# Proposed Record of Decision Amendment
# WEST LAKE LANDFILL SUPERFUND SITE
**Bridgeton, St. Louis County, Missouri**

**U.S. Environmental Protection Agency, Region 7, Lenexa, Kansas** **February 6, 2018**

## 1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) invites the public to review and comment on this proposed plan to amend the Record of Decision (ROD) for Operable Unit 1 (OU-1) of the West Lake Landfill Superfund Site (Site) in Bridgeton, Missouri. The Site is an approximately 200-acre, inactive solid waste disposal facility (Figure 1). OU-1 addresses risks associated with radiologically contaminated soil and landfilled wastes at the Site. This proposal announces the EPA's preferred alternative that will amend the ROD for OU-1. This proposed plan provides the rationale for this preference and includes summaries of the other cleanup alternatives evaluated.

In May 2008, the EPA issued a ROD selecting a cap-in-place remedy for the radiological portions of the Site that comprise OU-1. As a result of stakeholder and community concern following the 2008 ROD, the EPA determined that further evaluation of remedial alternatives was warranted and required the Potentially Responsible Parties (PRPs) to prepare a Supplemental Feasibility Study (SFS) to further evaluate the off-site, as well as, on-site disposal of all Radiologically Impacted Material (RIM). In February 2012 EPA Region 7 consulted with the National Remedy Review Board (NRRB) regarding the updated remedial alternatives. The NRRB was established to help control remedy costs and to promote consistent and cost-effective remedy decisions. Based upon comments generated during that consultation, the EPA determined that additional studies were necessary, including additional characterization of RIM and further consideration of full and partial excavation scenarios. Between 2012 and 2016, the EPA required the collection of additional data and completion of various studies to support the basis for evaluation of the 2008 ROD. The resulting additional information is contained in the Remedial Investigation Addendum (RIA) and Final Feasibility Study (FFS) reports. These reports along with other key documents are part of the Administrative Record (AR) file for the Site.

RIM has been identified in several locations at the Site; Area 1, Area 2, Buffer Zone and Lot 2A2 (Figure 2). The 2008 ROD selected the presumptive remedy of containment as the remedy, consistent with the EPA's

### MARK YOUR CALENDAR

**PUBLIC COMMENT PERIOD:**
February 6 – March 22, 2018

The EPA will accept written comments on the Proposed Plan during the public comment period.

The public may submit comments via email to: **R7_WestLakeLandfillPublicComments@epa.gov**; or submit written comments to:
**Benjamin Washburn**, Office of Public Affairs,
EPA Region 7, 11201 Renner Boulevard,
Lenexa, KS 66219

**PUBLIC MEETING:**
March 6, 2018
6:00 PM-9:00 PM

The EPA will hold a public meeting to explain the proposed plan. Oral and written comments will also be accepted at the meeting. The meeting will be held at the District 9 Machinists Hall, 12365 St Charles Rock Road, Bridgeton, Missouri. The EPA will provide a brief presentation, followed by the public comment session beginning at 6:30 pm.

**What is RIM?**

Leached barium sulfate residues were a byproduct of uranium ore processing for the Manhattan Engineering District and the U.S. Atomic Energy Commission (AEC). This radioactive material was brought to and used at the Site as cover for landfill waste and subsequently impacted other waste materials in the landfill. Resulting radioactive contamination exceeding certain criteria based on UMTRCA standards is referred to as **radiologically impacted materials** or RIM.

**What is UMTRCA?**

The **Uranium Mill Tailings Radiation Control Act** is a federal law that provides for the safe and environmentally sound disposal, long-term stabilization, and control of uranium mill tailings in a manner that minimizes or eliminates radiation health hazards to the public. The EPA has cited these regulations as relevant and appropriate requirements because the RIM present at the Site is similar to mill tailings (contains isotopes of radium, thorium, and uranium).

**What is PTW?**

**Principal threat wastes** are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposures occur. The EPA expects to use treatment to address threats posed by principal threat waste whenever possible. The National Contingency Plan (NCP) recognizes that there may be situations where wastes identified as constituting a principal threat may be contained rather than treated due to difficulties in treating the wastes.

**Radioactive Contaminants?**

The primary contaminants at the Site are radioactive, and include the isotopes Radium-226, Thorium-230, and Uranium-238. There are three types of radiation: alpha, beta, and gamma. All of the primary site contaminants emit alpha radiation, which are most harmful if inhaled or ingested. Radium-226 also emits gamma radiation which can cause harm to the whole body without direct contact. The potential for harm from gamma radiation is decreased as the distance from the source increases.

Presumptive Remedy Guidance for CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) Municipal Landfill Sites, along with specification that the cover design would be enhanced to meet the UMTRCA standards. Since the SFS, additional data has been collected to further characterize the nature and extent of RIM at the Site, including testing that confirms RIM has the potential to leach under certain circumstances. Based upon the additional information collected and studies performed since 2008, the EPA has determined that the West Lake Landfill is not a typical municipal landfill due to the presence of PTW, the toxicity of the RIM, and the increasing risks due to radioactive decay. Excavation of hot spots is practicable and would result in a significant reduction in the long-term threat posed by the Site. Therefore, based on new information collected since 2008, the EPA no longer considers the presumptive remedy of containment alone to be appropriate for the Site and is proposing to amend the ROD for OU-1 from a cap-in-place containment remedy to an excavation of RIM at concentrations greater than 52.9 pCi/g (radium-226 + radium-228 or thorium-230 + thorium-232) down to a depth of 16 feet (below the 2005 ground surface). Following excavation of the RIM, a low permeability engineered cover will be constructed to meet more stringent cover design criteria and UMTRCA standards to limit radon releases, protect groundwater, and be effective for at least 200 to 1,000 years. Because thorium is present at higher levels than radium at the Site, concentrations of radium will increase due to radioactive decay. Estimates for the maximum concentrations of radium -226 due to this ingrowth (approximately 9,000 years) have been considered in the conceptual design of the cover to ensure protectiveness in the future. The engineered cover will also be designed consistent with the recommendations in the EPA's guidance for final covers on hazardous waste landfills in order to ensure the performance standards in UMTRCA can be met. RIM located at depths greater than 16 feet, regardless of concentration, will be left in place. The preferred alternative also includes institutional controls, long term surveillance and maintenance, and groundwater monitoring. Because some RIM would remain at the Site, 5-year review evaluations would be required. The preferred alternative will take

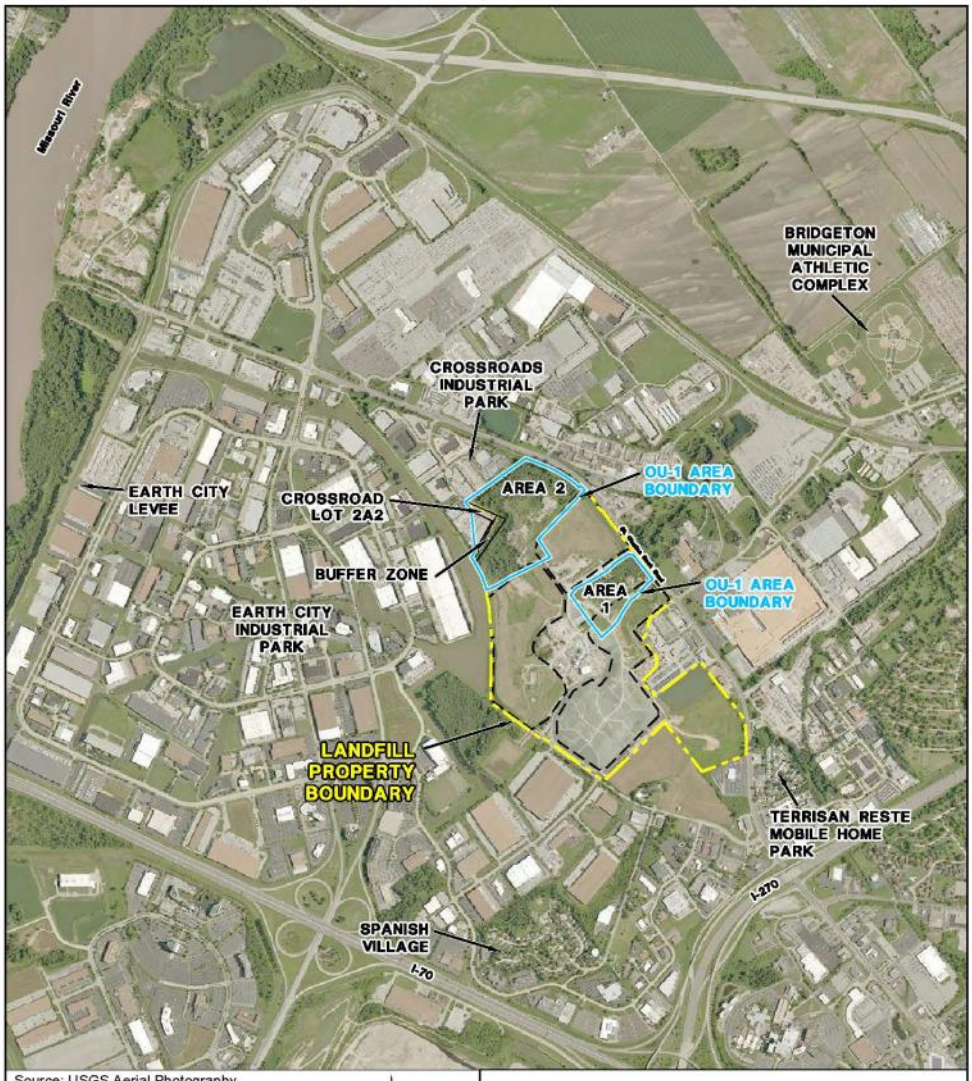
5 years to fully implement at an estimated cost of $236,000,000. The EPA has identified this preferred alternative over 7 others that were evaluated in the RIA/FFS — including no action, two cap-in-place alternatives, and five excavation alternatives — each of which is described in greater detail below. The EPA believes that this preferred alternative is protective and represents the best balance of the criteria prescribed by the CERCLA, as amended, and the NCP.

The EPA is issuing this proposal as part of its public participation responsibilities under Section 117 of CERCLA and 40 C.F.R. 300.435(c)(2) of the NCP. This proposal is intended to inform the community of the EPA's preferred alternative and to solicit public comments relating to the remedial alternatives evaluated, including the preferred alternative. The final decision to amend the ROD will be made after consideration of the comments received and any new information raised during the public comment period. Therefore, the public is encouraged to review and provide comment on all remedial alternatives.

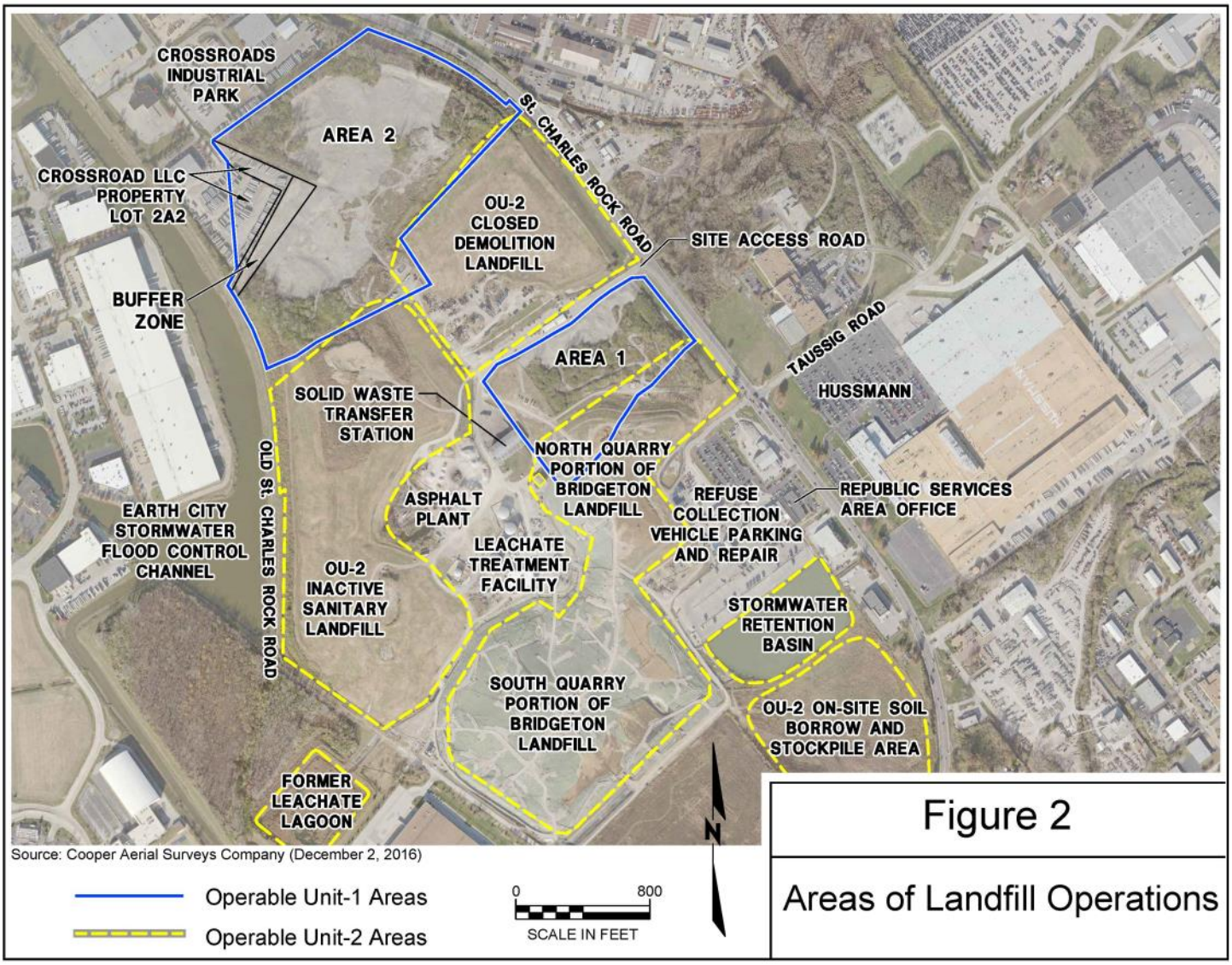
The Administrative Record file, including the RIA/FFS reports, is available on the EPA's website at https://semspub.epa.gov/src/collections/07/AR/MOD079900932. The EPA encourages members of the public to review these documents to obtain facts about the Site and the activities that have been conducted as part of the Superfund process.

