Office (Appendix A).

5.1.3 Compliance with Regulatory Requirements

Alternative 1, the no action alternative would result in doses below the 100 mrem/yr NRC limit, it would not comply with the 25 mrem/yr limit in 10 CFR 20 and would not be ALARA.

A portion of the impacted soil would be excavated and disposed at an offsite commercial facility under Alternatives 2, 3, and 4. Each of these alternatives reduce the dose limit to below the guideline of 25 mrem/yr. Following completion of Alternatives 2, 3, or 4, the site could be released for industrial use. In addition Alternative 4 meets the requirements of OAC 3701-39-021 for handling of radioactive soil.

Alternative 5, consolidation and placement of a cover, will comply with ARARs. Dose estimates for the consolidation area are anticipated to be below the guideline of 25 mrem/yr; however, the area would require long term monitoring and maintenance. Following completion of Alternative 5, deed restrictions and institutional controls would be imposed at the containment area. The remainder of the Painesville site could be released for use without radiological restrictions.

Alternative 6 would comply with ARARs. Following completion of Alternative 6, the site could be released for use without radiological restrictions.

5.1.4 Reduction of Contaminant Toxicity, Mobility, and Volume Through Treatment

Section 121 of CERCLA specifies a statutory preference for remedial actions that use treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume of the hazardous substances as a principal element. Because of the nature of the primary COCs in the Painesville site soils (Ra-226 and Th-230 and their associated decay products), treatment for toxicity reduction is not feasible. Therefore, only treatment to reduce contaminant mobility and/or volume may be considered. However, due to the limited volume of impacted material at the Painesville site and the cost and time associated in implementing a treatment alternative, none of the alternatives considered in the EE/CA include treatment.

5.2 IMPLEMENTABILITY

The implementability of an alternative is defined by its technical feasibility, availability of services and materials, and administrative feasibility. Technical feasibility refers to the ability to construct, operate, maintain, replace, and monitor an alternative's technical components. The performance of technical components is also considered, as are potential constraints associated with the site environment. Availability of services and materials refers to the resources required to implement an alternative and the ability to obtain them. Administrative feasibility addresses the acceptability of an alternative by other agencies, and how well it satisfies specific project requirements (such as budget, schedule, and efficient performance of the removal action for the site).

5.2.1 Technical Feasibility

Technical feasibility does not apply to Alternative 1, the no-action alternative. All components of Alternatives 2, 3, 4, 5, and 6 are technically feasible and have been implemented at other sites. Excavation of the impacted materials at the Painesville site is technically feasible using readily available construction equipment; its performance has been demonstrated during past removal actions at similar FUSRAP sites.

Alternatives 2, 3, and 4 require simple excavation techniques; therefore, there are no technical impediments to implementation. Manpower and equipment are readily available for this type of work. They could be completed in less than 4 months with minimal federal administrative concerns.

As called for in Alternative 5, the installation of a soil cover is technically feasible using available construction equipment. Clean soil is readily available. Monitoring and maintenance activities, which are implementable, would be continued at the Painesville site for 30 years following completion of the action to ensure protection of human health and the environment. Deed restrictions would continue until further removal actions are performed.

Alternative 6 also uses simple excavation techniques; thus, there are no technical impediments to its implementation. Manpower and equipment are readily available for this type of work. Alternative 6 would be completed in less than 6 months with minimal federal administrative concerns. This alternative would satisfy the state of Ohio requirements and therefore would present no administrative feasibility concern.

Commercial disposal of the impacted materials removed from the Painesville site is also technically feasible. The materials from similar FUSRAP sites have been transported to licensed commercial facilities for permanent disposal. All commercial waste disposal facilities are required to maintain comprehensive environmental monitoring and occupational health physics programs as a license/permit condition.

5.2.2 Availability of Services and Materials

Availability does not apply to Alternative 1, the no-action alternative. The services and materials required to implement Alternatives 2, 3, 4, 5, and 6 are readily available.

5.2.3 Administrative Feasibility

Administrative feasibility considerations include the potential of a proposed action to achieve removal objectives and to satisfy state and local concerns. These concerns include permitting and interagency cooperation, public and occupational safety, transportation factors, impacts on land use and values, compliance with policies and requirements, and public acceptance.

Alternative 1, no action, would not require permits or approvals from other agencies. Alternative 5 would leave radioactive materials onsite above release criteria; deed restrictions or notices would be required, thus Alternative 5 would be administratively more difficult than Alternatives 2 and 6. Alternative 4 would allow handling of any remaining material to be exempt

from licensure under the Ohio Administrative Code which would make it more feasible than Alternatives 2 and 3. State and local authorities have indicated a strong preference for removal of impacted materials from the Painesville site for off-site disposal. Therefore, Alternative 6 is expected to be preferred by regulatory agencies, followed by Alternatives 4, 3, 2 and 5.

No administrative feasibility issues are anticipated with respect to commercial disposal of the impacted material generated under Alternatives 2, 3, 4 and 6. The volume associated with this proposed removal action would comprise a small fraction of the total waste capacity of the commercial disposal facility.

Removal activities conducted under Alternatives 2, 3, 4, 5, and 6 would be conducted in coordination with affected local authorities. All response activities at the Painesville site are coordinated with EPA Region V and state and local government authorities. Active communications would be maintained with the public, local media, EPA, and state and local officials throughout the cleanup action.

5.3 COST

The costs of alternatives are considered only in a comparative manner to determine if the cost of one alternative is much greater than that of another alternative of similar effectiveness. Estimates of potential costs for each alternative can be compared to permit a screening according to relative costs. Funds from USACE, not from EPA's Superfund program, would be used to implement the proposed removal action. Because the proposed action would be completed within a short time, present value considerations would not appreciably affect cost estimates; cost estimates for this analysis assume no discount or escalation factors.

Cost elements common to Alternatives 2, 3, 4, 5, and 6 include mobilization and demobilization expenses, medical monitoring, training, engineering and health and safety support, contingencies, and program management and integration costs.

No direct incremental costs would be incurred with Alternative 1.

The total cost of implementing Alternative 2 is estimated at approximately $1.1 million. This estimate includes all direct and indirect costs, including subcontracts, engineering, environmental health and safety support, procurement, overhead, and contingencies. The primary cost component is the cost for field and home office project support (44%). Other significant cost elements include site development (6%), contingency (18%), and program management costs (9%). Additional detail regarding the cost estimate is provided in Appendix D.

The total cost of implementing Alternative 3 is estimated at approximately $1.2 million. This estimate includes all direct and indirect costs, including subcontracts, engineering, environmental health and safety support, procurement, overhead, and contingencies. The primary cost component is the cost for field and home office project support (42%). Other significant cost elements include site development (6%), contingency (18%), and program management costs (9%). Additional detail regarding the cost estimate is provided in Appendix C.

The total cost of implementing Alternative 4 is estimated at approximately $1.5 million. This estimate includes all direct and indirect costs, including subcontracts, engineering, environmental health and safety support, procurement, overhead, and contingencies. The primary cost component is the cost for field and home office project support (34%). Other significant cost elements include site development (5%), contingency (18%), and program management costs (9%). Additional detail regarding the cost estimate is provided in Appendix C.

The total cost for Alternative 5 is estimated to be approximately $5.1 million. This estimate includes all direct and indirect costs, including subcontracts, engineering, environmental health and safety support, procurement, overhead, and contingencies. The primary cost elements for Alternative 3 include placement of a permanent soil cover (4%), long term monitoring (8%), field and home office project support (19%), contingency (11%), and program management costs (22%). Additional detail regarding the cost estimate is provided in Appendix C.

The total cost of implementing Alternative 6 is estimated at approximately $4.3 million. This estimate includes all direct and indirect costs, including subcontracts, engineering, environmental health and safety support, procurement, overhead, and contingencies. The primary cost component is the cost for removal, transportation, and disposal of the impacted soil (42%). Other significant cost elements include field and home project support (22%), contingency (18%), and program management costs (9%). Additional detail regarding the cost estimate is provided in Appendix C.

5.4 COMPARATIVE SUMMARY

In the previous section, the six alternatives for managing the impacted soils at the Painesville site were compared against each of the following criteria: effectiveness, implementability, and cost. In this section, the alternatives are evaluated in relation to each other for each criterion. The key points of this comparison are summarized in Table 5-2.

Table 5-2. Comparative Summary of Alternatives

Criteria	Alternative 1 No action	Alternative 2 Partial removal and disposal	Alternative 3 Partial removal and disposal	Alternative 4 Partial removal and disposal	Alternative 5 Containment and cover	Alternative 6 Complete removal and disposal
Reduction of potential risks to human health and the environment	No change in current radioactive exposure. If structures were constructed over the most concentrated soils the maximum estimated dose is 99 mrem/yr (industrial worker). No additional impacts to soil, water resources, or air quality; no direct impacts to floodplains and wetlands, although existing potential for offsite migration would continue.	Some reduction of potential direct contact with radioactive soils is achieved by removing most concentrated soils. The maximum estimated dose is reduced from 99 mrem/yr to 22 mrem/yr. Possible generation of airborne particulates during construction would be minimized by dust suppression techniques.	Some reduction of potential direct contact with radioactive soils is achieved by removing most concentrated soils. The maximum estimated dose is reduced from 99 mrem/yr to less than 22 mrem/yr. Possible generation of airborne particulates during construction would be minimized by dust suppression techniques.	Some reduction of potential direct contact with radioactive soils is achieved by removing most concentrated soils. The maximum estimated dose is reduced from 99 mrem/yr to much less than 22 mrem/yr. Possible generation of airborne particulates during construction would be minimized by dust suppression techniques. Material remaining on site would be acceptable for disposal at a landfill without requiring a license for radioactive waste disposal under OAC 3701-39-021.	Reduced likelihood of direct contact with radioactive materials. Consolidation and cover will alter surface soils and surface water drainage; however, offsite potential for migration of radionuclides to surface water will be minimized. Possible generation of airborne particulates during construction would be minimized by dust suppression techniques.	Reduction of potential direct contact with radioactive soils is achieved by removing soils above 40 CFR 192 cleanup criteria. Possible generation of airborne particulates during construction would be minimized by dust suppression techniques. Potential for radioactive material migration would be minimized by preventive measures. Overall reduction of potential migration in the long term.
Compliance with regulatory requirements	Does not comply with potential ARARs.	Complies with all potential ARARs except OAC 3701-39-021.	Complies with all potential ARARs except OAC 3701-39-021.	Complies with all potential ARARs.	Complies with all potential ARARs	Complies with all potential ARARs.
Long-term effectiveness and permanence	Not effective	Effective.	Effective.	Effective.	Limited effectiveness.	Effective.

