TABLE 20

CONCENTRATION RANGES OF RADIONUCLIDES CHEMICALS IN STREAM SEDIMENTS
(concentrations in pCi/ml or pCi/g)

Radionuclide	Background[a] Sediments	Downstream of Site Area	Site Area Streams	MFDS Ponds and Weir
Tritium	<10	<10	<10-20	<10-70
K-40	8.0-16.0	12.0-30.0	17.0-22.0	12.0-21.0
Cs-137	<0.1-1.30	<0.1-0.10	<0.1	<0.1-0.40
Ra-226	0.90-2.50	1.50-2.40	1.70-3.70	0.60-1.10
Th-232	0.80-1.20	0.80-1.40	0.80-1.20	1.00-1.30
U-238	<2.0	<2.0	<2.0	<2.0
Co-60	<0.1	<0.1	<0.1	<0.1

a) Daniel Boone National Forest and Stream Sampling Station A (upstream of Site Area)

Volatile organic chemicals (acetone, 2-butanone, methylene chloride, and toluene) detected in sediment samples ranged from 5 ppb to 170 ppb. Semi-volatile organic chemical constituents (phthalate esters, phenol, phenanthrene, fluoranthene, and pyrene) ranged from 5 ppb to 1800 ppb. The highest concentration detected was phthalate esters. Phthalate esters were only detected in samples associated with surface water runoff from the Restricted Area and the probable source of the phthalate esters is the PVC used to cover the trenches. (See Tables 21 and 22 for concentration ranges of organics and inorganics, respectively, in stream sediment samples.)

5.1.5 - Air

Although an air quality investigation was not performed during the Remedial Investigation of the MFDS, atmospheric data is available for the site from 1983 to present. For the years 1983 to 1987, the average gross alpha, gamma, and beta concentrations measured at the air monitoring stations around the perimeter of the Restricted Area were three to five times lower than the maximum concentration permitted by Commonwealth regulations outside the Restricted Area for individual radionuclides. The average tritium activity measured at the air monitoring stations ranged from 240 to 3,000 pCi/m^3 during the years 1983 to 1986, and averaged 275 pCi/m^3 in 1987. For comparative purposes, the average tritium activity for 1987 is less than 0.2 percent of the maximum permissible concentration (200,000 pCi/m^3) for areas outside the Restricted Area. The highest average airborne tritium concentration measured at a single location during 1987 was 1,260 pCi/m^3, 0.6 percent of the average annual maximum permissible concentration.

The primary source of airborne radiation prior to 1987 was the evaporator system. (The site evaporator ceased operation at the MFDS in 1986). The trend of airborne tritium concentrations has closely followed the release of tritium by the site's evaporator system. Tritium concentrations measured at the air monitoring stations markedly decreased during 1983 and 1987 when the evaporator was not operating, and again in 1986 when the evaporator was operating at lower capacities. Other potential sources of airborne radiation are tritium transpired by trees, diffusion of tritium vapor directly through the trench cap, and the ascension of tritium-bearing gases escaping from trench sumps.

TABLE 21

CONCENTRATION RANGES OF ORGANIC CHEMICALS IN STREAM SEDIMENTS
(concentrations in ppb)

Organic Chemical	Background[a] Sediments	Downstream of Site Area	Site Area Streams	MFDS Ponds and Weir
Methylene Chloride	<5	<5-10	<5	<5
Chloroform	<5	<5	<5-10[j]	<5
Toluene	<5-75	<5-10	<5-5	<5
Acetone	<10-72	<10-170	<10-20	<10
2-Butanone	<10	<10-31	<10	<10
Di-n-octyl phthalate	<330	<330	<330	<330-1800
Dieldrin	<16	<16	<16	<16
Phenanthrene	<330	<330	<330	<330-510
Fluoranthene	<330	<330	<330	<330-410
Pyrene	<330	<330	<330	<330-380[j]

a) Daniel Boone National Forest and Stream Sampling Station A (upstream of Site Area)

j) Estimated value because of exceeding a data validation criterion, or below detection limit due to laboratory sample dilution.

TABLE 22

CONCENTRATION RANGES OF INORGANIC CHEMICALS IN STREAM SEDIMENTS
(concentrations in ppm)

Analyte	Background[a] Sediments	Downstream of Site Area	Site Area Streams	MFDS Ponds and Weir
Al	4800-8140	5820-8390	3750-8230	8000-11400
Sb	<12	<12	<12	<12-13
As	13.3[J]-38.9	10.8[J]-59.3	14.2-38.0[J]	<2-39.0
Ba	<40-96	<40-63	43-83	<40-230
Be	<1-1.5	1.3-2.6	<1-1.8	<1
Cd	<1	<1	<1	<1
Ca	<1000	<1000-18200	1250-30800	<1000-39900
Cr	14.3[J]-30.0	16.4-30.7	9.5-24.1	17.2-39.6
Co	<10-59.2	21.4-40	10.5-26.9	<10-65.0
Cu	8.6-27.3	23.2-54.9	23.2-46.7[J]	8.5-41.0[J]
Fe	4300-73200	36600-71300	22300-65400	22200-70700
Pb	19.4-42.1	9.8-30.7	21.2-23.9	<1-46.6
Mg	<1000	<1000-2310	<1000-5070	1240-3940
Mn	261-682	295[J]-999	330-784[J]	92[J]-3530
Hg	<0.04	<0.04-0.07[jn]	<0.04	<0.04-0.07[jn]
Ni	16-42.0	52[J]-86[J]	31-74[J]	14-48[J]
[illegible]	<1000-1570	<1000-1950[J]	<1000-1220[J]	<1000-1500[J]
Se	<1	<1	<1	<1
Ag	<2	<2	<2	<2
Na	<1000	<1000-1390	<1000	<1000-1490
Tl	<2	<2	<2	<2
V	28-76	62-109	39-81[J]	28[J]-66
Zn	55[J]-163[J]	177-297[J]	<4-236[J]	40-123[J]
Cyanide	<2	<2	<2	<2
Phenolics	<2	<2	<2	<2

a) Daniel Boone National Forest and Stream Sampling Station (upstream of Site Area)

j) Estimated value because of exceeding a data validation criterion, or below detection limit due to laboratory sample dilution.

jn) Estimated value and tentative identification.

SECTION 6.0 - SUMMARY OF SITE RISKS

As part of the RI/FS, an assessment of site risks was performed by the Maxey Flats Steering Committee (Committee) using existing site data and information gathered during the Remedial Investigation. The Committee's Appendix D to the Feasibility Study Report, and EPA's Addendum Report to the FS Report, may be consulted for a more in-depth explanation of both the process and results of the risk assessment for the Maxey Flats Disposal Site. The dose estimates presented in this section are median doses, unless otherwise noted. Additionally, the assumptions employed in the calculation of site risks and resultant dose estimates, provided in this section, are derived from the Committee's final, April 1991 risk assessment, unless otherwise noted.

The risk assessment identified the contaminant sources and exposure pathways which pose the greatest potential threat to human health and the environment and then evaluated the baseline risks associated with a No Action alternative; i.e., a scenario which assumed that the site would be abandoned. The risk assessment assumed exposure scenarios that involved (1) the degradation of the existing soil cap and the subsequent leaching and transport of radionuclides offsite, and (2) individuals trespassing and establishing residence at the site.

Potential contamination sources at the MFDS were determined to include trench material, leachate, site structures, above-ground tanks, ground surfaces, ground water, and soil. Potential routes of exposure to contaminants, called exposure pathways, were developed based on both the current site conditions and future, potential pathways typically examined in a public health evaluation. For the MFDS, two sets of potential pathways were evaluated - intruder (on-site) pathways and non-intruder (off-site) pathways. For the intruder scenario, it was assumed that the site would be abandoned and an individual would occupy an area of the site which is currently known as the Restricted Area. The non-intruder scenario, like the intruder pathways, assumed the site would be abandoned, but involved pathways (primarily off-site pathways) other than those associated with occupying the site.

Of the contaminants identified at the MFDS, two sets of contaminants representing the greatest potential for impacting human health, called indicator contaminants, were developed. Table 23 identifies the two groups of indicator contaminants selected for the Maxey Flats Disposal Site, radionuclide and non-radionuclide indicators.

TABLE 23

INDICATOR CONTAMINANTS

Radionuclides	Non-Radionuclides
Hydrogen-3 (Tritium)	Arsenic
Carbon-14	Benzene
Cobalt-60	Bis(2-Ethylhexyl) Phthalate
Strontium-90	Chlorobenzene
Technetium-99	Chloroform
Iodine-129	1,2-Dichloroethane
Cesium-137	Lead
Radium-226	Nickel
Thorium-232	Toluene
Plutonium-238	Trichloroethylene
Plutonium-239	Vinyl Chloride
Americium-241	

6.1 Off-Site Exposure Scenario

The pathways evaluated for the off-site exposure scenario are listed in Table 24, and described below. In order to evaluate the potential off-site exposure scenario, it was assumed that the site was abandoned and no measures are in place to control or mitigate site releases. Approximately 10% of rainwater was assumed to penetrate deep into the trenches and leach radionuclides from the waste. The contaminated rainwater was assumed to percolate down into the strata underlying the trenches and migrate laterally beneath the trenches to the MFDS hillslopes. From here, the contaminated water was assumed to partially evaporate and partially to be transported down the hillslopes to the valley below. As a result of evapotranspiration, tritiated water becomes airborne and is transported off-site to receptor locations.

6.1.1 - Well Water Pathway

The off-site well water pathway includes the following assumptions:

- A drinking water well in the alluvium becomes contaminated; leachate migrates in ground water from the trenches through the Lower Marker Bed (LMB), lower Nancy and Farmers Members to the hillslope; migration down the hillslope is via surface water runoff in washes; dilution by surface runoff water, evapotranspiration losses on the hillslope, infiltration into the alluvium at the bottom of the hillslope, and dilution in the alluvial ground water by additional recharge and upstream ground water occur.

- The MFDS and surrounding area are divided into eight sub-basin drainage areas, which carry different proportions of runoff and contaminants and are analyzed individually for contributions to alluvial ground water in the stream valleys.

- Individuals use a well in the alluvium for drinking water over a lifetime and consume two liters per day.

- No contaminants migrate via ground water through the colluvium, soil, or bedrock into the alluvial aquifer.

- Radioactive decay reduces radionuclide concentrations over the estimated travel time for the pathway.

TABLE 24

OFF-SITE (NON-INTRUDER) PATHWAYS

- Well Water Pathway -- involves the movement of contaminants in ground water to the hillsides adjacent to the site and into the surface water system moving down the hillsides. At the bottom of the hillsides, the contaminated runoff recharges the alluvium (soils). A well is excavated in the contaminated alluvium and a family uses the well as a source of drinking water.

- Surface Water Pathway -- in this pathway, contaminants move off-site in ground water and enter the surface water system. The stream water is then used as a drinking water and irrigation source for beef and milk cows and their forage. Humans then ingest the animal products.

- Soil Erosion Pathway -- this pathway actually is a combination of pathways. It involves the resuspension in air of soil particles contaminated with radionuclides and the washing of soil into the surface water. It is assumed that the trenches overflow with contaminated liquids. Dry contaminated soil is then suspended in air and carried to a person and inhaled or washed away in runoff. Also, crops are grown in the alluvium contaminated by surface runoff. A person ingests contaminated farm products and is exposed to external radiation.

- Sediment Pathway -- involves the movement of contaminants in ground water to the hillsides adjacent to the site and into the surface water system (streams). As the contaminated surface water moves through the stream bed, some of the contaminants adhere to the soils in the stream bed. Through the course of play in the stream beds, a child ingests the contaminated soils.

- Deer Pathway -- Contaminated water moves through the ground water system to the hillsides adjacent to the site. Upon reaching the hillside, the contamination is incorporated into plants. The contaminated plants are then eaten by deer foraging on the hillslopes. Also, the deer drink contaminated water from the streams. The contaminants are then incorporated into the meat of the deer. A hunter kills the deer and ingests the meat.

TABLE 24 (Continued)

OFF-SITE (NON-INTRUDER) PATHWAYS

- Evapotranspiration Pathway -- this pathway involves the uptake of contaminated liquid into plants; the liquids are released from the plants to the environment. Tritium is the only contaminant to move by this pathway. Once released to the air, the tritium could be incorporated into food and drinking water sources or directly inhaled by a human.

- Trench Sump Pathway -- This pathway involves the escape of tritiated water from trenches via trench sumps and cracks in the trench cap. A person then inhales the contaminated air.

- Radionuclides and other contaminants are subject to retardation by sorption effects.

Figure 12 illustrates the projected extent of potentially contaminated alluvium, under a No Action alternative, used in evaluating exposures associated with the well water pathway.

6.1.2 - Surface Water Pathway

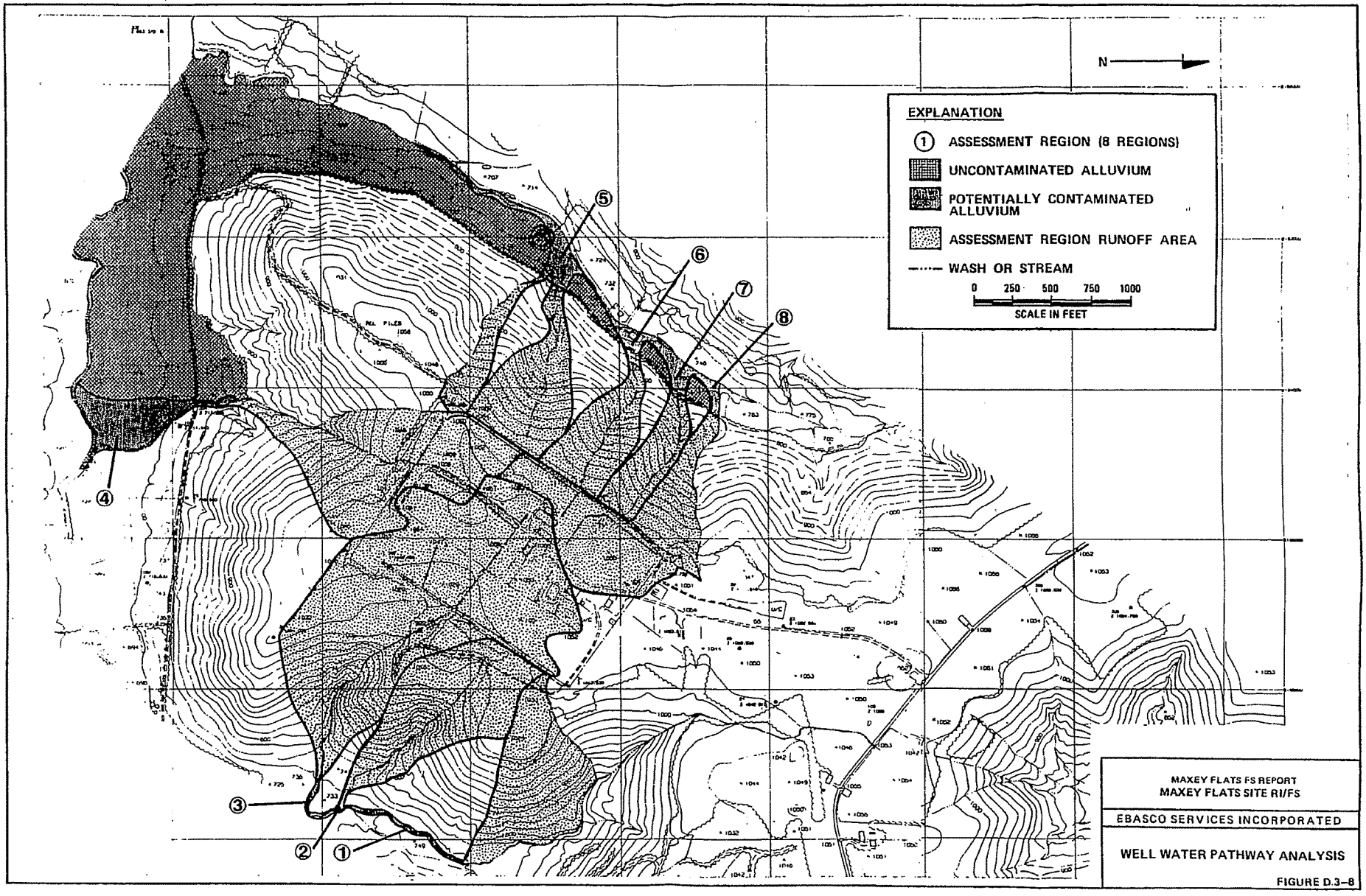
This pathway begins in the same manner as the well water pathway; that is, contaminated runoff travels down the hillslope. However, unlike the well water pathway, where the flow is divided into eight regions, all the radioactivity is assumed to be deposited into a creek, and the creek water is used as a source of drinking water for livestock. In addition, grass in the vicinity of the creek is ingested by the livestock. Humans then ingest the contaminated milk and beef.

6.1.3 - Erosion Pathway

Another pathway included in the off-site exposure scenario is the erosion pathway. The erosion pathway assumed that, without erosion controls, surface and hillslope soil will be transported to the alluvial valley. The analysis is based on the assumption that no steps are taken to prevent the "bathtub" effect or to protect the overlying soil from erosion. As a result of the "bathtub" effect, leachate is assumed to rise up periodically, saturate the overlying soil, and overflow the trenches. The overlying soil thereby becomes contaminated and, when eroded down to the alluvial valley, becomes a source of exposure to individuals living in the valley.

The erosion pathway actually consists of a subset of pathways which include the following: (1) direct radiation from living on contaminated alluvium, (2) the ingestion of contaminated surface water, (3) the ingestion of vegetables grown in contaminated alluvium, and (4) the ingestion of beef and milk obtained from cattle and milk cows raised on water obtained from the creek and fodder from the contaminated alluvial plain.

The drinking water pathway of the erosion pathway is based on the assumption that an individual obtains all his drinking water from a local creek. Doses from the ingestion of vegetables are based on the assumption that all vegetables are obtained from gardens located on the contaminated alluvium. Similarly, milk and beef doses are based on the assumption that the cattle and cows obtain all their drinking water from the creek and fodder


N
EXPLANATION
1 ASSESSMENT REGION (8 REGIONS)
UNCONTAMINATED ALLUVIUM
POTENTIALLY CONTAMINATED ALLUVIUM
ASSESSMENT REGION RUNOFF AREA
WASH OR STREAM
0 250 500 750 1000
SCALE IN FEET
1
2
3
4
5
6
7
8
MAXEY FLATS FS REPORT
MAXEY FLATS SITE RI/FS
EBASCO SERVICES INCORPORATED
WELL WATER PATHWAY ANALYSIS
FIGURE D.3-8

from grass growing in the contaminated alluvium. The doses also include direct radiation from continual exposure from living on contaminated alluvium. These doses were based on the assumption that the contamination is an effective infinite plane, with no credit taken for shielding.

The exposures associated with the erosion pathways were performed for a range of time periods that reflect a decaying source term and a changing erosion rate. The results of the analyses for the upperbound estimate for the erosion pathway are presented in Table 25. EPA believes that the upperbound estimates are the appropriate values associated with the erosion pathway due to the number of uncertainties in the erosion pathway analysis. See Section 6.3 - Risk Uncertainties, for a discussion of risk assessment uncertainties.

6.1.4 - Sediment Pathway

Another off-site pathway evaluated in the MFDS baseline risk assessment was that of a child ingesting contaminated sediments. Contaminants travel to the hillslopes and into the surface water system. As the contaminated surface water moves over the stream beds, some of the contaminants adhere to the sediments of the stream bed. Then, through the course of play in the stream beds, a child ingests 0.7 grams of contaminated sediments per day. It was assumed that the sediments are approximately 50% water, which contains tritium at the same concentration as the surface water.

6.1.5 - Deer Pathway

This pathway involves the migration of contaminants to the hillslopes. Upon reaching the hillslopes, the contamination is incorporated into plants. Approximately 150 kilograms/year of contaminated plants are then eaten by deer foraging on the hillslopes. Also, the deer drinks 3650 liters/year of contaminated water from the streams. The contaminants are then incorporated into the meat of the deer. A hunter kills the deer and ingests 5 kilograms of deer meat per year.

6.1.6 - Evapotranspiration Pathway

This pathway involves the uptake of contaminated liquids into plants. Through the process of evapotranspiration, which is the release of water vapor from the plants to the atmosphere, tritium is released to the air and incorporated into food and drinking water sources, or directly inhaled by a human. Tritium is the only contaminant to move by this pathway.

Table 25

EROSION PATHWAYS

PATHWAY	DOSE (MREM/YEAR)
External Exposure	160
Drinking Water	440
Vegetables	11
Milk	1.4
Meat	1.9

6.1.7 - Trench Sump Pathway

This pathway involves the escape of tritiated water from trenches via trench sumps and cracks in the trench cap. A person then inhales the contaminated air. Tritium is the only contaminant to move by this pathway.

6.1.8 - Conclusions of the Off-Site Exposure Scenario

The results of the risk assessment revealed that, for off-site exposure pathways, tritium is the critical radionuclide. The well water pathway is, by far, the dominant off-site pathway. If no action is taken at the site, the total dose equivalent from all indicators from all combined off-site pathways to individuals would be 75 mrem per year for the average case, almost half of which is attributable to tritium. The upper bound estimate of exposure from such a scenario would total 4300 mrem per year. For each year of exposure under a No Action alternative, it is estimated that the lifetime risk of fatal cancer would be 3×10^{-5} for the average case (75 mrem) and 1.7×10^{-3} for the upperbound case (4300 mrem). (EPA's target risk range is 1×10^{-4} to 1×10^{-6} which equates to one additional cancer in 10,000 for 1×10^{-4} and one additional cancer in 1,000,000 for 1×10^{-6}.)

The lifetime risk of cancer from prolonged exposure (many years of exposure) from off-site pathways would be approximately 1×10^{-3} (average case) and 6×10^{-2} (upperbound case). The well water pathway contributes the single highest dose among pathways, with soil erosion contributing almost all of the remaining dose. Both the average and upper bound estimates of off-site exposure exceed the MFDS remediation goal of 25 mrem per year for the entire site.

During the 70-year timeframe (the period of time typically used in evaluating risks at Superfund sites) for a No Action alternative, tritium and strontium-90 would exceed drinking water limits in water extracted from wells located at the base of the hillslopes and the 4 mrem/yr Maximum Concentration Limit for beta activity would be exceeded.

Over the 500-year time frame (which is a more lengthy period of time than typically used at Superfund sites, but necessary due to the presence of long-lived radionuclides at the MFDS), tritium, strontium-90, and radium-226 would exceed the drinking water limits in water extracted from wells located at the base of the hillslopes during the initial part of the 500-year timeframe, before tritium and strontium-90 have decayed away.

6.2 On-Site Exposure Scenarios

Table 26 lists the on-site (intruder) pathways evaluated in the MFDS baseline risk assessment, as described below. Evaluation of the on-site exposure scenarios involved the assumption that the site is abandoned and no institutional controls are in place to prevent site access.

For the intruder scenarios, which consist of a number of exposure pathways, a broad range of potential on-site exposures were evaluated in order to gain insight into the full range of potential impacts of the site and how those impacts may change with time.

It is unlikely that the Intruder-Discovery, Intruder-Construction, and Intruder-Agriculture scenarios could occur today or in the immediate future; however, these scenarios were included in the risk assessment to characterize fully the range of potential exposures that could be associated with the site. As time passes, these scenarios would become more likely.

6.2.1 - Intruder-Trespasser Scenario

Under the Intruder-Trespasser Scenario, a trespasser who occasionally gains access to the site would be exposed to direct external radiation and perhaps the inhalation of radioactive particulates that may become airborne through suspension processes. In addition, it is likely that the trespasser would also be exposed to airborne tritiated water vapor due to the evaporation of leachate.

6.2.2 - Intruder-Discovery Scenario

This pathway involves the assumption that no controls exist for the site and an intruder inadvertently occupies the disposal site and begins construction activities. The intruder contacts solid remains of waste or barriers, realizes that something is wrong, and ceases construction activities. Human exposure to radiation is assumed to result for a short time from external exposure to the contaminated soils and inhalation of contaminated air.