## 2.0 BACKGROUND

The West Lake Landfill Superfund Site is an approximately 200-acre, inactive solid waste disposal facility located in Bridgeton, Missouri (Figure 1). The site was used agriculturally prior to 1939 when the limestone quarrying and crushing operation began. Beginning in the early 1950s, the quarried areas and adjacent areas were used for landfilling municipal refuse, industrial solid wastes, and construction/demolition debris. Two areas of the Site were radiologically contaminated in 1973 when 39,000 tons of (potentially contaminated) surface soil mixed with 8,700 tons of radioactive leached barium sulfate residues were reportedly stockpiled at the Site and used for landfilling operations.




The U.S. Nuclear Regulatory Commission (NRC), as successor to the AEC, performed and/or commissioned multiple site investigations in the 1970s and 1980s to identify radiological




portions of the Site and investigate potential remedial measures. The EPA placed the Site on the Superfund National Priorities List (NPL) in 1990. From 1994 to 2008, a group of PRPs performed several investigations and monitored surface water, sediment, groundwater, and air at the Site. These evaluations were summarized in the Remedial Investigation (RI) and Feasibility Study (FS) reports and considered by the EPA in the development of the June 12, 2006 proposed plan for OU-1.

In May 2008, the EPA issued a ROD for OU-1 of the Site. The major components of the ROD-selected remedy included installation of a landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills, including enhancements such as an armoring layer and radon barrier consistent with standards for uranium mill tailing sites. As part of the remedy, surface soils from the Buffer Zone and Lot 2A2 of the Crossroads Industrial Park, radiologically contaminated as a result of migration to adjacent properties through erosion, were to be consolidated into the containment area. In addition, monitoring and control of groundwater, surface water runoff, and radon and decomposition gases were to be implemented. Institutional controls and long-term surveillance were to be required to ensure appropriate future land use and ongoing maintenance of the remedy.

After issuance of the 2008 ROD, in response to significant public and other stakeholder input and concerns, the EPA determined that further evaluation of the remedial alternatives was warranted. In January 2010 the EPA directed the PRPs to perform the SFS. The SFS was completed in 2011 and evaluated two full excavation of RIM alternatives; one with disposal off-site and the other with disposal in an on-site engineered cell.

After completion of the SFS and consultation with the EPA's NRRB, the EPA required further investigations and evaluations of conditions and risks at the Site. Developing new Site conditions also led the EPA to direct additional Site investigations and response actions, each of which is summarized below.

### 2.1 Subsurface Heating Event

In December 2010, Bridgeton Landfill, LLC, detected changes in its landfill gas extraction system that indicated the presence of an exothermic (heat-generating) subsurface chemical reaction in the southern portion of Bridgeton Landfill. This reaction produces effects such as odors, elevated temperatures, and excess carbon monoxide. Due to the proximity of the Bridgeton Landfill to Area 1 and community concern, the EPA conducted a series of actions in addition to actions taken under regulatory authority and oversight of the Missouri Department of Natural Resources (MDNR):

- 2013 - Conducted an aerial radiological and infrared survey of the Site
- 2014 - Directed the PRPs to prepare a qualitative evaluation of the potential impacts of the subsurface exothermic event on OU-1
- 2015 and 2016 - Developed and conducted pyrolysis testing to evaluate the potential impacts of a subsurface heating event contacting RIM
- 2016 - Pursued enforcement actions which resulted in the installation of a heat extraction system, additional temperature monitoring probes, and an ethylene vinyl alcohol (EVOH) cover over large portions of the North Quarry

### 2.2 Groundwater Monitoring and Evaluation

The EPA required additional groundwater sampling to supplement data previously collected and presented in the original RI and FS. Between 2012 and 2014, over 300 groundwater samples from approximately 80 monitoring wells were collected and analyzed for multiple contaminants including: thorium, uranium, and radium isotopes, trace metals, volatile and semi-volatile organic compounds. The EPA partnered with the U.S

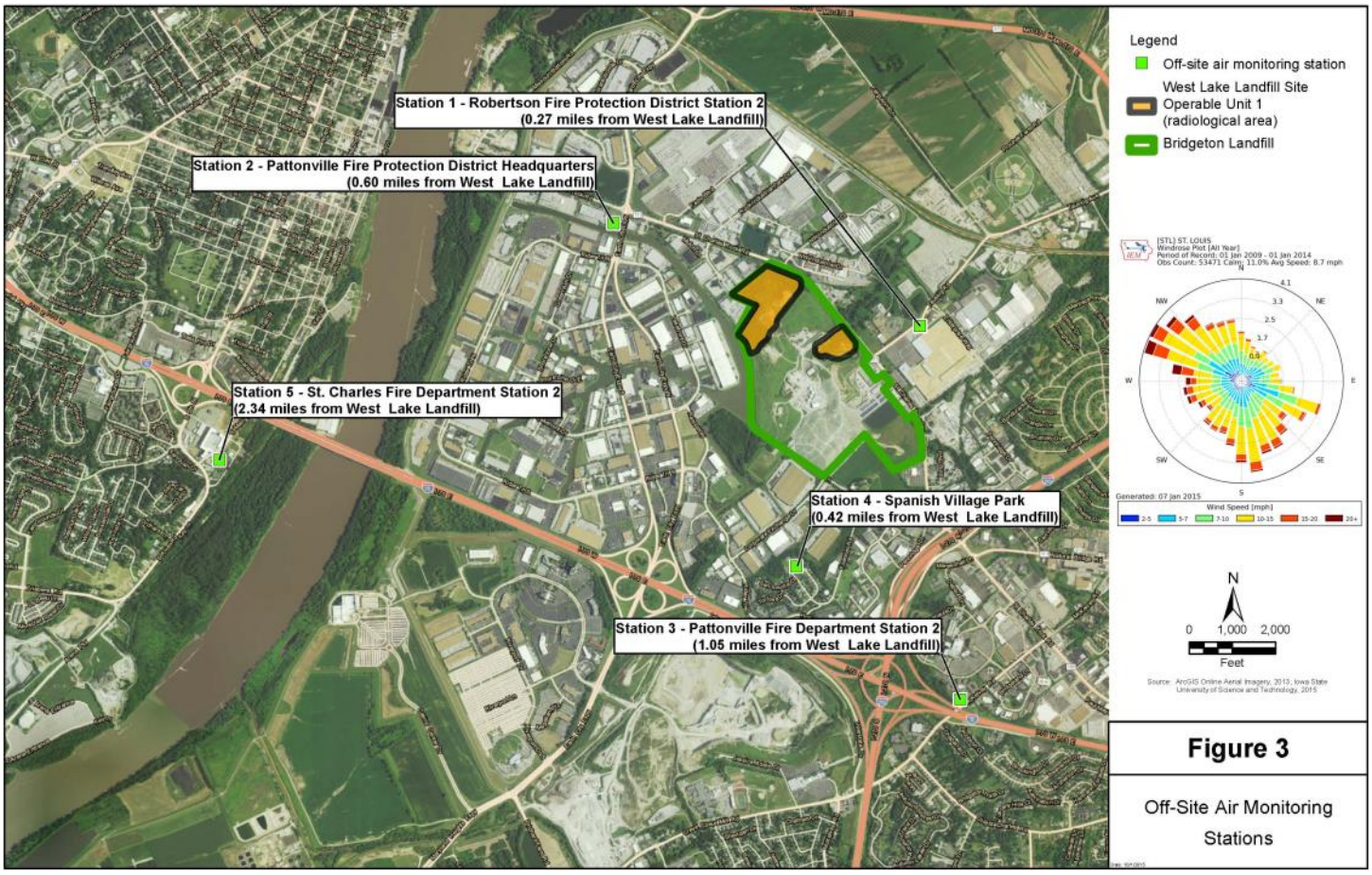



**Figure 3**

Off-Site Air Monitoring Stations

Geological Survey (USGS) to further characterize groundwater in and around the Site. The resulting USGS report found landfill leachate effects in 47 of 83 of the on-site wells, and 13 of these wells had an average dissolved combined radium ranging between 5.1 picoCuries per liter (pCi/L) to 26.7 pCi/L, which is above its drinking water Maximum Contaminant Level (MCL) of 5 pCi/L. However, the USGS report did not conclude the source of radium identified in those wells. Based in part upon these findings, the EPA determined that additional investigation of groundwater was necessary, and designated groundwater as Operable Unit 3 for the Site. As a separate action, the EPA is initiating this additional work to investigate the extent and nature of groundwater contamination.

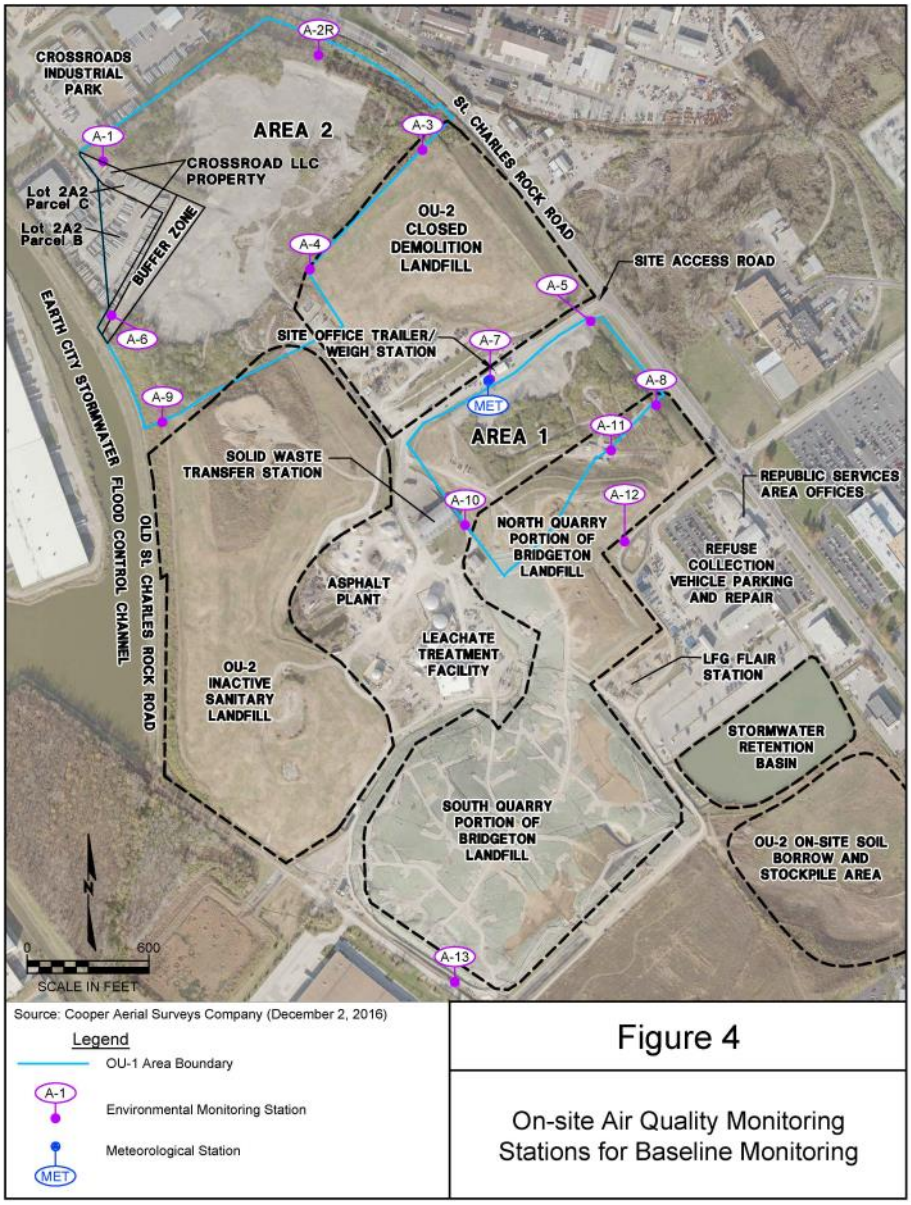



Figure 4

On-site Air Quality Monitoring Stations for Baseline Monitoring

### 2.3 Off-site Investigations

In response to public concerns, the EPA investigated potential off-site impacts at two locations near the Site. In May 2014, the EPA evaluated potential exposure to off-site receptors (e.g., park visitors and on-site workers) at the Bridgeton Municipal Athletic Complex (BMAC), which lies approximately one mile northeast of the Site (Figure 1). No radionuclides were found above levels of concern for human health during the investigation at BMAC, and the EPA announced that the facility is suitable for public use and does not warrant further environmental response (U.S, EPA, 2014). In December 2016, the EPA screened areas within and around two homes located in the Spanish Village residential subdivision, located approximately one mile southwest of the Site (Figure 1). Exterior soil samples and interior surface and bulk dust samples were collected. Soil sampling results were within normal background ranges for the analyzed radionuclides, and the results of interior wipe sampling were below the EPA's residential screening levels (U.S.EPA, 2017). As a result, the EPA determined that further action under CERCLA was not warranted.

