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Screening and Comparison of Remedial Alternatives for the South Field and Flyash Piles at the Fernald Site

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ABSTRACT

The South Field, the Inactive Flyash Pile, and the Active Flyash Pile are in close proximity to each other and are part of Operable Unit 2 (OU2) at the Fernald Environmental Management Project (FEMP). The baseline risk assessment indicated that the exposure pathways which pose the most significant risk are external radiation from radionuclides in surface soils and use of uranium contaminated groundwater. This paper presents screening and comparison of various remedial alternatives considered to mitigate risks from the groundwater pathway. Eight remedial alternatives were developed which consisted of consolidation and capping, excavation and off-site disposal with or without treatment, excavation and on-site disposal with or without treatment and combinations of these.

Risk-based source (soil) preliminary remediation levels (PRLs) and waste acceptance criteria (WACs) were developed for consolidation and capping, excavation, and on-site disposal cell. The PRLs and WACs were developed using an integrated modeling tool consisting of an infiltration model, a surface water model, a vadose zone model, and a three-dimensional contaminant migration model in saturated media. The PRLs and WACs were then used to determine need for soil treatment, determine excavation volumes, and screen remedial alternatives. The selected remedial alternative consisted of excavation and on-site disposal with off-site disposal of the fraction exceeding the WAC.

INTRODUCTION

The Fernald Environmental Management Project (FEMP) is a 1,050-acre, U.S. Department of Energy (DOE) facility located approximately 18 miles northwest of Cincinnati, Ohio, near the small rural community of Fernald. The primary mission of the facility, which operated from 1952 to 1989, was to provide high-purity uranium metal products to support U.S. defense programs. As a result of these processes, the facility generated radioactive and non-radioactive wastes. In 1989, the facility was placed on the National Priorities List by the U.S. Environmental Protection Agency (EPA). A Consent Agreement was signed by DOE and EPA in 1990 and was amended in 1991. A Remedial Investigation/Feasibility Study (RI/FS) program was initiated pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

To promote a more structured and expeditious cleanup of the FEMP, the facility and environmental issues associated with the project are being managed as five operable units (Figure 1):

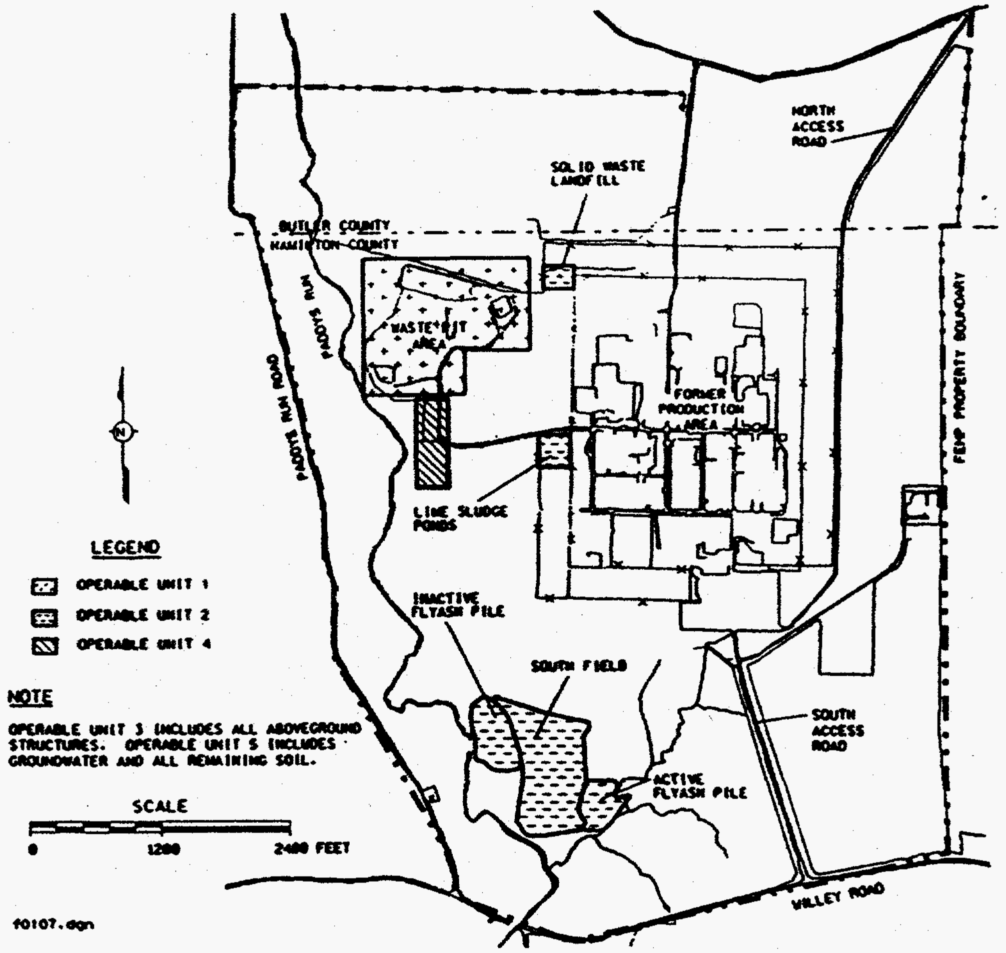

Figure 1. FEMP Site Map and RI/FS Operable Units

- Operable Unit 1 - Waste Pit Area
- Operable Unit 2 - Other Waste Areas
- Operable Unit 3 - Former Production Area
- Operable Unit 4 - Silos 1 through 4
- Operable Unit 5 - Environmental Media (groundwater, surface water, and remaining soils)

Operable Unit 2 (OU2) consists of five subunits, located in different parts of the FEMP (Figure 1): the Solid Waste Landfill, North and South Lime Sludge Ponds, Inactive Flyash Pile, Active Flyash Pile, and South Field. The flyash piles and the South Field are in close proximity to each other and constitute the Site which is the subject of this paper.

A baseline risk assessment was conducted as part of the OU2 RI (DOE, 1995a). Risk was evaluated in the context of four land-use scenarios:

- Current land use with DOE ownership and control of public access
- Current land use without DOE access control
- Future land use assuming federal ownership
- Future land use assuming private ownership

For the private ownership land-use scenario, the incremental lifetime cancer risk (ILCR) for the on-property resident farmer due to exposure to all media and all pathways was 3.4×10^{-2} for the South Field, 1.5×10^{-3} for the Inactive Flyash Pile, and 5×10^{-5} for the Active Flyash Pile.

The baseline risk assessment indicated that the exposure pathways which pose the most significant risk are external radiation from radionuclides in surface soils and use of uranium contaminated groundwater. This paper presents screening and comparison of various remedial alternatives considered to mitigate risks from soils through the groundwater pathway. Remediation of groundwater was considered as part of Operable Unit 5 and not discussed here.

