Executive Summary of the Supplemental Feasibility Study

Radiological-Impacted Material Excavation Alternatives Analysis West Lake Landfill Operable Unit-1

Prepared on behalf of

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Executive Summary

The West Lake Landfill is a 200 acre, closed solid waste disposal facility that accepted wastes for on-site landfilling from the 1940's or 1950's through 2005. Operable Unit-1 (OU-1) addresses two disposal areas (Areas 1 and 2) where radionuclides are mixed within landfilled soil and solid waste materials, plus an adjacent area (the Buffer Zone/Crossroad Property) where erosion from Area 2 deposited radiologically-impacted materials (RIM). Operable Unit-2 (OU-2) consists of the remainder of the site including areas never used for landfilling, several inactive fill areas containing sanitary waste or demolition debris which were closed prior to state regulation, and a permitted sanitary landfill currently undergoing closure under the State of Missouri's solid waste regulatory program.

Consistent with the National Oil and Hazardous Substance Contingency Plan (NCP), 40 CFR § 300.430 (EPA, 2009a), a Remedial Investigation (RI) and Feasibility Study (FS) were previously completed for OU-1 and approved by the United States Environmental Protection Agency (EPA) in 2006. Based on those reports, EPA developed a Proposed Plan for OU-1 and, after an extended public comment process including three public meetings, issued a Record of Decision (ROD) in 2008. The ROD-selected remedy called for containing the RIM and solid waste materials with a new multi-layered engineered landfill cover system, long-term operation and maintenance and environmental monitoring, and land use controls including deed restrictions.

In January 2010, EPA determined that a Supplemental Feasibility Study (SFS) should be prepared for OU-1 to evaluate two additional potential remedial alternatives. Specifically, EPA requested that the OU-1 Respondents perform an updated engineering and cost analysis of the ROD-selected remedy, and a similar analysis of two new alternatives which would excavate all RIM in excess of a specified cleanup level from OU-1 and either send the excavated materials to a permitted, out-of-state landfill for disposal ("complete rad removal" with off-site disposal), or re-dispose of the excavated material in a new engineered landfill cell to be built within the boundaries of the West Lake Landfill site ("complete rad removal" with on-site disposal).

This Executive Summary summarizes the findings and conclusions of the SFS. Briefly stated:

- All three remedial alternatives -- the ROD-selected remedy and both "complete rad removal" alternatives -- meet EPA's criteria for long-term protection of human health, welfare and the environment.

- The ROD-selected remedy and the "complete rad removal" with off-site disposal alternatives appear implementable. The "complete rad removal" with on-site disposal alternative has potential implementability issues caused by proximity to Lambert-St. Louis International Airport and regulatory and contractual restrictions on the disposal of putrescible solid waste near the Airport's runways. The two "complete rad removal" alternatives also pose a greater potential bird or other wildlife hazard to aircraft and airport facilities because performing either would open up larger areas of the landfilled waste to excavation and take longer to complete than the ROD-selected remedy.

- While all three alternatives have long-term risks within EPA's acceptable risk range, the risks (at 1,000 years) of the "complete rad removal" with off-site disposal alternative are better than the other two alternatives.

- The short-term risks to on-site workers and to the community are worse under either of the "complete rad removal" alternatives than under the ROD-selected remedy, and short-term risks to workers associated with the "complete rad removal" alternatives are outside of EPA's acceptable risk range.

- The time required to implement the ROD-selected remedy is the shortest, followed by the off-site and then the on-site "complete rad removal" disposal alternatives.

- The cost estimate for the ROD-selected remedy is the lowest, followed by the on-site and then the off-site "complete rad removal" disposal alternatives.

Table ES-1 summarizes in numerical format the results of the SFS evaluation of long-term risks, short-term risks, time to achieve the remedial action objectives, and the anticipated costs of each of the alternatives.

