PROPOSED PLAN FOR
OPERABLE UNITS 1 AND 2
FORMER HARSHAW CHEMICAL COMPANY SITE

CLEVELAND, OHIO
AUTHORIZED PROJECT UNDER THE
FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

FINAL—MARCH 2019
PREPARED BY:
U.S. ARMY CORPS OF ENGINEERS
BUFFALO DISTRICT
1776 NIAGARA STREET
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ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASURE

AEC	Atomic Energy Commission
ARARs	applicable or relevant and appropriate requirements
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	constituent of concern
EU	exposure unit
FUSRAP	Formerly Utilized Sites Remedial Action Program
HHRA	human health risk assessment
IA	Investigative Area
LDR	land disposal restrictions
MED	Manhattan Engineer District
mrem/yr	millirems per year
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PRG	preliminary remediation goals
OU	operable unit
pCi/g	picocuries per gram
RAO	remedial action objective
RESRAD	RESidual RADioactivity computer code
RI	remedial investigation
TEDE	total effective dose equivalent
USACE	U.S. Army Corps of Engineers
UU/UE	unlimited use/unrestricted exposure
yd^3	cubic yards

CORPS OF ENGINEERS ANNOUNCES PROPOSED PLAN

Public Comment Period
March 14, 2019 – May 14, 2019
The Corps of Engineers will accept written comments on the proposed plan during the public comment period.

Public Meeting
April 2, 2019, 6:30 p.m.
Holiday Inn Cleveland South located at 6001 Rockside Road, Independence, OH 44131

Major documents are available at: https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Harshaw-Site/ on the USACE Harshaw Site website in the Reports Section.

The administrative record file is available electronically at the following locations:

Cuyahoga County Public Library - Brooklyn Branch
4480 Ridge Road
Brooklyn, OH 44144

Cleveland Public Library
325 Superior Avenue NE
Cleveland, OH 44114

Or by appointment only:
U.S. Army Corps of Engineers Buffalo District
1776 Niagara Street
Buffalo, NY 14207

The public is invited to review and comment on this *Proposed Plan for Operable Units 1 and 2 at the Former Harshaw Chemical Company Site*. The U.S. Army Corps of Engineers (USACE) prepared this document as part of its investigations under the Formerly Utilized Sites Remedial Action Program (FUSRAP). This program was initiated in 1974 to identify, investigate, and if necessary, clean up or control sites contaminated as a result of activities supporting the Nation's early atomic energy program. The USACE executes FUSRAP in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The purpose of this document is to solicit input from the public regarding the USACE preferred alternatives, Alternative 3—Complete Excavation and Off-Site Disposal (OU-1) and Alternative 7—Complete Excavation and Off-Site Disposal (OU-2) to address FUSRAP-related soil contamination at the Former Harshaw Chemical Company Site. The preferred alternatives may be modified based on any new information acquired during the designated public comment period. Therefore, the public is encouraged to review and comment on all the alternatives presented in this proposed plan.

Members of the public may submit their comments in writing to USACE at:

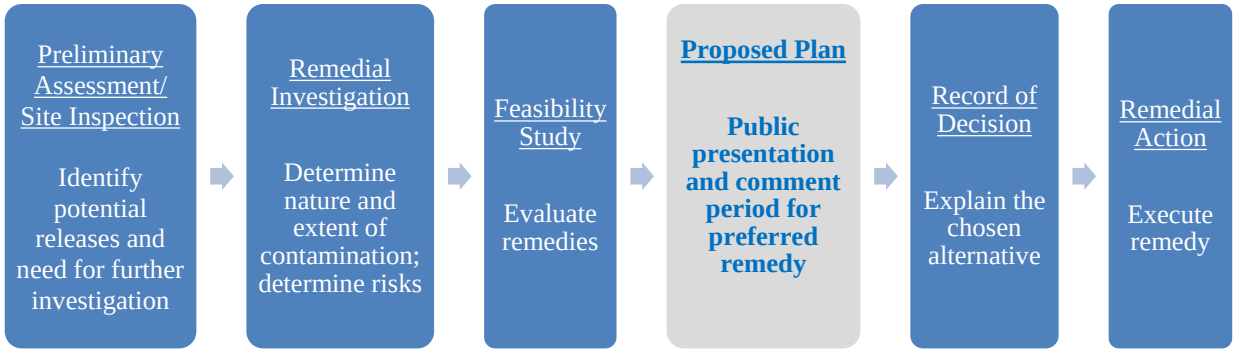
U.S. Army Corps of Engineers, Buffalo District
Special Projects Branch, Environmental Project Management Team
1776 Niagara Street
Buffalo, New York 14207-3199

Comments may also be submitted electronically by emailing *fusrap@usace.army.mil*. Please refer to this proposed plan or the Harshaw Site in any comments. If there are any questions regarding the comment process or the proposed plan, please direct them to the address noted above or telephone 1-800-833-6390 (Option 4).

INTRODUCTION

This proposed plan presents the recommended cleanup strategy for soils impacted by FUSRAP-related activities at the Former Harshaw Chemical Company Site in Cleveland, Ohio. The lead agency, USACE, concluded that no action is needed to address FUSRAP-related contamination in groundwater. Groundwater is not a current source or potential future source of drinking water at the Harshaw Site because residents are required to connect to the municipal water source.

The proposed plan is one of the documents required by the NCP and CERCLA process, as shown in the illustration below. The main purpose of this phase is to communicate the USACE preferred alternatives for OU-1 and OU-2 at the Harshaw Site and encourage public input to select the final remedy for the site.



CERCLA Process

This proposed plan only addresses FUSRAP-related contamination on the site. It does not address other contamination that may exist. The FUSRAP does not authorize cleanup of contamination that does not relate to specific government activities. Only certain radioactive contamination is eligible for cleanup at the Harshaw Site. However, if other contaminants are mixed with FUSRAP-related contamination, USACE will remediate this waste stream irrespective of origin. The USACE selected Alternative 3—Complete Excavation and Off-Site Disposal (OU-1) and Alternative 7—Complete Excavation and Off-Site Disposal (OU-2) as preferred alternatives to address FUSRAP-impacted soils based on the evaluation of seven of nine CERCLA criteria. The remaining two CERCLA criteria (state acceptance and community acceptance), will be evaluated following the public comment period for this proposed plan.