6.2.3 - Intruder-Construction Scenario

For the Intruder-Construction scenario, it is assumed that, in the scenario described for the Intruder-Discovery above, the construction worker continues construction activities. In the Intruder-Construction scenario, the builder is assumed to be exposed from the following pathways:

TABLE 26

ON-SITE (INTRUDER) PATHWAYS

- Intruder-Trespasser Scenario: This scenario involves the assumption that no controls exist for the site and a trespasser occasionally gains access to the site.

- Intruder-Discovery Scenario -- This scenario assumes that no controls exist for the site and an intruder inadvertently occupies the site and begins construction activities. The intruder contacts solid remains of waste or barriers, realizes that something is wrong, and ceases construction activities. Human exposure would occur through the external exposure to contaminated soil pathway and through the inhalation of contaminated air pathway.

- Intruder-Construction Scenario: This scenario assumes that, in the scenario described for the intruder-Discovery Scenario above, the construction worker continues construction activities. Construction activities penetrate and expose the waste. Human exposure would occur through the external exposure to contaminated soil pathway and through the inhalation of contaminated air pathway.

- Intruder-Agricultural Scenario -- This scenario involves the assumption that no controls exist for the site and an inadvertent intruder occupies the site. After some construction activities, the intruder (site resident) begins agricultural activities. It is assumed that some percent of the intruder's annual diet comes from crops raised in the contaminated soil and from food products produced by animals. External exposure and ingestion of contaminated ground water from a well are two pathways included in this scenario. It is also assumed that a quantity of contaminated soil is ingested by a child during play or an adult at work in the fields. Inhalation of resuspended contaminated soil and the migration of radon into the intruder's basement are additional pathways of the Intruder-Agriculture Scenario.

- Direct Gamma - Direct radiation from standing in the excavated hole.

- Suspension of Particulates from Construction - Inhalation of particles suspended during construction, external exposure from suspended particulates, and exposure to an area source consisting of particles deposited on the soil following suspension during construction.

- Airborne tritium - Inhalation and skin absorption of airborne tritiated water vapor.

6.2.4 - Intruder-Agriculture Scenario

The Intruder-Agriculture scenario was based on the assumption that an individual builds a home and lives on the site beginning today. It was also assumed that the intruder obtains his food locally and sinks a well into the aquifer underlying the site to obtain drinking water. In the Intruder-Agriculture scenario, the intruder is assumed to live in the house, plant a garden in soil excavated from the waste disposal site during construction, use water from an on-site well, and raise cattle and milk cows on the contaminated soil at the site. In addition, a child in the family is assumed to ingest contaminated soil, and products of radon decay are assumed to build up indoors due to the radium contamination in the waste.

6.2.5 - Conclusions of the On-Site Exposure Scenarios

For the Intruder-Trespasser scenario, the direct external radiation dose rate to a person standing on the trenches depends on whether the soil overlying the trenches is intact and uncontaminated. If the overlying soil becomes contaminated as a result of the "bathtub" effect which is known to occur at the site, the shielding effectiveness of the overlying soil is markedly reduced, resulting in dose rates up to approximately 1.4 mrem/hour. If it were assumed that the trespasser frequents the site, on the average, once per week, spending one hour per visit, the resultant dose from the Intruder-Trespasser scenario would be approximately 73 mrems/year.

If the overlying soil is contaminated as a result of the "bathtub" effect, wind and mechanical erosion processes could cause contaminated soil particles to become airborne. Once airborne, they could cause internal exposures due to inhalation and also external exposures from immersion in the airborne particulates.

Individuals standing in the vicinity of the trenches would likely be exposed to airborne tritiated water vapor. If the trench cap degrades and/or the trench leachate overflows, evaporation processes will result in airborne tritiated water vapor. The dose to a trespasser from airborne tritiated water vapor is presented in Table 27.

For the Intruder-Construction scenario, the results revealed that if a home were constructed at the site today, the dose to the construction worker over the 500 hours required for construction is estimated to be 3.2 rems and the lifetime risk of fatal cancer is approximately 1.2×10^{-3}. Most of this dose and risk is due to direct radiation, primarily from cobalt-60, cesium-137, and radium-226. The doses associated with the Intruder-Discovery scenario are substantially less than the Intrduer-Construction scenario due to less duration of on-site activities.

If a 100-year period of institutional control[5] is assumed, the dose and risk to a construction worker at the site decrease by about an order of magnitude, to 320 mrem. The decrease is due primarily to the decay of cobalt-60 and cesium-137. However, direct radiation is still the major contributor to dose, though the dominant radionuclide is now radium-226.

After a 500-year period of institutional control, the dose and risk to the construction worker decrease further, but by less than a factor of about 2, to 210 mrem. Direct radiation is still the major contributor to dose, and radium-226 is still the dominant radionuclide.

For the Intruder-Agriculture scenario, the results revealed that if a person were to live in a home constructed directly over the waste trenches today, the dose equivalents to an adult from all pathways, not including radon, total 26,000 mrem per year for the average case, with the upperbound estimate totalling 1,000,000 mrem per year. Forty-three percent of the impact would be derived from drinking water, 47 percent from food produced on-site, and 10 percent from external exposure. Tritium, carbon-14, strontium-90, and radium-226 dominate the

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5 - As it is used here, institutional controls includes access restrictions such as fences, on-site personnel, land use and deed restrictions and maintenance activities such as fence repair and limited custodial maintenance and monitoring activities.

TABLE 27

EFFECTIVE DOSE EQUIVALENTS (MREM/HOUR) FOR TRANSIENT INTRUDER

Years Decay	1 Direct Gamma Waste	2 Direct Gamma Soil	3 Resuspension Inhalation[1]	4 Resuspension Immersion[2]
0	4.5E-04	1.4E+00	1.4E-01	4.9E-08
10	1.7E-04	1.3E+00	1.3E-01	4.5E-08
20	9.7E-05	1.3E+00	1.3E-01	4.4E-08
30	7.8E-05	1.3E+00	1.3E-01	4.4E-08
40	7.3E-05	1.3E+00	1.3E-01	4.4E-08
50	7.1E-05	1.3E+00	1.3E-01	4.4E-08
75	6.8E-05	1.2E+00	1.3E-01	4.3E-08
100	6.7E-05	1.2E+00	1.3E-01	4.3E-08
200	6.4E-05	1.2E+00	1.2E-01	4.3E-08
300	6.1E-05	1.2E+00	1.2E-01	4.3E-08
400	5.9E-05	1.2E+00	1.2E-01	4.3E-08
500	5.6E-05	1.2E+00	1.2E-01	4.2E-08

1 Major Contributors are Th-232 and Pu-238
2 Major contributor is Th-232

ingestion doses, with cobalt-60, cesium-137, and radium-226 dominating the external exposure.

For each year a person lives on-site, the average case lifetime risk of fatal cancer would be approximately 1×10^{-2}, or one in 100. Under the same scenario, the upperbound case lifetime risk of developing fatal cancer would be 4×10^{-1}, or four in 10. Both cases significantly exceed EPA's target risk range.

Prolonged exposures (many years of exposure) result in a lifetime risk of cancer approaching 1. The exposure to radon progeny was conservatively estimated to be 50 WLM per year, which corresponds to a lifetime risk of fatal lung cancer of close to 1.0.

If a period of 100 years of site institutional control were assumed before a person constructs and occupies a home on-site, the dose decreases and the longer-lived radionuclides such as radium-226, thorium-232, and plutonium-238 become the significant radionuclides. Tritium and strontium-90 no longer contribute to the dose because they have decayed away. Cesium-137 will have decayed to less than 90% of its original activity.

Assuming occupancy of the site does not begin for 100 years or more, the doses and associated risks decrease, but by only a small margin since most of the exposure is associated with the relatively long-lived radionuclides. If a 100-year period of institutional control is assumed, the dose associated with an intruder-agriculture scenario decreases by a factor of approximately 3, to 7.2 rem/year. Of this dose, the direct radiation exposures have declined by about a factor of 10, to 780 mrem/year, primarily due to the decay of Cobalt-60. Radium-226 is now the dominant source of external exposure. At 100 years, the lifetime risk of fatal cancer (not including radon progeny) due to continual exposure decreases to approximately 4×10^{-2}. The exposures and risks associated with elevated levels of radon progeny indoors decrease only slightly, as expected, given the long half-life of Radium-226.

If a 500-year period of institutional control is assumed, the dose decreases to 5.1 rem/year, and the risk (not including radon progeny) is approximately 3.1×10^{-2}. The reason for the small decrease is that the dose from drinking water is dominated by very long-lived radionuclides. If uncontaminated sources of drinking water are used, the dose is approximately 600 mrem/year. This dose is primarily due to direct radiation, which is dominated by Radium-226. The food ingestion pathways contribute less than 100 mrem/year.

Even after 500 years, on-site occupancy would result in risks exceeding the acceptable risk range. See Figures 13 and 14 for an illustration of the decay of radionuclide indicators with time. It can be seen that beyond 100 years the risks associated with the MFDS remain unacceptably high and tend to become constant rather than decreasing significantly; thus, the need for institutional controls, maintenance and monitoring to be implemented and funded in perpetuity is apparent.

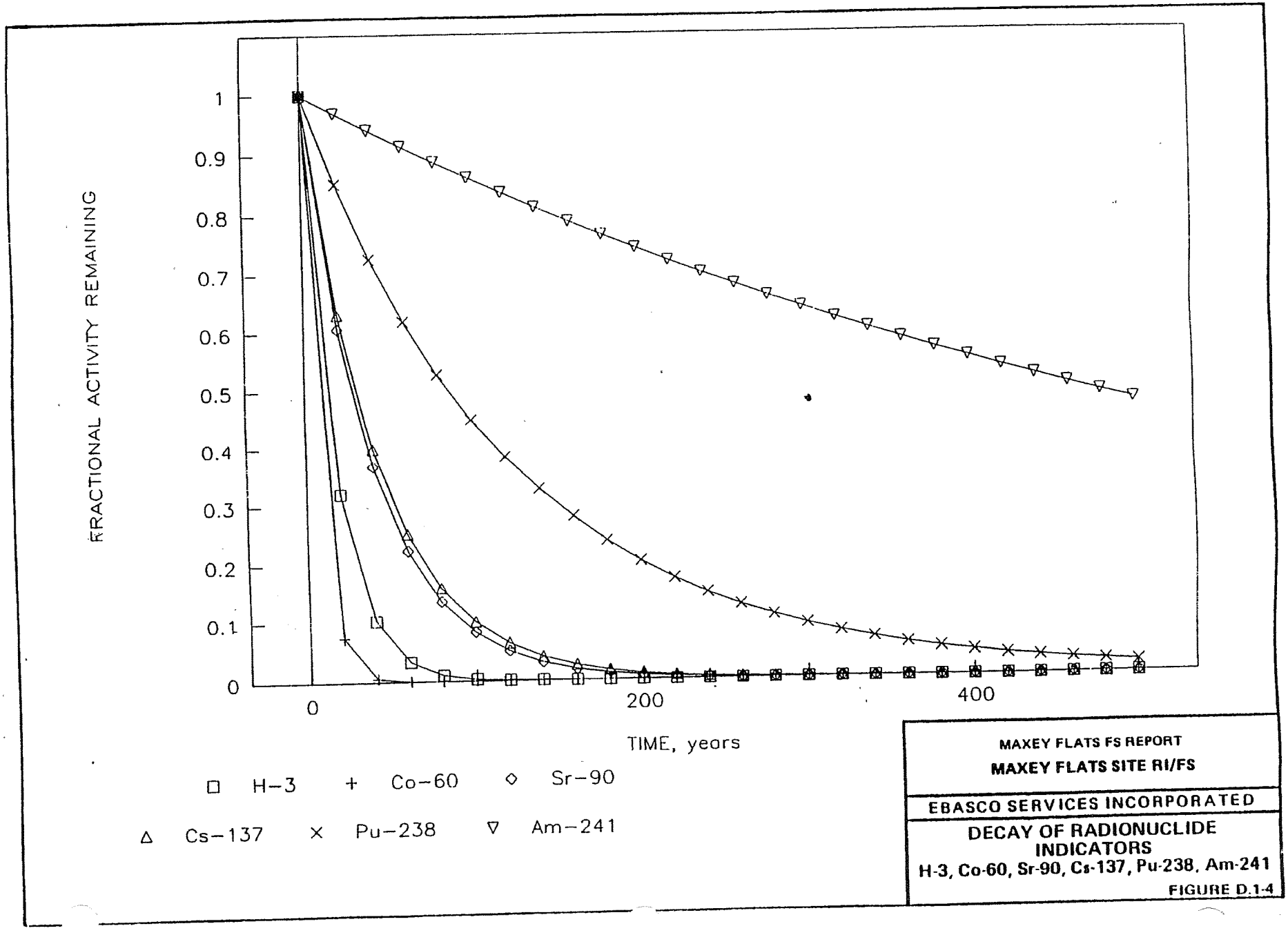
As the foregoing discussion demonstrates, the threatened release of hazardous substances from the MFDS, if not addressed by the preferred alternative or one of the other active measures considered, may present an imminent and substantial endangerment to public health, welfare, or the environment.

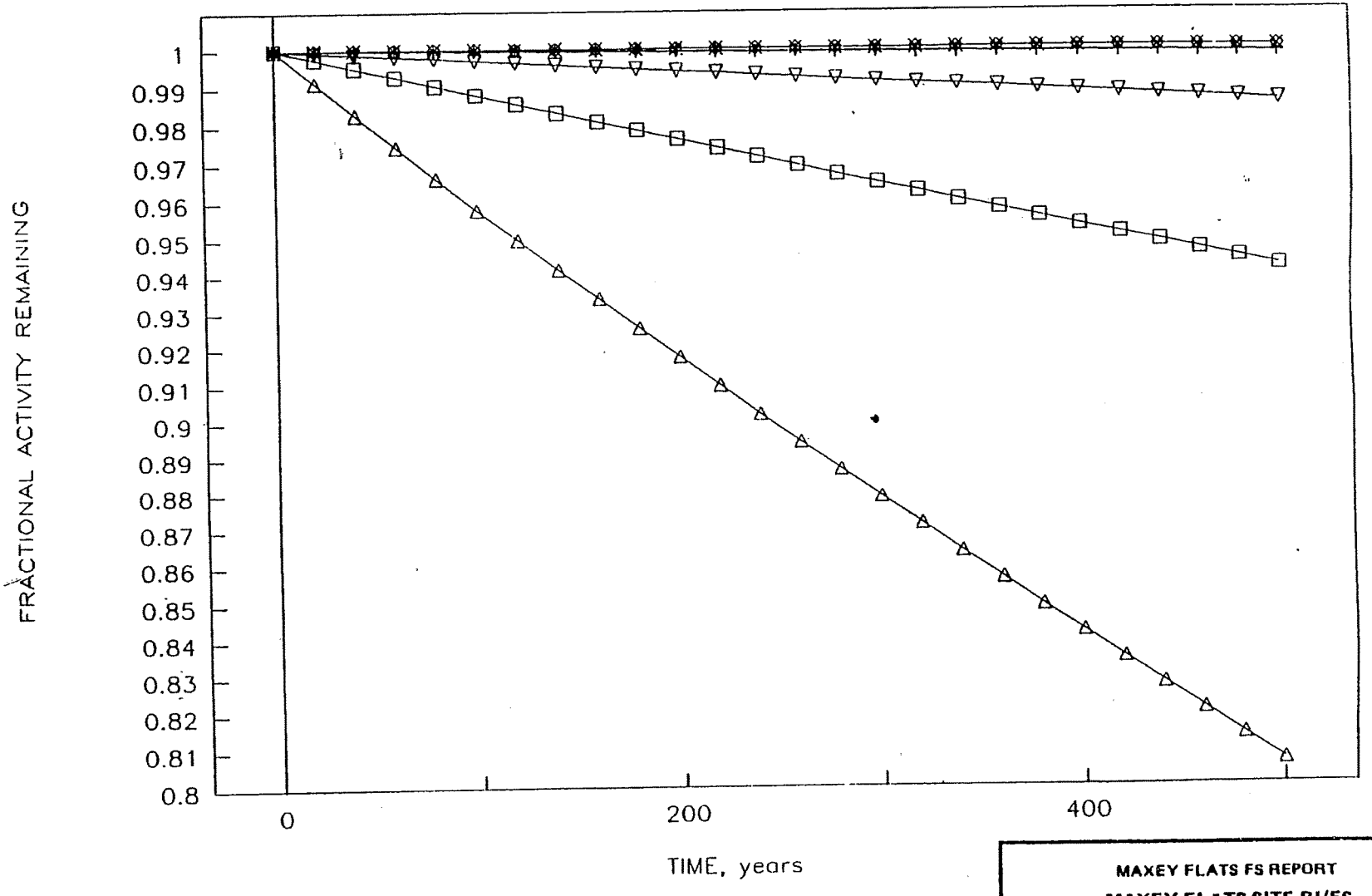
6.3 Risk Assessment Uncertainties

As with most baseline risk assessments, a number of uncertainties are associated with the MFDS risk assessment. The following discussion describes some of those uncertainties which may have led to an underestimation of the estimated exposures associated with some of the pathways evaluated:

In the April 1991 final risk assessment, in-transit decay is assumed for the transport of the radionuclides from the trenches to the receptor location. The in-transit time for water is assumed to be several years, and the transit time for many radionuclides is much longer due to the radionuclide binding coefficients. For some radionuclides, this in-transit decay assumption results in substantial decay. If the MFDS were to experience "bathtubbing" (trench overflow) conditions under a No Action scenario, the radionuclide transit time would be substantially reduced and, consequently, the concentrations of radionuclides reaching the potential receptors would be much greater.

Additionally, the magnitude of retardation for some of the radionuclides, such as plutonium and carbon-14, may have been overestimated in the risk assessment. Retardation of plutonium is complex and poorly understood. Plutonium is known to be fairly mobile under some conditions of valence, complexation, and colloidal suspension. Plutonium has also been shown to be in a micro-particulate form in the MFDS trench leachates rather than in a typical ionic solution state; this may make it more mobile. Plutonium has also been detected in ground water migrating away from the trenches in the LMB, indicating that plutonium is more mobile than would be indicated by the high Kd values assumed in the risk assessment. Thus, the risk


FRACTIONAL ACTIVITY REMAINING
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
200
400
TIME, years
□ H-3
+ Co-60
◇ Sr-90
△ Cs-137
× Pu-238
▽ Am-241
MAXEY FLATS FS REPORT
MAXEY FLATS SITE RI/FS
EBASCO SERVICES INCORPORATED
DECAY OF RADIONUCLIDE INDICATORS
H-3, Co-60, Sr-90, Cs-137, Pu-238, Am-241
FIGURE D.1-4



MAXEY FLATS FS REPORT
MAXEY FLATS SITE RI/FS

EBASCO SERVICES INCORPORATED

DECAY OF RADIONUCLIDE INDICATORS
C-14, Tc-99 I-129, Ra-226, Th-232, Pu-239

FIGURE D.1-5

assessment may have underestimated the doses associated with some of the off-site pathways, in particular, the erosion pathway. It is for these reasons that EPA feels that the upperbound dose estimates for the erosion pathway are appropriate.

The risk assessment assumes migration of leachate to the hillslope drainage channels with subsequent migration of leachate to the alluvium, quickly, via surface water runoff. However, it is likely that leachate will also migrate down the entire hillslope through the shallow soil-colluvium layer and enter directly into the alluvial aquifer without major dilution from uncontaminated surface water. The risk assessment also assumes that a significant portion of alluvial ground water is recharged and diluted by stream water. A more appropriate assumption is that no recharge filtration from upstream water occurs to the band of contaminated ground water passing through the alluvium to the creek. This is more appropriate because, in the MFDS hydrogeological environment, alluvial ground water flows from the alluvium into the creek (rather than the reverse, as was assumed in the risk assessment). These factors, as well as the points made previously with regard to the in-transit decay and retardation factors, may have resulted in an underestimation of the potential doses associated with the off-site well water pathway.

The following uncertainties may have led to an overestimation of the exposures associated with some of the pathways evaluated:

The average case values for the Intruder-Agriculture well analysis are all greater than the maximum concentrations detected in the Remedial Investigation (RI) well sampling, with the exception of tritium. The tritium data from the RI may have been skewed by a well near a trench with very high tritium concentrations. Additionally, trench leachate data is also skewed toward high concentrations of certain radionuclides, since specific trenches were targeted during the RI because of the elevated radionuclide concentrations. Since the generation of leachate is a major component of most of the pathways modeled in the risk assessment, the model results may be conservative compared to previous field measurements.

The impacts for individual pathways for the 500-year timeframe are the sums of all radionuclides that impact the receptor at any time during that 500 year span. In other words, impacts seen from tritium in the early part of the time frame are added to those from radium-226, which are seen at the end of the time frame. This approach tends to overestimate the total dose, which is used to estimate exceedance ratios.

The I-129 source term has probably been significantly overestimated in the risk assessment. The source of three curies for the MFDS is based on the assumption that I-129 was at its detection limit in the waste. Preliminary results of a recent study indicate that the I-129 source could be as much as 1000 times lower than its detection limit in low-level radioactive waste. The industry is still uncertain about the I-129 source term in low-level waste. However, since I-129 does not contribute significantly to the impacts estimated at the MFDS based on the three curie value, there is no real effect of adopting the overestimate.

Another uncertainty deals with the B_{iv} value for carbon-14. A recent study has shown that the B_{iv} for carbon-14 reported in Regulatory Guide 1.109 is as much as 50 times too high. However, the traditional value was employed in the MFDS risk assessment. It was thought that the traditional value would be used until the recent work becomes more widespread. As a consequence, the dose for carbon-14 from the ingestion of plants and deer meat may be overestimated.

SECTION 7.0 - DESCRIPTION OF ALTERNATIVES

7.1 Remedial Action Objectives

As previously discussed, the primary mechanism for release of contaminants to the environment from the MFDS is the migration of leachate from the disposal trenches, through the underlying, fractured bedrock, to the hillslopes surrounding the site. The major cause of leachate generation is the infiltration of precipitation through the subsided trench cover. Historically, trench leachate pumping operations at the MFDS have been necessary to address trench overflow conditions; thus, trench overflow is a pathway of concern as well.

Trench subsidence is the lowering of the trench caps due to trench waste consolidation over time. Areas affected by subsidence can range in size from a few square feet of a cap to the entire area of a trench or group of trenches. Subsidence can cause cap failures by cracking or deforming of the cap materials. Depressed areas commonly result in ponding of rain water, which would have run off naturally if subsidence had not occurred. Both subsidence and ponding can lead to increased rates of water infiltration into the waste. Subsidence is evident in most waste disposal trenches. After a few years, therefore, soil must be added to the trench surfaces and the caps must be regraded to maintain surface water runoff.

The objectives of remedial action at the MFDS are to:

- Minimize the infiltration of rainwater and ground water into the trench areas and migration from the trenches;
- Stabilize the site such that an engineered cap that will require minimal care and maintenance over the long term can be placed over the trench disposal area;
- Minimize the mobility of trench contaminants by extracting trench leachate to the extent practicable;
- Promote site drainage and minimize potential for erosion to protect against natural degradation;
- Implement institutional controls to permanently prevent unrestricted use of the site;
- Implement a site performance and environmental monitoring program;

As with any remedial action under Superfund, these objectives must be met in ways that are protective of human health and the environment and achieve applicable or relevant and appropriate federal and state requirements.

7.2 Alternatives

Eighteen potential remedial alternatives to achieve the remedial action objectives for the MFDS were developed and evaluated during the FS. These 18 alternatives were then screened on the basis of their effectiveness, implementability and cost. This screening produced a manageable group of seven alternatives. Each of the seven alternatives was then subjected to a detailed analysis which applied the nine evaluation criteria established by the Superfund Amendments and Reauthorization Act (SARA).