Table ES-1 SUMMARY OF POTENTIAL RISKS, IMPLEMENTATION SCHEDULES AND COSTS
WEST LAKE LANDFILL SFS REMEDIAL ALTERNATIVES

	ROD-Selected Remedy	"Complete Rad Removal" with Off-site Disposal	"Complete Rad Removal" with On-Site Disposal
Long term residual cancer risk 1,000 years after cleanup	1.3×10^{-6} (1.3 extra incidences in 1,000,000 people)	$<1 \times 10^{-7}$ (less than 0.1 extra incidence in 1,000,000 people)	1.5×10^{-6} (1.5 extra incidences in 1,000,000 people)
Short term risks during cleanup	On-Site Workers Industrial accidents: 4.7 Cancer risk: 7.2×10^{-5} (0.72 extra incidences in 10,000 people) Worker dose: 50 mrem/yr	On-Site Workers Industrial accidents: 7.6 Cancer risks: 7.6×10^{-4} (7.6 extra incidences in 10,000 people) Worker dose: 260 mrem/yr	On-Site Workers Industrial accidents: 9.0 Cancer risks: 7.4×10^{-4} (7.4 extra incidences in 10,000 people) Worker dose: 260 mrem/yr
	Community Transportation accidents: 0.61 Cancer risk: 3.3×10^{-6} (0.33 extra incidences in 100,000 people) Carbon dioxide emissions: 8,350 tons	Community Transportation accidents: 1.4 Cancer risks: 2.1×10^{-5} (2.1 extra incidences in 100,000 people) Carbon dioxide emissions: 35,400 tons	Community Transportation accidents: 0.79 Cancer risks: 2.0×10^{-5} (2.0 extra incidences in 100,000 people) Carbon dioxide emissions: 17,900 tons
Schedule to reach cleanup goals	3 years (or 5 years at spend rate of $10M per year)	4 years (or 29 years at spend rate of $10M per year)	6 years (or 13 years at spend rate of $10M per year)
Costs	Capital construction: $41,400,000 OM&M per year: $42,000 to $414,000	Capital construction: $259,000,000 to $415,000,000 OM&M per year: $40,000 to $412,000	Capital construction: $117,000,000 OM&M per year: $52,000 to $604,000

A. Specifics of the ROD -Selected Remedy and the "Complete Rad Removal" Remedial Alternatives

1) <u>ROD-Selected Remedy</u>

The ROD-selected remedy for OU-1 would protect human health and the environment through a new multi-layered engineered landfill cover system and institutional controls for the landfilled waste materials. A description of and reasons for selection of this remedy are presented in EPA's ROD for OU-1 (EPA, 2008a). The engineered cover and institutional control measures would prevent human receptors from contacting the waste material. The source control measures also would mitigate contaminant migration to air and restrict infiltration of precipitation into the landfill, which contributes to protection of groundwater quality.

The major components of the ROD-selected remedy for OU-1 are as follows:

- Installation of a landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills including enhancements consistent with the standards for uranium mill tailing sites, i.e., armoring layer and radon barrier;
- Consolidation of radiologically contaminated surface soil from the Buffer Zone/Crossroad Property to the containment area;
- Application of groundwater monitoring and protection standards consistent with the requirements for uranium mill tailing sites and sanitary landfills;
- Surface water runoff control;
- Gas monitoring and control including radon and decomposition gas, as necessary;
- Institutional controls to prevent land and resource uses that are inconsistent with a closed sanitary landfill containing long-lived radionuclides; and
- Long-term surveillance and maintenance of the remedy.

Performance standards for each of the remedy components are specified in the ROD.

As a result of subsequent discussions between EPA Region 7 and EPA's Office of Superfund Remediation and Technology Innovation (OSRTI), additional performance standards have been identified for the ROD-selected remedy. The SFS analysis incorporates those additional performance standards, along with other information obtained during development of a draft remedial design work plan, for the ROD-selected remedy.