The main accompanying documents to this proposed plan are the *Former Harshaw Chemical Site Remedial Investigation Report* (USACE 2009), *Former Harshaw Chemical Company Site Feasibility Study Report* (USACE 2012), and *Feasibility Study Addendum for the Harshaw Site* (USACE 2018). The feasibility study addendum and the feasibility study describe all the aspects of the proposed plan in greater technicality and detail. The reader can consider the feasibility study addendum and feasibility study to be the primary references for this document. The remedial investigation is another important reference since it contains information about the nature of contamination and associated human health risks, among other topics.

SITE BACKGROUND

Site Characteristics

The Harshaw Site is located at 1000 Harvard Avenue, in Cleveland, Ohio, 4.8 kilometers (3.0 miles) south of downtown Cleveland (Figure 1). It is a 22-hectare (55-acre) property located in an industrialized area that is bordered by the Cuyahoga River and Big Creek. The Harshaw Site is surrounded by other industrial operations and residential areas.

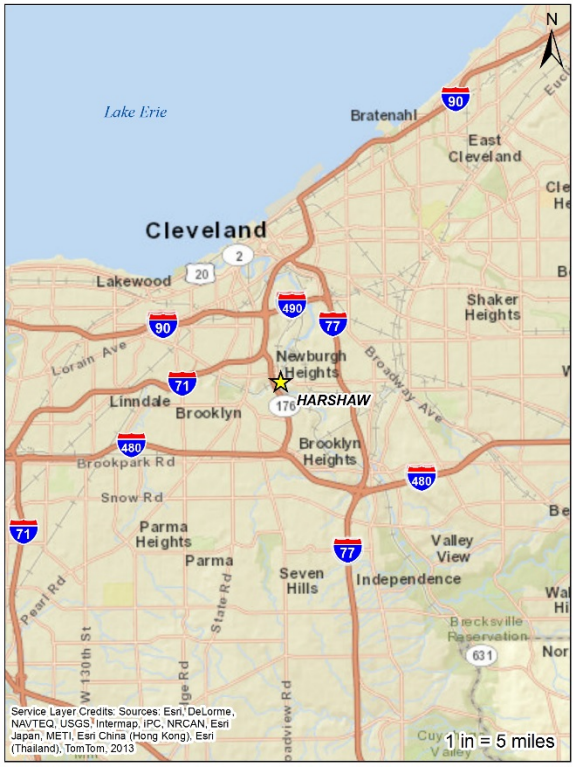


Figure 1: Harshaw Site Location

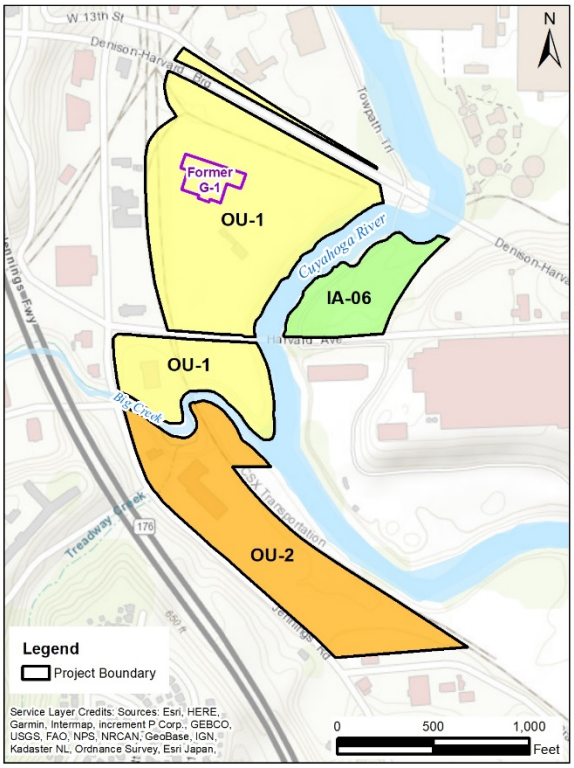


Figure 2: Harshaw Site Layout

The Harshaw Site is separated into two operable units, OU-1 and OU-2, and an investigative area (IA), IA-06 (Figure 2). Operable Unit-1 is located north of Big Creek and west of the Cuyahoga River. It contains undeveloped industrial properties, open fields, and wooded areas. Operable Unit-2 is south of Big Creek and west of the Cuyahoga River, and consists mainly of undeveloped industrial properties and open fields. Investigative Area-06 is an undeveloped parcel located east of the Cuyahoga River and north of Harvard Avenue. Commercial and municipality-owned properties are in the northwest portion of OU-2.

Site History

The Harshaw Site was initially purchased by the Harshaw, Fuller & Goodwin Company in 1905; the company developed the property to manufacture chemical solvents, metal salts, fluorides, hydrofluoric acids, and other chemical products for commercial use. Between 1942 and 1954,

the Harshaw Chemical Company conducted government-contracted uranium processing operations in the former Building G-1 (Figure 2). The primary activity involving the conversion of uranium concentrate feed materials to uranium tetrafluoride, uranium hexafluoride, and uranium trioxide ceased in 1951. In 1953 and 1954, the refinery purified uranium trioxide from recycled uranium, after which all government-contracted uranium processing operations at the Harshaw Site ceased.

Site ownership changed several times after the completion of government-contracted operations. In 1966, Harshaw merged with the Kewanee Oil Company of Bryn Mawr, Pennsylvania, and Kewanee was acquired by the Gulf Oil Corporation in 1977. Gulf organized a joint venture with the Kaiser Aluminum & Chemical Corporation in 1983, combining its two chemical units into the Harshaw/Filtrol Partnership to produce specialty chemicals. In 1988, Kaiser sold the Harshaw/Filtrol partnership to Engelhard, a specialty chemical and metallurgical maker based in Oakland, California. In June 2006, Engelhard was acquired by the German chemical company BASF Corporation. Most of the site is currently owned by BASF. The former Building G-1 area and the undeveloped parcel east of the Cuyahoga River (IA-06) are now owned by the Chevron Corporation.

In 2011, USACE signed a no-action record of decision for IA-06 (USACE 2011) after it was determined that risks from FUSRAP-related materials within IA-06 were below actionable limits established by the NCP.

Table 1 summarizes key historic events and investigations at the Harshaw Site.