Table 5-2. Comparative Summary of Alternatives (continued)

Criteria	Alternative 1 No action	Alternative 2 Partial removal and disposal	Alternative 3 Partial removal and disposal	Alternative 4 Partial removal and disposal	Alternative 5 Containment and cover	Alternative 6 Complete removal and disposal
Short-term effectiveness and environmental impacts	No short-term improvements or impacts.	Increased short-term worker exposures during remediation. Minimal transportation risks of spillage or accident.	Increased short-term worker exposures during remediation. Minimal transportation risks of spillage or accident.	Increased short-term worker exposures during remediation. Minimal transportation risks of spillage or accident.	Increased short-term worker exposures during remediation. Potential offsite hazard due to above-background dust inhalation during construction would be minimized using dust suppression techniques. External gamma exposure would be negligible. Minimal transportation risks from transport of cover material.	Increased short-term worker exposures during remediation. Minimal transportation risks of spillage or accident.
Reduction of toxicity, mobility, or volume through treatment	No treatment provided.	No treatment provided.	No treatment provided.	No treatment provided.	No treatment provided.	No treatment provided.
Implementability	Not applicable as no further activities would be performed at the site by USACE. No disturbance of cultural resources.	No technical barriers to implementation. Materials and services readily available. No disturbance of cultural resources.	No technical barriers to implementation. Materials and services readily available. No disturbance of cultural resources.	No technical barriers to implementation. Materials and services readily available. No disturbance of cultural resources.	No technical barriers to implementation. Materials and services readily available. No disturbance of cultural resources.	No technical barriers to implementation. Materials and services readily available. No disturbance of cultural resources.
Cost	$0 million	$1.1 million	$1.2 million	$1.5 million	$5.1 million.	$4.3 million

5.4.1 Effectiveness

Reduction of potential risks to human health and the environment

Alternative 6 provides the highest degree of protection of human health and the environment because all materials above the 5/15 criteria would be removed and disposed off-site. It would be effective in the short and long term. This alternative is also best at reducing dose to future workers. Total dose estimates are 0.25 mrem/yr and 1.5 mrem/yr for a construction worker and an industrial worker, respectively.

Alternatives 4, 3, and 2 provide the next highest levels of protection, in descending order. Alternative 4 would remove contaminated material from the site so that the maximum Ra-226 activity left would be 27 pCi/g. Alternatives 3 and 2 would leave 65 pCi/g and 100 pCi/g, respectively. The maximum estimated dose to an on-site worker is reduced from 99 mrem/yr to much less than 22 mrem/yr, less than 22 mrem/yr, and 22 mrem/yr for Alternatives 4, 3, and 2, respectively.

Of the action alternatives, Alternative 5 would provide the least amount of protection in the long-term, but it would be effective in the short-term. Alternative 5 would reduce the dose to an on-site maintenance worker to less than 1 mrem/yr. Alternative 1 would not reduce current risks to human health and the environment.

Compliance with regulatory requirements

Alternative 4, 5 and 6 comply with all potential ARARs. Alternatives 2 and 3 comply with all potential ARARs except OAC 3701-39-021. Alternative 5 also complies with ARARs. However, this alternative would require long term monitoring and maintenance and deed restrictions to ensure continued compliance. Alternative 1 does not comply with ARARs.

Reduction of contaminant toxicity, mobility, and volume

None of the alternatives provide for treatment. Therefore, none of the alternatives ranks higher than another with respect to this criterion.

5.4.2 Implementability

Technical feasibility

All alternatives are technically implementable. Alternatives 2, 3, 4, 5, and 6 are equal with respect to this criterion. All use well established construction techniques and readily available equipment. Commercial disposal of the waste generated in Alternatives 2, 3, 4, and 6 is technically feasible and currently available. Installation of the cover in Alternative 5 is also technically feasible.

Availability of services and materials

The necessary materials, equipment, and personnel for each alternative are readily available. Therefore, none of the alternatives ranks higher than another with respect to this criterion.

Administrative feasibility

Alternative 1, no action, would not require permits or approvals regarding site activities from other agencies. Alternative 5 would leave radioactive materials onsite above release criteria; deed restrictions or notices would be required, thus Alternative 5 would be administratively more difficult than Alternatives 2 and 6. Alternative 4 would allow any remaining material to be exempt from licensure under the OAC which would make it more feasible than alternatives 2 and 3. State and local authorities have indicated a strong preference for removal of impacted materials from the Painesville site for off-site disposal. Therefore, Alternative 6 is expected to be preferred by regulatory agencies, followed by Alternatives 4, 3, 2, and 5.

5.4.3 Cost

Costs for Alternative 2 are expected to be approximately $1.1 million which makes it the least expensive alternative that complies with ARARs and achieves long and short term effectiveness. Costs for Alternatives 3 and 4 are incrementally higher than Alternative 2 because more material would be removed from site and disposed in these alternatives. Costs for Alternative 3 are estimated to be approximately $ 1.2 million, which makes it the second least expensive. Costs for Alternative 4 are expected to be approximately $ 1.5 million, which makes it the third least expensive.

Costs for Alternative 6 are expected to be approximately $4.3 million. This makes this alternative the second most expensive but the only one which leaves the site completely free from radiological restrictions.

Alternative 5 is the most expensive alternative at approximately $5.1 million. Primary costs for this alternative are long term monitoring and maintenance requirements.

6. PROPOSED ACTION

Based on the evaluation of alternatives, USACE proposes Alternative 4, partial excavation and offsite disposal of material exceeding 27 pCi/g Ra-226 as the preferred alternative for the Painesville site. A preliminary determination has been made that the proposed alternative will present no unacceptable risk to either workers or the general public, and can be implemented in a cost-effective manner. The materials removed are expected to achieve the NCP-established risk range for protectiveness but that will be finally established and confirmed in a Record of Decision. This activity is intended to remove health risks to the industrial worker and to allow the current land owner flexibility in dealing with any future construction on the site.

Detailed engineering plans and work instructions will be prepared prior to initiation of removal activities, providing detailed specifications for all applicable procedures. Associated planning activities will include preparation of a health and safety plan detailing measures to ensure worker protection, and preparation of an environmental compliance plan specifying measures for compliance with environmental requirements (e.g., monitoring requirements, mitigative measures). Remediation will comply with all applicable state, federal, and local laws.

Under Alternative 4, approximately 790 cubic yards of contaminated material would be excavated from the site primarily from around the butadiene tank area and loaded for transportation to an offsite facility. This volume consists of a 45 cm (1.5 ft) layer along the east side of the butadiene tank extending around the south end of the tank enclosure, a small area in the west field and two small areas near the southern end of the eastern rail spur. The excavated areas would be backfilled with clean soil, graded, and vegetated.

Materials requiring offsite shipment are assumed to be transported by rail to an appropriate waste disposal facility (truck transport may be used). Wastes will be packaged and shipped in accordance with the receiving facility's waste acceptance criteria. Applicable transportation requirements of the U.S. Department of Transportation (DOT), and the State of Ohio will be adhered to as well.

Appropriate precautions will be used to prevent the spread of radioactive materials during waste handling and transportation. Dust suppression techniques, such as keeping soils moist during excavation and handling, will be employed and all loads will be covered before leaving the site. If needed, erosion controls will be erected prior to the onset of dirt moving activities. The exteriors of all vehicles will be surveyed for radioactivity before being allowed to leave the Painesville site. Any vehicle found to exceed applicable guidelines will be decontaminated before being released from the site. Transportation routes will be established, and an emergency response plan will be developed and coordinated with appropriate local authorities.

Physical and administrative controls (contamination control zones, protective coverings, restrictions on materials and personnel entering controlled areas) will be used to prevent migration of radioactive materials to nonimpacted areas. Materials and equipment that exceed surface criteria as a result of their contact with radioactive materials will be decontaminated if practical.

All activities will be conducted in accordance with the site-specific health and safety plan and detailed work instructions will be prepared before initiation of the work. Appropriate precautions will be taken to reduce potential adverse impacts on the environment and minimize health risks throughout the removal action as summarized in Table 6-1.

Table 6-1. Mitigation Measures for the Proposed Action

Mitigative Measure	Description
Dust Control	Dust suppressants will be used during all activities having the potential for generating significant quantities of airborne particulates.
Worker Protection	An operational environmental safety and health plan will be developed for the proposed action. Respiratory protective equipment and other appropriate personnel protective equipment will be used as necessary. All workers will wear protective clothing and will have a radioactivity scan prior to leaving the work area. A comprehensive radiation monitoring and personnel dosimetry program will be implemented.
Environmental Surveillance	Gamma radiation levels and airborne particulate and radon concentrations will be monitored in the work area and site periphery to protect workers and the general public. Appropriate responses, such as increasing engineering controls, will be taken if measured radiation levels approach project administrative control limits.
Equipment Inspection	Equipment used for excavation, and transportation of radioactive materials will be routinely inspected during operations. Equipment will be decontaminated as necessary to prevent migration of radioactive materials into uncontrolled areas.
Run-on/Run-off Controls	Surface water run-on will be controlled as needed by temporary berms or other diversion structures. If necessary, migration of radionuclides through run-off will be mitigated by sediment filters or silt fences.
Access Restrictions	Access to work areas will be restricted, and current access controls will be maintained during the removal action.
Traffic Controls	Transportation routes will be established for vehicle traffic at the site during remediation activities.

