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EPA Superfund Record of Decision:

Green River Disposal, Inc. (O.U. 1), Maceo, KY 12/14/1994

GREEN RIVER DISPOSAL LANDFILL SUPERFUND SITE

RECORD OF DECISION

U.S. Environmental Protection Agency
Region IV

DECEMBER 14, 1994

GREEN RIVER DISPOSAL LANDFILL SUPERFUND SITE
RECORD OF DECISION

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DECLARATION FOR THE RECORD OF DECISION

Site Name and Location

Green River Disposal Landfill
Kelly Cemetery Road
Maceo, Daviess County, Kentucky

Statement of Basis and Purpose

This Record of Decision presents the selected remedial action for the Green River Disposal Landfill site, located in Maceo, Daviess County, Kentucky. The remedial action selected conforms with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document is based on the information contained in the Green River Disposal Landfill Administrative Record.

The Commonwealth of Kentucky Department for Environmental Protection concurs with the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

Based on the findings of the Remedial Investigation and Risk Assessment, three problem areas of the site requiring a cleanup remedy are: the landfill waste; leachate; and contaminated sediment in the sedimentation pond and unnamed intermittent stream.

The objectives for the remedy selected are:

- Prevent direct exposure of the landfill waste by humans and fauna
- Prevent infiltration of water into the landfill waste and limit the potential migration of hazardous substances to the groundwater and nearby stream
- Prevent direct exposure of leachate by fauna
- Prevent direct exposure of contaminated sediment by fauna

Based on the Remedial Investigation, the Baseline Risk Assessment, and the Feasibility Study, the selected remedy consists of following components:

1. Capping the landfill (waste disposal) area with a composite barrier cover (the exact configuration and cover system components will be determined during the design process).

2. Collection of the leachate with subsurface drains, and treatment by chemical and/or physical methods. Treated water will be discharged to the unnamed stream.

3. Excavation of contaminated stream and pond sediment and consolidation with the landfill waste.

4. Removal of surface debris and/or buried wastes located in the east and west ravines, and dispose these wastes within the landfill cap.

This Record of Decision does not provide a final determination on groundwater quality at the site or provide a basis for selecting a groundwater remedy. The data collected during the remedial investigation did not conclusively provide a direct relationship between the landfill waste and groundwater quality at the site. Therefore, EPA will require additional groundwater monitoring to sufficiently determine groundwater quality at the site and conclusively establish the landfill's impact to the groundwater.

Declaration

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternate treatment technologies/methods to the maximum extent practicable. However, because treatment of the principal threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Richard D. Green
Associate Director
Office of Superfund and Emergency Response

14 DEC 94
Date

DECISION SUMMARY

1.0 BACKGROUND

1.1 Site Location

The site is located in Daviess County approximately 12 miles northeast of Owensboro, Kentucky, in the community of Maceo (Figure 1). The site is located within the Lewisport, Kentucky - Indiana USGS 7.5 Minute Topographic Quadrangle; its approximate coordinates are 37° 53' 30" latitude and 86° 58' 30" longitude.

1.2 Site Description

The Green River Disposal Landfill Site (site) is comprised of two separate areas: the Green River Disposal Landfill (landfill) and the Kelly Cemetery Road (KCR) Site. The landfill is a 14-acre tract of land formerly permitted by the state of Kentucky for disposal of industrial solid waste. The Kentucky Department of Environmental Protection (KDEP) initially defined the KCR Site as a 4-acre tract of undeveloped land adjacent to the eastern property boundary of the landfill where drummed waste had been placed. From a review of the KDEP files, the location of the 4-acre tract was not apparent. State file maps indicated that three distinct locations within a 25-acre area north of Kelly Cemetery Road contained drums. When the drums were removed in 1985, the former locations were not well documented by the KDEP. As a result, the area (25 acres) between the Kelly Cemetery Road and the bottom of the ravine located north of Kelly Cemetery Road was investigated (Figure 2). Based on information collected during the RI, only 4 of the 25 acres which were investigated likely define the KCR Site.

The topography of the area surrounding the site is characterized by knobs connected by long, narrow ridges and steep hillsides and ridgetops. The ridges and knobs are dissected by intermittent stream channels and small streams. Ground-surface elevations vary from about 550 feet (above the North American Geodetic Vertical Datum (NGVD) on ridgetops to about 400 feet along the major valleys. The ridge and valley topography is bordered by the Ohio River floodplain, which is at an average elevation of about 390 feet NGVD. Figure 3 is a portion of the USGS 7.5 minute Lewisport KY-IND quadrangle map showing the site location and the surrounding topographic features.

Kelly Cemetery Road, located along a narrow ridge line, marks the southern border of the site. The topography slopes downward from Kelly Cemetery Road to the north where a narrow valley occupied by an unnamed intermittent tributary is located at the base of the landfill. Elevations range from about 520 feet NGVD along the road to between 380 and 415 feet NGVD at the tributary. Chestnut Grove Road is located on a ridge north of the unnamed tributary.

The unnamed tributary flows to the west into a sedimentation pond located topographically downgradient of the landfill outside of the Green River Disposal, Inc., property boundary but within the site boundaries as shown on Figure 2. The sedimentation pond is within the Browning Ferries Industries (BFI) property and was designed and built as part of the landfill closure activities. The sedimentation pond also receives drainage from other intermittent tributaries in the valley. The pond outfall continues west approximately 2000 feet where it meets Little Blackford Creek. Little Blackford Creek flows into Blackford Creek and then into the Ohio River. The travel distance of surface water flow from the site to the Ohio River is approximately 3 miles.

The study area watershed occupies approximately 187 acres. Chestnut Grove Road follows the northern boundary of the watershed, and Kelly Cemetery Road marks the major portion of the southern boundary. Immediately west of the site, the watershed border diverges from Kelly Cemetery Road and follows a northwest ridge to Little Blackford Creek. The area of the watershed topographically upgradient of the sedimentation pond is approximately 114 acres. Figure 3 illustrates these features.

The western side of the landfill is comprised of a steep ravine with a northwest downward sloping axis. Although landfilling activities have not occurred in this area, isolated areas containing deteriorated empty drums and drum debris have been observed on the land surface. The typical slope of the sides of the ravine range from 35 to 45 percent (%). The intermittent stream in the ravine flows off site to the northwest at a gradient of 7%.

The landfill topography slopes north and has variable gradients: near Kelly Cemetery Road, the slope ranges from nearly flat to approximately 15%; in the center of the landfill, the slope ranges from 20% to 30%, and at the base, near the unnamed tributary to Little Blackford Creek, the slope ranges from 13% to 17%.

The western portion of the KCR Site includes grids K1 through K4, K6, K7 and K8. A steep ravine separates the landfill from the KCR Site. Landfilled materials consisting of tile and construction debris were encountered in grid K1 during exploratory trenching activities. Empty drums and drum debris were observed on the land surface in the ravine below K1, and empty drums and drum debris were observed in grids K4, K6 and K7. Irregular topography was observed at the western boundary of K8 (common to K7) and may indicate the presence of drum debris. The remainder of K8 is heavily wooded and no evidence of drums or landfilling has been detected in this area. Slopes in this area range from 20 to 22 % to the north.

The eastern section of the area investigated as part of the KCR Site is composed of grids K5 and K9 through K25. This area is the eastern head of the valley formed by the unnamed tributary. The topography slopes to the west at 10% to 30%. The area is wooded and does not contain buried waste material or drums.

The site is located in a sparsely populated area of Daviess County, near the town of Maceo. Land use in the site area ranges from undeveloped deciduous forests, to farmland, to scattered residential development. Thirty-seven occupied residences are located within a one-mile radius of the site. The typical crops of the area include corn, livestock, soybeans, and tobacco.

Recreational activities in the area around the site include hunting, fishing, and dirt bike riding. The landfill area, portions of the unnamed tributary, and sedimentation pond are currently fenced, discouraging access for potential recreational activities in on the site. Hunting may occur at the KCR Site since it is not fenced.

A door-to-door well survey was conducted at dwellings located within a one-mile radius of the Green River Disposal Site in order to assess the usage of groundwater in the area. There are ten occupied dwellings, possessing at least one well for drinking, bathing, cooking and other domestic uses. Other dwellings in proximity to the site are serviced by a public water supply system.

1.3 Site History and Enforcement Activities

The Green River Disposal, Inc., Landfill was operated from 1970 to 1983. Initially the site contained two landfills, Reliable Sanitation Company, Inc., (also known as the W. D. Coleman landfill) and the Dyer Salvage Company, which were merged to form the landfill. An approximate 14-acre tract of land was authorized by the State to receive specific industrial wastes from numerous local companies. Table 1, on page 4, is partial list of the industrial wastes believed to be disposed of in the landfill. Because of the topography of the site, the waste was pushed into the ravine and covered with soil.

The landfill was closed in 1983. During and after its operations, the landfill was investigated by the Kentucky Division of Waste Management (KDWM). In January 1983, the facility entered into an Agreed Order with the KDWM and a formal Closure Plan was submitted.

A construction permit was issued on March 30, 1983 by the KDWM for a sedimentation basin. The construction date of the sedimentation basin/pond is unknown.

The landfill was reviewed on June 8, 1987, by the KDWM and rated at 31.24 on the HRS scoring package. In response to comments received by the USEPA regarding the HRS scoring package, the final score was reduced to 29.12. The site was placed on the NPL in August 1990.

In 1985, following an investigation by KDEP, 776 drums were staged and removed from the KCR Site located adjacent to the eastern property line of the landfill. The drums were staged and removed under supervision and approval of KDEP.

Industrial Wastes Contained in the Landfill

- *Spray Booth Paint Sludge*
- *Zinc Phosphate Tank Bottom Sludge*
- *Cured Epoxy Resin*
- *Dried Paint Filter Waste*
- *Phenolic Resins*
- *Coagulated Latex*
- *Cresylic Acid*
- *Paintline Wastewater Treatment Sludge*
- *Aluminum Dross Saltcake*
- *Waste Rolling Oil*
- *Steel Dust*
- *Asbestos Containing Waste*
- *Pulverized Aluminum*

TABLE 1

In 1990, through an Administrative Order (AO) issued by EPA, Immediate Response activities were initiated. These activities included: residential well survey and sampling, construction of a security fence, sampling to characterize the leachate, geophysical surveys of the landfill, construction of a temporary leachate control and collection system for the landfill, and installation of a temporary cover over the landfill.

An Administrative Order on Consent (AOC) between EPA and four Potentially Responsible Parties (PRPs) to conduct a Remedial Investigation (RI) and Feasibility Study (FS) was signed in May 1990. The RI field activities were initiated in October 1991, and the combined RI/FS was completed in June 1994.

2.0 COMMUNITY PARTICIPATION

A Community Relations Plan (CRP) was developed to establish a framework for community relations activities at the Green River Disposal Landfill Site. The Plan outlines the community relations program, which was designed to provide the public with: an opportunity to participate in the decision-making process; information to remain informed on planned and current site activities; and access to EPA staff to efficiently communicate the community's concerns. The CRP, dated November 6, 1990, was implemented throughout the Remedial Investigation and Feasibility Study (RI/FS), and is consistent with the requirements of CERCLA §113(k)(2)(B) and §117.

Prior to the start of the remedial investigation, in November 1990, EPA issued a Fact Sheet describing the Superfund process and the planned RI/FS activities. The fact sheet was sent to the local community, and to local, State, and Federal officials. It invited the public to participate in the Superfund process by attending an EPA sponsored public meeting held in the community. The public meeting was held on November 15, 1990, in the Maceo community to announce the beginning of the RI/FS and was well attended.

The fact sheet also provided an opportunity for community groups to receive Technical Assistance Grants (TAG) for closely monitoring the technical progress of the investigation through their own environmental consultant. However, no applications for grants were received by EPA.

EPA also established and maintained an information repository and Administrative Record (AR) at the Owensboro Public Library, located in Owensboro Kentucky. The information repository included general information about EPA, the Superfund Program and site specific documents. The AR was established as an official record of all documents and information EPA used as a basis for developing the proposed final action.

EPA issued another fact sheet in March 1993 to inform the public about the results of trenching activities conducted at the site. The fact sheet also announced a public meeting EPA hosted on March 18, 1993. The meeting was held to discuss the trenching activities and answer any questions concerning the site. Approximately forty concerned citizens attended.

In 1992 a members of a local community organization called the Maceo Concerned Citizens Group formed a subgroup called the Green River Toxic Waste Cleanup Association. This association is very active in participating in the Superfund process at the Green River Site. EPA provided the association with the opportunity to review and comment on draft remedial investigation and feasibility study reports and other related documents. Additionally, EPA participated in several meetings with the Cleanup Association to answer questions about the investigation and discuss their concerns about the site.

On July 15 1994, EPA issued a Proposed Plan Fact Sheet presenting the results of the remedial investigation, feasibility study and Baseline Risk Assessment. The fact sheet also described EPA's proposed final remedy for the site and announced the public comment period. The Fact Sheet was sent to the local community, and to local, State, and Federal officials. The public comment period began on July 19, 1994 and ended on August 17, 1994.

EPA conducted a public meeting on August 4, 1994 to discuss the findings of the investigation, to describe the proposed cleanup remedy, and answer questions concerning the site. Those in attendance at the meeting included concerned citizens, the Green River Toxic Waste Cleanup Association, a reporter from the Owensboro Messenger-Inquirer newspaper; a reporter from a local television station; representatives from Green River (Potentially Responsible Party) Coordinating Group; and representatives from the Commonwealth of Kentucky, Division of Waste Management. A transcript of the meeting is included in Appendix B.

3.0 SCOPE AND ROLE OF THIS RESPONSE ACTION

This Record of Decision (ROD) presents the selected remedial action for the Green River Disposal Landfill Superfund Site. This decision document and response action are issued for the landfill portion of the site and other contaminated media except on-site groundwater. For reasons described in section 4.1, EPA will issue a future ROD for groundwater. Therefore, this ROD will not address a potential remedial action for groundwater.

The selected remedial action for the landfill and other on-site contaminated media was chosen based on the results of Remedial Investigation, Baseline Risk Assessment, Feasibility Study and all other documents and information contained in the Administrative Record. EPA makes this determination pursuant to the requirements of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The selected remedy described in this ROD is intended to address conditions at the site that have been determined to present current and potential ecological threats.

4.0 SUMMARY OF SITE CHARACTERISTICS

4.1 Hydrogeology

Hydrogeologic studies conducted at the site included: rock coring; soil test borings; drilling and monitoring well installation; downhole geophysical logging; hydraulic conductivity testing. Subsurface geologic information indicates that the lithologies present at the site were deposited in a fluvial depositional environment forming laterally discontinuous interlensing beds of siltstone, shale, and sandstone, interbedded with discontinuous beds and lenses of coal and limestone. A hydrogeological cross-section traversing the site from east to west is provided in Figure 4.

At the site, water within the vadose zone percolates through the soil horizon to the ground-water surface within the surficial aquifer. It appears that the ground water then flows to the north to discharge to the intermittent stream along the northern boundary of the landfill. Data from coring, air rotary drilling, and geophysical logging indicated that vertical flow of ground water is restricted. The core logs describe shale layers which likely act as an aquiclude or aquitard; the air rotary drilling within the bedrock penetrated distinct water bearing zones followed by dry zones; and the geophysical logging of the borings also detected potential distinct isolated moist zones within the bedrock indicating that the surficial aquifer is isolated from the lower aquifer. Additionally, in-situ slug testing within the monitoring wells revealed that hydraulic conductivity values decrease with depth. The logarithmic average of the hydraulic conductivities was 6.6×10^{-3} ft/min in the residual soil and weathered bedrock zone, 1.9×10^{-4} ft/min in the shallow bedrock zone, and 1.2×10^{-6} ft/min in the intermediate bedrock zone. Horizontal ground-water flow mimics the topography and is the dominant ground-water flow path. A potentiometric surface map of the ground-water elevations on January 13, 1993 is shown in Figure 5.

Samples collected from monitoring wells installed around the perimeter of the landfill indicate that no significant contamination problem exists. The results show that groundwater may have been impacted since some maximum contaminant levels were exceeded in a few monitoring wells. However, these results are not conclusive in determining the landfill's impact on groundwater. Therefore, EPA has decided to continue monitoring for a period not to exceed two years to collect enough data to conclusively establish the landfill's relationship with the groundwater. EPA will make a final determination on groundwater quality at the site after the data has been collected and evaluated. EPA's decision concerning a groundwater remedy will be established in a future Record of Decision document.

4.2 Surface Water and Sediment

The main surface water features on the site are an unnamed tributary, the sedimentation pond north of the landfill, and smaller intermittent tributaries located in ravines east and west of the landfill. Sixteen stream sediment sample locations (SD-1 through SD-16) and eleven surface water sample locations (SW-1, SW-2, SW-3, SW-10 through SW-16 and SW-121) were sampled as shown in Figure 6. Three background stream sediment samples (SD-17, 18, and 19) were also collected. The surface water and sediment samples were analyzed for TCL/TAL constituents. Five surface water samples (SW-120 through SW-123 and SW-3) were sampled in January 1993 and analyzed for ammonia.

The sedimentation pond was investigated in November 1991. The thickness of the sediment was measured at 57 locations and the sediment was sampled at ten locations. The samples were analyzed for TCL/TAL constituents.

A former catchment basin existed at the toe of the landfill when the landfill was operational; it was backfilled during closure. Sediment from the former catchment basin was collected from four borings, sampled and analyzed for the TCL/TAL constituents.

4.3 Soil

Landfill Surface and Subsurface Soil Characterization

The soils investigation was divided into two areas: the landfill and the KCR Site. The purpose of the soil sampling in the landfill area was to characterize the undisturbed soils at the perimeter of the landfill. As shown on Figure 7, a total of 11 locations were sampled from the landfill perimeter (SS-01 through SS-11) and one background sample (SS-12) was collected. Each sample was analyzed for TCL/TAL constituents by CLP Methods.

A risk-based statistical sampling plan with a grid sampling system was used to systematically sample the soil at the KCR Site (Figure 8). Twenty-five grids cover the areas where drums may have been present. In December 1992, surface soil samples from grids K5, K9, K21, and K22 were collected and analyzed for the TCL/TAL constituents.

The analytical results from the four initial grid samples were used to determine the Constituents of Concern (COCs). In March and April 1993, the remainder of the grids were sampled. The samples were analyzed for the COCs (chromium, lead, and arsenic) by CLP methods. Because of the detection of drum debris in grids K6 and K7, soil samples from these grids and others that may have been impacted (K4, K6, K7, and K8) were analyzed for the full TCL/TAL. Five background surface soil samples (BSS-1 through BSS-5) were collected along Chestnut Grove Road. The background surface soil samples were analyzed for TCL/TAL compounds.

Both surface and subsurface soil samples were collected and analyzed around the perimeter of the landfill. The analytical results from the surface soil samples indicated that most constituents detected were equivalent to background concentrations. Two times the mean concentration was calculated, and a constituent greater than two times the mean was considered a outlier. This process was repeated until the outliers were removed and the remaining constituents considered background were below two times the mean concentration. The only exception occurred with manganese which was detected at the maximum concentration in the designated background sample. Outliers not associated with blank contamination from the surface soil landfill perimeter samples are aldrin, endosulfan I, PCB 1248, aluminum, calcium, cadmium, chromium, copper, magnesium, lead, sodium, and zinc. Most of the outliers occurred at locations along the western landfill boundary.

Beryllium, calcium, cobalt, magnesium, manganese, and 2-butanone were detected in the subsurface soil samples around the landfill perimeter at concentrations greater than two times the mean of background. Semi-volatile organics and pesticides/PCBs were not detected above the Contract Required Quantitation Limit (CRQL).

Since the perimeter soil locations will be incorporated in the design of the landfill cover, a risk assessment evaluating exposure scenarios for this soil was not performed.

KCR Surface Soil Characterization

A risk-based, statistical-sampling approach with a grid sampling system was used to systematically sample the soil at the KCR Site. A statistical analysis was performed to determine which of the COCs in the 25 Exposure Units (EUs) were not consistent with background levels. A Student's t-test with a false negative rate of 20 percent and a false positive rate of 0.2 percent indicated that chromium in EUs K2 and K6 (66.3 to 82.4 mg/kg) and lead in EUs K1 and K22 (243 to 307 mg/kg) exceeded the statistical test for a background comparison. The statistical test was conducted in accordance with the procedures presented in the FSP (September 1993).

No volatile or semi-volatile organic compounds were detected above the CRQL in the surface soils. PCB 1248 was detected in EUs K6 and K7 at 0.31 mg/kg and 2.1 mg/kg, respectively. PCB 1260 was detected in EUS K6 and K4 at 0.091 mg/kg and 0.16 mg/kg, respectively. Cyanide was detected in EUs K4 and K6 at 6.6 mg/kg and 62.9 mg/kg, respectively. Based on the sampling data and visual observation, it appears that the original KCR Site may be limited to that area occupying EUs K6 and K7 where deteriorated drums and drum debris were encountered.

4.4 Leachate Seep, Sediment and Pond Characterization

In August 1990, as part of the Immediate Response Action, six leachate water and leachate sediment samples were collected and analyzed for TCL/TAL constituents by CLP Methods. A leachate containment and collection system consisting of two leachate collection ponds, an infiltration trench, and a pump station was also constructed as part of the Immediate Response Action, in November of 1990. Leachate is collected in the two collection ponds located at the toe of the landfill and pumped to an infiltration trench at the to of the landfill where it is recirculated through the waste. As a result of the operation of the leachate collection system, the original configuration of the seeps has been modified. The frequency and range of concentrations of constituents detected in the 1990 leachate seep sediment and water samples are listed in Tables 2 and 3.

In January 1993, water samples were collected from Leachate Collection Pond A, Leachate Pond B, and from two active leachate seeps (at the time of sampling) LW-01E and LW-02E, located near Leachate Collection Pond B (Figure 9). The frequency and range of constituents detected in the 1993 samples of the leachate seeps and leachate pond samples are listed in Table 4. The leachate seep samples, LW-01E and LW-02E were composited for non-volatile TCL/TAL analyses and were analyzed separately for volatile organic TCL analyses.

A comparison of the maximum concentrations of constituents detected in the aqueous leachate samples in 1990 and 1993 indicates that dilution has occurred from the accumulation of precipitation infiltrating through the landfill waste. Constituents detected in both the 1990 and 1993 samples were reduced by 2 to 96 percent with the exception of cadmium which remained the same and 2-methylphenol which increased.

Because the configuration of the seeps has changed over time and the sediment collected at the seep locations in 1990 are covered by the lined leachate collection ponds, there are no current exposure pathways for the 1990 seeps and sediment.

Analysis of the leachate data indicate that the concentrations of ammonia nitrogen, sodium, chromium, cyanide, and zinc may contribute to an increased risk to human health and/or the environment. Risks associated with these constituents are discussed in Section 5. These constituents and the corresponding concentrations are depicted on Figure 10. The maximum concentrations of ammonia nitrogen (530 mg/l), sodium (8,050 mg/l), chromium (0.024 mg/l), and cyanide (0.0271 mg/l) were detected in the seeps and Leachate Collection Pond B samples. The 1993 leachate water samples were also analyzed for hexavalent chromium; all results were non-detects. Therefore, the 0.024 mg/l concentration in the composite sample consists of trivalent chromium. The highest concentration of zinc (1.18 mg/l) was detected in the leachate pond sample from Leachate Pond B.

4.5 Landfill Waste Characterization

Geophysical surveys were performed to collect subsurface data in a non-intrusive manner. The geophysical surveys at the landfill included electromagnetic, seismic refraction, and electrical resistivity surveys. The surveys aided in the assessment of the areal extent of the landfilled material and in the identification of conductive zones within the landfill (Figure 11).

The vertical extent of the landfill was determined from a comparison of topographic maps which show the landfill site prior to disposal activities and post disposal activities. The deepest portion of the landfill is approximately 35 feet (+/- 10 feet) below the existing topography. Figures 12 and 13 shoe the areal extent of the landfill, which is approximately 14 acres.

Exploratory Trenching and Waste Sampling

Exploratory trenching and waste sampling at the landfill was conducted to assess if hot spots (areas with intact drums) were present within the landfill. A total of eight trenches were excavated and sampled at the landfill in January and February of 1993 (Figure 14). At the request of the USEPA RPM, two additional trenches were excavated in areas outside the known limits of the landfill. Trench 9 contained landfilled material; however, no waste material was detected in T10. No intact or partially intact drums were encountered in any of the trenches.

Unconsolidated waste samples were collected from Trenches T1 through T7. The samples collected from each trench were analyzed for the Target Compound List/Target Analyte List (TCL/TAL) constituents by the SW-846 methods except for pesticides/PCBs which were analyzed by the CLP methods. Additionally, one composite sample of the aluminum dross salt cake exposed at the landfill surface was collected and analyzed for TAL constituents and ammonia.

Unconsolidated waste samples were collected and analyzed from eight trenches at the landfill to evaluate the potential presence of hot spots within the landfill. No intact drums were encountered, but between three to five crushed empty drums were observed in each of four trenches during the excavation. To assess the potential presence of hot spots, a statistical test was performed on the waste sample results for the Toxicity Characteristics (TC) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). If the concentration of TC metals from any trench exceeded the sum of two times the average concentration from all waste samples analyzed from the eight trenches plus an upper confidence bound of 80 percent, then the remaining trench samples were submitted for the Toxicity Characteristic Leaching Procedure (TCLP) and the extract was analyzed for those TC metals which failed the statistical criteria. The statistical criteria was exceeded in five of the eight trenches sampled and the samples from these trenches were extracted by the TCLP and analyzed. All TC metal analytical results were below TCLP regulatory levels. As a result, the landfill does not contain hot spots that are highly toxic and/or mobile per the statistical analysis and TCLP results for the TC metals.

An assessment of risk associated with the buried landfill waste was not performed because no hot spots were identified and a presumptive remedy approach for the landfill will be used. A landfill cover system, leachate collection/treatment system, and gas collection system have been evaluated in the FS. Since the USEPA recognizes that containment is the appropriate response action for landfills, a decision to evaluate and implement remedial action for the landfill waste material has already been made.

4.6 Characterization of Surface Water, Sediment and Soil in the East and West Ravines

Based on the observation of deteriorated drums and drum debris, additional sampling outside the original scope of work in the FSP was conducted in three areas. One surface water, sediment, and surface soil sample each were collected in the east and west ravines. Two surface soil samples were also collected near EUs K6 and K7. These samples were collected immediately adjacent to empty drums or drum debris.

Pesticides and PCBs were detected in the sediment and soil samples; none were detected in the surface water samples. Sediment and surface soil from the west ravine contained endrin (tentatively identified at 0.05T mg/kg), PCB-1016 at 0.099 mg/kg in the sediment to 8.4 mg/kg in the soil, and PCB-1248 at 0.16 mg/kg in the sediment to 14 mg/kg in the soil. Surface soil samples from the KCR Site EUs contained isophorone at 1.3 mg/kg, PCB 1248 at 3.3 mg/kg, and PCB 1260 at 0.56 mg/kg. The PCB levels were below remedial action levels.

Inorganic constituents greater than two times the mean of background include:

- Chromium was detected in the surface soil and sediment in the west ravines at concentrations ranging from 42.3 to 144 mg/kg and in surface soil sample SS-13 and SS-14 from 43.7 to 444 mg/kg.

- Lead was detected at concentrations ranging from 69.9 to 211 mg/kg in sediment and soil samples from the west ravines and from 23 to 659 mg/kg in sediment and soil samples in the east ravine.

- Cyanide was detected at 10 mg/kg in the surface soil sample collected in the west ravines and at 75.9 mg/kg in SS-14 located at the KCR Site.

4.7 Air Quality Characterization

The air study consisted of (1) canister and high-volume air sampling, (2) an air emissions study, and (3) air monitoring during the landfill trenching activities. Each component of the study is discussed below.

The air emission study was a qualitative study performed to assess gas emissions from the landfill for consideration in remedial design. Air emission measurements were planned to be performed for six gases at 61 locations located on 100 by 100 foot grid centers over the surface of the landfill. A spectrophotometer was utilized to sample for the presence of acetylene, ammonia, hydrogen cyanide, methane, and total hydrocarbons. Hydrogen sulfide was measured with a hydrogen sulfide monitor.

The air monitoring data collected during the exploratory trenching were used to assess emissions if the landfill surface is disturbed during remedial action. The total hydrocarbon monitoring results may also be used to fill spectrophotometer hydrocarbon data gaps.

In general, air emissions from the landfill contain relatively low concentrations of VOCs, ammonia (where aluminum dross salt cake or leachate are present), methane, and hydrocarbons. Hydrogen cyanide and hydrogen sulfide are compounds unlikely to be present at the landfill. Although the methods used to collect the air monitoring and air emission data were very different, they correlated well. Where data was rejected because of instrumentation problems with one method, the data from another sampling method was used to fill the data gap. Acetylene is the only analyte for which no data is available.

The human health COCs for the air pathway were established from the canister and high-volume air sampling. They are acetone, benzene, cumene, ethylbenzene, hexane, toluene, trichloroethene, xylenes, and manganese. Several of these constituents are included although they were also detected in the upwind sample location because an off-site, upwind sample location was unavailable. Therefore, it cannot be assumed that these constituents were emitted from an off-site source such as vehicular traffic on Kelly Cemetery Road. The exposure pathways include inhalation of ambient air by current and future trespassers and hunters and near-site and off-site residents. Based on the annual average concentration, the risk characterization indicates a 3×10^{-6} and 7×10^{-8} cancer risk for future residential and current/future trespassers, respectively. The HQ for future adult and child residential receptors and trespassers is less than one. An ecological risk assessment for air was not performed.

5.0 SUMMARY OF SITE RISKS

A Baseline Risk Assessment (BRA) was performed to estimate the potential human health and environmental impacts if contaminated media at the site were not remediated. The BRA, presented in Section 6.0 of the Remedial Investigation Report, includes the Human Health Evaluation, the Ecological Baseline Risk Assessment and Remediation Goal Options. The Baseline Risk Assessment for Human Health and the Ecological Baseline Risk Assessment present estimates of potential health and environmental risks based on information acquired during the RI.

The BRA for human health includes an assessment for exposure to groundwater. However, since the groundwater analytical data collected during the remedial investigation could not establish a conclusive relationship between the landfill and groundwater, the human health risks estimated for groundwater exposure is considered to be a preliminary estimate. Additional groundwater samples will be collected and analyzed to determine the influence of naturally occurring constituents on groundwater quality. Upon completion of the additional groundwater sampling and analysis, the risk assessment associated with human health and/or environmental groundwater exposure will be completed. A future decision document will establish the need for groundwater remediation based on an evaluation of the analytical results and on the conclusions of the risk assessment completed for groundwater exposure. The summary of the site's risks presented in this section will include the preliminary groundwater risks estimated. These risks are presented only as a preliminary estimate and not to support a decision for a groundwater remedial action.

5.1 Summary of Human Health Risks

5.1.1 Constituents of Concern

Media associated with the landfill investigation include air, groundwater, leachate, surface water, and sediments. The majority of the samples collected relative to the investigation of the landfill were located on or adjacent to the landfill and are not reflective of site conditions for the KCR site. The eastern most surface water and sediment sample locations collected during the RI may be indicative of KCR site conditions, but also cannot be completely dissociated from the landfill as a source area for detected constituents.

Tables 5 through 9 summarizes the results of the RI sampling and identifies the Constituents of Concern (COC) for each media evaluated in the BRA.

5.1.2 Exposure Assessment

The purpose of an exposure assessment is to provide an evaluation of the potential for human or environmental exposure to constituents at a site in the absence of remedial action. The exposure assessment incorporates data that identify the COCs and their potential transport through the environment. The assessment identifies potential exposure pathways and receptors associated with a site in order to identify potential human or environmental risks associated with the site. Table 10 summarizes the exposure routes considered in the BRA.

Seventeen potential exposure pathways were quantified in this assessment, including 11 current exposure pathways and 17 future pathways. The pathways quantified include the following:

Current and Future Land Uses - Trespassers

1. Dermal contact with surface water while wading
2. Dermal contact with stream sediments while wading
3. Dermal contact with leachate water while wading
4. Inhalation of fugitive dust
5. Incidental ingestion of surface soils
6. Dermal contact with surface soils
7. Inhalation of ambient air

Future Land Uses - Near-Site and Off-Site Residents

8. Ingestion of ground water used for drinking water
9. Dermal contact with ground water while showering and household use
10. Dermal contact with surface soils (KCR Site)
11. Inhalation of fugitive dust (KCR Site)
12. Incidental ingestion of surface soils (KCR Site)
13. Inhalation of ambient air

Current and Future Land Uses - Hunters

14. Inhalation of fugitive dust (KCR Site)
15. Incidental ingestion of surface soils (KCR Site)
16. Dermal contact with surface soils (KCR Site)
17. Inhalation of ambient air

Exposure point concentrations for each of these pathways were determined based on the results of current monitoring data from sampling locations on-site. The exposure point concentrations are multiplied by pathway-specific intake assumptions to yield quantitative estimates of chemical intakes for each pathway.