SITE HYDROGEOLOGY

The geology at the FEMP is dominated by glacial sediments. The Great Miami Aquifer (GMA), the principal regional aquifer, consists of extensive deposits of well sorted sand and gravel glacial outwash ranging in thickness from 120 to 200 feet. The GMA is designated as a sole-source aquifer. Figure 2 is a generalized cross-section at the FEMP. A relatively continuous, 1 to 20 feet thick, clay interbed divides the GMA. A sequence of fine grained till deposits interbedded with sand and gravel glaciofluvial stringers forms the glacial overburden at the FEMP. Glacial till, where present, separate the fill material and GMA at the Site.

Soil boring data indicate that the undisturbed glacial overburden thins and does not extend beneath the far west and southern half of the Site. The inferred extent of the undisturbed glacial overburden is shown on Figure 3. Perched water has been observed at the interface of brown and gray till. Brown till was suspected to be weathered and was not considered to retard contaminant migration. Two seeps, one on the western boundary of the Inactive Flyash Pile and one on eastern side of the South Field, have been observed after the rainfall. These seeps are known to contain elevated uranium concentrations.

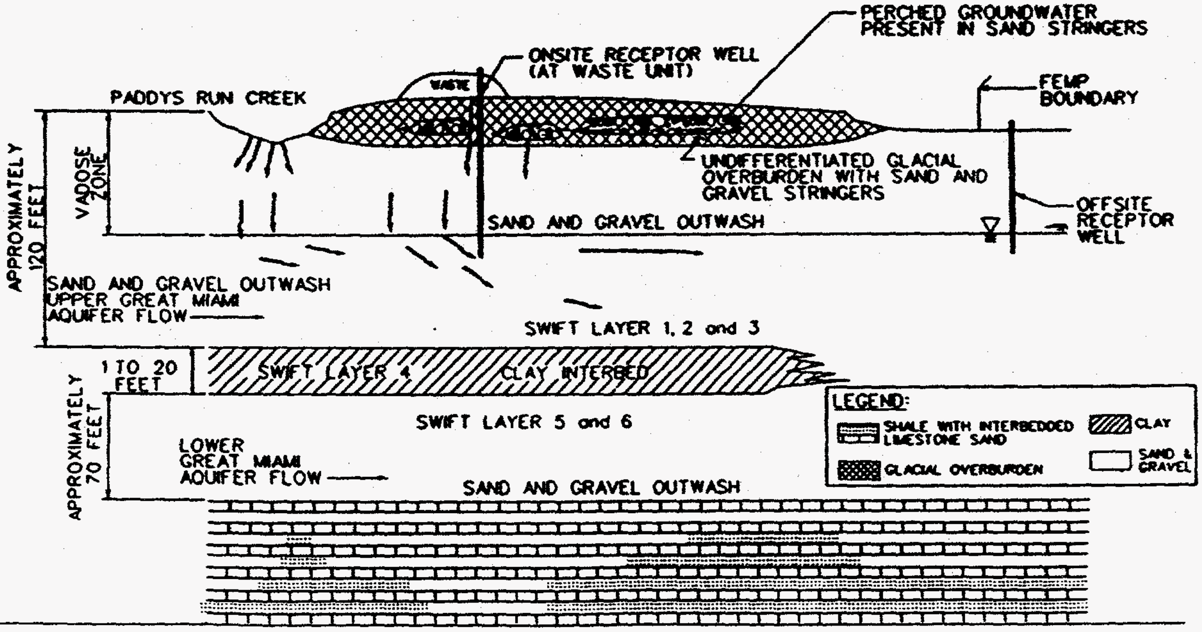

Figure 2. Generalized Cross-section at the FEMP

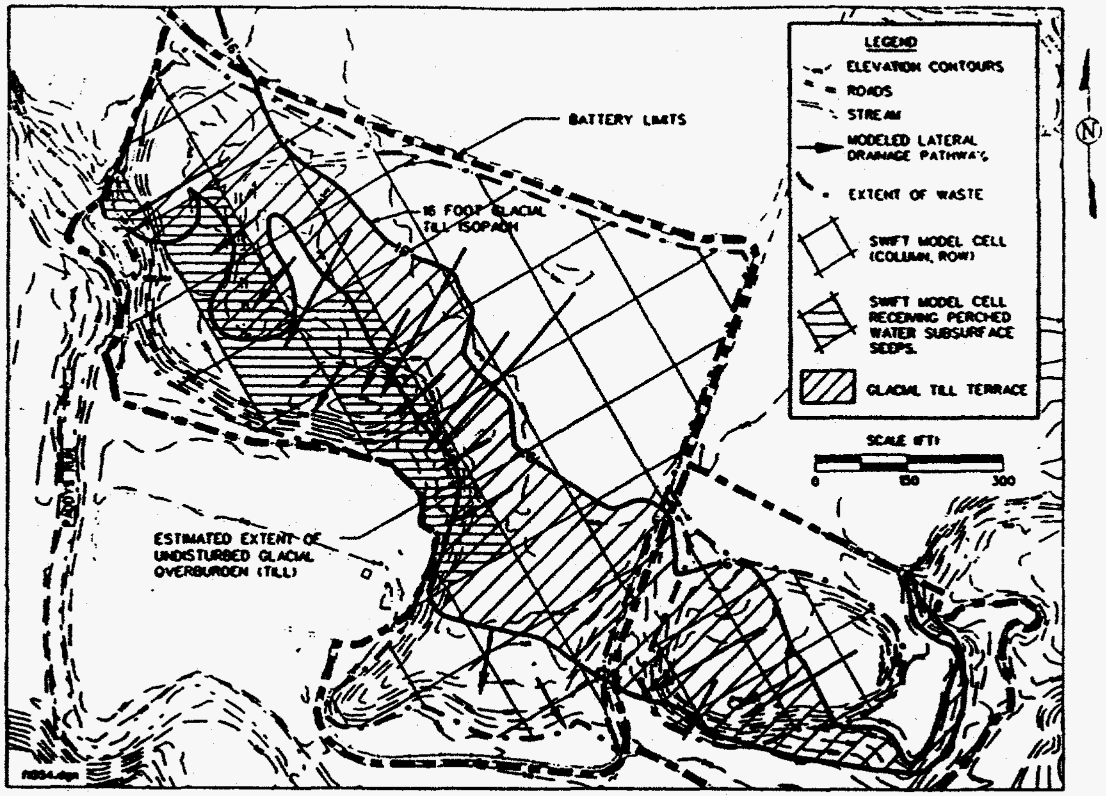

Figure 3. Contours of Undisturbed Glacial Till Thickness

NATURE AND EXTENT OF CONTAMINATION

The Inactive Flyash Pile was reportedly used for the disposal of ash from the boiler plant, building rubble, concrete, asphalt, steel rebar, and asbestos containing transite between 1952 and mid-1960s (DOE, 1995b). The Active Flyash Pile received approximately 65,000 cubic yard of ash from boiler plant since mid-1960s. The South Field was reportedly used as a burial area for FEMP nonprocess wastes such as flyash, on-site construction/demolition rubble, and soils that may have contained low levels of radioactivity. Approximately 120,000, and 96,000 cubic yard of waste was placed in the South Field and Inactive Flyash Pile, respectively. Contours of waste thickness are shown on Figure 4. Aerial photographs and interviews with workers indicate that the flyash was deposited by dump trucks as in-filling of depressions in the till surface.