2) <u>Definition of "Complete Rad Removal"</u>

In a January 11, 2010, letter and associated Statement of Work (SOW), EPA specified the two "complete rad removal" alternatives to be evaluated as part of the SFS (in addition to the ROD-selected remedy) as follows:

1. Excavation of radioactive materials with off-site commercial disposal of the excavated materials (referred to as “complete rad removal” with off-site disposal alternative); and

2. Excavation of radioactive materials with on-site disposal of the excavated materials in an on-site engineered disposal cell with a liner and cap if a suitable location outside the geomorphic flood plain can be identified (referred to as “complete rad removal” with on-site disposal alternative).

EPA indicated that “complete rad removal” means attainment of the risk-based radiological cleanup levels specified in U.S. EPA’s Office of Solid Waste and Emergency Response (OSWER) Directives 9200.4-25 and 9200.4-18 (EPA, 1998a and 1997a).

Although the new excavation alternatives have been termed “complete rad removal,” implementation of either of these alternatives would not actually remove all RIM from the site, but instead would remove sufficient RIM from OU-1 such that additional engineering and institutional controls would not be required based on the radiological content of these areas. Because Areas 1 and 2 would still contain landfilled solid wastes after removal of the RIM, regrading and capping the landfills and establishing land use controls at Areas 1 and 2 would still be necessary.

3) <u>“Complete Rad Removal” with Off-Site Disposal Alternative</u>

The “complete rad removal” with off-site disposal alternative includes the following components:

- Excavating and stockpiling uncontaminated soil and waste (overburden) in Areas 1 and 2 in order to access the RIM, then excavating RIM from Areas 1 and 2 until the level of remaining radionuclides is low enough to allow for unrestricted use based on the presence of radionuclides. This excavation stage also includes surveying and identifying the presence and extent of RIM on the Buffer Zone/Crossroad Property, with excavation of any RIM that contains radionuclides at levels greater than those that would allow for unrestricted use;

- Surface water runoff control;

- Loading, transporting cross-country, and disposing of excavated RIM and impacted soil at an off-site disposal facility;

- Replacing the stockpiled overburden and regrading the remaining solid waste materials, then installing a landfill cover meeting the Missouri Department of Natural Resources (MDNR) closure and post-closure care requirements for sanitary landfills over Areas 1 and 2;

- Application of groundwater monitoring and protection standards consistent with the requirements for uranium mill tailing sites and sanitary landfills;

- Gas monitoring and control, as necessary;
- Institutional controls to prevent land and resource uses that are inconsistent with a closed sanitary landfill; and
- Long-term surveillance and maintenance of the remedy.

4) <u>"Complete Rad Removal" with On-Site Disposal Alternative</u>

The "complete rad removal" with on-site disposal alternative includes the following components:

- Excavating stockpiled soil from the current OU-2 on-site soil borrow and stockpile area and relocating the soil material to the area of the previously closed leachate lagoon, then constructing the liner system for the on-site engineered disposal cell at the site of the current OU-2 on-site soil borrow and stockpile area;
- Excavating and stockpiling uncontaminated soil and waste (overburden) in Areas 1 and 2 in order to access the RIM, then excavating from Areas 1 and 2 RIM materials that contain radionuclides above levels would allow for unrestricted use based on the presence of radionuclides;
- Surveying and identifying the presence and extent of RIM on the Buffer Zone/Crossroad Property, and excavating any RIM that contains radionuclides at levels greater than those that would allow for unrestricted use;
- Loading and transporting the excavated RIM and impacted soil to the on-site engineered disposal cell and placement and compaction of the RIM in the cell, then closing the on-site cell with a final cover configuration consistent with both the MDNR solid waste regulations and Uranium Mine Tailings Radiation Control Act (UMTRCA) requirements, plus leachate monitoring and control for the on-site cell, as necessary;
- Replacing the stockpiled overburden and regrading the remaining solid waste materials in Areas 1 and 2, then installing a landfill cover meeting the Missouri closure and post-closure care requirements for sanitary landfills over Areas 1 and 2;
- Surface water runoff control;
- Application of groundwater monitoring and protection standards consistent with the requirements for uranium mill tailing sites and sanitary landfills;
- Gas monitoring and control including radon and decomposition gas, as necessary;
- Institutional controls to prevent land and resource uses that are inconsistent with a closed sanitary landfill containing long-lived radionuclides; and
- Long-term surveillance and maintenance of the remedy.