5.1.3 Toxicity Assessment

Several constituents that have the potential for causing adverse human health effects have been identified in the environmental media at the site. This section presents the available toxicity values which were used for the COCs at the site. Toxicity values are not available for all the constituents detected. Lack of toxicity data may cause risks to be underestimated. In accordance with EPA guidance, constituent which lack toxicity values are evaluated qualitatively and the absence of toxicity values is identified as an uncertainty. Uncertainties also arise because toxicity values are often based on data extrapolated from other species.

The Reference Dose (RfD) and Inhalation Exposure Reference Concentration (RfC) for noncarcinogenic constituents, and the weight-of-evidence classification and Slope Factors for carcinogenic constituents used in the BRA are listed in Table 11.

5.1.4 Carcinogenic and Noncarcinogenic Risks for the Green River Disposal Landfill

Ambient Air

The cancer risk for residential exposure is within the acceptable risk range at 3 x 10^{-6}. Estimated risks for trespassers are slightly lower at 7 x 10^{-8}. The estimated risk is due primarily to the presence of benzene in the sample.

Hazard indices of 0.04 and 0.2 were calculated for future residential adults and children. Hazard indices for trespassers were also below one. Cumene, hexane, and toluene present most of the noncarcinogenic risk for ambient air exposures.

A highly conservative approach was used to quantify air exposures. It was assumed that downwind residents would be exposed to concentrations equal to those actually present at the site. No dispersion or dilution was included; under realistic atmospheric conditions, dispersion can create an order of magnitude or more of concentration reduction over source to receptor distances of approximately 100 feet.

Ground Water

The groundwater risk assessment presented in the RI is considered preliminary. The groundwater portion of the risk assessment will become final after additional groundwater analytical data is collected and evaluated. The preliminary risk assessment for groundwater is presented in this ROD for information purposes only, and also to aid the reader in developing a conceptual model of the site.

The excess cancer risk estimated for residents via ingestion, was 9 x 10^{-4} and was primarily attributed to the presence of beryllium in turbid samples collected from four on-site ground-water monitoring wells. Estimated risk for the dermal contact route was 2 x 10^{-6}. Beryllium was detected in site background soil samples and is commonly present in shale within Kentucky. Its presence in the turbid samples may be the result of naturally occurring beryllium.

Hazard indices for the ingestion route exceeded the departure point of one. The hazard indices for future residential adults and children were 30 and 200, respectively. The majority of the risks are associated with one constituent, manganese, in turbid on-site ground-water monitoring wells.

It was assumed that residents would be drinking water with constituents at levels equal to those currently found on the site. The highest concentrations were associated with wells near the eastern leachate collection pond. Due to its steep slopes and nearby low-lying wetland areas, the landfill is an unlikely location for residential development and not a suitable source of drinking water. Concentrations measured in off-site residential wells were considered acceptable for drinking. Fate and transport conditions at the site are not well defined, but appear to reduce ground water concentrations to acceptable levels before reaching off-site residential receptors. In addition, levels measured at the landfill may be influenced by turbidity in the samples since turbidity is an indication of suspended solids. Only one sampling point was available for the determination of background ground water levels for metals.

Surface Water and Sediments

Trespassing youth may be potentially exposed to constituents present in surface water and sediments during wading. Estimated cancer risks for surface water and sediments were 1×10^{-7} and 3×10^{-6}, respectively. Hazard indices for trespassing youth exposed to surface water and sediment were below one. All dermal contact scenarios for wading assumed a 2.6 hour duration for 45 events a year, i.e., recreational swimming. Therefore, the exposure assumptions were conservative for a remote site with intermittent stream flow.

Leachate Water

Trespassing youth may be potentially exposed to constituents present in leachate water during wading. Estimated excess cancer risk was 2×10^{-7} for dermal exposures. The related hazard index was less than one. The wading exposure assumptions were conservative as mentioned above. In addition, the leachate collection ponds do not represent an attractive site for recreational wading on a regular basis.

Cumulative Risk Estimates

The residential cumulative cancer risk for exposures related to air and ground water at the landfill, was 9 x 10^{-4}. The cumulative hazard indices for adults and children were 30 and 200, respectively. The majority of the risk is associated with the ingestion of ground water. As mentioned previously, the landfill is an unlikely source of potable water, now or in the future.

The cumulative cancer risk for trespassers was 3 x 10^{-6}. Most of the risk was associated with sediment exposures. The hazard indices for hunters and trespassing youth did not exceed one.

Table 19 presents a summary of the site human health risks estimated for the landfill in the BRA.

5.1.5 Carcinogenic and Noncarcinogenic Risks for Kelly Cemetery Road Site

Excess cancer risks associated with surface soil exposures at the KCR Site were within the acceptable range of 1 x 10^{-4} to 1 x 10^{-6}. The risks for residents and trespassers were 5 x 10^{-6} and 1 x 10^{-7}, respectively. Cancer risks were associated with the presence of chromium which was assumed to be hexavalent chromium. As some percentage of the total chromium, and possibly the great majority, would be expected to be trivalent (and thus not classified as a potential carcinogen), the excess cancer risks are overstated. The hazard indices for soil exposures were all below one. In addition, the lead soil levels and ground water levels were input in the Lead Uptake/Biokinetic Model and shown not to present an unacceptable level of risk to young children potentially residing on or near the site. Surface soils were the only media of concern at the KCR Site. While this site is upgradient of surface drainage features addressed during the RI/FS, no apparent impacts on the surface and stream sediments quality were identified which could be associated distinctly with the KCR Site, and or with the landfill.

Table 13 presents a summary of the site human health risks estimated for the KCR area in the BRA.

5.1.6 Comparison to Regulatory Guidance and Criteria

Three compounds in ground water exceeded State and/or Federal primary MCLs for drinking water. The constituents were barium, beryllium, and cadmium. Manganese

exceeded the Kentucky secondary MCL level. The maximum constituent levels for these four compounds were measured in shallow monitoring wells near the northern "toe" of the landfill. These wells, which are installed adjacent to the landfill wastes, are not representative of ground water sampled off-site in residential wells.
Several compounds sampled in surface water exceeded State and Federal surface water quality regulations protective of human health. The regulations assume the ingestion of 2 liters of water and/or 6.5 grams of fish. Because of the intermittent flow of site surface features, the surface water streams do not support fish life and are not a suitable source of drinking water. However, the surface water regulations were considered in discerning potential impacts on downstream water resources such as the Ohio River.

The constituent levels detected in stream sediments were compared to NOAA sediment criteria. Five metals, above estimated concentrations, exceeded NOAA criteria which indicates that sediment quality may be adversely impacted by constituents leaching from the landfill. These included cadmium, chromium, lead, nickel and zinc.

5.2 Summary of the Ecological Assessment

The ecological baseline risk assessment, presented in Section 6.0 of the Remedial Investigation Report, was conducted in accordance with USEPA's "Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual" and MITRE Corporation's "General Guidance for Ecological Risk Assessment at Air Force Installations". The objectives of the ecological baseline risk assessment for the site were:

1. Identify and evaluate the current and future uses of natural resources (land, air, water, biota) at and adjacent to site;

2. Identify potential environmental impacts associated with the site;

3. Quantitatively and qualitatively assess the significance of any potential environmental impacts.

Potential receptors present in the vicinity of the site and the potential pathways by which these receptors may be exposed to constituents of concern present in surface soils, surface water, stream sediments, and leachate water were evaluated. Potential risks to environmental receptors arising from exposure to site constituents were quantitatively characterized for surface water, stream sediments, and leachate water. Potential risks associated with surface soil exposures at the KCR Site were qualitatively characterized.

Sediments associated with the drainage of the site tributary have constituents which show the potential for impacting indicator species. Zinc, chromium, and lead have ecological quotients of greater than 1000 which indicates significant impacts may occur if species come into contact with site sediments. To a lesser but no less important extent, cadmium, manganese, nickel, sodium, bis(2-ethylhexyl)phthalate, and PCB-1248 (EQ of 160 or below) have the potential to have moderate impact to flora and fauna coming into contact with sediments on the site. It should be noted that PCB 1248 concentrations at the site were well below any regulatory standards and below the NOAA sediment criteria. These conservative ecological quotients suggest the lower life forms (water fleas, fathead minnow) may be impacted by sediments which can impact food chain mechanisms for predator species which prey upon them. The impact may be direct by ingesting lower forms contaminated by the sediment or, more likely, by the absence of lower forms due to the toxicity of the sediment.

Surface water associated with the intermittent site tributary has constituents which show the potential for impacting indicator species. Ammonia nitrogen has ecological quotients of 42 to 94 which indicates a moderate impact may occur if species come into contact with site surface water. Ammonia nitrogen is the main concern for impact as toxicity tests performed indicated a severe impact to organisms in surface water was related to the concentration of ammonia nitrogen. To a lesser extent, sodium (EQ of 120 or below) has the potential to have an impact to flora and fauna coming into contact with sediments on the site. These ecological quotients suggest the lower life forms (water fleas, Fathead Minnow) may be impacted by surface water which can impact food chain mechanisms for predator species which prey upon them. The impact may be direct by ingesting lower forms contaminated by the sediment or, more likely, the absence of lower forms due to the toxicity of the surface water. Table 14 presents a comparison of surface water ecological COC concentrations to ambient water quality criteria.

Leachate water also has the same potential to impact species present on site. Ammonia nitrogen with an ecological quotient ranging from 124 to 277 indicates the potential for moderate impact to site species utilizing the leachate water as a drinking water source, foraging area, or as habitat. Zinc, sodium, and chromium may also have an impact but to a much lesser degree.

Surface soils at the KCR Site are not expected to have a significant impact to the environment. Metals and PCBs bind to soils and the soils are covered by shrubs, grasses, and humus. Burrowing animals have the greatest potential for impact but the burrowing species likely to inhabit the area are limited to squirrels and snakes. Fox species have a more suitable habitat in which to burrow at the landfill.

Fauna species can come into contact with leachate water and surface water during drinking, hunting, or swimming activities. Ingestion of surface water is the most readily available route of uptake while dermal contact is also expected. Fauna species may also come into contact with site sediments during these same activities but dermal contact is the route of exposure which is most likely for contact with sediments. Fauna species also can be exposed to site constituents by preying upon lower life forms or plants which may bioaccumulate or bioconcentrate constituents through their own uptake mechanisms. These same species may be impacted if the lower life forms are not present due to the inability to survive constituents in the surface water, leachate water, or sediments.

Flora species inhabiting the riparian of the surface water have the potential for exposure through the uptake of surface water by the roots or coming into contact with surface water sediments. Two areas of stressed vegetation were observed along the sedimentation pond and the periphery of the landfill, but were related to an accumulation of sediment and heavy equipment damage.

Five federally endangered or threatened species were identified as inhabiting Daviess County, but none have been observed on the site. Certain trees with shaggy bark are present at the site which could possibly be used by the Indiana bat as a maternity habitat.

Overall, impacts to the lower life forms are expected to have occurred given the high ecological quotients, predominantly for the zinc, chromium, and lead in the sediments; but also for ammonia nitrogen in surface waters and leachate water. Impacts to the higher life forms cannot be quantitated due to lack of available LC_{50}s or EC_{50}s for those species and limited data on population estimates of species on-site before and after exposure to COCs. Tables 15 through 17 summarize the results of the ecological risk assessment for surface water, surface water sediment, and leachate.

6.0 DESCRIPTION OF REMEDIAL ALTERNATIVES

The Feasibility Study (FS) utilized the presumptive remedy approach for municipal landfills. Title 40 C.F.R. Section 300.430(a)(iii)(B) of the NCP contains the expectation that engineering controls, such as containment, will be used where treatment is impracticable. The preamble to the NCP identifies municipal landfills as a type of Site where treatment of the waste may be impracticable because of the size and heterogeneity of the contents (55 Federal Register 8704, 1990). Because treatment is usually impracticable for a landfill, EPA considers containment to be the appropriate response action, or the "Presumptive Remedy". The presumptive remedy for CERCLA municipal landfill sites relates primarily to containment of the landfill mass and collection and/or treatment of landfill gas. Other measures to control leachate, affected groundwater, and/or upgradient groundwater that are causing saturation of the landfill mass may also be implemented as part of the presumptive remedy. The presence of concentrated waste areas, or "Hot Spots" would require additional characterization; however, no hot spots were present at this Site. Use of the presumptive remedy also eliminates the need for the initial identification and screening of alternatives during the feasibility study.

Table 18 summarizes the Baseline Risk Assessment Results and remedial action conclusions for each media. Based on the remedial investigation and on unacceptable ecological risks associated with site contaminants, three site media will require implementation of a remedial action. These media are: the landfill waste, leachate, and sediment in the unnamed tributary and sedimentation pond.

A description of the alternatives evaluated in the Feasibility Study and a summary of the comparative analysis of EPA's primary balancing criteria is presented in the following sections.

6.1 Landfill Remedial Alternatives

Four capping options related to the layered components of the cap system are described and evaluated in the following sections. These capping alternatives include:

- a native soil cover
- single barrier provided by a compacted clay layer
- single barrier provided by a geomembrane
- composite barrier cover

Each option was considered feasible for application to the containment of the landfill waste at the site. Table 19 provides a summary of the detailed analysis of capping alternatives for the landfill waste. A No Action Alternative was not evaluated because of the presumptive remedy approach of the Feasibility Study.

The area of past landfilling activities was estimated from geophysical surveys and topographic maps. Additional soil sampling or investigative methods would be required on the periphery of the estimated area of landfill activity to confirm the actual extent of the area to be capped. This should be performed during the remedial design phase.

Implementation of each capping alternative requires excavation, hauling and placement of soil and some landfill waste material as sub-grade fill. Clean soil fill is available locally. In order to reduce the slope of the capped area, the excavation of certain areas of landfill waste may be required. The amount of cut and fill material needed to prepare the cap's subgrade would depend on the final grade design of the cap.

Figure 14 presents an estimated extent and preliminary grading plan for the cap. This plan was prepared primarily for cost estimating purposes. According to the figure, the estimated area that would be capped is 14 acres. Currently, the steepest slopes in the landfill area range from 25 to 30 percent. The grades on Figure 14 range from approximately ten percent on the upper (southern) end of the landfill to 17 percent over the steepest slopes. An estimated 18,600 cubic yards of borrow material would be handled from various on-site and off-site sources for construction of the cap's sub-grade. This volume estimate is based on the preliminary grading plan. It is expected that some excavation and re-grading of landfill waste would be required for subgrade preparation. The actual volumes of cut and fill at the landfill area would be determined during Remedial Design.

Excavating and grading soil and the landfill's waste material would increase the potential for soil erosion and COC migration to the Unnamed Tributary. However, these would only be short-term effects during construction. To minimize erosion, temporary erosion control measures such as silt fences, ditches and sediment basins would be implemented.

Natural drainage conditions in the vicinity of the landfill would be slightly altered during cap construction. Run-off would be channeled around the capped area and run-off would be routed across the slope of the capped area and allowed to dissipate naturally according to the existing contour of the surrounding areas. With completion of the cap, surface drainage controls such as ditches, berms and "breaking" slopes with terraces would be implemented to decrease sedimentation and erosion and facilitate drainage management.

A passive gas venting system may be required beneath the cap regardless of the capping option chosen. At a minimum, the system would consist of a continuous granular layer placed above the landfill waste or a series of sand-filled trenches. Vertical gas vent pipes extending above the surface of the cap would be installed within the granular layer or trenches at regular intervals along the perimeter of the cap.

6.1.1 Landfill Alternative 1: Capping With a Soil Cover

This alternative involves the design and construction of a native soil cover over the area of suspected landfilling activity (i.e. approximately 14 acres). After the sub-grade is completed, an approximately two-foot thick compacted soil layer would be constructed. The soil would be obtained from on-site borrow sources, most likely excavated from the side slopes which consist primarily of loess (silt) deposits.

A lateral drainage layer consisting of a geosynthetic mesh (geonet) would be placed on top of the compacted soil layer. Geotextile filter fabric would be placed on both sides of the geonet to prevent clogging of the geonet from the compacted soil below and the vegetative soil above.

A layer of native soil sufficient to sustain vegetative growth for erosion control and prevent root penetration of the underlying compacted layer would be placed over the compacted soil layer. For cost estimation, a three foot thick layer is assumed. This layer would also provide surface drying and freeze-thaw protection to the compacted layer. A layer of geogrid reinforcement may be required within the vegetative soil layer on the steeper slopes of the cap. Figure 15 includes a generalized cross-section of the soil cap layers.

The estimated present worth cost for this alternative is $5,914,000. The construction cost is estimated to be $4,948,000 and the estimated present worth cost of maintenance for years 1 through 30 is $476,000 (1993 dollars). The present worth cost ($490,250) of the institutional actions is also included this alternative.

6.1.2 Landfill Alternative 2: Capping With a Clay Barrier

This alternative involves the design and construction of a compacted clay cover over the area shown on Figure 14. The term "clay" refers to soil classified as CL or CH according to the United Soil Classification System. After the sub-grade is completed, an approximately eighteen inch thick compacted clay layer would be constructed. This thickness is a requirement for clay layers used in Kentucky Solid Waste landfill caps. The clay would be obtained from an off-site borrow source since site soils have been identified as loess (silt). A lateral drainage layer consisting of a synthetic geonet would be placed on top of the clay layer. Geotextile filter fabric would be placed on both sides of the geonet to prevent clogging of the drainage layer from the clay soil below and the vegetative soil above. A vegetative layer of native soil approximately three feet thick would be placed over the drainage layer. This layer would support vegetation for erosion control and would provide freeze-thaw and surface drying protection to the compacted clay layer. A layer of geogrid reinforcement may be required within the vegetative soil layer on the steeper slopes of the cap. Figure 15 includes a generalized cross-section of the layered components of the clay barrier cap. Long-term periodic maintenance of the clay barrier cap is required.

The estimated present worth cost for this alternative is $6,320,000. The construction cost is estimated to be $5,354,000 and the estimated present worth cost of maintenance for years 1 through 30 is $476,000 (1993 dollars). The present worth cost ($490,250) of the institutional actions is also included in this alternative.

6.1.3 Landfill Alternative 3: Capping With a Single Barrier Geomembrane

The design of this alternative is similar to that of alternative 2 except that a flexible geomembrane replaces the compacted clay as the barrier layer. A geomembrane (for cost estimation, 40-mil HDPE was assumed) would be installed over the sub-grade surface. The sub-grade would be prepared with a smooth surface to reduce the potential of tearing the geomembrane. A lateral drainage layer consisting of a geonet mesh would be placed on top of the geomembrane layer. Geotextile filter fabric would be installed over the geonet to prevent clogging of the drainage layer from the above vegetative soil. A vegetative layer of native soil approximately three feet thick would be placed over the drainage layer. This layer would support vegetation for erosion control and ultraviolet radiation protection to the geonet and geomembrane components. A layer of geogrid reinforcement may be required within the vegetative soil layer on the steeper slopes of the cap. Figure 15 includes a generalized cross-section of the layered components of the single barrier geomembrane cap. Long-term periodic maintenance of the this cap is required.

The estimated present worth cost for this alternative is $5,793,000. The construction cost is estimated to be $4,827,000 and the estimated present worth cost of maintenance for years 1 through 30 is $476,000 (1993 dollars). The present worth cost ($490,250) of the institutional actions described in Section 3.1.2.2 is also included in this alternative.

6.1.4 Landfill Alternative 4: Capping With a Composite Barrier Cover

Sub-grade preparation is similar to alternatives 1, 2 and 3. This particular capping option includes two barrier layers which consist of an eighteen inch thick compacted clay layer covered by a geomembrane (40-mil HDPE is assumed for cost estimation). A geonet drainage layer would be placed over the geomembrane to provide lateral drainage. Filter fabric would be placed over this drainage layer to prevent overlying vegetative soil from clogging the drainage net. A vegetative layer of native soil about three feet thick would be placed over the drainage layer. This layer would support vegetation for erosion control. This soil layer would also provide freeze-thaw and surface drying protection to the clay layer and ultraviolet radiation protection to the geonet and geomembrane components. A layer of geogrid reinforcement may be required within the vegetative soil layer on the steeper slopes of the cap. Figure 3-4 includes a generalized cross-section of this composite barrier cap option.

The estimated present worth cost for this alternative is $8,782,000. The construction cost is estimated to be $7,722,000 and the estimated present worth cost of maintenance for years 1 through 30 is $570,000 (1993 dollars). The present worth cost ($490,250) of the institutional actions is also included in this alternative.

6.1.5 Comparative Analysis of Landfill Alternatives

Overall Protectiveness

In terms of preventing direct contact with landfill waste, all four alternatives would provide equivalent protection. The main factor related to the degree of protectiveness that differentiates the capping alternatives is the relative reduction in surface water infiltration and leachate generation. All the alternatives appear to reduce leachate percolation by at least 90 percent. Alternative 4 would typically provide the best overall protection due to its redundancy of barrier layers. Capping alternatives that include the installation of a geomembrane may result in reduced integrity due to subsidence of landfill waste. This is especially the case with alternative 3 in which the geomembrane is not underlain by an additional barrier layer.

Compliance with ARARs

All the capping alternatives can comply with the location and action-specific ARARs outlined in Section 8.2. Landfill capping in itself may not provide compliance with the chemical-specific ARARs related to water quality. However, leachate collection/treatment should provide compliance with these ARARs.

Alternatives 2 and 3 comply directly with Kentucky Solid Waste Rules for final cap systems components. Alternative 4 also complies with the Kentucky Rules for final cap components with an additional barrier layer incorporated.

The performance of alternative 1 would be demonstrated according to Kentucky Solid Waste Rules for alternative specifications of a final cap system. Physical tests performed on site soils indicate that on-site borrow soils can be engineered to achieve a hydraulic conductivity of 10^{-7} cm/sec which is a requirement of the Kentucky Solid Waste Rules.

Long-term Effectiveness and Permanence

In general, alternative 4 would have the highest long-term effectiveness with respect to infiltration reduction. All the capping alternatives would have equivalent long-term effectiveness in preventing direct contact with waste and minimizing erosion. Routine maintenance of the vegetative soil cover is the same for all the alternatives.

Reduction of Toxicity, Mobility, or Volume

The mobility and volume but not the toxicity of leachate would be significantly reduced by implementing any of the capping alternatives. Because surface water infiltration is considered the only mechanism by which leachate is generated, the HELP model provides a good indication of leachate generation rate via surface water percolation. The model indicates that alternative 4 would essentially eliminate future leachate generation. However, the model also indicates that the other alternatives would reduce leachate generation by 90 percent or more. The toxicity and volume of landfill waste would not be reduced with any of the capping alternatives.

Short-Term Effectiveness

Alternative 1 would have a significantly better short-term effectiveness than the other capping alternatives. Because borrow sources for construction of the cap layers are located on site, there would be fewer haul trucks transporting materials to the site. This reduction in traffic would decrease associated hazards to the local citizens especially those on Kelly Cemetery Road and/or Chestnut Grove Road.

Implementability

Alternative 1 would be the simplest cap to construct due to the availability of the earthen materials. Alternative 2 is relatively simple to construct. However, there would be a significant effort to transport and handle clay material from off-site. This effort would also apply to alternative 4. Alternatives 3 and 4 would require more extensive quality assurance and quality control procedures than alternatives 1 and 2 since 3 and 4 both involve placement and seaming of a geomembrane.

<u>Cost</u>

Alternative 3 has the lowest construction (capital) cost estimate ($4,827,000) of the capping alternatives. Alternative 1 is slightly more expensive with a construction cost estimate of $4,948,000. The construction cost estimate for alternative 2 ($5,354,000) is approximately eleven percent higher than that of alternative 3.

Alternative 4 is the most expensive capping alternative. The construction cost estimate for Alternative 4 ($6,194,000) is more than $1,300,000, or about 28 percent, higher than the least expensive capping alternative (alternative 3).

Only cap construction costs are compared because operation and maintenance costs and institutional control costs are considered approximately the same for each alternative.

6.2 Leachate Remedial Alternatives

The following discussion and evaluation of alternatives for leachate considers the areas near the base of the landfill where leachate seeps have been observed. It is assumed that leachate would continue to seep from these areas if no action is taken to reduce or eliminate leachate generation. It is believed that a landfill cap may virtually cease leachate production within 2 to 4 years after construction.

Three remedial alternatives were evaluated for leachate:

- No Action
- Limited Institutional Action
- Collection with Subsurface Drains: Chemical/Physical Treatment for Removal of Heavy Metals and Organic Compounds; Discharge of Treated Water into the Unnamed Tributary

6.2.1 Leachate Alternative 1: No Action

The no-action alternative includes no on-site remediation or institutional controls to address leachate. The leachate seeps would essentially remain in their current state. However, the placement of a landfill cap would significantly reduce the production of leachate through decreased subsurface infiltration presented in the detailed analysis of landfill waste alternatives.

6.2.2 Leachate Alternative 2: Limited Institutional Action

This action involves maintenance of the perimeter fence and long-term security and inspections. A long-term monitoring program of sediment, surface and ground water sampling and analysis would be implemented. It is anticipated that sampling would be performed annually. However, this schedule is subject to alteration depending upon fluctuations, if any, in sediment and/or water quality results. It can be expected that the sampling frequency would vary throughout the life of the program. Deed restrictions would also be instituted to the extent possible to restrict future land use.

Long-term site monitoring was assumed to include sampling in the eleven ground-water monitoring wells currently on-site. Monitoring at three surface water and three sediment sample locations is also proposed for this alternative.

The current state of the leachate outbreaks remains relatively unchanged with the implementation of the limited institutional action alternative.

6.2.3 Leachate Alternative 3: Collection with Subsurface Drains; Chemical/Physical Treatment for Removal of Heavy Metals and Organic Compounds; Discharge of Treated Water into the Unnamed Tributary

In this alternative, leachate would be collected through subsurface interceptor drains. The collected leachate would be pumped into a equalization tank to begin the treatment process. The metals would be removed by hydroxide precipitation. Ammonia and VOCs would be removed by air stripping. The treated leachate would be discharged through a National Pollutant Discharge Elimination System (NPDES) discharge point. This alternative includes the Institutional Controls of Alternative 2.

Unit operations proposed for this alternative are common. For cost estimation purposes some process detail assumptions, such as sodium hydroxide as the reagents or plate and frame filters as the dewatering equipment, have been made. Actual process details such as amounts and types of reagents, clarification and dewatering methods, and filtration equipment will be specified as a result of bench and/or pilot scale testing which will be performed during the Remedial Design phase.

The major components of this alternative are as follows:

Leachate Collection

The location of interceptor drains will depend upon the landfill cap configuration. In general, the drains would be located along the northern edge of the cap topographically downgradient of the observed leachate outbreaks. The total length of drain would be approximately 1,100 feet.

The collection drains would consist of perforated pipe placed in a gravel filled trench. The trench would be excavated to the depth of the soil-bedrock interface. The trench depth would range from approximately 10 to 15 feet below ground surface. If significant fractures are encountered within the bedrock, they will be sealed with grout prior to completion of the drain installation. A geotextile filter fabric would be placed around the gravel envelope in the trench to prevent soil or landfill material from entering the drain. The bottom of the trench and the downgradient wall would be lined with a synthetic membrane to contain the leachate. The drains would be sloped to convey the leachate to one or more sump/pump stations. The leachate will then be pumped to the equalization tank to begin treatment. A conceptual typical cross-section of a leachate interceptor drain is shown in Figure 16.

Leachate flow monitored from April 1991 to March 1993 during operation of the temporary leachate control and collection system (discussed in Section 1.2.4 of the RI report) indicated the following average flow rates from the landfill due to leachate recirculation:

- Approximately 7 gallons per minute (gpm) for the first six months of operation
- Approximately 12 gpm for the second six month period of operation
- Approximately 13 gpm for the third six month period of operation
- Approximately 14 gpm for the last six months of operation

These flow data indicate that the recirculation flow rate of leachate through the landfill had reached a maximum approximately 14 gpm. Natural leachate discharge from the landfill, (i.e. without recirculation), would likely be considerably lower than 14 gpm. However, an average flow rate of 5 gpm is considered reasonable for the life of the landfill closure especially since capping would significantly reduce the leachate generation rate. Therefore, cost estimations and conceptual design for treatment are based upon a flow rate of 5 gpm.

<u>Leachate Treatment</u>

Figure 17 is a conceptual process flow diagram of the treatment process. Leachate would be stored in an equalization tank to equalize flow. From there, the leachate would be pumped into a metals-removal process where the metals would be precipitated using sodium hydroxide. The precipitate would be removed by clarification. Polymer would be added to enhance clarification.

Metal precipitate sludge would be dewatered in a plate and frame filter press or an equivalent process. The sludge can then be tested and disposed of in an approved landfill.

Clarified liquid from the metals-removal process, would be filtered to remove suspended solids and passed through an air stripper to remove ammonia and any trace VOCs. The air stripper is comprised of a column filled with specially designed packing with large surface areas and low fouling characteristics. Air would be passed counter current to the leachate to strip the ammonia out of the liquid. Some of the volatile organic compounds would also be removed in the air stripper. It is not anticipated that the vapor discharge would need treatment. However, this would be verified during remedial design.

After air stripping, the pH of the leachate would be lowered to discharge limits, usually between 6.0 and 9.0. The treated leachate would then be discharged to an KYPDES approved discharge outfall.

6.2.4 Comparative Analysis of Leachate Alternatives

Overall Protectiveness

Alternative 3 would provide the best overall protection since leachate would be collected and treated. Alternative 1 and 2 will provide little or no protection to ecological receptors.

Compliance with ARARs

Only Alternative 3 is expected to be in compliance with ARARs outlined in Section 8.2. Alternatives 1 and 2 may result in a failure to meet Ambient Water Quality Criteria (AWQC) downstream of the site.

Long-term Effectiveness and Permanence

Alternative 3 would provide the best long-term effectiveness since the leachate is controlled and hazardous constituents removed. Alternatives 1 and 2 will not provide any protection to the environment since uncontrolled leachate discharge would continue.

Reduction of Toxicity, Mobility, or Volume

Alternative 3 is the only alternative that provides direct reduction in toxicity, mobility and volume of this liquid waste. Landfill capping should considerably reduce the volume of leachate generated with time since surface water infiltration into the waste is the only mechanism for generating leachate.

Short-Term Effectiveness

Alternative 1 poses the lowest short-term risk since no remedial activities are performed. Typical construction hazards associated with trench excavations would be present with alternative 3. Health risks to site workers who come in contact with leachate constituents during implementation of alternatives 2 or 3 are considered minimal and controllable.

Implementability

Alternative 2 is considered highly implementable since its components (fencing, monitoring wells) have already been completed. Implementation of Alternative 3 is expected to present only routine construction and planning problems.

Cost

No costs are associated with Alternative 1. The present worth total for Alternative 2 is $490,250. Most of this cost is for long-term monitoring and is representative of the institutional actions for the whole site. The present worth total for Alternative 3 is approximately $3,312,179. Approximately seventy-five percent of this total is for operation and maintenance of the treatment system and institutional controls.

6.3 Sediment Remedial Alternatives

The remedial alternatives considered address contaminated sediment located along the unnamed tributary and in the sedimentation pond, shown on Figure 18.

Three remedial alternative were evaluated for sediment:

- No Action
- Limited Institutional Action
- Excavation and consolidation in the landfill

6.3.1 Sediment Alternative 1: No Action

This no-action alternative requires no remediation or institutional constraints to address sediments in the unnamed tributary and sedimentation pond. Sediments would remain in their current state.

6.3.2 Sediment Alternative 2: Limited Institutional Action

The activities for his alternative as applied to sediments are the same as those described in Section 5.2.2 except that leachate and ground-water quality monitoring would not be applicable to sediments.

6.3.3 Sediment Alternative 3: Excavation and Consolidation in the Landfill

This alternative involves excavation of stream and impoundment sediments, dewatering and consolidation of the sediments with landfill waste, both of which would be capped. Executing this alternative during dry periods may preclude the need for surface water diversion.

Continued use of the sedimentation pond can be achieved by removal of the impoundment sediments. A compacted clay lining would be placed within the sedimentation pond after sediment removal is completed to eliminate possible exposure by ecological receptors to any remaining sediment residues.

The Unnamed Tributary would return to a more natural state after removal of the stream sediments. Sediments would be removed from the tributary to the extent that native soil is visually exposed.

Excavation and removal of the sediments must precede the capping of the landfill. Placement in the landfill would necessitate regrading of the placement areas. Placing the sediments under the landfill cap would significantly reduce the potential for migration of constituents.

6.3.4 Comparative Analysis of Sediment Alternatives

<u>Overall Protectiveness</u>

Overall protection provided by Alternative 3 is considered better than the other sediment alternatives primarily because the sediments would be contained beneath the landfill cap preventing both contact with ecological receptors and migration of sediment constituents off-site. Alternative 1 and 2 would not be protective of ecological receptors as indicated by the Baseline Risk Assessment and downstream migration of impacted sediments is expected.