Table 1: Key Historical Events for the Harshaw Site

Year(s)	Event
1905	Harshaw Chemical Company purchased property and started commercial manufacture of chemicals
1942–1954	Harshaw Chemical Company conducted FUSRAP-related uranium processing activities
1999	United States Department of Energy designated the Harshaw Site eligible for inclusion into FUSRAP
2001	The USACE completed the preliminary assessment (USACE 2001)
2009	The USACE completed the remedial investigation (USACE 2009)
2010	The USACE completed the proposed plan for IA-06 (USACE 2010)
2011	The USACE completed the record of decision for IA-06 (USACE 2011)
2012	The USACE completed the feasibility study (USACE 2012)
2016	The USACE completed the project construction report for the Building G-1 deconstruction and groundwater investigation (USACE 2016)[a]
2018	The USACE completed the feasibility study addendum (USACE 2018)

[a] The USACE dismantled former Building G-1 in December 2014 to facilitate further groundwater investigations beneath the building slab. Concurrently, the property owner removed several other site buildings and stormwater features.

SITE CHARACTERIZATION

The Harshaw Site consists of 22 hectares (55 acres) that include several separate parcels of land both north and south of Harvard Avenue. The site includes areas of pavement, broken pavement, and nonpaved (vegetated, dirt, or gravel) surfaces. The Harshaw Site is located at the confluence of the Cuyahoga River and Big Creek where low-lying portions of the site lie within the Q3 Federal Emergency Management Agency Flood Hazard Area. The upland industrial or commercial plateaus in OU-1 and OU-2 are both above the 100-year recurrence flood elevation. The site is relatively flat, with a slope of less than 1 percent toward the east (where the Cuyahoga River is located) and to the south (where Big Creek is located). Large portions of land surface in the northern portion of the site have been modified to permit the construction of buildings, paved surfaces, and associated drainage systems. All of the developed parcels within the site boundary have been filled to raise the land surface elevation and limit the potential for flooding. The southern portion of the site represents mainly undeveloped parcels where no known drainage systems exist. Surface water flow across the northern and central portions of the site is controlled by the stormwater drainage systems, drainage ditches and culverts, and land cover, although segments of these conveyances are nonoperational (i.e., plugged or removed).

On average, subsurface geology consists of 6.7 meters (22 feet) of unconsolidated material that overlies shale bedrock. Bedrock is relatively shallow beneath the northern and western parts of the property and becomes deeper towards the north, east, and south, where the thickness of the unconsolidated material also increases. This unconsolidated material consists of both anthropogenic (manmade) fill and native fluvial or alluvial sediment deposits. The native sediments are indicative of the site's geographic setting within the Cuyahoga River valley (i.e., glaciated terrane sculpted by postglacial fluvial action).

Groundwater flow across the site is controlled by the nature of the unconsolidated deposits, the topography of the underlying shale bedrock, and the relative elevation of the discharge areas (Cuyahoga River and Big Creek). Potentiometric maps show groundwater flow in the unconsolidated fluvial material is generally from west to east across the site. Groundwater flow directions appear to be influenced by changes in surface water levels and flow into the Cuyahoga River and Big Creek. Primary groundwater flow occurs within the coarse-grained layers of subsurface fill and alluvial sediments. Groundwater is assumed to extend into the upper few feet of the shale bedrock. The alluvial sediment represents the primary water-bearing zone in the vicinity of the site. Appendix B of the feasibility study addendum (FSA) discusses the Harshaw Site groundwater conditions, while Appendix C of the FSA discusses the surface water conditions and associated risks.

The Harshaw Site was largely characterized during a remedial investigation (RI) (USACE 2009). The RI fully describes the site's physical characteristics, history, nature and extent of contamination, and human health and ecological risk assessments. Environmental samples collected during the RI to determine nature and extent of contamination focused on the following:

- Buildings
- Soil
- Groundwater
- Surface water
- Sediment
- Sewers and drains

What are the "Constituents of Concern?

The USACE has identified three FUSRAP-related contaminants that pose the greatest potential risk to human health at the Harshaw Site.

Radium: Radium is a naturally-occurring radioactive metal (or radionuclide) formed by the decay of uranium and thorium in the environment. It occurs at low levels in virtually all rock, soil, water, plants, and animals. Long-term exposure to radium increases the risk of developing several diseases. Inhaled or ingested radium increases the risk of developing such diseases as lymphoma, bone cancer, and diseases that affect the formation of blood, such as leukemia and aplastic anemia. These effects usually take years to develop. External exposure to radium's gamma radiation increases the risk of cancer to varying degrees in all tissues and organs.

Thorium: Thorium is a naturally-occurring radioactive metal found at very low levels in soil, rocks, and water. It has several different isotopes, all of which are radioactive. The principal concern from low- to moderate-level exposure to ionizing radiation is increased risk of cancer. Studies have shown that inhaling thorium dust causes an increased risk of developing lung cancer and cancer of the pancreas. Bone cancer risk is also increased because thorium may be stored in bone.

Uranium: Uranium is a naturally-occurring radioactive metal commonly found in rocks, soil, water, plants, and animals (including humans). Uranium is weakly radioactive and contributes to low levels of natural background radiation in the environment. Intakes of uranium can lead to increased cancer risk, kidney damage, or both. Long-term chronic intakes of uranium isotopes in food, water, or air can lead to internal irradiation and/or chemical toxicity to the kidney.

Source: https://www.epa.gov/radiation

As described in the text above, USACE determined that remedial action was required for site soils to address the following constituents of concern (COCs) in OU-1 and OU-2: radium-226, thorium-230, thorium-232, and uranium-238.

Table 2 lists both the maximum levels of FUSRAP-related contamination found in soil at the Harshaw Site during various site investigations and the mean background concentrations.

Table 2: Maximum and Background COC Concentrations in Soil at the Harshaw Site[a]

Radionuclide	OU-1		OU-2		Mean Background Value[b]
	Maximum Detected	PRG	Maximum Detected	PRG	
Ra-226	19.23	9.1	7.98	3.6	0.941
Th-230	632	35	84.5	16	0.878
Th-232	329	6	74.8	3.6	0.981
U-238	2,710	190	1,680	150	1.27

[a] All values in units of picocuries per gram (pCi/g).
[b] Mean background values are calculated with concentrations in background natural soil samples collected from 0 to 13 feet below ground surface (see Table 8-7 in the RI).
OU = operable unit
Ra = radium
Th = thorium
U = uranium

Contamination related to FUSRAP is centered on where the former Building G-1 stood. However, some other areas of the site were contaminated. The locations of FUSRAP-related contaminants in excess of the soil preliminary remediation goals (PRGs) are shown on Figure 3. The PRGs are initial cleanup goals that are protective of human health and the environment and comply with applicable or relevant and appropriate requirements (ARARs). Both the ARARs and PRGs are discussed in detail in the 2012 feasibility study (FS).