B. Detailed Evaluation of Remedial Alternatives

The two "complete rad removal" alternatives along with the ROD-selected remedy were evaluated using the threshold and primary balancing criteria set forth in the NCP. These criteria include the following:

- Threshold Criteria:
  - Overall Protection of Human Health and the Environment;
  - Compliance with applicable or relevant and appropriate requirements (ARARs) of other regulations.

- Primary Balancing Criteria:
  - Long-term Effectiveness and Permanence;
  - Reduction of Toxicity, Mobility, or Volume through Treatment;
  - Short-term Effectiveness;
  - Implementability; and
  - Cost.

The NCP also requires EPA to evaluate remedial alternatives in terms of two Modifying Criteria -- state and community acceptance. Pursuant to EPA direction, state and community acceptance are not evaluated in the SFS but will be considered as part of any decision process that may be undertaken by EPA after completion of the SFS.

C. Results of the Detailed Evaluation of the Remedial Alternatives

Each SFS-specific alternative was evaluated against the seven NCP criteria listed above. A comparative analysis of the alternatives was also performed to identify the relative advantages and disadvantages of each alternative and trade-offs among the alternatives in terms of the NCP criteria.

1) <u>Protection of Human Health and the Environment</u>

All of the alternatives are protective of human health and the environment. Installation of a new multi-layer engineered landfill cover system at Areas 1 and 2 pursuant to the ROD-selected remedy and excavation of RIM under both "complete rad removal" alternatives would reduce potential risks from exposure to external gamma radiation or radon gas emissions from the RIM. Likewise, installation of a multi-layer engineered landfill cover over a new engineered disposal cell as part of the "complete rad removal" with on-site disposal alternative would reduce potential risks from exposure to external gamma radiation or radon gas emissions from excavated RIM.

Installation of a new multi-layer engineered landfill cover over Areas 1 and 2 is included as part of all of the alternatives and would eliminate potential risks associated with non-radiological contaminants via inhalation or ingestion of contaminated soils or wastes, dermal contact with contaminated soils or wastes, and wind dispersal of fugitive dust. Installation of such a cover over Areas 1 and 2 also would greatly reduce the potential for infiltration of water via rain or snow precipitation and thus the potential for leaching of contaminants from wastes into groundwater. Finally, installation of a liner system beneath a new, engineered disposal cell included in the “complete rad removal” with on-site disposal alternative would further reduce the potential for leaching to groundwater for those waste materials that are placed in the cell.

2) Compliance with ARARs

The SFS analyzed each alternative’s compliance with the three types of ARARs identified by the NCP: chemical specific, location-specific, and action-specific (*i.e.*, inherent in the cleanup option under evaluation).

All of the alternatives will meet chemical-specific ARARs consisting of: the uranium mill tailings and National Emissions Standard for Hazardous Air Pollutants (NESHAP) standards for radon emissions; the uranium mill tailings standards for cleanup of contaminated land (Buffer Zone/Crossroad property), as modified by the EPA OSWER directives regarding use of these standards at Superfund sites; Missouri state radiation protection standards; the maximum concentrations for groundwater protection under the uranium mill tailing standards; and the Missouri maximum contaminant levels (MCLs) for groundwater.

The ROD-selected remedy and the “complete rad removal” with off-site disposal alternative would meet the location-specific ARARs found in the Missouri solid waste regulations for landfills located within a 100-year floodplain or within 10,000 feet of an airport runway. The “complete rad removal” with on-site disposal alternative could be designed to meet most but possibly not all of the location-specific ARARs and To-Be-Considered (TBC) criteria. The on-site engineered disposal cell alternative would not meet a Federal Aviation Administration (FAA) advisory criterion (a TBC) for siting new landfill units within certain distances of airports. In addition, siting the on-site engineered disposal cell in the only location which satisfies EPA’s instructions (located on-site and outside the geomorphic floodplain) also would conflict with the Negative Easement and Restrictive Covenant (Restrictive Covenant) previously purchased by the City of St. Louis from the site owners. The Restrictive Covenant prohibits any new or additional deposition or dumping of municipal waste, organic waste, and putrescible waste above, upon, on, or under the West Lake property in order to reduce or mitigate wildlife hazards to aircraft and airport facilities. The Restrictive Covenant is not a federal or state regulation and so is not an ARAR, but may qualify as a TBC.