Compliance with ARARs

Alternative 3 appears to be the sediment alternative mostly likely to comply with the ARARs outlined in Section 8.2. Alternatives 1 and 2 are unlikely to satisfy the location-specific ARARs related to wildlife protection.

Long-term Effectiveness and Permanence

Long-term effectiveness is achieved best with Alternative 3 since the sediments would be removed from pathways of continued surface water flow which may promote long-term leaching. Ecological risks posed by the existing sediment quality are expected to remain with Alternatives 1 and 2.

Reduction of Toxicity, Mobility, or Volume

Alternative 3 would be effective in reducing the mobility of sediment constituents since alternative 3 involves landfill containment. No reduction of toxicity or volume of sediment constituents would be anticipated with implementation of alternative 3. No reduction of toxicity, mobility or volume of sediment constituents can be anticipated with alternative 1 and 2.

Short-Term Effectiveness

Short-term effectiveness is achieved best with alternatives 1 and 2 since no remedial actions (i.e. disturbance of the sediments) would take place. Alternative 3 would have the lowest short-term effectiveness. However, short-term risk resulting from sediment excavation and transport can be easily mitigated with engineering controls.

Implementability

Alternative 3 is considered implementable since consolidation of sediments with landfill waste would allow re-use of the existing sedimentation pond for surface water run-off control of the capped landfill. Implementation of alternative 3 would also provide needed subgrade backfill for landfill cap placement.

Cost

No costs are associated with alternative 1. The estimated cost for alternative 3 is approximately $244,000. The present worth cost of 2 is about $490,000. This total is not directly comparable to the other sediment alternatives since it is applicable to the site as a whole as previously discussed.

7.0 THE SELECTED REMEDY

Based on the Remedial Investigation, Baseline Risk Assessment, Feasibility Study and on consideration of the requirements of CERCLA and the NCP, EPA has determined that the most appropriate remedy to mitigate the current and potential ecological risks associated with the Green River Disposal Landfill will consist of the following:

1. Landfill Alternative 4: Capping With a Composite Barrier Cover

2. Leachate Alternative 3: Collection with Subsurface Drains; Chemical/Physical Treatment for Removal of Heavy Metals and Organic Compounds; Discharge of Treated Water into the Unnamed Tributary

3. Sediment Alternative 3: Excavation and Consolidation in the Landfill

4. Removal of surface debris and/or buried wastes located in the east and west ravines, and dispose these wastes within the landfill cap.

The total present worth cost of implementing these remedies is estimated at $11,000,000. The objectives for the remedial action are:

Landfill:

- Prevent direct exposure with the landfill contents
- Minimize storm water infiltration and production of leachate
- Prevent migration of contaminants by leachate collection and treatment
- Control surface water runoff and erosion
- Control fugitive gas emissions

Leachate:

- Prevent direct exposure or ingestion of leachate by environmental receptors
- Prevent migration of contaminants from the landfill wastes to the groundwater and unnamed tributary

Sediment:

- Prevent direct exposure to ecological receptors.

7.1 Performance Standards

Landfill Cap

The landfill cap shall, at minimum, be designed and constructed to meet State performance requirements outlined in 401 KAR 48:080. The components of the cap shall include: a vegetation/soil top layer (graded to maximize storm water run-off); a filter and drainage layer; and a combination of a clay layer and a geomembrane layer to minimize infiltration. The design of the cap shall consider long-term permanence and minimal long-term maintenance as principal design elements. EPA in consultation with KDEP and the local community will review and approve the final cap design.

The cap shall be designed to accommodate for possible settlement, and requirements for gas venting will be evaluated during the design phase. Applicable or Relevant and Appropriate Requirements (ARARs) identified for this component are listed in Section 8.2.

Leachate

The leachate collection system shall be designed and constructed to collect leachate from the landfill waste at the perimeter of the waste disposal area and from below the landfill cap. Leachate shall not be permitted to seep through the landfill cap or migrate off site by any means.

The leachate treatment system shall be designed and constructed to remove or substantially reduce the concentrations of any hazardous or toxic constituents present. The treatment system effluent shall meet all applicable, or relevant and appropriate requirements for discharge on-site to the unnamed tributary. The effluent discharge shall comply with effluent standards and monitoring requirements pursuant to the Kentucky Pollutant Discharge Elimination System (KPDES) program. The leachate collection and treatment system shall be maintained functional and operational for up to 30 years to meet the objectives outlined in the previous section.

The system shall be designed and constructed based on the conceptual model presented in Figure 17. ARARs identified for this component of the remedy are listed in Section 8.2.

Sediment

Contaminated sediment from the unnamed tributary identified in Figure 18, shall be excavated and consolidated within the landfill, under the landfill cap. Excavation of the sediment shall be conducted in a manner that will minimize destruction of the surrounding environment (i.e. trees, wildlife habitats, etc.). The contaminated sediment in the stream and sedimentation pond identified in the Remedial Investigation Report shall be removed to the extent that all of the sediment at these locations will be excavated. EPA will verify by visual inspection that all sediments in the areas of concern are removed in accordance with this ROD. The stream shall then be restored to its natural state by regrading and replacement of sediment where necessary. ARARs identified for this component are listed in Section 8.2.

7.2 Modifying Criteria

7.2.1 State Acceptance

The Kentucky Department for Environmental Protection (KDEP) assisted EPA in reviewing all technical reports produced during the RI and FS. Upon review of this ROD, KDEP raised a concern regarding the proposed landfill cap. KDEP believes that a more appropriate landfill cap would be a cap that meets the requirements of Kentucky Hazardous Waste Regulations (i.e. a RCRA Subtitle C Hazardous Waste Landfill Cap). This concern is based on the belief that Kentucky Hazardous Waste Regulations are ARARs because hazardous wastes may have been disposed at the site.

EPA does not agree with this assessment for the following reasons. EPA has determined that Kentucky Hazardous Waste Regulations (i.e. RCRA landfill cap closure requirements) are not applicable to the Green River Disposal site. Site records indicate that industrial wastes, that may have been characterized as a hazardous wastes (under the current RCRA definition), were accepted at the site prior to 1980, when hazardous waste restrictions became effective. The records also indicate that wastes disposed of at the site after 1980 were primarily miscellaneous trash, with a few specifically approved exceptions. Therefore, since no RCRA-defined hazardous wastes were disposed at the site after 1980, RCRA landfill closure requirements or Kentucky Hazardous Waste Regulations do not apply.

With respect to the design of the landfill cap, EPA has determined that a RCRA Subtitle C cap may be relevant based on the types of wastes disposed at the site, but it is not appropriate because of the low-level threats posed by the site and the high level of protectiveness achieved by a comparable cap. Analytical results of samples collected from the buried wastes show that the wastes do not exhibit hazardous waste toxicity characteristics (40 CFR §261.24). The landfill cap selected in this ROD is the best alternative to the RCRA Subtitle C cap and provides the greatest degree of protection in comparison to other cap alternatives evaluated.

EPA recognizes that RCRA Closure and Post Closure Care groundwater monitoring requirements may be relevant and appropriate; however, groundwater monitoring to further evaluate the extent of contamination at this site will be completed as discussed in Section 4.1, and the need for a groundwater cleanup action will be addressed in a subsequent ROD.

Upon consideration of EPA's response to the landfill cap issue, KDEP concurs with the selected remedy for the landfill. However, KDEP does not fully agree with the remedial investigation conducted at the KCR site, and therefore, does not concur with EPA's decision to take no action at the KCR site. A copy of the Kentucky's letter is included in Appendix A.

7.2.2 Community Acceptance

The local Maceo community organized a group of concerned citizens to monitor the progress of EPA's investigation and cleanup of the site. This group, called the Green River Toxic Waste Cleanup Association, is very involved at the site and has actively participated in the remedy selection process.

Based on the comments provided by the group at the Proposed Plan Public Meeting, EPA believes that the community accepts and supports the proposed remedy outlined in this ROD.

8.0 STATUTORY DETERMINATIONS

8.1 Overall Protection of Human Health and the Environment

The selected remedy will provide the best overall protection to human health and the environment by:

- Containing the landfilled mass by capping and immobilizing hazardous constituents, minimizing leachate generation
- Preventing direct exposure of leachate by ecological receptors and minimizing off-site leachate migration through collection and treatment
- Preventing/eliminating direct exposure to the landfill wastes and contaminated sediments by human and ecological receptors.

Implementation of the selected remedy will reduce ecological risks below the acceptable threshold of one Ecological Quotient (EQ). The selected remedy meets the NCP's required threshold criteria for protection of human health and the environment.

8.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The selected remedy, consisting of the four components identified in Section 7.0, will meet all Federal and State ARARs identified below. The ARARs are presented as Chemical-Specific, Location-Specific, and Action-Specific requirements, and are identified as follows:

<u>Action-Specific ARARs:</u>

1. The landfill cap will, at minimum, meet the requirements established in the following Kentucky Solid Waste Rules:

   - Cap Design Requirements for Contained Landfills (401 KAR 48:080)
   - Operating Requirements for Contained Landfills (401 KAR 48:090)

   These regulations establish requirements for landfill cap design and site closure, and are considered relevant and appropriate since the Green River Landfill was constructed before the effective date of these rules.

2. Groundwater monitoring associated with operation and maintenance of the landfill after construction of the cap shall meet the substantive requirements outlined in Kentucky Solid Waste Rules, Surface and Groundwater Monitoring and Corrective Action (401 KAR 48:300). Because the site is an existing closed facility, these requirements are considered to be relevant and appropriate. Additionally, EPA recognizes that RCRA Closure and Post Closure Care groundwater monitoring requirements may be relevant and appropriate; however, groundwater monitoring to further evaluate the extent of contamination at this site will be completed as discussed in Section 4.1, and the need for a groundwater cleanup action will be addressed in a subsequent ROD.

3. Air quality at the site during construction shall meet the National Ambient Air Quality Standards (CAA, 40 CFR Part 50) and the Kentucky Ambient Air Quality Standards (401 KAR 53:010). These standards are considered applicable.

4. The effluent discharge from the leachate treatment system shall meet the substantive requirements of the Kentucky Pollutant Discharge Elimination System program (401 KAR 5:055, Section 6). These requirements are applicable for regulating effluent discharges from the leachate treatment system into the unnamed tributary.

5. If hazardous wastes are generated by implementation of the selected remedy, then these wastes shall be managed in accordance with the requirements of the Resource, Conservation and Recovery Act (RCRA, 40 CFR Parts 260 to 270). These requirements, considered applicable to the selected remedy, regulate the treatment, storage, and disposal of hazardous waste.

<u>Location-Specific ARARs:</u>

1. Fish and Wildlife Protection (16 USC 661-666c, 6 USC 2901 <u>et seq</u> 33 CFR 320-330; 40 CFR 6.302) requires adequate protection of fish and wildlife if any stream or body of water is modified. These regulations are applicable to remedial activities associated with the unnamed tributary.

2. Protection of Wetlands (Executive Order 11009 40 CFR 6.302, Appendix A) regulates actions involving construction of facilities or management of property in wetlands to avoid adverse effects, minimize potential harm, and preserve and enhance wetlands to the extent possible. This requirement is considered relevant and appropriate because remedial actions on-site may affect wetlands and surface water bodies off-site through effluent discharges in the unnamed tributary.

3. Endangered Species Act of 1973 (16 USC 1531-1544) provides protection of endangered or threatened species. Although no endangered and threaten species were observed at the site, this requirement is relevant and appropriate to preserving protected wildlife and their habitats at or near the site during construction of the remedy.

Chemical-Specific ARARs:

1. Kentucky Water Quality Standards (401 KAR 5:031) establishes surface water standards protective of aquatic life. These standards are applicable to the remedy selected to protect surface water bodies from the leachate treatment effluent discharge.

To Be Considered (TBC) Criteria or Guidance

CERCLA guidance provides for the identification of criteria that may be relevant and appropriate to the circumstances of the release at a site, but which do not meet the statutory definition of an ARAR. To be defined as an ARAR, a standard or criterion must be a requirement or regulation promulgated under federal or state authority, and must be of general applicability. Other standards or criteria, known as criteria "to be considered", or TBCs, may be necessary in order for the remedy to be fully protective of human health and the environment.

EPA has identified the following TBCs which may be used to establish cleanup levels and other performance standards for the selected remedy:

1. NOAA Technical Memorandum NOS-OMA52 "Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trend Program"

2. Interim Guidance on Establishing Soil Lead Clean-up Levels at Superfund Sites, OSWER 9355.4-02, September 7, 1989

3. Handbook to Support the Installation Restoration Program (IRP) Statements of Work, Volume 1, Section 3, "Ecological Risk Assessment", May 1991

4. Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites EPA/540/P-91/001, February 1991, Guidance Document

5. Covers for Uncontrolled Hazardous Waste Sites, EPA/540/2-85/002, September 1985 Guidance Document

6. Overview of RCRA Land Disposal Restrictions (LDRs) USEPA Directive: 9347.3-01FS, July 1989

7. Superfund Accelerated Cleanup Bulletin, Presumptive Remedies for Municipal Landfill Sites, Publication 9203.1-021, February 1993

8. Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities, USEPA Office of Research and Development, EPA/600/R-93/182, September 1993

9. Technical Guidance Document: Construction Quality Management for Remedial Action and Remedial Design Waste Containment Systems, USEPA Office of Research and Development, EPA/540/R-92/073, October 1992

10. Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments, USEPA Office of Solid Waste and Emergency Response, EPA/530-SW-89-047, July 1989

11. Seminar Publication: Design and Construction of RCRA/CERCLA Final Covers, USEPA Office of Research and Development, EPA/625/4-91/025, May 1991.

RESPONSIVENESS SUMMARY

1.0 OVERVIEW

A 30 day public comment period for the Green River Disposal Site was established from July 19, 1994 through August 17, 1994. The purpose of the comment period was to request public input concerning EPA's recommended cleanup remedy for the site. The public comment period was initiated through the Proposed Plan Fact Sheet (sent to concerned citizens and local officials on EPA's mailing list) and through a notice placed in the local newspaper. A public meeting was held on August 4, 1994 to discuss the remedial investigation with concerned citizens and formally present EPA's recommended remedy for the site. The meeting was held at the Maceo Elementary School in Maceo, Kentucky. EPA representatives responded to comments and questions from the local community at the meeting. A transcript of the meeting is included with this document in Appendix B.

Based on the comments provided by the Green River Toxic Waste Cleanup Association (Cleanup Association), EPA believes that the Maceo community supports EPA's selected remedy. EPA worked closely with the Cleanup Association to determine and address the community's concerns throughout the Superfund process.

2.0 BACKGROUND ON COMMUNITY INVOLVEMENT

The local community has had concerns about the site since the landfill began operating in the early 1970s. The site file retained by the Kentucky Department for Environmental Protection, Division of Waste Management, documents many nuisance complaints about the site from neighbors. There were also concerns from adjacent property owners about leachate and contaminated groundwater.

When the EPA became involved at the site in 1988, the community organized into a loosely cohesive group. In 1992 a local community group, called the Maceo Concerned Citizens Group, adopted the Green River Site as one of their projects. By 1993, members of this group primarily concerned about the Green River Site established themselves as the Green River Toxic Waste Cleanup Association (Cleanup Association) to monitor progress at the site. The Cleanup Association remains very involved in activities related to the site. This group has provided valuable information about the site and provided assistance to EPA in coordinating meetings with local officials and with the community at large.

Throughout the remedial investigation and feasibility study, EPA worked closely with the Cleanup Association. Draft reports and documents were provided for the Cleanup Association's comments and input. Formal and informal meetings were held in the community to keep citizens informed about the site and to discuss issues of concern.

3.0 SUMMARY OF MAJOR PUBLIC COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD, AND EPA RESPONSES

EPA issued a Proposed Plan Fact Sheet summarizing the results of the remedial investigation, feasibility study and baseline risk assessment on July 15 1994. The fact sheet also described EPA's proposed final remedy for the site and announced a public comment period. The Fact Sheet was sent to the local community, and to local, State, and Federal officials.

The 30-day public comment period began on July 19, 1994 and ended on August 17, 1994. Two sets of written comments were received by EPA. One set of comments was submitted by the Kentucky Resources Council, a nonprofit environmental organization, and the other set of comments was submitted by the Green River Coordinating Group, who are the Potentially Responsible Parties that have completed the RI/FS.

The following is a summary of the major comments EPA received during the comment period and EPA's response:

Kentucky Resources Council (KRC) comments:

It appears that all of the comments provided by KRC were based on a cursory review of the Proposed Plan Fact Sheet. One of the purposes of the Proposed Plan Fact Sheet is to provide the public with a brief summary of the remedial investigation results. Conclusions about how the investigation was conducted, cannot be made from the information presented in the fact sheet. Many of KRC's concerns can be specifically addressed by a review of the RI and FS Report, located in the Green River Disposal Landfill Site Administrative Record.

1. **COMMENT:** The KRC is concerned that the investigation and characterization of the Kelly Cemetery Road Site (Road Site) was not adequate to support a remedial decision. The following two points were presented:

    1) Not enough samples were collected at the Road Site to perform an adequate risk assessment in accordance with Kentucky Regulations (KRS 224.01-400).

    2) No sediment samples were collected in the drainage ways or intermittent stream located in the ravine between the Road Site and the landfill.

EPA RESPONSE: The Kelly Cemetery Road Site was included as part of the Green River Disposal Landfill Superfund Site because of concerns that residual soil contamination was not addressed during the drum removal conducted by the Commonwealth. Kentucky Division of Waste Management files do not clearly indicate the extent in which soil in the drum disposal area was investigated or remediated. Additionally, the files do not clearly define or locate the area where the drum removal occurred. Subsequently, twenty-five acres were investigated alongside Kelly Cemetery Road to locate the drum disposal area and determine if a remedial response was necessary.

The Potentially Responsible Parties prepared a risk-based statistical sampling plan with assistance from EPA's Office of Research and Development, Quality Assurance Management Staff. The sampling plan for the Road Site was prepared and implemented in accordance with the Data Quality Objectives Process for Superfund (EPA 540-R-93-071). The number, types and location of soil samples were meticulously determined. It was shown statistically that a sample composed of nine aliquots adequately characterizes the presence of contaminants in an acre area. Composite soil samples were collected from each acre in the 25 acre study area. The samples were analyzed for specific contaminants associated with the wastes disposed at the site. Additionally, soil samples collected from the areas suspected to be the drum disposal area were analyzed for a complete list of compounds (Target Compound List and Target Analyte List compounds). The highest concentrations detected in the samples were then used to estimate human health risks associated with exposure to the surface soil. The results of the risk assessment were within EPA's acceptable limits.

A sediment and surface water sample was collected from the ravine between the Road Site and the landfill, and numerous sediment and surface water samples were collected topographically upgradient of the landfill and downgradient from the Road Site. The sample results did not show the presence of contaminants associated with the Road Site.

The amount and types of soil samples collected from the Kelly Cemetery Road site fully satisfies the remedial investigation/feasibility study (RI/FS) requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR §300.430). The State statute KRS 224.01-400 is substantially equivalent to the NCP requirements for performance of an RI/FS and selection of a remedy. EPA believes that the quantity and quality of the data collected from the Kelly Cemetery Road Site is sufficient to adequately support a no-action decision.

2. **COMMENT:** KRC believes that Resource Conservation and Recovery Act (RCRA) closure requirements is an action-specific Applicable or Relevant and Appropriate Requirement (ARAR) because of the nature of the ferrocyanide wastes disposed at

the site. Additionally, since RCRA should be an ARAR and the area may be considered a land disposal unit, KRC suggests that groundwater monitoring would also be considered an action-specific ARAR.

EPA RESPONSE: The premise of this comment is that soil contamination exists at the Kelly Cemetery Road Site. However, based on the results of the remedial investigation (indicating that no significant residual surficial soil contamination exists), EPA has determined that no further action is necessary. Therefore, since no remedial action is proposed, RCRA closure requirements are not appropriate for consideration.

3. **COMMENT:** It appears from the fact sheet that soil sampling around the landfill perimeter showed significant levels of contamination. It is not clear whether sufficient sampling was performed to determine the full extent of such contamination, or if such sampling is planned as part of the remedy to ensure that all the contamination is brought under the cap.

   EPA RESPONSE: No supplemental surface soil sampling will be necessary for soil around the landfill since the proposed landfill cap will encompass all of the areas where surficial soil samples were collected. Additionally, surface soils adjacent to the landfill in areas outside the cap will be consolidated within the cap. Those areas will be regraded and covered with a vegetative layer.

4. **COMMENT:** Based on the nature of the identified industrial wastes disposed of at the landfill, and the hazardous constituents detected at the site, a RCRA cap over the landfill would appear to be an action-specific ARAR.

   EPA RESPONSE: EPA has determined that RCRA closure requirements are not applicable to the Green River Disposal site. Site records indicate that industrial wastes, that may have been characterized as a hazardous wastes (under the current definition), were accepted at the site prior to 1980, when RCRA restrictions became effective. The records also indicate that wastes disposed of at the site after 1980 were primarily miscellaneous trash, with a few specifically approved exceptions. Therefore, since no RCRA-defined hazardous wastes were disposed at the site after 1980, RCRA landfill closure requirements are not applicable.

   With respect to the design of the landfill cap, EPA has determined that a RCRA Subtitle C cap may be relevant based on the circumstances at the site, but it is not appropriate because of the low-level threats posed by the site and the high level of protectiveness achieved by a comparable cap. Analytical results of samples collected from the buried wastes show that the wastes do not exhibit hazardous waste toxicity characteristics (40 CFR §261.24). The landfill cap selected in this ROD is the best alternative to the RCRA Subtitle C cap and provides the greatest degree of protection in comparison to the other cap alternatives evaluated.

EPA recognizes that RCRA Closure and Post Closure Care groundwater monitoring requirements may be relevant and appropriate; however, groundwater monitoring at this site will be addressed in a subsequent ROD.

5. **COMMENT:** The KRC is concerned that the Presumptive Remedy Approach implemented at this site has limited the types of possible remedial alternatives evaluated in the feasibility study.

   EPA RESPONSE: The presumptive remedy approach for municipal landfills was developed by EPA based on an analysis of feasibility studies conducted for similar types of sites. The EPA analysis concluded that containment is the most appropriate type of remedy for municipal landfills, except under unusual or site-specific circumstances. EPA decided to use this approach at the Green River site since the remedial investigation confirmed that there were no unusual circumstances to consider. This approach was utilized to streamline the evaluation of the containment remedies for the landfill only, and was not applied to the remedy evaluation for leachate or sediment treatment alternatives. The feasibility study conducted for this site complies with the requirements of the NCP and included all reasonable remedial technologies appropriate for this site.

6. **COMMENT:** The KRC is concerned that selecting a landfill remedy prior to reaching a conclusion regarding groundwater may result in a final overall site remedy that would be a less effective source control remedy.

   EPA RESPONSE: At this site, selection of a landfill cap, leachate collection and treatment, and sediment treatment, is based on factors independent of groundwater remedy considerations. As stated in the Proposed Plan Fact Sheet, EPA will conduct additional groundwater sampling and analysis to better determine the relationship between the landfill and groundwater. Selection of a landfill cap and leachate collection system will have no relevancy on selecting a groundwater remedy, or have no impact on the effectiveness of a groundwater pump-and-treat system.

   Upon evaluation of the additional groundwater analyses, EPA will issue a separate Record of Decision to document a final decision concerning groundwater at the site.

Green River Coordinating Group (Coordinating Group) Comments:

1. **COMMENT:** The Coordinating Group supports EPA's decision to conduct additional groundwater analyses, but recommends shortening the planned two year groundwater monitoring period. The Coordinating Group feels that based on the age of the landfill, a two year period may not be required.

   EPA RESPONSE: EPA is not opposed to shortening the monitoring period, and encourages any efforts to collect the data necessary as quickly as possible. However, EPA will not approve a sampling plan that does not provide the necessary data upon which to base a remedy decision, or accept any data that may be suspect.

2. **COMMENT:** The Coordinating Group agrees that containment is the most appropriate type of remedy for this site. However, they do not agree with the landfill cap remedy alternative selected by EPA. The Coordinating Group believes that the low risks associated with the site does not justify the use of a composite barrier throughout the site. They recommend selecting a combination of Alternatives 2 (capping with a clay barrier) and 3 (capping with a single barrier geomembrane), with the flexibility of formally deciding upon the final configuration during the design process.

   EPA RESPONSE: EPA selected the composite barrier cap as the preferred alternative because this design, in comparison to the other alternatives evaluated, provides the optimum balance of the nine evaluation criteria required by the NCP. EPA recognizes the need for design flexibility, and believes that the composite barrier cap selected can provide the flexibility needed for this site. EPA also acknowledges that the composite cap may be difficult to construct over certain areas of the site because of slope considerations. Therefore, to allow for the difficult constraints imposed by site (slope, site access, etc.), and according to the NCP (40 CFR 300.430(e)(5)), EPA may consider alternate innovative cap design modifications if those design modifications provide comparable or superior performance or implementability; provide for fewer or lessor adverse impacts to the surrounding community than the original approach; and lowers costs. EPA in consultation with KDEP and the local community will review and approve the final cap design.

TABLES INCLUDED IN THIS
RECORD OF DECISION
HAVE BEEN REPRODUCED FROM
THE GREEN RIVER DISPOSAL SITE
REMEDIAL INVESTIGATION REPORT AND
FEASIBILITY STUDY, JULY 1994
PREPARED BY LAW ENVIRONMENTAL, INC.

TABLE 1

IS LOCATED ON PAGE 4

Ta[illegible] 2

CONSTITUENTS DETECTED IN LEACHATE SEDIMENT SAMPLES
GREEN RIVER DISPOSAL SITE
DAVIESS COUNTY, KENTUCKY
AUGUST 1990

Constituents	Frequency of Detection			Range of Detected Concentrations		Location of Maximum Concentration Detected
VOLATILES (mg/kg)						
2-Butanone	1	of	10	NA	0.065	LS-09
4-Methyl-2-pentanone	1	of	10	NA	0.017	LS-08D
Acetone	7	of	10	0.007J	0.24	LS-09
SEMI-VOLATILE (mg/kg)						
2-Chlorophenol	1	of	11	NA	0.85	LS-C05
4-Methylphenol (p-Cresol)	2	of	11	1.6	2.4	LS-06
Anthracene	1	of	11	NA	0.8	LS-C05
Benzo(b)fluoranthene	1	of	11	NA	0.66	LS-C05
Benzo(g,h,i)perylene	1	of	11	NA	0.79	LS-C05(RE)
Benzyl Alcohol	3	of	11	0.077J	2.4	LS-06
Di-n-butyl phthalate	3	of	11	0.12	1.1	LS-C03
Isophorone	1	of	11	NA	1	LS-C05
Pentachlorophenol	3	of	11	NA	1.9	LS-C05
Phenanthrene	3	of	11	0.17J	0.71	LS-C05
Phenol	1	of	11	NA	0.36	LS-06
Pyrene	4	of	11	0.042J	1.0	LS-C05
TOTAL METALS (mg/kg)						
Aluminum	10	of	10	874	10900	LS-02
Antimony	4	of	10	11.6B	44.2	LS-14
Arsenic	10	of	10	1.2B	24.3	LS-14
Barium	9	of	10	28.6B	1350	LS-14
Beryllium	9	of	10	2	9.6	LS-14

Table 2 (continued)
CONSTITUENTS DETECTED IN LEACHATE SEDIMENTS
GREEN RIVER DISPOSAL SITE
DAVIESS COUNTY, KENTUCKY
AUGUST 1990

Constituents	Frequency of Detection			Range of Detected Concentrations		Location of Maximum Concentration Detected
Cadmium	6	of	10	1.2B	36.3	LS-06
Calcium	10	of	10	147B	26900	LS-06
Chromium	9	of	10	16.3	200	LS-06
TOTAL METALS (Continued)						
Cobalt	9	of	10	9B	22.8	LS-C02
Copper	8	of	10	14.3	124	LS-06
Iron	10	of	10	334	175000	LS-14
Lead	10	of	10	1	2340	LS-06
Magnesium	9	of	10	1480	4570	LS-06
Manganese	10	of	10	5.8	4450	LS-06
Mercury	1	of	10	NA	0.56	LS-06
Nickel	9	of	10	24.3	133	LS-06
Potassium	9	of	10	1760	6950	LS-08
Silver	1	of	10	NA	8.8	LS-09
Sodium	9	of	10	3340	8810	LS-06
Vanadium	10	of	10	1.9B	25.1	LS-02
Zinc	10	of	10	9.4	16400	LS-06

J - Indicates an estimated value. Concentration detected was below the Contract Required Quantitation Limit (CRQL).
B - The reported value was obtained from a reading less than the Contract Required Detection Limit (CRDL).
RE - Sample results from reanalysis.
NA - Not applicable.

For sample locations, see Figure 2-6.

Prepared by: TDM Date: 7-12-94
Checked by: CPS Date: 7-12-94
Approved by: CHS Date: 7/14/94

Table 3

CONSTITUENTS DETECTED IN LEACHATE SEEP WATER SAMPLES
GREEN RIVER DISPOSAL SITE
DAVIESS COUNTY, KENTUCKY
AUGUST 1990

Constituents	Frequency of Detection			Range of Detected Concentrations		Location of Maximum Concentration Detected
VOLATILES (ug/L)						
4-Methyl-2-pentanone	3	of	7	1J	13	LW-8
Chlorobenzene	3	of	7	1J	44	LW-6
Ethylbenzene	3	of	7	5	26	LW-6
Toluene	3	of	7	0.3J	14	LW-8
Xylenes	2	of	7	18J	32	LW-8
SEMI-VOLATILES (ug/L)						
2-Methylphenol (o-Cresol)	1	of	7	NA	19	LW-8 D
4-Methylphenol (p-Cresol)	1	of	7	NA	17	LW-8 D
Naphthalene	5	of	7	3J	21	LW-8 D
bis(2-Ethylhexyl)phthalate	5	of	7	3J	30	LW-2
Dimethyl phthalate	3	of	7	7J	13	LW-8
INORGANICS (mg/L)						
Aluminum	7	of	7	0.134 BEN	3.70	LW-2
Arsenic	1	of	7	NA	0.016 BW+	LW-8
Barium	7	of	7	0.370	2.46	LW-14
Cadmium	2	of	7	0.004 B	0.008	LW-2
Calcium	7	of	7	65.8	925	LW-2
Chromium	5	of	7	0.009 B	0.017	LW-25 (A)
Copper	6	of	7	0.011 B	0.412	LW-8
Cyanide	4	of	7	0.0191 N	0.137	LW-2

Table 3 (continued)

CONSTITUENTS DETECTED IN LEACHATE SEEP WATER SAMPLES
GREEN RIVER DISPOSAL SITE
DAVIESS COUNTY, KENTUCKY
AUGUST 1990

Constituents	Frequency of Detection			Range of Detected Concentrations		Location of Maximum Concentration Detected
Iron	7	of	7	5.55	69.2	LW-14
Lead	4	of	7	0.003 BWN	0.457	LW-C01
Magnesium	7	of	7	169	710	LW-16
Manganese	7	of	7	0.130	12.4	LW-2
Mercury	1	of	7	NA	0.00023	LW-6
Nickel	7	of	7	0.026 B	0.065	LW-8
Potassium	7	of	7	443	6010	LW-8
Silver	3	of	7	0.011	0.024	LW-2 & LW16
Sodium	7	of	7	4370	9850	LW-8
Zinc	7	of	7	0.012 B	2.05	LW-C01

NOTE: Samples analyzed included LW-02, LW-06, LW-08, LW-09, LW-14, LW-16, and LW-C01.

B - The reported value was obtained from a reading less than the Contract Required Detection Limit (CRDL).
E - The reported value is estimated because of the presence of interference.
N - Spiked sample recovery was not within control limits.
W - Post-digestive spike for Furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
J - Indicates an estimated value.
\+ - Correlation coefficient for the MSA is less than 0.995.
(A) - Duplicate of LW-06.
NA - Not applicable.

For sample locations, see Figure 2-6.