### 2.4 Air

Radon gas and particulates can be emitted from the Site into the atmosphere as a result of the RIM present at the Site. From 2014 to 2015, the EPA performed air monitoring at five off-site stations, four in the vicinity of the Site and one background station in St. Charles, Missouri (see Figure 3). Monitoring data from all locations were consistent with urban background. Starting in 2015, the EPA required the PRPs to perform on-site monitoring at 13 locations (Figure 4). Levels of radon measured on-site by the PRPs (<0.4 pCi/L to 0.7pCi/L) were similar to levels measured at the EPA's off-site reference location in St. Charles, Missouri (median of 0.3 pCi/L) and below the UMTRCA standard (40 CFR 192.02) of 0.5 pCi/l above background at the


Site boundary.

The EPA's off-site air monitoring as well as the PRP's on-site monitoring included fugitive dust sampling. The gross alpha (and gross beta concentrations) from the PRP's on-site monitoring tended to be higher than the levels measured at the EPA's off-site reference station; however, concentrations of radium-226, thorium-230, and uranium-238 from the PRP's on-site monitoring tended to be lower than the levels measured at the EPA's off-site reference station. On-site monitoring is ongoing and ensures coverage under all wind directions.

Landfill related odors have been examined for the Site. Odors were exacerbated by the presence of the subsurface heating event in the South Quarry of Bridgeton Landfill. Based upon the results of investigations, it has been determined that the compounds responsible for the odors are total reduced sulfur compounds. MDNR air monitoring data in the area surrounding the landfill indicate that levels of total reduced sulfur compounds have decreased since 2013, coinciding with the completion of the EVOH cover and installation of additional landfill gas extraction wells at Bridgeton Landfill.

### 2.5 Surface Fire

A brush fire occurred on a portion of OU-2 in 2015. In response, the EPA directed the PRPs to develop and implement surface fire prevention measures in OU-1. This resulted in the placement of a rock layer and geo-textile fabric over surface RIM in Area 1 and Area 2 as an interim action until a final remedy is implemented. In addition, the EPA required the PRPs to coordinate with local first responders to develop and fully implement a site-specific Incident Management Plan for OU-1.

### 2.6 Stormwater and Sediment Sampling

In 2016, the EPA directed the PRPs to conduct stormwater sampling. More than 60 stormwater samples have been collected and analyzed for landfill contaminants, uranium, radium, and thorium isotopes (Figure 5). All

results obtained to date (ranging from non-detect to 2.907 pCi/L for thorium-230, non-detect to 2.967 pCi/L for radium-226 and non-detect to 62.652 ug/L for total uranium) are below the site-specific preliminary screening levels which the EPA calculated for exposure to stormwater at the Site for a trespasser scenario (342.5 pCi/L for thorium, 10.2 pCi/L for radium and 131 ug/L for uranium). The PRPs, the EPA, and the MDNR have collected and analyzed sediment samples from multiple locations near the perimeter of the Site (Figure 5). While one of the collected samples met the definition of RIM, confirmation sampling at and around that location did not detect RIM. The EPA continues to require stormwater monitoring at the Site; however, based upon current data, stormwater does not pose an unacceptable risk to public health.

### 2.7 Additional RIM Characterization

The EPA directed the PRPs to perform field investigations between 2013 and 2016 to further characterize the location and levels of RIM in OU-1, and to inform decisions on how to address the subsurface heating event in the South Quarry of the Bridgeton Landfill. These field investigations included collection of additional samples for laboratory analysis and additional field screening such as, downhole gamma logging and gamma and alpha scanning of core material. All laboratory data and field screening data were used to estimate the extent and volume of RIM. The risk estimates provided in the Baseline Human Health Risk Assessment (BRA) and the FFS considered laboratory data only. Notably, RIM was identified southwest of previously identified RIM locations under a portion of the North Quarry of the Bridgeton Landfill. Above grade solid wastes were placed in this location as late as 2004 as a part of the closure activities in the North Quarry. At the EPA's direction, the investigation was expanded to define the extent of RIM in southern portions of Area 1. The investigation included a total of 104 new boring and Gamma Cone Penetration Testing (GCPT) locations. In 2015, 26 borings were drilled; seven borings in Area 1 and 19 borings in Area 2. Ten direct push soil borings were drilled to support landfill studies, including leaching tests on RIM.

## 3.0 SITE CHARACTERISTICS

The Site lies approximately 18 miles northwest of downtown St. Louis within 2 miles of the St. Louis Lambert International Airport. The Missouri River is located approximately 2 miles west of the Site, which is situated on the eastern boundary of the river's alluvial floodplain. Residential properties are located within one mile of the Site. Industrial properties exist both on and adjacent to the Site, and commercial properties almost completely surround its perimeter.

RIM is located in two landfill disposal areas known as Areas 1 and 2, as well as, in two parcels of industrial property referred to as the Buffer Zone and Lot 2A2 of the Crossroads Industrial Park (Figure 2). The RIM within Areas 1 and 2 consist of soils containing radium and thorium isotopes that have impacted other municipal solid waste, industrial waste, and construction and demolition debris as the landfill has aged over more than 40 years. These waste materials contain other non-radionuclide contaminants such as trace metals and volatile organic compounds. Historical soil erosion from sloped portions of Area 2 is believed to have caused the deposition of radionuclides observed on the surface of the Buffer Zone and Lot 2A2 of the Crossroads Industrial Park.

The placement of contaminated soil over the top of compacted but uneven landfill waste has resulted in relatively discontinuous layers of variable thickness of RIM. The ultimate location of RIM was also likely impacted by the subsequent placement and compaction of wastes and cover soil, as well as, more than 40 years of decomposition, consolidation, and differential settlement of municipal solid waste and other soil materials. These factors have resulted in irregular occurrences of radionuclides within the larger overall matrix of landfilled refuse, debris, fill material, and quarry spoils in Areas 1 and 2.

While the general nature of radiological contamination is comparable between Areas 1 and 2, the spatial and volumetric distribution of RIM in these areas is distinct, and other specific site conditions also vary. There are a variety of appropriate methodologies to estimate the nature and extent of contamination at any Superfund site. The volume estimates presented in this proposed plan were based on a geostastistical analysis (kriging)

Figure 6

Area 1 Image from the 3D Geostatistical Model

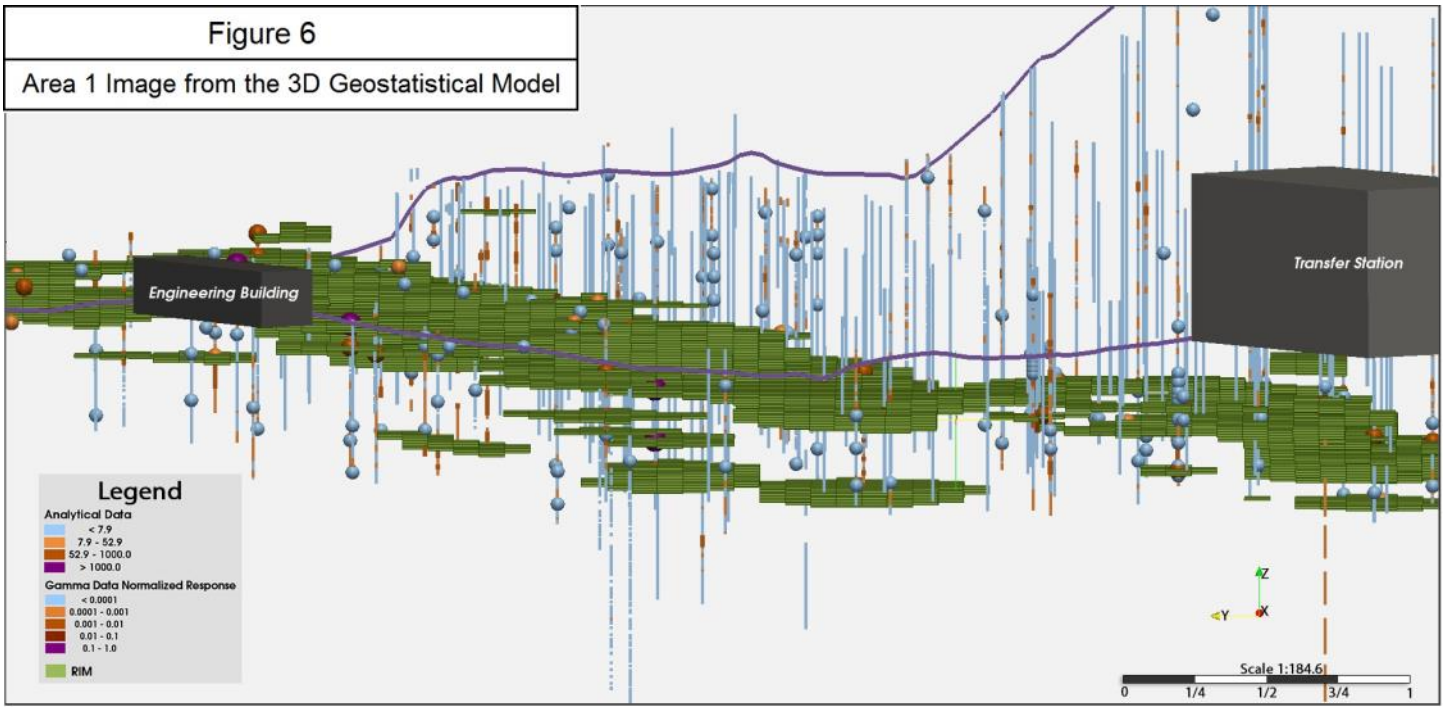
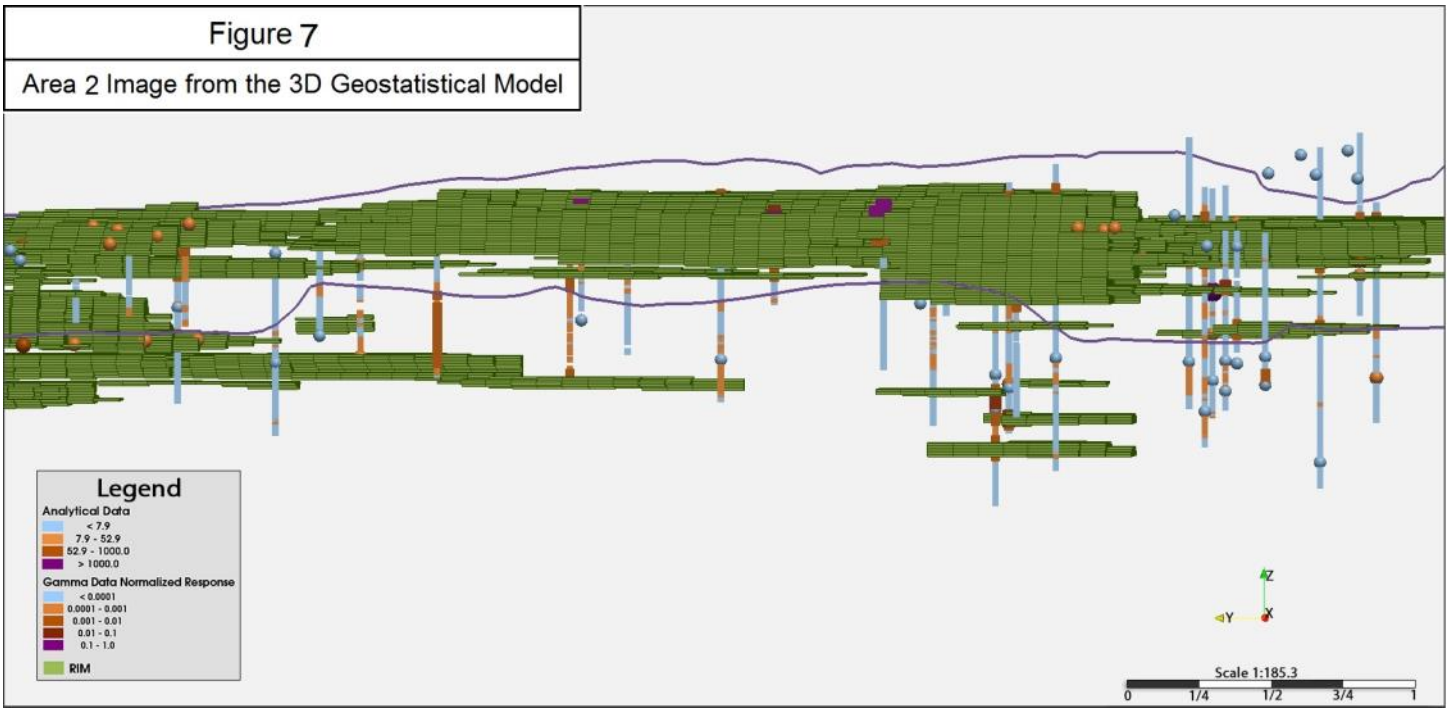



Figure 7

Area 2 Image from the 3D Geostatistical Model




A 3-D Geostatistical Model was used to estimate RIM volumes in Area 2 (SSP&A, 2017). The green blocks in the figure above depict an estimate of the RIM present in OU-1. The blocks have a side length of 5 meters and a thickness of 6 inches. The vertical bars represent borings that were collected from the various investigations performed at the Site. The size and color of the spheres represent analytical lab results. Note that a vertical exaggeration of 3 is used to help visualize this information.

of all data collected at the Site. As with any Superfund site, some uncertainty with the precise location and volume of contamination is typical at this point in the remedial process. The site has been sufficiently characterized to compare the alternatives and make a final remedy decision. As a part of the remedial design process, additional characterization of RIM locations and volume may need to be performed.

Area 1 encompasses approximately 17.6 acres in total and approximately 8.4 acres are impacted by radionuclides. The total volume of RIM in Area 1 is estimated at 58,700 cubic yards ($yd^3$) in place. RIM has been identified at depths ranging from 0 to 89.4 feet below ground surface (ft bgs) (Figure 6). The depth of RIM relative to the ground surface is greater in Area 1 than in Area 2 because solid wastes were placed above ground surface in this location as late as 2004, as described in Section 2.7 above. Area 1 is situated above bedrock deposits adjacent to the North Quarry of the Bridgeton Landfill. Portions of Area 1 are within 10,000 feet of the nearest runway at the St. Louis Lambert International Airport and closer to residential areas near the Site.