Finally, the ROD-selected remedy and the “complete rad removal” with off-site disposal alternative would meet the requirements of all action-specific ARARs, while the “complete rad removal” with on-site disposal alternative would meet most but not all of these requirements. All three alternatives would meet the Missouri closure and post-closure standards for solid waste landfills, the Missouri radiation protection standards, and the Missouri noise protection standards during implementation of a remedial action and closure of Areas 1 and 2. The new engineered disposal cell included in the “complete rad removal” with on-site disposal alternative would meet the Missouri solid waste regulations for design, operation, closure and post-closure standards for a new solid waste landfill; however, it would not meet the prohibition against disposal in a solid waste cell of radioactively-contaminated material resulting from the cleanup of a radioactively-contaminated waste disposal site. There does not appear to be a basis for waiver of this requirement.

3) Long-Term Effectiveness and Permanence (Including Long-Term Risks)

All of the alternatives result in waste materials remaining on site and therefore require the installation, maintenance and monitoring of one or more landfill caps (engineered containment structures) and land use controls. Under the “complete rad removal” with off-site disposal alternative, no RIM would remain on site at levels above those that would allow for unrestricted use relative to the presence of radionuclides.

Engineered containment is the primary method that would be used to control both radiological and non-radiological waste materials that remain on site. The primary engineering measures included in all three alternatives are construction, inspection, and maintenance of multi-layer engineered landfill cover systems (*i.e.*, caps) over Areas 1 and 2.

Under the ROD-selected remedy, the new cap would be designed to reduce potential exposures to gamma radiation and to reduce actual radon emissions to acceptable levels, including the expected increased levels of gamma radiation and radon emissions that will occur with 1,000 years of radioactive decay of thorium. The new cap would also prevent potential exposure to non-radiological contaminants in the Areas 1 and 2 solid waste landfill materials. Under the “complete rad removal” with on-site disposal alternative, the RIM would be excavated and placed in a new engineered on-site disposal cell that would be designed to achieve the same results – reduce potential exposures to current and 1,000 year levels of gamma radiation and radon emissions. Lastly, the “complete rad removal” with off-site disposal alternative would excavate and transport the RIM off-site for disposal, thereby reducing on-site potential exposures to gamma radiation and radon emissions. Both the on-site and the off-site “complete rad removal” disposal alternatives would also include the construction, inspection and maintenance of a cap over Areas 1 and 2 after RIM removal to protect against exposure to non-radiological contaminants remaining in these solid waste landfills.

The engineering measures implemented under each alternative would be augmented and supported by maintenance of current land use restrictions in place at the site, plus implementation of additional institutional controls as necessary. Institutional controls would limit future uses of the land and resources at the site so as to eliminate or restrict potential exposure to the wastes or contaminated media, and to reduce the potential for future land uses which could impact or reduce the effectiveness of the engineered measures.

The long-term (1,000 year) non-cancer risks associated with each of the alternatives are essentially the same, and the residual cancer risks posed are below or within EPA’s target risk range of 1 additional cancer incidence in 1,000,000 people [1×10^{-6}] to 1 additional incidence in 10,000 people [1×10^{-4}].