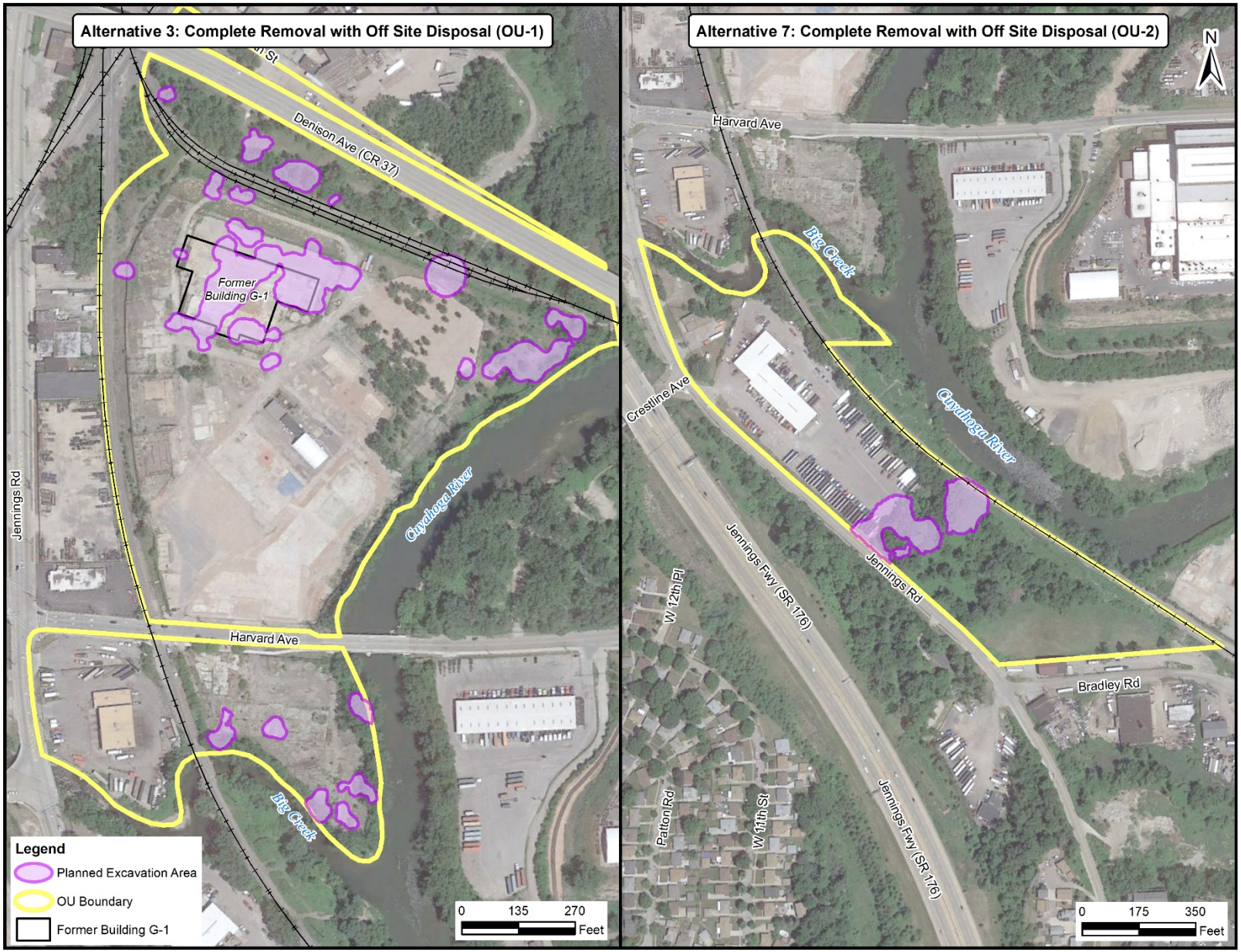


Figure 3: Planned Excavation Areas for the Preferred Alternatives

FUTURE LAND USE

Future land use in OU-1 is likely to remain industrial. Alternately, all or portions of OU-1 may be developed for recreational use. Future land use in OU-2 is also likely to remain industrial. However, City of Cleveland planning indicates a portion of OU-2 may be zoned residential. Therefore, USACE evaluated the impacts in OU-2 with regard to future residential development.

To determine what risks may occur in the future, USACE evaluated a full range of receptors across the site. Potential receptors included the adult maintenance worker, adult industrial worker, adult and adolescent recreational users, construction worker, the adult and child resident, and hypothetical subsistence farmer.

SCOPE AND ROLE OF THE RESPONSE ACTION

The response action under FUSRAP will address COC-impacted soils that are FUSRAP-related at the Harshaw Site. At the Harshaw Site, these COCs include radioactive residuals only. Constituents that are not FUSRAP-related may be remediated only if mixed with FUSRAP-related COCs. If these constituents are commingled with FUSRAP-related COCs, they will be remediated and addressed in terms of proper disposal and other actions. The scope of this response action addresses the following constituents: radium-226, thorium-230, thorium-232, and uranium-238. Although other media (i.e., building surfaces, surface water, sediment, and groundwater) were also investigated and evaluated, only soil remains a medium of concern based on potential health risks to critical groups selected for the site. The critical group is defined by the ARAR as the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

SUMMARY OF SITE RISKS

The USACE conducted both a human health baseline risk assessment (BRA) and a screening-level ecological risk assessment to determine the current and potential future effects of FUSRAP-related constituents on human health and the environment.

What is "risk" and how is it calculated?

A FUSRAP baseline risk assessment is an estimate of the likelihood of health problems occurring if no cleanup action were taken at a site. The USACE follows the process developed by the U.S. Environmental Protection Agency:

Step 1: Analyze Contamination (hazard identification) occurs during the remedial investigation phase. The Corps of Engineers collects samples from site soils, groundwater, sediments, surface water, and building materials, where appropriate. These samples are analyzed for hazardous substances that are likely present as a result of past FUSRAP-related activities. For example, if a site processed uranium compounds, the site would be tested for uranium and associated decay products, such as thorium-230.