In summary, the proposed removal action will include the following activities:

- Preparation of a detailed work plan and health and safety plan.
- Site preparation and preparation of appropriate decontamination facilities to clean equipment and tools used in the excavation.
- Implementation of environmental monitoring throughout the removal action to ensure compliance with all pertinent requirements.
- Excavation of the soil, and loading for off-site shipment.
- Rail transport of radioactive material to an offsite disposal facility (truck transport may be used)
- Verification of cleanup goals.
- Backfill site with clean soil, grade, and revegetate disturbed area.
- Release of site for approved future industrial use without radiological restrictions.

US Army Corps of Engineers
Buffalo District

FUSRAP

Comment Period Extended

Painesville FUSRAP Site

The public comment period for the
Engineering Evaluation/Cost Analysis
now closes Friday, August 7,1998.

Comments must be faxed or postmarked by Friday August 7, 1998.
Comments can be faxed to: **(716) 879-4434**

Please mail your comments to the:
U.S. Army Corps of Engineers
FUSRAP Public Information Center
1776 Niagara Street - Buffalo, N.Y. 14207

For further information, call (716) 879-4438 or (800) 833-6390

7. PUBLIC PARTICIPATION: HOW TO PARTICIPATE IN THE DECISION-MAKING PROCESS

The public is encouraged to review this document during the public comment period which begins June 24, 1998 and ends July 23, 1998. The USACE will evaluate and respond to all significant comments received during this period. The USACE is especially interested in input regarding the proposed action and any considerations for carrying out the cleanup remedy.

Copies of this EE/CA can be obtained by calling the USACE's toll-free number at 1-800-833-6390.

Final selection of the removal action will not be made until comments have been evaluated and concerns have been addressed. Written comments should be addressed to

U.S. Army Corps of Engineers
FUSRAP Public Information Center
1776 Niagara Street
Buffalo, NY ~~14202~~ 14207

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7. PUBLIC PARTICIPATION: HOW TO PARTICIPATE IN THE DECISION-MAKING PROCESS

The public is encouraged to review this document during the public comment period which begins June 15, 1998 and ends July 14, 1998. The USACE will evaluate and respond to all significant comments received during this period. The USACE is especially interested in input regarding the proposed action and any considerations for carrying out the cleanup remedy.

Copies of this EE/CA can be obtained by calling the USACE's toll-free number at 1-800-833-6390.

Final selection of the removal action will not be made until comments have been evaluated and concerns have been addressed. Written comments should be addressed to

U.S. Army Corps of Engineers
FUSRAP Public Information Center
1776 Niagara Street
Buffalo, NY 14202

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8. REFERENCES

Aller, L. and Ballou, K. 1991. *Ground Water Pollution Potential of Lake County, Ohio.* Ohio Department of Natural Resources, Division of Water, Ground Water Resources Section, Ground Water Pollution Potential Report No. 8.

DOC (U.S. Department of Commerce) 1995. Local Climatological Data, Annual Summary with Comparative Data for Cleveland, Ohio.

DOE 1996, *Sampling and Analysis Plan for the Painesville Site*, DOE/OR/21950/018, August.

DOE 1995, *Preliminary Remediation Goals for Use at the US Department of Energy Oak Ridge Operations Office*, ES/ER/TM-106, June.

Freeze, R., and Cherry, J. 1979. *Groundwater.* Prentice-Hall, Inc.

LCPC (Lake County Planning Commission) 1990a. Census of Population and Housing for Tract 2048, Painesville, Ohio.

LCPC 1990b. Census of Population and Housing for Tract 2042, Painesville, Ohio.

NPD 1993. City of Painesville Comprehensive Plan, Painesville, Ohio.

Means R.S., Inc. 1996. Means Heavy Construction Cost Data: 1996 (10th Edition).

ORNL (Oak Ridge National Laboratory) 1990. *Preliminary Site Survey Report for the Uniroyal Chemical Company, Formerly the Painesville Company, 720 Fairport-Nursery Road, Painesville, Ohio (DMP001)*, ORNL/TM-11119, March.

ORNL 1991. *Radiological Characterization Survey of the Former Painesville Company Site, 720 Fairport-Nursery Road, Painesville, Ohio (DMP001, DMP002)*, ORNL/TM-11817.

Paustenbach, D. J. 1989. *A Comprehensive Methodology for Assessing the Risk to Humans and Wildlife Posed by Contaminated Soil: A Case Study Involving Dioxins,* in the Risk Assessment of Environmental and Human Health Hazards: A Textbook of Case Studies, John Wiley and Sons, New York.

SAIC (Science Applications International Corporation) 1994. *Work Breakdown Structure*, Environmental Studies Contractor, FUSRAP, June 6.

Schmidt, M. L. 1988. *Shoreline Erosion at Painesville Township Park, Lake County, Ohio.* The Compass of Sigma Gamma Epsilon, Vol. 57, No. 3, Kent State University, Kent, Ohio.

Stout, W., Ver Steeg, K., and Lamb, G. F. 1943. *Geology of Water in Ohio.* State of Ohio Department of Natural Resources, Division of Geological Survey, Bulletin 44, Columbus.

USACE 1998, *Characterization Report for the Painesville Site.*

White, George W. 1980. *Glacial Geology of Lake County, Ohio.* State of Ohio Department of Natural Resources Report of Investigation No. 117, Columbus.

Williams, W. A. 1992. Memorandum from W. A. Williams, DOE, (Authority Determination—Former Diamond Magnesium Company Facility) Painesville, Ohio, July 22.

Yu, C., C. Loureiro, J.J. Cheng, L.G. Jones, Y.Y. Wang, Y.P. Chia, and E. Faillace 1993. *Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil.* ANL/EAIS-8, Argonne National Laboratory, Argonne, Illinois, April.

Yu, C., A.J. Zielen, L. Cheng, Y. Yuan, L. Jones, D. LePoire, et al. 1993. *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0 (working draft),* ANL/EAP/D-2, ANL-Environmental Assessment Division, Argonne, Illinois, September.

APPENDIX A

CONSULTATION WITH OTHER AGENCIES

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OHIO Department of Natural Resources

MAY 1 17 '97

George V. Voinovich • Governor
Donald C. Anderson • Director

May 16, 1997

Gary S. Hartman
Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, TN 37831

Dear Mr. Hartman:

After reviewing our Natural Heritage maps and files, I have found that the Division of Natural Areas and Preserves has no rare species at the Painesville Industrial site. This project area is northeast of the Grand River in Painesville Township, Perry Quad., Lake County.

No existing or proposed state nature preserves or scenic rivers exist in this project area. We are also unaware of any unique ecological sites, geologic features, breeding or nonbreeding animal concentrations, champion trees, or state parks, forests or wildlife areas at this location.

Our inventory program has not completely surveyed Ohio and relies on information supplied by many individuals and organizations. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that site. Please note that we inventory only high-quality plant communities and do not maintain an inventory of all Ohio wetlands.

Please contact me at (614) 265-6409 if I can be of further assistance.

Sincerely,

Treva J. Kriesel
Ecological Analyst
Division of Natural Areas & Preserves

Fountain Square • Columbus, Ohio 43224-1387

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
6950-H Americana Parkway
Reynoldsburg, Ohio 43068

MAY 23 3 31 PM '97

IN REPLY REFER TO:

May 20, 1997

Mr. Gary S. Hartman
Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, TN 37831-8723

Dear Mr. Hartman:

This responds to your request for endangered species information regarding the Painesville Site located at 720 Fairport-Nursery Road, Painsville, Ohio (Lake County). If the project will involve filling wetlands that may occur on site, you should contact the Buffalo District of the U.S. Army Corps of Engineers regarding the need for a Clean Water Act Section 404 permit.

ENDANGERED SPECIES COMMENTS: The proposed project lies within the range of the Indiana bat (E), piping plover (E), and bald eagle (T), federally listed endangered (E) or threatened (T) species. Due to the project type, size, and location the proposed project will have no affect on these species. This precludes the need for further action on this project as required by the 1973 Endangered Species Act, as amended. Should the project be modified or new information become available that indicates listed or proposed species may be affected, consultation should be initiated with this office.

Two divisions of the Ohio Department of Natural Resources, the Division of Wildlife (DOW, 614-265-6300) and the Division of Natural Areas and Preserves (DNAP, 614-265-6472), maintain lists of plants and animals of concern to the State of Ohio. If you have not already done so, you may wish to contact each of these agencies to obtain site-specific information on species of state concern.

If you have questions or we may be of further assistance in this matter please contact Mr. Bill Kurey of this office at 614-469-6923.

Sincerely,

Kenneth A. Multerer

Kenneth A. Multerer
Acting Supervisor

cc: John Marshall, ODNR DOW
Linda Merchant, OEPA

Ohio Historic Preservation Office

567 East Hudson Street
Columbus, Ohio 43211-1030
614/297-2470
Fax 297-2496

Aug 2 12 57 PM '96

OHIO HISTORICAL SOCIETY
SINCE 1885

July 17, 1996

Mr. Gary S. Hartman
Environment Scientist
Former Sites Restoration Division
Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, TN 37831-8723

Dear Mr. Hartman:

Re: Painesville Site - NHPA (Section 106) Determination
Diamond Magnesium Corporation Site

This is in response to your correspondence, received on July 9, 1996, concerning the project noted above. My staff has reviewed the information that you provided. Based on their recommendation, it is my opinion that the proposed project will have no effect on properties listed in or eligible for the National Register of Historic Places. No further coordination with this office is necessary unless the scope of the project should change.