Extensive investigations conducted at the Site revealed that waste contained radionuclides, metals, and semi-volatile compounds. Baseline risk assessment indicted that uranium is the only contaminant of concern for the groundwater pathway at this Site. Uranium concentrations varied as a function of location and depth. Figure 5 shows the uranium distribution along two cross-section in an area of the Inactive Flyash Pile and the South Field with high radionuclide activities. A contour line for background uranium concentration (1.22 pCi/g) is also shown for reference. The analytical results suggests that waste were deposited over a different time period and in different locations. Maximum uranium concentrations of 1570 pCi/g was detected at the Site. Analytical data indicate that the migration of uranium contamination into the gray till is confined to about 4.25 ft and 2 ft below the fill/till interface at the South Field and flyash piles.

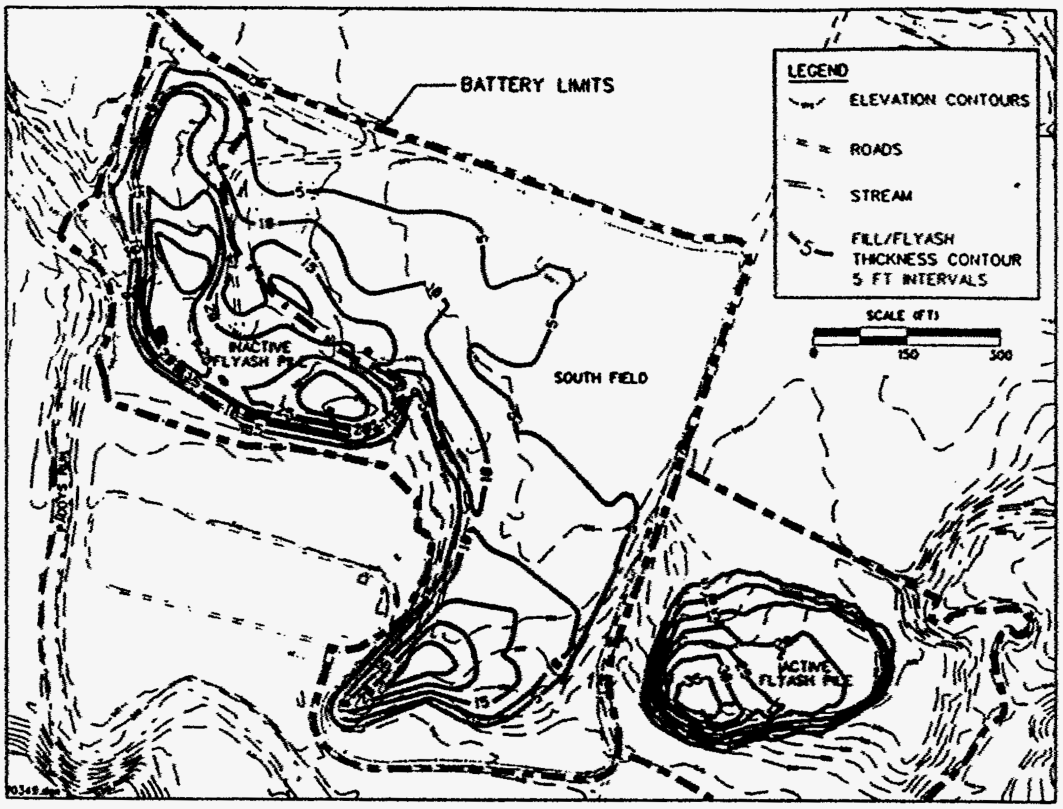

Figure 4. Fill/Flyash Thicknesses at the South Field and Flyash Piles

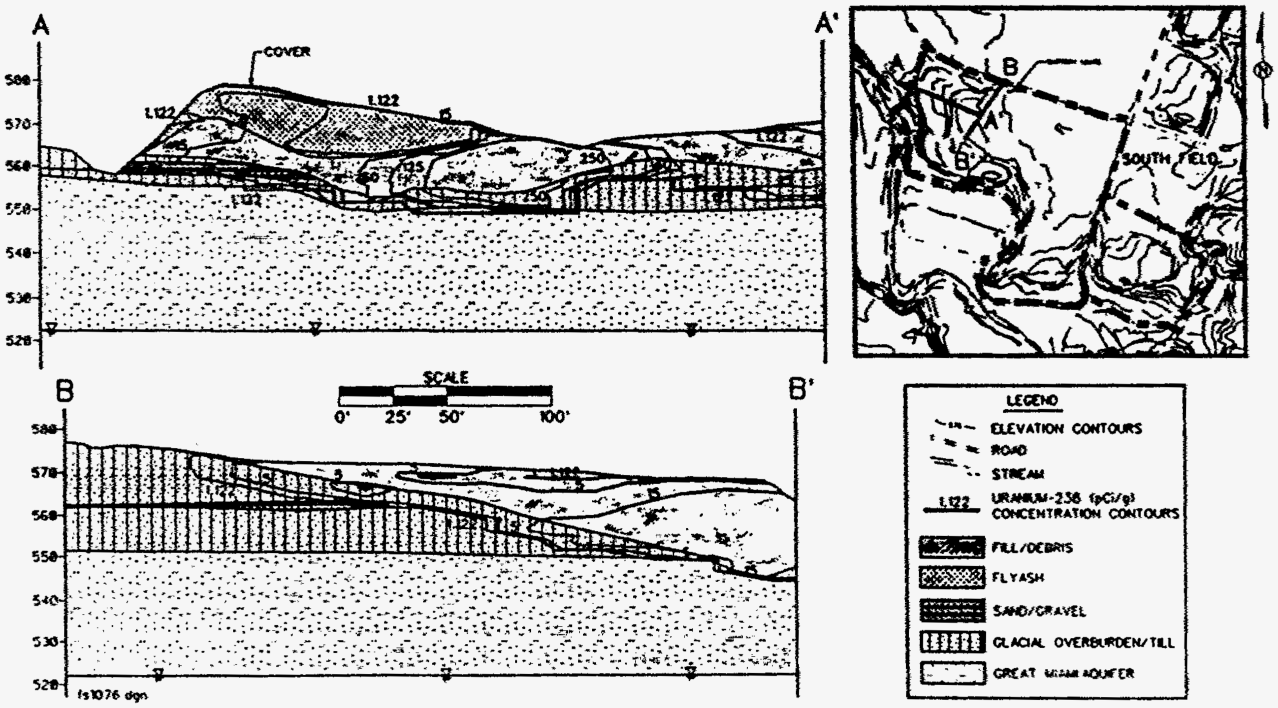

Figure 5. Uranium-238 Concentration in the Fill

The distribution of uranium in perched groundwater is controlled by elevated uranium concentrations in shallow soils, by a sand layer in the till, and by groundwater flow patterns. Figure 6 shows two regions of perched groundwater containing greater than 100 µg/L total uranium (28 pCi/L uranium-238). One area on the west side, may originate as leachate from buried waste. The second area of elevated uranium concentration is in the northeast corner.

Contours of total uranium concentrations (µg/L) detected in the GMA during Phase II of RI are plotted on Figure 7. (Note that 1 µg of total uranium is equal to 0.28 pCi uranium-238 at the Site.) Elevated concentrations in the GMA on the western boundary may be related to lateral recharge (subsurface seeps) that occurs in that area. The plume at the southeast corner of the South Field appears to be separated from the plume to the north by a zone of less contaminated groundwater that extends from Well No. 2016 to Well No. 2048.

CONCEPTUAL MODEL AND MODELING APPROACH

The following five pathways for migration of contaminants from the Site soils to the GMA were identified and used for the modeling:

- Surface Water Pathway - Migration of contaminants from the surface soil with stormwater runoff to Paddys Run or the Storm Sewer Outfall Ditch (SSOD) and then through the streambed to the GMA.

- Vadose Zone Pathway - Contaminant migration from the waste laterally (along the waste and glacial till interface) and/or vertically through the vadose zone (glacial till) to the GMA.

- Perched Water Infiltration Pathway - Vertical migration of contaminants from the perched water to the GMA.

- Surface Seep Pathway - Migration of contaminants in the seeps (as surface water) to an area where glacial overburden is not present. Contaminants then migrate vertically through the unsaturated portion of the GMA to the groundwater.

- Subsurface Seep Pathway - Lateral migration of contaminants through the perched water to an area where the sand layer within the glacial till comes in contact with the waste. Contaminants then migrate along an interface between glacial till and waste until the contaminants arrive at an area where glacial till is not present and the waste is in direct contact with the GMA. At that point, contaminants seep into the GMA (Figure 8).

The uranium loading via the surface water pathway was calculated by estimating surface runoff and assuming that surface soils are in equilibrium with the runoff. The Modified Universal Soil Loss Equation (MUSLE) model was used to calculate runoff for a single storm event of 2.5 inch in 24 hours, a worst-case scenario (Hershfield 1961). Storm runoff was then scaled to estimated annual runoff. As a conservative assumption, all uranium reaching the SSOD from the Active Flyash Pile was considered to infiltrate to the GMA. Based on surface water modeling, it was assumed that 30 percent of uranium reaching Paddys Run infiltrates to the GMA.