Prepared by: TDM Date: 7-12-94
Checked by: CED Date: 7-12-94
Approved by: EHS Date: 7/14/94

Table 4

CONSTITUENTS DETECTED IN LEACHATE WATER SAMPLES
GREEN RIVER DISPOSAL SITE
DAVIESS COUNTY, KENTUCKY
JANUARY 1993

Constituents	Frequency of Detection			Range of Detected Concentrations		Location of Maximum Concentration Detected
VOLATILES (ug/l):						
4-Methyl-2-pentanone	2	of	4	9 J	10	LW01E
Acetone	1	of	4		69	LW01ED
Benzene	2	of	4	1 J	8	LW01E
Chlorobenzene	2	of	4	1 J	13	LW01E
Ethylbenzene	2	of	4	5 J	14	LW01E
Xylenes, Total	3	of	4	0.9 J	29	LW01E
SEMI-VOLATILES (ug/l):						
2,4-Dimethylphenol	2	of	3	7 J	76	LW01DE
2-Methylphenol (o-Cresol)	1	of	3	NA	50	LW01DE
TOTAL METALS (mg/L):						
Aluminum	3	of	3	1.44	2.48	LW01DE
Barium	3	of	3	0.0676 B	2.42	LW01DE
Cadmium	1	of	3	NA	0.008	SWLCPB
Calcium	3	of	3	33.8	141	LW01DE
Chromium	1	of	3	NA	0.024	LW01DE
Cyanide	3	of	3	0.0061 B	0.0271	SWLCPB
Iron	2	of	3	3.24 N	35.8 N	LW01DE
Magnesium	3	of	3	24.7	316	LW01DE
Manganese	3	of	3	0.16	1.21	LW01DE
Nickel	2	of	3	0.034 B	0.097	LW01DE
Potassium	3	of	3	28.8	3590	LW01CE
Sodium	3	of	3	204	8050	LW01CE
Zinc	3	of	3	0.0224	1.18	SWLCPB
Ammonia Nitrogen (mg/l)	3	of	3	2.1	530	LW01CE

NOTES: SWCPA and SWCPB are leachate pond samples. LW-O1CE is a non-volatile seep composite and LW-O1E and LW-O2E are grab-seep samples for volatile organics.

B - The reported value was obtained from a reading less than the Contract Required Detection Limit (CRDL).
N - The value is estimated because spike sample recovery was not within control limits.
J - Indicates an estimated value. Concentration detected was below the Contract Required Quantitation Limit (CRQL).
NA - Not applicable.

The sample locations are shown on Figure 2-7.

Prepared by: TDM Date: 7-12-94
Checked by: CPD Date: 7-12-94
Approved by: EHS Date: 7/14/94

Table 5

CONSTITUENTS DETECTED IN AMBIENT AIR
Green River Disposal Site
Daviess County, Kentucky

PARAMETER	FREQUENCY OF DETECTION	DETECTION LIMITS	RANGE OF DETECTED CONCENTRATION	SELECTION CRITERIA
VOLATILE COMPOUNDS ($\mu g/m^3$):				
2–Butanone	1 / 6	10	15	
* Acetone	2 / 6	10	5 J – 30	a
* Benzene	6 / 6	5	3.6 J – 28	a
* Cumene	1 / 6	5	7.1	a
* Ethylbenzene	6 / 6	5	5.5 – 100	a
Heptane	3 / 6	5	6 – 43	
* Hexane	6 / 6	5	5.4 – 52	a
* Toluene	6 / 6	5	27 – 110	a
* Trichloroethene	1 / 6	5	6.8	a
* Xylenes, Total	6 / 6	5	17 – 107	a
TOTAL METALS ($\mu g/m^3$):				
Copper	2 / 6	0.0036	0.023 – 0.034	
Iron	5 / 6	0.011	0.142 – 0.284	
* Manganese	5 / 6	0.0018	0.009 – 0.0296	a

* = Constituents of concern
a = Selected as constituent of concern based on the toxicity screen

Table 6

CONSTITUENTS DETECTED IN SURFACE WATER
Green River Disposal Site
Daviess County, Kentucky

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTION LIMITS	RANGE OF DETECTED CONCENTRATIONS	SELECTION CRITERIA
DISSOLVED METALS (mg/L):				
Aluminum, Dissolved	2 / 3	0.0115 – 0.023	0.0252 B – 0.0332 B	
Barium, Dissolved	3 / 3	0.002	0.0357 B – 0.157 B	
Calcium, Dissolved	3 / 3	0.02	30.5 – 70.9	
Copper, Dissolved	3 / 3	0.005	0.0059 B – 0.0097 B	
Iron, Dissolved	3 / 3	0.005	0.0216 B – 0.12	
Magnesium, Dissolved	3 / 3	0.144	10.7 – 42.4	
Manganese, Dissolved	3 / 3	0.004	0.419 – 0.763	
Potassium, Dissolved	2 / 3	1.985 – 3.97	181 – 237	
Sodium, Dissolved	3 / 3	0.254	4.97 B – 515	
Zinc, Dissolved	3 / 3	0.002	0.037 E – 0.163 E	
TOTAL METALS (mg/L):				
Aluminum, Total	19 / 21	0.023 – 0.2	0.1 B – 2.29	
* Arsenic, Total	2 / 21	0.001 – 0.01	0.0037 BW – 0.006 B	c
* Barium, Total	21 / 21	0.002 – 0.2	0.0367 B – 1.43	b,c
* Beryllium, Total	4 / 21	0.0005 – 0.005	0.0016 B – 0.0036 B	b,c
Cadmium, Total	1 / 21	0.0025 – 0.0249	0.0249 N	a
Calcium, Total	21 / 21	0.02 – 5	29.6 E – 335 E	
Chromium, Total	2 / 21	0.0035 – 0.01	0.0072 B – 0.0099 B	
Cobalt, Total	2 / 21	0.0035 – 0.05	0.0092 B – 0.0195 B	
* Copper, Total	14 / 21	0.0025 – 0.025	0.0051 B – 0.0256	c
* Cyanide, Total	12 / 21	0.004 – 0.01	0.0043 B – 0.0683	c
* Iron, Total	21 / 21	0.005 – 0.1	0.175 – 29.1	c
* Lead, Total	11 / 21	0.001 – 0.003	0.0013 BN – 0.019 B	c
Magnesium, Total	21 / 21	0.1 – 5	11 – 190	
* Manganese, Total	21 / 21	0.003 – 0.015	0.294 E – 9.67 E	b,c
* Mercury, Total	4 / 21	0.02	0.0002 – 0.0004	c
* Nickel, Total	5 / 21	0.011 – 0.04	0.0198 B – 0.0835	c
Potassium, Total	17 / 21	5	1.06 B – 779	
Selenium, Total	3 / 21	0.001 – 0.01	0.0013 B – 0.0019 BN	
* Sodium, Total	21 / 21	5	4.71 B – 2920 E	c
Thallium, Total	1 / 21	0.0015 – 0.01	0.001 B	a
Vanadium, Total	1 / 21	0.0025 – 0.05	0.0057 B	a
* Zinc, Total	20 / 21	0.001 – 0.02	0.004 B – 0.803	c
VOLATILES (µg/L):				
1,1,1-Trichloroethane	1 / 21	2.5 – 5	0.4 J	
Acetone	7 / 20	5 – 10	4 J – 20	
Carbon disulfide	3 / 21	2.5 – 5	0.7 J – 3 J	
Dichloromethane-Methylene Chloride	10 / 21	2.5 – 70	1 J – 6	
Xylenes, Total	5 / 21	2.5 – 5	0.4 J – 0.8 J	
SEMI-VOLATILES (µg/L):				
4-Methyl-2-pentanone	1 / 21	5 – 10	4 BJ	
Acenaphthene	1 / 18	5 – 12	0.7 J	
Benzoic Acid	4 / 16	25 – 50	2 J – 4 J	
bis(2-Ethylhexyl) phthalate	2 / 18	5 – 12	0.6 J – 2 J	
Diethyl phthalate	3 / 18	5 – 12	0.6 J – 6 J	
* Ammonia Nitrogen (mg/L)	4 / 5	0.03	17 – 180	c

* = Constituents of concern
a = Eliminated because of low frequency of detection
b = Selected because of toxicity screening (Appendix H)
c = Selected because constituent maximum concentration exceeded AWQC (human health or aquatic life)

Table 7

CHEMICALS DETECTED IN SURFACE WATER SEDIMENTS
Green River Disposal Site
Daviess County, Kentucky

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTION LIMITS	RANGE OF DETECTED CONCENTRATIONS	SELECTION CRITERIA
TOTAL METALS (mg/kg):				
Aluminum	30 / 30	NA	1710 / 27000 *	a
Antimony	1 / 30	18.1	16.5 N*	a
* Arsenic	30 / 30	NA	1.1 BS / 28.3 N	a,b
* Barium	30 / 30	NA	17 B / 159	a,b
* Beryllium	19 / 30	0.58	0.31 B / 1.2	a,b
* Cadmium	18 / 30	2.3	1.2 N / 9.5	a,b,c
Calcium	30 / 30	NA	533 B / 23100	a,b
* Chromium	30 / 30	NA	5.2 / 88.8 N*	a,b
Cobalt	30 / 30	NA	3.8 B / 14.1	
Copper	30 / 30	NA	1.7 B / 116 N*	a
Iron	30 / 30	NA	10400 / 53800	a
* Lead	30 / 30	NA	3.4 / 580 E*	a,c
Magnesium	30 / 30	NA	379 B / 8670	a
* Manganese	30 / 30	NA	183 * / 2580	a,b
Mercury	3 / 30	0.18	0.21 N / 0.39 N	
* Nickel	29 / 30	3.2	3.4 B / 57.7	a,b,c
Potassium	28 / 30	1840	123 B / 4730	a
Selenium	3 / 30	2.8	0.2 B / 0.46 B	a
Silver	4 / 30	1.9	1 B / 1.4 B	
Sodium	25 / 30	118	74.3 B / 4920	a
* Thallium	3 / 30	1.4	0.19 B / 0.4 B	a,b
* Vanadium	30 / 30	NA	5.2 B / 38.5	a,b
* Zinc	30 / 30	NA	22.9 * / 4300 *	a,b,c
VOLATILES (mg/kg):				
1,1,1-Trichloroethane	2 / 34	0.005 / 0.012	0.0005 J	
2-Butanone	12 / 34	0.01 / 0.017	0.004 J / 0.025	
Acetone	24 / 34	0.01 / 0.024	0.004 J / 0.19 B	
Carbon disulfide	1 / 34	0.005 / 0.012	0.001 J	
Dichloromethane-Methylene Chloride	17 / 34	0.005 / 0.012	0.003 J / 0.088 B	
Ethylbenzene	1 / 34	0.005 / 0.012	0.0009 J	
Toluene	14 / 34	0.005 / 0.012	0.0004 J / 0.004 BJ	
Trichloroethene	1 / 34	0.005 / 0.012	0.01	
Xylenes, Total	2 / 34	0.005 / 0.012	0.0009 J / 0.001 BJ	
SEMI-VOLATILES (mg/kg):				
2-Methylnapthalene	1 / 30	0.35 / 2.3	0.019 J	
4-Methylphenol (p-Cresol)	1 / 30	0.35 / 2.3	0.32 J	
Acenaphthene	2 / 30	0.35 / 2.3	0.024 J / 0.03 J	
Anthracene	8 / 30	0.35 / 2.3	0.018 J / 0.081 J	
Benzoic Acid	10 / 30	1.8 / 12	0.11 J / 1.1 J	
Benzo(a) anthracene	15 / 30	0.35 / 2.3	0.011 J / 0.18 J	
Benzo(a) pyrene	12 / 30	0.35 / 2.3	0.026 J / 0.17 J	
Benzo(b) fluoranthene	15 / 30	0.35 / 2.3	0.013 J / 0.24 J	
Benzo(g,h,i) perylene	8 / 30	0.35 / 2.3	0.026 J / 0.11 J	
Benzo(k) fluoranthene	10 / 30	0.35 / 2.3	0.013 J / 0.073 J	
bis(2-Ethylhexyl) phthalate	24 / 30	0.35 / 2.3	0.038 J / 14	
Butyl benzyl phthalate	7 / 30	0.35 / 2.3	0.01 J / 0.36 J	
Chrysene	16 / 30	0.35 / 2.3	0.009 J / 0.17 J	
Dibenzofuran	1 / 30	0.35 / 2.3	0.011 J	
Dibenzo(a,h) anthracene	1 / 30	0.35 / 2.3	0.064 J	
Diethyl phthalate	6 / 30	0.35 / 2.3	0.01 J / 0.025 J	

Table 7 (continued)

CHEMICALS DETECTED IN SURFACE WATER SEDIMENTS
Green River Disposal Site
Daviess County, Kentucky

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTION LIMITS	RANGE OF DETECTED CONCENTRATIONS	SELECTION CRITERIA
Di-n-butyl phthalate	1 / 30	0.35 / 2.3	0.14 BJ	
Di-n-octyl phthalate	4 / 27	0.35 / 2.3	0.008 J / 0.026 J	
Fluoranthene	19 / 30	0.35 / 2.3	0.006 J / 0.38 J	
Fluorene	4 / 30	0.35 / 2.3	0.014 J / 0.029 J	
Indeno(1,2,3-cd) pyrene	8 / 30	0.35 / 2.3	0.023 J / 0.11 J	
Naphthalene	1 / 30	0.35 / 2.3	0.014 J	
Phenanthrene	19 / 30	0.35 / 2.3	0.009 J / 0.27 J	
Pyrene	18 / 30	0.35 / 2.3	0.005 J / 0.42 J	
PESTICIDES/PCBs (mg/kg):				
4,4-DDD	1 / 26	0.007 / 0.016	0.22	
4,4-DDT	1 / 26	0.007 / 0.016	0.0096 J	
Aldrin	1 / 29	0.003 / 0.018	0.0021 J	
Dieldrin	1 / 29	0.007 / 0.036	0.0052 J	
gamma-BHC	1 / 29	0.003 / 0.018	0.0022 J	
Methoxychlor	1 / 29	0.035 / 0.18	0.046 J	
* PCB-1248	23 / 29	0.07 / 0.18	0.0059 J / 0.31	b,c

NA = Not Available -- Inorganic detection limits were not furnished with the data package.
* = Constituents of concern
a = Constituents above two times the mean background concentration
b = Constituents selected by toxicity screen which are above estimated concentrations
c = Constituents exceeding NOAA criteria which are above estimated concentrations

Table 8

CONSTITUENTS DETECTED IN LEACHATE WATER
Green River Disposal Site
Daviess County, Kentucky

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTION LIMITS	RANGE OF DETECTED CONCENTRATIONS	SELECTION CRITERIA
TOTAL METALS (mg/L):				
Aluminum, Total	3 / 3	0.1	1.44 – 2.48	
* Arsenic, Total	3 / 3	0.002	0.0017 BN – 0.033 BN	a,b
* Barium, Total	3 / 3	0.016	0.0676 B – 2.42	a,b
* Beryllium, Total	3 / 3	0.001	0.001 B – 0.002 B	a,b
* Cadmium, Total	1 / 3	0.006	0.008	a,b
Calcium, Total	3 / 3	0.1	33.8 – 141	
* Chromium, Total	1 / 3	0.01	0.024	a,b
Copper, Total	3 / 3	0.004	0.0074 B – 0.01 B	
* Cyanide, Total	3 / 3	0.004	0.0061 B – 0.0271	b
Iron, Total	2 / 3	0.05	3.24 N – 35.8 N	
* Lead, Total	3 / 3	0.003	0.0034 B – 0.017 B	b
Magnesium, Total	3 / 3	0.1	24.7 – 316	
Manganese, Total	3 / 3	0.003	0.16 – 1.21	
* Nickel, Total	2 / 3	0.011	0.034 B – 0.097	a,b
Potassium, Total	3 / 3	0.1	28.8 – 3590	
Selenium, Total	1 / 3	0.01	0.0028 B	
* Silver, Total	1 / 3	0.003	0.003 B	b
Sodium, Total	3 / 3	0.24	204 – 8050	
Vanadium, Total	1 / 3	0.005	0.008 B	
* Zinc, Total	3 / 3	0.004	0.0224 – 1.18	a,b
VOLATILES (µg/L):				
4–Methyl–2–pentanone	2 / 4	10	9 J – 10	
Acetone	1 / 4	10	69	
* Benzene	2 / 4	5	1 J – 8	a,b
Chlorobenzene	2 / 4	5	1 J – 13	
Ethylbenzene	2 / 4	5	5 J – 14	
Toluene	2 / 4	5	4 J – 5 J	
Xylenes, Total	3 / 4	5	0.9 J – 29	
SEMI–VOLATILES (µg/L):				
1,2–Dichlorobenzene	1 / 3	10 – 12	1 J	
* 2,4–Dimethylphenol	2 / 3	10 – 20	7 J – 76	a
2–Methylnaphthalene	1 / 3	10 – 20	3 J	
2–Methylphenol (o–Cresol)	1 / 3	10	50	
bis(2–Ethylhexyl) phthalate	3 / 3	10 – 20	1 J – 4 J	
Dibenzofuran	1 / 3	10 – 20	0.9 J	
Isophorone	2 / 3	10 – 20	3 J – 6 J	
Naphthalene	1 / 3	10 – 20	9 J	
* Ammonia Nitrogen (mg/L)	3 / 3	0.03	2.1 – 530	b

* = Constituent of concern
a = Constituent selected based on toxicity screen (Appendix H) and is above background concentration (inorganic)
b = Constituent selected based on exceedance of AWQC (human health or aquatic life) and is above estimated concentration

Table 9

CONSTITUENTS DETECTED IN SOIL FROM KELLY CEMETERY
Green River Disposal Site
Daviess County, Kentucky

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTION LIMITS	RANGE OF DETECTED CONCENTRATIONS	SELECTION CRITERIA
METALS (mg/kg):				
Aluminum	8 / 8	NA	7260 – 14800	
Arsenic	25 / 25	NA	4.1 N – 17.8 S	
Barium	8 / 8	NA	67.9 – 112	
Beryllium	8 / 8	NA	0.3 B – 0.55 BN	
Calcium	8 / 8	NA	1560 – 4770	a
* Chromium	25 / 25	NA	9 – 82.4	a,b,c
Cobalt	8 / 8	NA	8.2 B – 12.3 N	
Copper	8 / 8	NA	10.8 – 29.2	
* Cyanide	2 / 8	NA – 0.55	6.6 – 62.9	a,b
Iron	8 / 8	NA	17900 – 32500	a
* Lead	25 / 25	NA	14.4 – 307	a,c
Magnesium	8 / 8	NA	1430 – 2840	a
Manganese	8 / 8	NA	418 – 732	
* Mercury	2 / 8	NA – 0.13	0.12 – 0.15	a,b
Nickel	8 / 8	NA	17.5 – 30 N	
Potassium	8 / 8	NA	675 B – 1160 E	a
Selenium	6 / 8	NA – 0.19	0.27 B – 0.53 B	a
Silver	1 / 8	NA – 1.5	0.7 BN	a
Sodium	4 / 8	NA – 49.9	78.3 B – 89.6 B	a
* Thallium	2 / 8	NA – 2	0.19 BN – 0.23 BN	a,b
Vanadium	8 / 8	NA	17.4 – 31 N	
* Zinc	8 / 8	NA	52.6 – 212 N	a,b
SEMI-VOLATILES (mg/kg):				
1,2,4-Trichlorobenzene	1 / 8	0.42 – 0.45	0.053 J	
4-Chloro-3-methyl Phenol	1 / 8	0.42 – 0.45	0.14 J	
Acenaphthene	1 / 8	0.42 – 0.45	0.089 J	
Benzo(a) anthracene	1 / 8	0.42 – 0.45	0.037 J	
Benzo(b) fluoranthene	1 / 8	0.42 – 0.45	0.061 J	
bis(2-Ethylhexyl) phthalate	1 / 8	0.02 – 0.12	0.019 JV*	
Chrysene	1 / 8	0.42 – 0.45	0.046 J	
Di-n-butyl phthalate	4 / 8	0.02 – 0.45	0.009 J – 0.03 J	
Fluoranthene	3 / 8	0.42 – 0.45	0.014 J – 0.096 J	
N-Nitrosodi-n-propylamine	1 / 8	0.42 – 0.45	0.051 J	
Phenanthrene	2 / 8	0.42 – 0.45	0.008 J – 0.018 J	
Pyrene	5 / 8	0.42 – 0.45	0.013 J – 0.13 J	
PESTICIDES/PCBs (mg/kg):				
Endrin ketone	1 / 8	0.0006 – 0.009	0.0031 J	
PCB-1248	2 / 8	0.042 – 0.09	0.31 – 2.1	
PCB-1260	2 / 8	0.042 – 0.09	0.091 – 0.16	

NA = Not Available -- Inorganic detection limits were not furnished with laboratory package. (The detection limits have been requested from the laboratory.)
* = Constituents of concern
a = Exceeds two times the background mean
b = Selected because of toxicity screen (Appendix H)
c = Selected because the constituent was above background and was a "historic CoC (Field Sampling Plan, 1992)

Table 10

EXPOSURE ROUTES CONSIDERED
Green River Disposal Site
Daviess County, Kentucky

ME FRAME	MEDIUM	LOCATION	EXPOSURE ROUTE	POPULATION	COMPLETE	EXPLANATION
ent and Future	Ground Water	Off-Site and On-Site	Ingestion (drinking water), Dermal Contact, and Inhalation (shower/household use)	Residential Adult Residential Child	Yes Yes	Existing residential wells potentially used for irrigation and potable water uses Potential for future installation of additional wells for these uses
ent and Future	Surface Water	On-Site and Off-Site Surface Water Bodies	Dermal Contact (wading)	Trespassing Youth	Yes	Use of Little Blackford Creek, Blackford Creek and its tributaries by locals for wading and playing
				Residential	No	No residential development of landfill
			Ingestion	Trespassing Youth	Yes	Periodic sipping while visiting site
ent and Future	Surface Soils (Kelly Cemetery Road Site)	On-Site	Incidental Ingestion	Residential Adult Residential Child Trespassing Adult Trespassing Youth	Yes Yes Yes Yes	Hand-to-mouth contact while eating, drinking, smoking after visiting the site
			Dermal Contact	Residential Adult Residential Child Trespassing Adult Trespassing Youth	Yes Yes Yes Yes	Absorption of contaminants on exposed body parts while visiting the site
			Inhalation of Fugitive Dust	Residential Adult Residential Child Trespassing Adult Trespassing Youth	Yes Yes Yes Yes	Exposure to dust from surface soils disturbed while visiting the site

Table 10 (continued)

EXPOSURE ROUTES CONSIDERED
Green River Disposal Site
Daviess County, Kentucky

IME FRAME	MEDIUM	LOCATION	EXPOSURE ROUTE	POPULATION	COMPLETE	EXPLANATION
rrent and Future	Stream Sediments	On-Site and Off-Site Surface Water Bodies	Dermal Contact	Trespassing Youth	Yes	During wading and exploration
				Residential	No	No residential development of Landfill
			Incidental Ingestion	Trespassing Youth	Yes/No	Only when sediments are parched and physically disturbed
			Inhalation of Fugitive Dust	Trespassing Youth	Yes/No	Only when sediments are parched and physically disturbed
rrent and Future	Leachate Waters	On-Site	Dermal Contact	Trespassing Youth	Yes	Contact of exposed body parts with leachate while wading
				Residential	No	No residential development of Landfill
rrent and Future	Animal and Plant Life	On-Site and Off-Site	Ingestion	Hunters/Farmers	Yes	Animal/Plant species drinking SW and ingesting or growing in site soils - Bioaccumulation
rrent and Future	Ambient Air	On-Site and Off-Site	Inhalation	Trespassers	Yes	Intermittent Exposure
				Residential	Yes	Exposed to dispersed and diluted concentrations

Table 11

TOXICITY VALUES FOR POTENTIAL CARCINOGENIC AND NONCARCINOGENIC EFFECTS
GREEN RIVER DISPOSAL SITE
Daviess County, Kentucky

'arameter	Slope Factor [a] (kg-day/mg)	Weight of Evidence Classification [b]	Type of Cancer	Source
)ral Route:				
\cetone	no data	D		IRIS
\mmonia Nitrogen	no data	NA		IRIS
\rsenic	1.8E+00	A		EPA
3arium	no data	NA		IRIS
3enzene	2.9E-02	A	Inc. incidence of nonlymphocytic leukemia, in occupational exposure: neoplasia in rats/mice by inhalation & gavage	IRIS
3eryllium	4.3E+00	B2	Lung cancer in rats/monkeys via inhalation	IRIS
;admium (food)	no data	B1		IRIS
;admium (water)	no data	B1		IRIS
;hromium VI	no data	A		IRIS
;hromium III	no data	NA		IRIS
;opper	no data	D		IRIS
;umene	no data	NA		IRIS
;yanide	no data	D		IRIS
!,4 - Dimethylphenol	no data	NA		IRIS
:thylbenzene	no data	D		IRIS
›is (2-Ethylhexyl)phthalate	1.4E-02	B2	Liver tumors in rats/mice orally	IRIS
4exane	no data	NA		HEAST
ron	no data	NA		IRIS
.ead	no data	B2		IRIS
/langanese (food)	no data	D		IRIS
/langanese (water)	no data	D		IRIS
/lercury	no data	D		HEAST
lickel	no data	A		IRIS
'olychlorinated biphenyls (PCBs)	7.7E+00	B2	Heptacellular carcinomas in rats	IRIS
;ilver	no data	D		IRIS
;odium	no data	NA		IRIS
'hallium	no data	NA		IRIS
'oluene	no data	D		IRIS
'richloroethene	1.1E-02	C-B2	Elevated incidences of pleuritis and pericarditis	IRIS
(ylenes, Total	no data	D		IRIS
:inc	no data	D		IRIS

Table 11 (continued)
TOXICITY VALUES FOR POTENTIAL CARCINOGENIC AND NONCARCINOGENIC EFFECTS
GREEN RIVER DISPOSAL SITE
Daviess County, Kentucky

arameter	Slope Factor [a] (kg–day/mg)	Weight of Evidence Classification [b]	Type of Cancer	Source
halation Route:				
cetone	no data	D		IRIS
mmonia Nitrogen	no data	NA		IRIS
rsenic	1.5E+01	A	Lung cancer	IRIS
arium	no data	NA		IRIS
enzene	2.9E–02	A	Inc. incidence of nonlymphocytic leukemia,	IRIS
			in occupational exposure: neoplasia in	IRIS
			rats/mice by inhalation & gavage	IRIS
eryllium	8.4E+00	B2	Lung cancer in rats/monkeys (inh)	IRIS
admium	6.3E+00	B1	Carcinogenic in mice by various routes	IRIS
hromium VI	4.2E+01	A	Lung cancer	IRIS
hromium III	no data	NA		IRIS
opper	no data	D		IRIS
umene	no data	NA		IRIS
yanide	no data	D		IRIS
,4 – Dimethylphenol	no data	NA		IRIS
thylbenzene	no data	D		IRIS
is (2–Ethylhexyl)phthalate	no data	B2		IRIS
exane	no data	NA		HEAST
on	no data	NA		IRIS
ead	no data	B2		IRIS
anganese	no data	D		IRIS
ercury	no data	D		HEAST
ickel [c]	8.4E–01	A	Carcinomas in rats	IRIS
olychlorinated biphenyls (PCBs)	no data	B2		IRIS
ilver	no data	D		IRIS
odium	no data	NA		IRIS
hallium	no data	NA		IRIS
oluene	no data	D		IRIS
richloroethene	6.0E–03	C–B2	Elevated incidences of pleuritis and pericarditis	IRIS
ylenes, Total	no data	D		IRIS
inc	no data	D		IRIS

Table 11 (continued)

TOXICITY VALUES FOR POTENTIAL CARCINOGENIC AND NONCARCINOGENIC EFFECTS
GREEN RIVER DISPOSAL SITE
Daviess County, Kentucky

Parameter	Chronic RfD (d) (mg/kg-day)	Confidence Level (e)	Critical Effect	Uncertainty Factor (f)	Source
Oral Route:					
Acetone	1E-01	low	Increased liver & kidney weight, nephrotoxicity	1000	IRIS
Ammonia Nitrogen	no data				
Arsenic	3E-04	medium	Hyperpigmentation, keratosis, vascular complications	3	IRIS
Barium	7E-02	medium	Increased blood pressure	3	IRIS
Benzene	pending				IRIS
Beryllium	5E-03	low	No adverse effects	100	IRIS
Cadmium (food)	1E-03	high	Significant proteinuria	10	IRIS
Cadmium (water)	5E-04				
Chromium VI	5E-03	low	No effects reported	500	IRIS
Chromium III	1E+00	low	No effects reported	100	IRIS
Copper	no data				
Cumene	4E-02	low	Increased kidney weight	3000	IRIS
Cyanide	2E-02	medium	Weight loss, thyroid	100	IRIS
2,4 - Dimethylphenol	2E-02	low	Lethargy, prostration, and ataxia	3000	IRIS
Ethylbenzene	1E-01	low	Liver and kidney toxicity	1000	IRIS
bis(2-Ethylhexyl)phthalate	2E-02	medium	Increased relative liver weight	1000	IRIS
Hexane	6E-02		Neuropathy, atrophy, and decreased weight gain	10000	HEAST
Iron	no data				
Lead	no data				IRIS
Manganese (food)	1E-01	medium	CNS effects	1	IRIS
Manganese (water)	5E-03				
Mercury	3E-04		Kidney effects	1000	HEAST
Nickel	2E-02	medium	Lung and nasal tumors	300	IRIS
Polychlorinated biphenyls (PCBs)	no data				
Silver	5E-03	low	Argyria	3	IRIS
Sodium	no data				
Thallium (g)	8E-05	low	Increased levels SGOT & LDH	3000	IRIS
Toluene	2E-01	medium	Changes in liver and kidney weights	1000	IRIS
Trichloroethene	pending				IRIS/HEAST
Xylenes, Total	2E+00	medium	Hyperactivity, decreased body weight, & increased m	100	IRIS
Zinc	3E-01	medium	47% dec. in erythrocyte superoxide dismutage (ESOD) concentration in adult females	3	IRIS

Table 11 (continued)
TOXICITY VALUES FOR POTENTIAL CARCINOGENIC AND NONCARCINOGENIC EFFECTS
GREEN RIVER DISPOSAL SITE
Daviess County, Kentucky

Parameter	Chronic RfD (d) (mg/kg-day)	Confidence Level (e)	Critical Effect	Uncertainty Factor (f)	Source
Inhalation Route:					
Acetone	no data				IRIS
Ammonia Nitrogen	3E-02	medium	Pneumonia and respiratory lesions	30	IRIS
Arsenic	no data				IRIS
Barium	1E-04		Fetotoxicity	1000	HEAST
Benzene	pending				IRIS
Beryllium	no data				IRIS
Cadmium	pending				IRIS
Chromium VI	pending				IRIS
Chromium III	no data				IRIS
Copper	no data				IRIS
Cumene	3E-03	low	Increased kidney weight	10000	IRIS
Cyanide	no data				IRIS
2,4 - Dimethylphenol	no data				IRIS
Ethylbenzene	3E-01	low	Liver and kidney toxicity	300	IRIS
bis(2-Ethylhexyl)phthalate	no data				IRIS
Hexane	6E-02		Neuropathy, atrophy, and decreased weight gain	3000	HEAST
Iron	no data				IRIS
Lead	no data				IRIS
Manganese	1E-05	medium	Increased prevalence of respiratory symptoms and psychomotor disturbances	1000	IRIS
Mercury	9E-05		Kidney effects	30	HEAST
Nickel	no data				IRIS
Polychlorinated biphenyls (PCBs)	no data				
Silver	no data				IRIS
Sodium	no data				IRIS
Thallium	no data				IRIS
Toluene	1E-01	medium	Neurological effects	300	IRIS
Trichloroethene	pending				IRIS
Xylenes, Total	pending				IRIS
Zinc	no data				IRIS

Table 11 (continued)
TOXICITY VALUES FOR POTENTIAL CARCINOGENIC AND NONCARCINOGENIC EFFECTS
GREEN RIVER DISPOSAL SITE
Daviess County, Kentucky

No Data – No value listed in reference
Withdrawn – Withdrawn (from IRIS) as a result of further review
Pending – Under review by an EPA work group
(a) Slope factors provided in terms of unit risk are converted prior to input on this table as follows:
for oral route: UNIT RISK (L/ug) * 1,000 ug/mg * day/2 L * 70 kg = CSF (kg–day/mg)
for inhalation route: UNIT RISK (m^3/ug) * 1,000 ug/mg * day/20 m^3 * 70 kg = CSF (kg–day/mg)
(b) Weight of Evidence Classification:
A – Human Carcinogen
B1 – Probable human carcinogen; limited human data available
B2 – Probable human carcinogen; inadequate or no evidence in humans
C – Possible human carcinogen
D – Not classifiable as to human carcinogenicity
(c) Value is for nickel refinery dust.
(d) Inhalation RfCs are converted to RfDs using the following equation:
RfC (mg/m^3) * 20 m^3/day * 1/70 kg = RfD (mg/kg–day)
(e) Confidence Level (i.e., high, medium, or low) as reported in IRIS
(f) Uncertainty Factors (UF) are assigned by USEPA in multiples of 10 based on the following limitations in the database used to develop the RfC/RfD:
A – Animal to human extrapolation (UF of 10)
H – Variations in human sensitivity (UF of 10)
S – Extrapolation from a subchronic NOAEL instead of a chronic NOAEL (UF of 10)
L – Extrapolation from a LOAEL to a NOAEL (UF of 10)
(g) Value is for Thallium Sulfate.