Any questions concerning this matter should be addressed to Kate Elliot at (614) 297-2470. Thank you for your cooperation.

Sincerely,

Martha J. Raymond

Martha Raymond, Department Head
Technical and Review Services

MJR/sch

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APPENDIX B

RADIOLOGICAL DOSE AND RISK ASSESSMENT

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INTRODUCTION

A radiological dose and risk assessment for the Painesville site was performed to determine the need for remedial actions and to provide a basis for comparison of remedial alternatives. Potential radiation doses were assessed from exposure to impacted soil under current and plausible future conditions at the site. The following sections discuss the major components of the assessment, including evaluation and aggregation of site data (Data Evaluation), determination of appropriate exposure conditions for each remedial alternative (Exposure Assessment), and calculation of potential doses and risks for each alternative (Dose Characterization).

DATA EVALUATION

The data set used for the Painesville Engineering Evaluation/Cost Analysis (EE/CA) consists of results from the 1996 characterization effort (DOE 1997). A description of the characterization activities and the results obtained for on-site soil is contained in Section 2 of USACE 1998.

Because Uniroyal and Lonza (the current tenants of the Painesville site) have been in operation for over 30 years and other land-use scenarios are not expected in the foreseeable future, it is expected that the future use of the Painesville site will remain commercial/industrial. Thus, a plausible sequence of events for the site includes the construction of new chemical processing, general office, or warehouse structures. To assess potential exposures, it was assumed that new structures would be constructed directly over a large area known to contain elevated radionuclide concentrations. This large area (containing the butadiene tank to the west of all current site structures) was selected to provide reasonable worst case exposure scenarios. Other areas known to contain highly localized elevated radioactivity are also considered but are not specifically addressed in quantitative risk calculations because the butadiene tank area scenarios result in upper bound limits of possible dose and risk. Table B-1 shows a summary of radionuclide concentrations in on-site soil from the areas of interest. Also shown in Table B-1 are summaries of site-wide data both below and above 40 CFR 192 radionuclide concentration limits. This table summarizes the combined sample results for U-238, Th-230, Th-232, and Ra-226 from the 1996 characterization effort. Site background concentrations are estimated to be 0.95 pCi/g for Ra-226, 1.4 pCi/g for Th-230, 1.1 pCi/g for Th-232, and 1.3 pCi/g for U-238.

EXPOSURE ASSESSMENT

Introduction

To analyze likely remedial action alternatives, on-site soil data were evaluated under the no-action scenario to determine if remedial actions would be warranted. In addition, doses and

Table B-1. Raw Radionuclide Concentration Data for the Painesville Site (values reported in pCi/g)[a]

Location	Isotope	Units	Detected/ Sampled	Minimum Detect	Maximum Detect	Mean
NE Rail Spur	Ra-226	pCi/g	9/9	0.6	1.09	0.892
NE Rail Spur	Th-230	pCi/g	9/9	1.39	1.96	1.71
NE Rail Spur	Th-232	pCi/g	8/9	0.8	1.45	1.10
NE Rail Spur	U-238	pCi/g	0/9	not applicable	not applicable	not applicable
NW Hot Spot	Ra-226	pCi/g	11/11	1.04	125	16
NW Hot Spot	Th-230	pCi/g	8/11	1.47	304	33
NW Hot Spot	Th-232	pCi/g	11/11	0.43	2.11	1.15
NW Hot Spot	U-238	pCi/g	6/11	6.25	44.6	9.67
Area SW of Pond	Ra-226	pCi/g	12/12	0.76	1.12	0.948
Area SW of Pond	Th-230	pCi/g	12/12	1.17	2.45	1.8
Area SW of Pond	Th-232	pCi/g	12/12	0.92	1.53	1.21
Area SW of Pond	U-238	pCi/g	0/12	not applicable	not applicable	not applicable
SE Rail Spur	Ra-226	pCi/g	72/72	0.38	27.4	5.09
SE Rail Spur	Th-230	pCi/g	54/68	1.03	36.8	11
SE Rail Spur	Th-232	pCi/g	70/72	0.27	1.96	0.921
SE Rail Spur	U-238	pCi/g	23/72	2.28	50.4	4.76
Butadiene Tank	Ra-226	pCi/g	71/71	0.44	1010.8	29.7
Butadiene Tank	Th-230	pCi/g	51/71	1.03	58.2	20.6
Butadiene Tank	Th-232	pCi/g	68/71	0.13	1.8	1.06
Butadiene Tank	U-238	pCi/g	42/71	0.72	218.2	13.6
Soil < SOR 1	Ra-226	pCi/g	292/292	0.28	9.95	1.69
Soil < SOR 1	Th-230	pCi/g	284/284	0.60	7.93	2.25
Soil < SOR 1	Th-232	pCi/g	285/288	0.13	1.82	1.10
Soil < SOR 1	U-238	pCi/g	68/288	0.65	12.2	3.36
Soil > SOR 1	Ra-226	pCi/g	51/51	0.61	1011	67.4
Soil > SOR 1	Th-230	pCi/g	51/51	1.60	304	35.0
Soil > SOR 1	Th-232	pCi/g	47/51	0.29	2.11	1.06
Soil > SOR 1	U-238	pCi/g	38/51	3.98	218	36.5

[a] Concentrations are provided as a summary of site radiological data and were not used in dose or risk calculations.

risks under the proposed alternatives were assessed as part of the evaluation of the effectiveness of each alternative. The proposed exposure scenarios were evaluated in part to determine the dose and risk from residual materials left on site after remediation and in part to determine the level of cleanup necessary to meet both current and proposed dose standards (i.e., what concentrations can be left in place and still meet a 25 mrem/yr dose limit) and CERCLA risk criteria (i.e., lifetime risk between 10^{-6} to 10^{-4}).

The cleanup alternatives include no action (Alternative 1), partial removal of soil containing the highest radionuclide concentrations and shipment off site (Alternatives 2, 3 and 4), consolidation and covering of soil exceeding site cleanup guidelines (Alternative 5), and complete removal of soil exceeding site cleanup guidelines and shipment off site (Alternative 6). The no action alternative assumes no remedial action takes place. Of the partial removal alternatives only Alternative 2 was modeled since the dose and risk values for Alternatives 3 and 4 would be intermediate between Alternative 2 and Alternative 6, the complete removal alternative. The site is assumed to remain an industrial (nonresidential) facility in all alternatives.

To assess each remedial action alternative, the most likely future use of the site was considered, based on knowledge of current and projected land use. The Painesville site has been operated as a chemical production facility for over 30 years; the Uniroyal and Lonza companies are not expected to abandon the site, nor is the site expected to change to residential use. It is, therefore, assumed that commercial/industrial exposure scenarios are most appropriate for the Painesville site. Under current conditions in the area, it is unreasonable to assume that future use of this site would be for residential purposes.

Thus, for the Painesville site, one possible progression of events would include the erection of additional chemical processing, office, or warehousing structures to support facility operations. The no action alternative (Alternative 1) assumes that future activities consist only of normal construction and light industrial activities under current site conditions (i.e., no removal of radioactive material occurs). Partial and complete removal alternatives (Alternatives 2, and 6) also include the construction and industrial worker scenarios. The consolidate and cover alternative (Alternative 5) assumes that institutional controls remain in place and a maintenance worker is the maximally exposed individual. A remediation worker is also considered for Alternative 2 to determine if dose criteria (i.e., the 5,000 mrem/yr limit for radiation workers) could be exceeded during removal actions.

Based on the analysis outlined above, four primary exposure scenarios have been identified to represent the plausible current and future exposure possibilities at the Painesville site: (1) a current or future construction worker involved in the erection of new site structures, (2) future light industrial workers located in a newly constructed building (after building construction), (3) a worker who maintains the appearance (by mowing, watering, etc.) of the covered area containing the impacted material, and (4) remediation workers involved in the excavation and movement (for shipment or consolidation on site) of soil exceeding cleanup guidelines.

Table B-2 provides a summary matrix showing how each of the alternative combinations was analyzed using the exposure scenarios described above. The matrix shown in Table B-2 shows only the most likely or highest potential exposure pathways. There are other possible exposure route combinations besides those listed on the matrix, but the exposures for such combinations are considered very small compared to the primary exposure routes shown. The following sections provide brief summaries of the significant potential exposure routes for each alternative.

Table B-2. Summary of Exposure Assessment

Alternative	Exposure Scenario			
	Industrial	Construction	Maintenance	Remediation
Alt. 1: No Action	A	A	not applicable	not applicable
Alt. 2: Partial Removal	A	A	not applicable	B
Alt. 5: On-Site Consolidation	not applicable	not applicable	C	B
Alt. 6: Complete Removal	D	D	not applicable	B

A - Exposure to in situ soil containing elevated radioactivity after implementation of removal alternative
B - Exposure during excavation and movement of impacted soil
C - Exposure to materials that have been consolidated into one area and capped.
D - Exposure to residuals left after complete removal of all material above 40 CFR 192 concentration guidelines

Identification of Exposure Pathways

The impacted soil can potentially expose humans or ecological receptors. To determine dose and risk to a receptor it is necessary to understand how radioactive materials move from the source to the point where the material can expose humans, flora, or fauna. The course, or "pathway," that the radionuclides take through the environment can be described using a block diagram representing a conceptual exposure model. The following discussion describes the conceptual site models for exposures from the impacted media.