4) Reduction of Toxicity, Mobility or Volume Through Treatment

None of the alternatives include treatment technologies that would reduce the toxicity, mobility, or volume of the waste materials through treatment. Treatment technologies are generally not applicable to solid waste landfills because of the large volume of waste which is deposited in a landfill. For the RIM interspersed within the solid waste at OU-1, the radionuclides are naturally occurring elements (primarily isotopes of uranium, thorium, radium and daughter decay products such as radon), which cannot be neutralized or destroyed by treatment. The radionuclides within Areas 1 and 2 are intermixed with soil material which is further dispersed throughout an overall matrix of municipal refuse, construction and demolition debris, and other nonimpacted soil materials. Consequently, separating and removing the RIM from the landfill matrix for above-ground, ex-situ treatment techniques are considered impracticable. In addition, the uneven, heterogeneous nature of the solid waste materials and the unpredictable dispersal of the radionuclides within the overall solid waste matrix make underground treatment in place using in-situ treatment techniques equally impracticable.

It is theoretically possible to reduce the volume of materials handled as RIM (but not the overall total volume of waste materials in Areas 1 and 2) by using a physical separation processes such as shredding and sorting. While not specifically a "treatment" process, this physical separation process could potentially be employed for the excavation alternatives to reduce the volume of RIM that would be transported to an off-site disposal facility or to an on-site disposal cell. Because such physical separation processes have never been used at a solid waste landfill that contains radiologically-impacted soil, no data exists regarding the potential effectiveness, implementability or cost of using such technologies at this site.

5) Short-Term Effectiveness (Including Short-Term Risks and Schedules)

The greatest potential risks to the community are associated with the "complete rad removal" with off-site disposal alternative. These risks arise largely from the much greater number of truck trips associated with off-site disposal, leading to increased traffic congestion on St. Charles Rock Road and other nearby highways and the associated potential for traffic accidents and fatalities, plus greater greenhouse gas emissions, and greater noise impacts. The projected incidence of traffic accidents is 140% for the "complete rad removal" with off-site disposal alternative, compared to 61% for the ROD-selected remedy and 79% for the "complete rad removal" with on-site disposal alternative. If an on-site rail spur is determined to be feasible (i.e., if it is possible to obtain permits to build an at-grade crossing over St. Charles Rock Road, purchase or lease off-site land for construction of the spur on the other side of the road, and negotiate tie-in and use rights to an existing private rail spur or line), then the projected incidence of traffic accidents for the "complete rad removal" with off-site disposal would decrease slightly to 130%.

In addition, the "complete rad removal" with off-site disposal alternative is the only alternative that includes the potential for an off-site release resulting from potential vehicle accidents or other losses of vehicle or container integrity during cross-country material transport, handling and transfer activities. Projected carbon dioxide (greenhouse gas) emissions are also substantially greater for the "complete rad removal" with off-site disposal alternative: 35,400 tons of carbon dioxide compared to 8,350 tons and for the ROD remedy and 17,900 tons for the “complete rad removal” with on-site disposal alternative.

Another potential local risk considered was from fugitive dust emissions during implementation of each alternative. Potential carcinogenic risks to local community residents resulting from fugitive dust emissions during project construction (assuming no mitigation measures are employed or the mitigation measures prove ineffective) are greatest for the “complete rad removal” alternatives, estimated at 2 additional cancer incidences in 100,000 people [2×10^{-5}] for the on-site and 2.1 additional cancer incidences in 100,000 people [2.1×10^{-5}] for the off-site alternatives, compared with 0.33 additional cancer incidences in 100,000 [3.3×10^{-6}] from the ROD-selected remedy. However, the potential carcinogenic risks to off-site residents for all three alternatives are within EPA’s range of acceptable risks (10^{-4} to 10^{-6}).

The highest potential risks to on-site workers are also associated with the two “complete rad removal” alternatives due to the greater amount of handling of RIM required for these alternatives. In addition, because implementation of the excavation remedies will take longer than the ROD-selected remedy, those two alternatives would subject workers to gamma radiation exposures over a longer time period.