Step 2: Estimate Exposure (exposure assessment) where the risk assessor considers different pathways for human exposure to the FUSRAP-related radionuclides and chemicals identified in Step 1. The risk assessor develops a conceptual site model that identifies current and potential future land users and maps out the different ways in which each could be exposed to hazardous materials at the site. For example, someone who traverses the site occasionally could be exposed approximately two hours a day, up to seven days a week. He or she would likely not come in contact with groundwater or soils below a certain depth. By comparison, a construction worker might come in contact with deeper soils through excavation activities. The exposure assessment considers the concentrations that people might be exposed to in environmental media and the potential frequency and duration of exposure. Using this information, the risk assessor identifies reasonable and likely future land use scenarios, and computes reasonable maximum exposure values for them, which are the highest levels of human exposure that could be reasonably expected to occur.

Step 3: Assess Potential Health Dangers (toxicity assessment) where the risk assessor compiles information on the toxicity of each FUSRAP-related constituent to assess potential health risks. The risk assessor considers two types of health risk: cancer risk and noncancer risk. The likelihood of the occurrence of cancer resulting from exposures at remediation sites is generally expressed as an upper bound probability; for example, a one in 10,000 chance of cancer occurrence over a lifetime. In other words, for every 10,000 people that could be exposed at the reasonable maximum exposure level, at most, one extra cancer would be expected to occur over a lifetime. An extra cancer case means that one more person could get cancer than would normally be expected to from all other causes. For noncancer health effects, the risk assessor calculates a hazard index.

Step 4: Characterize Site Risk (risk characterization) where the results of the three previous steps are combined, evaluated, and summarized. The risk assessor determines whether the potential health risks are acceptable for people at or near the site according to relevant benchmarks promulgated by the U.S. Environmental Protection Agency or other agencies, such as the Nuclear Regulatory Commission.

The Harshaw Site BRA consisted of three components:

- **Human Health Risk Assessment (HHRA)**: An evaluation of the potential for unacceptable risk or radiological dose to human receptors from radioactive and chemical constituents remaining in environmental media at the site as a result of on-site FUSRAP-related activities.
- **Building HHRA**: An evaluation of the potential unacceptable risk or radiological dose to human receptors from radiological contamination remaining within the buildings at the site.
- **Screening Level Ecological Risk Assessment:** An evaluation of the potential hazard to ecological receptors from FUSRAP-related chemical and radioactive constituents remaining in environmental media.

The USACE and a site owner (BASF Corporation) have removed all impacted buildings from the Harshaw Site. The following sections summarize the findings of the remaining BRA components.

Human Health Risks

The HHRA identified FUSRAP-related constituents by media and exposure unit (EU) based on an evaluation of data collected during the site characterization process. The assessment evaluated potential exposure to the following human receptor populations that may be exposed to the identified FUSRAP-related contamination:

- Maintenance worker (current)
- Trespasser/recreational user (current/future) adult and adolescent
- Industrial worker (future)
- Construction worker (future)
- Resident (future) adult and child
- Subsistence farmer (future) adult and child

Potentially impacted media evaluated in the risk assessment included soil, surface water and sediment (both in underground site utilities, and the Cuyahoga River), and groundwater. Exposure pathways include inhalation, dermal contact, incidental ingestion (of soil for all receptors, and soil, sediment, surface water, and groundwater for other receptors according to the conceptual site model), external gamma exposure, and consumption of potentially impacted game fish (for hypothetical residents and farmers only). The risk posed to human-receptor populations was quantified for each impacted medium and exposure pathway. Through this evaluation, specific FUSRAP-related contaminants were identified posing the greatest potential risk to human health: radium-226, thorium-230, thorium-232, and uranium isotopes (including uranium-234, uranium-235, and uranium-238).

Soil was identified as a medium of concern based on potential health risks to human-receptor populations, or critical groups, selected for the site. Unacceptable incremental lifetime cancer risks were identified for the industrial worker, maintenance worker, resident, and subsistence farmer receptors for soil. Unacceptable radiological doses (i.e., above 25 mrem/yr total effective dose equivalent [TEDE]) in soil were noted for the maintenance worker, construction worker, resident, and subsistence farmer receptors.

There were no actionable cancer, noncancer, or radiological dose risks associated with AEC/MED-related contaminants for any receptor for surface water, sediment, or sewers and drains.

The only noncancer chemical risk found to have a hazard quotient exceeding the acceptable limit of 1 was uranium exposure to the hypothetical subsistence farmer by drinking groundwater from the site. Unacceptable radiological doses also were noted for the subsistence farmer receptor for hypothetical exposures to groundwater. Based on an analysis of likely future land use, farming is not expected to occur at this property in the future; therefore, risks associated with drinking groundwater at this site is not considered to be applicable. The groundwater at the site would not provide a significant source of drinking water due to the following: 1) relatively poor quality and

slow production rate; 2) proximity to Lake Erie that provides a supply for the public drinking water in the area; 3) the location of the site within the buffer zones of two Ohio voluntary action program urban setting designations; and 4) the requirement for occupied dwellings to be connected to the City of Cleveland municipal water supply system. The USACE has concluded no action is needed to address groundwater.

Further details for the HHRA can be found in the *Feasibility Study for the Harshaw Site* (USACE 2012).

Future land use in OU-1 is likely to remain industrial. Alternately, all or portions of OU-1 may be developed for recreational use. Future land use in OU-2 is also likely to remain industrial. However, City of Cleveland planning indicates a portion of OU-2 may be zoned residential. Therefore, in the FS, USACE evaluated the impacts in OU-2 with regard to future residential development. Based on these results, the critical receptors, or populations with the greatest future hypothetical risk, were identified as the construction worker for OU-1 and the resident for OU-2.

Although other media (i.e., building surfaces, surface water, sediment, and groundwater) were also investigated and evaluated, only soil remains a medium of concern based on potential health risks to critical exposure groups.