For on-site soil, the most significant potential exposures at the site would be to a construction worker or a future industrial worker, because both activities involve direct contact with impacted soil. A construction worker could be exposed through incidental ingestion of soil, inhalation of dust, and through direct external gamma radiation from impacted soil. A future industrial worker could be exposed through the same general pathways but with varying levels of intensity (e.g., different inhalation rates and exposure times). Figure B-1 shows the conceptual site model for exposures to on-site soil. Significant ecological exposure scenarios were considered unlikely and were not evaluated as part of this assessment.

Exposure Parameters

The amount of radioactive material taken into the body and the exposure duration must first be estimated or measured to determine potential radiation dose and risk. For the Painesville

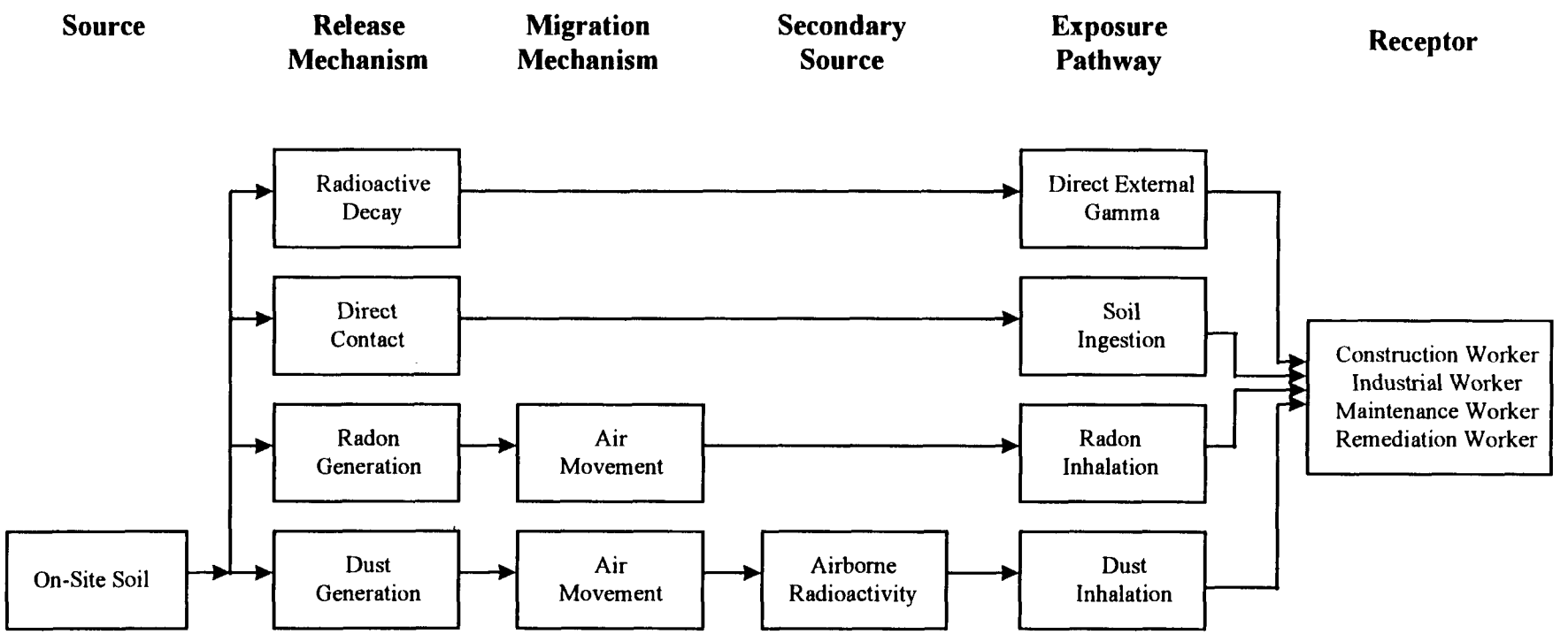

Figure B-1. Conceptual Model for Exposures from On-site Soil

site, a combination of measured data (from sample and survey results) and estimated data (for exposure parameters such as ingestion rate, breathing rate, etc.) were used to determine potential radiation exposures. The following sections provide summaries of the critical exposure parameters used for calculating radiation doses and risk for each exposure scenario.

Construction Worker Exposure Scenario

The future construction worker scenario includes exposures to on-site soil during the installation of a large building foundation. Critical exposure and intake parameters for the construction worker scenario are shown in Table B-3A. Because of deed restrictions in Alternative 5 buildings would not be constructed over or adjacent to the containment area and so this scenario is not applicable to that alternative. The assessment assumes that the size of the impacted area is 3,600 m^2 (39,000 ft^2), the thickness of the impacted soils is 1 m (3 ft), and there is no clean cover over this impacted area due to excavation activities. The surface area was selected as the largest area known to contain elevated radionuclide concentrations (the butadiene tank's spill containment area). The soil depth was selected as a conservative depth for material that is primarily in the top few feet of soil, and dose and risk via the soil ingestion, dust inhalation, and external gamma pathways are most sensitive to source material in surface soil.

The future construction worker was assumed to spend approximately 8 hours each day outdoors for 20 working days during a one year construction project. This occupancy was selected by estimating the amount of time it would take to install forms and joints, and pour a 3,600 m^2 (39,000 ft^2) foundation for a new building. According to Means 1996, it takes 6.8 days to set forms and joints around the 40-m by 90-m (100-ft by 300-ft) butadiene tank spill containment area assuming a rate of 182 linear meters (600 feet) per day and that joints are installed approximately every 6 m (18 ft). It would also take 11.6 days to pour the concrete assuming a rate of 311 m^2 (3,350 ft^2) per day. The total time is, thus, estimated to be 18.4 days, which was rounded up (to be conservative) to 20 days or 4 full work weeks. The future construction worker is exposed to dust during on-site activities. He/she is assumed to breath at a rate of 12,300 m^3/yr (14,700 yd^3/yr) while on-site, with an average dust loading of 0.00018 gram per cubic meter (g/m^3). It was also assumed that the construction worker ingests soil on-site at a rate of 480 mg/day. All soil and dust are assumed to come from the impacted soil. The construction worker is not assumed to stay on-site and perform other duties such as constructing framework or installing drywall because different phases of a building's construction are usually handled by different specialists. The installation of the foundation is also considered the scenario with the highest potential for exposure considering there is no clean cover over the impacted soil during this period of activity, and the excavation activities would involve dust generation and direct contact with soil.

Light Industrial Worker Exposure Scenario

It was assumed that at some point in the future new industrial-use buildings will be constructed on the Painesville site. Under the industrial exposure scenario, a building could be constructed on soils containing elevated radioactivity and workers could be exposed through incidental soil ingestion, inhalation of dust and radon decay products, and direct external gamma

Table B-3A: Construction Worker

RESRAD Parameter	Value	Units	Reference/Comment
Surface Area	3,600	m2	Approximate area of largest contaminated zone (around butadiene tank)
Thickness Impacted Zone	1	m	Conservative depth assumed based on site characterization data
Contaminated Zone Erosion Rate	0.0	m/yr	No erosion assumed for the construction scenario considering that the worker is generally exposed to subsurface soils (that do not erode).
Thickness Cover	0	m	The worker is assumed to dig through any protective cover
Distribution Coefficients	-	cm3/g	Larger of the average values listed in the 1997 Painesville Characterization Report (radium = 13,000; uranium = 150; thorium = 6,700).
Inhalation Rate	12,300	m3/yr	Yu et al. (1993 Data Collection Handbook) - typical mix for outdoor activities including 37% at a moderate activity level, 28% both at rest and at light activity levels, and 7% at a heavy activity level.
Mass Loading for Inhalation	0.00018	g/m3	Yu et al. (1993 Data Collection Handbook) - mass loading for construction activities adjusted by a 30% respirable fraction (Paustenbach 1989).
Exposure Duration	1	yr	Assuming the construction worker is on site during one calendar year to work on the construction of a building foundation in a large contaminated area
Time Fraction Indoors	0.0	0-1	No indoor exposure assumed
Time Fraction Outdoors	0.0183	0-1	According to Means Heavy Construction Cost Data (10th Annual Edition, 1996), forms are set at a rate of 182 m per day and concrete is poured at a rate of 311 sq-m per day. Assuming the maximum contaminated area is the 40-m by 90-m (3,600 sq-m) block surrounding the butadiene tank, it would take 6.8 days to lay forms and joints and 11.6 days to pour for a total of 18.4 days. The forms and joints are layed using 6-m by 6-m blocks in the 40-m by 90-m area (7 blocks wide by 15 blocks long). For this assessment, the total exposure time is assumed to be 20 8-hour days (or 4 full work weeks).
Soil Ingestion	175.2	g/yr	EPA 1991 (RAGS Vol. 1 Human Health Evaluation Manual, Supplemental Guidance) - 480 mg/day for construction or landscaping activities, usually short term and dictated by weather

exposures. Because the impacted soil is isolated from potential groundwater drinking supplies (USACE 1998), the drinking water pathway was not included in this assessment. Because of deed restrictions in Alternative 5 buildings would not be constructed over or adjacent to the containment area and so this scenario is not applicable to that alternative.

The future industrial worker was assumed to spend seven hours per day indoors on site and one hour per day outdoors on-site 250 days each year for a total of 25 years. This worker receives exposures through incidental ingestion of on-site soil containing radioactive material (at a rate of 18.25 g/year) and inhalation of dust from impacted soil. The worker breathes at a rate of 8,400 m^3/yr (300,000 ft^3/yr) while on-site, with an average dust loading of 0.00003 g/m^3. It was assumed that for indoor activities, 40 percent of the dust indoors comes from impacted soil. A summary of critical exposure parameters for the industrial scenario is included in Table B-3B.