The projected incidence of industrial accidents is greater for the two “complete rad removal” alternatives (7.6 for the off-site and 9 for the on-site alternatives) compared to those for the ROD-selected remedy (4.7). The potential risks to workers from exposure to carcinogenic substances and gamma radiation is ten times higher for the “complete rad removal” alternatives: 7.6 extra incidences in 10,000 people for the off-site and 7.4 for the on-site “complete rad removal” alternatives (7.6 and 7.4×10^{-4}, respectively), compared to 0.72 extra incidences in 10,000 people (7.2×10^{-5}) for the ROD-selected remedy. The gamma exposure to an on-site worker is projected to be 260 millirems per year (mrem/year) for either the off-site and on-site “complete rad removal” alternatives, compared with only 50 mrem/year of projected exposure under the ROD-selected remedy. The “complete rad removal” alternatives pose the greatest risks to on-site workers due to the greater amount (both in degree and duration) of handling of waste materials generally, and RIM specifically, required for these alternatives.

No measurable long-term impacts to plants or animals in surrounding ecosystems are expected to occur from any of the alternatives.

For each of the SFS-specific alternatives, Remedial Action Objectives (RAOs) would be achieved upon completion of construction, which is estimated at the following time frames (calculated from EPA’s issuance of notice to proceed with remedial design):

- approximately 3 years for the ROD-selected remedy,
- approximately 4 years for the “complete rad removal” with off-site disposal alternative, and
- approximately 6 years for the “complete rad removal” with on-site disposal alternative.

These estimated durations assume that remedial design (RD) for each alternative can be completed and approved within one year of remedy approval and authorization to begin the RD phase, and that construction of the remedy is not fiscally constrained. Under a fiscally constrained approach in which project expenditures are limited to $10 million per year, the estimated time frames for remedial design and construction completion increase to 5 years for the ROD-selected remedy, 29 years for the "complete rad removal" with off-site disposal alternative, and 13 years for the "complete rad removal" with on-site disposal alternative.

6) Implementability

All of the alternatives would use standard technologies that are routinely applied at closed sanitary landfills such as regrading or excavating portions of the landfill mass, installation and maintenance of an engineered landfill cover, monitoring of landfill gas and groundwater quality, fencing and other access restrictions, and institutional controls. Each alternative therefore is considered to be technically implementable. For the two "complete rad removal" alternatives, questions arise regarding the ability to remove all of the RIM from Area 2 due to the depth of the RIM and proximity of the RIM to closed or inactive landfill units at OU-2. Excavation of RIM would also present significant implementability concerns associated with the excavation and handling of non-radiological contaminated materials; management of fugitive dust and potential odors; mitigation of bird and wildlife hazards; management and treatment of stormwater exposed to RIM during excavation; management of liquid RIM that fails the paint filter liquids test; and the identification, segregation, and disposal off-site of any hazardous wastes or regulated asbestos containing materials (ACM) that may be encountered during RIM excavation.

The Restrictive Covenant held by the City of St. Louis for the benefit of Lambert-St. Louis International Airport could affect the administrative implementability of the "complete rad removal" with on-site disposal alternative. The greater areal extent of refuse that would be disturbed under the two "complete rad removal" alternatives, combined with the greater amount of time required to implement these two alternatives, poses the greatest potential for creation of wildlife hazards to the nearby Lambert-St. Louis International Airport. In addition, the Missouri solid waste regulatory prohibition against the disposal of radioactively-contaminated material resulting from the cleanup of radioactively-contaminated sites in a solid waste landfill cell could also affect the administrative implementability of this alternative.

7) Cost

The final balancing criterion is cost.

- The ROD-selected remedy would result in the lowest overall capital (design, construction and environmental monitoring during construction) costs of all of the alternatives at $41 million, with estimated annual operation, maintenance and monitoring (OM&M) costs ranging from $42,000 to $414,000.

- Implementation of the "complete rad removal" with off-site disposal alternative would result in the highest total capital cost at $259 to $415 million (depending upon which off-site disposal facility is used), with estimated annual OM&M costs of $40,000 to $412,000.

- Implementation of the "complete rad removal" with on-site disposal alternative would result in a capital cost of $117 million, with estimated annual OM&M costs of $52,000 to $604,000.

Ranges in values for the annual OM&M costs result from variations in the specific activities that occur each year (e.g. additional monitoring, maintenance repairs or five-year reviews).