The No Action alternative, which is required to be evaluated at all Superfund sites, serves as a baseline for comparison against the other alternatives and must be carried through the detailed analysis of alternatives. The No Action alternative is not an action-based alternative but rather consists solely of monitoring and activities in support of monitoring.

With the exception of the No Action alternative, each of the alternatives evaluated incorporates technologies for trench stabilization as well as horizontal and vertical flow barriers. These technologies are discussed in the following sections.

7.2.1 - Stabilization Technologies

Stabilization at the MFDS refers to the consolidation and densification of trench soils and/or waste materials. The purpose of stabilization at the MFDS is to achieve trench stability such that a vertical infiltration barrier (cap) can be placed over the trench disposal area which requires minimum repair and maintenance over the long term.

The dynamic compaction technology is a stabilization method common to Alternatives 4, 10, and 17. The dynamic compaction technology involves the repeated dropping of a large weight on each trench cover (except for those trenches where it is not appropriate) until the waste and trench cover are sufficiently consolidated. The weight, or tamper, is dropped using a crane specially designed for that purpose. As the trench contents densify, backfill soil is added to the resulting depressions. The backfill soil is then compacted so that a stable cap can be constructed over the compacted trenches.

The natural subsidence technology is common to Alternatives 5 and 8. Natural subsidence is the natural densification and consolidation of soils and waste materials in the trenches over time. As the waste mass densifies by natural processes, causing subsidence, the overall rate of subsidence would decrease and the waste mass would become more stable. As natural subsidence continues, depressions would form in the overlying cap and these depressed areas would require backfilling with soil to prevent the ponding of rainwater and subsequent infiltration of rainwater into the trenches. Because of the many physical and chemical variables involved and the limited quantitative information available, it is not possible to predict accurately how long it would take for waste trenches to naturally subside at the MFDS.

Alternative 11 employs the grouting technology as a means of trench stabilization. The grouting technology would consist of injecting grout, a mixture of materials (e.g., cement, bentonite, fly ash, etc.) and water, through specially inserted probes into the majority of trenches to fill voids and other openings in the waste. Grouting would stabilize the trenches by reducing the subsidence that might otherwise occur as the trench contents settle into the voids. Stabilization could be only partially achieved by this technology because, although it might retard deterioration significantly, grouting would not likely prevent the continuing deterioration and collapse of the waste.

7.2.2 - Flow Barriers

Each action-based alternative that is described in the following sections utilizes barriers to prevent (1) vertical infiltration of precipitation to the trench waste, and (2) horizontal infiltration of ground water through subsurface strata to the trench waste.

7.2.2.1 Vertical Infiltration Barriers

The following four types of vertical infiltration barriers are included among the action-based alternatives evaluated: Structural Cap, Initial Cap, Engineered Soil Cap With Synthetic Liner, and Engineered Soil Cap (with all natural materials).

Alternative 4 employs a structural cap for minimizing vertical infiltration. The structural cap would consist of a two-foot-thick reinforced concrete slab over the trenches with a two-foot-thick clay layer elsewhere. The concrete/clay layer would be topped by a drainage layer and a topsoil layer to

support a vegetative cover. The topsoil and drainage layers would protect the concrete/clay layer against weathering. They would also control excessive runoff rates which would minimize damaging erosive forces. Prior to placement of an initial layer of compacted soil over the existing trench cover, the trenches would be dynamically compacted to provide a stable support for the structural cap. A structural cap would then be placed over both the compacted trenches and the initial layer of compacted soil.

Alternative 5 employs an initial cap to serve as a barrier to vertical water infiltration while the natural stabilization process takes place, after which a final, multi-media cap would be installed. The initial cap would consist of a compacted soil layer covered with an approximate 30-40 mil thick synthetic cover[6]. The clay and synthetic material cover would cover an approximate 40 to 50 acre area. The intent of this approximate two-foot thick cap is to allow subsidence to occur naturally, while adding backfill material as necessary to maintain proper grading for drainage and repairing the synthetic cover as required. The final cap would be the engineered soil cap with synthetic liner described below.

Alternatives 8, 10, and 11 employ an engineered soil cap with synthetic liner as a barrier to vertical water infiltration. Alternative 5 also employs an engineered soil cap with synthetic liner, to be installed upon completion of the natural stabilization process. This type of vertical infiltration barrier consists (from bottom to top) of an initial layer of compacted soil placed over the existing trench cover, a two-foot-thick clay layer, an 80 mil (or sufficiently similar) synthetic liner, a geotextile fabric layer, a one-foot-thick drainage layer, a geotextile fabric layer, and a two-foot-thick soil layer supporting a vegetative cover. The composition of

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6 - The Commonwealth has proposed use of an initial cap consisting of: compacted soil cover over the trench disposal area, topped with a 25-year life, 60 to 80 mil thick, synthetic liner with a drainage layer/filter fabric on top, followed by a layer of topsoil to support a vegetative cover. As discussed in Section 10.1, the selected remedy includes an initial cap that does not employ a drainage/vegetative cover. However, an alternate design, such as the one proposed by the Commonwealth, may be used if the selected remedy's initial cap can not effectively control anticipated rates of surface water runoff and consequent erosion.

this cap would be designed to provide the most suitable soil properties and conditions to support and maintain a healthy vegetative cover (e.g., provide adequate moisture during prolonged rainless periods). Table 34 provides a description of the contribution of each layer contained in this type of vertical infiltration barrier.

Alternative 17 employs an engineered soil cap consisting of all natural materials as a barrier to vertical water infiltration. This type of barrier consists of several layers of natural materials designed and arranged to promote drainage, minimize infiltration, and provide protection from erosion. The layers (in order of placement from bottom to top) are: a four-foot-thick infiltration barrier consisting entirely of clay or a combination of clay and soil-bentonite (or equivalent) layers with a permeability of 1×10^{-7} cm/sec or less to provide a barrier against infiltration of precipitation; a four-foot-thick drainage layer consisting of a mixture of sand, crushed rock and gravel of high permeability to drain water off the cap into drainage ditches and away from the disposal trenches; and, a three-foot-thick soil layer with an eight-inch topsoil layer which would support a vegetative cover and allow infiltration of water (to be carried off through the underlying drainage layer), thus minimizing surface runoff and consequential erosion problems.

7.2.2.2 Horizontal Flow Barriers

Two types of potential horizontal flow barriers are included among the action-based alternatives evaluated: (1) a lateral drain and cutoff wall combination that encircles the entire trench area and (2) a cutoff wall that extends from the east slope to the west slope of the site, beneath the cap and along its north perimeter (north cutoff wall). Alternatives 4 and 17 employ the lateral drain/cutoff wall combination; Alternatives 5, 8, 10, and 11 employ the north cutoff wall flow barrier.

The lateral drain/cutoff wall would block exfiltration of any remaining leachate in the unlikely event that, without a hydrostatic head, the leachate could flow through tight fissures in the rock formations beneath the trenches. Specifically, the barrier would intercept leachate flow originating from shallow trenches and block or contain any leachate originating from deeper trenches. The lateral drain component of this horizontal flow barrier would involve excavation of a trench around the perimeter of the desired trench group and installation of a perforated pipe at the bottom of the trench to collect any

liquids flowing into the drain. Crushed rock or gravel would surround the perforated pipe to allow flow into the pipe without clogging from soil particles. Sumps would be placed at specified intervals to collect leachate in the pipe; the leachate would then be solidified and disposed on-site. The lateral drain would be limited to the more shallow trenches in the western and central trench series due to practical equipment limitations.

The cutoff wall component of the lateral drain/cutoff wall barrier would consist of two sections: an upper section cut into the surface soil strata and a lower, much deeper section extending into the rock strata down to the desired depth. The upper section of the cutoff wall would consist of either a compacted clay key trench or a slurry wall with a permeability of 1×10^{-7} cm/sec or less. The upper section would block ground water flow at the interface of the soil cover and the Lower Marker Bed. The lower section of the cutoff wall would consist of a grout curtain utilizing a cementitious grout or a cement/bentonite grout. The lower portion, or grout curtain, would form a barrier against ground water flow into the trenches and/or outflow of leachate from the trenches. The cutoff wall design would include a series of collection wells near the inside of the wall to facilitate the removal of water mounding against the barrier. Water collected from these wells would be solidified for disposal in new trenches.

The second horizontal flow barrier evaluated consists of a cutoff wall without the lateral drain component[7]. The cutoff wall in this barrier is somewhat different than the previously described cutoff wall. This cutoff wall, sometimes referred to as a north cutoff wall, would be a slurry trench (identical to the upper section of the cutoff wall described above, except that a gravel drain would be installed near the bottom along its exterior side) without the grout curtain (lower section of the cutoff wall described above). The gravel drain along the exterior side of the wall (exterior to the trench disposal area)

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[7] - The Commonwealth has proposed the installation of a horizontal flow barrier that would extend down to the Henley Bed if site monitoring data indicates that lateral recharge of the trenches is occurring. The selected remedy does not specify the type, exact location or extent of the horizontal flow barrier, if one is needed. The Commonwealth's proposal will be considered during evaluation of the necessity of a horizontal flow barrier.

would shunt ground water toward the hillslopes and prevent its seepage under the wall. By preventing water from entering the trenches, no new leachate would be generated in the trenches. The wall would be designed for a permeability of 1×10^{-7} cm/sec or less.

7.2.3 - Baseline Features

Each alternative also includes baseline features - features that are common to all alternatives, with the exception of the No Action alternative. The baseline features are as follows:

- Non-functional and unstable site structures would be decommissioned, demolished and buried on-site.
- Additional trenches would be constructed for disposal of solidified trench leachate and/or waste generated during site remediation.
- A buffer zone, contiguous to the existing site licensed property boundary, would be acquired. The buffer zone would encompass an approximate 200-acre area, at a minimum, and would: (1) ensure long-term access for the purpose of monitoring to assess remedy compliance; and, (2) control activities on the hillslopes adjacent to the MFDS to minimize hillslope erosion.
- Institutional controls would be established and maintained in perpetuity to prevent unauthorized and/or inappropriate use of the site.
- Monitoring and maintenance activities would be conducted routinely, and in perpetuity, to assess remedy performance and to preserve the integrity of the remedy, respectively.
- A remedy review would be performed by EPA at least every five years to ensure the remedy continues to meet the remedial action objectives, including compliance with state and federal ARARs and protection of human health and the environment.

The remedial alternatives receiving detailed analysis in the Feasibility Study are summarized in the following sections; estimated costs and design/construction times are summarized in Table 29, following the Description of Alternatives.

7.2.4 - ALTERNATIVE 1 - NO ACTION

Estimated Construction Cost:	$ 636,000
Estimated O & M Cost:	$ 6,167,000
Estimated Present-Worth Total Cost:	$ 6,803,000
Estimated Implementation Time:	6 months

Alternative 1 consists of the following activities:

- Site Monitoring
- Installation of Additional Monitoring Wells
- Repair, Maintenance and Replacement of Monitoring Equipment

Monitoring activities would consist of the installation of additional monitoring wells, sample collection and analyses on a frequent basis, and repair, maintenance and replacement of monitoring equipment as needed. The estimated cost of 6.8 million dollars for an alternative involving only monitoring activities arises from the need to monitor this site in perpetuity. The No Action alternative is not an engineered remedial alternative, and it would not satisfy the remedial objectives. The No Action alternative does not comply with ARARs and would, likewise, not provide overall protection of human health and the environment.

7.2.5 - ALTERNATIVE 4 - STRUCTURAL CAP/DYNAMIC COMPACTION/ HORIZONTAL FLOW BARRIER

Estimated Construction Cost:	$ 59,332,000
Estimated O & M Cost:	$ 6,175,000
Estimated Present-Worth Total Cost:	$ 65,507,000
Estimated Implementation Time:	38 months

Alternative 4 includes the following remedial activities:

- Trench Leachate Removal
- Solidification Of Leachate And Disposal In New Trenches
- Installation Of Horizontal Flow Barrier (Lateral Drain/ Cutoff Wall), If Necessary
- Dynamic Compaction Of Existing Disposal Trenches Concurrent With Addition Of Compacted Soil And Sand Backfill
- Installation Of A Two-Foot-Thick Reinforced Concrete (Structural) Cap Over The Compacted Trenches And A Two-Foot-Thick Low-Permeability Clay Cap Over The Rest Of The Trench Disposal Area.

- Drainage Channel Improvements And Other Necessary Surface Water Control Features
- Baseline Features

This alternative combines the technologies of trench leachate removal, dynamic compaction and structural capping. Leachate would be extracted, solidified, and disposed in newly-constructed trenches on-site. After leachate removal and dynamic compaction of the disposal trenches, a reinforced concrete structural slab and several feet of soil cover would be placed over the disposal trenches. The use of dynamic compaction on the trench area prior to placement of the structural cap would provide a stable foundation for the cap and minimize future subsidence. The reinforced concrete cap would not be capable of spanning the wide trenches without the support provided by stabilization.

The lateral drain/cutoff wall, if found to be necessary, would help reduce the off-site migration of contaminants and prevent the infiltration of subsurface water.

7.2.6 - ALTERNATIVE 5 - NATURAL SUBSIDENCE/INITIAL CAP AND FINAL ENGINEERED SOIL CAP WITH SYNTHETIC LINER/HORIZONTAL FLOW BARRIER - "NATURAL STABILIZATION"

Estimated Construction Cost:	$ 23,910,000
Estimated O & M Cost:	$ 9,643,000
Estimated Present-Worth Total Cost:	$ 33,553,000

Estimated Implementation Time: 22 Months For Initial Closure Period;

35 - 100 Years For Interim Maintenance Period Following Initial Closure Period;

10 Months For Final Closure Period Following Interim Maintenance Period

The implementation of this alternative would involve the following activities:

- Trench Leachate Removal
- Solidification Of Leachate And Disposal Into New Trenches
- Installation of An Initial Cap And Periodic Replacement Of Synthetic Liner
- Installation of Horizontal Flow Barrier (North Cutoff Wall), If Necessary

- Natural Subsidence With Active Maintenance And Monitoring
- Installation Of A Final Engineered Soil Cap with Synthetic Liner
- Initial and Final Cap Grading And Contouring To Control Surface Water Flow And Erosion
- Drainage Channel Improvements And Other Necessary Surface Water Control Features
- Baseline Features

The "Natural Stabilization" alternative[8] combines elements of containment, leachate removal, and treatment. Following leachate extraction, solidification and disposal, an initial cap would be installed over the trench disposal area to prevent infiltration of precipitation into the trenches. The distinguishing feature of this alternative is the use of an initial cap during the period of natural subsidence, estimated to take approximately 35 to 100 years (the Interim Maintenance Period). This cap would be designed to prevent the infiltration of rainfall and surface water into the disposal trenches while subsidence and maintenance are taking place. Cap grading and contouring would be performed to enhance the control of surface water flow, better distribute the flow of surface water, and control and minimize, to the extent practicable, erosion of hillslopes. Improvements to drainage channels would be performed to enhance distribution of surface water runoff and to minimize erosion. Cap repairs and backfilling of subsided areas would be performed during the Interim Maintenance Period.

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[8] - The term "closure", in the "Initial Closure Period" and "Final Closure Period" components of the Natural Stabilization Alternative, is used in a generic sense to denote sets of remedial activities to be implemented during those limited time periods. Neither the term closure nor the designations "Initial Closure Period" and "Final Closure Period" are used in any specific regulatory sense (i.e., AEC or RCRA closure).

The type of initial cap utilized would be contingent upon its ability to control surface water runon and runoff. Accelerated rates of hillslope and/or drainage channel erosion would necessitate a modification to the proposed initial cap design.

A final, multilayer cap with synthetic liner would be installed at the completion of natural subsidence, at which time the trenches would form a stable foundation for the final cap.

Additionally, a north cutoff wall would be constructed, if determined to be necessary, to prevent lateral ground water infiltration into the disposal trenches. Other types of horizontal flow barriers, such as a lateral drain/cutoff wall, could also be considered.

Maintenance requirements for this alternative would be significant during the interim maintenance period. Once the trenches have sufficiently stabilized, the final cap would be installed and maintenance requirements would be minimal. The timing of final cap construction would be based upon specific subsidence criteria developed in the remedial design.

7.2.7 - ALTERNATIVE 8 - NATURAL SUBSIDENCE/ENGINEERED SOIL CAP WITH SYNTHETIC LINER/HORIZONTAL FLOW BARRIER

Estimated Construction Cost:	$ 34,302,000
Estimated O & M Cost:	$ 13,105,000
Estimated Present Worth Total Cost:	$ 47,407,000
Estimated Implementation Time:	23 months

Alternative 8 includes the following remedial activities:

- Leachate Removal
- Solidification Of Leachate And Disposal In New Trenches
- Installation Of A Horizontal Flow Barrier (North Cutoff Wall), If Necessary
- Installation Of An Engineered Soil Cap With Synthetic Liner
- Cap Grading And Contouring To Control Surface Water Flow And Erosion
- Drainage Channel Improvements And Other Necessary Surface Water Control Features
- Baseline Features

Following leachate extraction, solidification and disposal, an engineered soil cap with synthetic liner would be placed over the trench disposal area to prevent infiltration of precipitation into the trenches. The cap utilized in this alternative is identical to the final cap described in Alternative 5. Alternative 8 is identical to Alternative 5 except for the time of placement of the final cap. Alternative 8 places the final cap over the trench disposal area immediately, rather than waiting for subsidence to run its course during the estimated 35 to 100 year subsidence period as in Alternative 5. Trench stabilization would be accomplished by natural subsidence as in Alternative 5 with repairs to the final cap being made over the period of subsidence.

The required maintenance activities for this alternative would be high since trench subsidence and resulting repair of the complex final cap would be significant. Surface water control would be addressed through cap grading and contouring and drainage channel improvements. The north cutoff wall would provide a barrier against infiltration of ground water into the trench area.

7.2.8 - ALTERNATIVE 10 - DYNAMIC COMPACTION/ENGINEERED SOIL CAP WITH SYNTHETIC LINER/HORIZONTAL FLOW BARRIER

Estimated Construction Cost:	$ 39,538,000
Estimated O & M Cost:	$ 4,790,000
Estimated Present-Worth Total Cost:	$ 44,328,000
Estimated Implementation Time:	35 months

Alternative 10 includes the following remedial activities:

- Leachate Removal
- Solidification Of Leachate And Disposal Into New Trenches
- Installation Of A Horizontal Flow Barrier (North Cutoff Wall), If Necessary
- Dynamic Compaction Of Existing Trenches With Concurrent Addition Of Compacted Soil And Sand Backfill
- Installation Of An Engineered Soil Cap With Synthetic Liner
- Cap Grading And Contouring To Control Surface Water Flow And Erosion
- Drainage Channel Improvements And Other Necessary Surface Water Control Features
- Baseline Features

With Alternative 10, the dynamic compaction technology would be employed to stabilize the trench wastes artificially rather than relying on natural subsidence. Prior to dynamic compaction of the trenches, leachate would be extracted, solidified and disposed on-site in new disposal trenches.

Upon compaction of the trenches, an engineered soil cap with synthetic liner would be placed over the trench disposal area to minimize vertical infiltration of water into the disposal trenches. The cap would be graded and contoured to control the rate of surface water flow and minimize erosion to the extent practicable.

A north cutoff wall (or other sufficient horizontal flow barrier) would be installed, if determined to be necessary, to control the infiltration of ground water into the disposal trenches.

7.2.9 - ALTERNATIVE 11 - TRENCH GROUTING/ENGINEERED SOIL CAP WITH SYNTHETIC LINER/HORIZONTAL FLOW BARRIER

Estimated Construction Cost:	$ 61,870,000
Estimated O & M Cost:	$ 6,989,000
Estimated Present-Worth Total Cost:	$ 68,859,000
Estimated Implementation Time:	46 months

Alternative 11 includes the following remedial activities:

- Trench Leachate Removal
- Installation Of A Horizontal Flow Barrier (North Cutoff Wall), If Necessary
- Grouting Of Accessible Voids In The Existing Disposal Trenches With Grout Made From Potable Water And/Or Leachate
- Installation Of An Engineered Soil Cap With Synthetic Liner.
- Cap Grading And Contouring To Control Surface Water Flow And Erosion
- Drainage Channel Improvements And Other Necessary Surface Water Control Features
- Baseline Features

Alternative 11 would achieve trench stabilization by injecting grout through lances or probes into the majority of trenches for the purpose of filling voids and other openings in the trenches. Trench leachate would be extracted and would then be used in the grout mix for injection into the trenches. Once injected with grout, the trenches would provide a stable foundation for a trench

cover. An engineered soil cap with synthetic liner would be placed over the trench disposal area to prevent infiltration of precipitation into the trenches. The cap would be graded and contoured to enhance control of surface water runon and runoff and improvements to drainage channels would be performed to enhance distribution of surface water runoff and to minimize erosion.

A north cutoff wall (or other sufficient horizontal flow barrier) would be installed, if necessary, to prevent the infiltration of ground water into the disposal trenches

7.2.10 - ALTERNATIVE 17 - DYNAMIC COMPACTION/ENGINEERED SOIL CAP/ HORIZONTAL FLOW BARRIER

Estimated Construction Cost:	$ 51,920,000
Estimated O & M Cost:	$ 4,634,000
Estimated Present-Worth Total Cost:	$ 56,554,000
Estimated Implementation Time:	38 months

Alternative 17 includes the following remedial activities:

- Leachate Removal
- Solidification Of Leachate With Disposal Into New Trenches
- Installation Of A Horizontal Flow Barrier (Lateral Drain/ Cutoff Wall), If Necessary
- Dynamic Compaction Of Existing Disposal Trenches Concurrent With The Addition Of Compacted Soil And Sand Backfill
- Installation Of An Engineered Soil Cap (With All Natural Materials)
- Cap Grading And Contouring To Control Surface Water Flow And Erosion
- Drainage Channel Improvements And Other Necessary Surface Water Control Features
- Baseline Features

Alternative 17 combines the remedial technologies of capping and dynamic compaction to stabilize the trenches. Prior to dynamic compaction of the trenches, leachate would be extracted, solidified and disposed on-site in new disposal trenches. The differences between this alternative and Alternative 10 are the types of horizontal flow barrier and cap employed. This alternative would involve installation of a lateral drain/cutoff wall rather than the north cutoff wall used in Alternative 10 and the engineered soil cap would be made of all natural materials and would not contain a synthetic liner as in Alternative 10.

The cap would be installed over the trench disposal area to minimize infiltration into the trenches. The cap would be graded and contoured to enhance control of surface water runon and runoff and improvements to drainage channels would be performed to enhance distribution of surface water runoff and to minimize erosion.

Table 28 lists the alternatives that underwent a detailed analysis for the MFDS.

TABLE 28

SUMMARY OF ALTERNATIVES
THAT UNDERWENT A DETAILED ANALYSIS

ALTERNATIVE 1	NO ACTION
ALTERNATIVE 4	STRUCTURAL CAP/DYNAMIC COMPACTION/ HORIZONTAL FLOW BARRIER
ALTERNATIVE 5	NATURAL SUBSIDENCE/INITIAL CAP AND FINAL ENGINEERED SOIL CAP WITH SYNTHETIC LINER/HORIZONTAL FLOW BARRIER - "NATURAL STABILIZATION"
ALTERNATIVE 8	NATURAL SUBSIDENCE/IMMEDIATE ENGINEERED SOIL CAP WITH SYNTHETIC LINER/HORIZONTAL FLOW BARRIER
ALTERNATIVE 10	DYNAMIC COMPACTION/ENGINEERED SOIL CAP WITH SYNTHETIC LINER/HORIZONTAL FLOW BARRIER
ALTERNATIVE 11	TRENCH GROUTING/ENGINEERED SOIL CAP WITH SYNTHETIC LINER/HORIZONTAL FLOW BARRIER
ALTERNATIVE 17	DYNAMIC COMPACTION/ENGINEERED SOIL CAP/ HORIZONTAL FLOW BARRIER

TABLE 29

COST/SCHEDULE SUMMARY FOR
REMEDIAL ALTERNATIVES

Alternative	Cost[1]	Implementation Time[2]
1	$ 6,803,000	6 Months
4	65,507,000	38 Months
5	33,553,000	22 Months[a] 35 - 100 Years[b] 10 Months[c]
8	47,407,000	23 Months
10	44,328,000	35 Months
11	68,859,000	46 Months
17	56,554,000	38 Months

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1 - Cost estimates for the alternatives are present worth costs which include capital costs and operation and maintenance costs. All alternatives assume a 4% discount rate for the purpose of alternative comparison. The actual discount rate used to establish the remedy trust fund may differ from the 4% discount rate used here.