Source: IRIS = Integrated Risk Information System (6/93)
HEAST = Health Effects Assessment Summary Tables (FY–1992 Annual)
EPA = Memorandum to Assistant Administrators. Recommended Agency Policy on the Carcinogenicity Risk Associated with the Ingestion of Inorganic Arsenic. USEPA, Office of the Administrator, Washington, D.C. June 21, 1988.

Table 12

SUMMARY OF SITE HUMAN HEALTH RISKS
GREEN RIVER LANDFILL
GREEN RIVER DISPOSAL SITE
Daviess County, Kentucky

	Future Residential Receptors			Current and Future Trespassing Receptors		
Pathway	Adult HQ	Child HQ	Lifetime Excess Cancer Risk	Hunter Adult HQ	Trespasser Youth HQ	Lifetime Excess Cancer Risk
Ground Water:*						
Ingestion	30*	200*	9E−04*	NA	NA	NA
Dermal Contact	0.1	0.1	2E−06	NA	NA	NA
Ambient Air:						
Inhalation	0.07	0.3	3E−06	0.001	0.002	7E−08
Surface Water:						
Dermal Contact	NA	NA	NA	NA	0.04	2E−07
Leachate Water:						
Dermal Contact	NA	NA	NA	NA	0.4	4E−07
Sediments:						
Dermal Contact	NA	NA	NA	NA	0.001	3E−06
Summary for Five Media	30	200	9E−04	0.001	0.4	4E−06

HQ Hazard Quotient
NA Not Applicable
* The risks associated with ground water are preliminary only. The ground−water preliminary risk assessment will be re−evaluated after additional ground−water samples have been collected and analyzed.

Table 13

SUMMARY OF SITE HUMAN HEALTH RISKS
KELLY CEMETERY ROAD
GREEN RIVER DISPOSAL SITE
Daviess County, Kentucky

	Future Residential Receptors			Current and Future Trespassing Receptors		
Pathway	Adult HQ	Child HQ	Lifetime Excess Cancer Risk	Adult HQ	Youth HQ	Lifetime Excess Cancer Risk
Surface Soils:						
Dermal Contact	0.001	0.004	NA	0.0001	0.0001	NA
Incidental Ingestion	0.05	0.16	NA	0.001	0.005	NA
Inhalation of Fugitive Dust	0.00002	0.00008	5E−06	0.0000004	0.000001	1E−07
Summary of Soil Exposures	0.051	0.16	5E−06	0.001	0.005	1E−07

HQ Hazard Quotient
NA Not applicable

Table 14

COMPARISON OF SURFACE WATER ECOLOGICAL COC CONCENTRATIONS TO AMBIENT WATER QUALITY CRITERIA
Green River Disposal Site
Daviess County, Kentucky

Parameter	Frequency of Detection	Maximum Detected Concentration	AMBIENT WATER QUALITY CRITERIA, for the protection of: AQUATIC LIFE: (mg/L) Federal[a]		State of Kentucky[b]	
			acute	chronic	acute	chronic
DISSOLVED METALS: (mg/L)						
Aluminum	2/3	0.0332 B	--	--	--	--
Barium	3/3	0.157 B	--	--	--	--
Calcium	3/3	70.9	--	--	--	--
Magnesium	3/3	42.4	--	--	--	--
Manganese	3/3	0.763	--	--	--	--
Potassium	2/3	237	--	--	--	--
Sodium	3/3	515	--	--	--	--
Zinc	3/3	0.163 E	0.12	0.11	0.117 •	0.106 •
TOTAL METALS: (mg/L)						
Aluminum	19/21	2.29	--	--	--	--
Barium	21/21	1.43	--	--	--	--
Cadmium	1/21	0.0249 N	0.0039	0.0011	0.0039 •	0.0011 •
Calcium	21/21	334 E	--	--	--	--
Cobalt	2/21	0.0195 B	--	--	--	--
Copper	14/21	0.0256	0.018	0.012	0.0177 •	0.0118 •
Cyanide	12/21	0.0683	0.022	0.0052	0.022	0.005
Iron	21/21	29.1	--	1	4	1
Lead	21/21	0.019 B	0.082	0.0032	0.0816 •	0.0032 •
Magnesium	21/21	190	--	--	--	--
Manganese	21/21	9.67 E	--	--	--	--
Mercury	4/21	0.0004	0.0024	0.000012	0.0024	0.000012
Potassium	17/21	779	--	--	--	--
Sodium	21/21	2920 E	--	--	--	--
Vanadium	1/21	0.0057 B	--	--	--	--
Zinc	20/21	0.803	0.12	0.11	0.117 •	0.106 •
VOLATILES: (mg/L)						
Acetone	7/20	0.02	--	--	--	--
Dichloromethane	6/21	0.006	--	--	--	--
INORGANICS: (mg/L)						
Ammonia Nitrogen	4/5	180	0.083–4.6 (c) 0.53–22.8 (e)	0.0017–0.612 (c) 0.304–1.2 (e)	0.05 (d)	0.05 (d)

[Box] Indicates a state or federal chemical specific standard that was exceeded by the maximum concentration detected on site.

• – Calculated from a chemical specific hardness dependent equation. A default value of 100 mg/L was used.
a – Values from Quality Criteria for Water, EPA 440/5–86–001, 1987.
b – Values from Kentucky Water Quality Standards, The Bureau of National Affairs, Inc., 786:1001 S–209, January, 1992.
c – Value is for fish species.
d – Value is for un–ionized Ammonia. Un–ionized Ammonia concentration can be calculated using total Ammonia by the following calculation: $Un \approx 1.2(\text{Total ammonia}-(N))/(1 + 10^{pK_a\hat{} - pH})$
e – Value is for invertebrate species.
B – (inorganic) Estimated value
E – Value is associated with matrix interference.
N – Value is associated with a spiked sample outside of control limits.

Table 15

GREEN RIVER ECOLOGICAL RISK SUMMARY FOR SURFACE WATER
Green River Landfill, Green River Disposal Site
Daviess County, Kentucky

Parameter	Maximum Concentration Sample Location	Indicator Species	Ecological Quotient[a]	Risk Number		Effect Type/ Length of Study
DISSOLVED METALS:						
Aluminum	SW-01	No Data	---	---		---
Barium	SW-03	Daphnia magna[b]	0.157 / 410	0.0004		LC50/48 hour
Calcium	SW-02	No Data	---	---		---
Magnesium	SW-02	No Data	---	---		---
Manganese	SW-02	Daphnia magna[b]	0.763 / 1020	0.75		EC50/21 day
Potassium	SW-02	No Data	---	---		---
Sodium	SW-02	Daphnia magna[b]	515 / 1640	0.31		EC50/21 day
Zinc	SW-02	Ceriodaphnia reticulata[b]	0.163 / 0.076	2.14		LC50/48 hour
		Daphnia magna[b]	0.163 / 0.068	2.40		LC50/48 hour
		Daphnia pulex[b]	0.163 / 0.107	1.52		LC50/48 hour
		Daphnia lumholzi[b]	0.163 / 0.4375	0.37		LC50/96 hour
TOTAL METALS:						
Aluminum	SW-16	No Data	---	---		---
Barium	SW-11	Daphnia magna[b]	1.43 / 410	0.003		LC50/48 hour
Cadmium	SW-03D	Ceriodaphnia dubia[b]	0.0249 / 0.038	0.66		LC50/48 hour
		Daphnia magna[b]	0.0249 / 0.054	0.46		LC50/48 hour
		Daphnia pulicaria[b]	0.0249 / 0.184	0.14		LC50/48 hour
		Daphnia lumholzi[b]	0.0249 / 6.704	0.004		LC50/24 hour
		Pimephales promelas[b]	0.0249 / 9.7	0.003		LC50/96 hour
Calcium	SW-15	No Data	---	---		---
Cobalt	SW-03D	No Data	---	---		---
Copper	SW-03D	Ceriodaphnia dubia[b]	0.0256 / 0.051	0.50	avg	LC50/48 hour
		Daphnia pulicaria[b]	0.0256 / 0.053	0.48		LC50/48 hour
		Pimephales promelas[b]	0.0256 / 0.55	0.05		LC50/96 hour
Cyanide	SW-03	No Data	---	---		---
Iron	SW-12	No Data	---	---		---
Lead	SW-12	Ceriodaphnia reticulata[b]	0.019 / 0.53	0.04		LC50/48 hour
		Daphnia magna[b]	0.019 / 4.4	0.004		LC50/48 hour
Magnesium	SW-11	No Data	---	---		---
Manganese	SW-11	Daphnia magna[b]	9.67 / 1020	0.01		EC50/21 day
Mercury	SW-03	Rana hexadactyla[d]	0.0004 / 0.051	0.008		LC50/96 hour
		Daphnia pulex[b]	0.0004 / 0.107	0.004		LC50/48 hour
Potassium	SW-02	No Data	---	---		---
Sodium	SW-10	Daphnia magna[b]	2920 / 1250	2.34	avg	EC50/21 day
Vanadium	SW-03D	No Data	---	---		---
Zinc	SW-10	Ceriodaphnia reticulata[b]	0.803 / 0.076	10.6		LC50/48 hour
		Daphnia magna[b]	0.803 / 0.068	11.8		LC50/48 hour
		Daphnia pulex[b]	0.803 / 0.107	7.5		LC50/48 hour
		Daphnia lumholzi[b]	0.803 / 0.4375	1.8		LC50/96 hour

Table 15 (continued)

GREEN RIVER ECOLOGICAL RISK SUMMARY FOR SURFACE WATER
Green River Landfill, Green River Disposal Site
Daviess County, Kentucky

Parameter	Maximum Concentration Sample Location	Indicator Species	Ecological Quotient[a]	Risk Number		Effect Type/ Length of Study
VOLATILES:						
Acetone	SW-03/121	Pimephales promelas[d]	0.020 / 8120	0.000002		LC50/96 hour
Dichloromethane	SW-14/16	Daphnia magna[b]	0.006 / 224	0.00003		LC50/48 hour
		Pimephales promelas Rafinesque[d]	0.006 / 193	0.00003		LC50/96 hour
SEMI-VOLATILES:						
Ammonia Nitrogen	SW-122	Amphipod[c]	180 / 1.91	94.2		LC50/96 hour
		Ceriodaphnia reticulata[b]	180 / 2.71	66.4		LC50/48 hour
		Pimephales promelas[b]	180 / 4.25	42.4	avg	LC50/96 hour

[box] Departure point of 1 for the risk number is exceeded.
a – Is the Maximum Contaminant Concentration in mg/L / Effective Concentration in mg/L (i.e., LC_{50})
b – LC_{50} for this constituent is from the AQUIRE database.
c – LC_{50} for this constituent is from Environmental Toxicology and Chemistry, vol. 12, 1993.
d – LC_{50} for this constituent is from HSDB.
avg – LC_{50} for this constituent is an average of all bioassays for the same species and test duration.

Table 16

GREEN RIVER ECOLOGICAL RISK SUMMARY FOR LEACHATE WATER
Green River Landfill, Green River Disposal Site
Daviess County, Kentucky

Parameter	Maximum Concentration Sample Location	Indicator Species	Ecological Quotient[a]	Risk Number	Effect Type/ Length of Study
TOTAL METALS:					
Aluminum	LW-01CE	No Data	---	---	---
Barium	LW-01CE	Daphnia magna[b]	2.42 / 410	0.006	LC50/48 hour
Cadmium	SWCPB	Ceriodaphnia dubia[b]	0.008 / 0.038	0.211	LC50/48 hour
		Daphnia magna[b]	0.008 / 0.054	0.148	LC50/48 hour
		Daphnia pulicaria[b]	0.008 / 0.184	0.043	LC50/48 hour
		Daphnia lumholzi[b]	0.008 / 6.704	0.001	LC50/24 hour
		Pimephales promelas[b]	0.008 / 9.7	0.001	LC50/96 hour
Calcium	LW-01CE	No Data	---	---	---
Chromium	LW-01CE	Ceriodaphnia reticulata[b]	0.024 / 0.045	0.53	LC50/48 hour
		Daphnia magna[b]	0.024 / 0.022	1.09	LC50/48 hour
		Daphnia pulex[b]	0.024 / 0.048	0.50	LC50/48 hour
		Pimephales promelas[b]	0.024 / 44.5	0.00 avg	LC50/96 hour
Cyanide	SWCPB	No Data	---	---	---
Iron	LW-01CE	No Data	---	---	---
Lead	LW-01CE	Ceriodaphnia reticulata[b]	0.017 / 0.53	0.03	LC50/48 hour
		Daphnia magna[b]	0.017 / 4.4	0.004	LC50/48 hour
Magnesium	LW-01CE	No Data	---	---	---
Manganese	LW-01CE	Daphnia magna[b]	1.21 / 1020	0.001	EC50/21 day
Potassium	LW-01CE	No Data	---	---	---
Silver	LW-01CE	Ceriodaphnia reticulata[b]	0.003 / 0.011	0.3	LC50/48 hour
		Daphnia pulex[b]	0.003 / 0.014	0.2	LC50/48 hour
Sodium	LW-01CE	Daphnia magna[b]	8050 / 1250	6.4 avg	EC50/21 day
Vanadium	LW-01CE	No Data	---	---	---
Zinc	SWCPB	Ceriodaphnia reticulata[b]	1.18 / 0.076	15.5	LC50/48 hour
		Daphnia magna[b]	1.18 / 0.068	17.4	LC50/48 hour
		Daphnia pulex[b]	1.18 / 0.107	11.0	LC50/48 hour
		Daphnia lumholzi[b]	1.18 / 0.4375	2.7	LC50/96 hour
VOLATILES:					
Acetone	LW-01CE	Pimephales promelas[d]	0.069 / 8120	0.00001	LC50/96 hour
4-Methyl-2-pentanone	LW-01E	Pimephales promelas[d]	0.01 / 505	0.00002	LC50/96 hour
Xylene	LW-01E	Pimephales promelas[d]	0.029 / 42	0.001	LC50/24-96 hour
SEMI-VOLATILES:					
Ammonia Nitrogen	LW-01CE	Amphipod[c]	530 / 1.91	277	LC50/96 hour
		Ceriodaphnia reticulata[b]	530 / 2.71	196	LC50/48 hour
		Pimephales promelas[b]	530 / 4.25	125 avg	LC50/96 hour
2-Methylphenol	LW-01CE	Daphnia cucullata[b]	0.025 / 15.5	0.002	LC50/48 hour
		Daphnia magna[b]	0.025 / 8.6	0.003	LC50/48 hour
		Daphnia pulex[b]	0.025 / 8.5	0.003	LC50/48 hour

[box] Departure point of 1 for the risk number is exceeded.
a – Is the Maximum Contaminant Concentration in mg/L / Effective Concentration in mg/L (i.e. LC_{50})
b – LC_{50} for this constituent is from the AQUIRE database.
c – LC_{50} for this constituent is from Environmental Toxicology and Chemistry, vol. 12, 1993.
d – LC_{50} for this constituent is from HSDB.
avg – LC_{50} for this constituent is an average of all bioasssays for the same species and test duration.

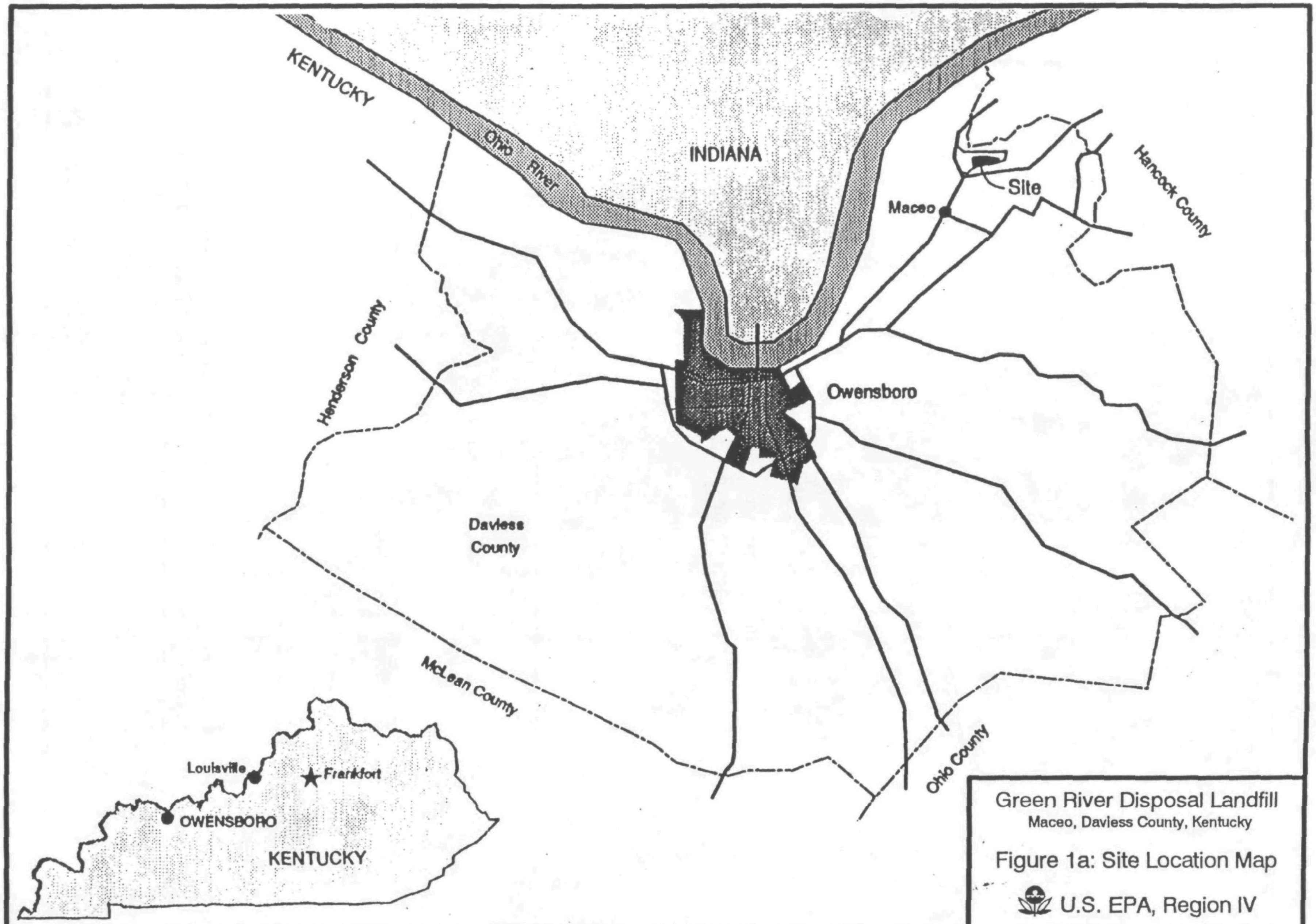
Table 17

GREEN RIVER ECOLOGICAL RISK SUMMARY FOR SURFACE WATER SEDIMENTS
Green River Landfill, Green River Disposal Site
Daviess County, Kentucky

Parameter	Maximum Concentration Sample Location	Indicator Species	Ecological Quotient[a]	Risk Number		Effect Type/ Length of Study
TOTAL METALS:						
Aluminum	SD-10	No Data	---	---		---
Barium	SD-01	Daphnia magna[b]	159 / 410	0.39		LC50/48 hour
Beryllium	SD-06	No Data	---	---		---
Cadmium	SD-06	Ceriodaphnia dubia[b]	9.5 / 0.058	164	avg	LC50/48 hour
		Daphnia magna[b]	9.5 / 0.085	112	avg	LC50/48 hour
		Daphnia pulicaria[b]	9.5 / 0.212	45	avg	LC50/48 hour
		Daphnia lumholzi[b]	9.5 / 6.704	1.4		LC50/24 hour
		Pimephales promelas[b]	9.5 / 12.85	0.74	avg	LC50/96 hour
Chromium	SD-10	Ceriodaphnia reticulata[b]	88.8 / 0.045	1970		LC50/48 hour
		Daphnia magna[b]	88.8 / 0.022	4040		LC50/48 hour
		Daphnia pulex[b]	88.8 / 0.048	1850		LC50/48 hour
		Pimephales promelas[b]	88.8 / 44.5	2.00	avg	LC50/96 hour
Iron	SD-06	No Data	---	---		---
Lead	SD-10	Ceriodaphnia dubia[b]	580 / 0.53	1090		LC50/48 hour
		Daphnia magna[b]	580 / 4.4	132		LC50/48 hour
Magnesium	SDH-061525	No Data	---	---		---
Manganese	SD-01	Daphnia magna[b]	2580 / 1020	2.5		EC50/21 day
Nickel	SDD-0265	Daphnia pulicaria[b]	57.7 / 2.3	25.1	avg	LC50/48 hour
		Pimephales promelas[b]	57.7 / 5.209	11.1		LC50/96 hour
Selenium	SDD-0265	Daphnia magna[b]	0.46 / 0.523	0.9	avg	LC50/96 hour
		Pimephales promelas[b]	0.46 / 1	0.5		LC50/96 hour
Sodium	SD-07	Daphnia magna[b]	4920 / 1250	3.9	avg	EC50/21 day
Thallium	SDD-066	No Data	---	---		---
Vanadium	SDD-0265	No Data	---	---		---
Zinc	SD-10	Ceriodaphnia reticulata[b]	4300 / 0.076	56600		LC50/48 hour
		Daphnia magna[b]	4300 / 0.068	63200		LC50/48 hour
		Daphnia pulex[b]	4300 / 0.107	40200		LC50/48 hour
		Daphnia lumholzi[b]	4300 / 0.4375	9830		LC50/96 hour
VOLATILES:						
2-Butanone	SD-16	Daphnia magna[b]	0.025 / 11	0.0023		LC50/48 hour
		Daphnia pulicaria[b]	0.025 / 1.034	0.02		LC50/48 hour
		Pimephales promelas[b]	0.025 / 55	0.0005		LC50/96 hour
SEMI-VOLATILES:						
bis(2-Ethylhexyl)phthalate	SDD-04	Daphnia magna[c]	14 / 8	1.75	avg	LC50/48 hour
PESTICIDES/PCBs:						
PCB-1248	SD-14	Pimephales promelas[b]	0.31 / 0.125	2.48	avg	LC50/96 hour
		Daphnia magna[b]	0.31 / 0.067	4.63		LC50/21 day

[Box] Departure point of 1 for the risk number is exceeded.
a – Is the Maximum Contaminant Concentration in mg/kg / Effective Concentration in mg/kg (i.e. LC_{50})
b – LC_{50} for this constituent is from the AQUIRE Database.
c – LC_{50} for this constituent is from the HSDB.
avg – LC_{50} for this constituent is an average of all bioassays for the same species and test duration.

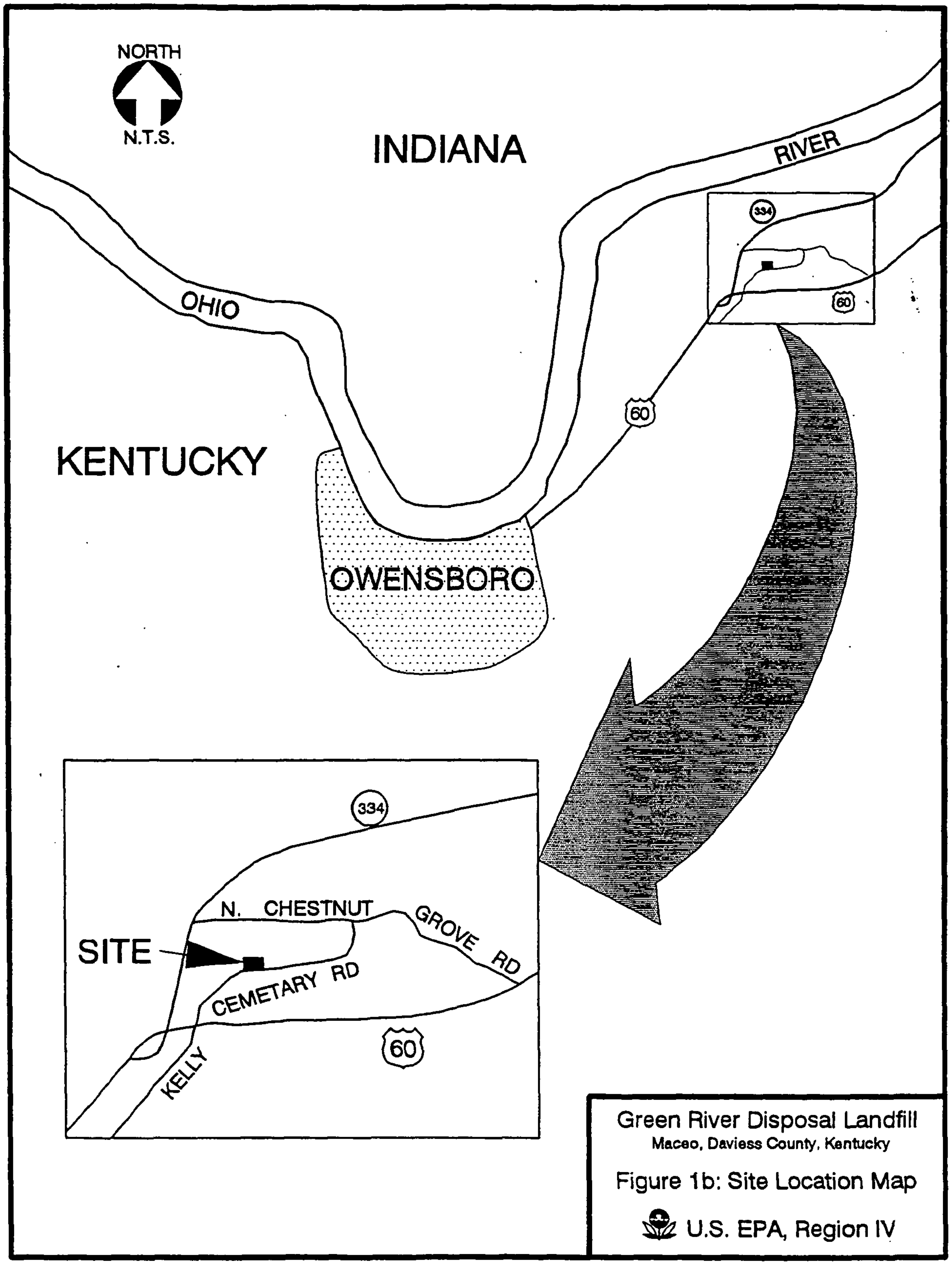
FIGURES INCLUDED IN THIS
RECORD OF DECISION
HAVE BEEN REPRODUCED FROM
THE GREEN RIVER DISPOSAL SITE
REMEDIAL INVESTIGATION REPORT AND
FEASIBILITY STUDY, JULY 1994
PREPARED BY LAW ENVIRONMENTAL, INC.



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 1a: Site Location Map

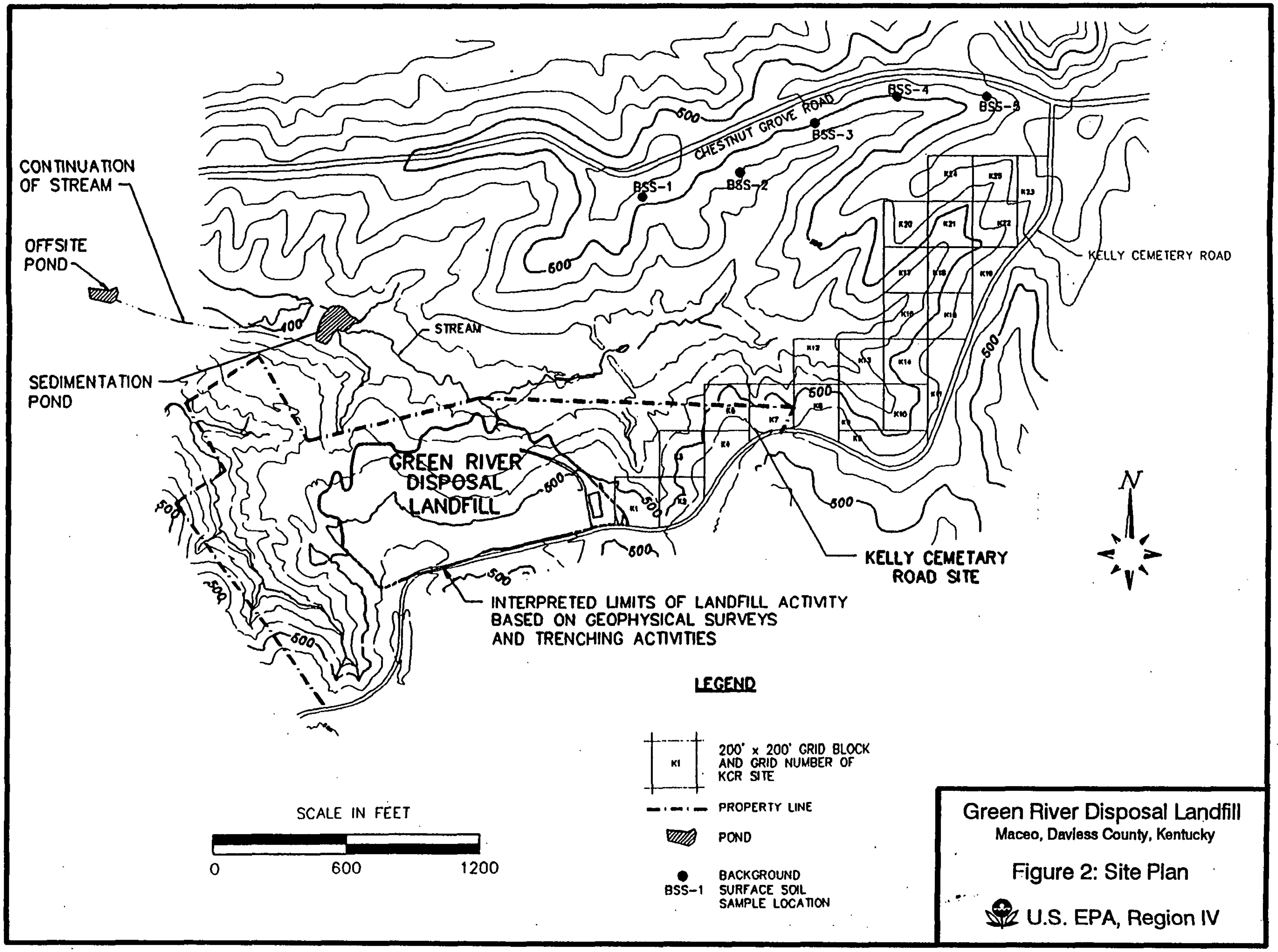
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 1b: Site Location Map

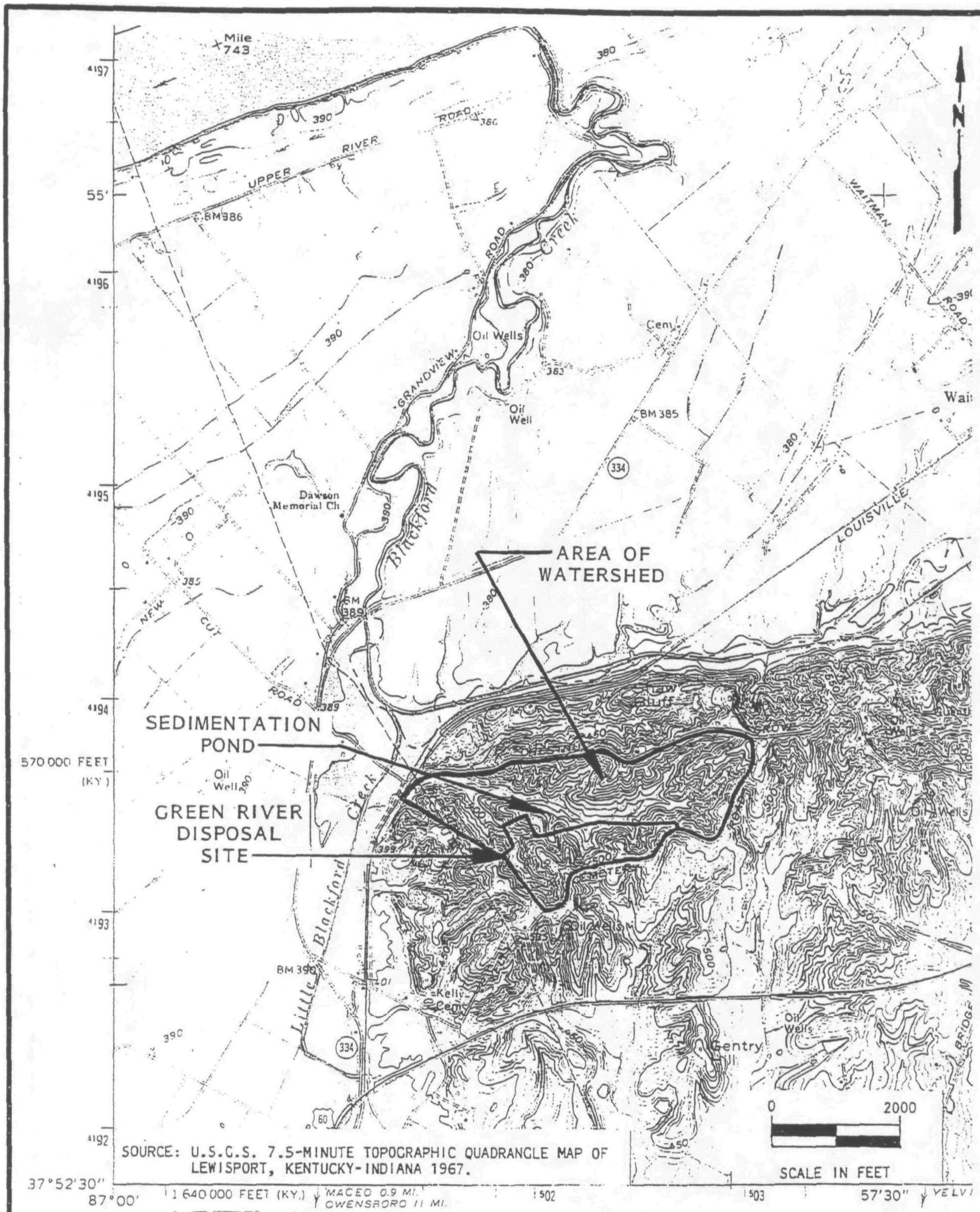
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 2: Site Plan