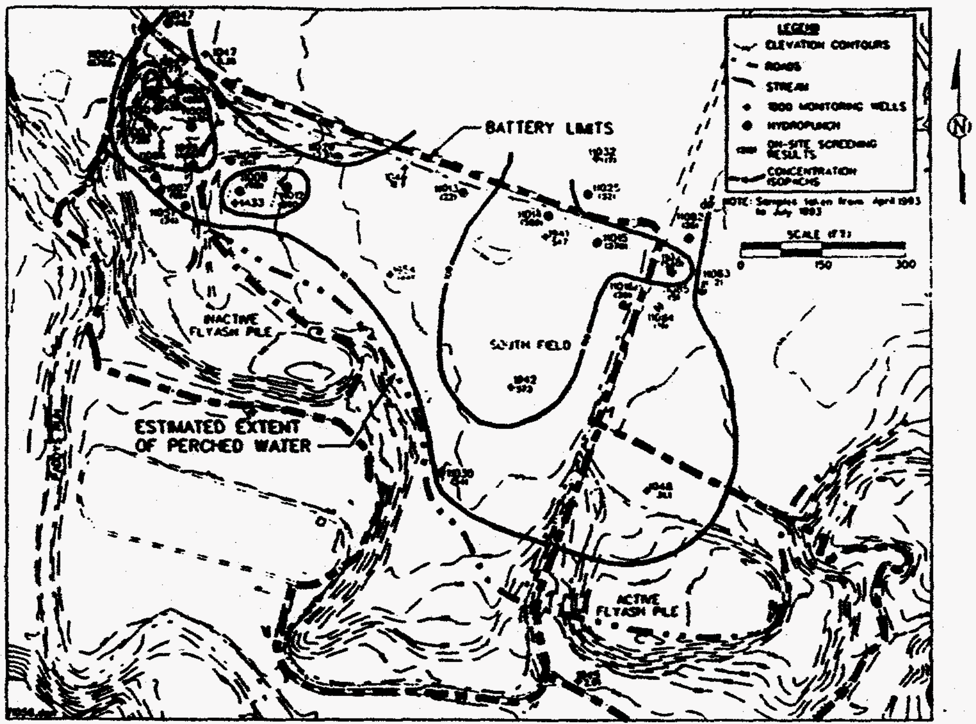

Figure 6. Uranium Concentration (µg/L) Distribution in the Perched Water

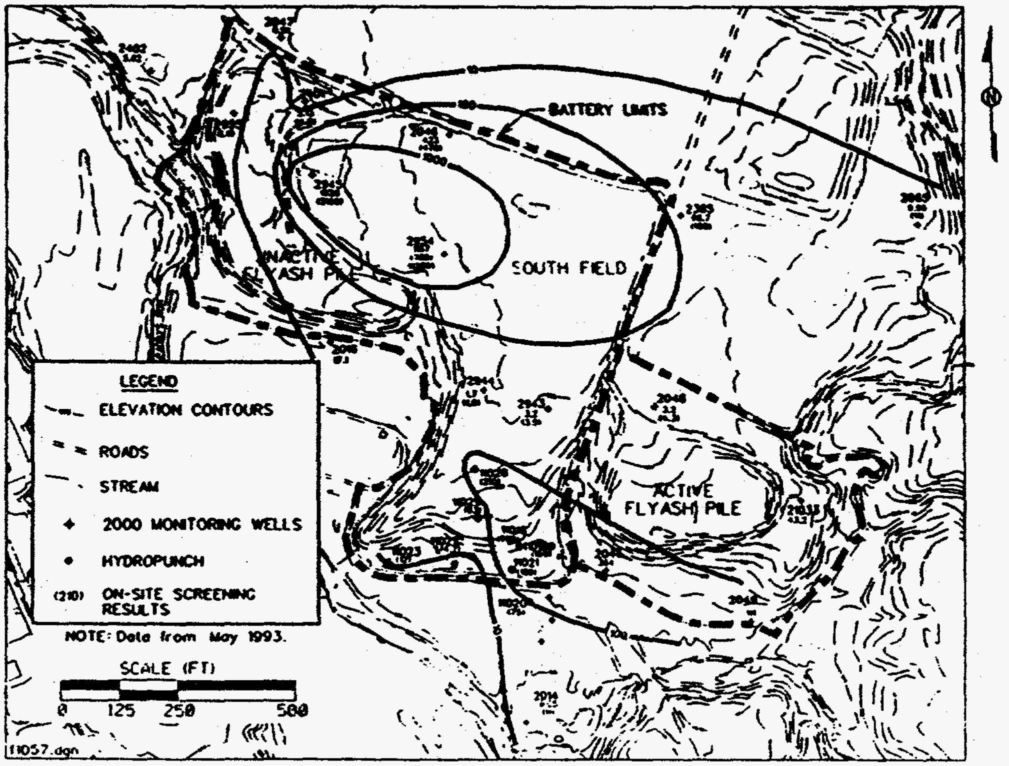

Figure 7. Uranium Concentrations (µg/L) Distribution in the Great Miami Aquifer

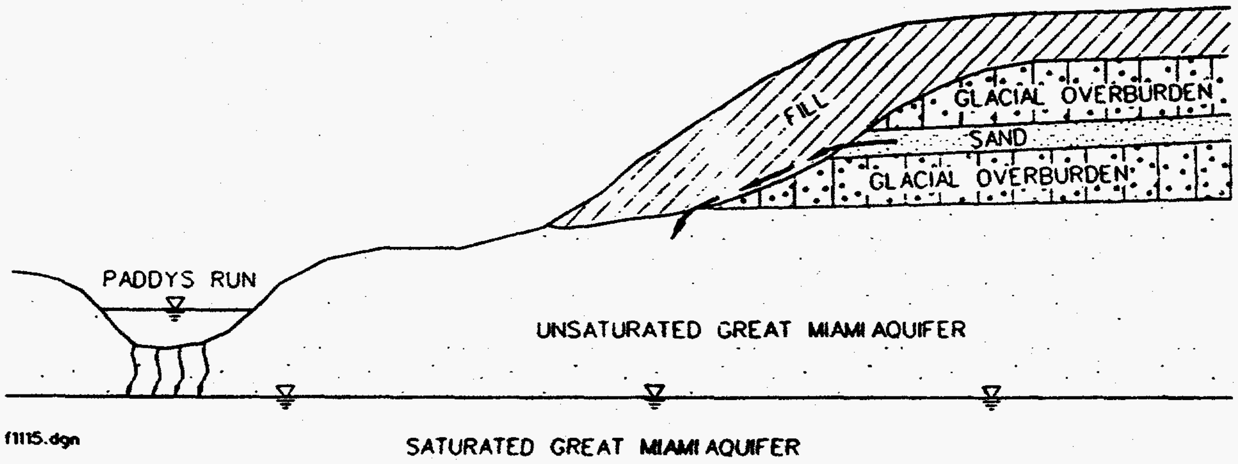

Figure 8. Conceptual Model of Subsurface Seep Pathway

The Hydrologic Evaluation of Landfill Performance (HELP) model (Schroeder et al., 1988) was used to estimate infiltration rates and lateral drainage. Leachate concentrations were calculated using the EPA's 70-year rule (EPA, 1988) for the baseline risk assessment modeling and using the site-specific partitioning coefficients for screening alternatives. The leachate concentrations and infiltration rates were input to the One-Dimensional Analytical Solute Transport (ODAST) model (Javandel et al., 1984) to simulate transport through the vadose zone to the GMA (pathways 2 through 5).

The vadose zone and perched water pathways were modeled as two layers: the glacial overburden (Layer 1) and the unsaturated portion of the GMA (Layer 2). Layer 1 soils consist of tills in the glacial overburden. The sand and gravel units within the glacial till were not included in the modeling because this layer has much higher hydraulic conductivity and low absorption properties. Uranium mass in the perched water, as well as adsorbed to the sand layer, was considered in the source term for perched water infiltration.

Figure 8 shows the conceptual model for the perched water subsurface seep pathway. This pathway and the surface seep pathway were simulated using a single vadose zone layer consisting of the unsaturated GMA.

GREAT MIAMI AQUIFER MODELING