2 - Includes design and construction time.

a - The Initial Closure Period would be completed in 22 months.
b - The Interim Maintenance Period would commence upon completion of the Initial Closure Period and would take approximately 35 to 100 years for completion.
c - A 10 month Final Closure Period would follow the Interim Maintenance Period.

SECTION 8.0 - APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

CERCLA Section 121(d)(2) requires that the selected remedy comply with all federal and state environmental laws that are applicable or relevant and appropriate to the hazardous substances, pollutants, or contaminants at the site or to the activities to be performed at the site. Therefore, to be selected as the remedy, an alternative must meet all ARARs or a waiver must be obtained. Tables 30 and 31 summarize the action-specific and contaminant-specific applicable or relevant and appropriate requirements (ARARs) identified for the MFDS. A discussion of how each ARAR applies to the MFDS is also provided below.

8.1 Action-Specific ARARs

An action-specific ARAR is a performance, design, or other similar action-specific requirement that impacts particular remedial activities. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. These requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved. The following are action-specific requirements for the Maxey Flats Disposal Site remedy:

- Occupational Safety and Health (OSHA) Standards (29 CFR Sections 1910.120, .1000 - .1500, Parts 1926.53, .650 - .653)

The OSHA hazardous substance safety standards, 29 CFR 1910.120, .1000 - .1500, are applicable, action-specific requirements for remedial activities at the MFDS. The OSHA standards (1910.120) for hazardous substance response actions under CERCLA establish safety and health program requirements that must be implemented in the cleanup phase of a CERCLA response. Under the regulations, a health and safety program will be required for employees and contractors working at the MFDS. The standards found in 1910.1000 - .1500 govern CERCLA response actions involving any type of hazardous substance that may result in adverse effects on employees' health and safety. These standards also incorporate all of the requirements of 29 CFR Part 1926, the OSHA health and safety standards for construction. The provisions of 29 CFR 1926.650 - .653 are applicable to any excavation, trenching, and shoring that is undertaken as part of the construction of trenches, cut-off walls, etc.

TABLE 30

SUMMARY OF ACTION-SPECIFIC
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

Applicable	Relevant and Appropriate
Occupational Safety and Health (OSHA) Standards (29 CFR Parts 1910 and 1926, both in part)	Occupational Safety and Health (OSHA) Standards (29 CFR 1926, in part)
National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61, Subpart I)	Federal Standards for Protection Against Radiation (Allowable Doses in Restricted Areas) (10 CFR Part 20)
Kentucky Standards for Protection Against Radiation (Allowable Doses In Restricted Areas) (902 KAR 100:020)	Federal Licensing Requirements for Land Disposal of Radioactive Waste (10 CFR Part 61)
Kentucky Standards for the Disposal of Radioactive Material (902 KAR 100:021)	Kentucky Licensing Requirements for Land Disposal of Radioactive Waste (902 KAR 100:022)
General Kentucky Requirements Concerning Radiological Sources (ALARA) (902 KAR 100:015)	Kentucky Soil and Water Conservation Requirements (KRS 262)
Kentucky Hazardous Waste Management Regulations (401 KAR Chapter 34, In Part)	Resource Conservation and Recovery Act (RCRA) Hazardous Waste Management Standards (40 CFR Part 264, In Part)
Resource Conservation and Recovery Act (RCRA) Hazardous Waste Management Standards (40 CFR Part 268)	
Kentucky Fugitive Air Emissions Standards (401 KAR 63:010)	

TABLE 31

SUMMARY OF CONTAMINANT-SPECIFIC
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

Applicable	Relevant and Appropriate
Kentucky Standards for Protection Against Radiation (Allowable Doses in Unrestricted Areas) (902 KAR 100:020, Table II of 902 KAR 100:025)	Federal Standards for Protection Against Radiation (Allowable Doses in Unrestricted Areas) (10 CFR Part 20.105, .106 and Appendix B, Table II)
Kentucky Surface Water Quality Standards (401 KAR 5:026 - :035)	Ambient Water Quality Criteria (Section 304(a)(1) of the Clean Water Act)
Kentucky Hazardous Waste Management Regulations (401 KAR 34:060, Section 5)	Kentucky Drinking Water Standards-Maximum Contaminant Levels (401 KAR 6:015)
	Federal Drinking Water Regulations - Maximum Contaminant Levels and Maximum Contaminant Level Goals (40 CFR Parts 141, 142 and 143)
	National Emission Standards for Hazardous Air Pollutants (NESHAPS) (40 CFR Part 61.92)
	Kentucky Licensing Requirements for Land Disposal of Radioactive Waste (902 KAR 100:022)
	Federal Licensing Requirements for Land Disposal of Radioactive Waste (10 CFR Part 61.41)
	Federal Standards for Uranium and Thorium Mill Tailings (40 CFR Part 192)

The OSHA standards found in 29 CFR 1926.53 are relevant and appropriate requirements for construction and related activities involving the "use" of ionizing radiation. While the actions to be pursued at the MFDS do not, necessarily, involve the"use" of sources of ionizing radiation or radioactive materials, these standards do pertain to the substances involved at the site and to the activities of the workers in undertaking any part of the remedial action in the restricted area.

- National Emission Standards for Hazardous Air Pollutants (NESHAPS) (40 CFR Part 61, Subpart I)

The NESHAPS standards found in 40 CFR Part 61, Subpart I, are applicable to those portions of remedial action that would result in fugitive emission of radionuclides into an unrestricted area. Compliance with this applicable requirement is determined by calculating the dose to members of the public at the point of maximum annual air concentration in unrestricted areas, using EPA-approved sampling procedures and computer codes. The air emission standard for NRC licensees, which includes the MFDS, is set at 25 mrem per year to the whole body and 75 mrem per year to the critical organ of any member of the public[9].

- Kentucky Standards for Protection Against Radiation (Allowable Doses in Restricted Areas) (902 KAR 100:020)

The Kentucky regulations found in 902 KAR 100:020 are applicable requirements for any employee performing work and for any other individual occupying the restricted area during remediation of the MFDS. These regulations include: limits to total occupational dose received, limits to airborne exposure in restricted areas, required surveys to establish compliance, and the use of appropriate signs, labels, signals and controls to minimize exposure to radiation.

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9 - A revision to this Subpart, changing the emission standard to 10 mrem/year effective dose equivalent, has been promulgated but the effective date has been stayed.

- Federal Standards for Protection Against Radiation (Allowable Doses in Restricted Areas) (10 CFR Part 20)

The requirements found in 10 CFR 20.101 - .103, .210(b)(1), .202, .203(a) - (c)(5), (d), and Appendix B, Table I are relevant and appropriate for the MFDS. Because Kentucky is an Agreement State, its radiation protection standards for protecting against radiation in restricted areas (902 KAR 100:020 above), as opposed to the federal standards, are the applicable standards.

- General Kentucky Requirements Concerning Radiological Sources (ALARA) (902 KAR 100:015)

The requirement found in 902 KAR 100:015, Sections 1 and 2, which requires that all persons "who receive, possess, use, transfer, own, or acquire" any radioactive sources must make every reasonable effort to maintain radiation exposures and releases in unrestricted areas to "as low as reasonably achievable" (ALARA), is applicable to the MFDS.

- Kentucky Fugitive Air Emissions Standards (401 KAR 63:010)

The fugitive air emissions standards found in 401 KAR 63:010 are applicable to the MFDS remedial activities because they apply to potential operations such as cap installation, excavation of disposal trenches, demolition activities, and other activities that may emit dust and other air contaminants. The standards require individuals to take reasonable precautions to prevent particulate matter from becoming airborne when material is handled or processed, a building is constructed, altered, or demolished, or a road is used. Visible fugitive dust emissions must be contained within the lot line of the property on which the emissions originate.

- Kentucky Standards for the Disposal of Radioactive Material (902 KAR 100:021)

The radioactive waste classification system and the radioactive waste characteristics requirements, found in Sections 7 and 8 of 902 KAR 100:021, are applicable requirements for the waste disposed of during the remediation of the MFDS. Section 7 provides the criteria for classifying waste for near-surface disposal. Section 8 contains minimum waste handling requirements for waste disposed of in new trenches, packaging requirements, permissible waste characteristics, and stability requirements of waste generated during remediation of the MFDS.

- Kentucky Licensing Requirements for Land Disposal of Radioactive Waste (902 KAR 100:022)

Sections 14, 19, 21, 23, 24(1) - (11), 25(3) and 27(2) of 902 KAR 100:022 are relevant and appropriate requirements for the disposal of waste generated during remediation in new units at the MFDS. The Kentucky Licensing Requirements for Land Disposal of Radioactive Waste specify that closure shall be designed to achieve long-term stability and isolation of the radioactive waste, to protect against inadvertent intrusion, and to eliminate, to the extent practicable, the need for on-going, active maintenance of the disposal site so that only surveillance, monitoring, and minor custodial care is required. The regulations further provide for post-closure surveillance of the site, which includes a monitoring system that provides early warning of releases of radionuclides before they reach the site boundary, and institutional control requirements.

- Federal Licensing Requirements for Land Disposal of Radioactive Waste (10 CFR Part 61)

The requirements found in 10 CFR Part 61.29, .42, .44, .51(a), .52(a)(1) - (11), .53(d), .55 and .56 are relevant and appropriate for new disposal units at the MFDS. Section 61.41 will be treated as relevant and appropriate provided the new trenches are located in a manner that allows compliance with the standard to be measured at the boundary of the Restricted Area without interference from radionuclides migrating from existing trenches. Sections 61.42, .44, .51(a), .52(a)(6), .53(d), and .59(b) are relevant and appropriate with respect to the caps, monitoring system and institutional controls at the MFDS.

- Kentucky Soil and Water Conservation Requirements (Chapter 262 of Kentucky Revised Statutes)

Chapter 262 of the Kentucky Revised Statutes, which provides for the establishment of soil and water conservation requirements to prevent and control soil erosion, are relevant and appropriate requirements for the MFDS. Remedial activities could create changes in soil conditions and surface water flow. Thus, the generally applicable requirements for the technologies/actions that could lead to large-scale soil disturbance are relevant and appropriate.

- Kentucky Hazardous Waste Management Regulations (401 KAR Chapter 34)

Federal regulations under the Resource Conservation and Recovery Act (RCRA) establish minimum national standards defining the acceptable management of hazardous waste. States can be authorized by EPA to administer and enforce RCRA hazardous waste management programs in lieu of the Federal program if the States have equivalent statutory and regulatory authority. If the CERCLA site is located in a State with an authorized RCRA program, the State's promulgated RCRA requirements will replace the equivalent Federal requirements as potentially ARAR. If the State is authorized for only a portion of the RCRA program, both Federal and State standards may be ARARs.

Since EPA has delegated the Resource Conservation and Recovery Act (RCRA) program to Kentucky, the Kentucky hazardous waste management regulations are applicable, except for requirements such as those promulgated under the Hazardous and Solid Waste Amendments of 1984 (HSWA), which have not yet been delegated to Kentucky.

Radioactive Shipment Records for the MFDS indicate the disposal of Liquid Scintillation Vials (LSVs) at the site. LSVs, during the 1963 to 1977 site disposal period, typically contained a xylene or toluene solvent base. The fluids from LSVs containing xylene and toluene are considered RCRA spent solvent, listed hazardous waste. Sample analyses detected the presence of low levels of toluene and xylene in trench leachate during the MFDS Remedial Investigation. Consequently, the leachate at the MFDS is considered to be a listed hazardous waste.

Although disposal of the LSVs at the MFDS originally occurred prior to the effective date of RCRA Subtitle C regulations (November 19, 1980), the selected remedy for the MFDS will constitute disposal of a hazardous waste via the extraction, solidification and disposal of approximately three million gallons of trench leachate on-site. Thus, the RCRA requirements, or their Kentucky counterparts, are applicable to the MFDS.

The following Kentucky Hazardous Waste Management regulations are ARARs that must be met by the selected remedy:

- 401 KAR 34:060 - Ground Water Protection: Sections 8 and 9 set forth general ground water monitoring requirements and detection monitoring program requirements. Sections 10 and 11 set forth

standards for the compliance monitoring program and corrective action programs which establish how the data gathered will be evaluated and what actions must be taken to eliminate contamination of ground water. Should ground water monitoring in the alluvium indicate Maximum Concentration Limits (MCLs/MCLGs) have been exceeded, the selected remedy must implement corrective action to comply with the MCLs/MCLGs.

- 401 KAR 34:070 (Sections 2, 5, 7, 8 and 10) - Closure and Post-Closure: Section 2 sets out closure performance standards which, among other requirements, are intended to minimize the need for further maintenance and control, minimize or eliminate to the extent necessary post-closure escape of hazardous constituents to ground or surface water or through the atmosphere, to protect human health and the environment.

Section 5 provides for the disposal or decontamination of equipment, structures, and soils. Section 7 requires a survey plat to be submitted to the local zoning authority and the Commonwealth. Section 8 provides for post-closure care and use of property. Section 10 requires a notation on the deed to the property noting the previous management of hazardous wastes thereon and the land use restrictions resulting from that use.

- 401 KAR 34:190 - Tanks: 401 KAR 34:190 regulates tank systems that are used for treatment and storage of hazardous waste.

- 401 KAR 34:230 Landfill Closure Standards: Section 6 provides standards for covers (caps) for sites where waste is left in place. These standards will apply to the design of the final cap at the MFDS.

- Resource Conservation and Recovery Act (RCRA) Hazardous Waste Management Standards (40 CFR Part 268)

Although EPA has delegated the RCRA program to Kentucky, those federal hazardous waste management regulations promulgated under HSWA, which have not been delegated to Kentucky, are also applicable to the MFDS. Specifically, 40 CFR Part 268, which sets out Land Disposal Restrictions (LDRs), is applicable to the MFDS. The LDRs require hazardous wastes to be treated to specified levels prior to land disposal. The LDRs are waived for remedial action at the MFDS; see Section 8.3 - ARARs Waiver of this Record of Decision.

The requirements of 40 CFR 264, related to minimum technology trench design requirements, are neither applicable nor relevant and appropriate to the remedial actions at the MFDS for those disposal trenches constructed within the Area of Contamination[10] (AOC) for the MFDS. The RCRA minimum technology requirements are not applicable because disposal of solidified trench leachate will not occur in a new RCRA unit, a lateral expansion of an existing unit, or a replacement unit. The selected remedy presumes that sufficient space is currently available within the AOC for the desired number of new disposal trenches to be constructed. However, if spacial limitations necessitate construction of new disposal trenches outside the Area of Contamination, minimum technology trench design requirements would be applicable requirements. For the MFDS, the AOC is best described as the entire area of the Restricted Area, an approximate 400 foot wide area parallel to the entire western boundary of the Restricted Area, an area 400 feet by 400 feet at the northwest corner of the Restricted Area, and an approximate 700 feet wide area parallel to the entire east boundary of the Restricted Area. The AOC, as illustrated in Figure 15, is subject to redefinition should new information become available, through additional site sampling, which indicates the presence of additional areas of contamination contiguous to the current AOC.

While minimum technology trench design requirements might be considered relevant to the disposal of hazardous waste at the MFDS, EPA does not consider them appropriate for the MFDS based upon such factors as the very low concentrations of chemical constituents relative to the threat posed by the radioactivity at the MFDS; the potentially significant increased infiltration into the trenches as a result of the much greater surface area that minimum technology trenches would require at the MFDS due primarily to the restrictive site geology; and, EPA's assessment that no appreciable additional level of protection to public health or the environment will be gained by imposing these requirements at the MFDS.

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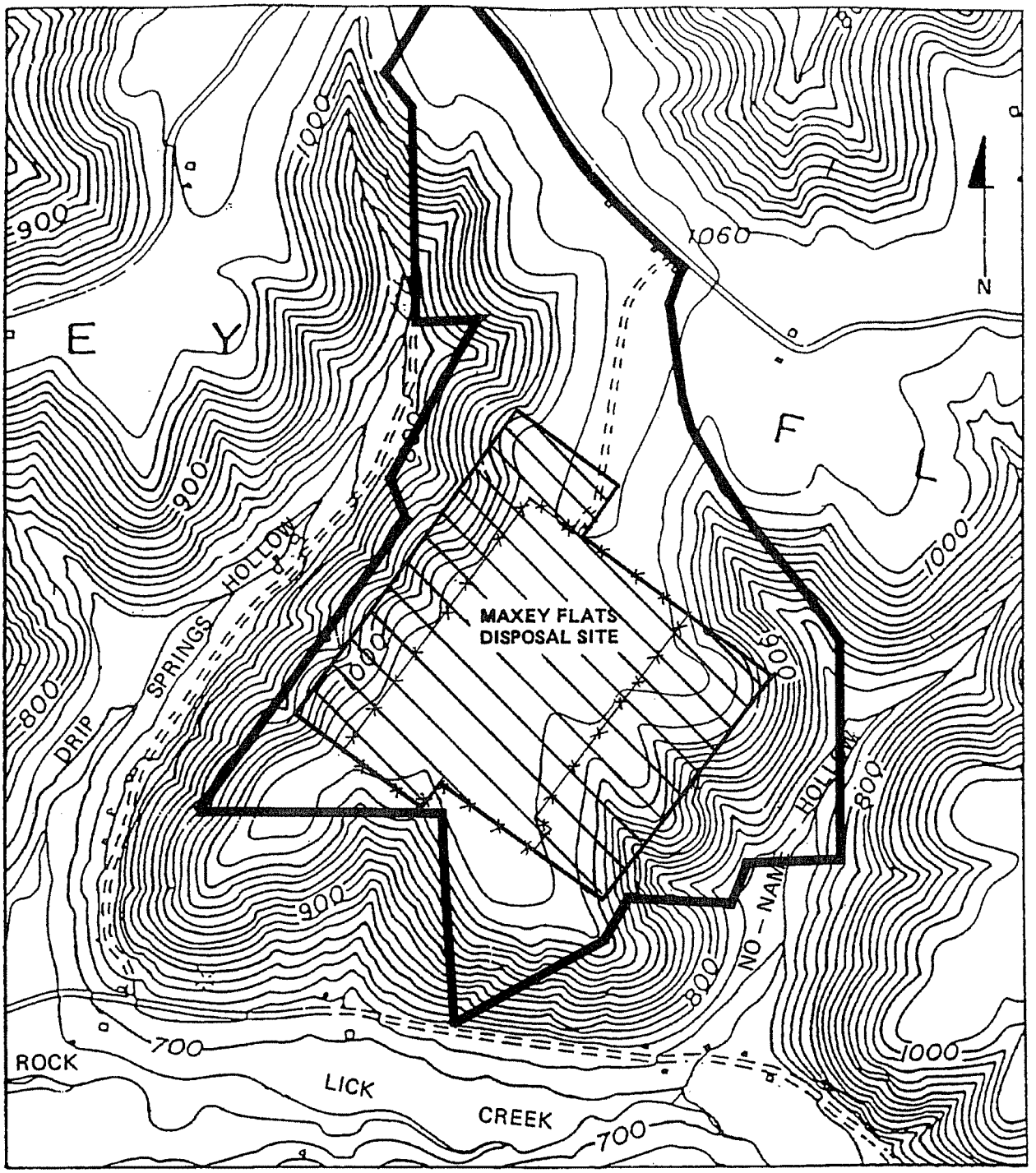
10 - An Area of Contamination (AOC) is delineated by the areal extent (or boundary) of contiguous contamination. Such contamination must be contiguous, but may contain varying types and concentrations of hazardous substances. An example of an Area of Contamination includes a landfill and the surrounding contaminated soil.

FIGURE 15



EXPLANATION

FENCE ENCLOSING BURIAL AREA

MFDS PROPERTY BOUNDARY

500 0 500 1000

SCALE IN FEET

MAXEY FLATS
EXECUTIVE SUMMARY
MAXEY FLATS SITE RI/FS

EBASCO SERVICES INCORPORATED

MAXEY FLATS DISPOSAL SITE—
SITE MAP

FIGURE 1

8.2 Contaminant-Specific ARARs

Contaminant-specific ARARs set health or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants, or contaminants. Examples of such media are air and water. These ARARs set protective cleanup levels for the contaminants of concern in the designated media or indicate an acceptable level of discharge into a particular medium during a remedial activity.

- Kentucky Standards for Protection Against Radiation (Allowable Doses in Unrestricted Areas) (902 KAR 100:020 and Table II of 902 KAR 100:025)

Sections 7 and 8 of 902 KAR 100:020 and Table II of 902 KAR 100:025, Section 2, provide general and isotope-specific radiation protection standards for individuals in unrestricted areas, and are applicable requirements for the radioisotopes at the MFDS. Section 7 requires that individuals in unrestricted areas should not receive a dose to the whole body in excess of 500 mrem in any year. Section 8 establishes limits, on an isotope-by-isotope basis, on the amount of radiation that can be released to unrestricted areas. Specifically, the section provides that radioisotopic concentrations in air and water above natural background cannot exceed the limits in 902 KAR 100:025, Table II.

- Federal Standards for Protection Against Radiation (Allowable Doses in Unrestricted Areas) (10 CFR Part 20.105, .106 and Appendix B, Table II)

Because of Kentucky's Agreement State status, its radiation protection standards provide the applicable requirements for protection against radiation in unrestricted areas at the MFDS. The analogous federal radiation protection standards found in 10 CFR Part 20.105, .106, and Appendix B, Table II are relevant and appropriate contaminant-specific standards for the MFDS. The federal standards were lowered in May 1991 so as to limit the allowable dose in unrestricted areas to 100 mrem/year and to provide specific radionuclide concentrations in Appendix B, Table II. In that these new federal standards are more stringent than the Kentucky regulations, the federal standards shall be the governing ARARs for allowable doses in unrestricted areas.

- Kentucky Surface Water Quality Standards (401 KAR 5:026 - :035)

Kentucky's Surface Water Quality Standards, set out in 401 KAR 5:026 - :035, set "minimum criteria applicable to all surface waters". These criteria include specific limits on

radionuclides. These standards are applicable contaminant-specific standards for the surface water streams (i.e., Drip Springs Hollow, No Name Hollow, and Rock Lick Creek) surrounding the MFDS. In addition, to the extent that the site contains surface waters as defined by 401 KAR 5:029 Section 1(bb), including intermittent streams with well defined banks and beds, the surface water standards are, likewise, applicable contaminant-specific standards.

- Ambient Water Quality Criteria (Section 304(a)(1) of the Clean Water Act)

The EPA water quality criteria found in Section 304(a)(1) of the Clean Water Act are relevant and appropriate criteria for the MFDS. The EPA criteria for protection of aquatic life from acute or chronic toxic effects or the human health criteria for consumption of fish, whichever is more stringent, is the relevant and appropriate requirement for the surface waters at and around the MFDS.