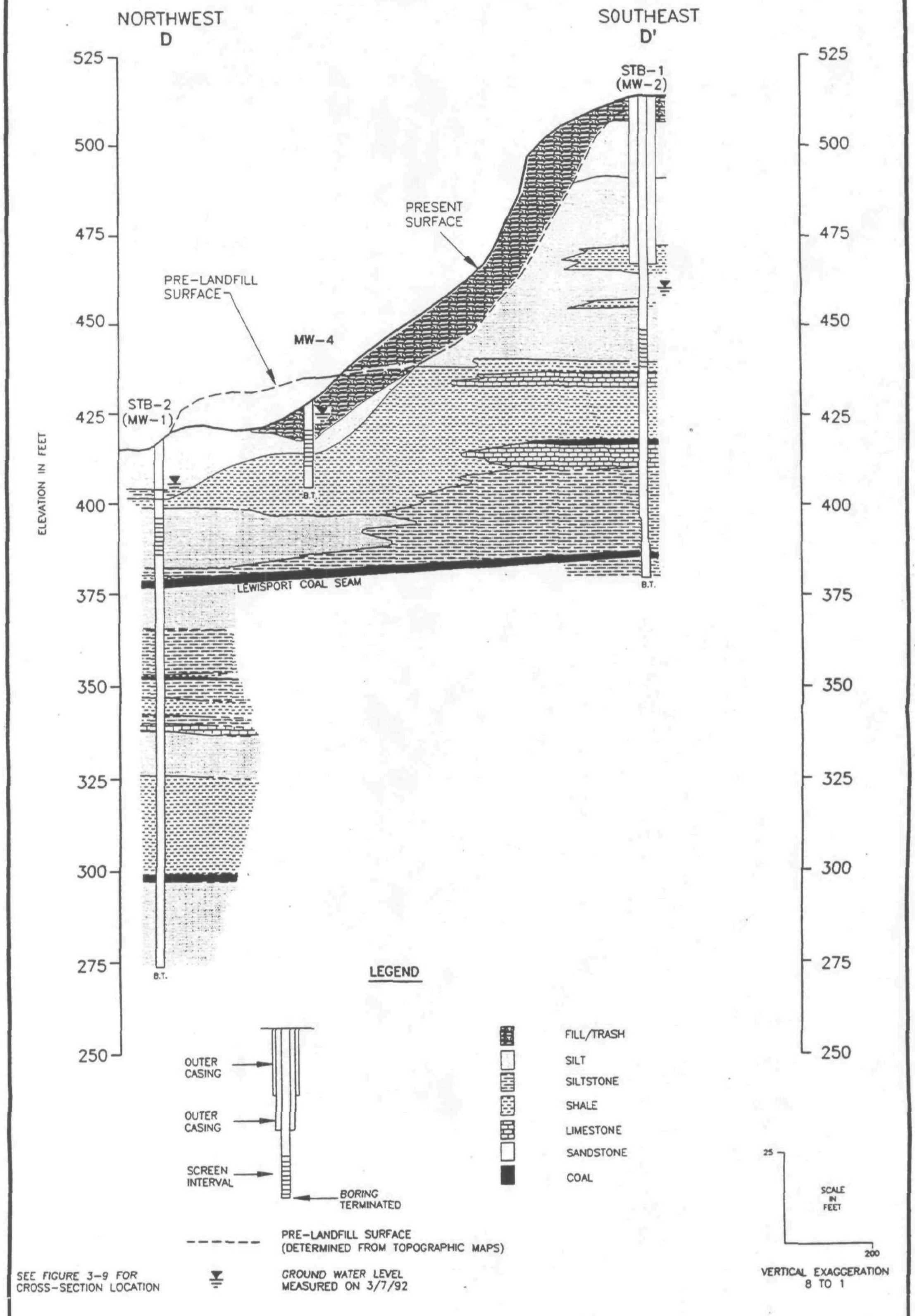
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 3: Site Watershed Map

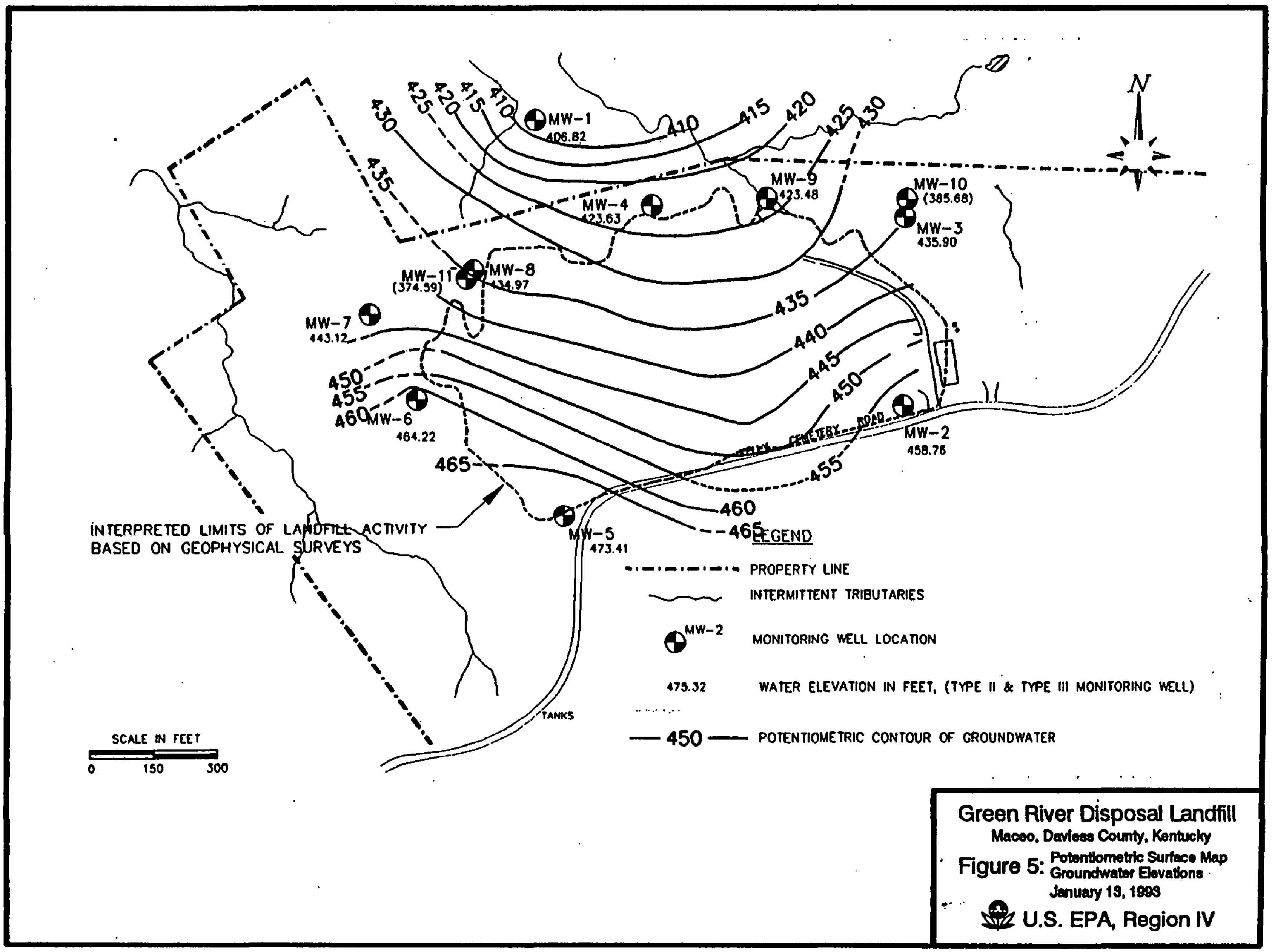
U.S. EPA, Region IV



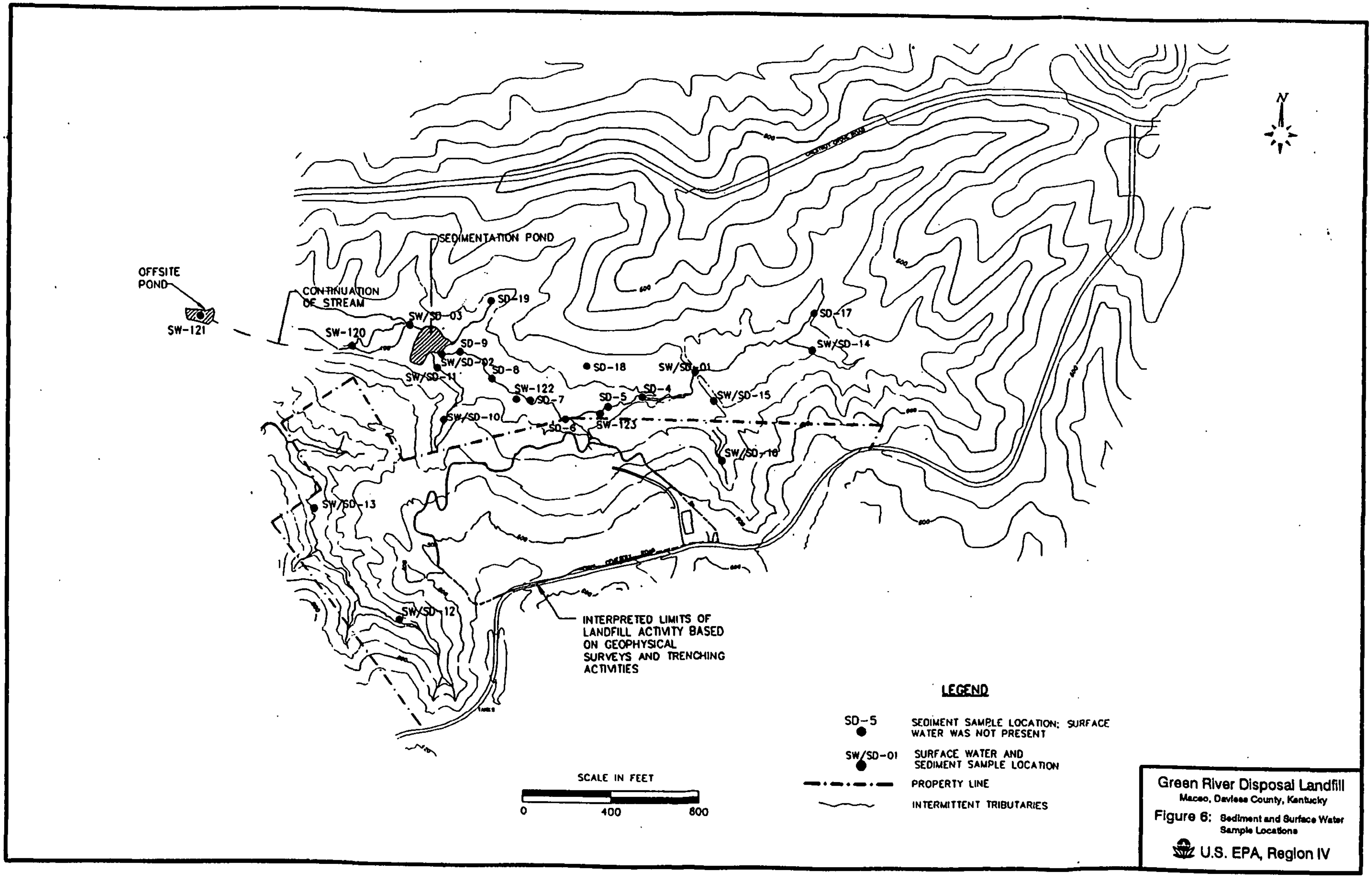
Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 4: Hydrogeologic Cross-Section SE to NW Across the Landfill

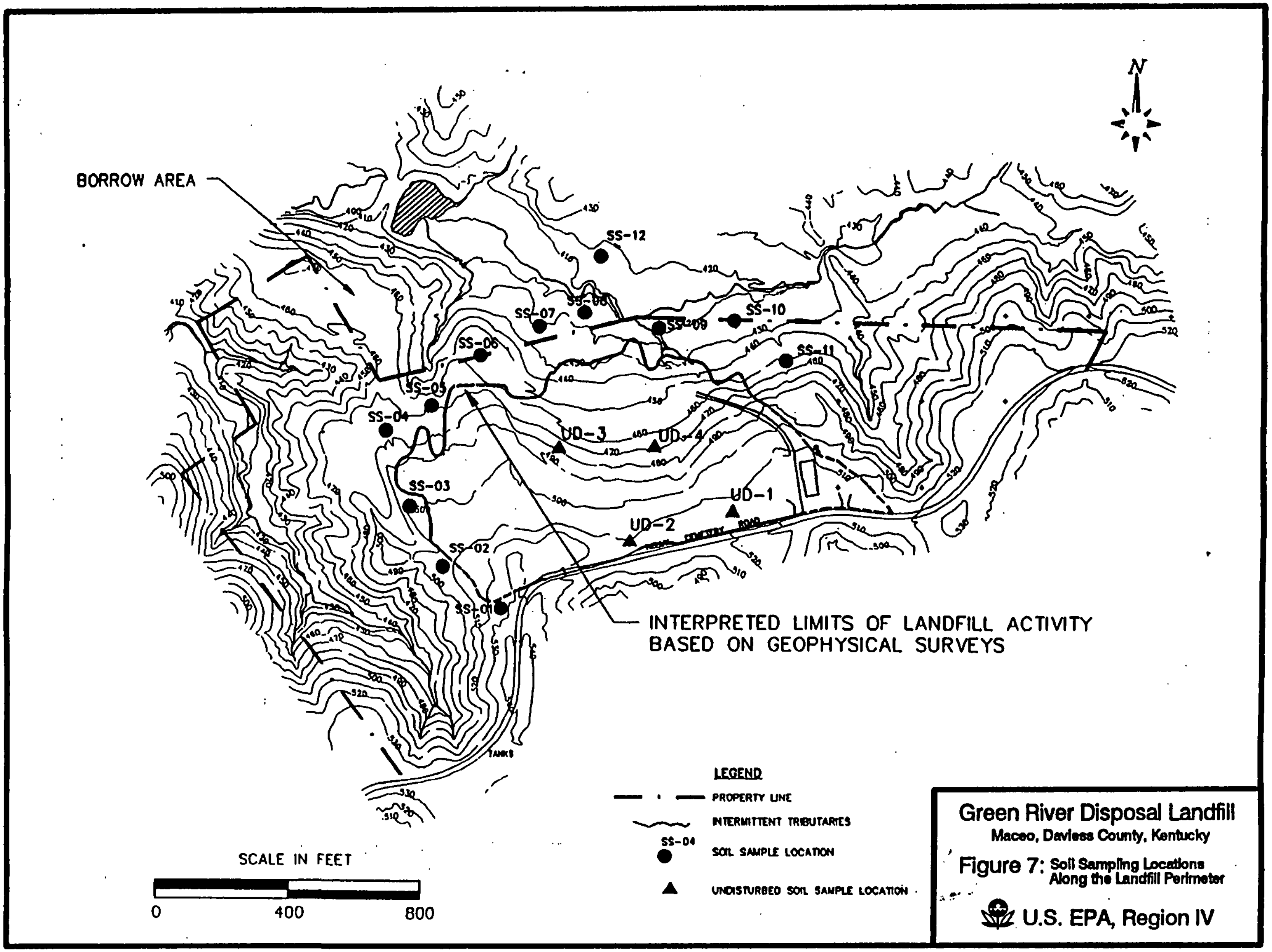
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky
Figure 5: Potentiometric Surface Map Groundwater Elevations January 13, 1993
U.S. EPA, Region IV



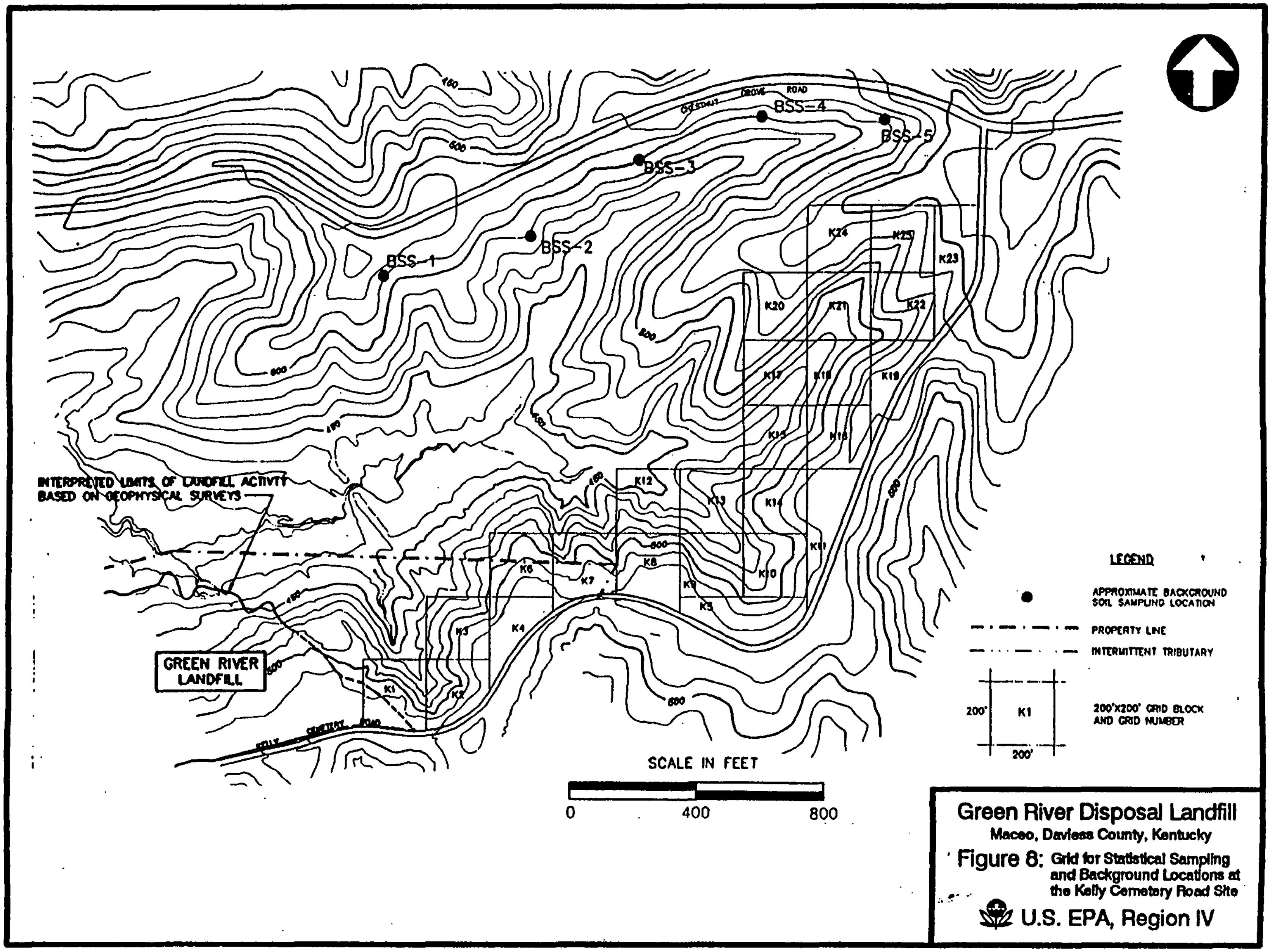
Green River Disposal Landfill
Maceo, Daviess County, Kentucky
Figure 6: Sediment and Surface Water Sample Locations
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 7: Soil Sampling Locations Along the Landfill Perimeter

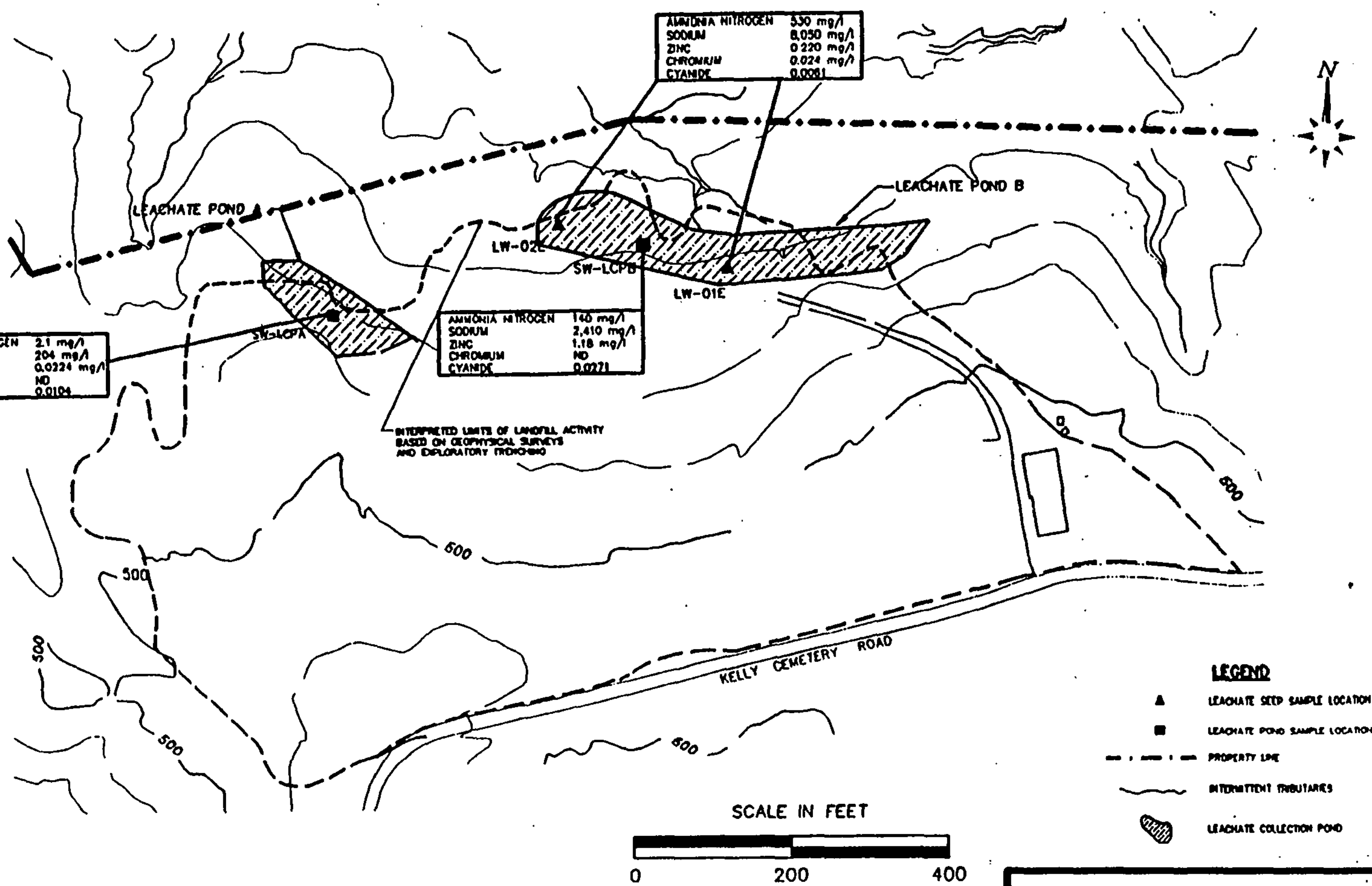
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 8: Grid for Statistical Sampling and Background Locations at the Kelly Cemetery Road Site

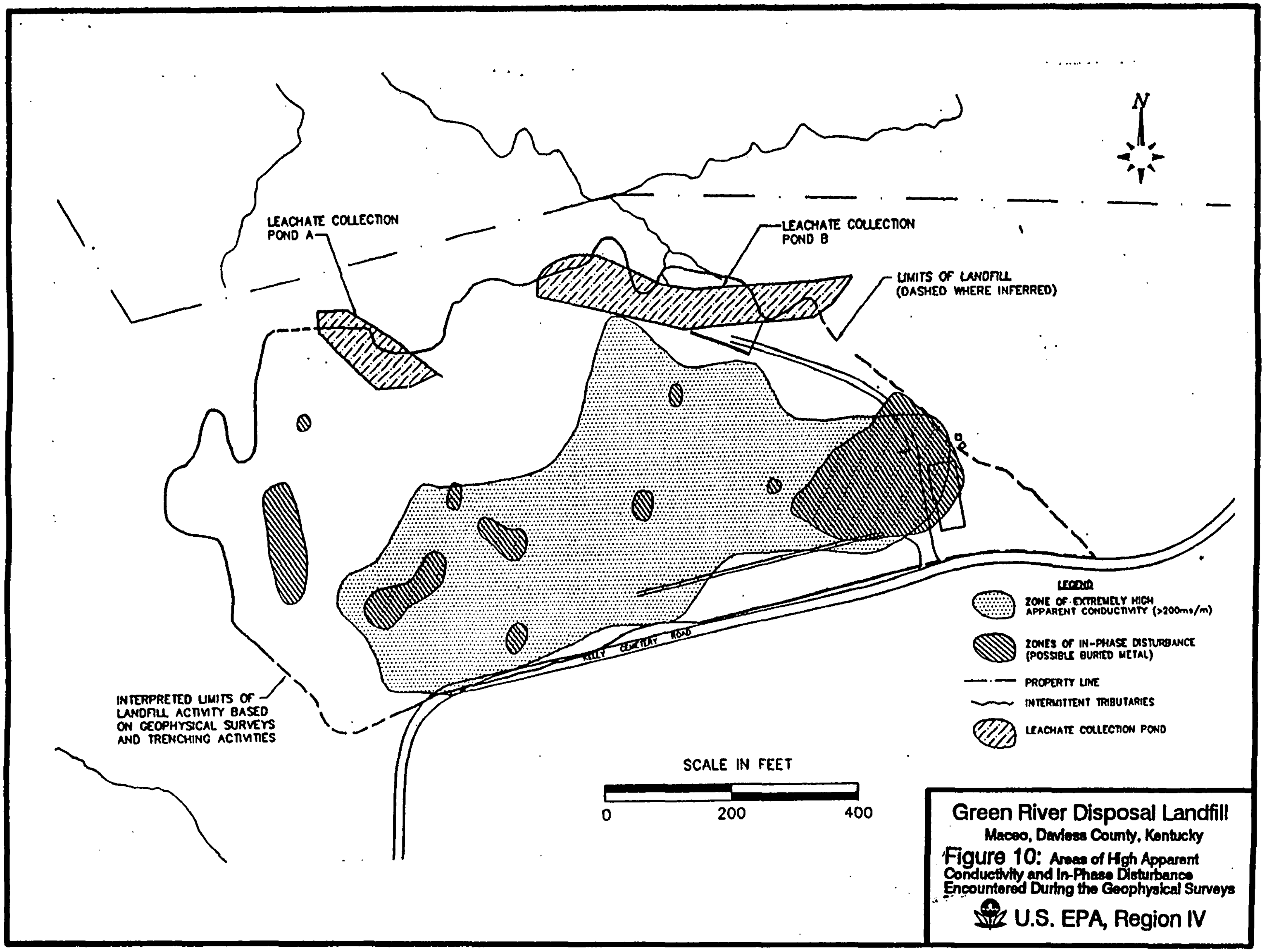
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 9: Leachate Seep and Pond Samples, January 1993

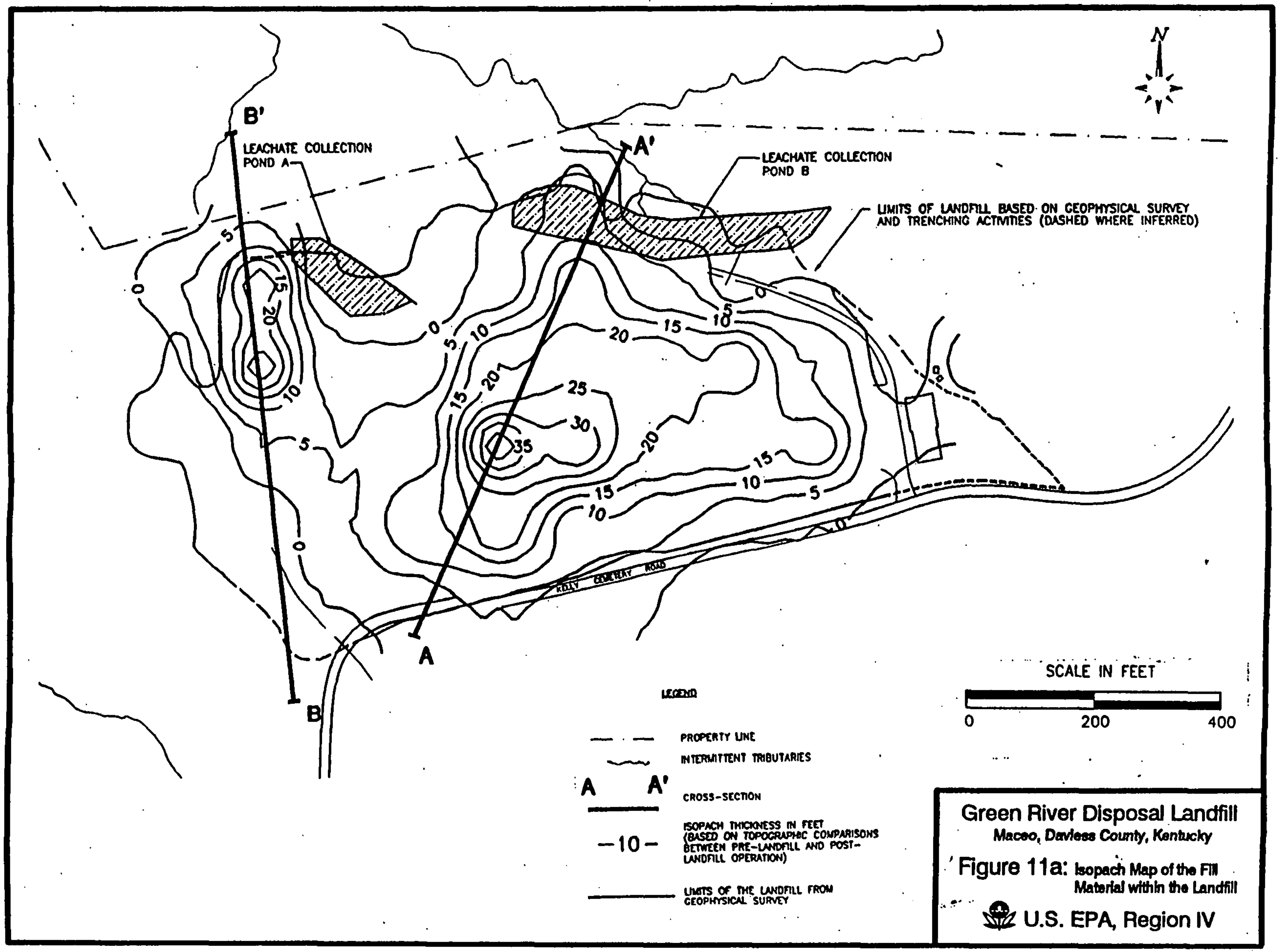
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 10: Areas of High Apparent Conductivity and In-Phase Disturbance Encountered During the Geophysical Surveys