Sandia Waste Isolation Flow and Transport (SWIFT) III (GeoTrans, 1992) was used to model three-dimensional fate and transport of uranium in the GMA for 1000 years. The GMA was divided into six layers (Figure 2). The regional flow model covers an area of 28.7 square miles. The flow model for the FEMP was calibrated against seasonal water level measurements and the pump tests. Calibrated model was run in steady state mode to provide a flow field for the uranium transport calculations. Transport model grid contained 120 x 112 cells, each 125 ft x 125 ft in size. Transport model was calibrated using FEMP-wide uranium data (DOE, 1994).

Areas overlying each SWIFT III grid block were modeled separately with individual stratigraphy, constituent type and concentration, infiltration rate parameters, and applicable pathways. All grids containing waste are shown in Figure 3. Grids affected by the surface and subsurface seep pathways are also identified. The waste concentration in each block was estimated using kriging to allow for the simulation of hot spots that were identified during the RI field activities.

Through the calibration process, the distribution coefficient in the GMA was estimated to be 1.78 mL/g to match current uranium-238 concentrations. The predicted maximum on-site uranium-238 concentration (517 pCi/L) occurs at 160 years, while the predicted maximum off-site concentration (26.5) occurs at 220 years. One of major pathway for contaminants to reach GMA was the subsurface seep pathway. This pathway contributed 303 pCi/L out of a maximum of 517 pCi/L uranium-238 concentration in the GMA.

REMEDIAL ACTION OBJECTIVES (RAOs)

RAOs for protecting human health and the environment depend on the contaminated media and the exposure pathways. As noted earlier, exposure pathways depend on the future land use designated for the FEMP. The specific RAOs for the Site include one or more of the following:

- Reduction of contaminated source to meet preliminary remediation levels (PRLs).
- Restrict use and access of the Site.
- Eliminate lateral movement of perched water.
- Reduce infiltration of water through the contaminant source.
- Eliminate surface water and air transport of contaminants.