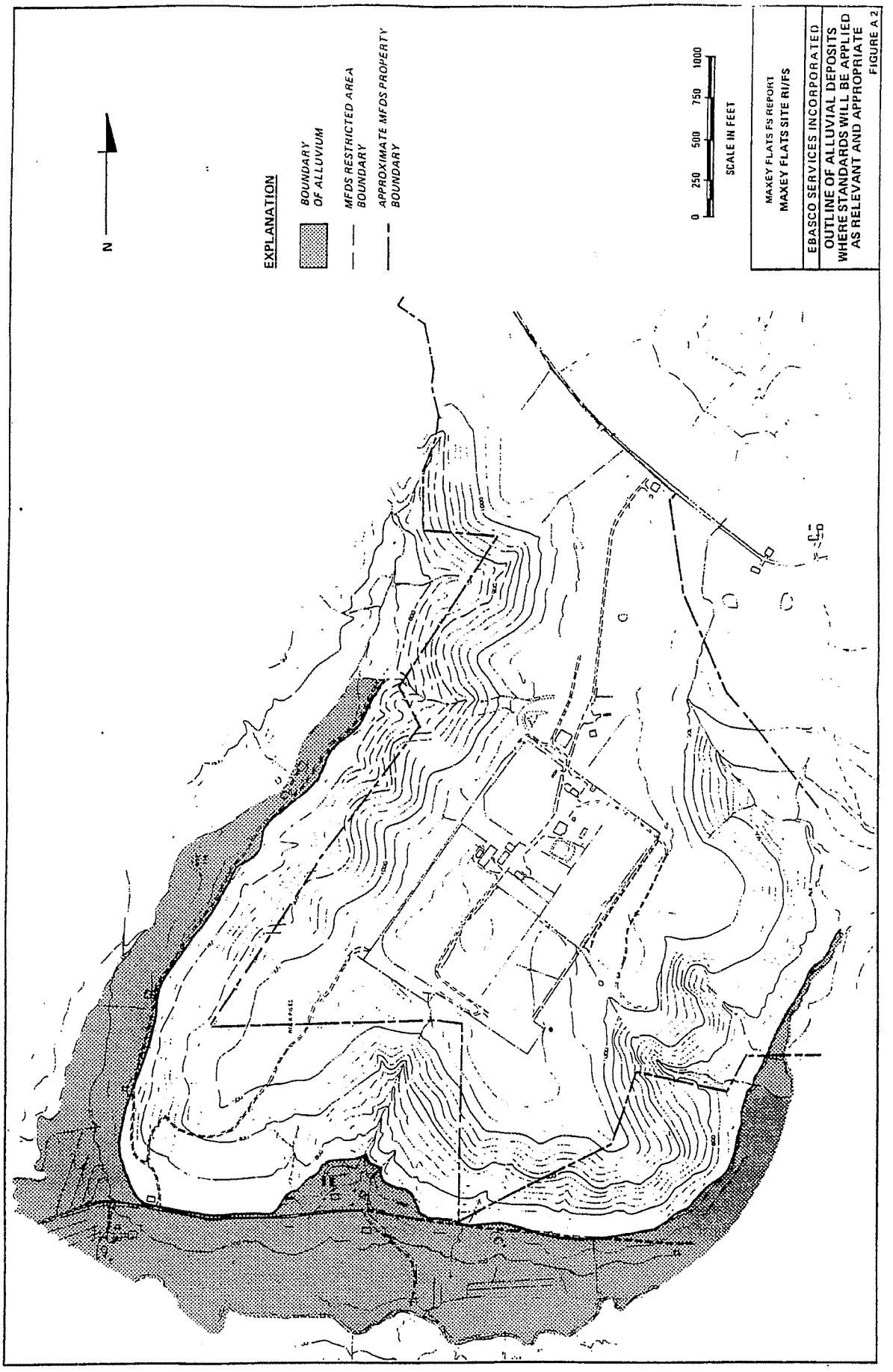
- Kentucky Drinking Water Standards - Maximum Contaminant Levels (401 KAR 6:015)

The Kentucky drinking water standards establish maximum concentration levels for a number of inorganic, organic, and radionuclide contaminants. The MCLs established in 401 KAR 6:015 are relevant and appropriate requirements for the MFDS. Compliance with these ARARs will be judged beginning at the contact of the alluvium with the hillside and ending at the streams. Figure 16 provides an outline of alluvial deposits where drinking water standards will be enforced.

- Federal Drinking Water Regulations - Maximum Contaminant Levels and Maximum Contaminant Level Goals (40 CFR Parts 141, 142, and 143)

On January 30, 1991, EPA promulgated the new Safe Drinking Water Act (SDWA) National Primary Drinking Water Regulations (Phase II). See 56 Federal Register 3526 (January 30, 1991) (to be codified at 40 CFR Parts 141, 142, and 143). The Phase II National Primary Drinking Water Regulations establish Maximum Contaminant Level Goals (MCLGs) and Maximum Contaminant Levels (MCLs) for 31 contaminants, which are effective July 30, 1992. A second regulation, promulgated in July 1991, established MCLGs and MCLs for five additional contaminants. MCLs are enforceable standards that apply to specified contaminants which EPA has determined have an adverse effect on human health above certain levels. MCLGs are non-enforceable health-based goals that have been established at levels at which no known or anticipated adverse health effects occur and which allow an adequate margin of safety.

FIGURE 16


N
EXPLANATION
BOUNDARY OF ALLUVIUM
MFDS RESTRICTED AREA BOUNDARY
APPROXIMATE MFDS PROPERTY BOUNDARY
0 250 500 750 1000
SCALE IN FEET
MAXEY FLATS FS REPORT
MAXEY FLATS SITE RI/FS
EBASCO SERVICES INCORPORATED
OUTLINE OF ALLUVIAL DEPOSITS WHERE STANDARDS WILL BE APPLIED AS RELEVANT AND APPROPRIATE
FIGURE A-2

Under the NCP, EPA requires that MCLGs set at levels above zero (non-zero MCLGs) be attained during a CERCLA cleanup where they are relevant and appropriate. Where the MCLG is equal to zero, EPA sets the cleanup level to be the corresponding MCL. The MCLs and all non-zero MCLGs are relevant and appropriate requirements that must be achieved at the MFDS because ground or surface waters at the site are current or potential sources of drinking water. The recently added MCLs and MCLGs will supplement the Kentucky MCLs as relevant and appropriate requirements at the MFDS, and compliance with these ARARs will be judged at the contact of the alluvium with the hillside and ending at the streams. These criteria are presented in Appendix B to this Record of Decision.

- Kentucky Hazardous Waste Management Regulations (401 KAR Chapter 34)

- 401 KAR 34:060 (Section 5) - Ground Water Protection: Section 5 establishes maximum ground water concentration limits for certain metals and organic compounds. Given the specific characteristics of site topography and geology, the first point beyond the waste management area boundary at which corrective action would be technically practicable is at the contact of the alluvium with the hillslopes. Given the institutional control and perpetual maintenance features of the remedy to be implemented, this is also the first point at which the public could be exposed to contaminated ground water. Compliance with maximum ground water concentration limits will, therefore, be judged at the contact of the alluvium with the hillslopes.

- National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61, Subpart H)

The NESHAPs for radionuclides in 40 CFR Part 61, Subpart H, establish an effective dose equivalent of 10 mrem/year for Department of Energy facilities. This standard is relevant and appropriate to the MFDS and compliance with this requirement will be judged at the current site licensed property boundary.

- Kentucky Licensing Requirements for Land Disposal of Radioactive Waste (902 KAR 100:022)

The 25 mrem/year dose limit found in Section 18 of 902 KAR 100:022 is a relevant and appropriate requirement for the MFDS. Compliance with the 25 mrem/year standard will be judged on the combined doses contributed by air, water, drinking water and soil pathways. The point of compliance for this requirement will be the current site licensed property boundary.

- Federal Licensing Requirements for Land Disposal of Radioactive Waste (10 CFR Part 61.41)

Because Kentucky is an Agreement State, its radiation protection standards provide the standards for protecting against radiation in the general environment. Nevertheless, the analogous federal standard (10 CFR Part 61.41) to 902 KAR 100:022, Section 18 is relevant and appropriate.

- Federal Standards for Uranium and Thorium Mill Tailings (40 CFR Part 192)

The UMTRCA standard found in 40 CFR Part 192.12(a)(1), which applies to remedial actions at inactive uranium processing sites, limits radium-226 concentrations in soil to 5 pCi/gram in the top 15 centimeters. Radium-226 is present at the MFDS. Therefore, EPA has determined that the referenced UMTRCA standard is relevant and appropriate for the MFDS remedial action and is a contaminant-specific ARAR for soils at the Maxey Flats site.

8.3 ARARs Waiver

CERCLA Section 121(d) provides that, under certain circumstances, an ARAR may be waived using one (or more) of the following waivers:

- Interim Remedy Waiver - The remedial action selected is only a part of a total remedial action that will attain such a level or standard of control when completed. (CERCLA 121(d)(4)(A).)

- Greater Risk to Health and the Environment Waiver - Compliance with such requirement at the facility will result in greater risk to human health and the environment than alternative options. (CERCLA 121(d)(4)(B).)

- Technical Impracticability Waiver - Compliance with such requirement is technically impracticable from an engineering perspective. (CERCLA 121(d)(4)(C).)

- Equivalent Standard of Performance Waiver - The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation, through use of another method or approach. (CERCLA 121(d)(4)(D).)

- Inconsistent Application of State Standard Waiver - With respect to a State standard, requirement, criteria, or limitation, the State has not consistently applied (or demonstrated the intention to consistently apply) the standard, requirement, criteria, or limitation in similar circumstances at other remedial actions. (CERCLA 121(d)(4)(E).)

- Fund-Balancing Waiver - In the case of a remedial action to be undertaken solely under Section 104 using the Fund, selection of a remedial action that attains such level or standard of control will not provide a balance between the need for protection of public health and welfare and the environment at the facility under consideration, and the availability of amounts from the Fund to respond to other sites which present or may present a threat to public health or welfare or the environment, taking into consideration the relative immediacy of such threats. (CERCLA 121(d)(4)(F).)

At the MFDS, fifteen trench leachate samples were collected and analyzed for a variety of organics and inorganics during the RI. Additionally, RCRA analyses (pH, sulfide screen, ignitability screen) were performed on all fifteen samples. All samples tested negative for the RCRA parameters analyzed. Very low levels of organics were detected during the RI (e.g., toluene ranged from not detected to 5.3 parts per million, xylene ranged from not detected to 4.4 parts per million). The organic and inorganic analyses performed on the trench leachate indicate that Extraction Procedure (EP) Toxicity tests and Toxicity Characteristic Leachability Procedure tests would be negative for the fifteen samples. Therefore, RCRA characteristic levels would not be expected in the leachate once it is extracted and batched during RD/RA. Nontheless, the documented disposal of a listed waste at the MFDS (liquid scintillation vials containing xylene and toluene), and the presence of xylene and toluene in trench leachate, triggers RCRA requirements (or their Kentucky counterparts) as applicable to the MFDS.

Based on the very low levels of chemical constituents detected in trench leachate during RI sampling, it is unlikely that batched leachate would contain hazardous waste at levels above those which trigger prohibition of land disposal under Part 268. No further leachate testing for listed constituents or for waste at potentially characteristic levels is planned because, based on factors including those discussed below, EPA has determined that it is appropriate to invoke a waiver at this time.

During remedial action, approximately three million gallons of trench leachate will be extracted, batched, mixed with solidifying agents, and then disposed on-site in new disposal units. The leachate to be solidified includes concentrations of tritium as high, or higher than, 12,000,000 pCi/ml, Strontium-90 up to 2,000 pCi/ml, Plutonium-238 up to 320 pCi/ml, and Uranium-233/234 up to 130 pCi/ml. The objective of the leachate solidification program is to produce a solid, physically stable form of the leachate, thereby minimizing the mobility of radionuclides within the newly-constructed trenches. Treatment processes intended to remove the chemical portion of the leachate will significantly increase site worker exposure to radiation. In addition, by-products from treatment processes would require further handling, treatment and disposal, thereby further increasing worker exposure to radiation.

Risks associated with the MFDS are primarily due to potential exposure to radionuclides rather than the very low concentrations of chemical constituents detected at the site. However, measures taken to contain the radionuclides within the site (e.g., solidification and capping), will be effective in containing the chemical constituents as well. Thus, the implementation of treatment processes to remove the minor fraction of chemical constituents is not necessary to protect human health and the environment.

EPA has determined that compliance with 40 CFR Part 268 during remedial action at the MFDS would result in a greater risk to human health and the environment due to the volume of leachate to be treated and nature of the leachate and is hereby invoking a waiver of these requirements.

SECTION 9.0 - SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

9.1 Evaluation Criteria

Nine criteria are used to evaluate alternatives at Superfund sites. These nine criteria are categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The threshold criteria must be satisfied in order for an alternative to be eligible for selection. The primary balancing criteria are used to weigh major tradeoffs among alternatives. Generally, the modifying criteria are taken into account after public comment is received on the Proposed Plan. The nine criteria are as follows:

Threshold Criteria:

- Compliance with ARARs - Compliance with ARARs addresses whether a remedy will meet all of the ARARs of Federal and State environmental laws and/or justifies a waiver.

- Overall protection of human health and the environment - Overall protection of human health and the environment addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Primary Balancing Criteria:

- Short-term effectiveness - Short-term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until remedial action objectives are achieved.

- Long-term effectiveness - Long-term effectiveness refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time.

- Reduction of toxicity, mobility or volume - Reduction of toxicity, mobility, or volume through treatment is the anticipated performance of the treatment technologies a remedy may employ.

Primary Balancing Criteria (Continued):

- Implementability - Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

- Cost - Cost includes estimated capital and O & M costs, also expressed as net present-worth costs.

Modifying Criteria:

- State acceptance - State acceptance indicates whether, based on its review of the RI/FS Reports and Proposed Plan, the State concurs with, opposes, or has no comment on the preferred alternative.

- Community acceptance - Community acceptance summarizes the public's general response to the alternatives, based on public comments received during the public comment period.

9.2 Comparative Analysis

Compliance With ARARs

All of the alternatives, with the exception of Alternative 1, No Action, comply with all ARARs for the MFDS, or obtain an ARARs waiver as allowed under CERCLA Section 121(d). Since Alternative 1, the No Action alternative, does not meet the threshold criteria (does not achieve ARARs, does not provide overall protection of human health and the environment), Alternative 1 will not be evaluated further in this comparative analysis.

Overall Protection of Human Health and the Environment

All of the remedial alternatives provide overall protection of human health and the environment. However, the remedial alternatives have varying degrees of uncertainty associated with with long-term stability and potential release of contaminants. Alternative 5 provides the best assurance that, once the final cap is installed, cap maintenance will be at a minimum. Additionally, Alternative 5 is the least likely to involve container rupture and subsequent contaminant release.

In that wastes would be left at the site above health-based levels under each of the alternatives, the selected remedy will necessarily undergo an EPA-conducted review every five years following commencement of remedial action. The purpose of this review process is to ensure that the remedy prevents water infiltration into the trenches, mitigates hillslope erosion to the extent practicable, and minimizes the migration of site contaminants. Modifications to the remedy would occur through a Record of Decision amendment process if it were determined during a five-year review, or at any point between, that the remedy was not providing overall protection of human health and the environment.

Short-Term Effectiveness

Alternative 5 provides the greatest short-term effectiveness of the seven alternatives evaluated because it achieves initial capping of the trench disposal area earlier than any other alternative and with less exposure of site workers to radiation. Alternative 8 is only slightly less effective than Alternative 5, the principal difference being the greater amount of materials handling required for Alternative 8. Both of these natural subsidence alternatives (5 and 8) provide greater short-term effectiveness than Alternatives 4, 10 and 17, which use dynamic compaction to achieve stabilization, because dynamic compaction has a greater potential for exposing workers to direct radiation. Alternatives 4, 10 and 17 are roughly equal with respect to short-term effectiveness, but 10 provides a slightly greater degree of short-term effectiveness. The lack of a synthetic liner feature of Alternative 17 and the structural cap component of Alternative 4 make them less effective in the short term.

Alternative 11, grouting, is clearly the most hazardous to implement of the six alternatives and, therefore, is the least effective in the short term. Injecting more than 21 million gallons of grout into LLRW trenches at high injection rates and high pressures would be far more hazardous than any other activity considered for remediation of the site.

Long-Term Effectiveness

Alternative 5 provides a greater degree of long-term effectiveness overall than do the dynamic compaction alternatives even though, during the interim maintenance period of Alternative 5, a maintenance staff would be required to perform frequent inspections and to make prompt repairs

following subsidence. This is because when the final cap is installed after an approximate 35 to 100 years, the amount of data that would be available for assessing stability would likely provide more certainty of stability than can be predicted about the dynamic compaction alternatives (10 and 17). Moreover, the dynamic compaction alternatives could result in the release of additional radionuclides due to container rupture during the compaction process, whereas Alternative 5 would allow for continued radionuclide decay and containerization for a longer period of time. Thus, while initial maintenance requirements are more intense for Alternative 5, the dynamic compaction alternatives may result in increased monitoring and maintenance to address the potential increased source term and long-term stability.

Alternative 10 provides a slightly greater degree of long-term effectiveness than Alternative 17 because Alternative 10 has the synthetic liner in the cap to provide a back-up to the clay layer.

Alternative 11 provides less long-term effectiveness than Alternative 5. While grouting (Alternative 11) would provide greater stability than natural stabilization during the early years, and possibly well beyond the early years, ultimately, natural stabilization would provide more stability. Because grout used in Alternative 11 would fill only the accessible voids at the time of grout injection, at some unpredictable time, one or more trenches might have a major subsidence and permit water to infiltrate the trenches. By contrast, Alternative 5 would be easy to repair, and the maintenance staff would likely discover the subsidence before water infiltrated the trenches.

Alternative 8 would require more frequent maintenance than Alternative 4; however, two potential major repair problems with Alternative 4 - concrete cracking and water infiltration - result in it providing a lesser degree of long-term effectiveness.

Reduction of Toxicity, Mobility or Volume

Because radioactivity is an intrinsic property of the nuclides in the trench leachate and other media at the site, leachate toxicity cannot be altered by treatment. Time is the principal means by which the toxicity of radionuclides is reduced. Toxicity is reduced by decay of the radionuclides to concentrations at which they no longer present a threat to human

health and the environment. None of the alternatives evaluated employ a treatment technology aimed at satisfying the reduction of toxicity evaluation factor. However, mobility and volume can be addressed by treatment; decreasing mobility has a direct impact on health and safety since decreased mobility results in longer travel times for radionuclides and a decrease in activity resulting from radionuclide decay.

Reduction of the mobility of site radionuclides is achieved in varying degrees by each of the alternatives evaluated. All remedial alternatives involve the extraction, solidification and on-site disposal of solidified trench leachate. The solidification of radioactively contaminated water does not destroy or alter the radioactivity, but changes its form to a physically stable mass which binds the radionuclides so that they are far less mobile than they were in their liquid form. Approximately three million gallons of trench leachate will be solidified and disposed; thus, a significant reduction of the mobility of trench leachate would be accomplished by each of the alternatives. However, other factors, as discussed below, result in some alternatives being more acceptable than others in terms of mobility.

Other than exhumation and off-site disposal of the contaminated media at the site, a significant reduction in volume at the MFDS is not currently attainable. Exhumation and off-site disposal, while physically possible to perform, would result in unacceptably high doses to site workers involved in excavation of the solid wastes in the trenches. Additionally, due to the activity of some of the waste present at the site, and the volume of waste involved, no present-day commercial low-level waste facility would likely accept the waste. Furthermore, exhumation would not meet 902 KAR 100:015 which, as an applicable action-specific requirement for the MFDS. 902 KAR 100:015 requires exposures to be kept to as low as reasonably achievable.

The following factors were used to evaluate the alternatives against the reduction of toxicity, mobility or volume criteria: release of trench contaminants due to waste container rupture, the ability of an alternative to prevent infiltration of water and subsequent generation of new leachate, and the generation of contaminated material (increase in the volume of waste). Alternatives 5 and 8 are the superior alternatives in terms of reducing mobility and volume for several reasons. First, they do not involve the forced consolidation of trench waste;

therefore, the potential for release of radionuclides is not as great as the dynamic compaction alternatives (4, 10 and 17). Second, Alternatives 5 and 8 are superior to the grouting alternative (11) because they do not generate waste grout resulting from grout setup prior to injection or grout break-through, which must then be disposed of on-site.

Alternative 11 is more effective than Alternatives 4, 10 and 17 because the grout would solidify and may fixate the contaminants and would result in a more predictable trench chemistry. Alternatives 10 and 17, which utilize dynamic compaction, result in a more complex trench chemistry with a less than predictable impact on the environment. Alternative 4 is less effective than Alternatives 10 and 17 because it would be more difficult to keep water out of the trenches and to prevent contamination or construction runoff water when installing the structural cap.

Implementability

Alternative 5 would be the easiest to implement because it would be a continuation of the present operation but with improvements. Alternative 8 would be more difficult than Alternative 5 because of the problems associated with repair of the final cap over the period of trench subsidence. Both Alternatives 5 and 8 would be easier to implement than the alternatives involving grouting, dynamic compaction, or structural concrete, all of which are more complicated technologies. The dynamic compaction alternatives (4, 10 and 17) would be more easily implemented than the grouting alternative (11). Nevertheless, dynamic compaction would require pilot scale demonstrations of the suitability of this technology to the MFDS.

Alternative 11 is the least implementable of the alternatives evaluated at the MFDS. High production grouting (large volumes, high injection rates, high pressures), although technically feasible, has experienced difficulties at other similar sites. Additionally, the scale to which it would be employed at the MFDS is much greater than other sites where it has been applied. Significant difficulties could be expected during attempts to drive injection lances into the trenches. Grouting would require additional research and testing at the MFDS due to the complexities associated with grouting in trenches.

Cost

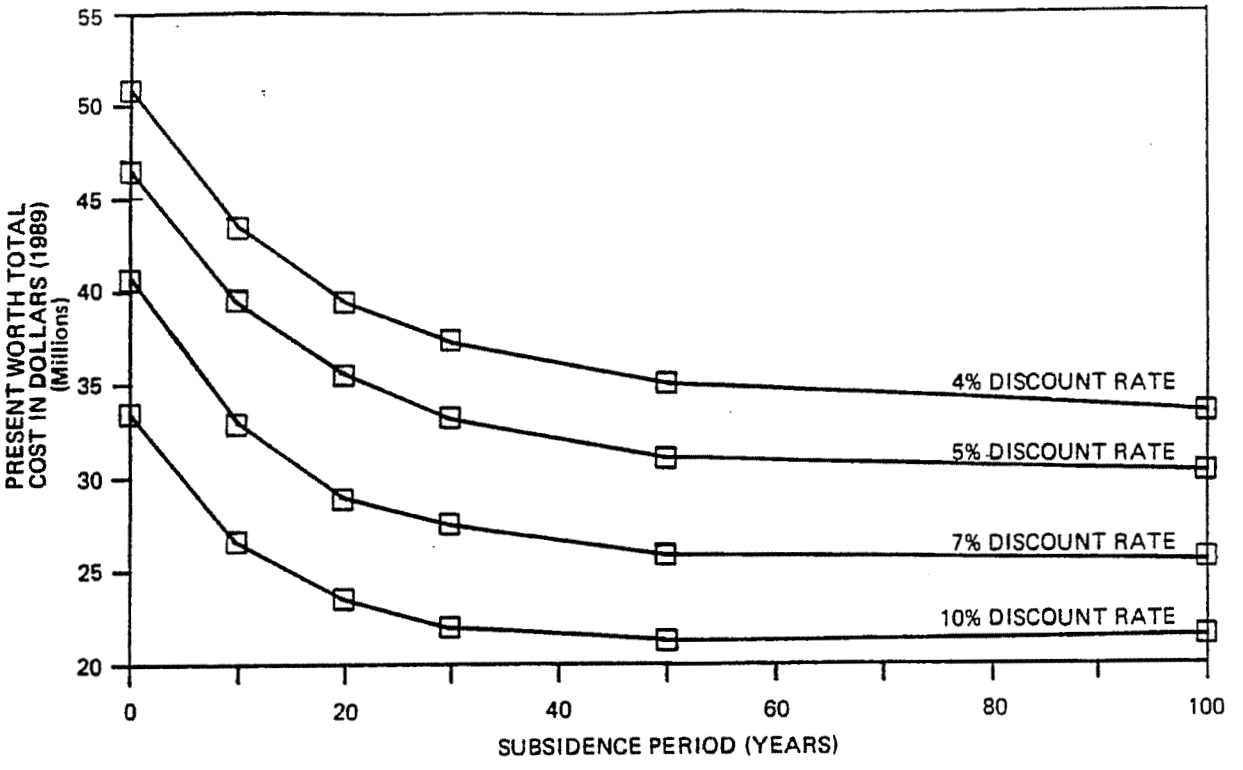
The present worth total cost of Alternative 5 depends on the period assumed for interim maintenance and is a maximum when the interim maintenance period equals zero years. Nevertheless, comparing the maximum present worth total costs of Alternative 5 with those of other alternatives shows that Alternative 5 has the lowest present worth total cost of any alternative regardless of the length of the interim maintenance period. Figure 16 illustrates the differences in total present worth for four assumed discount rates over the projected subsidence period.