U.S. EPA, Region IV

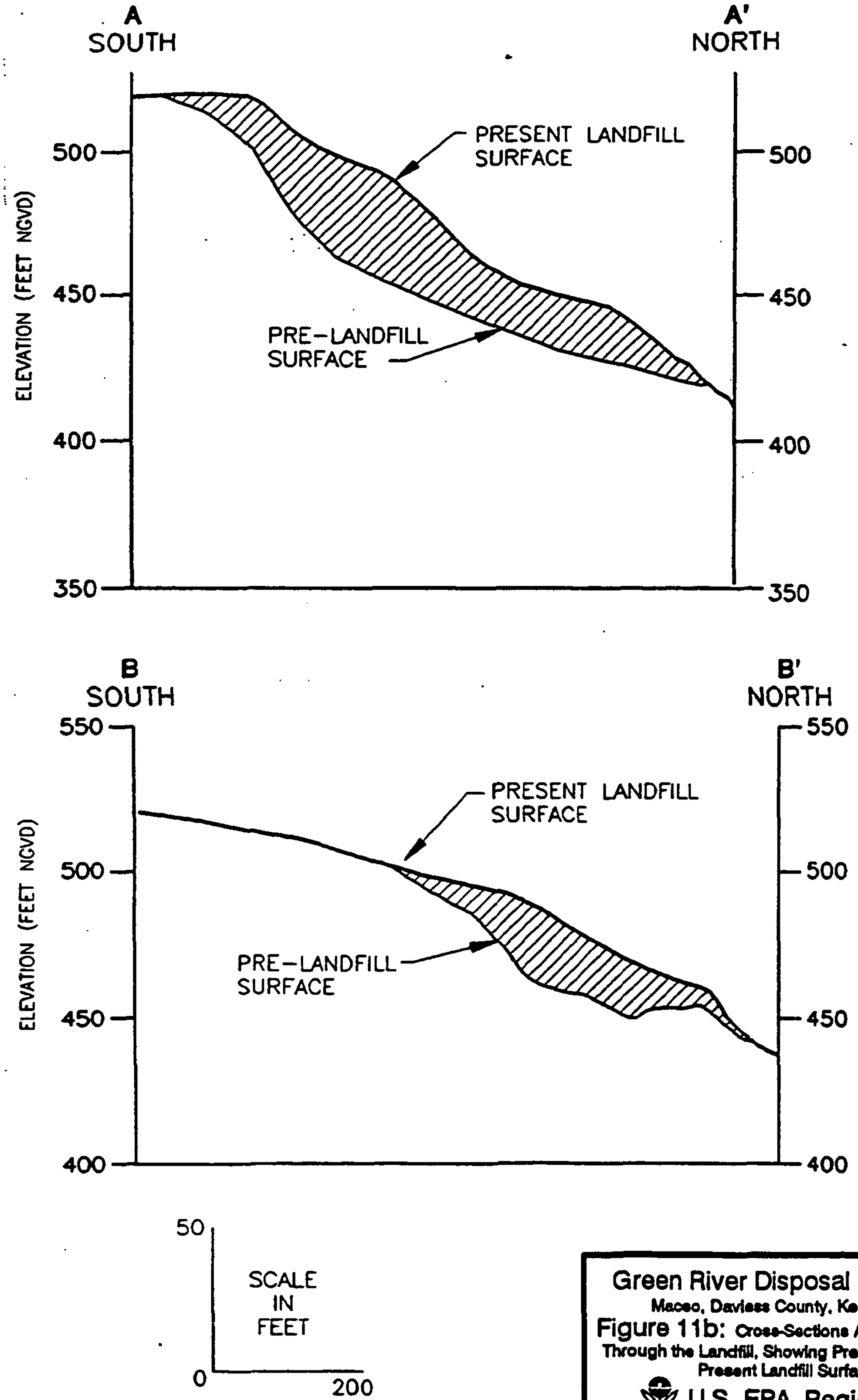


Green River Disposal Landfill

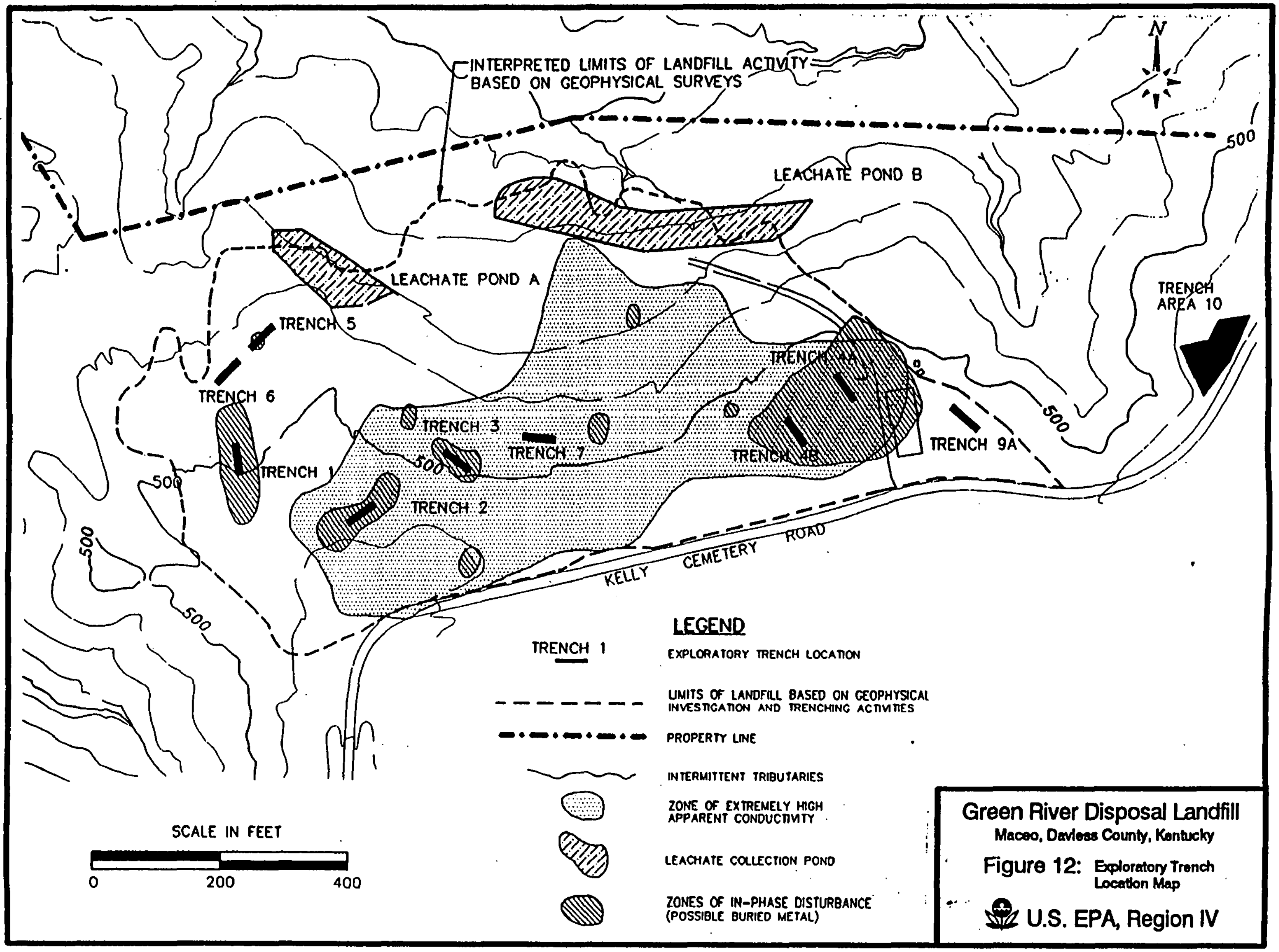
Maceo, Daviess County, Kentucky

Figure 11a: Isopach Map of the Fill Material within the Landfill

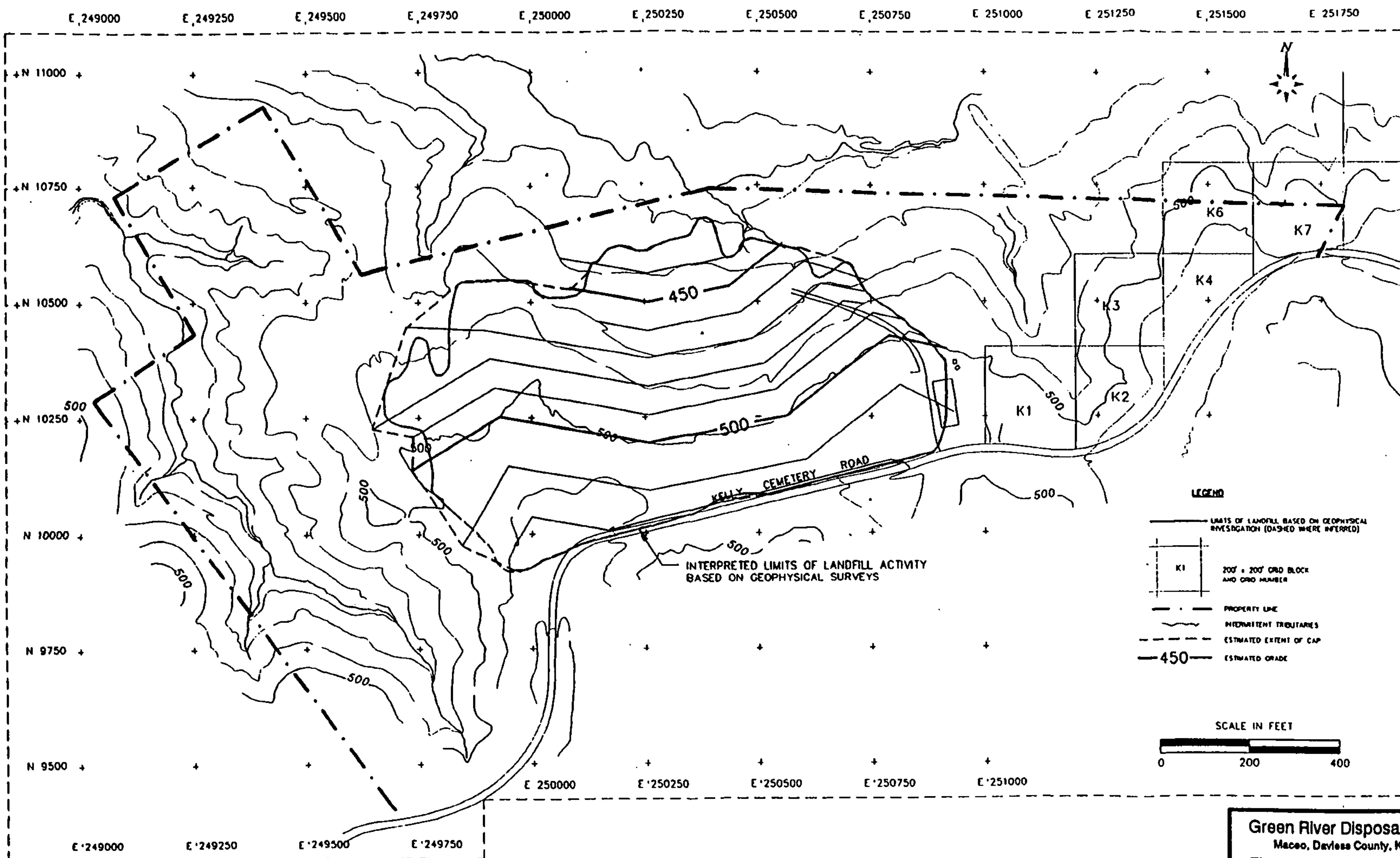
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky
Figure 11b: Cross-Sections A-A' and B-B' Through the Landfill, Showing Pre-Landfill and Present Landfill Surfaces
U.S. EPA, Region IV



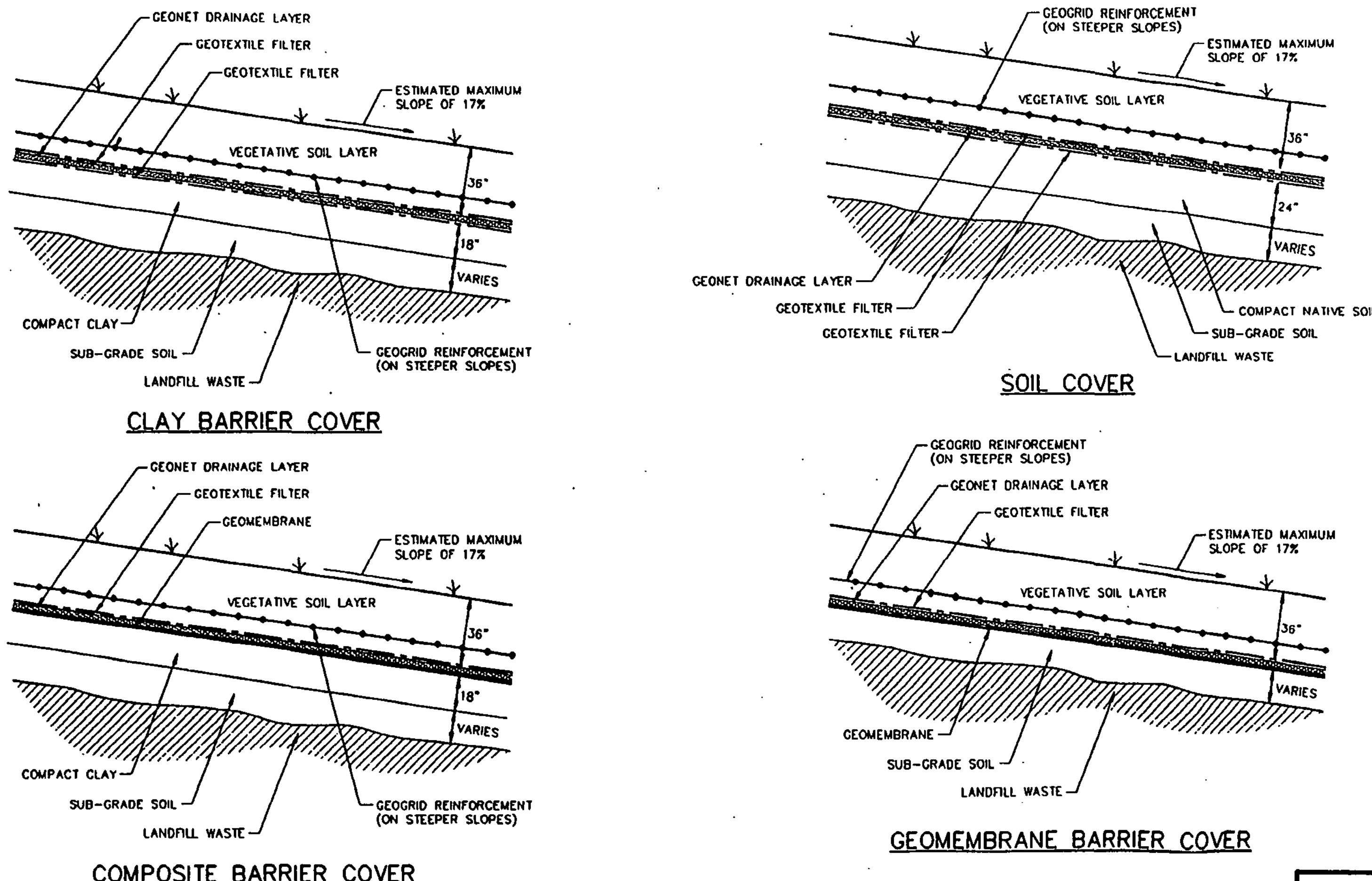
Green River Disposal Landfill
Maceo, Daviess County, Kentucky
Figure 12: Exploratory Trench Location Map
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 13: Estimated Grade and Areal Extent of the Landfill Cap

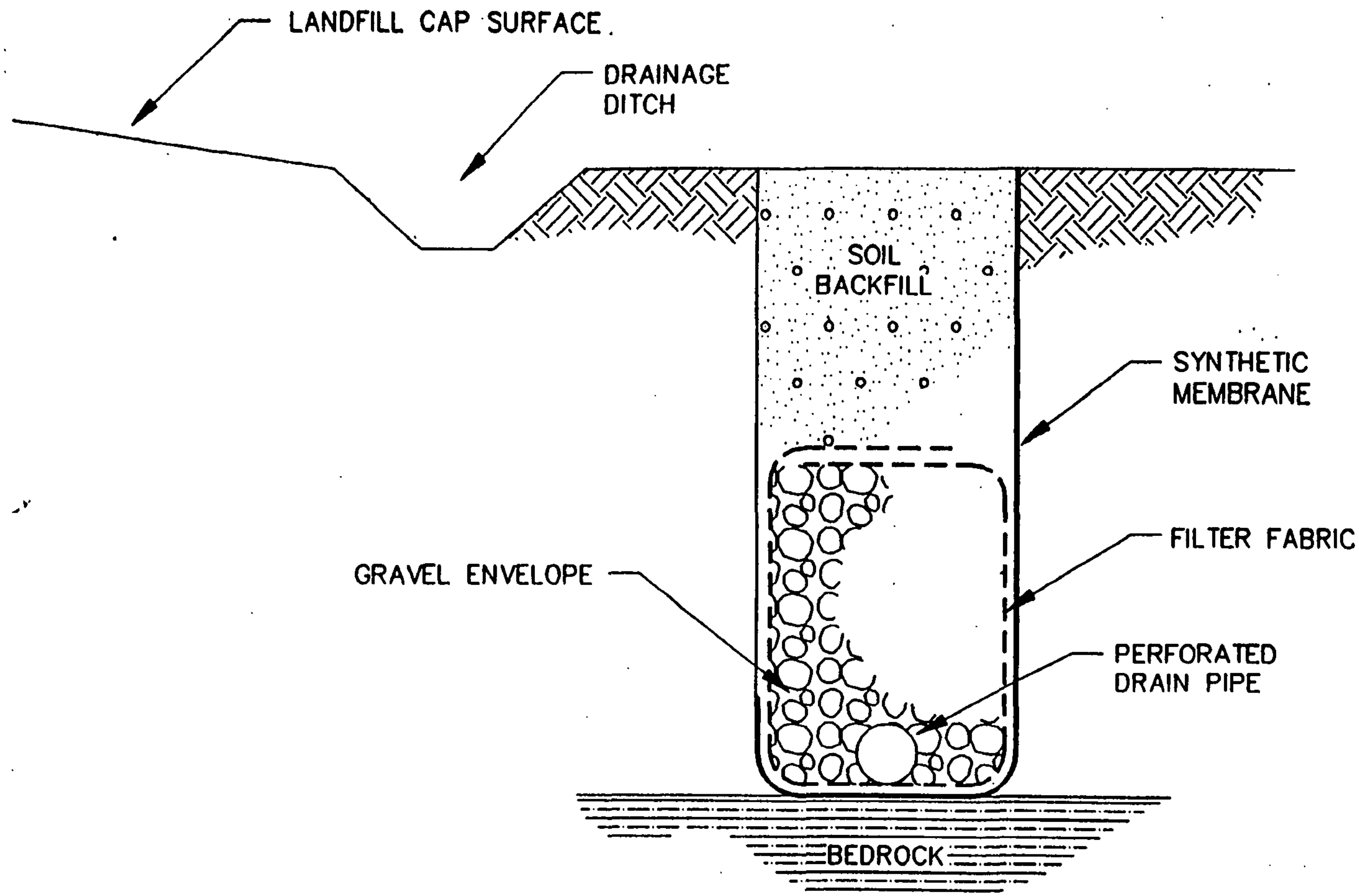
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 14: Generalized Cross-Sections of the Capping Options Evaluated

U.S. EPA, Region IV

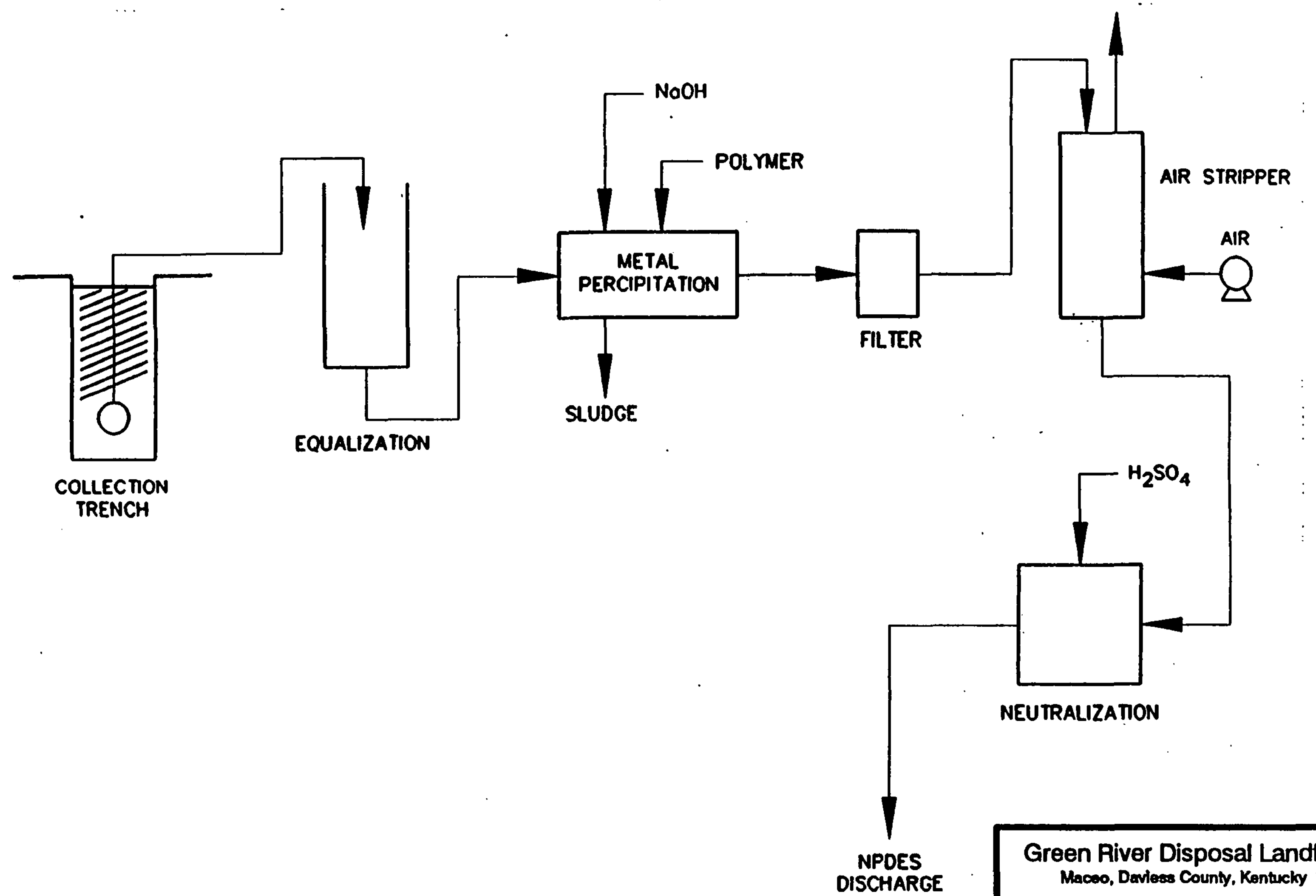


NOT TO SCALE

Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 15: Cross-Section of a Typical Leachate Interceptor Drain

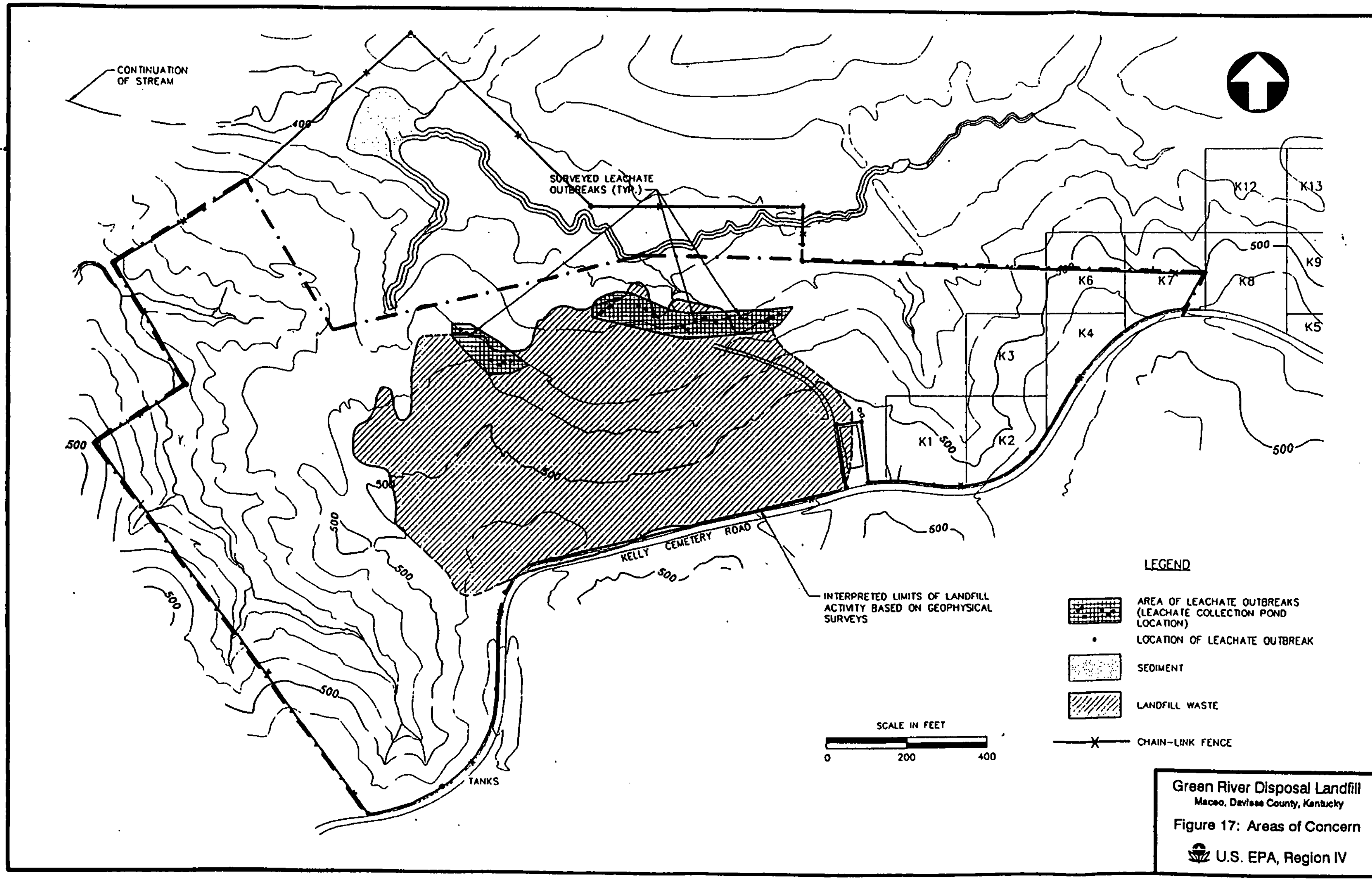
U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 16: Conceptual Process Flow Diagram for Leachate Treatment

U.S. EPA, Region IV



Green River Disposal Landfill
Maceo, Daviess County, Kentucky

Figure 17: Areas of Concern

U.S. EPA, Region IV

GREEN RIVER DISPOSAL LANDFILL SUPERFUND SITE RECORD OF DECISION

APPENDIX A

COMMONWEALTH OF KENTUCKY CONCURRENCE LETTER for the RECORD OF DECISION

PHILLIP J. SHEPHERD
SECRETARY

BRERETON C. JONES
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY ROAD
FRANKFORT, KENTUCKY 40601

December 14, 1994

Mr. Nestor Young, Remedial Project Manager
North Remedial Superfund Branch
United States Environmental Protection Agency
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Re: Record of Decision
Green River Disposal Superfund Site, Daviess Co., Kentucky

Dear Mr. Young:

The Kentucky Division of Waste Management (KDWM) has reviewed the Record of Decision(ROD) for the Green River Disposal site, which incorporates the Remedial Investigation/Feasibility Study, the Proposed Plan, and all supporting documents. We concur with the remedial action plan for the landfill portion of the site, which consists of burial of contaminated stream sediments within the landfill, a multi-media cap, and leachate collection and treatment. Please note however that, despite our concurrence, we do not agree with your analysis that Kentucky Hazardous Waste Regulations are neither applicable nor relevant and appropriate as they apply to landfill cover requirements. We also object to the exclusion of Kentucky Revised Statute 224.01-400 and Kentucky Groundwater Regulation 401 KAR 5:037 as applicable or relevant and appropriate.

The Division of Waste Management also concurs with the proposed course of action regarding groundwater, which calls for the collection of a minimum of two years of additional data which will be used to determine whether there is statistically significant evidence of groundwater contamination attributable to the site, while a final decision concerning a groundwater remedy will be established in a future record of decision.

No action is proposed for the adjacent Kelly Cemetery Road portion of the site or the East and West Ravines. KDWM cannot concur with this course of action, as it is based on a faulty risk assessment. Our specific comments notwithstanding, procedurally, the assessment contains many of the same elements with which fault has been found in previous risk assessments. Examples include use of the lead model, basing PCB action levels on the Toxic Substances Control Act and not on a risk basis, establishing background levels

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with limited data, and the use of action levels less conservative than the 10 E-6 excess cancer risk level required in Kentucky. Taken together, these errors lead to an underestimation of risk and do not afford an adequate level of protection for human health and the environment.

As always, we will be glad to discuss these issues at your convenience.

Sincerely,

Linda Stacy
For Caroline P. Haight, Director
Division of Waste Management

cc: Randall McDowell, DOL
Rick Hogan, Superfund Branch
Jeffrey Pratt, Superfund Branch

GREEN RIVER DISPOSAL LANDFILL
SUPERFUND SITE
RECORD OF DECISION

APPENDIX B

PROPOSED PLAN PUBLIC MEETING TRANSCRIPTS

UNITED STATES OF AMERICA
ENVIRONMENTAL PROTECTION AGENCY

MEETING

LOCATION: Maceo School Gymnasium
Green River Superfund Site
Maceo, Kentucky

The following is a transcript of the public meeting held on August 4, 1994, beginning at the approximate hour of 7:00 P.M. CTS, in the Maceo School Symnasium, Maceo, Kentucky.

REPORTED BY: James A. Joplin, RPR

Maceo, Kentucky
August 4, 1994 - 7:00 P.M.

PROCEEDINGS

MS. DURHAM: Good evening and welcome. My name is Suzanne Durham, and the purpose of tonight's meeting is to discuss with you the long term investigation which has been conducted here at the site, and to tell you exactly what we have found and announce EPA's proposed course of action, but more importantly, we are here to solicit comments from the Community.

Before we go any further, I would like to introduce a few individuals to you. This is Nestor Young. Nestor is the Remedial Project Manager who handles the day-to-day technical activities.

Here on the front row is Harold Taylor. Harold is the Chief of the Tennessee-Kentucky Section of the North Superfund Remedial Branch. Nestor and I work for Harold. We are with the United States EPA out of Atlanta, Georgia.

We have Rick Hogan who is with the Superfund Program and Larry Moscoe who is with the Department of Law Commonwealth of Kentucky.

We thank you all for coming.

I don't believe we have any local officials with us tonight, but we did meet with them today, and they said they were very sorry, but they had other commitments and could not be here today.

I am sorry. I missed Tracey Johnson with the Superfund Program from Atlanta, Georgia. Nestor will be going over the site background and Remedial Investigation summary. He is going to give you a little bit of detail about EPA's proposal, and in a few minute I will get back up and tell you all about the public participation opportunities, and then we will tell you the next step, what happens after tonight.

Then we get to the most important part, and that's the question and answer period. I will ask you all to hold your questions and comments until all of the presentations have been made, and I promise we will get to each and every one of you. Nestor.

MR. YOUNG: Hi, and welcome. We normally start by saying a few important things. If you need to use the bathroom facilities, they are down the hall toward the end of the hall. I am going to basically talk about the investigation that we have conducted; the results of the investigation and the feasibility study.

The Feasibility Study, basically is looking at all possible alternatives that we can implement. So let me start by talking a little bit about the site background.

Most of you who are here tonight I have spoken to before, and have a good understanding about the background of the site, but for those of you who have not, or who don't know about the site, let me tell you a few words about that.

Green River Landfill is basically composed of two separate areas, natural landfill itself, and the area adjacent to the landfill that we call the Kelly Cemetery Road Site.

By the way, if you didn't pick up a handout, you might do so over there on the table and you can follow along. It is a copy of the overheads I will be using. You can follow along in case you can't see the screen too well, or in case you want to take some notes.

On that table is a copy of EPA's Fact Sheet, which is a summary of an investigation and summary of a Feasibility Study, and I am going to go through that tonight. Tonight' lecture or talk is a little bit of a summary of that information on the Fact Sheet. But anyway, the landfill is composed of two areas, the Kelly Cemetery Road Site. The Kelly Cemetery Road Site is an area along the north side of Kelly Cemetery Road. Let me show you a picture of the site. Kelly Cemetery Road area is these squares here.

This diagram is toward the back of that packet. This area used to contain about 776 drums of ferrocyanide waste, and back in 1985 the Commonwealth of Kentucky removed those drums. They were disposed of on the ground, on the side of the road, and they all removed those drums.