PRELIMINARY REMEDIATION LEVELS (PRLs)

The cleanup levels, called PRLs, for contaminated media/soil were established using the following process. First, risk-based soil and groundwater preliminary remediation goals (PRGs) were established for uranium for the on-property farmer. PRGs for surface soil and groundwater were 0.25 pCi/g and 0.73 pCi/L, respectively for an ILCR of 10^{-6}. These PRGs do not assume any source control. Only PRLs for ILCR of 10^{-6} are shown in this paper although other target risks were evaluated in the OU2 FS.

The modified soil PRGs were, then, developed from risk-based PRGs based on various combinations of institutional controls, cross-media impacts, and source controls. Source controls consisted of barriers to potential lateral flow of perched water and infiltration controls. Modified PRGs for soils due to groundwater pathways are the cleanup levels that would result in target risk from groundwater pathway. The PRLs are background concentration plus the lowest value from any of the pertinent risk-based PRGs and cross-media modified PRGs.

Surface water pathways was not included in the modeling because all remediation areas will be covered with backfill and vegetated to eliminate this pathway. Similarly, any remediation plan will eliminate surface and subsurface seep pathways. Therefore, they were also not included in the modeling for the modified PRG calculations.

Soil PRLs were determined for four scenarios: (1) private ownership, (2) federal ownership without source control, (3) federal ownership with lateral perched water control, and (4) federal ownership with vertical infiltration control and lateral perched water control. Furthermore, separate soil PRLs were developed for waste on top of terrace (more than 16 feet thick glacial till in Figure 3) and rest of the area including waste directly over the GMA sands and gravel. These two soil sources were evaluated individually because uranium travel times are vastly different depending on the presence of glacial till.

For federal ownership, cleanup levels must be protective of an expanded trespasser and off-property resident farmer. The direct exposure PRL for expanded trespasser is 54.8 pCi/g. Groundwater pathway is not applicable to the expanded trespasser. When no source controls are used, the modeling showed that the off-property farmer has a direct exposure PRL of 221 pCi/g and a cross-media impact to groundwater PRLs of 6.1 and 3.2 pCi/g for source material over the GMA and the glacial till terrace, respectively. Therefore, the lowest applicable PRLs for Federal ownership without source controls are 6.1 pCi/g and 3.2 pCi/g for materials over the GMA and glacial till terrace. If lateral migration of perched water is eliminated in the glacial till terrace, PRL for this source increases 71 pCi/g. However overall PRL is now limited to 54.8 pCi/g for an expanded trespasser. Table 1 provides various PRLs for the Site and volumes of contaminated soils to be remediated.

TABLE 1
URANIUM PRLs AND VOLUMES OF SOILS TO BE REMEDIATED

Land Use Scenario	PRL for Top of Till Terrace (pCi/g)	PRL for Directly on GMA (pCi/g)	Volume (cubic yard)
Private Ownership	1.47	1.47	515,200
Federal Ownership without Source Controls	3.22	6.12	236,700
Federal Ownership with Perched Water Control	54.8	6.12	Not Calculated
Federal Ownership - Consolidation and Capping	>3,000	6.12	201,200

DEVELOPMENT AND PRELIMINARY SCREENING OF REMEDIAL ALTERNATIVES

A wide range of potential remedial technologies and process options were identified. These technologies and process options were screened for effectiveness, implementability and cost. Those which passed this screening process include mechanical excavation, subsurface drains to control potential horizontal flow in the perched groundwater zone, stabilization/solidification, drying, vitrification, soil washing, capping, and on- and off-site disposal. Institutional actions, such as physical barriers, security guards, and deed restrictions were also identified.

These technologies/process options were then combined to form eight preliminary remedial alternatives which are representative of potential combination. All alternatives listed below, except No Action alternative, include installation of monitoring wells to monitor effectiveness of remediation. The eight alternatives are:

- Alternative 1 -- No Action

  In accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), this alternative provides a baseline for comparison where no further action would be taken. It does not provide for long-term monitoring or institutional actions.

- Alternative 2 -- Consolidation and Capping

  Under this alternative, waste and contaminated soil above the PRLs would be consolidated and capped in the northeast portion of the South Field (Figure 9). The northeast area of the South Field would be graded, a drainage layer would be placed on top of the graded surface area, and contaminated material would be consolidated and capped. After capping, a subsurface drainage system would be constructed downgradient along the southwest and southeast sides of the capped material to collect perched groundwater that may be migrating laterally. Collected water from the drainage layer and the subsurface drainage system would be treated at the advanced waste water treatment (AWWT) facility.

- Alternative 3 -- Excavation and Off-Site Disposal

  Under this alternative, all contaminated material with concentrations exceeding PRLs would be removed and disposed off-site, such as Envirocare disposal facility.

- Alternative 4 -- Excavation and Off-Site Disposal with Treatment of Fraction Exceeding Waste Acceptance Criteria (WAC)

  This alternative is essentially the same as Alternative 3, except that any material exceeding WAC at the off-site disposal facility would be treated to achieve those criteria prior to shipment.

- Alternative 5 -- Excavation and On-Site Disposal

  Under this alternative, all contaminated material with concentrations exceeding PRLs would be removed and disposed in an on-site engineered disposal cell.

- Alternative 6 -- Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding WAC

  This alternative is essentially the same as Alternative 5, except that material exceeding the WAC for on-site disposal would be disposed off-site.

- Alternative 7 -- Excavation and On-Site Disposal with Treatment and Disposal of Fraction Exceeding WAC

  This alternative is essentially the same as Alternative 5, except that material exceeding the WAC for on-site disposal would be treated to achieve these criteria prior to disposal.

- Alternative 8 -- Excavation and Treatment with On-site Disposal

  Under this alternative, all contaminated material with concentrations exceeding PRLs would be removed, treated, and placed in an on-site engineered disposal cell.