Ecological Risks

There are no sensitive habitats or threatened and endangered species on the Harshaw Site that warrant special consideration or protection. Available habitat at the site is limited under current use conditions, and much of it is paved or covered by degraded pavement. Future development of the site may not necessarily continue to be industrial, but any future development would likely be for human benefit. In addition, no ecosystem or habitat restoration is planned for the site. The screening level ecological risk assessment indicates no further action is warranted with respect to ecological receptors.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are established to: 1) protect human health and the environment; 2) provide the basis for selecting appropriate technologies; and, 3) develop and evaluate remedial alternatives against legal requirements. The RAO for the Harshaw Site is intended to provide for long-term protection of human health and the environment. To provide this protection, USACE determined that a soil-specific RAO is required. The RAO described below includes the following key components:

- Applicable or relevant and appropriate requirements (see more detail below)
- Current and anticipated future land uses
- Potential current and future receptors
- COCs and their associated PRGs

The RAO developed for the soil in OU-1 and OU-2 is to prevent exposure to impacted soil containing concentrations of COCs (identified in Table 3, below) to ensure the critical group does not receive a total dose equivalent exceeding 25 millirems per year (mrem/yr) TEDE above background. The critical group is defined by the ARAR as the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances. Based on current and projected future site use discussed in the Human Health Risk section, the critical group for OU-1 is a construction worker. The critical group for OU-2 is a resident adult.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

To meet this objective, USACE developed PRGs for each of the FUSRAP COCs based on a review of federal requirements that are applicable or relevant and appropriate to the situation or COCs at the site. Table 3 presents the FUSRAP-related soil PRGs for OU-1 and OU-2. The PRGs developed for the Harshaw Site are based on the requirements contained in 10 Code of Federal Regulations 20 Subpart E. For the Harshaw Site, this regulation means ensuring overall protectiveness and that the critical receptor does not receive a dose more than 25 mrem/yr TEDE above background from FUSRAP-related contamination. The critical group is defined in the regulation as the group of individuals expected to receive the greatest exposure in the future. The ARAR requires that the maximum exposure over 1,000 years must be considered. The critical group for OU-1 is a construction worker. The critical group for OU-2 is a resident adult.

Table 3: FUSRAP-related Radionuclide Preliminary Remediation Goals in Soil[a,b]

Radionuclide	Units	OU-1	OU-2	Average Background
Ra-226[c]	pCi/g	9.1	3.6	0.941
Th-230	pCi/g	35	16	0.878
Th-232[d]	pCi/g	6	3.6	0.987
U-238	pCi/g	190	150	1.27
Total U[e]	pCi/g	400	360	3.8

[a] Values represent minimum of RESidual RADioactivity Computer Code (RESRAD) calculated PRG at years 0, 185, or 1,000 (year of peak dose per nuclide group).
[b] Groundwater was not considered a drinking water source during development of these values. The cleanup goals are based on a dose of 25 millirems per year TEDE for each radionuclide. Since there are four COCs, a sum of ratios approach must be used to ensure the total dose for all four together does not exceed 25 millirems. The sum of ratios is calculated by dividing each soil radionuclide concentration, adjusted for background, by the cleanup goal and then adding them together. A number greater than 1 indicates unacceptable radiological dose. See the FSA for more information.

[c] PRGs for Ra-226 include Pb-210 contribution to dose at time 0.
[d] PRGs for Th-232 include Ra-228 and Th-228 contribution to dose at time 0.
[e] PRGs for total uranium include contribution to dose from U-234, U-235, and U-238.

OU = operable unit
Pb = lead
PRG = preliminary remediation goals
Ra = radium
Th = thorium
U = uranium

SUMMARY OF REMEDIAL ALTERNATIVES

This section summarizes remedial alternatives developed in the *Former Harshaw Chemical Company Site Feasibility Study Report* (USACE 2012) and the *Former Harshaw Chemical Company Site Feasibility Study Report Addendum* (USACE 2017) to address FUSRAP-related COCs in soil at the Harshaw Site. The USACE selected Alternative 3—Complete Excavation and Off-Site Disposal (OU-1) and Alternative 7—Complete Excavation and Off-Site Disposal (OU-2) as the preferred alternatives.

Alternative 1—No Action (OU-1) and Alternative 5—No Action (OU-2)

Evaluation of the no-action alternative is required under CERCLA regulations to provide a baseline for comparison with other alternatives. Under these alternatives, no remedial action is taken, even though CERCLA (or dose) risk is exceeded. Accordingly, there is no time estimated to complete these alternatives and no cost associated with these alternatives.

Alternative 2—Limited Action and Land Use Controls (OU-1)

Under Alternative 2, no remedial action would occur, bank stabilization would be conducted along the Cuyahoga River, and land use controls would control access to FUSRAP-impacted soil. The bank stabilization would be performed in segments along the Cuyahoga River that are adjacent to FUSRAP-related constituents (see east corner of OU-1 on Figure 1). This technology is designed to minimize potential bank erosion and ecological exposures and impacts on the environment. Land use controls would include environmental covenants applied to the land to restrict future uses of the site where concentrations of radionuclides remain above PRGs. Access control measures would be aimed at limiting access to reduce the potential for human exposure for the critical group (construction worker) to soil located at the site. Access control (fencing) is already in place at the site. Additional access controls, such as additional fencing, would be implemented under this alternative. Although the land use controls would be in place to preclude exposures to the critical group, under this alternative the land could be used for passive recreation (e.g., concrete bike or walking paths), and no full-time maintenance or commercial workers would be at the recreational facility. Informational tools would include posting signs and placing placards to indicate the presence of hazardous substances and warn against intruding the site.

Five year reviews would be required when hazardous substances remain on-site above levels that permit unlimited use and unrestricted exposure (UU/UE). The duration of implementation of Alternative 2 is six months with an initial capital cost of $4,546,000 and a total annual O&M cost of $66,000.