Onsite Consolidation Area Maintenance Worker Exposure Scenario

It is assumed that a worker is assigned to maintain the appearance and integrity of the clean 1-ft cover over the impacted consolidated material under Alternative 5. Duties include mowing, watering, and any other general activities involved in maintaining institutional controls at the site. This worker is assumed to perform these duties for 25 years including 8 hours once every 2 weeks during the 6-month growing season for a total of 96 hours per year. This worker receives exposures through incidental ingestion of soil from the area (at a rate of 36.5 g/yr) and inhalation of dust from impacted soil. The worker breaths at a rate of 8,400 m^3/yr (300,000 ft^3/yr) while performing on-site activities, assuming an average dust loading of 0.00006 g/m^3. The worker is also exposed to direct gamma radiation. A summary of critical exposure parameters for the maintenance worker scenario is included in Table B-3C.

Remediation Worker Exposure Scenario

The remediation worker exposure scenario applies only to partial or complete removal alternatives (i.e., excludes the no action alternative). It was assumed that an individual will be exposed to radioactive material during the excavation and movement (for shipment off site or consolidation in an on-site area) of soil containing elevated radioactivity. This receptor's exposure parameters are essentially the same as those for the construction worker with the exception of total time on site. From the cost calculations, it is estimated that partial removal alternative will take 11 hours to implement (i.e., to excavate impacted soil and transport to a gondola for shipment). The total excavation alternatives (Alternatives 5 and 6) are estimated to take less than 20 days to implement (including preparation for shipment, backfilling excavated areas, or consolidation under a 1-ft cover, where applicable). Exposure parameters such as soil ingestion rates and dust loading are conservative in that they do not account for personal protective equipment or health and safety practices. It is also assumed that the worker is always in direct contact with impacted soil (when, in fact, heavy equipment will likely be used for much of the excavation work). Because the remediation worker exposure would be comparable but less than the construction worker, and because doses would be a small fraction of the applicable limit (5,000 mrem/yr from 10 CFR 20), separate dose and risk calculations were not performed.

Table B-3B: Light Industrial Worker

RESRAD Parameter	Value	Units	Reference/Comment
Surface Area	3,600	m2	Approximate area of largest contaminated zone (around butadiene tank)
Thickness Impacted Zone	1	m	Conservative depth assumed based on site characterization data
Thickness Cover	0	m	No clean cover assumed.
Cover Erosion Rate	0.00006	m/yr	Yu et al. (1993 Data Collection Handbook) - assuming 2% slope and a non-agricultural scenario
Distribution Coefficients	-	cm3/g	Larger of the average values listed in the 1997 Painesville Characterization Report (radium = 13,000; uranium = 150; thorium = 6,700).
Inhalation Rate	8,400	m3/yr	RESRAD default for light industrial scenario assuming activities are more strenuous than typical indoor activities associated with residential or office worker scenarios
Mass Loading for Inhalation	0.00003	g/m3	Yu et al. (1993 Data Collection Handbook) - average ambient conditions, 30% respirable fraction (Paustenbach 1989)
Exposure Duration	25	yr	EPA (1990 Exposure Factors Handbook) - reasonable maximum exposure in a single workplace
Time Fraction Indoors	0.2	0-1	Assumes 7 hrs/day for 250 days/yr
Time Fraction Outdoors	0.0285	0-1	Assumes 1 hr/day for 250 days/yr
Soil Ingestion	18.25	g/yr	EPA (1991 RAGS Vol. 1 Human Health Evaluation Manual, Supplemental Guidance) - 50 mg/day for standard adult soil ingestion in the workplace
Building Air Exchange Rate	1.0	1/hr	Yu et al. (1993 Manual for Implementing RESRAD) - average value for a single family detached home. Rates in an industrial facility are likely higher.
Depth of Soil Mixing Layer	0	m	No mixing assumed for non-agricultural setting

Table B-3C: Onsite Consolidation Area Maintenance Worker

RESRAD Parameter	Value	Units	Reference/Comment
Surface Area	3,600	m2	Approximate area of largest contaminated zone (around butadiene tank) for worst case scenario. Consolidation area would likely be deeper with a smaller surface area.
Thickness Impacted Zone	1	m	Conservative depth assumed based on site characterization data
Thickness Cover	0.30	m	Assuming a 12-inch (30-cm) vegetative cover over the consolidation area to limit erosion of radioactive materials.
Cover Erosion Rate	0.00006	m/yr	No erosion assuming institutional controls are maintained
Distribution Coefficients	-	cm3/g	Larger of the average values listed in the 1997 Painesville Characterization Report (radium = 13,000; uranium = 150; thorium = 6,700).
Inhalation Rate	8,400	m3/yr	RESRAD default for maintenance worker scenario assuming activities are more strenuous than typical indoor activities associated with residential or office worker scenarios
Mass Loading for Inhalation	0.00006	g/m3	RESRAD default adjusted by a 30% respirable fraction (Paustenbach 1989)
Exposure Duration	25	yr	EPA (1990 Exposure Factors Handbook) - reasonable maximum exposure in a single workplace
Time Fraction Indoors	0.0	0-1	No indoor exposure
Time Fraction Outdoors	0.011	0-1	Assumes 8 hr/day for 12 days/yr (every two weeks during the 6-month mowing season)
Soil Ingestion	36.5	g/yr	Non-child rate assuming 100 milligrams per day

Geotechnical Parameters

Geotechnical parameters such as distribution coefficients and hydraulic conductivity were measured during the 1996 characterization effort. All relevant parameters were considered in this assessment to model site conditions as closely as possible. Whenever a range of values is available for a parameter, the more conservative value was generally used. When measured values vary greatly (e.g., ranging over several orders of magnitude), the RESidual RADioactivity (RESRAD) software default values were used assuming that the specific parameter is not well known and default values tend to be conservative.

Exposure Point Concentrations

Exposure point concentrations are the radioactive constituent concentrations in soil at the location where a receptor could be exposed. For this assessment, the exposure point concentrations were calculated using EPA guidance for baseline risk assessments under CERCLA. The upper 95 percent confidence level estimate of the mean concentration (UCL_{95}) was used as the best estimate of the reasonable maximum exposure point concentration (RME) for each radionuclide in soil. Average background concentrations for each radionuclide were subtracted from the calculated UCL_{95} concentrations to determine the net RME value used for the dose assessment. The background concentrations were measured in soil samples taken to the north of the site from Painesville Township Park. For estimated indoor radon concentrations, UCL_{95} concentrations were used (without subtraction of background) because limits for radon include background.

Because the Painesville site handled uranium that was neither enriched or depleted, U-234 was assumed to be present at the same activity concentration as U-238 (i.e., secular equilibrium). In addition, based on the activity ratios for natural uranium and alpha spectroscopy results from a portion of the samples, U-235 was assumed to be present at 4.6 percent of the U-238 activity concentration. For assessing doses from other radionuclides, it was assumed that short lived decay products are in secular equilibrium with long lived parents. For example, it was assumed that for the thorium decay series, all of the decay products were considered to be present at the same concentration as the Th-232 parent. Data collected during the characterization effort do generally show equilibrium between short lived decay products and their parent radionuclide. Long lived radionuclides were measured directly, if possible, and the dose assessment used UCL_{95} concentrations derived from these data. The list of long lived radionuclides includes U-238, Th-230, and Ra-226 from the uranium decay series; Th-232 from the thorium decay series; and protactinium-231 (Pa-231) and actinium-227 (Ac-227) from the actinium decay series. Based on the limited characterization data available and the results from a linear regression analysis, it was assumed that Ac-227 and Pa-231 are present at 28 percent of the U-238 concentration as opposed to 4.6 percent as found in typical background soil.

A cumulative frequency plot of site data shows that UCL_{95} concentrations are skewed by a few sample results with relatively high concentrations. Because Ra-226 is the primary radionuclide of concern in terms of concentration and dose, the high concentration samples were removed from the distribution (7100 pCi/g) and UCL_{95} concentrations were recalculated. This

recalculation effectively represents the data that represents the partial removal alternative (Alternative 2). This approach was used to simulate the partial excavation of only the most impacted soil leaving average soil concentrations that meet dose and risk criteria.

For the complete excavation alternatives (Alternatives 5 and 6), exposure point concentrations were determined by assuming that U-238 was removed to 17.5 pCi/g and Th-232, Th-230, and Ra-226 were removed to the 5/15 pCi/g criteria specified in DOE Order 5400.5. This order limits the total soil concentration (using the greater of the Th-230 and Ra-226, plus the greater of Th-232 and Ra-228) to 5 pCi/g in surface soil (0 to 6 in.), and 15 pCi/g in subsurface soil (deeper than 6 in.). To assess doses to industrial and construction workers after removal actions, the RME concentrations for each radionuclide were recalculated after excluding all data from samples that exceed these cleanup levels. For the maintenance worker, exposure concentrations were calculated using only soil that would be excavated and consolidated (i.e., soils that exceed concentration criteria).

The exposure point concentrations are shown in Table B-4.