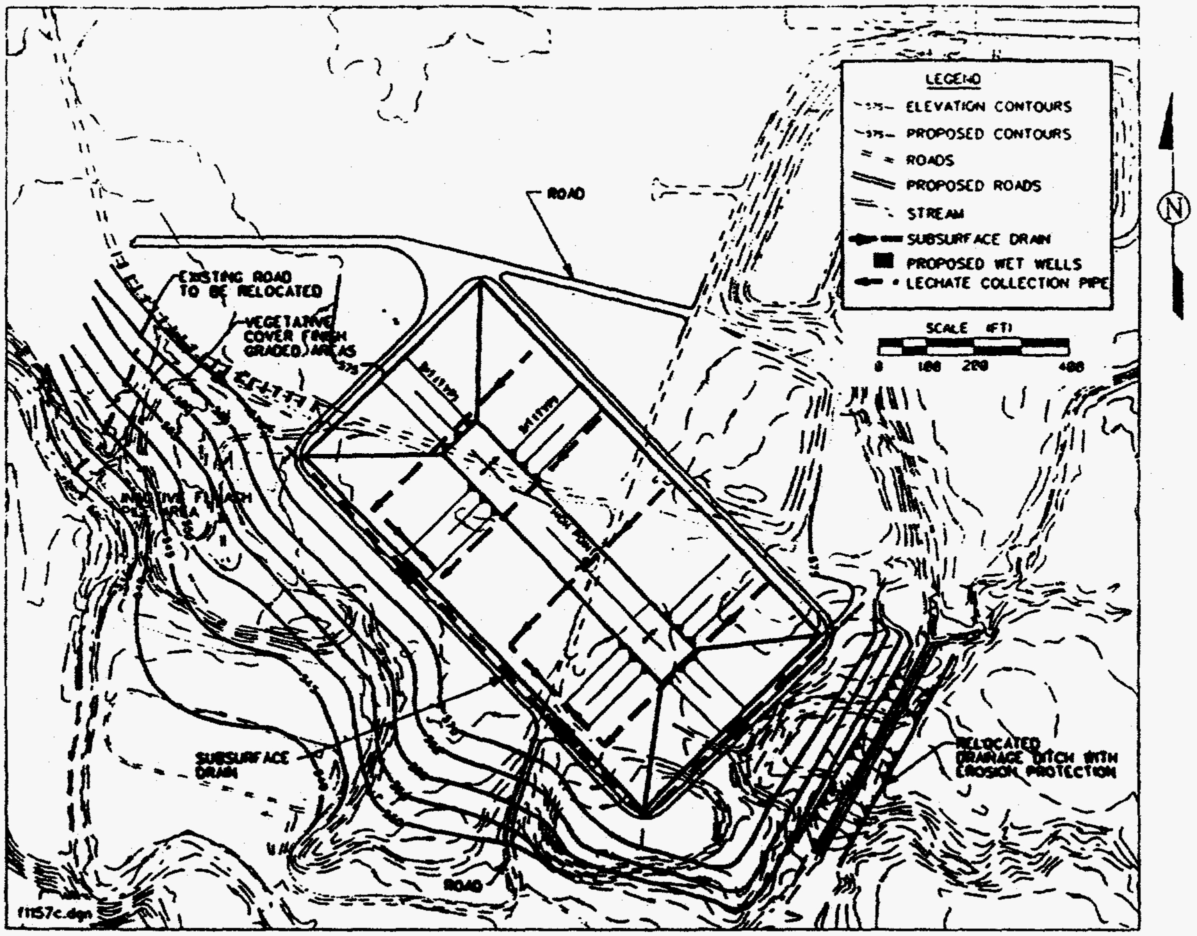

Figure 9. Site Plan for Consolidation and Capping

The WAC for on-site disposal facility was developed by modeling an area of proposed on-site disposal facility location (Figure 10) where gray till thickness was minimum. The following conservative assumptions were made to provide a margin of safety in the WAC development:

- Evaluating the MCL criterion anywhere under the facility rather than at the edge of the facility where additional dilution, adsorption, and dispersion in the aquifer would have occurred,
- Ignoring the geomembrane in the capping system and liner system,
- Ignoring the contributions of the liner, leachate collection, and leak detection systems,
- Ignoring adsorption and transport time through the brown till, and
- Utilizing assumptions for moisture content and infiltration that result in conservative (smaller) values of contaminant travel time.

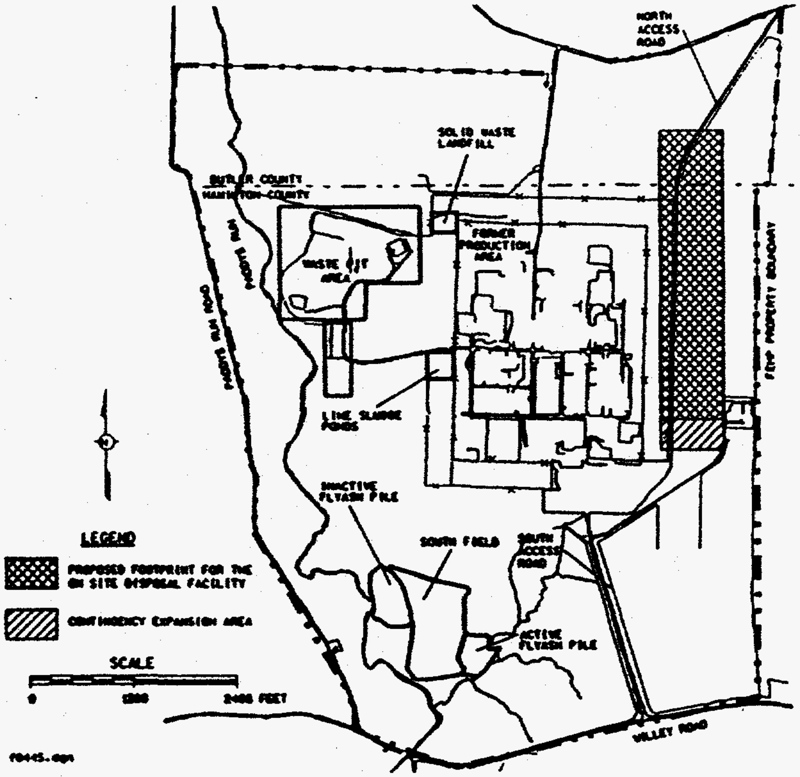

Figure 10. Proposed On-site Disposal Cell Location

The lowest desorption coefficient for leaching (K_d) for wastes from the Site was 37.5 mL/g for flyash. Since wastes from other Operable Units will be placed at his disposal facility, a K_d of 15 mL/g was used for modeling. Furthermore, due to unknown nature of geochemistry of wastes from other sources, a distribution coefficient for gray till was reduced from 24 mL/g to 3.1 mL/g. The WAC for the 10^{-4} ILCR for 1000 years protection was calculated to be 345 pCi/g for uranium-238.

Alternative 1, No Action, was carried forward into the detailed analysis as a baseline for comparison as required by the NCP. Remaining preliminary remedial alternatives were then screened for effectiveness, implementability and cost. On the basis of this screening process, Alternatives 2, 3, and 6 (referred as "action" alternatives") were selected as the most appropriate for detailed analysis. Alternative 4 was screened out in favor of Alternative 3 because contaminated material from the Site is not expected to exceed the WAC for the off-site disposal facility. Alternative 5 was screened out in favor of Alternative 6 because approximately 3,000 cubic yard of contaminated material will exceed the WAC for on-site disposal. Alternative 7 was screened out in favor of Alternative 6 because it offers no significant advantage because of the small amount of material expected to exceed the WAC for on-site disposal. Alternative 8 was screened out in favor of Alternative 6 because the additional cost is not justified.