Comparatively, the total volume of RIM in Area 2 is greater and is estimated at 251,000 $yd^3$ in place. The total surface area of Area 2 is approximately 41.8 acres, of which approximately 26.8 acres are impacted by radionuclides. RIM has been identified in the sub-surface at depths ranging from 0 to 42.5 ft bgs (Figure 7). Area 2 is located above alluvial deposits and is located closer to the Missouri River. This radiological area is located further from residential properties and is greater than 10,000 feet away from St. Louis Lambert International Airport

The EPA has determined that radioactive contamination present in OU-1 at concentrations above 52.9 pCi/g may represent PTW. Elevated thorium and radium concentrations indicate high toxicity, and radioactive decay of thorium to radium will produce higher levels of gamma radiation and radon gas in the future. In addition to high radioactivity and anticipated ingrowth, laboratory analyses demonstrate that radionuclides have the potential to leach from radioactive contamination under certain conditions, and could migrate to groundwater.

## 4.0 SCOPE AND ROLE OF THE RESPONSE ACTION

The Site has been divided into three operable units. As described above, OU-1 consists of areas at the Site where radioactive contamination has been identified within surface soil and subsurface solid waste. The remaining area of the Site is designated as OU-2, which consists of several inactive landfills that contain sanitary waste or demolition debris. The EPA has designated OU-3 to address potential groundwater contamination at the Site. The EPA is the lead agency for OU-1 and OU-3, while oversight of OU-2 (with the exception of the Inactive Sanitary Landfill) has been deferred to the MDNR.

In 2008, the EPA selected remedial actions for OU-1 (areas containing RIM) and OU-2 (areas containing non-radiological wastes). This proposed plan addresses the EPA's proposal to amend the 2008 ROD for OU-1 that addresses the radiological source materials found in Area 1, Area 2, the Buffer Zone, and Lot 2A2 of the Crossroads Industrial Park. A separate remedial investigation will be performed at OU-3 to determine whether potential groundwater contamination may exist as a result of releases which occurred at the Site prior to the implementation of the remedy at OU-1. The remedy for OU-1 will be consistent with the remedy selected for OU-2 and any remedy that may be selected for OU-3.

## 5.0 SUMMARY OF SITE RISKS

A BRA and Screening Level Ecological Risk Assessment (SLERA) were conducted for OU-1 as part of the RI/FS and as a part of the RIA/FFS. These studies were designed to examine the current and potential future effects of the contaminants on human health and the environment. The BRA process evaluates a range of current and potential future exposures assuming that no land use controls are in place to prevent or limit exposure. The BRA identified receptors with potentially complete exposure pathways to contaminated soil, air, and/or external radiation (Table 14, Auxier, 2018 ). It also provides the basis for taking action and identifies the

contaminants and exposure pathways that need to be addressed by the remedial action.

The BRA and SLERA indicate that Chemicals of Potential Concern (COPCs) present within OU-1 pose current potential significant risk to ecological receptors and potential significant future risks to human receptors. COPCs are contaminants that are present at the Site at concentration levels that might be of potential health concern to humans. Radionuclides associated with the uranium and thorium decay series and 13 inorganic constituents were evaluated as COPCs for human health risk.

**5.1 Human Health Risks**

The BRA assessed the cancer and non-cancer health hazards associated with exposure to COPCs present at the Site. The BRA identified thorium-230 and radium-226, including their respective decay products, as the primary Chemical of Concern (COCs). These isotopes and their associated decay products accounted for more than 95% of the risk to the target receptors. Non-radiological COPCs, including lead, were also fully evaluated in the BRA. Exposure to COPCs was evaluated using information about current and the reasonably anticipated future land uses. A summary of potential exposure pathways, including receptors and exposure routes, has been included in the BRA.

**What is EPA's "risk range"?**

Exposures are evaluated based on the potential risk of developing cancer and the potential for noncancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10-4 cancer risk means one additional cancer may occur in a population of 10,000 people as a result of exposure to site contaminants. Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10-4 to 10-6, corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk.

For non-cancer health effects, the EPA calculates a "hazard index." The key concept here is that a "threshold level" (measured usually as a hazard index of less than 1) exists below which non-cancer health effects are no longer predicted. For more information on the EPA's risk assessment process visit www.epa.gov/risk/

The risks related to radioactive materials at the Site will increase in the future due to ingrowth of radium-226 from its parent thorium-230. These risks will increase according to the radioactive decay of thorium and will result in peak risks in approximately 9,000 years. Current risks would exceed the CERCLA risk range for an on-site storage yard worker, but current Site use does not include a storage yard. Current exposure is limited by access restrictions such as fencing in place around Area 1 and Area 2 and the recent placement of a temporary non-combustible cover which reduces radon releases and the potential for particulate migration. To address the UMTRCA disposal standard, estimates of risks were calculated in the BRA and the FFS with 1,000 years of ingrowth. Consistent with the EPA guidance, future risk estimates were developed to determine a reasonable maximum exposure. To ensure that risk estimates are provided that represent a reasonable maximum exposure, a discussion of the effects of the maximum ingrowth (in approximately 9,000 years) have been included in the BRA and the FFS. The timeframes associated with the effects of ingrowth do not specify when in the future the contamination at the Site will pose unacceptable risks.

The following conclusions were reached regarding the human health risks:

- For future human receptors, potential risks to on-site and some off-site receptors exceed the CERCLA cancer risk range of $10^{-6}$ to $10^{-4}$ and a non-cancer hazard of 1 in part because the future no action assumptions do not include the non-combustible cover currently in place (refer to Table ES.1 Summary of Human Health Risks in Auxier 2018).
- Future on-property receptor cancer risks are primarily attributable to direct gamma radiation from radium-226 in OU-1 soil. Future off-property cancer risks are primarily attributable to radon and its daughter products in air.
- For current on-site and off-site human receptors, no risks exceeded the CERCLA cancer risk

range of $10^{-6}$ to $10^{-4}$, and non-cancer hazards were below a hazard index of 1, considering the current site use restrictions.

### 5.2 Ecological Risks

The SLERA indicated that OU-1 COPCs, primarily metals, potentially pose a risk to plants, invertebrates, and wildlife receptors at OU-1 under current conditions. However, because it is anticipated that the surface of the Site will be engineered and properly maintained as required by Federal and State regulations, the Site will not provide suitable habitat for ecological receptors under future conditions. No measurable long-term impacts to plants or animals in surrounding ecosystems are expected from implementation of the remedial alternatives. No wetlands are located within the on-site construction footprint of OU-1 and no endangered species were identified.

### 5.3 Conclusion

The BRA concludes that risks to a future reasonable maximally exposed individual results in a $2x10^{-2}$ cancer risk when considering 1,000 years of radium-226 ingrowth. The maximum reasonably exposed individual will exceed $5x10^{-2}$ when considering 9,000 years of radium-226 ingrowth (maximum ingrowth). These risks exceed the CERCLA risk range, and therefore, action is warranted under CERCLA.

## 6.0 REMEDIAL ACTION OBJECTIVES and PRELIMINARY REMEDIATION GOALS

The EPA developed updated RAOs for OU-1. RAOs serve as the design basis for the remedial alternatives discussed in the following section.

- Prevent direct contact to contaminated media (including waste material, fill, stormwater, sediments, leachate and groundwater) located on or emanating from OU-1.
- Limit inhalation and external radiation exposure from contaminated media (including waste material, fill, leachate, and gas emissions) located on or emanating from OU-1 to within the acceptable risk range ($10^{-4}$ to $10^{-6}$ risk or a Hazard Index of less than 1 for non-carcinogenic risk).
- Minimize water infiltration to prevent contaminants from leaching to groundwater above levels protective for the reasonably anticipated use of the groundwater and surface water
- Control and manage leachate that emanates from OU-1 in accordance with standards identified in the ARARs.
- Control and treat landfill gas from OU-1 including radon in accordance with standards identified in the ARARs.
- Control surface water runoff, and minimize erosion associated with OU-1 in accordance with standards identified in the ARARs.
- Additional RAO for Crossroads Lot 2A2 – Remediate soils to the extent necessary to allow for unrestricted land use.

What are RAOs?

**Remedial action objectives** are specific goals that the remedial alternatives must accomplish to protect human health and the environment from risks posed by the Site.

The definition of RIM is considered a protective cleanup level for the landfill portion of the Site (Area 1 and Area 2). Area 1 and Area 2 contain other waste materials and thus institutional controls including land use restrictions and engineering controls consistent with the closure of a landfill will be required even for the full excavation alternatives. Removal of radioactive materials according to the definition of RIM is expected to leave Area 1 and Area 2 in a condition that would not require additional engineering and institutional controls due to their radiological content even though some residual radioactive material may remain on-site.

The EPA has developed risk based Preliminary Remediation Goals (PRGs) for the cleanup of radiologically contaminated soils in the Buffer Zone and Lot 2A2 based on anticipated future land use (commercial building

user). Those calculated PRGs for the primary contaminants of concern (radium-226, thorium-230, uranium-234, and uranium-238) turn out to be indistinguishable from background. PRGs for residential land use would be more conservative than for a commercial land use; therefore, background based PRGs would allow for unrestricted use (residential) of this portion of the Site. Background has been estimated previously for the Site but is expected to be further evaluated as a part of the remedial action. These background based PRGs are estimated as follows:

- Radium-226 + Radium-228 ≥ 2.9 pCi/g
- Thorium-230 + Thorium-232 ≥ 2.9 pCi/g
- Uranium-238 + Uranium-235 + Uranium-234 ≥ 4.5 pCi/g

Final cleanup levels will be determined in the amended Record of Decision (ROD).

## 7.0 SUMMARY OF REMEDIAL ALTERNATIVES

The remedial alternatives described below are cleanup options that the EPA evaluated to achieve the RAOs for OU-1. They are based upon information currently available in the FFS and the AR. Additional sampling or pilot tests may be conducted as needed to support the remedial design for the alternative that is ultimately selected.

| Summary of Alternatives | |
|---|---|
| 1 | No Action-Required by NCP as a baseline for comparison |
| 2 | Engineered Cover (cap) - Modified 2008-ROD Selected Remedy |
| 3 | Engineered Cover (cap) - UMTRCA Engineered Cover |
| 4 | Excavation of RIM Greater Than 52.9 pCi/g Down 16 Feet Plus Engineered Cover |
| 5 | Excavation of RIM Greater Than 1,000 pCi/g Plus Engineered Cover |
| 6 | Risk Based Excavation of RIM Plus Engineered Cover |
| 7 | Excavation of RIM Greater Than 7.9 pCi/g with Off-Site Disposal in Engineered Cell |
| 8 | Excavation of RIM Greater than 7.9 pCi/g with Disposal in an On-Site Engineered Cell |

The EPA's preferred alternative is Alternative 4 Excavation of RIM Greater than 52.9 pCi/g Down to 16 Feet. A summary of remedial components that are common to all alternatives is provided below, followed by a description of the distinguishing features of each remedial alternative evaluated in the FFS.

### 7.1 Common Elements of Remedial Alternatives

Under all remedial alternatives, a landfill cap will need to be constructed. Institutional controls will be implemented that restrict future land use. All remedial alternatives will require excavation or regrading, and because the Site will still contain solid wastes, they will all require surface water runoff controls, groundwater monitoring, and institutional controls for the existing landfill cells. While on-site disposal in an engineered cell is currently only evaluated in Alternative 8, the EPA is taking comment on on-site disposal in an engineered cell for all excavation alternatives. All radioactive materials sent off-site for disposal may go to one or more of the following permitted sites: U.S. Ecology in Wayne, Michigan; Clean Harbors Deer Trail in Last Chance, Colorado; Energy Solutions in Clive, Utah; or U.S. Ecology in Grand View, Idaho. Under all alternatives, continued protectiveness of the remedy will be ensured by regular 5-year reviews as required by CERCLA, as well as, long-term monitoring and maintenance and proper site management.

All remedial alternatives will address the presence of radiologically-impacted soil in the Buffer Zone and Lot 2A2 of the Crossroads Industrial Park. Radioactive materials present in these areas will either be placed on-site (Areas 1, 2 or on-site cell) and managed under an engineered cover or excavated and sent to an off-site disposal facility, depending on the alternative selected.

Certain mitigation measures will be incorporated into all remedial alternatives involving excavation of existing landfill cells. Due to the Site's proximity to the St. Louis Lambert International Airport, a bird management plan will be implemented during excavation activities to minimize the potential for bird strikes to aircraft. Additionally, daily cover will be applied to excavation areas and stockpiles of excavated waste material to minimize odors, bird risks, windblown debris, and stormwater impacts. The toe of the landfill cover for each alternative will be evaluated during design to meet flood protection needs.