Table 32 provides a cost breakdown for Alternative 5 and provides cost estimates for Alternative 5 using four different discount rates, 4%, 5%, 7%, and 10%. The $ 33,500,000 cost estimate for Alternative 5 is based upon a 4% discount rate, which is the most conservative rate of the four rates used in the Feasibility Study. A 4% discount rate was used to compare alternatives. The actual discount which will be used to establish the MFDS trust fund has yet to be determined.

Furthermore, the cost estimate for Alternative 5 assumes a 10% contingency and installation of a North Cutoff Wall. The actual contingency factor employed in the establishment of the MFDS trust fund may be higher than 10%. The necessity of a horizontal flow barrier and type of horizontal flow barrier (i.e., North Cutoff Wall, Lateral Drain/Cutoff Wall, etc.) will be determined during the Interim Maintenance Period; therefore, the cost estimate for Alternative 5 is subject to change.

State Acceptance

The Commonwealth generally endorses the selection of Alternative 5 (Natural Stabilization) as the remedy for the Maxey Flats Disposal Site. The Commonwealth considers trench cover repair and a horizontal flow barrier, if needed, to be integral features of the remedy chosen for the site. The Commonwealth rejects the use of Alternative 10 and 17 (dynamic compaction) for either a site demonstration or for total site remediation due to potential release of contaminants into the environment and uncertainties regarding dynamic compaction's effect on the underlying geologic strata. The Commonwealth also rejects the use of grouting (Alternative 11) for implementation at the MFDS due to potential unacceptable releases to the environment, implementability problems, and required demonstration of this technology prior to implementation.



MAXEY FLATS FS REPORT
MAXEY FLATS SITE RI/FS

EBASCO SERVICES INCORPORATED

ALTERNATE 5 SUBSIDENCE PERIOD PRESENT WORTH SENSITIVITY CURVES

040191

FIGURE G-2

ALTERNATIVE-5: NATURAL STABILIZATION (50-ACRE CAP)

CAPITAL COSTS AND COST LAYOUT	Estimated Total	Year 1 1990	Year 2 1991	Year 3 1992	Year 4 1993	Interim Period	Year 103 2092	Year 104 2093
A. Construction Cost								
Site Preparation and Support								
1. Road Construction (Cut, Gravel, Fabric)	$530,000	$0	$0	$430,000	$0		$0	$100,000
2. Decon. Facility(Equip't & Personnel)	$130,000	$0	$0	$80,000	$0		$0	$50,000
3. Utilities	$50,000	$0	$0	$30,000	$0		$0	$20,000
4. Field Offices & Construction Fence	$200,000	$0	$0	$120,000	$0		$0	$80,000
5. Topographic & Bkgd Radiation Survey	$140,000	$0	$0	$70,000	$0		$0	$70,000
6. Ground Penetration Radar Survey	$150,000	$0	$0	$150,000	$0		$0	$0
7. Construction Erosion Control	$200,000	$0	$0	$100,000	$0		$0	$100,000
8. Health and Safety	$2,000,000	$0	$0	$1,000,000	$500,000		$0	$500,000
9. QA/QC	$1,080,000	$0	$0	$450,000	$250,000		$0	$380,000
Sub-total	$4,480,000	$0	$0	$2,430,000	$750,000		$0	$1,300,000
Specific Construction Activities								
1. Leachate Removal	$1,252,000	$0	$0	$1,252,000	$0		$0	$0
2. Contaminated Liquid Handling and Disposal	$4,079,000	$0	$0	$4,079,000	$0		$0	$0
3. Contaminated Soil Disposal	$174,000	$0	$0	$174,000	$0		$0	$0
4. Existing Tank Leachate-Rem'l, Solid'n & Disp'l	$0	$0	$0	$0	$0		$0	$0
5. Horizontal Flow Barrier (North Cutoff Wall)	$1,156,000	$0	$0	$1,156,000	$0		$0	$0
6. Additional Backfill	$0	$0	$0	$0	$0		$0	$0
7. Dynamic Compaction	$0	$0	$0	$0	$0		$0	$0
8. Trench Grouting	$0	$0	$0	$0	$0		$0	$0
9. Site Grading	$160,000	$0	$0	$160,000	$0		$0	$290,000
10. Demol'n, Material Handling & Decon.	$740,000	$0	$0	$450,000	$0		$0	$0
11. Leachate Solidificat'n/Add'l Disposal Trenches	$4,706,000	$0	$0	$4,706,000	$0		$0	$674,000
12. Drainage Ditches	$889,000	$0	$0	$0	$215,000		$0	$14,040,000
13. Initial and Final Closure Caps	$17,489,000	$0	$0	$0	$3,449,000		$0	$1,241,000
14. Cap Erosion Control	$1,445,000	$0	$0	$0	$204,000		$0	$65,000
15. Long Term Monitoring	$691,000	$0	$0	$0	$626,000		$0	$0
16. Security Fence	$120,000	$0	$0	$60,000	$60,000		$0	
Sub-total	$32,901,000	$0	$0	$12,037,000	$4,554,000		$0	$16,310,000
Total Construction Cost	$37,381,000	$0	$0	$14,467,000	$5,304,000		$0	$17,610,000
B. Engineering and Management Cost								
1. Engineering & Design (1)	$2,990,480	$0	$1,581,680	$0	$0		$1,408,800	$0
2. Construction Management (2)	$11,214,300	$0	$0	$4,340,100	$1,591,200		$0	$5,283,000
Total Engineering & Management Cost	$14,204,780	$0	$1,581,680	$4,340,100	$1,591,200		$1,408,800	$5,283,000
Total Capital Cost	$51,585,780	$0	$1,581,680	$18,807,100	$6,895,200		$1,408,800	$22,893,000
10% Contingency	$5,158,578	$0	$158,168	$1,880,710	$689,520		$140,880	$2,289,300
Total Capital Cost with Contingency	$56,744,358	$0	$1,739,848	$20,687,810	$7,584,720		$1,549,680	$25,182,300

ALTERNATIVE-5: NATURAL STABILIZATION (50-ACRE CAP)

PRESENT WORTH CALCULATION - CAPITAL COSTS

Assumptions:

1. Estimated Engineering and Design cost is based on 8% of total construction
2. Estimated construction management cost is based on 30 % of total construction
3. Scheduled construction period for Alternative 5 is 20 months for initial construction and 10 months for final capping.

	Discount Rates			
	4%	5%	7%	10%
PW of Total Capital Costs	$25,900,882	$24,625,424	$22,632,720	$20,147,951

PRESENT WORTH CALCULATION - O & M COSTS

Assumptions:

1. Present worth of O&M costs is based on perpetual annual maintenance and subsidence repair as required
2. All O&M costs include inflation at 0% per year.
3. O&M begins in December of Year 4 (1993).
4. Cost of yearly custodial maintenance excluding subsidence repair is $385,000 for years 1 to 10, $295,000 for years 11 to 100, $240,000 years 101 to 110, and $190,000 years 111 onwards in perpetuity. In addition, $40,000 is applied every 5 years for the first 100 years for leachate pumping and solidification.
5. O&M costs do not include taxes, insurance and license fees.

	Discount Rates			
	4%	5%	7%	10%
PW of Total O&M Costs	$10,097,549	$7,692,612	$4,924,075	$2,921,415

PRESENT WORTH - TOTAL COST

	Discount Rates			
	4%	5%	7%	10%
PW of Total Cost	$35,998,431	$32,318,036	$27,556,795	$23,069,366

Community Acceptance

Verbal comments received at the Proposed Plan public meeting, held on June 13, 1991 in Wallingford, Kentucky, and on comments submitted to EPA during the public comment period on the Proposed Plan, indicate that the community favors Alternative 5, Natural Stabilization, over the other alternatives considered. However, the community urged inclusion of a number of features in the Record of Decision and RD/RA Consent Decree. The community's comments and suggestions, as well as EPA responses, can be found in the Responsiveness Summary section of this Record of Decision.

The community opposes the dynamic copaction alternative (Alternatives 4, 10 and 17) for the MFDS, primarily because of concerns over accelerated release of contaminants to the environment during the compaction process. The community does not favor the grouting alternative due to concern over potential contaminant release from intact containers during the grout injection process and uncertainties over the ability of grout to adequately fill void spaces within the trenches.

9.3 Conclusions of the Comparative Analysis Summary

Of the nine criteria described above, the differences between the six remedial alternatives evaluated are not great, except with respect to the following four criteria: 1) Implementability; 2) Reduction of Toxicity, Mobility or Volume; 3) State Acceptance, and 4) Community Acceptance. All remedial alternatives provide for roughly the same degree of long-term and short-term effectiveness. All remedial alternatives provide for overall protection of human health and the environment and all achieve ARARs. Although cost estimates differ amongst the remedial alternatives, none differ by more than an order of magnitude.

Therefore, Implementability, Reduction of Toxicity, Mobility or Volume, State Acceptance, and Community Acceptance weighed heavily in favor of selection of Alternative 5. Alternative 5 is the least difficult remedy to implement, utilizing proven and reliable technologies to achieve final remediation, while not requiring time-consuming research and development prior to implementation. It is less likely to result in container rupture and, therefore, benefits from the added protection of containers within the trenches. Both the State and Community favor the Natural Stabilization technology.

SECTION 10.0 - THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives, and public comments, EPA has determined, and the Commonwealth agrees, that Alternative 5, Natural Stabilization, is the most appropriate remedy for the Maxey Flats Disposal Site.

The natural stabilization process at Maxey Flats will allow the materials to subside naturally to a stable condition prior to installation of a final engineered cap. It is not known how long it will take for waste trenches to stabilize because of the many physical and chemical variables involved and the limited trench-specific information upon which predictions are based. However, it has been estimated that this stabilization process could potentially take 100 years before the final cap is placed.

Stabilization of the trenches by natural subsidence over a relatively long time period will virtually eliminate the potential problem of future subsidence expected with other alternatives in which the trenches would be stabilized by mechanical means and a final cap installed within a few years. Therefore, the natural stabilization alternative will reduce the redundancy of efforts necessary to construct and maintain the final cap. Natural stabilization does not disrupt intact metal containers such as 55-gallon drums and, therefore, provides an extra measure of protection to prevent movement of radionuclides to the hillsides. The other alternatives have the potential of rupturing intact containers, thereby releasing radioactive material immediately to the trenches. Additional benefits of the natural stabilization alternative will be the opportunity for continued data collection and analyses and the ability to take advantage of technological advances during the subsidence period.

Alternative 5 can be divided into the following four phases which together comprise the CERCLA remedial action for the MFDS:

- Initial Closure Period (22 months)
- Interim Maintenance Period (35 - 100 years)
- Final Closure Period (10 months)
- Custodial Maintenance Period (in perpetuity)

10.1 - Initial Closure Period

The initial closure period will consist of the design and implementation of remedial activities appropriate to the early stages of site remediation. An Interim Site Management Plan will also be developed to define the maintenance and monitoring tasks to be conducted during the subsequent interim maintenance period.

The following remedial activities will be performed during the initial closure period:

- Baseline Topographic Surveys
- Geophysical Surveys
- Ground Water Monitoring
- Ground Water Modeling
- Trench Leachate Extraction and Solidification
- Disposal of Solidified Leachate Into New Trenches On-Site
- Demolition of Existing Buildings and Structures With On-Site Disposal
- Installation of an Initial Cap
- Grading and Recontouring of the Initial Cap to Enhance Surface Water Flow
- Improvements to Site Drainage
- Installation of Subsidence Monitors
- Closure of Selected, Poorly Designed, Historical Wells
- Monitoring, Maintenance, and Surveillance
- Procurement of a Buffer Zone Contiguous to the Existing Site Property
- Posting and Repairing of Signs and Fences, Road Maintenance
- Development of the Interim Site Management Plan

Baseline Topographic and Geophysical Surveys will be conducted prior to design of the initial cap. Topographic surveys will be performed prior to installation of the initial cap and following construction of the cap to be used as a baseline survey for subsidence monitoring. A geophysical survey will enhance the definition of trench boundaries to ensure that the initial cap will adequately cover the trenches.

Historical site monitoring data, the Commonwealth's site database, and ground water models will be used to determine the appropriate areal extent of the initial cap, to evaluate the need for a horizontal ground water flow barrier, and to develop an effective ground water monitoring plan for the Interim Maintenance and Custodial Maintenance Periods. The ground water monitoring program will involve installation of new monitoring wells, as appropriate, in the alluvium of the surrounding stream valleys, and in other areas as required, to ensure compliance with drinking water standards and to achieve RCRA monitoring requirements.

Trenches will be dewatered to help prevent the migration of contaminants by ground water flow. A trench dewatering test program will be conducted either during the design phase or during initial remedial activities to provide information on the most effective design of the dewatering program, to determine the need for new sumps, and to provide an estimate of the duration of the dewatering program.

Leachate pumped from the trenches will be extracted simultaneously from multiple trenches and batched prior to solidification. Additional sumps will be added in select trenches with significant quantities of leachate in order to facilitate the dewatering of trenches. Trench dewatering is the most time-consuming component of the Initial Closure Period. A minimum of nine months will be required to dewater the trenches.

Once batched, the leachate will undergo testing for NRC classification purposes. Once classified, the leachate will be solidified using an NRC-approved mix. The waste form will likely be in block form, provided an acceptable leachability index and cumulative fraction leached can be achieved. However, high activity leachate will be required to be placed in a primary container and solidified. The solidified leachate will also be designed to achieve a sufficient minimum compressive strength. The objectives of the leachate solidification will be to produce a solid, physically stable form of the leachate, thereby minimizing the mobility of the contamination within the trenches. During the leachate solidification operations, external exposure to ionizing radiation will be kept as low as reasonably achievable by using engineering safeguards, such as shielding, and administrative safeguards such as detailed health and safety procedures for all operations. Internal exposure to radioactivity should be insignificant, since the systems that handle radioactivity would be designed to minimize leakage.

The solidified leachate will then be placed into new disposal trenches on-site and within (or in close proximity to) the current Restricted Area. Grout will be used in the newly constructed trenches to fill the void spaces between the solidification forms, in effect, creating a monolith within the trench. Each new disposal trench will, at a minimum, include a sump and a synthetic liner (unless it is later determined by EPA and the Commonwealth that use of a liner is inappropriate).

Non-functional and unstable buildings and structures will be dismantled, decommissioned and buried in a trench on-site

during the Initial Closure Period. Such buildings and structures will probably include: the storage building, evaporator building, garage building, radiological control building, the sewage treatment plant, and tank farm buildings. Those buildings necessary to the management and maintenance of the site will be moved to a new location that will not impede remedial activities. Figure 18 is a typical construction planning drawing that may be employed during the Initial Closure Period.

An initial cap, consisting of a soil layer of compacted clay (averaging 21 inches thick) and covered with a synthetic liner, will be installed toward the end of the Initial Closure Period. Soil will be added to the site and graded and compacted in preparation for the installation of the synthetic cover over the trench disposal area. Conceptual cross-sections of both the initial cap and the final cap are presented in Figure 19. The areal extent of the interim cover will be based upon geophysical surveys, ground water modelling and other parameters evaluated during design. It has been estimated that the interim cap will cover approximately 40 to 50 acres. Fugitive dust problems during earth-moving operations will be controlled by using water or other dust suppressants. Kentucky Soil and Water Conservation requirements for controlling soil erosion will be met by designing and locating technologies and activities to minimize potential erosion.

The surface will be graded to design specifications to allow for adequate drainage and to minimize surface water velocities and consequent erosion. Lined drainage ditches will be incorporated in the trench cap to channel the surface water runoff to the three existing discharge basins located along the periphery of the trench disposal area. Improvements will also be made to the existing site drainage channels on the hillslopes. These erosion protection measures could include, but will not necessarily be limited to, stabilization of the drainage channels where necessary by such measures as rock rip-rap or gabions to reduce the velocity of flow. Additional drainage channels in the vicinity of the site may be added if found to be necessary to control, and more equitably distribute, the anticipated increased rates of surface water runoff. Because of the high peak discharge volumes resulting from the initial cap, the capacity of the retention ponds will be increased to improve control of stormwater runoff. Approval of the initial cap design will be contingent upon the ability of the surface water controls to adequately maintain rates of surface water runoff throughout the anticipated duration of the Interim Maintenance Period.

FIGURE 18

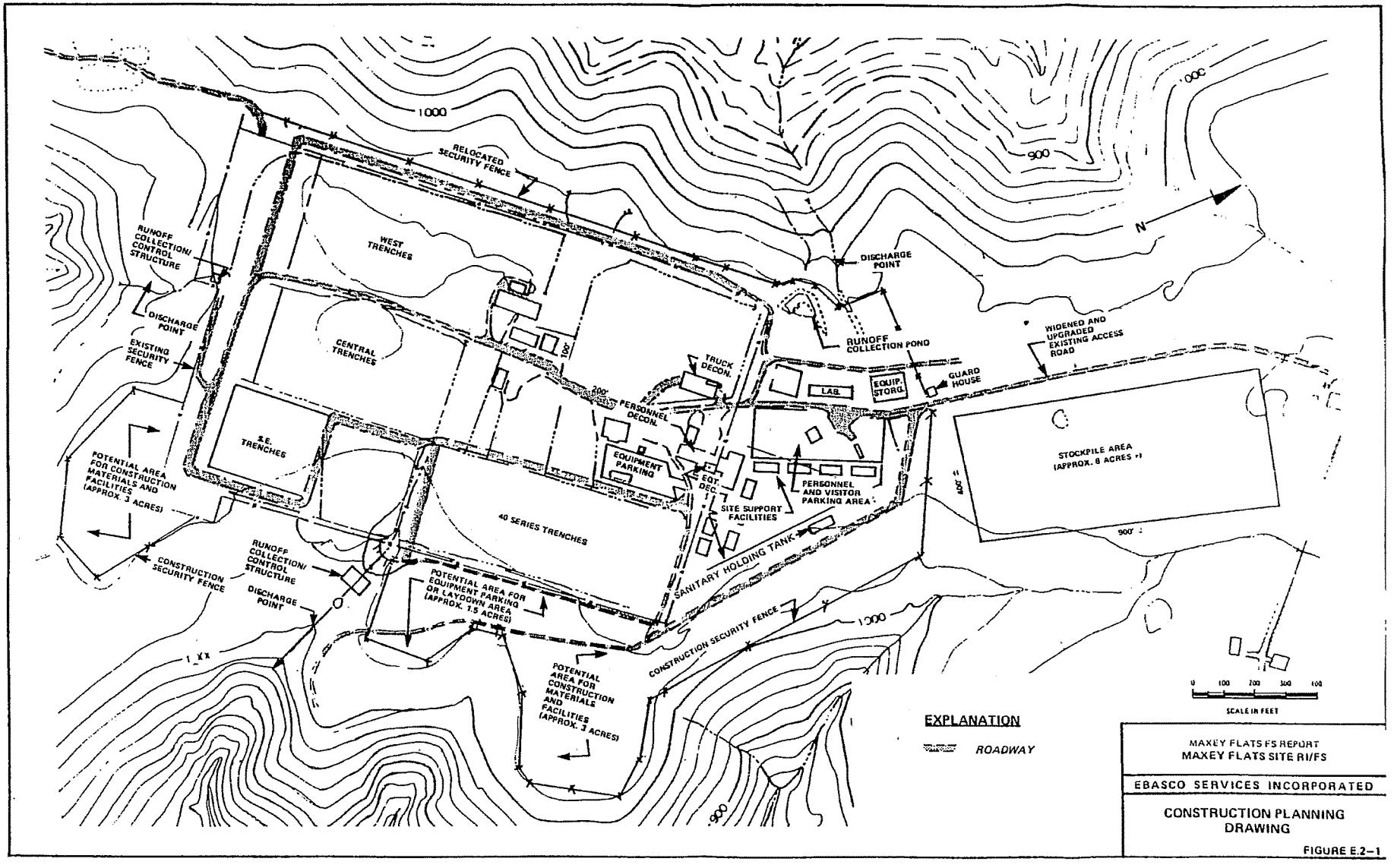
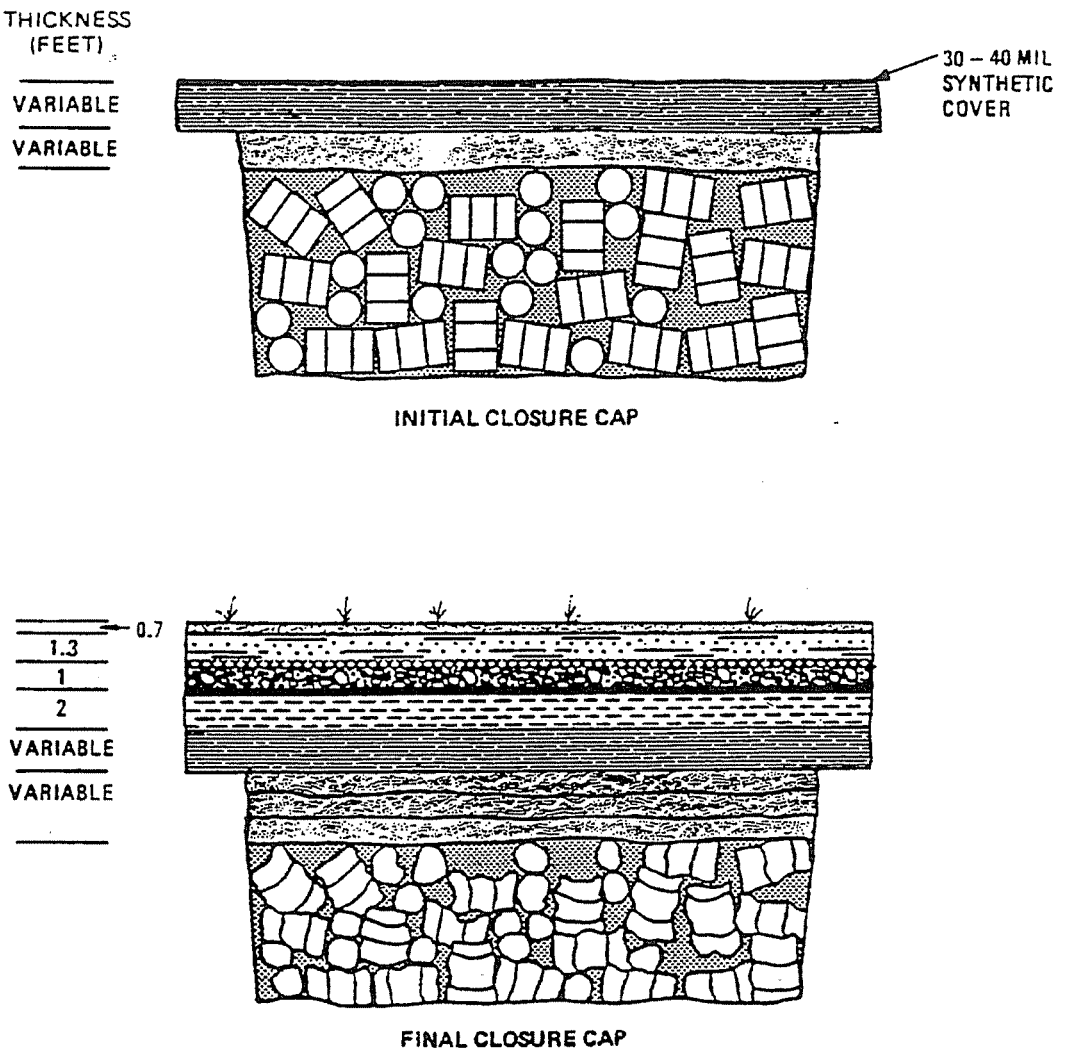

1000
900
RELOCATED SECURITY FENCE
RUNOFF COLLECTION/ CONTROL STRUCTURE
DISCHARGE POINT
EXISTING SECURITY FENCE
WEST TRENCHES
CENTRAL TRENCHES
S.E. TRENCHES
40 SERIES TRENCHES
TRUCK DECON.
PERSONNEL DECON.
EQUIPMENT PARKING
EQUIP. DECON.
LAB.
EQUIP. STORG.
GUARD HOUSE
RUNOFF COLLECTION POND
DISCHARGE POINT
WIDENED AND UPGRADED EXISTING ACCESS ROAD
PERSONNEL AND VISITOR PARKING AREA
SITE SUPPORT FACILITIES
SANITARY HOLDING TANK
STOCKPILE AREA (APPROX. 8 ACRES +)
POTENTIAL AREA FOR CONSTRUCTION MATERIALS AND FACILITIES (APPROX. 3 ACRES)
CONSTRUCTION SECURITY FENCE
RUNOFF COLLECTION/ CONTROL STRUCTURE
DISCHARGE POINT
POTENTIAL AREA FOR EQUIPMENT PARKING OR LAYDOWN AREA (APPROX. 1.5 ACRES)
POTENTIAL AREA FOR CONSTRUCTION MATERIALS AND FACILITIES (APPROX. 3 ACRES)
CONSTRUCTION SECURITY FENCE
N
0 100 200 300 400
SCALE IN FEET
EXPLANATION
ROADWAY
MAXEY FLATS FS REPORT
MAXEY FLATS SITE RI/FS
EBASCO SERVICES INCORPORATED
CONSTRUCTION PLANNING DRAWING
FIGURE E.2-1

FIGURE 19


THICKNESS (FEET)
VARIABLE
VARIABLE
30 – 40 MIL SYNTHETIC COVER
INITIAL CLOSURE CAP
0.7
1.3
1
2
VARIABLE
VARIABLE
FINAL CLOSURE CAP
EXPLANATION
30 TO 40 MIL SYNTHETIC COVER
TOPSOIL LAYER WITH VEGETATIVE COVER
SILTY SAND
GEOTEXTILE FABRIC
CRUSHED ROCK
80 MIL SYNTHETIC LINER
CLAY LAYER (PERMEABILITY ≤ 1 x 10⁻⁷ cm/sec)
COMPACTED SOIL LAYER
EXISTING TRENCH SOIL COVER
TRENCH WITH RANDOMLY PLACED WASTE CONTAINERS
NOT TO SCALE
MAXEY FLATS FS REPORT
MAXEY FLATS SITE RI/FS
EBASCO SERVICES INCORPORATED
ALTERNATIVE 5
NATURAL STABILIZATION
040191
FIGURE 4-3

Subsidence monitors will be installed on the initial cap and on natural soils in the vicinity of the Restricted Area as a method of determining when the trenches have stabilized to an acceptable degree and final cap installation can begin.