Table B-4. Exposure Point Concentrations (pCi/g) Used in Dose and Risk Calculations

Radionuclide	Alt. 1: Worst Case No Action	Alt. 2: Partial Removal	Alts. 5: Consolidate and Cover	Alts. 6: Complete Removal
Ac-227	6.7	3.3	10	0.10
Pa-231	6.7	3.3	10	0.10
Pb-210	53	11	66	0.75
Ra-226	53	11	66	0.75
Ra-228	0.0	0.0	0.0	0.0
Th-228	0.0	0.0	0.0	0.0
Th-230	15	6.6	34	0.80
Th-232	0.0	0.0	0.0	0.0
U-234	23	11	35	2.1
U-235	1.0	0.49	1.6	0.097
U-238	23	11	35	2.1

Uncertainties

Parameter Assumptions

Exposure parameters were selected to provide a conservative, yet reasonable, estimate of potential radiological dose and risk to each receptor. Site-specific measurements and data were used, where available, to describe site conditions as accurately as possible. Where site-specific data were not available, standard default values recommended by EPA or other authorities or RESRAD default values were used. Pertinent references for parameter values are provided in Tables 3A-3C. Exposure scenarios and parameter values have been consistently chosen to provide conservative, yet reasonable, estimates of potential radiation dose and risk, in accordance

with the EPA guidance to reduce potential radiation exposures to as low as reasonably achievable (ALARA).

Identification of Areas of Elevated Radioactivity

Five separate areas were considered in this assessment, but risk and dose calculations were only evaluated for the area containing the highest relative radionuclide concentrations to produce a reasonable worst case exposure scenario. These five areas were initially identified as those locations with radiation levels several times background according to the walkover survey (see Figures 2-4 and 2-5. Soil samples were collected from all five areas to confirm the existence of elevated radioactivity and to establish lateral and vertical boundaries (for volume estimates). As shown in Table B-1, samples from the area near the northeast rail spur and to the northwest of the waste pond show no elevated concentrations of Ra-226, Th-230, or U-238. It was determined these two areas would not be included in assessment calculations because analytical results could not confirm the existence of elevated concentrations of relevant radionuclides. Table B-1 does show that an area in the northwest portion of the site contains elevated Ra-226, Th-230, and U-238 concentrations. This area is, however, highly localized with a total surface area of a few square meters. This area was not considered in dose and risk calculations because of its isolation from other impacted soil and because the total area containing elevated radioactivity is too small to consider reasonable exposure scenarios. The butadiene spill containment area and the southeast rail spur area were both considered as potential exposure locations because soil samples did confirm the existence of elevated radioactivity and the surface areas are large enough to create reasonable exposure scenarios. Of these, the butadiene tank area was selected as the location that would produce the worst case reasonable exposure because of its larger surface area and higher relative concentrations of Ra-226 and Th-230.

> Note: The dose/risk assessment addressed all areas which could contribute doses or risks which are significant with respect to remedial action decision making. The fact that an area was not specifically included in the assessment does not mean that it would not be addressed during remedial actions.

Limitations on Available Data

The primary radionuclide of concern in Painesville soils in terms of both dose/risk and concentration is Ra-226. Each of the 339 soil samples collected during the 1996 effort includes a Ra-226 analysis above the minimum detectable activity (MDA). Other radionuclides, like Th-230 (which can drive dose estimates when present at high concentrations) and U-238 (which has historically been considered the primary radionuclide of concern even though it contributes only a minor fraction of the total dose and risk), were also included in dose calculations but were not always detected above the respective MDA. Of the 335 samples analyzed for Th-230 by gamma spectroscopy, only four results are reported as detected. Using these gamma analysis detection limits as surrogate values (in place of actual results) for estimating UCL_{95} concentrations would be unreasonable (considering the 1% successful detection rate), and doses could be significantly overstated. Fortunately, 274 samples were also analyzed by alpha spectroscopy with 100 percent of the results above detection limits. Because Th-230 detected by alpha spectroscopy show a

good correlation with Ra-226 results ($r^2 > 0.7$), a correlation equation was developed between Th-230 alpha results and Ra-226 results so that Th-230 non-detects (which range over two orders of magnitude) could be replaced with estimated values. Exposure point concentrations for Th-230 were calculated using the combination of alpha detected data plus estimated values. The regression equation is shown below:

$$\text{Th-230 (pCi / g)} = e^{\log_e (\text{Ra-226})*0.689052+0.54101}$$

Two secondary data issues include the relative abundance of U-235 and the reporting of non-MED/AEC radionuclides. Uranium-235 in typical soil is present at concentrations approximately 4.6 percent of the U-238 activity concentration. If the uranium has been depleted, U-235 concentrations will be less than 4.6 percent and if enriched, greater than 4.6 percent by activity concentration. The Painesville gamma spectroscopy data indicate that U-235 is present at an approximate average relative concentration of 20 percent of the U-238 activity concentration. Because there is no evidence that enriched uranium was present at the Painesville site, it was assumed that the concentration ratio anomaly was the result of interference in the gamma spectroscopy analysis. Background samples could not be used to confirm whether native soil has an imbalance of uranium isotopes. Of the 15 background samples with detectable concentration of either U-238 or U-235, no single sample had detectable concentrations in both U-238 and U-235. Also, several samples were analyzed for isotopic uranium using alpha spectroscopy (a more reliable method than gamma spectroscopy for quantification of U-238 and U-235). These alpha spectroscopy results confirm a natural abundance distribution. For this assessment, natural abundance (4.6 percent) was assumed.

Several miscellaneous radionuclides were reported in the final Painesville data set (e.g., europium-152, niobium-95, and promethium-146). These radionuclides are not normally associated with uranium processing (i.e., MED/AEC) operations but are classified as fission products associated with fallout or nuclear fuel operations. Because these results are likely anomalies, are probably not truly detected given the short half-lives and site history, and were detected in a small fraction of the samples (less than 1 to 3 percent), these radionuclides were screened out and not considered as COCs for the dose/risk assessment.

Weighted Average Assumptions

An additional uncertainty in the sample data relates to the volumetric distribution of the residual radioactive materials. Each data point is given equal weight in calculating the concentration statistics, although each data point does not necessarily represent a fixed volume of soil nor are sampling locations uniformly distributed throughout the impacted soil. Because sample locations are typically biased toward locations of increased direct gamma activity, the sample statistics are likely to over-estimate the actual radionuclide concentrations in site soils.

DOSE CHARACTERIZATION

Potential current and future doses from radioactive material at the Painesville site were assessed using the RESRAD computer model (version 5.621) developed by Argonne National Laboratory. The following sections describe the results of the radon, dose, and risk calculations for each remedial action alternative. For each of the scenarios discussed below, the total radiation dose and risk includes the contributions from all applicable pathways (i.e., external gamma radiation, soil ingestion, and dust inhalation) except for radon inhalation. Because EPA has developed separate standards for indoor radon concentrations, and because radon modeling is very uncertain, this pathway has been evaluated separately. Under Alternative 5 (consolidate and cover), material maintenance requirements (such as institutional controls to prevent an inadvertent intruder exposure to contained material and limitations on outdoor radon concentrations and radon flux from the containment area) would also be addressed as specified in 40 CFR 192. For this assessment, it is assumed that institutional controls remain in place and a maintenance worker is the maximally exposed individual due to routine mowing and general ground cover upkeep.

Indoor Radon

Radon concentrations were modeled for each alternative using RESRAD. The predicted indoor working level (WL) concentrations of radon for the no action alternative (Alternative 1) show estimated values at 0.057 WL, thus, exceeding the 0.02 WL standard for indoor radon progeny specified by EPA in 40 CFR 192. When sufficient impacted soil is removed to limit total dose to less than 25 mrem/yr (i.e., remove any Ra-226 > 100 pCi/g), the drop in the exposure point concentration resulted in an indoor radon concentration of 0.013 WL, thus meeting the 40 CFR 192 criterion for Alternative 2. Any additional removal of radium-bearing soil assuming removal alternatives (Alternatives 3, 4, 5 and 6) would further reduce indoor radon concentrations. Outdoor radon levels emanating from the on-site consolidation area under Alternative 5 are well below the 3.0 pCi/L DOE limit for levels released from a DOE facility.

On-site Soil

Dose and risk estimates from the exposure to on-site soil are summarized in Table B-5. Results under Alternative 1 indicate that doses range from 11 mrem/yr (construction worker) to 99 mrem/yr (industrial worker). Most of the dose comes from direct gamma radiation. The 1×10^{-3} risk to the industrial worker exceeds the CERCLA criteria of 10^{-4}.

The Alternative 2 dose estimates of 21 mrem/yr to the industrial worker and 2.2 mrem/yr to the construction worker were calculated by removing from consideration any Ra-226 result more than 100 pCi/g. This results in a reduction of the source term and a revised Ra-226 RME of approximately 11 pCi/g. The Ra-226 cutoff of 100 pCi/g was established in two steps. Step one included determining what concentration could be removed to limit potential future doses to less than or equal to 25 mrem/yr (the 10 CFR 20 limit). Step two included an evaluation of site data using a cumulative frequency plot to determine if there is a natural break in the data. This

approach is used to optimize soil removal activities by removing the most elevated radioactivity resulting in substantially lower residual radioactivity (and, therefore, substantially lower residual doses). A cumulative frequency plot of site data shows that only 5 of the 51 site samples exceed both 40 CFR 192 generic cleanup criteria and 100 pCi/g of Ra-226. By removing these samples from the population, estimated maximum doses are limited to less than 25 mrem/yr. The maximum risk estimate is 3×10^{-4} for the industrial worker under this alternative.[1]

Table B-5. Dose and Risk Assessment Results

Scenario	Receptor	Total Dose (mrem/yr)	Gamma Dose (mrem/yr)	Excess Lifetime Risk (lifetime^{-1})
Alternative 1: No Action	Construction Worker	15	10	6.E-06
	Industrial Worker	99	95	1.E-03
Alternative 2: Partial Removal	Construction Worker	4.1	2.2	1.E-06
	Industrial Worker	22	21	3.E-04
Alternative 5: On-Site Consolidation	Maintenance Worker (1-ft cover)	< 1	< 1	3.E-06
Alternative 6: Total Removal[a]	Construction Worker	0.25	0.15	1.E-07
	Industrial Worker	1.5	1.4	2.E-05

[a] Removal of soil concentration > SOR = 1 according to DOE Order 5400.5.