### 7.2 Description of Remedial Alternatives

| Alternative 1 – No Action | |
|---|---|
| Present worth cost with 7% discount: | $0 |
| Estimated Capital Costs: | $0 |
| Annual operations and maintenance cost: | $0 |
| Estimated Construction Time: | NA |
| Estimated Time to Achieve RAOs: | NA |
| Percent of radioactivity removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell: | 0% |
| Volume of RIM removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell (volume of overburden): | 0 $yd^3$ |
| Volume of overburden excavated in order to access RIM for removal: | 0 $yd^3$ |

Alternative 1, The Superfund program requires that a No Action Alternative be considered to provide a baseline against which all the other alternatives are evaluated. The EPA has determined that this alternative does not meet the threshold criteria and is not protective of human health and the environment.

| Alternative 2 – Engineered Cap: Modified 2008-ROD Selected Remedy | |
|---|---|
| Present worth cost with 7% discount: | $71,000,000 |
| Estimated Capital Costs: | $75,000,000 |
| Annual operations and maintenance cost: | $176,000 to $389,000 |
| Estimated Construction Time: | 1.8 years |
| Estimated Time to Achieve RAOs: | 2.8 years |
| Percent of radioactivity removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell: | 0% |
| Volume of RIM removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell (volume of overburden): | 0 (15,750 $yd^3$ will be relocated and placed under the engineered cover) |
| Volume of overburden excavated in order to access RIM for removal: | (112,000 $yd^3$ of other waste materials will be relocated/regraded and placed under the engineered cover) |

Under Alternative 2, Areas 1 and 2 would be brought up to grade using inert fill and regrading of existing material. Final grades will achieve a minimum slope of two percent. In contrast to the 2008 ROD-Selected Remedy, this alternative would use a regrading plan that does not extend the toe of the landfill out an estimated 100 lateral feet. Any radiologically-contaminated soil on the Buffer Zone and Crossroad Lot 2A2 property would be consolidated in the area of containment prior to the installation of a landfill cover. An engineered landfill cover would be constructed over Area 1 and Area 2 to address the presence of RIM and other wastes. The design of this cover would meet standards specified in the EPA's UMTRCA regulations which include limits on radon releases, groundwater protection standards, and longevity requirements (200 to 1,000 years). The cover would also be designed to meet the Missouri closure and post-closure care

requirements for sanitary landfills to address municipal solid wastes present in Area 1 and Area 2. The conceptual landfill cover includes a compacted clay layer to minimize stormwater infiltration and radon releases, a rubble/rock layer to minimize bio-intrusion, and a vegetated layer to minimize erosion potential and to increase the longevity of the cover. The need for and nature of gas control measures would be evaluated and defined as part of the remedial design phase.

Surface water drainage diversions, controls, and structures would also be designed and constructed as necessary. Groundwater monitoring and protection standards consistent with requirements for uranium mill tailing sites and sanitary landfills would be applied. The landfill cover would be routinely inspected and maintained to ensure the long-term integrity of the cover. Institutional controls must be implemented to limit future uses and to insure future uses do not impact the effectiveness or integrity of the remedial actions. The time to achieve RAOs for this alternative is estimated to take 2.8 years.

| **Alternative 3 – Engineered Cap: UMTRCA Engineered Cover** | |
|---|---|
| Present worth cost with 7% discount: | $90,000,000 |
| Estimated Capital Costs: | $96,000,000 |
| Annual operations and maintenance cost: | $176,000 to $389,000 |
| Estimated Construction Time: | 1.8 years |
| Estimated Time to Achieve RAOs: | 2.8 years |
| Percent of radioactivity removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell: | 0% |
| Volume of RIM removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell (volume of overburden): | 0 (but some will be relocated for installation of the engineered cover) |
| Volume of overburden excavated in order to access RIM for removal: | 6,418 $yd^3$ of overburden (in addition 15,750 $yd^3$ of RIM and 112,000 yd3 of other waste materials will be relocated but not |

Alternative 3 is similar to Alternative 2 which requires a cover that is compliant with the UMTRCA performance based standards discussed above. The design of the cover for Alternative 3 also incorporates recommendations included in the EPA's guidance for final covers on hazardous waste landfills. A key difference between Alternative 2 and Alternative 3 is the permeability requirement for the cover system that addresses the rate of water infiltration through the landfill. The cover for Alternative 3 includes a low permeability layer that lowers the allowed permeability from $10^{-5}$ cm/sec associated with the ROD-selected remedy down to a maximum of $10^{-7}$ cm/sec which is the standard for hazardous waste landfills and would further limit water infiltration. Any radiologically-contaminated soil on the Buffer Zone and Crossroad Lot 2A2 property would be consolidated in the area of containment (Areas 1 or 2) prior to the installation of the landfill cover. Other aspects described in Alternative 2 would also be implemented as a part of Alternative 3.

| **Alternative 4 – Excavation of RIM Greater Than 52.9 pCi/g Down 16 Feet Plus Engineered Cover** | |
|---|---|
| Present worth cost with 7% discount: | $236,000,000 |
| Estimated Capital Costs: | $274,000,000 |
| Annual operations and maintenance cost: | $176,000 to $389,000 |
| Estimated Construction Time: | 3.7 years |
| Estimated Time to Achieve RAOs: | 5 years |
| Percent of radioactivity removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell: | 67% |
| Volume of RIM removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell (volume of overburden): | 83,900 $yd^3$ |
| Volume of overburden excavated in order to access RIM for removal: | 190,100 yd3 |

Alternative 4 requires excavation of RIM with radioactivity levels greater than 52.9 pCi/g for combined radium and combined thorium that is located within 16 feet of the 2005 topographic surface of Areas 1 and 2.

The 52.9 pCi/g criterion was selected to identify RIM that may represent PTW. The EPA's UMTRCA regulations include a health based surface soil clean-up standard for radium of 5 pCi/g over background (40 C.F.R. § 192.12). The purpose of this standard is to limit the exposure to people in houses built on land contaminated with tailings. According to the EPA's PTW guidance, while there are no "threshold levels" of risk that correspond to "principal threat," generally treatment alternatives should be evaluated in those instances where toxicity and mobility combine to pose a potential risk of 1 X $10^{-3}$ which is 10 times greater than the upper end of the CERCLA risk range. Establishing a concentration criterion for radium and thorium ten times higher than the health based surface soil standard in UMTRCA was considered a suitable benchmark to identify RIM that may represent PTW.

The 16-foot depth for Alternative 4 was developed before the additional investigation work was completed at the Site. Since that time, the location and distribution of RIM has been refined in Area 1 and Area 2 based on the results of the additional characterization investigation performed between 2013 and 2016.

RIM located at depths greater than 16 feet, regardless of concentration, would be left in place. Any radiologically-contaminated soil on the Buffer Zone and Crossroad Lot 2A2 property in excess of unrestricted use criteria would be excavated and sent off-site for disposal if above 52.9 pCi/g or placed on-site beneath the engineered cover if less than 52.9 pCi/g. A full scale pilot study to evaluate the ability to effectively separate RIM from landfill wastes and to segregate RIM by concentration to reduce the volume of material shipped off-site would be implemented for this option. Where possible, any excavated overburden with RIM at concentrations below 52.9 pCi/g would be placed towards the bottom of the excavation to reduce the future risks at the Site. After excavation is complete, an engineered cap meeting UMTRCA standards (as described in Alternative 3) would be placed over Areas 1 and 2. Because radionuclides above the unrestricted use criteria would remain at the Site, institutional controls, long term surveillance and maintenance, 5-year review evaluations, groundwater monitoring for radionuclides, and radon gas monitoring would be required.

| **Alternative 5 – Excavation of RIM Greater Than 1,000 pCi/g Plus Engineered Cover** | |
|---|---|
| Present worth cost with 7% discount: | $287,000,000 |
| Estimated Capital Costs: | $379,000,000 |
| Annual operations and maintenance cost: | $176,000 to $389,000 |
| Estimated Construction Time: | 7 years |
| Estimated Time to Achieve RAOs: | 8.3 years |
| Percent of radioactivity removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell: | 63% |
| Volume of RIM removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell (volume of overburden): | 38,700 $yd^3$ |
| Volume of overburden excavated in order to access RIM for removal: | 645,300 $yd^3$ |

Alternative 5 requires excavation of RIM with radioactivity levels greater than 1,000 pCi/g at all depths. This alternative would eliminate radioactivity in excess of what is typical for uranium mill tailings. This alternative requires deep excavation (up to 96 feet below the land surface) of the newer Bridgeton Landfill wastes in Area 1. Any radiologically-contaminated soil on the Buffer Zone and Crossroad Lot 2A2 property in excess of unrestricted use standards would be excavated and sent off-site for disposal if above 1,000 pCi/g, or placed on-site beneath the engineered cover if less than 1,000 pCi/g. A full-scale pilot study to evaluate the ability to effectively separate RIM from landfill wastes and to segregate RIM by concentration to reduce the volume of

material shipped off-site would be implemented for this option. Where possible, any excavated overburden that may contain RIM at concentrations below 1,000 pCi/g would be placed towards the bottom of the excavation to further reduce future risks at the Site. After excavation is complete, an engineered cover would be placed over Areas 1 and 2, as described in Alternative 3. In addition, because radionuclides above the unrestricted use criteria would remain at the Site, institutional controls, long term surveillance and maintenance, 5-year review evaluations, groundwater monitoring, and gas monitoring would be required for this alternative.

| Alternative 6 – Risk Based Excavation of RIM Plus Engineered Cover | |
|---|---|
| Present worth cost with 7% discount: | $165,000,000 |
| Estimated Capital Costs: | $187,000,000 |
| Annual operations and maintenance cost: | $176,000 to $389,000 |
| Estimated Construction Time: | 2.6 years |
| Estimated Time to Achieve RAOs: | 4.1 years |
| Percent of radioactivity removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell: | 1.3% |
| Volume of RIM removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell (volume of overburden): | 15,580 $yd^3$ |
| Volume of overburden excavated in order to access RIM for removal: | 89,420 $yd^3$ |

Alternative 6 requires excavation of all RIM to a depth that would be protective of anticipated future land uses. Risk estimates were developed for exposures for a future on-site storage yard worker to the remaining RIM after backfilling the excavation with non-RIM materials, but prior to the installation of the cover system. To achieve these goals, RIM located within 2.2 feet of the regraded surface of Area 1 and Area 2 must be excavated and backfilled with non-RIM material. As a result, this alternative ensures at least 7.2 feet of shielding between the ground surface and RIM after the placement of the cap.

Any radiologically-contaminated soil on the Buffer Zone and Crossroad Lot 2A2 property will be removed and disposed of off-site. After excavation is complete, the engineered UMTRCA cover, as described in Alternative 3, would be placed over the 2.2 feet of inert fill in Areas 1 and 2. In addition, because radionuclides above the unrestricted use criteria would remain at the Site, institutional controls, long term surveillance and maintenance, 5-year review evaluations, groundwater monitoring, and gas monitoring would be required.

| Alternative 7 - Excavation of RIM Greater Than 7.9 pCi/g with Off-Site Disposal in Engineered Cell | |
|---|---|
| Present worth cost with 7% discount: | $455,000,000 |
| Estimated Capital Costs: | $695,000,000 |
| Annual operations and maintenance cost: | $176,000 to $340,000 |
| Estimated Construction Time: | 13.3 years |
| Estimated Time to Achieve RAOs: | 14.6 years |
| Percent of radioactivity removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell: | Close to 100% (note some radioactive contamination with activity less than 7.9 pCi/g will remain in Areas 1 and 2) |
| Volume of RIM removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell (volume of overburden): | 309,700 $yd^3$ |
| Volume of overburden excavated in order to access RIM for removal: | 1,511,300 $yd^3$ |

Alternative 7 requires excavation of all RIM in Areas 1 and 2, including deep excavation (up to 96 feet below the land surface) of the newer Bridgeton Landfill wastes overlying portions of Area 1. Removal of RIM

greater than 7.9 pCi/g is expected to leave Area 1 and Area 2 in a condition that would not require additional engineering and institutional controls due to their radiological content even though some residual radioactive material may remain on-site. Any radiologically-contaminated soil on the Buffer Zone and Crossroad Lot 2A2 property above levels allowing unrestricted use would be excavated and disposed of off-site. RIM would be sorted, loaded, and transported for disposal at an off-site facility. A full-scale pilot study to evaluate the ability to effectively separate RIM from landfill wastes and to segregate RIM by concentration to reduce the volume of material shipped off-site would be implemented for this option. The remaining solid waste materials would then be regraded to meet the minimum (5%) and maximum (25%) slope criteria. A landfill cover, meeting the Missouri closure and post-closure care requirements for sanitary landfills, would then be installed over Areas 1 and 2. Surface water runoff controls, groundwater monitoring, and landfill gas monitoring and control would then be designed, installed and maintained as necessary.

| Alternative 8 - Excavation of RIM Greater than 7.9 pCi/g with Disposal in an On-Site Engineered Cell | |
|---|---|
| Present worth cost with 7% discount: | $391,000,000 |
| Estimated Capital Costs: | $591,000,000 |
| Annual operations and maintenance cost: | $182,100 to $444,100 |
| Estimated Construction Time: | 13.5 years |
| Estimated Time to Achieve RAOs: | 14.8 years |
| Percent of radioactivity removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell: | close to 100% (some radioactive contamination with activity less than 7.9 pCi/g will remain in Areas 1 and 2) |
| Volume of RIM removed from Areas 1 and 2 and managed in an on-site or off-site engineered cell (volume of overburden): | 309,700 $yd^3$ excavated and relocated to on-site cell |
| Volume of overburden excavated in order to access RIM for removal: | 1,511,300$yd^3$ |

Alternative 8 requires excavation of all RIM in Areas 1 and 2, including deep excavation (up to 96 feet below the land surface) of the newer Bridgeton Landfill wastes overlying Area 1. Excavated RIM would be disposed in a new engineered on-site disposal cell. Removal of RIM greater than 7.9 pCi/g is expected to leave Area 1 and Area 2 in a condition that would not require additional engineering and institutional controls due to their radiological content even though some residual radioactive material may remain on-site. Any radiologically-contaminated soil on the Buffer Zone and Crossroad Lot 2A2 property in excess of unrestricted use would be excavated and placed in the on-site cell. The on-site cell would be constructed to meet UMTRCA standards, and would include a liner, an engineered cover (as described in Alternative 3) and a leachate collection system. After excavation is complete, an engineered cover meeting UMTRCA standards would be placed over Areas 1 and 2. The current Bridgeton Landfill soil stockpile area, which is outside of the geomorphic flood plane was evaluated as the location of the on-site disposal cell for purposes of the FFS; however, other locations within the landfill complex may be considered for the on-site disposal cell, if necessary. The final location of the on-site cell would be determined as part of Remedial Design. A landfill cover, meeting the Missouri closure and post-closure care requirements for sanitary landfills, would then be installed over Areas 1 and 2. Surface water runoff controls, groundwater monitoring, and landfill gas monitoring and control would then be designed, installed and maintained as necessary.