Alternative 3—Complete Removal With Off-Site Disposal (OU-1)

Alternative 3 consists of excavating impacted soil exceeding the PRGs (developed for protection of the construction worker) and off-site disposal to a properly permitted disposal facility. The FUSRAP-related contamination is distributed irregularly in the soil. The soil excavated from OU-1 would be characterized as low activity radioactive waste or as mixed waste. Low activity radioactive waste would be disposed of at a disposal facility without treatment. Mixed waste is impacted with both low activity radiological and inorganic contaminants, and requires treatment prior to land disposal to comply with the Resource Conservation and Recovery Act Land Disposal Restrictions (LDRs). The cost estimate for Alternative 3 includes a conservative assumption that the mixed waste will be shipped off-site for treatment by a mixed waste disposal facility prior to land disposal. As a cost saving measure, the future remediation contractor may choose on-site treatment of mixed waste for the RCRA component and satisfy LDRs for placement into an off-site land based unit. The on-site treatment could eliminate the requirement for the disposal facility to treat the waste and may allow the waste to be accepted directly into a

disposal facility. Confirmatory sampling and site restoration would also take place. Five year reviews would be required when hazardous substances remain on-site above levels that permit UU/UE. Since this action will address only soil impacted by AEC/MED activities, stakeholder coordination would also be required to address non-FUSRAP-impacted soil left on-site. The duration of active remediation for Alternative 3 is 2.5 years with a capital cost of $32,552,000, and annual O&M cost of $9,000.

Alternative 6—Limited Action and Land Use Controls (OU-2)

Under Alternative 6, no remedial action would occur; however, land use controls, access controls, and informational tools would control access to FUSRAP-impacted soil. Land use controls would include environmental covenants applied to the land to restrict future uses of the site where concentrations of radionuclides remain above PRGs. Access control measures would be aimed at limiting access to reduce the potential for human exposure for the critical group (resident) to soil located at the site. Access controls, such as fencing, would be implemented under this alternative. Although the land use controls would be in place to preclude exposures to the critical group, under this alternative the land use could be passive recreation (e.g., concreted bike or walking paths), and no full-time maintenance or commercial workers would be at the recreational facility. Informational tools would include posting signs and placing placards to indicate the presence of hazardous substances and warn against intruding onto the site. The land use control plan, prepared after the record of decision, would detail specific implementation action items.

Five year reviews would be required when hazardous substances remain on-site above levels that permit UU/UE. The duration of implementation of Alternative 6 is six months with an initial capital cost of $2,420,000 and annual O&M cost of $46,000.

Alternative 7—Complete Removal With Off-Site Disposal (OU-2)

Alternative 7 consists of excavating impacted soil exceeding the PRGs (developed for protection of the resident) for OU-2 and disposing of the soil at a properly permitted off-site facility. The soil excavated from OU-2 would be characterized as low activity radioactive waste or as mixed waste. Low activity radioactive waste would be disposed of at a disposal facility without treatment. Mixed waste is impacted with both low activity radiological and inorganic contaminants, and requires treatment prior to land disposal to comply with the Resource Conservation and Recovery Act Land Disposal Restrictions.

The cost estimate for Alternative 7 includes a conservative assumption that the mixed waste would be shipped off-site for treatment by a mixed waste disposal facility prior to land disposal. As a cost saving measure, the future remediation contractor may choose on-site treatment of mixed waste for the RCRA component and satisfy LDRs for placement into an off-site land based unit. The on-site treatment could eliminate the requirement for the disposal facility to treat the waste and may allow the waste to be accepted directly into a disposal facility.

Confirmatory sampling and site restoration would also take place. Long-term monitoring of FUSRAP-related contaminated soils, and land use controls would not be necessary after implementation of this alternative since FUSRAP-related COCs would be removed to levels that would meet or exceed the remedial goals.

The site is also expected to reach UU/UE; therefore, five year reviews would not be required. Stakeholder coordination would also be required to address soil to be left on-site. The duration of active remediation for Alternative 7 is 1.5 years with an initial capital cost of $5,910,000. There are no annual O&M costs associated with Alternative 7.

EVALUATION OF ALTERNATIVES

Nine criteria are used to evaluate the different remediation alternatives individually and against each other to select a remedy. This section of the proposed plan profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are discussed below. The feasibility study and feasibility study addendum present this information in greater technicality and detail.

EVALUATION CRITERIA FOR CERCLA REMEDIAL ALTERNATIVES
Overall Protectiveness of Human Health and the Environment determines whether an alternative eliminates, reduces, or controls threats to human health and the environment through institutional controls, engineering controls, or treatment.
Compliance with ARARs evaluates whether the alternative meets cleanup criteria, standards of control, or other requirements from other environmental laws and regulations that pertain to the contamination, or whether a waiver is justified.
Long-Term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
Short-Term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to –30 percent.
State/Support Agency Acceptance considers whether the state agrees with Corps of Engineers' analyses and recommendations
Community Acceptance considers whether the local community agrees with Corps of Engineers' analyses and preferred alternative. Comments received on the proposed plan are an important indicator of community acceptance.

In accordance with the NCP, both threshold criteria (overall protectiveness of human health and the environment, and compliance with ARARs) must be met by any remedial alternative for it to be considered a viable remedy. The five balancing criteria (long-term effectiveness and permanence; short-term effectiveness; reduction of toxicity, mobility, and volume through

treatment; implementability; and cost) represent the primary criteria upon which the detailed analysis is based.

Table 4 summarizes the comparative analysis of the six remedial alternatives. The USACE preferred alternatives for OU-1 and OU-2 are shaded gray in this table.

Table 4: Summary of Evaluation of Alternatives

Criteria	OU-1			OU-2		
	Alternative Number					
	1	2	3	5	6	7
Threshold Criteria						
Overall Protection of Human Health and Environment (Protective or Not Protective)	No	Yes	Yes	No	Yes	Yes
Compliance with ARARs (Compliant or Not Compliant)	No	Yes	Yes	No	Yes	Yes
Balancing Criteria						
Long-Term Effectiveness and Permanence	Low	Moderate	High	Low	Moderate	High
Reduction of Toxicity, Mobility, or Volume	None	None	None	None	None	None
Short-Term Effectiveness	High	High	Moderate	High	High	Moderate
Implementability	NA	Low	High	NA	Low	High
Cost (thousands of dollars)[a]						
Total Capital Cost	$0	$4,546	$32,552	$0	$2,420	$5,910
Total Operation & Maintenance Cost (Nondiscounted)[b]	$0	$58,649	$8,078[d]	$0	$40,396	$0
Total Nondiscounted Cost	$0	$63,196	$40,630	$0	$42,816	$5,910
Total Operation & Maintenance Cost (Discounted)	$0	$1,640	$232	$0	$1,230	$0
Total Present Worth Cost[c]	$0	$6,186	$32,784	$0	$3,650	$5,910

[a] All costs presented here in thousands (i.e., $66 = $66,000).
[b] Total operations and maintenance costs for the 1,000 year period.
[c] Assumes full funding is available and includes remedial action and closeout.
[d] For Alternative 3, the operation and maintenance costs are for five year reviews including a contingency
NA—Criteria not applicable

The remaining two of the nine CERCLA criteria (state acceptance and community acceptance), referred to as modifying criteria, are typically evaluated following the public comment period on the proposed plan and will be addressed in the responsiveness summary of the record of decision. A discussion of the alterative evaluations is listed below.