Dose and risk to the on-site maintenance worker (Alternative 5) were calculated assuming a consolidation area was constructed to store radioactive soils that were excavated from the butadiene tank spill area, southeast rail spur, etc., and then covered with 0.3 meters (1 ft) of clean soil. Results indicate that the worker would receive less than 1 mrem/yr from conducting general maintenance activities (all from the direct gamma pathway). The worker's risk is estimated at 3×10^{-6}. This alternative shows that if the impacted material were consolidated and stored under a 0.30-m (1-ft) cover and maintained by institutional controls, 10 CFR 20 dose limits and CERCLA risk criteria will likely by achieved.

If all soil above 40 CFR 192 cleanup regulations were removed from the site (Alternative 6), then the doses to the construction and industrial workers from exposure to residual material are estimated to be below the 25 mrem/yr limit. The maximum estimated dose is 1.5 mrem/yr to the industrial worker. Risks are within or below the CERCLA risk criteria of 10^{-4} to 10^{-6} with a maximum of 2×10^{-5} for the industrial worker.

[1] The estimated risks for Alternative 2, while exceeding 1×10^{-4}, generally fall within the range of risk determined by EPA to be acceptable at other sites. EPA has generally interpreted the 10^{-4} limit as meaning a few in 10,000 (not 1.0×10^{-4}). In fact, by EPA's estimates, the draft EPA cleanup standard for radioactive sites would result in a risk of approximately 3×10^{-4}.

APPENDIX C

COST BASIS FOR REMEDIAL ACTION ALTERNATIVES

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1.1 PURPOSE

The purpose of the Painesville EE/CA cost estimates is to compare the relative costs for various remediation alternatives. Each alternative is represented by a separate cost estimate.

1.2 ESTIMATE SCOPE

The scope of the estimates is defined by the work break down structure for each alternative. This structure is determined by the scope stated in the EE/CA.

1.3 WORK BREAKDOWN STRUCTURE

The SAIC FUSRAP Work Breakdown Structure (WBS) (SAIC 1994) was used as a basis to develop the Painesville EE/CA WBS. The WBS is designed to subdivide this project into logical elements for cost estimating purposes and to incorporate the project into the overall FUSRAP Program so that related program costs are recognized.

1.4 SCHEDULES

Schedules play an important role in determining the cost of an alternative since the costs for certain WBS elements are essentially schedule driven. For example, the cost associated with staffing a Health and Safety Officer at the site depends on how many days the action is expected to take. Schedules are derived for each alternative by breaking the project into major critical path activities. The duration for each activity is determined by one of two methods. Schedules for certain activities are based on engineering judgment and relate the Painesville site project to experience on previous similar projects. Schedules for other activities are calculated within respective WBS element cost estimate calculations. Durations for these activities are based on the size of the task, equipment quantity, crew sizes and productivity factors. Allowance is made for certain activities to run concurrently.

1.5 ESTIMATING METHODOLOGY

In general, FUSRAP cost estimates are generated for each of the activity-oriented WBS elements. In some instances, WBS elements are further subdivided in order to isolate the cost by sub-activity. For much of the Painesville EE/CA estimate, the estimating was performed at this detailed WBS level. Once estimated, costs are then "rolled up" from subordinate level WBS elements and summed to the parent level WBS element. Use of the WBS in this manner provides traceability from the total cost down to very specific estimate details.

The primary methodology utilized is quantity take-off where costs are calculated based on the unit cost multiplied by quantity or other input parameters. Unit cost data is primarily

drawn from Means Heavy Construction Cost Data 1996 (Means 1996). For example, Excavation and Backfill is based on excavation volume as well as specific complexities associated with the Painesville EE/CA site. This combination of volume and complexity drives equipment, labor and material requirements.

Several WBS elements incorporate a productivity adjustment process as part of the estimating methodology. This process is accomplished through the use of factors which are applied to equipment performance measures in order to account for a degradation in the productivity, performance, or output levels of the equipment resulting from site-specific conditions. Productivity factors exist for three conditions: site, soil, and safety. Site adjustments are made to account for temporary work interruptions and delays resulting from poor weather, unsafe work conditions and other similar unforeseen events. A safety adjustment is made to adjust productivity levels due to safety procedures associated with the radioactive nature of the materials. Soil adjustments are made to account for varying levels of difficulty associated with excavating different types of soil or rubble. Typically, soil adjustment factors are provided with performance data, or adjustments may be estimated by engineering judgment. Productivity adjustments are part of the methodology used to estimate costs for such WBS elements as Excavation and Backfill.

Schedule is a key cost driver for such WBS elements as Monitoring Sampling and Analysis and Building and Services. These elements are estimated by determining a base cost per month and then multiplying this base cost by the project duration (in months).

A contingency factor of 25 percent is applied to Painesville FUSRAP Project (subtotal project cost) at the bottom line. FUSRAP Program Management and Integration is calculated by using a 10 percent multiplier on the subtotal project cost (with contingency added).

In general, estimating methodology is not alternative specific. Once a methodology has been established for a given WBS element, it becomes the common methodology which is employed for that given WBS element across the various alternatives.

1.6 GROUNDRULES AND ASSUMPTIONS

Groundrules and assumptions are statements of guidance and/or logic which are established in order to bound or limit the cost estimate. They serve to define the estimate by clarifying the effort which the estimate addresses and how cost for that effort is derived. Groundrules and assumptions are included in the detailed estimates contained in the calculation package. Those groundrules and assumptions are either WBS element-specific or site specific and, as such are not included here for document brevity.

1.7 KEY PARAMETERS

Table C-1 provides key parameters (quantities, unit cost, etc.) for each alternative.

1.8 COST SUMMARY

Table C-2 summarizes costs for all alternatives.

Table C-1

PAINESVILLE SITE KEY PARAMETERS
Painesville EE/CA

PARAMETER	ALT. 1 NO ACTION	ALT. 2 PARTIAL REMOVAL & COMMERCIAL DISPOSAL	ALT. 3 PARTIAL REMOVAL & COMMERCIAL DISPOSAL	ALT. 4 PARTIAL REMOVAL & COMMERCIAL DISPOSAL	ALT. 5 CONSOLIDATION & PLACEMENT OF A PERMANENT SOIL COVER	ALT. 6 COMPLETE REMOVAL & COMMERCIAL DISPOSAL
Impacted Volume	0	251	320	790	4,000	4,000
Excavation Volume, Total (Insitu cy)	0	301	384	948	4,800	4,800
Disposal / Transport Volume (Exsitu cy)	0	377	480	1,185	6,000	6,000
Comm. Disp., Soil, Rail, small Volume ($/cy)	$ 149.00	$ 149.00	$ 149.00	$ 149.00	$ 149.00	$ 149.00
Rail (Ohio) ($/ton)	$ 72.00	$ 72.00	$ 72.00	$ 72.00	$ 72.00	$ 72.00
Loading rate ($/cy)	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00
Soil Expansion Factor (exsitu/insitu)	1.25	1.25	1.25	1.25	1.25	1.25
Soil density (tons/insitu cy)	1.35	1.35	1.35	1.35	1.35	1.35
Dump truck trips per day to rail (pile).	10	10	10	10	10	10
Dump truck trips per day to rail (subsurface).	4	4	4	4	4	4
Available construction weeks per year	40	40	40	40	40	40

Insitu cy includes overexcavation @ 20%

Table C-2

Painesville Project
FUSRAP Remediation Alternatives
Summary Table
30 Year Cost in 1997$

ACTIVITY	ALT. 1 NO ACTION	ALT. 2 PARTIAL REMOVAL & COMMERCIAL DISPOSAL	ALT. 3 PARTIAL REMOVAL & COMMERCIAL DISPOSAL	ALT. 4 PARTIAL REMOVAL & COMMERCIAL DISPOSAL	ALT. 5 CONSOLIDATION & PLACEMENT OF A PERMANENT SOIL COVER	ALT. 6 COMPLETE REMOVAL & COMMERCIAL DISPOSAL
	0 yd^3	251 yd^3	320 yd^3	790 yd^3	4000 yd^3	4000 yd^3
Excavation & Backfill	0	18,177	23,688	53,736	271,768	271,768
Transportation	0	40,082	51,100	125,422	0	638,756
Disposal	0	58,118	74,095	181,860	0	926,184
Monitoring, Sampling & Analysis	0	78,418	78,686	80,492	407,535	117,122
Site Development	0	68,329	68,329	68,620	131,296	127,111
Building & Services	0	3,249	3,271	3,419	6,417	6,417
Treatment	0	0	0	0	0	0
Demolition & Decontamination	0	0	0	0	0	0
Project Management & Engineering Support	0	252,780	254,486	265,991	499,242	499,249
Other Collection and Controls	0	0	0	0	214,771	0
Onsite Management and Engineering Support	0	233,245	234,819	245,435	460,660	460,658
Site Inst. Controls, Surv. & Maint.	0	1,062	1,069	1,118	2,098	2,098
Remedial Design	0	40,248	40,986	45,282	149,454	98,517
Subtotal Project	**0**	**793,708**	**830,529**	**1,071,375**	**2,143,241**	**3,147,880**
Contingency	0	198,427	207,632	267,844	535,810	786,970
Program Management and Integration	0	99,213	103,816	133,922	267,905	393,485
Total Removal Action	**0**	**1,091,348**	**1,141,978**	**1,473,141**	**2,946,956**	**4,328,335**
Post Remedial Action O&M	0	11,822	11,822	11,822	2,104,019	11,822
Total 30 Year Cost	**0**	**1,103,170**	**1,153,800**	**1,484,963**	**5,050,975**	**4,340,157**