## 8.0 EVALUATION OF ALTERNATIVES

As set forth in the NCP at 40 CFR 300.430(e)(9) (iii), nine criteria are used to evaluate the different remedial alternatives individually and against each other in order to select a remedy. This section profiles the relative performance of each alternative against seven of the nine criteria, noting how it compares to the other options under consideration. State and community acceptance will be considered after the public comment

| EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES | |
|---|---|
| **Threshold Criteria** | **Overall Protectiveness of Human Health and the Environment** determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment. |
| | **Compliance with ARARs** evaluates whether the alternative meets Federal and State environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified. |
| **Primary Balancing Criteria** | **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. |
| **Modifying Criteria** | **State/Support Agency Acceptance** considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and proposed plan. |
| | **Community Acceptance** considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the proposed plan are an important indicator of community acceptance. |

period and will be described in the ROD Amendment.

**Threshold Criteria**

**8.1 Overall Protectiveness of Human Health and the Environment**

Except for the No Action alternative, all the alternatives (2 through 8) are protective of human health and the environment and would achieve the site-specific RAOs through the use of engineered containment (alone or in conjunction with excavation and placement of RIM in an on- or off-site engineered cell) combined with long-term monitoring and maintenance, and institutional controls.

Excavation of all radioactive contamination above 7.9 pCi/g and management in an on-site or off-site engineered cell (Alternatives 7 and 8); excavation of radioactive contamination with different levels of radioactivity and management in an off-site engineered cell with installation of a new engineered landfill cover (Alternatives 4, 5, 6); as well as, leaving RIM in place with installation of a new engineered landfill cover (Alternatives 2 and 3) would all be successful in reducing potential future risks from exposure to all contaminants at the Site. Installation of some type of engineered landfill cover over Areas 1 and 2 is included as part of all the remedial alternatives. This engineered landfill cover would eliminate potential future risks associated with the inhalation or ingestion of contaminated soils or wastes, dermal contact with contaminated soils or wastes, and wind dispersal of gases or fugitive dust. The cover would also reduce infiltration of precipitation and the potential for leaching of contaminants from wastes into groundwater. This cover system for Alternatives 3, 4, 5, 6, and 8 would provide an additional level of protection of groundwater than that proposed in the Modified 2008 ROD Remedy (Alternative 2) because it includes a layer with lower permeability than what was selected in the Modified 2008 ROD Remedy. The on-site engineered disposal cell associated with Alternative 8 includes an engineered landfill cover over the disposal cell, as well, as an engineered liner beneath the cell which would further reduce the potential for radioactive materials leaching to groundwater.

Long-term maintenance of the engineered cover included under each remedial alternative, as well as, monitoring of the groundwater and subsurface occurrences of landfill gas and radon, would ensure that each remedial action functions as intended and remains protective. The institutional controls component of each remedial alternative further reduces potential future risks and ensures that land and resource uses are consistent with permanent waste disposal.

### 8.2 Compliance with ARARs

Alternatives 2 through 8 could all meet chemical, location, and action-specific ARARs, but additional data will need to be collected as a part of remedial design to confirm that all required landfill siting criteria can be met for an on-site disposal cell. The design of the engineered cover system required for Alternatives 3 through 6 and 8 will meet the standards for control of residual radioactive materials required in UMTRCA, as well as, portions of Resource Conservation and Recovery Act (RCRA) Subtitle D and requirements typically associated with hazardous waste landfills in RCRA Subtitle C. The National Emissions Standards for Hazardous Air pollutants (NESHAP) 40 CFR 61.222 is also relevant and appropriate for the engineered cover and all excavation alternatives. Under Alternative 7, all RIM would be managed in an off-site engineered cell, and therefore, the on-site engineered cover system for Area 1 and Area 2 only needs to be compliant with the solid waste closure requirements in RCRA Subtitle D. All off-site shipments of radioactive or hazardous wastes, if encountered, will be performed in accordance with requirements that address the proper transportation and disposal of waste at an off-site disposal facility.

**Primary Balancing Criteria**

### 8.3 Long-Term Effectiveness and Permanence

All of the remedial alternatives reduce long term residual risks to on-site workers and the general public to the lower end or below the CERCLA acceptable risk range.

The proposed landfill covers for each alternative will be designed to prevent direct contact with contaminants, mitigate exposures to gamma radiation and radon, and prevent infiltration of precipitation into the landfill and subsequent leaching of RIM or other landfill wastes to the groundwater. The UMTRCA engineered cover for Alternatives 3 through 6 and 8 would have a lower permeability ($10x10^{-7}$ vs $10x10^{-5}$ cm/sec) than the cover in Alternative 2, and therefore, allow less infiltration of precipitation into the landfill thereby reducing the potential for leaching of contaminants. In addition, the bio-intrusion layer in the UMTRCA engineered cover for Alternatives 3 through 6 and 8 is placed on top of the low permeability layer which increases the longevity of the cover system. The on-site disposal cell in Alternative 8 includes a liner, which provides increased groundwater protection compared to the Modified 2008 ROD-Selected Remedy and the UMTRCA engineered cover alternatives. Alternatives 4, 5, 6, and 7 move some or all of the RIM off-site, thereby permanently reducing the amount of radioactivity at the Site. The degree of additional protectiveness associated with the removal of radioactivity is related to the concentrations removed and the depth of the removal. Specifically, removal of radioactive material closer to the surface or limiting the maximum concentrations of radionuclides near the surface reduces the long-term risks and decreases the exposure potential if the cover would be damaged, or if a subsurface heating event were to occur. Engineered covers over all alternatives except full excavation with off-site disposal are designed to reduce leaching regardless of the depth of the RIM.

Additionally, potential impacts from severe weather and natural disasters, such as a tornado or flooding were evaluated for the alternatives, and are not expected to result in unacceptable exposures. Flooding is not expected to impact the long-term performance of the alternatives because the Site is currently located more than 1.3 miles from the Missouri River and the OU-1 landfill is above the 500-year flood level, except for a narrow area along the eastern toes of Areas 1 and 2. If the 500-year Earth City levee fails or ceases to exist, a 500-year flood event is not expected to include high-energy water flows due to the landfill's distance from the river, and is only anticipated to cause approximately two feet of flood waters to contact the toes. Due to

the length of time this remedy must remain protective, geologic and anthropogenic uncertainties will be considered during design of the required rock armoring along the toes of the landfill. The vertical height of this flood protection feature would be subject to design phase evaluations, but is expected to include a margin of safety over the 500-year flood level. Although the Buffer Zone and Lot 2A2 are located within the 500-year floodplain, all the alternatives include removal or relocation of radioactively contaminated soil which would allow for unrestricted use in these locations.

**8.4 Reduction of Toxicity, Mobility, or Volume through Treatment**

Future risks posed by contamination with higher radionuclide concentrations at the Site greatly exceed the CERCLA acceptable risk range. In addition, testing conducted after the EPA's Modified 2008 ROD-Selected Remedy confirms the potential for radioactivity to leach under certain conditions. The EPA has therefore concluded that some of the radioactive contamination at the Site (material with concentrations above 52.9 pCi/g) may represent PTW. CERCLA expresses a preference for treatment of PTW to reduce toxicity, mobility, and volume to the extent practicable. Several different in-situ and ex-situ treatment technologies were evaluated in the FFS. However, none of these treatment technologies are considered practicable due to the varied nature of landfill wastes.

The EPA evaluated technologies to separate landfill wastes and debris from soil, in combination with contaminated soil segregation, in an effort to reduce the volume of contaminated materials. While this resulted in the identification of some potentially suitable technologies for certain alternatives, the effectiveness of separation of landfill debris from soil at the Site is currently uncertain. Segregation of soils that contain radioactive materials relies on field measurements of gamma radiation. Due to the presence of higher concentrations of thorium relative to radium, and the lack of a measurable gamma signature from thorium, physical separation and/or radionuclide segregation are currently considered unlikely to be effective for lower radionuclide concentrations. Therefore, segregation of RIM greater than 1,000 pCi/g is more likely to be effective. Performance of a full scale pilot study is necessary to determine the effectiveness of these separation/segregation techniques to reduce RIM volume. This pilot study is proposed for Alternatives 4, 5 and 7.

**8.5 Short-Term Effectiveness**

No unacceptable short- term risks to the general public and surrounding community are expected from the implementation of any of the alternatives evaluated. Because Alternatives 7 and 8 take longer to implement and require contact with a substantially greater volume of radioactive contamination than the capping or other excavation alternatives, they have greater short-term impacts. Alternative 8 (excavation and on-site disposal of all radioactive contamination above 7.9 pCi/g) could result in the greatest potential off-site risk to the public due to the duration of implementation and the potential location of the engineered cell; however, the short-term risk from Alternative 8 is still within the CERCLA acceptable risk range.

All of the remedial alternatives potentially pose increased cancer risks to workers involved with the remedy implementation. The risks to workers associated with the excavation alternatives (Alternatives 4, 5, 6, 7, and 8) are higher than those associated with the two containment/cover only alternatives (Alternatives 2 and 3). In general, deeper excavations and RIM staging and loading activities increase the potential for worker exposure. For all of the alternatives, worker exposures will be closely monitored and engineering measures and best management practices will be taken to reduce exposures to within acceptable levels. However, risks to workers from exposure to gamma radiation can only be controlled by limiting exposure durations.

Storm water management would be required during implementation of all alternatives. Alternatives that require larger and deeper excavations over longer periods of time, such as Alternatives 5, 7 and 8, would potentially require substantially more stormwater and leachate management. Alternative 8 will require stormwater management during both the excavation of RIM and the new disposal cell construction phases of

this alternative. The longer an alternative takes to implement, the greater the potential for impacts from severe weather.

During implementation of the remedy, concerns regarding oxygen intrusion or other actions causing or aggravating a subsurface heating event are greater. Compared to Bridgeton Landfill, the potential for an occurrence of a subsurface heating event in OU-1 (Areas 1 and 2) is reduced due to the greater age (approximately 30+ years) and higher degree of decomposition of waste materials. The newer waste in the northern portion of the North Quarry of Bridgeton Landfill overlying the southwestern portion of Area 1 is more susceptible to a subsurface heating event or a surface fire due to oxygen intrusion, and therefore additional care must be taken if that waste is disturbed. Alternatives 5, 7 and 8 all require excavation in this newer waste which could increase the potential for a subsurface heating event or surface fire. Alternatives 7 and 8 would eliminate the future potential exposures which could potentially result from a subsurface heating event coming into contact with RIM in Area 1 or Area 2. The proposed location of the on-site disposal cell (Alternative 8) is separated from any of the other landfill cells currently at the Site so there would not be risk from a subsurface heating event moving from an adjacent landfill into the new disposal cell.

The timeframe to achieve the RAOs varies from 2.8 years to 14.8 years. The engineered cover remedies (Alternatives 2 and 3) are estimated to take the shortest time and the full excavation of RIM greater than 7.9 pCi/g with on-site or off-site disposal in an engineered cell (Alternatives 7 and 8) are projected to take the longest. The timeframe to achieve RAOs is largely driven by the depth of and volume of material excavated, the degree of handling that must occur, and the concentration of the materials being handled. The number of years to achieve the RAOs for each alternative is presented in the table. These timeframes include the time to design and construct the remedy.

| Alternatives | | Time to Reach RAOs |
|---|---|---|
| 1 | No Action | NA |
| 2 | Modified 2008 ROD Remedy – Engineered Cover (cap) | 2.8 years |
| 3 | Engineered Cover (cap) - UMTRCA Engineered Cover | 2.8 years |
| 4 | Excavation of RIM Greater Than 52.9 pCi/g Down 16 Feet Plus Engineered Cover | 5 years |
| 5 | Excavation of RIM Greater Than 1,000 pCi/g Plus Engineered Cover | 8.3 years |
| 6 | Risk Based Excavation of RIM Plus Engineered Cover | 4.1 years |
| 7 | Excavation of RIM Greater Than 7.9 pCi/g with Off-Site Disposal in Engineered Cell | 14.6 years |
| 8 | Excavation of RIM Greater than 7.9 pCi/g with Disposal in an On-Site Engineered Cell | 14.8 years |

**8.6 Implementability**

Installation of engineered landfill covers, excavation and off-site disposal of waste materials, and implementation of institutional controls are all technically feasible and have been implemented at other similar CERCLA sites. Monitoring of landfill cover surfaces, landfill gas, radon, groundwater, and surface water are easily implemented. While construction of an on-site disposal cell is readily implementable at some CERCLA sites, additional geotechnical testing/ evaluation would be required to determine whether construction of an on-site cell would be technically feasible at the West Lake Landfill Site.

Excavation of wastes, to some extent, is required for all the alternatives, and implementation of each remedy will require controls or best practices to mitigate the following impacts:

- management of exposure to construction workers during remedy implementation;
- management of fugitive dust and potential odors;
- management and treatment of stormwater, particularly stormwater exposed to RIM or other waste during excavation;

- prevention of oxygen intrusion into any exposed portion of the Bridgeton Landfill;
- mitigation of bird hazards;
- the identification, segregation, and off-site disposal of any hazardous wastes or regulated asbestos or PCB-containing materials that may be encountered during RIM excavation.