1. Overall Protection of Human Health and the Environment

Alternatives 1 and 5 do not provide increased protection over the current site conditions and would not be protective of human health and the environment over the long term for foreseeable future land uses. They are therefore eliminated from consideration under the remaining eight criteria. Alternatives 2, 3, 6, and 7 all effectively prevent exposure to FUSRAP-related COCs above PRGs.

2. Compliance with ARARs

Alternatives 2, 3, 6, and 7 all comply with the ARARs since they would prevent exposure to FUSRAP-related COCs above the ARAR-based PRGs.

3. Long-Term Effectiveness and Permanence

Alternatives 3 and 7 would remove, for permanent off-site disposal, all FUSRAP-impacted soils above ARAR-based PRGs, which promotes long-term effectiveness. Alternatives 2 and 6 provide slightly less permanence, since FUSRAP-related materials remain above ARAR-based PRGs on-site, and land use controls are required for the remedy to remain protective in the long term.

4. Reduction in Contaminant Volume, Toxicity, or Mobility through Treatment

None of the alternatives provide effective reduction in volume, toxicity, or mobility through treatment. However, waste minimization practices during excavation (radiological scanning and sorting) under Alternatives 3 and 7 may reduce the volume of soil requiring off-site disposal. Potential treatment of characteristically hazardous waste, as required for disposal purposes, may reduce the toxicity of soils and mobility of COCs.

5. Short-Term Effectiveness

Alternative 6 does not create any additional short-term risk. The installation of riverbank protection in Alternative 2 creates a small amount of short-term risk to on-site workers. The excavation and transportation of soil in Alternatives 3 and 7 creates potentially greater risk to workers and the public; however, these risks can be mitigated through well-established safe work practices.

6. Implementability

Alternatives 3 and 7 are easily implementable and involve routine equipment and procedures. Alternatives 2 and 6 involve more complicated legal and administrative actions with multiple site owners and stakeholders.

7. Cost

Table 5 summarizes alternative costs and other vital statistics for the remediation alternatives. The USACE preferred alternatives for OU-1 and OU-2 are shaded gray in this table.

Table 5: Vital Statistics for Remediation Alternatives

Estimate or Projection	OU-1			OU-2		
	Alternative Number					
	1	2	3	5	6	7
Total soil to be excavated (*in situ*) (yd^3)	0	0	10,195	0	0	808
Total debris (pavement and foundations) to be excavated (yd^3)	0	0	1,654	0	0	269
Total material shipped off-site (*ex situ*) (yd^3)[b]	0	0	5,178	0	0	538
Duration of active remedial action	0	6 months	2.5 years	0	6 months	1.5 years
Nondiscounted Costs						
Capital cost	$0	$4,546	$32,552	$0	$2,420	$5,910
Total operations & maintenance cost[c]	$0	$58,649	$8,078	$0	$40,396	$0
Total cost[d]	$0	$63,195	$40,630	$0	$42,816	$5,910
Discounted Costs						
Total operations & maintenance cost[c]	$0	$1,640	$232	$0	$1,230	$0
Total cost[d]	$0	$6,186	$32,784	$0	$3,650	$5,910

[a] All costs presented here in thousands (i.e., $66 = $66,000).
[b] The total material shipped off-site is only a portion of the total soil excavated. The volumes are estimated for planning purposes. The reduction in waste volume is based on assumed application of methods to reduce waste volume (radiological scanning and sorting).
[c] Total operations and maintenance costs for the 1,000 year period.
[d] Assumes full funding is available and includes remedial action and closeout.

The total present worth or discounted cost for Alternatives 2 and 6 (limited action and land use controls) are less than the cost of Alternatives 3 and 7 (complete removal); however, the total nondiscounted costs for Alternatives 2 and 6 are greater than the total nondiscounted costs for Alternatives 3 and 7. Alternatives 1 and 5 (No Action) have no costs associated with them.

8. State/Support Agency Acceptance

State/agency acceptance of the preferred alternatives will be evaluated after the public comment period ends and will be considered in the record of decision for the site.

9. Community Acceptance

Community acceptance of the preferred alternatives will be evaluated after the public comment period ends and will be considered in the record of decision for the site.

PREFERRED ALTERNATIVE

The USACE has selected Alternatives 3 and 7, Complete Removal with Off-Site Disposal, as the preferred alternatives to address FUSRAP-impacted soils in OU-1 and OU-2, respectively. These alternatives satisfy the two CERCLA threshold criteria of protectiveness and compliance with ARARs. Alternatives 3 and 7 provide long-term effectiveness and permanence and are easily implemented. Waste minimization practices may be used under Alternatives 3 and 7 to reduce the volume of contaminated soil requiring disposal. Risks associated with Alternatives 3 and 7 can be mitigated through safe work practices.

Implementation of Alternatives 3 and 7 involves the complete excavation of FUSRAP-impacted soils exceeding the respective alternative's ARAR-based PRGs, transportation and off-site disposal of soils, confirmatory sampling, and site restoration. Five year reviews are required for Alternative 3 but not required for Alternative 7 since the ARAR-based PRGs for OU-2 are based on residential use and would allow for UU/UE.

Given the information currently available, USACE believes Alternatives 3 and 7, Complete Removal with Off-Site Disposal, meet the threshold criteria and provide the best balance of tradeoffs among the other remedial alternatives with respect to the balancing and modifying criteria. USACE expects Alternatives 3 and 7 to satisfy CERCLA §121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element, or explain why the preference for treatment will not be met.

REFERENCES

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USACE 2018. *Feasibility Study Addendum for the Harshaw Site*. September.

Tear off sheet

Dear Buffalo District FUSRAP Team:

I would like to provide you with the following comments on the Proposed Plan for the Harshaw Site:

Submitted by:

Name: _____

Organization: _____

Address: _____

_____

E-mail: _____

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Please
Affix
First
Class
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Special Projects Branch
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