DETAILED AND COMPARATIVE ANALYSIS

The objectives of the detailed/comparative analysis was to further define the reasonable alternatives and assess the relative performance of each alternative with respect to the following nine evaluation criteria developed by EPA to address the CERCLA requirements (40 CFR 300.430):

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance

First two criteria are known as the threshold criteria. An alternative must satisfy the threshold criteria to be selected as a remedial action. The next five criteria are known as the balancing criteria and the final two criteria are known as the modifying criteria. The RI/FS process evaluates alternatives against threshold and balancing criteria and a Proposed Plan is developed. The modifying criteria area typically evaluated following public and agency comments on a Proposed Plan and addressed in the Record of Decision.

Threshold Criteria - Overall Protection of Human Health and the Environment

Except for Alternative 1, all other remedial ("action") alternatives would satisfy this threshold criteria for a minimum of 1000 years. Alternative 2 would provide protectiveness of human health and environment by capping the contaminated material in a consolidation area and installing a subsurface drainage system to eliminate the potential lateral pathway in the glacial till. The capping system would be designed to isolate the contaminated material, preclude human and ecological intrusion, and limit potential impacts to the groundwater to an acceptable level. However, there would be no liner nor a leak-detection system to monitor performance.

Alternative 3 would provide protectiveness by disposing of the contaminated material in an engineered facilities in the arid west where, due to harsh climatic conditions, there is little residential population or usable groundwater/surface water resources in the immediate vicinity.

Alternative 6 would provide protectiveness by disposing of the contaminated material in an on-site facility designed to isolate the contaminated material, preclude human and ecological intrusion, and limit potential impact to the groundwater to an acceptable level. Approximately 3000 cubic yard of soils that may exceed the WAC will be disposed off at an off-site facility. A feasible location, design, and WAC for an on-site disposal facility was developed. The geology of the on-site disposal facility location, based on a series of soil borings in the area, and the engineered design would be protective of human health and the environment. DOE would construct only one disposal facility at the FEMP. Therefore, selected on-site disposal facility has capacity to allow for waste from other Operable Units (Figure 10).

Threshold Criteria - Compliance with ARARs

With the exception of Alternative 6, all of the action alternatives would meet identified ARARs and non-ARAR requirements. The Ohio Environmental Protection Agency (OEPA) regulations prohibit the construction of solid waste landfills over a sole-source aquifers, such as the GMA, unless sufficient hydrogeologic conditions exist to protect the aquifer. Therefore, a waiver from this regulation, based on the equivalent standard of performance, would be required to implement Alternative 6. Models described in this paper were used to demonstrate that the equivalent standard of performance would be achieved by a combination of the design of the on-site disposal facility and existing hydrogeology to provide protection of the aquifer.

Balancing Criteria

The No Action alternative would not provide long-term effectiveness as indicated by the baseline risk assessment. All of the action alternatives would provide an effective long-term (1000 years) solution to the current or potential risk from the Site with proper maintenance. Federal ownership is required to ensure permanence of the remedy for alternatives 2 and 6.

Crushing/shredding, dewatering/drying, and in situ stabilization/solidification of contaminated material would be included in each alternative, as required. However, these treatments would affect only a very small volume of waste and would not result in significant reductions of toxicity, mobility, or volume.

Alternative 1 provides the best short-term effectiveness since there would be no remedial activities. Short-term risks to remediation workers and off-site receptors would differ slightly among the action alternatives, primarily because of the large amount of material being excavated and transported. Maximum short-term risk will be associated with the Alternative 3 requiring transportation to an off-site disposal facility.

All of the action alternatives would employ proven technology and conventional equipment and therefore would be equal on a technical feasibility basis. Alternative 3 would require public acceptance of the transport of contaminated material across several states to an off-site facility; this process is expected to be very difficult. Alternative 6 would require an EPA waiver from the OEPA disposal-facility siting requirements, which is expected to be moderately difficult to obtain.

The costs developed in the feasibility study process are estimates with an intended accuracy range of -30 to +50 percent. There are no costs associated with Alternative 1. For the action alternatives, Alternative 2 would be the least costly ($70 million) on a present worth basis, followed by Alternative 6 ($106 million) and Alternative 3 ($213 million).

SUMMARY AND PROPOSED PLAN

An integrated groundwater modeling approach was used to evaluate risks at the Site and develop PRGs, PRLs, and WACs for the on-site disposal facility. Groundwater modeling was also used to demonstrate equivalent standard of performance to protect human health and environment and obtain waiver from OEPA regulations restricting construction of a disposal facility over a sole source aquifer such as the GMA.

Eight remedial alternatives were developed and screened. Detail screening of three action alternatives and a No Action alternative was carried out. Only comparative analysis for a target ILCR of 10^{-6} was presented in this paper. However, other target risk levels and land-use scenarios were used for comparative analysis in the OU2 FS (DOE, 1995b). Results of those analysis do not change the conclusions presented here.

All of the action alternatives meet the two threshold criteria. The comparison of balancing criteria shows that the action alternatives have difference, but not major differences except costs.

Consolidation and capping is the lowest-cost alternative, but does not offer an engineered liner with leachate collection and leak detection to ensure cap integrity. However, monitoring of the groundwater wells at the edge of the Site would ensure the protection of the groundwater for off-property users.

Excavation and disposal at an off-site facility would remove the source of contamination from the Site. Thus, this alternative is considered to be the most protective. However, this alternative would cost about twice as much as the next costly alternative. Additionally, the public would be concerned about off-site transportation across many states and disposal of wastes.

Excavation and on-site disposal with off-site disposal of the fraction exceeding the WAC offers an increase in effectiveness from the other on-site option, consolidation and capping. This is based on an engineered liner that provides leachate collection and leak detection. By combining all the waste into one disposal location, this alternative also allows increased flexibility in land use options, a reduced buffer area, and centralized operation and maintenance.

The cost differences between alternatives do not vary significantly when the risk level changes. However, the cost difference between Alternatives 3 and 6 widens when private ownership is considered. All "action" alternatives are relatively indifferent to other evaluation criteria at different target risk. Costs for Alternative 6 is relatively indifferent to land use. Therefore, Alternative 6 is the preferred alternative. A ROD has been signed for the Site where Alternative 6 was the chosen remedy.

DISCLAIMER

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