The degree of difficulty necessary to mitigate or manage these impacts varies between the alternatives, and in general, increases with the volume of material and depth of excavation, the number of times materials have to be handled, and the duration of the project. Potential impacts to existing Site infrastructure, as well as, excavating in newer municipal solid waste, such as that disposed of in the North Quarry of Bridgeton Landfill adjacent to and overlying Area 1, exacerbates many of the existing implementability concerns. In particular, the 1,000 pCi/g Excavation (Alternative 5) and the two alternatives that excavate all RIM (Alternatives 7 and 8) would require deep excavation in Area 1 and significant excavation of the newer wastes in the North Quarry. These deeper excavations to access RIM and controls required to mitigate impacts described above create additional challenges for implementation. In comparison, alternatives which do not require excavating North Quarry wastes offer implementability advantages in terms of reduced odors, bird risks, likelihood of an exothermic reaction or landfill fire, and shorter implementation duration.

**Cost**

Capital (construction), annual operations and maintenance (O&M), and total present worth estimates were developed for each alternative, and are presented in the table below using a 7 percent net discount rate consistent with EPA guidance.

Annual O&M costs include environmental sampling and reporting expenses, inspection and maintenance costs for landfill covers, wells, leachate systems or any other required component of the remedy. The costs are listed as a range because required actions may vary from year to year.

The cost effectiveness is more than just a direct comparison of the cost criterion. A cost-effective remedy in the Superfund program is one whose "costs are proportional to its overall effectiveness," and meets the two threshold criteria. The "overall effectiveness" of a remedial alternative is determined by evaluating the following three of the five balancing criteria used in the detailed analysis of alternatives: (1) Long-term effectiveness and permanence; (2) Reduction in toxicity, mobility and volume through treatment; and, (3) Short-term effectiveness. More than one alternative may be determined to be cost effective. An alternative

| Alternatives | | Present Worth Using 7% Discount | Capital Costs | O&M Costs Annually* |
|---|---|---|---|---|
| 1 | No Action | N/A | N/A | N/A |
| 2 | Modified 2008 ROD Remedy – Engineered Cover (cap) | $71 million | $75 million | $176,000 to $389,000 |
| 3 | Engineered Cover (cap) - UMTRCA Engineered Cover | $90 million | $96 million | $176,000 to $389,000 |
| 4 | Excavation of RIM Greater Than 52.9 pCi/g Down 16 Feet Plus Engineered Cover | $236 million | $274 million | $176,000 to $389,000 |
| 5 | Excavation of RIM Greater Than 1,000 pCi/g Plus Engineered Cover | $287 million | $379 million | $176,000 to $389,000 |
| 6 | Risk Based Excavation of RIM Plus Engineered Cover | $165 million | $187 million | $176,000 to $389,000 |
| 7 | Excavation of RIM Greater Than 7.9 pCi/g with Off-Site Disposal in Engineered Cell | $455 million | $695 million | $176,000 to $340,000 |
| 8 | Excavation of RIM Greater than 7.9 pCi/g with Disposal in an On-Site Engineered Cell | $391 million | $591 million | $182,100 to $444,100 |

* O&M Cost ranges result from variations in the activities that occur each year (*e.g.*, higher costs for years with additional environmental monitoring, years when landfill cover repairs may occur, and years when 5-year reviews are conducted).

that costs more but achieves a higher overall effectiveness may be considered more cost effective than a less costly alternative.

## 9.0 SUMMARY OF THE PREFERRED REMEDY

All the remedy alternatives described in this proposed plan, except No Action, are protective of human health and the environment, and all the alternatives would comply with ARARs. The EPA has carefully evaluated the threshold criteria and five balancing criteria discussed above for each alternative in accordance with the NCP. The EPA's preferred alternative achieves the best balance of these criteria out of all the remedy alternatives considered.

EPA's preferred alternative is Alternative 4, excavation of radiological material greater than 52.9 pCi/g down to a 16-foot depth below the 2005 topographic surface. This alternative is based on both concentration and depth criteria. Alternative 4 includes excavation and off-site disposal of about 84,000 cubic yards of RIM from Area 1 and Area 2 which represents approximately 67% of the radioactivity (786 Ci out of 1,167 Ci of radium-226 and thorium-230) at the Site. Excavation of a majority of the radioactivity, in combination with installation and maintenance of an engineered cover, would prevent unacceptable risk in the future. In order to implement this alternative, a total of approximately 204,000 cubic yards of overburden, which includes some radioactive contamination below 52.9 pCi/g, will also need to be excavated. The lateral extent of radioactive contamination that will be excavated in Areas 1 and 2 under Alternative 4 is depicted on Figures 9 and 10.

After excavation, an UMTRCA compliant low permeability cover consistent with RCRA Subtitle C design criteria will be installed in Area 1 and Area 2 to minimize infiltration of rainwater and potential subsequent leaching of residual radioactive materials to groundwater, in addition to, further reducing long-term future risks from exposures to radon emissions and gamma radiation. This OU-1 preferred alternative addresses the

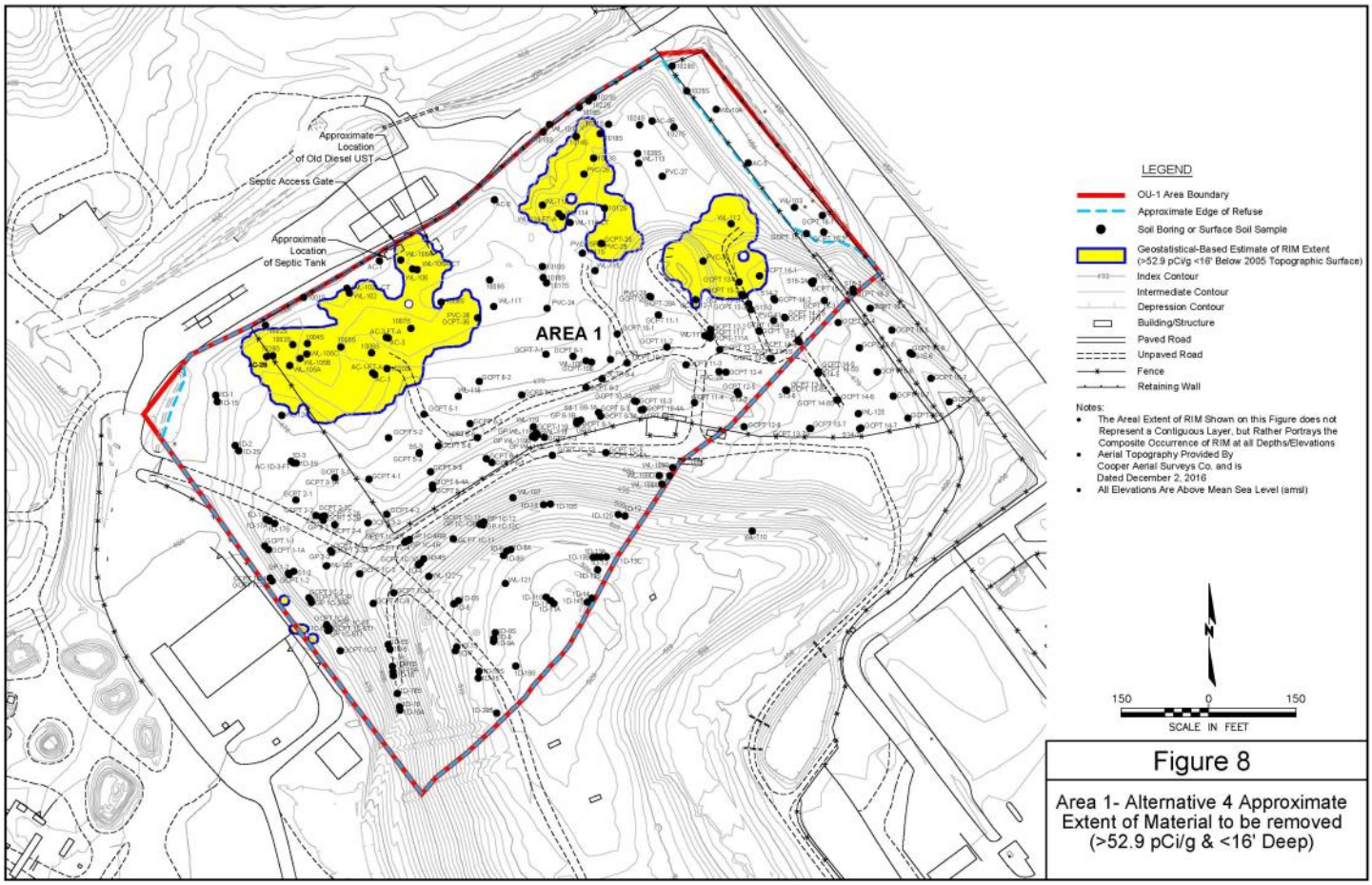



Figure 8

Area 1- Alternative 4 Approximate Extent of Material to be removed (>52.9 pCi/g & <16' Deep)

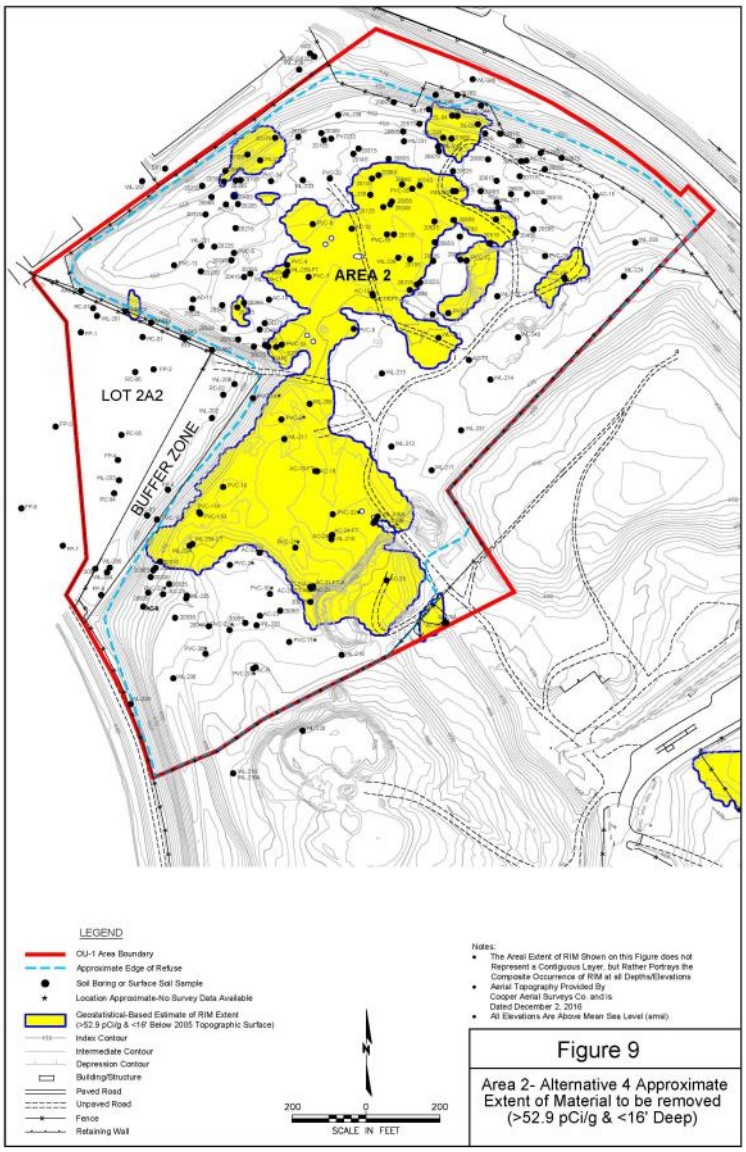



Figure 9

Area 2- Alternative 4 Approximate Extent of Material to be removed (>52.9 pCi/g & <16' Deep)

source of contamination in the West Lake Landfill. Minimizing infiltration and potential leaching of radionuclides to groundwater would be consistent with any remedial actions determined to be necessary at OU-3. The nature and extent of groundwater contamination will be characterized during the OU-3 investigation, and if warranted, a CERLCA remedy will be selected under a ROD for OU -3.

In addition, the preferred alternative requires the excavation of radioactive materials from Lot 2A2 and portions of the Buffer Zone to allow for unrestricted use. Alternative 4 will achieve the remedial action objectives in approximately 5 years, and is estimated to have a present worth cost of about $236,000,000. The preferred alternative also incorporates the use of Institutional Controls to restrict future uses of the Site to ensure the remedy is protective in the future and that land and resource uses remain consistent with the remedy implemented.

The radioactive materials at the Site are such that risks posed by the radionuclides will increase over approximately the next 9,000 years and then start to decrease. The EPA's preferred alternative will prevent direct contact with the contamination and significantly reduce the potential for exposures to gamma radiation and radon and impacts to groundwater. Alternative 4 removes RIM with activity levels that may represent PTW from the top 16 feet of Areas 1 and 2 and will reduce long term risks to the reasonable maximally exposed individual at peak concentrations (in 9,000 years) to $5X10^{-6}$ or 5 additional incidents of cancer in 1,000,000 people which is within the CERCLA risk range. These long-term residual risks may be further reduced through optimized replacement of the overburden prior to installation of the landfill cover.

Because some RIM will remain at the Site, the UMTRCA engineered landfill cover must be maintained and monitored at an estimated O&M cost of $173,000 to $337,000 per year (depending on the activities being conducted in a given year). The EPA will also conduct statutory reviews of the remedy every 5 years to ensure long-term protectiveness of the remedy.

The potential for effective separation of landfill debris from soil at the Site and segregation at concentrations greater than 52.9 pCi/g of combined radium and combined thorium is uncertain. The EPA's preferred alternative includes the performance of a full-scale pilot study during remedial design to determine the effectiveness of these technologies.

Implementation of the preferred alternative is estimated to take 5 years (1.3 years for remedial design and 3.7 years to construct), which is about twice as long as the landfill cover remedies and about a third as long as the other excavation alternatives. Short term risk to remediation workers from fugitive dust generated as part of the preferred alternative, in addition to risk from gamma radiation and radon, are considered moderate in comparison to the other alternatives. These risks will be managed to acceptable levels through

engineering controls, health and safety protocols and best management practices. The estimated total risk to off-site residents are below the CERCLA acceptable risk range and, as discussed above, are expected to decrease with the implementation of engineering controls and best management practices during construction.