A limited number of existing, poorly designed, wells (i.e., E-Wells) could potentially allow contaminants in ground water to migrate downward into the lower geologic units and will, therefore, be decommissioned and sealed. Existing sumps and wells (i.e., UE, UF UG, UK, etc.) that are deemed beneficial to the leachate extraction process, as well as those necessary for trench monitoring, will not be decommissioned.

Water monitoring equipment, as part of an Infiltration Monitoring System, will be installed in trenches, under the cap and within wells, to detect potential accumulation of leachate in trenches. Vibrating wire piezometers, such as the one illustrated in Figure 20, will be installed in riser pipes after construction of the initial cap. Riser pipes will be installed during cap construction and will be used to extend the monitoring wells through the cap. Water level data from the trenches and wells will be collected by data logging equipment located at the site. This data, in conjunction with other information, will be used to assess the degree to which infiltration is occurring, if any.

The monitoring program developed for the MFDS will, at a minimum, include the following objectives:

- Demonstration of compliance with the applicable or relevant and appropriate regulations, environmental standards, and other operational limits.

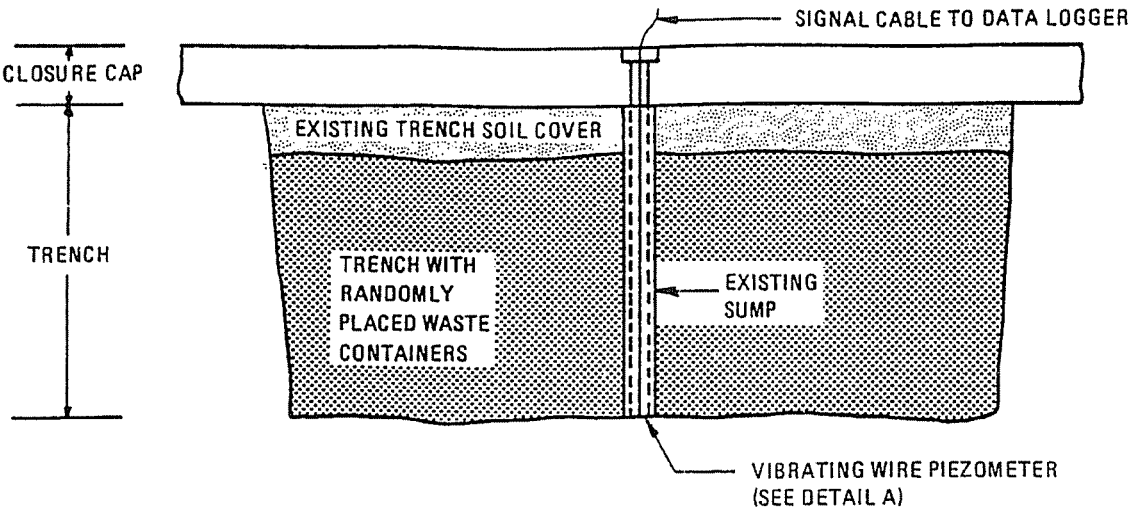
- Assessment of the actual or potential exposure of man to radioactive materials or chemical constituents in the environment.

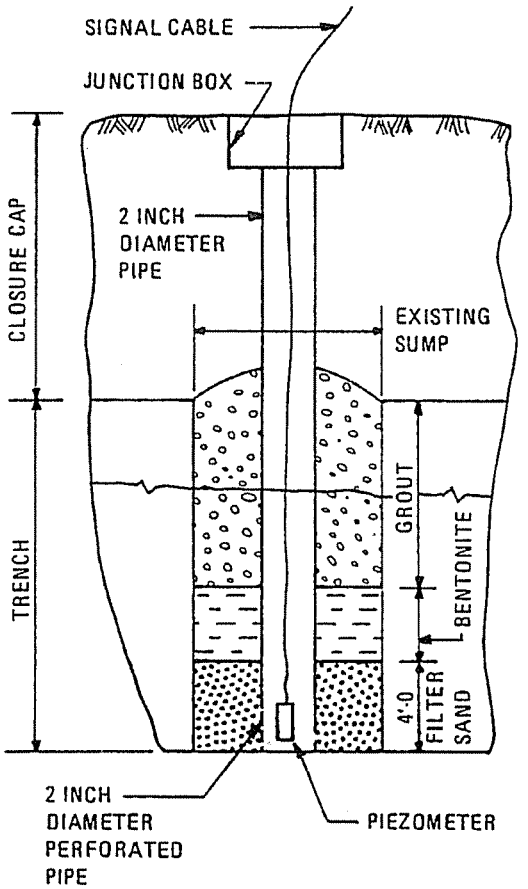
- Detection of any possible long-term changes or trends in the environment resulting from the site.

- Assessment of the performance (adequacy) of design features that limit the release of radioactive materials to the environment.

Radionuclide and chemical constituent testing of ground water, surface water, soil, sediment and air will be performed, as appropriate and on a routine basis, to ensure that the remedy

FIGURE 20





DETAIL A

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MAXEY FLATS SITE RI/FS

EBASCO SERVICES INCORPORATED

VIBRATING WIRE PIEZOMETER THROUGH TRENCH SUMPS

FIGURE E.11-1

for the MFDS is achieving all ARARs and continues to be protective of human health and the environment. Monitoring of leachate levels in trenches, subsidence monitoring and erosion and siltation monitoring will be routinely conducted. A program will be established to assess and track the impact of site remediation on local wildlife and vegetation and to confirm the assumptions and conclusions of the MFDS risk assessment. These monitoring programs will be established during the Initial Closure Period (as specified in the Interim Site Management Plan) and continued through the Interim Maintenance Period and on into the Custodial Maintenance Period.

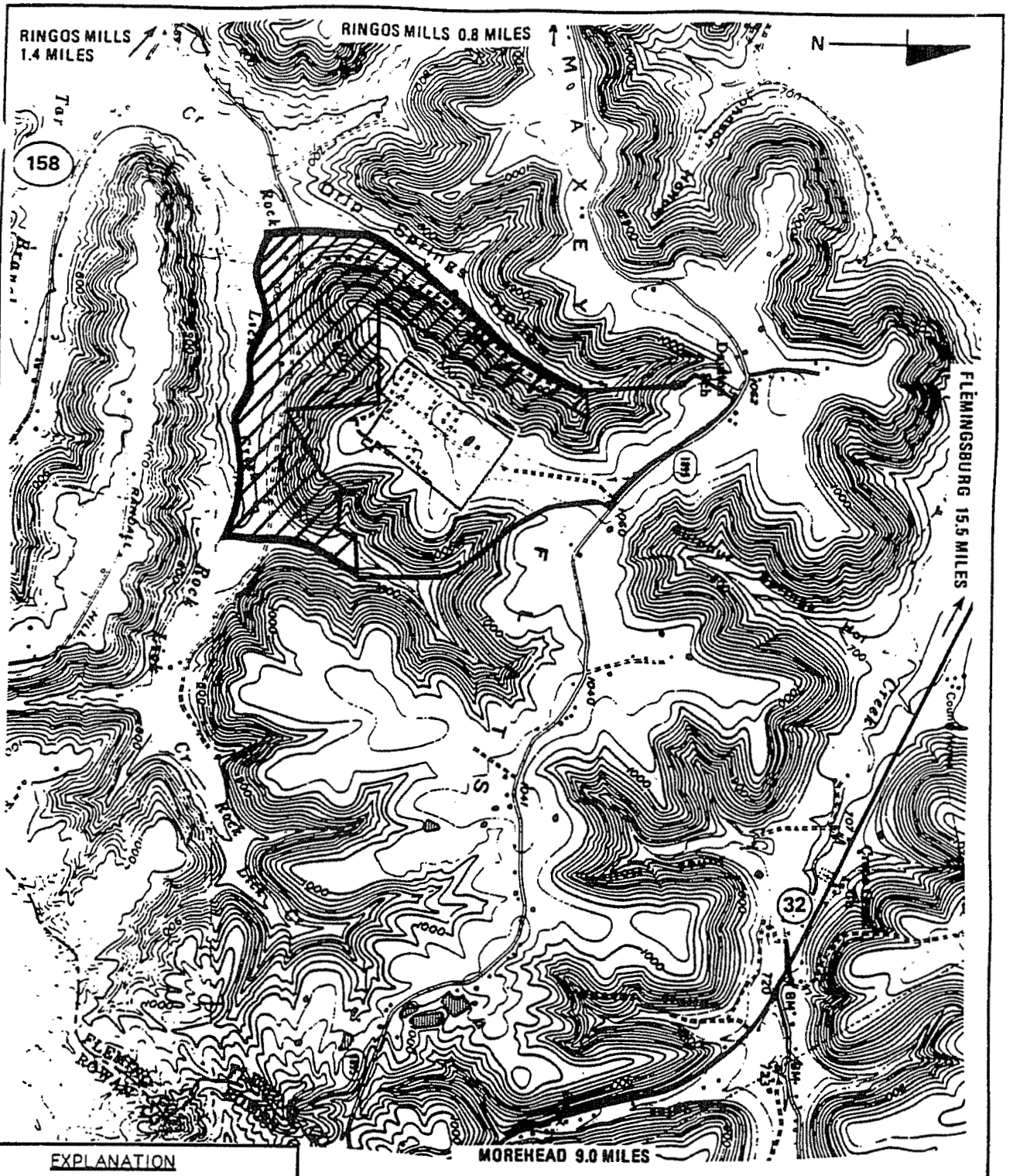
A buffer zone, adjacent to the existing site property boundaries, will be acquired. The primary purpose of a buffer zone is to protect environmentally sensitive areas such as the hillslopes from detrimental activities such as logging. Without control of activities on the hillslopes, increased erosion due to deforestation could severely affect the integrity of the remedy.

The buffer zone will not extend the current licensed site property boundary, although control over the property would likely be in the hands of the Commonwealth of Kentucky. Moreover, the points of compliance for ARARs will not be extended by procurement of the buffer zone. Monitoring of streams, ground water and other media will be conducted in the buffer zone and other areas deemed necessary to assure that the selected remedy achieves ARARs. Indeed, the secondary purpose of the buffer zone is to ensure unrestricted, long-term access to areas necessary for full and effective monitoring.

At a minimum, the buffer zone will extend from the current site property boundary to Drip Springs, No Name, and Rock Lick Creeks to the west, east, and southwest of the site, respectively. The tentatively identified Buffer Zone, illustrated in Figure 21, is a conceptual delineation of the minimum boundary of the buffer zone.

Signs will be posted warning potential trespassers of the presence of site contaminants. Fences will be constructed, repaired and/or re-aligned as needed to prevent unauthorized access to the capped trench disposal area, construction areas established during the Initial Closure Period, and other areas deemed inappropriate for access. Access to the MFDS from Interstate 64 is via State Road 32 to County Road 1895, which runs to the entrance of the MFDS. County Road 1895 is a two-lane paved road suitable for the maximum legal load allowed

FIGURE 21


RINGOS MILLS 1.4 MILES
RINGOS MILLS 0.8 MILES
N
158
32
FLEMINGSBURG 15.5 MILES
MOREHEAD 9.0 MILES
EXPLANATION
MFDS RESTRICTED AREA
MFDS PROPERTY BOUNDARY
PROPOSED BUFFER ZONE
MAP PRODUCED BY EBASCO SERVICES INCORPORATED AND LABELLED FOR THIS REPORT BY BOOZ, ALLEN & HAMILTON, Inc.
MAXEY FLATS DISPOSAL SITE
PROPOSED BUFFER ZONE MAP
MAP 6

by Kentucky's Department of Transportation and appears to be in good condition. Well in advance of construction activities, the need to upgrade County Road 1895 will be discussed with Fleming County officials. Should it be determined that site activities are having a detrimental effect on County Road 1895, the authority(ies) responsible for remediation of the MFDS will be responsible for funding such repairs.

A comprehensive Interim Site Management Plan will be developed during the Initial Closure Period to define the maintenance and monitoring tasks to be conducted during the Interim Maintenance Period.

10.2 Interim Maintenance Period

Upon installation of the initial cap, the Interim Maintenance Period will commence. The primary objective of the Interim Maintenance Period is to let the trenches stabilize by natural subsidence. The Interim Site Management Plan will provide the basis for work activities during the interim maintenance period. During this period, the initial cap will continue to be maintained to prevent infiltration of water into the trenches, maintenance of the site will continue, and the site will be monitored by an enhanced monitoring/surveillance program.

During the Interim Maintenance Period, the following activities will be performed as prescribed by the Interim Site Management Plan:

- Periodic Topographic Surveys and Subsidence Monitoring
- Initial Cap Maintenance
- Continuing Assessment of the Adequacy of the Initial Cap, Surface Water Control Measures and Erosion Control Measures
- Improvements to Site Drainage Features, As Needed
- Trench Leachate Management and Monitoring
- Monitoring, Maintenance, and Surveillance
- Enhanced Ground Water Monitoring
- Installation of a Horizontal Flow Barrier, As Required
- Five Year Reviews

Topographic surveys and elevation surveys of the subsidence monitors will be conducted routinely to evaluate subsidence. Settlement plates and slope inclinometers (and/or other subsidence monitoring instruments) will be installed at the MFDS to measure vertical movement, tilt or subsidence of the trench contents and trench cap over time. This information will form a database to be used to assess cap stability and the degree to which trench subsidence has occurred.

The initial cap will be routinely inspected to ensure that it has not failed and it is effectively controlling surface water runoff. As needed, the cap will be repaired and the synthetic liner replaced in accordance with the Interim Site Management Plan. Currently, it is anticipated that the synthetic liner will require replacement at 20-25 year intervals. Liner replacement will be performed in response to liner condition and the manufacturer's warranty and specifications. The specific liner type will be determined during development of the Interim Site Management Plan; however, the liner will be of the type to require replacement no more often that the afore-mentioned 20-25 year interval. The drainage ditches and retention ponds will also be cleaned and maintained as needed. Erosion damage to the cap and drainage systems will be repaired as needed.

The Infiltration Monitoring System, installed during the Initial Closure Period, will detect the accumulation of leachate in the trenches and provide a warning if leachate begins to accumulate in the trenches. This monitoring system will be used as a supplement to the Commonwealth's current trench leachate monitoring program. Measures could then be taken to eliminate the cause of the infiltration. If trench recharge is occurring, the leachate management plan, developed as part of the Interim Site Management Plan, will be implemented to remove, solidify, and dispose of the leachate. The data from the monitoring and leachate extraction program will be used to adjust the frequency of inspections, data collection, sample analyses, and planned leachate pumping and solidification.

Trench leachate recharge should be kept to a minimum, once the disposal trenches have been pumped to the extent practicable and the initial cap has been placed over the disposal area. However, should conditions warrant re-initiation of a trench leachate extraction program, trench leachate will be solidified and disposed in on-site trenches. On-site activities during the Interim Maintenance Period may generate additional wastes requiring disposal. Liquids will be temporarily stored until sufficient quantities have accumulated to warrant resumption of solidification processes. Once liquids have been solidified, a new disposal trench will be constructed to dispose of the solidified liquids and any solids generated during on-site activities.

Site monitoring activities will be performed as defined in the Interim Site Management Plan and established during the Initial Closure Period. Site maintenance activities will include custodial care such as grass cutting, ditch cleaning, and fence

repairing. On a less frequent basis, repairs will be made to the erosion control system, the initial cap, and monitoring instruments. Additionally surveillance activities will be performed on a routine basis to inspect the site. Maintenance and monitoring activities will be conducted in compliance with the Federal and Kentucky Licensing Requirements for Land Disposal of Radioactive Waste.

For those remedial actions that allow hazardous substances to remain on-site, Section 121(c) of CERCLA requires EPA to conduct a review of the remedy within five years after initiation of remedial action and at least once every five years thereafter. The purpose of this review is to evaluate the remedy's performance - to ensure that the remedy has achieved, or will achieve, the remedial action objectives set forth in the Record of Decision and that it continues to be protective of human health and the environment. Additionally, the Commonwealth will continue an environmental program to evaluate all aspects of the remediation during the five year review periods.

During any of the five year reviews, or at any point between the five year reviews, if the remedy is not meeting the defined remedial action objectives, a more detailed sampling program will be undertaken to determine the cause of the failure. Specifically, the reviews may focus on, among other things, the selected remedy's ability to prevent entry of water into the disposal trenches, to mitigate erosion to the extent practicable, and to minimize migration of radionuclides and chemicals.

Should site monitoring and surveillance demonstrate a failure of the remedy to achieve ARARs or remedial action objectives (e.g., alluvial ground water monitoring indicates Maximum Concentration Limits have been exceeded), the appropriate remedial steps will be taken, such as notification of regulatory agencies, public safeguards, repair of the remedial technology, or cleanup of the environmental medium.

The uncertainties of hydrogeologic flow conditions at the MFDS (as discussed in the RI Report for the MFDS and Section 5.1.2 - Geology and Ground Water of this document), as well as the uncertainties related to the impact of the leachate extraction operations on the hydrogeologic flow conditions, necessitate further evaluation of data in order to assess the necessity and likely effectiveness of a horizontal flow barrier. Sufficient data should be available from the trench dewatering program, information contained in the Commonwealth's historical leachate level database, the Infiltration Monitoring System, ground water

monitoring, and the ground water modeling program to determine the necessity of a horizontal flow barrier before or in conjunction with the first five year review. If statistical analysis of trench data (to include water level data, regression slopes, etc.) indicates that lateral recharge of the disposal trenches is occurring, a horizontal flow barrier will be installed to curtail ground water recharge of the disposal trenches. The necessity, location, depth, and extent of this horizontal flow barrier will be determined through ground water modeling and review of historical site monitoring data.

Two types of horizontal flow barriers were evaluated in the Feasibility Study, as discussed in Section 7.2.2.2 (Horizontal Flow Barriers of this document), and illustrated in Figures 22 through 24; a north cutoff wall and a lateral drain/cutoff wall. The type of horizontal flow barrier installed at the site will be one of the two described barriers or another design determined to be sufficient for prevention of lateral infiltration.

The decisions as to whether and what type of horizontal flow barrier to construct will be made by EPA, in consultation with the Commonwealth of Kentucky.

10.3 Final Closure Period

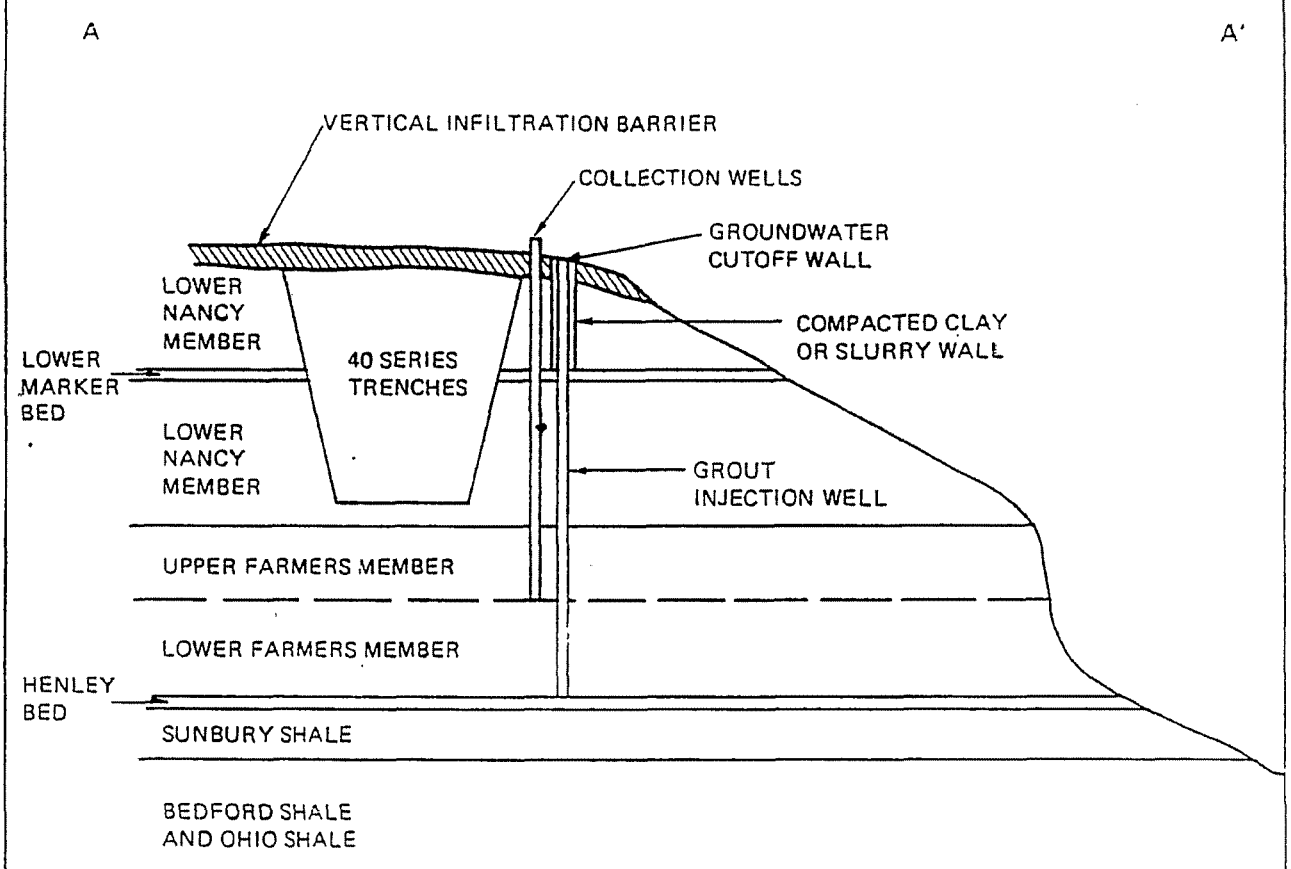
The end of the Interim Maintenance Period and the beginning of the Final Closure Period is defined as the time when subsidence of the trenches has nearly ceased and final cap installation can begin. The criteria for determining when this time has come could include such factors as acceptable void fraction, defined rate of minimal subsidence, defined backfilling rate to maintain design grade, etc. EPA, in consultation with the Commonwealth, will determine the acceptable subsidence criteria during remedial design and/or development of the Interim Site Management Plan.