We included this area as part of the investigation of the landfill to determine whether or not there was any residual contamination or contamination left behind by those drums in the surface soil. The records were not very clear as to exactly where the area was located, and where the drums were located, so what we decided to do was to take this area along the landfill and along the Kelly Cemetery Road Site, and we broke it up in 25 different grids and took samples in each one of those areas.

We pretty much determined more or less where the drums were disposed of, and they are sort of along in here, but we didn't find a whole lot. They did a pretty good job of picking up drums and residual contamination. There were a few contaminants we did find, but they were not found to pose a hazard or environmental risk.

Tonight I am going to be talking about something other than the Kelly Cemetery Road area because it is pretty much cleaned. If you don't know where the site is located, it's just north of Highway 60 along Kelly Cemetery Road.

EPA listed the site on the National Priorities List back in 1990. The National Priorities List is a listing of the most contaminated sites in the Country, and what we do is initially the states, I believe, referred this site to EPA.

We went out there and took a few samples, studied the site a little bit and calculated a number that will determine whether or not it gets placed on this list, and back in 1990 we determined that there was enough risk at the site that it warranted an EPA investigation. EPA Superfund Investigation, and basically the threat that we were looking at back in 1990 was, you know, a threat to the residential water supply as well as in the area, the neighborhood, and uncontroled discharge of leachate.

Leachate is the water that gets percolated through the landfill and it comes out the bottom. It is usually contaminated with waste material, so I will be referring to leachate quite a bit tonight.

The Green River site is approximately 14 acres, and it was operated by the Green River Disposal Company, more or less from 1970 to 1983, and it was a permitted landfill, and accepted basically general trash from local merchants and companies.

However, there was industrial waste that was also disposed of here. The waste was basically pushed into ravines. It is something like when you dig a hole and bury the waste in the hole. In this particular case, the waste was pushed into ravines and covered with soil.

Let me show you a general picture of what that looks like. If you would look at the profile of the site, it looks something like that. Generally, this is a natural ground here and the darker is the waste that was pushed over the side.

So the landfill looks more or less like this. If you haven't noticed, I have pinned up on the wall an aerial photograph of the site, and I would encourage you to take a look at that. It gives you an overall picture of the site, and a view from the sky. However, it is very deceiving because it is two-dimensional, and you really don't get a feel for how deep the landfill is, or how high the top is compared to the bottom of the hill, but it looks more or less like this.

The remedial investigation basically consisted of these items here that I have listed. I won't be going through all of those. I will be basically summarizing the data that we collected and the results of that data.

As you can see, the investigation was quite extensive. We did a lot of work out there. We took samples from soil, ground water, sediment, air. We surveyed the area. We trenched the landfill and collected samples of leachate and did ecological assessments.

Let me say a few words about the trenching. Because of the drums that were disposed of along the Kelly Cemetery Road Site and because of several references in the file to drums being located at the landfill, we thought that there was a good chance that there might be drums that were buried in the landfill that may contain waste and generally the types of waste that were put in the metal drums were either liquids, solids of material, or sludge that would have to be contained by a metal container, and over time the metal container rusts, and this liquid leaks and comes out, and if you don't take care of that early on, you know, years down the line you may see that coming in the leachate or seeping out of the ground.

So they thought there would be a potential for buried drums at this landfill and the one way to find out is to trench it. You could install holes and try to look for them that way, but that's like trying to look for a needle in a hay stack.

What we did was, we identified areas on the landfill using different types of field instruments that would give us a good chance of hitting some of those drums. Some of these would be like a metal detector, for instance.

So we have identified certain containers in the landfill that would possibly contain these drums, and we installed trenches in those areas to make sure, as you can see here.

The trenches were about twenty feet deep, fifty feet wide and fifty feet long and six feet wide, and the two reasons for the trenches were, one mainly to look for buried drums, and two, to look for hot spots.

When I say a hot spot, I am saying areas of the landfill that may contain highly toxic mobile waste or contaminants where leachate or water percolated through which might get very concentrated, and essentially take away those contaminants, so we were looking for hot spots and looking for the buried drums.

The results of the investigation was, we didn't find any buried drums. We found a few crushed drums, but it was very clean. The waste in the area, in the trenches, was the same. It was no different on the east side from the west side.

It was basically the same kind of waste all the way through. There wasn't one area particularly different form the other, and as far as hot spots were concerned, we took samples from each one of those trenches, and sampled for everything that we could think of and again, we didn't find any hot spots at all.

The results pretty much shows that the waste was pretty much the same throughout, so that's actually good news, because we don't have to necessarily treat one area of the landfill differently than all of the rest. We can basically treat the entire landfill the same.

Just to give you an idea of how many samples we took, this list kind of shows you a number of samples that we took in each type of media, surface soil, surface water and sediment, ground water, and these would be the trench samples and leachate, and again, we basically sampled for everything from metals to organic materials. Organics are compounds normally found in gas, say, or in an oil, and this overhead shows you the breakdown of the types of contaminants that we found in each one of those media.

As you can see, we did find a whole lot of normal contaminants. The main point is with metals, and this is inorganic compounds, and that's fairly good, because they don't travel as quickly as organic compounds. Organic compounds are lighter than water and tends to float.

When you have an organic contaminant, it tends to spread very easily along the ground water whereas metal will tend to move much slower. They bind off in soils, so you don't generally find a huge ground water problem, or a nasty contaminated area with metals.

Metal tends to say fairly confined to the local area, and it is not quite as toxic. Generally, with organics, we find organic compounds tend to post an excess cancer risk where that is not the case with metal. With metals, you find those pose a more toxic risk other than cancer.

There are a few metals that do pose a cancer risk, but they are very few. The results of the samples that we took in the remedial investigation, like I mentioned before, there was really no contamination in the landfill. The COC's don't pose a human health risk, and by that I mean we looked at the types of concentrations of the compounds, the concentrations and types of exposures that someone would come in contact with those contaminants, and looking at all of those various things, we came up with these risk numbers that will give you an idea how toxic or how bad this contamination would pose to someone being exposed to it.

So we didn't really find any human health risk with the compounds that we found. The ground water, we installed monitoring wells all around the site and let me show you the map of some of the ground water wells that we installed.

Each one of those black dots here represents a monitoring well, and well you can see we installed monitor wells all around the site looking for possible contaminants migrating from the site.

What we found out from the data that we collected is that there is not a significant ground water problem. Like I mentioned before, most of the contaminants found were metals and not organics, so we didn't find a significant contamination problem.

As a matter of fact, there were only a few contaminants and in a few monitoring wells that really posed a risk to human exposure, but it is not quite clear whether those contaminants came from the landfill or are naturally occurring, because they are metal, beryllium and manganese, mainly.

So what we decided to do is at this point in time we are not going to decide to do anything with the ground water other than to continue monitoring it. We want to collect more data to accurately determine the relationship between the landfill and the ground water, because like I said, some of those could be naturally occurring, but we haven't established that yet.

The data doesn't demonstrate that... We need to collect more data to accurately determine the relationship between the landfill and the ground water, so what we are proposing now is to continue the ground water monitoring for about a period of two years and collect samples roughly quarterly, and hopefully by then we will have enough data to make an accurate determination of whether or not the ground water is being impacted by the landfill.

But again, there is not a significant problem here, so by continuing monitoring, there wouldn't be a problem in doing so.

What we did find, though, is that there are three major problems with the landfill. The waste itself presents a problem. The leachate that is being generated from the waste is a problem, and we found that there are some sediments in a small creek in the valley of that area, and that sedimentation pond that is contaminated with some metals that pose an ecological risk.

So part of the remedy, well, the remedy will take care of those three problems, and like I mentioned before, there were no hot spots or buried drums in the landfill, and there didn't seem to be any harmful levels of gas emitted by the landfill.

Let me just give you a point of reference where the sedimentation pond is. This little dark area right here. This line here represents the stream along the valley. We also mentioned the Kelly Cemetery Road Site and Chestnut Grove Road along this area, which is along the rim of this hill, and all of this area in between slopes in towards the stream, towards the pond, and then out. The water flows out towards the west, and this sedimentation pond was constructed, I believe, at the request of the State back in the nineteen-eighties, and what it was designed to do was to stop sediment that was coming from the landfill from flowing down the creek.

So it has accumulated quite a bit of sediment. I believe the deepest portion is about six or seven feet deep, and like I mentioned, some of that sediment is contaminated with a few metals, so we will be implementing a clean-up remedy for that.

Like I mentioned, the three problems at this point are the landfill, leachate and the stream and sedimentation pond sediment.

The feasibility study that we conducted is basically a study to evaluate the various clean-up alternatives that we could possibly implement for the clean-up problems.

What we did in this particular case was sort of shorten that study period. Instead of looking at the possible alternatives, and some of those being to dig it out and take it somewhere else, or dig it up and burn it. Those alternatives for the most part are costly and not very practical.

We did what we call a presumptive remedy. That is, EPA has been involved in many of a number of landfill clean-ups and through our experience in doing these studies, we have also reached the same conclusion, that typically when you have a very common type of landfill, you usually construct a landfill cap and try to contain the waste.

That seems to be the most reasonable and appropriate remedy for these types of sites, so what we did was, we implemented a bridge to shorten the study period and look at the different types of landfill caps we could implement instead of looking at the other remedies that we know are too costly and are not very appropriate.

What I want to talk about next is basically run through the various problems and look at the objectives to those problems, and look at the alternatives to be considered for remedying the problems.

The first problem at the landfill is the actual waste itself. The problem with the waste is it produces leachate, and the way leachate is produced is, basically you have rain water falling on top of the landfill that seeps into the waste and migrates or flows through it and end up at the bottom of the hill, and starts coming out at concentrated amounts in the water in these sediments. Some of the waste in this landfill are currently exposed, meaning they are not under a cover. And the waste I am talking about is aluminum dross salt cake. That's the type of waste that has been disposed of here at the site.

This waste comes in generally two types, in a block, a very hard block, and in powder form. We encountered these blocks when we were trenching. As a matter of fact, the cutting tips were sort of ripped off the teeth of the backhoe we were using when we tried to chip into it.

It was very, very hard, but the dross is exposed, and is located at the top of the landfill. It is sort of a mound, and you can kind of see it in that area. So that's an additional problem here.

We've got the aluminum dross at the top of the landfill that is currently exposed, not covered by anything. And also, long term, you've got potential erosion problems, you know, over a long period of time. The soil cover that's on there will eventually degrade and just slump into the creek, and so you've got erosion problems.

So the objectives of correcting these problems are basically to prevent direct exposure to the waste, to put some kind of a cover on it so that humans or animals can't come in contact with the waste and therefore be contaminated by them.

And also, the infiltration of rain causing the generation of leachate. So those are basically the objectives of the remedy that we are considering for the landfill.

Now, we studied basically five alternatives, clean-up alternatives for the landfill. The very first one is 'no action'. We are required by law to evaluate not taking any action, meaning just walking away from the site and leaving it like it is.

That also provides us a baseline to compare all of the other ones too, so we are required by law to consider that.

The next alternative that we considered was capping with a soil cover, more or less what's out there now, but sort of augmenting the soil cover that's there, and basically, that's all it is, just putting another layer of soil on top of the landfill and compacting it and grading it so that not much infiltration occurs.

The next alternative was capping with a clay cover. The clay adds the benefit that clay is very dense, and it provides a fairly impervious cover

over the landfill. It is harder and resists erosion better than the soil cover.

The other two are basically combinations. The next one is capping with single barrier geomembrane. This geomembrane is a very thick hard plastic, and I have some samples here for you to see. After the meeting, you can come up and take a look at them and touch them. It is basically a hard plastic that, again, prevents water from going through it, and that alternative would just consider putting a sheet of plastic over the entire landfill and covering it with a layer of soil.

The next alternative is basically a combination of the two previous alternatives, which is the clay and geomembrane. Basically, that remedy is the combination of those two, a layer of clay and a layer of geomembrane.

And that adds obviously an added benefit to just one of those alternatives alone.

The next problem that we looked at is leachate. The problem with leachate, again, is that the water doesn't generate from the site. Currently, what we have done, we have installed a temporary system recirculating that water through the landfill, so we are collecting it at the bottom in berms, and we are pumping it back up to the top and recirculating that part. What we have found out, is that we are nearing the expected lifespan of that system. You have to understand that that system was a temporary system. It was not meant to last for years and years.

I think it has been running for about three years now, and again, it wasn't meant to last a very long time. We are nearing the end of its life-expectancy. What we determined is that the landfill is presently pretty much saturated with water, and there is a whole lot of water in the landfill itself.

Again, leachate presents unacceptable risks. These affects are to the local environment. The concentrations aren't high enough to produce a human health risk, but they are high enough to present an unacceptable ecological risk.

And that is it puts local species of animals in danger if they drink it, or if they live in the water, for example. Some of those contaminants are metals, again, and primarily ammonia. There is a high concentration of ammonia being generated there, and we as I previously mentioned, the aluminum dross salt cake.

It is a by-product of the reaction of

the waste and water. So the objectives, again, are to prevent direct contact with this water and prevent the migration of those hazardous substances to the stream and into the ground water.

Some various alternatives, again, that we evaluated were, again, no action, limited institutional action, and what that is is basically not necessarily cleaning up the leachate, but preventing contact with that waste.

In other words, maintain your fence around the site to prevent people from coming in contact with it, continue monitoring it to see if the contaminants in that waste are decreasing over time, to prevent deed restrictions for the property so that anybody in the future looking to maybe purchase the property at the site or near the site would know that there is a problem there, and that's basically limited institutional action.

You are not dealing with the problem, but dealing with the symptoms of the problem. And the third remedy is collection of the leachate, treating it and discharging the clean water.

So those are the three alternatives we considered for leachate. The next problem area that we looked at was sediment. Like I mentioned before, the sediment, the main problem with the sediment was the contaminants in the sediment which are high enough to pose an unacceptable ecological risk. In other words, the danger to animals coming in contact with it, but not high enough to present a human health risk, so people coming in contact won't be affected as would animals coming in contact with it.

So the objectives mainly are to prevent exposure to the environment of the contaminants that are in the sediment, and the various alternatives to be evaluated for the sediment is again, no action, limited institutional, again, just keeping a fence around the site, putting deed restrictions and continuing sampling or monitoring to make sure the problem is not getting worse.

And the third one is excavation of those contaminants, sediments, and disposing of those sediments in the landfill itself.

In other words, putting it into the landfill waste. After evaluating all of the alternatives that we came up with, what we decided to do was go ahead and install a cap that is a combination of the clay and the geomembrane.

Another question is, later on, how this cap would be constructed, and I really don't want to get into that because at this point in time I don't have any details of how it will be constructed, and we want to evaluate all of the alternatives and determine how that is to be done, but we believe this alternative provides the best way to address the concerns that we have uncovered.

As far as leachate is concerned, I think it is very clear what we need to do with it, and we intend to collect the leachate, treat it, removing the contaminants from the water and discharge the clean water into that unnamed stream, or the stream at the bottom of the valley, and for the sediment, I think the best thing to do is dig it up and place it in the landfill which will prevent the hazard for humans and animals as well, just cover it with a cap.

As Suzanne mentioned, the purpose of this meeting is to summarize the results of the investigation and to present to you EPA's recommendations for this site. Your comments are very important to the Agency, and as a matter of fact, you all play a very important role in selecting the remedy, so the purpose of this meeting tonight is merely to solicit your comments, and we have been working very closely with the Community group that has been organized here tonight that Patsy Gordon represents.

As a matter of fact, we met with them last night and went through the findings again, and we have been working very closely with this group.

We have been sending them draft documents all along, and results of the testing data. We have informed them of everything that has been happening at the site, and so they are fairly knowledgeable, So if you have any questions later on, and you can't get ahold of one of us, Patsy would be a very good resource in the local Community that could probably answer the question and help you out.

The other good source is the Administrative Record. The Administrative Record is a formal official file that is set up that contains all of the information that we have gathered, and that provides the basis for our remedies selection. We have located that file at the Owensboro-Daviess County Public Library in the Reference Section of the library.

It has all of the reports that have been generated. It has data. It has communications between EPA and the potential responsible parties, and with the Community group.

If you have any questions, or if you would like more detailed information, I would highly recommend you visit the Administrative Record because, again, the Record represents the basis for us taking an action here, and it contains very detailed information.

If you have even more questions, or would like to talk to me directly, I am as close as the telephone. Again, my name is Nestor Young, and Suzanne Durham was just up here before me, and here is our direct phone number.

Again, these are in your handouts, and we also have a toll free number, so if you have any other questions after tonight and you visited the Administrative Record, and would like to talk to me in more detail, I am as close as a phone call.

That is more or less my presentation. That is the summary of the Remedial Investigation, established Feasibility Study, and I believe up next is Suzanne Durham, who is going to talk about Community relations and how you get involved in this process. Suzanne.

MS. DURHAM: Well, Nestor pretty well covered the Community relations portion satisfactorily. Thank you, Nestor. I do want to remind you, and for those of you who came in after the meeting began, if you did not sign in at the registration table, you might want to do that before you leave.

Choosing a final clean-up remedy is

probably the most important decision ever made at a Superfund site, and that's why we are here tonight, to ask for your help in making that final decision.

We mailed to all of you a Fact Sheet about two weeks ago, which summarizes some of the things in the Administrative Record, and that Administrative Record is basically our legal file.

It contains all documents that the EPA has used in proposing this clean-up remedy. It's eight volumes. It is at the Owensboro Public Library, so I strongly urge you to go by there and familiarize yourself with that file.

The public comment hearing began July 19 and extends to August 17, 1994, and that will provide, you know, an opportunity for public participation. All comments and concerns must be carefully considered before we make a final decision.

We hope to sign a Record Decision by the end of September of this year. When that occurs, I will publish a notice in the local paper telling you exactly what the final clean-up remedy is going to be, and in the meantime, as Nestor said, if you have a question or comment, you can reach us at that address or telephone number in your handout. Thank you.

MR. YOUNG: Basically, I want to talk about what is next. So we are at the stage where we have completed the investigation. You know, we have considered various remedial alternatives, clean-up alternatives, and we are now faced with the decision of choosing one of those alternatives and what's next?

Basically, out of this meeting and after the public comment period ends, the Agency will issue what is called a Record of Decision, which is a document that establishes what the final remedy is. And we hope to get that document out by September of this year.

So after that point in time, after we decide what the remedy is going to be, we go back out and look at all the potentially responsible parties that we have identified previously.

Currently, we have four companies that have conducted the investigation, and there are other numerous companies that also have disposed of waste here, but did not actively participate in the investigation that we will be contacting to get them to participate in actually implementing the remedy. So the next phase really is to identify these reponsible parties and try to see if we can work out an agreement between the EPA and those responsible parties to get them to perform the clean-up remedy. The next step would be to actually design the remedy, design the landfill cap, design the leachate collection system and plan out how we intended to construct this.

After we have completed that, which I imagine will take a few, several months, the next step would be to implement remedy, go out in the field and construct it. Let me say that all along this process the Community is invited to participate and to comment, and as a matter of fact, we intend to stay in contact with you, the local Community group, and keep you involved in actually designing, having input in the designing of the remedy and during construction.

So the current schedule, as it stands, is the Agency will issue the Record of the Decision in September. We are currently negotiating or talking to the responsible parties that conducted the investigation, to try to expedite things and hopefully work things out so that we can actually have designed a remedy by the next construction season, so we can actually go out and start construction of the remedy.

But let me just caution you, that this is the 'best case' scenario. We are working with those responsible parties, which up to this point have been very, very cooperative. I think there has been a good relationship between the Community group, EPA and the responsible parties, working together to reach the final goal, and that is the final clean-up, and so far we have worked pretty well, and we don't see a problem with continuing that relationship in the future, so I hope that we could go ahead and quickly implement the remedy.

But under the best conditions what we could possibly have is complete the design in the next few months, and have a design ready for the next construction season, and that will be next summer.

However, things don't always work out as you planned, so Superfund is a very complicated program, and there are a lot of steps you have to go through, and there are a lot of road blocks that tend to pop up, unforeseen things, and something may happen that we may not be able to get to it in the next constructions season.

That would be the 'worse case' scenario. I don't think that's going to happen. I am very confident we can work things out and move things along.

Again, we've got a pretty serious commitment from the current PRPs, potential responsible parties, and again, we have a very good working relationship, and I am very confident we can work things out and move forward. That's pretty much it. The next step, issue a Record of Decision, and proceeding with the designing of the remedy and implementing the remedy, and by then it's pretty much operation and maintenance.

The current laws require that after you close the landfill, after you construct the cap, there will be a period of about thirty years where you continue to minitor the site, taking ground water samples and making sure there are no new leachate outbreaks, and make sure the landfill cap that was constructed is in good condition.

That will continue to occur after the landfill cap is constructed. That will be pretty much it. Again, we will be working with the local Community group in the next few months, and they will be involved in the process.

That's pretty much my presentation as to what is next. I believe next on the agenda are questions and answers, and what I would like to do before we get into that is, I know that Patsy Gordon, the President of the local Community group, has a few things to say, and before we get into the question and answer period. I am going to invite Patsy up here to make a few comments, and after that we will go ahead and open it up for the questions and answers.

MS. GORDON: Thank you. My name is Patsy Gordon, President of the Green River Toxic Waste Clean-up Association. We support the EPA's proposed plan as announced by the EPA in the newspaper, to cap the landfill with a composite barrier cover, which is option number four, treat the leachate by collection with sub-surface drains, chemical and physical treatment, and discharge of treated water into the stream, which is option three, and to contain the stream and sedimentation pond sediment by consolidating it with the landfill wastes, which is option three also.

Who are we, and what are we trying to do? Our group is an outgrowth of the Maceo Concerned Citizens Group. We formed our group because as citizens we were concerned about the site's impact in the long and short term on our environment, and on our local Community's economy. After studying the situation for some time, we also became concerned about the impact of the clean-up's costs on the financial well-being of some of the area's premier employers.

For the last two years, our purpose, as stated in our Mission Department, has been to encourage public participation in bringing about a prompt, cost effective and permanent solution of the highest quality of the Green River Disposal Superfund Site.

This involves working with the Potential Responsible Parties or companies and the United States Environmental Protection Agency, sharing knowledge, concerns and comments about the issues involved.

Our group's Mission Statement is available for you on the table. Our effort builds on the work begun by our neighbor, Mr. George Thompson, ten years ago.

As all of you who have attended our local citizens group meetings for the last two years know, we have had a continuous sharing of information between our group, the companies and the EPA during this time.

We have not always agreed. But we have always communicated. Those of you who attended all of our monthly meetings probably think we have communicated too much, and are tired of getting copies of all of our long letters back and forth with the EPA.

But if this proposal can be implemented next year instead of seven or eight years from now as originally proposed, it will all have been worth it.

Where did this proposal come from and what will happen next? This remedial investigation feasibility study has been developed by consultants hired by the companies with oversight by the EPA.

We are happy to report that our group has been asked for input and some of our input is reflected in the report you see today. The EPA will consider the RIFS Report and the input here tonight, and next it will select what it feels is the optimum solution, balancing risks and economics, and then move on to the design phase.

It will call for bids for design of that solution. At a later stage, once the design has been approved, bids for implementing the solution will be solicited. Then construction will begin.

What do we think about this proposal? We have always believed the main threat from this dump was water contamination. To us, the dump material is sort of like toxic coffee grounds, and the leachate, which is the stuff running out of the dump, is like coffee.

We have always said, if you put a good clay tea cup upside down over the grounds so the water can't percolate through them, you stop making coffee.

We think the composite barrier can be that tea cup. Then if you filter and treat the bad coffee so it is safe to drink, and if the material that spilled from the dump as sediment is picked up and put back under the clay cup, you have done about all you can do.

We understand this is the solution proposed here by the EPA. We endorse the solution published in the EPA's Notice. Naturally, we want to see the design to make sure it really is the best tea cup to keep the water out and really will do a good job of covering the bad material.

We have always urged an expedited approach with each step taken being a part of a final solution. We have always opposed steps, even as a temporary solution, like pumping the leachate up the hill and letting it recirculate through the dump in a loop, which is what has been going on for the last several years.

This type of response only delays facing the problems and permits the pollution to increase its damage to the environment as rainfall adds to the water going through the soup. The steps we see proposed here tonight are moving toward a solution.

Is this study perfect? We have questions about certain aspects of the ground water flow, but even if we are right, a properly deisnged cap is still the best answer. If this proposal is accepted, what remains is to see it properly designed and implemented, in a prompt high quality manner.

When you consider that the problem and the need to clean it up was pointed out clearly by Mr. George Thompson in 1984, ten years ago, you can see what a struggle it has been and why we fear the struggle isn't over yet.

Why do we favor the EPA published proposal? Given the reasonable alternatives, we feel this proposal best meets the test of being a prompt, cost effective, permanent fix of the highest quality.

This proposed solution of capping the dump site with a composite barrier cover consisting of clay and a geomembrane, coupled with pump and treatment of the leachate pool, is clearly what we have believed in from the beginning, and represents the best realistic solution for the environment, the Community and the companies.

We believe strongly in a maximum

quality cap as it will tend to degrade gracefully. We believe that in evaluating the proposed remedial actions, of key importance are the total short and long term costs of such actions, including the costs of operation and reality of long term maintenance.

We favor the treatment of the leachate because it reduces the volume of the hazardous substances and lessens the likelihood of its escape.

Placing the sediment back under the well-designed cap places all the problem material in one place, where if there are further problems, it will be easy to locate and deal with.

Why is speed important? Everybody is losing by delay. The longer we wait, the more leachate is built up, or escapes, and the environment suffers by delay.

Our Community and the adjoining landowners remain under a cloud of uncertainty as to the safety and value of our Community as a place to live and do business.

The companies' expenses at this site increase greatly by delay. Remember, the public, as consumers and stockholders and wage earners, will ultimately pay the companies' expense.

No one is winning by delay except the paper pushers. While it was not mentioned in the EPA Information Sheet, in addition to the five million dollars spent on testing and containment, and the ten million dollars proposed for a clean-up, well over five hundred thousand dollars has been spent on EPA oversight to date.

The companies are paying every dime spent. Even all of the EPA expenses. These clean-ups are very expensive. At this site, we are talking about a million dollars per acre.

Expeditious action tends to hold these costs down. The four companies listed are some of our area's premier employers, and benefit our Community in many ways.

They have assumed large financial burdens in undertaking this clean-up. Their sound financial health is important to us locally, and nationally.

These companies must compete nationally and internationally, and cannot afford large unproductive expenses. We have no desire to see these companies unnecessarily injured.

We are especially glad to see the EPA try an expedited solution of implementing a common sense solution to the problem now and monitor the results.

They call this common sense approach a presumptive remedy. The alternative is studying the site for years in search of some theoretically perfect solution while the pollution spreads and becomes more difficult to clean up. We want this site expedited.

How did we get in this mess? Probably this material shouldn't have been dumped here in the first place, considering the soil type and the folks running the dump shouldn't have been doing it the way they were.

It may have been legal and a commonly accepted business practice at the time, but it was short-sighted. However, hindsight is always perfect. This is history, and we have to do the best we can now for the future generations.

Is the problem permanently solved now? While this proposal puts us on the right path, we are not at the end of the journey. It is important to all of us to be sure this really is the best tea cup we can find to do the job.

I urge support for these proposals and their expedited implementation. We also ask your continued involvement in helping making sure they are implemented in a way that will protect our environment and future generations. Everyone knows things go better when someone is watching. Help us watch.

MR. YOUNG: Now I am going to go ahead and open the floor to questions. But first I would like to lay some ground rules. We have a court reporter who is taking down every word that is said, so for the sake of the court reporter, if you could, stand up, speak very clearly and very slowly. State your name and if the name is difficult to spell, please spell it for us, so we have an accurate record of the comments you make.

We would also like to kind of limit the number of questions to two every time I call on you, because what we would like to do is get everybody involved. We don't want any particular group to monopolize the time.

What I would like to do, if you have more than two questions, ask those two first and then I will get back to you as soon as we have given everyone else an opportunity to ask. So with that, I will go ahead and open it up for questions. Does anybody have any questions? Yes?

MR. TIM GOETZ: My name is Tim Goetz. I was just curious, is there any background wells drilled outside of the area to help determine if there were metal found in the ground water?

MR. YOUNG: Yes, we do have some background wells and metals show up in the well as well, so that's what we want to establish clearly, whether or not they are coming from the landfill or naturally occuring.

MR. GOETZ: And I have one more question about the leachate collection. I am assuming it is going to be below the cap?

MR. YOUNG: Right.

MR. GOETZ: Will the leachate eventually stop producing?

MR. YOUNG: Correct, over time. If you understand how leachate is generated, it is generated from the storm water that permeates waste, so over time we expect there would be no leachate.

After the cap is built and we prevent water from percolating through the waste, there is not going to be any leachate coming up. So we expect in the first year or two years to treat the water leachate, but after that period of time it will drop off significantly, so over a long period of time there will be essentially no leachate.

Anyone else? I know this takes a little bit of time before you feel a little bit more comfortable. I know there are a lot of questions out there. Yes?

MR. GEORGE HAWES: My name is George Hawes. I would like to know, number one, who is going to do the detailed engineering design, and number two, will we get a chance to review those design drawings before the contract is awarded to do the work?

MR. YOUNG: Yes. Like I said, we are working with the current potentially responsible parties that did the investigation. We are currently working with them to have them begin the design work. They will select the contractor that has experience and is competent in landfill design and construction to do that work.

EPA really has no input as to who those contractors are. The only rule that we have is to be sure the contractor is competent and experienced.

MR. HAWES: I am talking about the engineering drawings, the detailed engineering drawings.

MR. YOUNG: Yes, the detailed engineering drawings, as well as the construction both, the responsible parties will be responsible for doing that.

MR. HAWES: Will we get to review them before the contract is awarded?

MR. YOUNG: I don't know, because the contract needs to be awarded first, and then the drawing will be done.

MR. HAWES: You do the design first and then award it?

MR. YOUNG: Well, there is a bid package that goes out to the contractors, and the contractor is chosen, and correct me if I am wrong, Mike.

MR. MIKE MILLER: We will put out a request proposal and we will do design according to Patsy and rest of her group; that we have no problems with having them review the design as we proceed along. When that design is finalized by EPA, it will be prepared in a bid package before construction.

Just for the record, my name is Mike Miller.

MR. YOUNG: Any other questions?

MS. BRENDA PAYNE: Once construction is started on the site, how long will it take to get it finished?

MR. YOUNG: The actual construction of the cap and leachate and all of that I anticipate won't take longer than a few months, say six months. I don't know exactly. I can't tell you exactly how long it is going to take because I don't know what the design is, and I don't know what the plans are for implementing that design, so I can't tell you exactly how long it is going to take, so I know certainly within a few months during the construction period, during the summer months, maybe Mike has a better idea.

MR. MILLER: Mike Miller again. I agree it should be done in one construction season, but it depends on what kind of design it is. As you can see, we have just gone through the dry months, and it has rained every single day.

You can't go out there and put down a clay cap when it is raining every day. You have to have the proper content to get the compaction of the clay. Hopefully, this is not the summer we will have next summer.

If we do, it may be delayed because of the rain.

MR. YOUNG: That's a very important point. The weather plays a very important role in this. The clay is very susceptible to weather conditions, and you don't want to lay it down when it is wet.

MR. HAWES: This clay cover, that is not coming from this area, or is it going to be brought in?

MR. YOUNG: We will try to get as much clay from the area as possible. We will look on the site itself first and get as much clay from the site as possible. The next thing is to look at areas close to the site so there is a possibility that there will be dump trucks coming in on Kelly Cemetery Road or Chestnut Grove Road for the clay, but we are going to try to get as much clay as we can from the site itself.

We don't want to disrupt the neighborhood with trucks coming in and out, and it's more costly to do so anyway, so we are looking as much as possible on-site and get as much material as we can from right there.

Any other questions? Well, we are going to be around. I am going to be here until everybody leaves, so if you want to continue talking about it, I will be here to answer any questions that you may have, and you are welcome to come up here and look at the samples I have of the geomembrane, and also look at the aerial photograph, and please, if you haven't gotten a copy of the proposed Fact Sheet on the table there, I would recommend looking at that and also making a trip out to look at the Administrative Record.

I want to thank everybody for being here tonight and I will be around to answer any questions you have. Thank you.

REPORTER'S CERTIFICATE

STATE OF KENTUCKY)
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STATE AT LARGE)

I, James A. Joplin, Registered Professional Reporter and Notary Public, State at Large for the Commonwealth of Kentucky, do hereby certify that I reported the foregoing proceedings at the time and place set forth in the caption hereof, and thereafter I reduced the same to typewritten form, and the foregoing 45 pages, including this page, constitute a true, correct and complete transcript of said proceedings.

This the 14th day of August, 1994.

James A. Joplin
Registered Professional Reporter
Notary Public, State at Large

My Commission Expires: 8/9/97.