Because Alternative 4 does not require excavation of the newer waste in portions of Area 1, it avoids and reduces some of the potential implementability challenges and short-term impacts associated with Alternatives 5, 7, and 8. Alternative 4 does not impact the existing infrastructure in the Bridgeton Landfill, which limits the potential for oxygen intrusion and a subsequent subsurface heating event or landfill fire in the North Quarry of the Bridgeton Landfill. In addition, odors and the potential for the attraction of birds may be reduced. Any excavation in Area 1 and Area 2 can increase the potential for impacts to groundwater during construction; however the potential for groundwater impacts is considered lower for Alternative 4 compared to the deeper excavation required for Alternatives 5, 7 and 8.

The depth limit of 16 feet in Alternative 4 is a more readily implementable excavation that results in the removal of a majority (67%) of the contaminant activity significantly reducing the threat posed by the Site. Other alternatives involving deeper excavation require handling of more overburden and setback, which increases the complexity of the remedy and increases short-term impacts to workers and the community. Excavation of the majority of the contaminant activity in conjunction with installation of an engineered cover system reduces the long-term risks posed by the RIM remaining at the Site to the lower end of the CERCLA risk range. The cost effectiveness of this alternative is high given the level of reduction in risks as compared to its costs.

In summary, the EPA believes that Alternative 4 represents the best balance of long-term effectiveness, short -term effectiveness, implementability, and cost in comparison to the other alternatives. Alternative 4 is protective in the long-term and removes a majority of the radioactivity of RIM at the Site in contrast to other alternatives. Compared to the deeper excavation alternatives (Alternative 5, 7, and 8) Alternative 4 does not require excavation in the Bridgeton Landfill. Also, it is more implementable, minimizes the short term impacts to the community and workers, takes less time to construct, and is more cost-effective to implement (Table 1).

## 10.0 STATE ACCEPTANCE

The EPA has worked closely with the MDNR during the OU-1 remedial evaluations, including technical reviews, field investigations, and sampling of various media. The MDNR has provided specific comments on and input for a variety of submittals such as the RIA, BRA, and FFS. After the public comment period, the EPA will fully assess state and community acceptance of the preferred alternative.

## 11.0 COMMUNITY PARTICIPATION

In 2013, the EPA assisted the impacted community in establishing the West Lake Landfill Community Advisory Group (CAG), and began regular attendance at CAG meetings. Also in 2013, the EPA assigned a Technical Services for Communities (TASC) contractor to assist the impacted community. In 2014, the EPA conducted community interviews to assess community knowledge and interest in the Site. In the same year, the EPA also began to regularly publish the West Lake Update newsletter, providing consistent updates on Site progress. The EPA continued to engage regularly with the community and CAG throughout 2015. In 2016, the EPA opened a local site office at Bridgeton City Hall where the public could meet regularly with agency officials in their community. Also in 2016, the EPA held several meetings as part of a Community Dialogue Framework, bringing together representatives from federal and state partner agencies, local governments and agencies, the CAG, and other community groups, to engage in dialogue regarding the Site. In 2017, the EPA continued to regularly staff the local site office and support the CAG. The EPA also partnered with local

community groups, including the CAG, to host a Community Listening Session where the public had the opportunity to address senior agency leaders with the questions and concerns regarding the Site.

The EPA is now providing information on the proposed remedies for the West Lake Landfill Site through this proposed plan and by holding a public meeting. The AR file for the Site will also be available for review.

## 12.0 REQUEST FOR COMMENT

The EPA is seeking comment on all alternatives presented in the FFS. The public is encouraged to provide comments regarding the balancing criteria which include long term effectiveness, reduction in toxicity, mobility, or volume through treatment, short term effectiveness, implementability, and cost effectiveness. The EPA may modify the preferred alternative presented in this proposed plan based on new information and/or public comments.

While Alternative 4 will be protective of human health and the environment, consideration of a lower concentration criterion, particularly for RIM closer to the surface, may lower the potential for exposure over the several thousand years the remedy must remain in place. Risks due to exposure from gamma radiation and radon decreases as the depth to RIM increases. The depth for Alternative 4 (16 foot) was estimated before the additional investigation work was complete at the Site. Based on the results of the additional characterization investigation, the location and distribution of radioactive materials has been refined in Area 1 and Area 2. Area 2 contains 75% of the radioactive contamination at the Site, a majority of which is located closer to the surface. Area 1 is closer to the nearest residential areas, and contains only about 25% of the radioactivity at the Site.

The EPA is specifically soliciting comments related to the depth and concentration criteria, (16 feet depth limit and the 52.9 pCi/g concentration) established as a baseline for Alternative 4. The EPA is also soliciting comments related to the selection of different depths and concentration criterion between Area 1 and Area 2. Therefore, the EPA encourages the public to provide comments on the depth and concentration criteria selected in the EPA's preferred alternative that results in increased long-term protectiveness while maintaining the balance of the other NCP criteria.

The EPA is also soliciting comments on the disposal options for the excavated radioactive material. The FFS evaluated on-site disposal for Alternative 8 but did not do so for Alternative 4. As such, the EPA encourages the public to comment on both on- and off-site disposal options as a component of the proposed plan. Once the public comments are received on the proposed plan, the EPA, in consultation with the State, will reevaluate the preferred alternative and will consider any new information obtained during the public comment period to select a final remedy.

Following the comment period, the EPA, in consultation with the MDNR will make a final decision on amendment of the OU-1 ROD after reviewing and considering all comments and information submitted during the public comment period. The EPA may modify the preferred alternative or select another response action based on new information. Therefore, the public is encouraged to provide review and comment on all the alternatives presented in this plan.

The dates for the public comment period, the date and location of the public meeting, and the location of the AR file is provided in Section 1.

## 13.0 REFERENCES

Auxier & Associates, Inc. (Auxier), 2018, Updated Baseline Risk Assessment, West Lake Landfill Operable Unit 1, December 22.

Engineering Management Support, Inc. (EMSI), 2018a, Remedial Investigation Addendum, West Lake Landfill Operable Unit 1, Bridgeton, Missouri, January 25.

EMSI, 2018b, Final Feasibility Study, West Lake Landfill Operable Unit 1, Bridgeton, Missouri, January 26.

Papadopulos & Associates, Inc. (SSP&A), 2017, Estimated Three-Dimensional Extent of Radiologically Impacted Material, West Lake Landfill Operable Unit-1, Bridgeton, Missouri, December 22.

U.S. EPA, 2017. Results of Bridgeton Dust Pre-CERCLA Screening Memorandum, May 11.

U.S. EPA, 2014. Final Pre-CFRCLJS Screening Report Bridgeton Municipal Athletic Complex, Bridgeton, Missouri U.S. EPA Region 7 START 4, Contract No. EP-S7-13-06, Task Order No. 0002.023, July 30.

## Table 1 - Comparison of Alternatives

| | Modified ROD-Selected Remedy | UMTRCA Cover Alternative | 52.9 pCi/g to a 16-ft Depth Partial Excavation Alternative | 1,000 pCi/g Partial Excavation Alternative | Risk-Based Partial Excavation Alternative | Full Excavation of RIM with Off-Site Disposal | Full Excavation of RIM with On-Site Disposal |
|---|---|---|---|---|---|---|---|
| **Long-term residual cancer risk after 1,000 years[2]** | **1.2 x $10^{-6}$**<br>(1.2 extra cancer incidences in 1,000,000 people)<br>(With cover thickness 5-ft) | **7.3 x $10^{-6}$**<br>(7.3 extra cancer incidences in 1,000,000 people)<br>(With cover thickness 5-ft) | **2.3 x $10^{-6}$**<br>(2.3 extra cancer incidences in 1,000,000 people)<br>(With cover thickness 5-ft) | **2.7 x $10^{-7}$**<br>(0.27 extra cancer incidences in 1,000,000 people)<br>(With cover thickness 5-ft) | **9.3 x $10^{-9}$**<br>(0.009 extra cancer incidences in 1,000,000 people)<br>(With cover thickness 7.2-ft) | **5.4 x $10^{-8}$**<br>(0.054 extra cancer incidences in 1,000,000 people)<br>(With cover thickness 3-ft) | **2.3 x $10^{-6}$**<br>(2.3 extra cancer incidences in 1,000,000 people)<br>(With cover thickness 5-ft) |
| **Short-term risks during cleanup** | Waste excavation volume: **112,000 bcy**<br>RIM Excavation volume: **15,750 bcy**<br>Percent activity removed **0%**<br>RIM consolidated on site<br>No disturbance of North Quarry[3] | Waste excavation volume: **112,000 bcy**<br>RIM Excavation volume: **15,750 bcy**<br>Percent activity removed **0%**<br>RIM consolidated on site<br>No disturbance of North Quarry[3] | Waste excavation volume: **274,000 bcy**<br>RIM Excavation volume: **83,900 bcy**<br>Percent activity removed **67%**<br>RIM disposed off site<br>No disturbance of North Quarry[3] | Waste excavation volume: **684,000 bcy**<br>RIM Excavation volume: **38,700 bcy**<br>Percent activity removed **63%**<br>RIM disposed off site<br>Removal of part of North Quarry[3] | Waste excavation volume: **105,000 bcy**<br>RIM Excavation volume: **15,580 bcy**<br>Percent activity removed **1%**<br>RIM disposed off site<br>No disturbance of North Quarry[3] | Waste excavation volume: **1,821,000 bcy**<br>RIM Excavation volume: **309,700 bcy**<br>Percent activity removed **100%**<br>RIM disposed off site<br>Removal of part of North Quarry[3] | Waste excavation volume: **1,821,000 bcy**<br>RIM Excavation volume: **309,700 bcy**<br>Percent activity removed **100%**<br>RIM disposed in on-site cell<br>Removal of part of North Quarry[3] |
| | <u>On-Site Workers</u><br>Cancer risk: **2.8 x $10^{-5}$**<br>(28 extra incidences in 1,000,000) | <u>On-Site Workers</u><br>Cancer risk: **2.8 x $10^{-5}$**<br>(28 extra incidences in 1,000,000) | <u>On-Site Workers</u><br>Cancer risks: **2.2 x $10^{-3}$**<br>(2,200 extra incidences in 1,000,000) | <u>On-Site Workers</u><br>Cancer risks: **1.1 x $10^{-2}$**<br>(11,000 extra incidences in 1,000,000) | <u>On-Site Workers</u><br>Cancer risks: **5.0 x $10^{-5}$**<br>(50 extra incidences in 1,000,000) | <u>On-Site Workers</u><br>Cancer risks: **3.7 x $10^{-3}$**<br>(3,700 extra incidences in 1,000,000) | <u>On-Site Workers</u><br>Cancer risks: **3.7 x $10^{-3}$**<br>(3,700 extra incidences in 1,000,000 people) |
| | <u>Community</u><br>Cancer risk: **1.9 x $10^{-7}$**<br>(0.2 extra incidence in 1,000,000) | <u>Community</u><br>Cancer risk: **1.9 x $10^{-7}$**<br>(0.2 extra incidence in 1,000,000) | <u>Community</u><br>Cancer risks: **9.7 x $10^{-7}$**<br>(0.97 extra incidence in 1,000,000) | <u>Community</u><br>Cancer risks: **2.5 x $10^{-6}$**<br>(2.5 extra incidence in 1,000,000) | <u>Community</u><br>Cancer risks: **3.8 x $10^{-7}$**<br>(0.38 extra incidence in 1,000,000) | <u>Community</u><br>Cancer risks: **5.5 x $10^{-6}$**<br>(5.5 extra incidence in 1,000,000) | <u>Community</u><br>Cancer risks: **8.1 x $10^{-5}$**<br>(81 extra incidence in 1,000,000 people) |
| **Time to reach RAOs** | **2.8 years**<br>Including 1 yr for RD | **2.8 years**<br>Including 1 yr for RD | **5.0 years**<br>Including 1.3 yr for RD | **8.3 years**<br>Including 1.3 yr for RD | **4.1 years**<br>Including 1.5 yr for RD | **14.6 years**<br>Including 1.3 yr for RD | **14.8 years**<br>Including 1.3 yr for RD |
| **Estimated Costs** | Present Worth[4]: **$71,000,000**<br>Capital Construction: **$75,000,000**<br>OM&M per year: **$176,000 to $389,000** | Present Worth[4]: **$90,000,000**<br>Capital construction: **$96,000,000**<br>OM&M per year: **$176,000 to $389,000** | Present Worth[4]: **$236,000,000**<br>Capital construction: **$274,000,000**<br>OM&M per year: **$176,000 to $389,000** | Present Worth[4]: **$287,000,000**<br>Capital construction: **$379,000,000**<br>OM&M per year: **$176,000 to $389,000** | Present Worth[4]: **$165,000,000**<br>Capital construction: **$187,000,000**<br>OM&M per year: **$176,000 to $389,000** | Present Worth[4]: **$455,000,000**<br>Capital construction: **$695,000,000**<br>OM&M per year: **$176,000 to $340,000** | Present Worth[4]: **$391,000,000**<br>Capital construction: **$591,000,000**<br>OM&M per year: **$182,100 to $444,100** |

[1] The No Action Alternative is evaluated in the FFS and since it was found to not be protective of human health and the environment, it is not included on this summary table.

[2] For all evaluated alternatives, the long-term residual cancer risk after 1,000 years falls within or bellow EPA's risk range of $10^{-4}$ to $10^{-6}$.

[3] Removal/disturbance of North Quarry involves disturbance of newer waste and increased odors, bird-strike risks, and increased risk of an exothermic event as a result of oxygen intrusion.

[4] Present Worth presented using 7% Discount Rate per OSWER Dir. No. 9355.0-75 (July 2000).