The following activities will be undertaken during the Final Closure Period:

- Waste Burial
- Installation Of Final Cap
- Installation Of Permanent Surface Water Control Features
- Installation Of Surface Monuments

Prior to installation of the final cap, contaminated materials at the site will be buried in a new disposal trench on-site. These materials could include solidified leachate, leachate storage tanks, and on-site buildings which will be demolished during final remediation.

FIGURE 22



DIAGRAMATIC CROSS SECTION A – A'

LOCATION OF CROSS SECTION SHOWN ON FIGURE 3-2

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MAXEY FLATS SITE RI/FS

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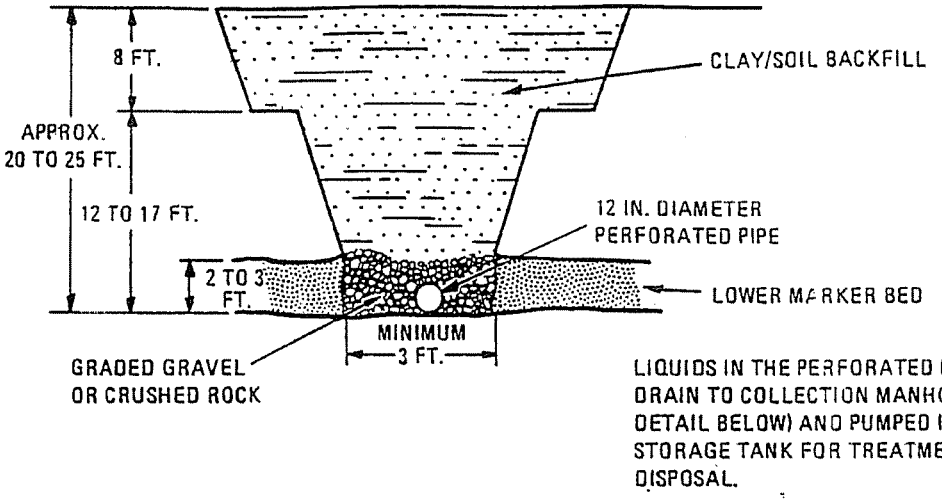
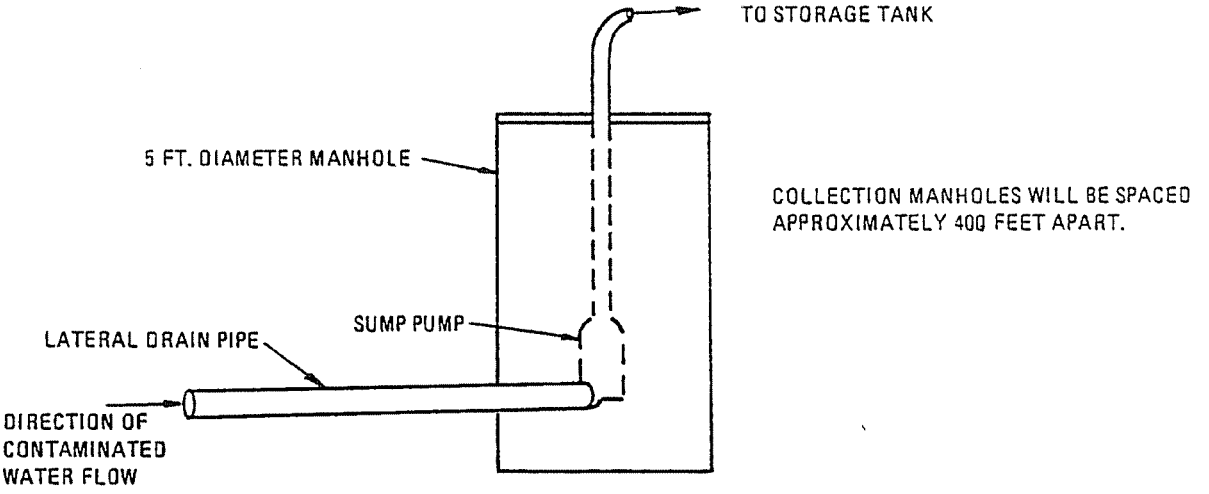
GROUNDWATER CUTOFF WALL AND COLLECTION WELLS FOR 40 SERIES TRENCHES

FIGURE 3-4



DETAIL 1



DETAIL OF COLLECTION MANHOLE

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MAXEY FLATS SITE RI/FS

EBASCO SERVICES INCORPORATED

LATERAL DRAIN

FIGURE 3-3

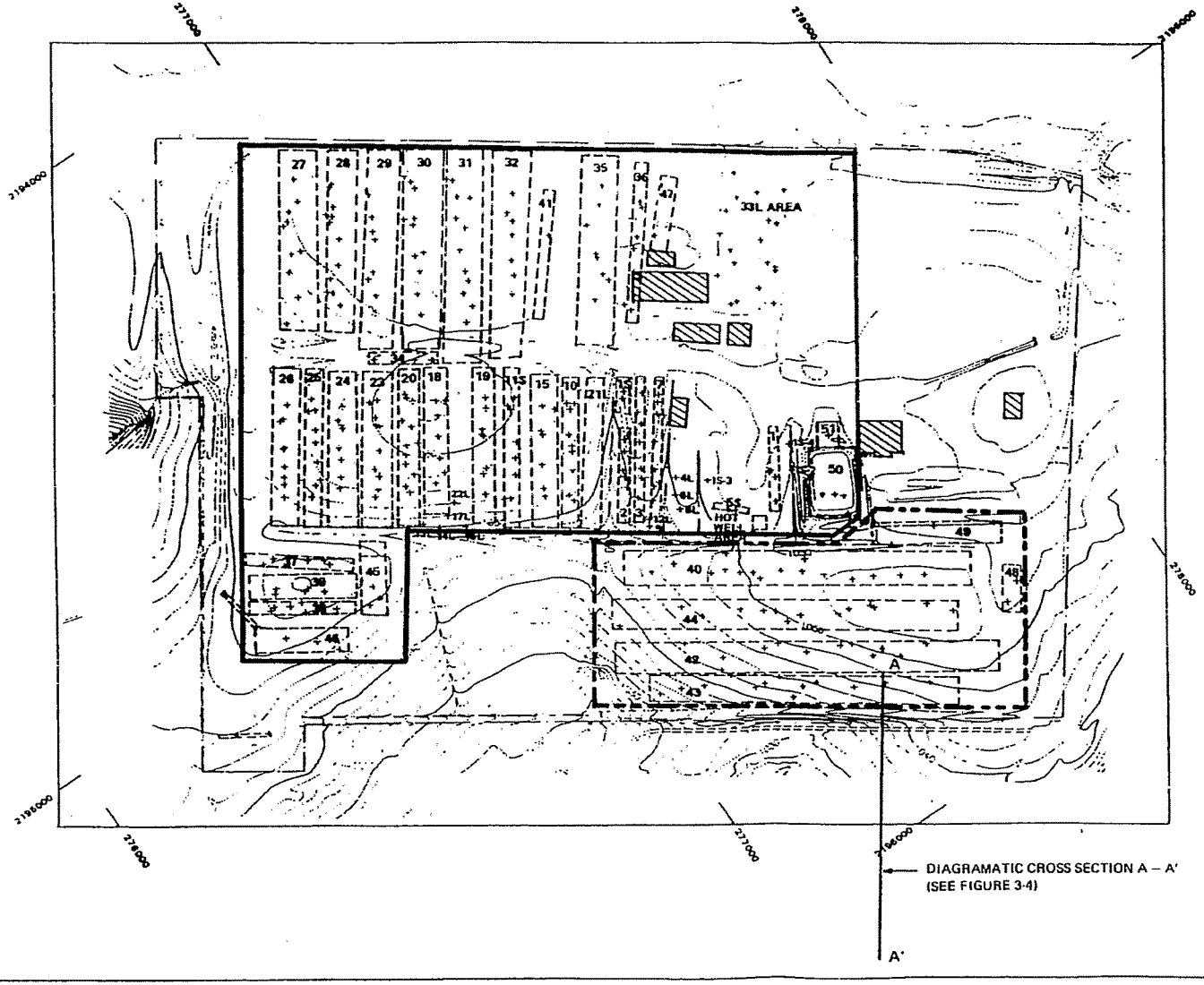
33L AREA
HOT WELL
DIAGRAMATIC CROSS SECTION A – A'
(SEE FIGURE 3-4)
A
A'
N
EXPLANATION
TRENCH SUMP
APPROXIMATE BOUNDARY OF TRENCH
FENCELINE AND BOUNDARY OF RESTRICTED AREA
BUILDING
LATERAL DRAIN
GROUNDWATER CUTOFF WALL
0 100 200 300 400
SCALE IN FEET
MAXEY FLATS FS REPORT
MAXEY FLATS SITE RI/FS
EBASCO SERVICES INCORPORATED
HORIZONTAL FLOW BARRIER
FIGURE 3.2

FIGURE 24

Because the selected remedy involves disposal of a RCRA listed hazardous waste, the RCRA Subtitle C closure standards are applicable to the MFDS. Consequently, the final cap will be designed and constructed to promote drainage, minimize erosion of the cover, and provide long-term minimization of migration of liquids. The design criteria and allowable soil loss for the final cap will conform, at a minimum, to the standards established in EPA's "Cover for Uncontrolled Hazardous Waste Sites", EPA/540/2 - 85/002 (USEPA, 1985).

The trench disposal area and appropriate areas contiguous thereto will be covered by an engineered soil cap with a synthetic liner. It is expected that this cap, as described in Table 33, will consist of (from top to bottom) an initial layer of compacted soil placed over the existing trench cover, a two-foot thick clay layer, an 80 mil (or sufficiently similar) thick synthetic liner, a geotextile fabric layer, a one-foot-thick drainage layer, a geotextile fabric layer, and a two-foot thick soil layer supporting a vegetative cover. The compacted clay layer will have a permeability of 1×10^{-7} (0.1 feet/year) or less.

The final cap will be constructed primarily of naturally occurring materials that are stable in the Maxey Flats environment. To provide additional protection against vertical infiltration of water and to provide additional durability during the first few decades following installation, some synthetic materials will be integrated within the multi-layered structure of the final cap. The engineered soil cap with synthetic liner, when installed, will provide an effective barrier against vertical infiltration of water. The cap should last for a long period of time if (a) repairs are performed promptly, as needed, during the first few decades following installation, and (b) minor custodial maintenance is provided. The cap will direct percolating water away from the disposed waste by drainage layers and its sloped design. The multi-layer construction will resist degradation through geological processes and biotic activity. Additionally, the seeded topsoil layer will enhance erosion control. Erosion control will be an integral component of the final cap design. Cap erosion, hillslope erosion, and rates of surface water runoff to downslope areas will be considered during final cap design.

Effective, permanent surface water control systems will also be installed to limit infiltration and control surface water runoff and minimize hillslope and cap erosion to the extent

TABLE 34

FINAL CAP COMPONENTS

- Vegetative Cover: Erosion control
- Geotextile Fabric: This fabric beneath the upper soil layer will keep soil fines from settling in the drainage layer and, thus, reducing the effectiveness of the drainage layer
- Drainage Layer: This will consist of suitably graded crushed rock with a minimum permeability of 1×10^{-3} cm/sec; will provide a stable drainage path to erosion control drains
- Geotextile Fabric: This fabric between the drainage layer and synthetic liner will protect the liner from puncture during installation of the drainage layer
- Synthetic Liner: Will provide a backup to the clay infiltration barrier for the purpose of minimizing infiltration of water to the disposal trenches
- Two-Foot-Thick Clay Layer: Will provide a barrier with a permeability of 1×10^{-7} cm/sec or less.
- Initial Soil Layer: Will provide support and establish the desired design grade for subsequent layers

practicable. After the final cap is constructed, channels and drainage ditches carrying storm water runoff from the site will be improved to ensure stability for runoff events up to that which would result from a 100-year, 24-hour storm. It is expected that a significant amount of research data and information on new technologies will be developed throughout the Interim Maintenance Period. Thus, the design of the final cap and surface water control features may reflect these technological advances.

The monitoring and surveillance program, established in the Initial Closure Period, will continue to ensure compliance with state and federal regulations, to ensure the remedy is meeting the remedial action objectives, and to ensure that the remedy continues to provide protection of human health and the environment. Surface monuments will be erected at the site to notify persons of the presence of site contaminants and the dangers posed by site contaminants if the site is disturbed.

10.4 Custodial Maintenance Period

After the final cap has been constructed, the Custodial Maintenance Period will begin. The following activities will be performed during the Custodial Maintenance Period:

- Monitoring and Surveillance
- Five Year Reviews

The monitoring and surveillance program will continue to be implemented at the site. The frequency of monitoring activities described for the Interim Maintenance Period will likely be reduced during the Custodial Maintenance Period due to the presumed reduction of water infiltration into the trenches (i.e., reduced contaminant mobility) and reduced radionuclide activity. Site monitoring and surveillance will be carried out in perpetuity. Maintenance activities will be carried out, as necessary, to preserve the integrity of the remedy.

The Custodial Maintenance Period will initiate the institutional control period which must be maintained for at least 100 years following completion of the site closure as required by 902 KAR 100:022 and 10 CFR part 61 for all low level radioactive waste disposal sites. In addition, the perpetual maintenance fund will ensure that institutional control activities, including fencing and other activities to control access to the MFDS, periodic surveillance, custodial care, and filing of notices, survey plats, and deed restrictions with the appropriate authorities, will accomplish the goal of preventing inadvertent intrusion onto the MFDS and providing of custodial care in perpetuity. The fund will also provide for collection and analysis of samples and data.

SECTION 11.0 - STATUTORY DETERMINATIONS

Under its legal authorities, the U.S. EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. One of the requirements specifies that, when complete, the selected remedial action for this site must comply with applicable or relevant and appropriate standards established under Federal and State environmental laws unless a statutory waiver is justified. The selected remedy also must be cost effective and must utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment technologies that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

11.1 Protection of Human Health and the Environment

Protection of human health and the environment will be achieved through the treatment, containment, engineering and institutional control components of the selected remedy.

Based upon the site risk assessment, unless remedial action is taken, exposure to drinking water, surface water, soil and sediments at, and in close proximity to, the site in the future would pose an unacceptable risk to human health. The risk assessment estimates that the risk from all combined on-site pathways at the MFDS, if no action is taken, could approach 1 (i.e., one additional case of fatal cancer for each person who would reside on-site). The risk assessment estimates that the risk from all combined off-site pathways at the MFDS, if no action is taken, could approach 6×10^{-2} (i.e., six additional cases of fatal cancer for every 100 persons engaging in the off-site exposure pathways as described in Section 6 of this document). The selected remedy will reduce these risks to a risk of 1×10^{-4} or less. EPA deems a risk of 10^{-4} to be generally protective of human health and the environment.

The extraction, solidification, and re-disposal of trench leachate will significantly reduce the mobility of radionuclides. Initial and final caps will significantly reduce the amount of vertical infiltration into the disposal trenches, thereby minimizing the production of leachate, thereby minimizing the migration of site contaminants into the environment. Surface water drainage improvements will help maintain the integrity of the remedy by

controlling the rate of site erosion. Site monitoring and maintenance and institutional controls, funded and conducted in perpetuity, will prevent unintended use of the site, minimize the amount of exposure to site contaminants, and maintain the integrity of the remedy.

There are no short-term threats associated with the selected remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the remedy.

11.2 Compliance With ARARs

The selected remedy will comply with all applicable or relevant and appropriate requirements (ARARs) except for the RCRA Land Disposal Restrictions which are being waived pursuant to CERCLA Section 121(d). ARARs identified for the MFDS are presented in Section 8.0 of this document.

11.3 Cost Effectiveness

The selected remedy provides overall effectiveness in proportion to its cost. Alternative 5 is the least costly of the seven alternatives that underwent a detailed analysis, with the exception of the No Action alternative.

11.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable and Statutory Preference for Treatment as a Principle Element

EPA and the Commonwealth of Kentucky have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the final source control remedy at the Maxey Flats Disposal Site. Of the alternatives evaluated and presented in this decision document, EPA and the Commonwealth have determined that this selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, cost, also considering the statutory preference for treatment as a principal element and considering State and community acceptance.

While the selected remedy does not reduce the volume of waste present at the site, or offer treatment as a principal element, Alternative 5 does address the primary threat associated with the site; that of the migration of contaminated leachate into the environment. The selected remedy will achieve a reduction of the mobility of the contaminated leachate through solidification and

prevention of the generation of new leachate, and will minimize erosion to the extent practicable to preserve the integrity of the remedy. The initial and final caps, surface water control features, monitoring and maintenance components, and other engineering features, as well as institutional controls will reduce or control site risks to the extent practicable.

Treatment of site wastes is not practicable at the MFDS due to the nature and volume of waste involved. Excavation and off-site disposal are not feasible at the MFDS due to the lack of facilities that could accept the volume and activity of the waste present at the MFDS and the greater risk to human health and the environment which would be associated with such activities. Furthermore, excavation of site wastes would not achieve the Commonwealth's applicable requirement - 902 KAR 100:015, which requires exposures to be kept to "As Low As Reasonably Achievable".

APPENDIX B

NUMERIC CRITERIA FOR APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

RELEVANT AND APPROPRIATE CONTAMINANT-SPECIFIC REQUIREMENTS FOR THE MAXEY FLATS DISPOSAL SITE SELECTED REMEDY

Clean Water Act - Water Quality Criteria (ug/l)

	Aquatic Life		Human Health[a]
Chemical	Acute (1-Hour Average)	Chronic (4-Day Average)	Fish Only
Nickel	790/1400/2500[d]	88/160/280[e]	100
Vinyl Chloride	b	b	5246[c]
Benzene	5300[f]	b	400.0[c]
Chloroform	28,900[f]	1240[f]	157.0[c]
1,2-dichloroethane	118,000[f]	20,000[f]	2430.0[c]
Trichloroethylene	45,000[f]	21,900[f]	807.0[c]
Arsenic	b	b	.175[c]
Lead	34/82/200[d]	1.3/3.2/7.7[e]	b
bis(2-ethylhexyl) phthalate	940	3	b
Chlorobenzene	250[f]	50[f]	488
Toluene	17,500[f]	b	424,000

Notes:

a) Assumed intake is 6.5 grams of fish per day for a 70-year lifetime. EPA assumes an adult body weight is 70 kilograms.
b) Clean Water Act - Water Quality Criteria are not available for this contaminant.
c) The value was calculated assuming risk levels of 10^{-5} per lifetime.
d) Because the toxicity of nickel is dependant on hardness, EPA's acute criterion is expressed as a formula: $e^{(0.8460\ [\ln\ (\text{hardness})]+\ 3.3612)}$. The criteria above were calculated using this formula, assuming hardness equal to 50, 100, and 200 mg/l as $CaCO_3$.
e) EPA's formula for calculating chronic criteria is: $e^{(0.8460[\ln\ (\text{hardness})]+\ 1.1645)}$. The criteria above were calculated using this formula, assuming hardness equal to 50, 100, and 200 mg/l as $CaCO_3$.
f) Lowest observed effect level.

TABLE A-1

APPLICABLE ACTION-SPECIFIC AND CONTAMINANT-SPECIFIC REQUIREMENTS
FOR REMEDIAL ALTERNATIVES AT MAXEY FLATS

RADIOLOGICAL CONTAMINANTS

Ky Average Radionuclide Concentrations[1]
(uCi/ml)
(902 KAR 100:025)

	Table[2]		Table II[3]	
	Air	Water	Air	Water
Strontium-90	1×10^{-9} (S)[4] 5×10^{-9} (I)[5]	1×10^{-5} 1×10^{-3}	3×10^{-11} 2×10^{-10}	3×10^{-7} 4×10^{-5}
Plutonium-238	2×10^{-12} (S) 3×10^{-11} (I)	1×10^{-4} 8×10^{-4}	7×10^{-14} 1×10^{-12}	5×10^{-6} 3×10^{-5}
Thorium-232	3×10^{-11} (S) 3×10^{-11} (I)	5×10^{-5} 1×10^{-3}	1×10^{-2} 1×10^{-2}	2×10^{-6} 4×10^{-5}
Americium-241	6×10^{-12} (S) 1×10^{-10} (I)	1×10^{-4} 8×10^{-4}	2×10^{-13} 4×10^{-12}	4×10^{-6} 3×10^{-5}
Cobalt-60	3×10^{-7} (S) 9×10^{-9} (I)	1×10^{-3} 1×10^{-3}	1×10^{-8} 3×10^{-10}	5×10^{-5} 3×10^{-5}
Cesium-137	6×10^{-8} (S) 1×10^{-8} (I)	4×10^{-4} 1×10^{-3}	2×10^{-9} 5×10^{-10}	2×10^{-5} 4×10^{-5}
Carbon-14	4×10^{-6} (S) 5×10^{-5} (Sub)[6]	2×10^{-2} -	1×10^{-7} 1×10^{-6}	8×10^{-4} -
Hydrogen-3 (tritium)	5×10^{-6} (S) 5×10^{-6} (I) 2×10^{-3} (Sub)	1×10^{-1} 1×10^{-1} -	2×10^{-7} 2×10^{-7} 4×10^{-5}	3×10^{-3} 3×10^{-3} -

1. For any possession or use of any source of ionizing or electronic product radiation and for regulating the disposal and handling of radioactive waste in restricted areas. Average concentrations of radioactivity in air or water above natural background. Exceptions exist.

2. Used for limiting individual exposure in restricted areas, sanitary sewer releases, and others.

3. Used for exposure to minors (under 18), exposure in unrestricted areas, exposure at the boundary of a restricted area, incident notification, and others.

4. (S) means Soluble.

5. (I) means Insoluble.

6. (Sub) means Submersion.

Source: Radioactive Materials 1986 (possession, use and disposal of radioactive waste and material), 902 KAR 100, Kentucky Cabinet for Human Resources.

CURRENT and PROPOSED MCLs, MCLGs, and SMCLs

CHEMICAL	MCL (ppm)	MCLG (ppm)	SMCL (ppm)
INORGANICS			
Aluminum (1/91)			0.05-0.2
Antimony (7/90)	* 0.01/0.005	* 0.003	
Arsenic (NPDWR)	0.050		
Asbestos (1/91)	7 million fibers/liter (>10 um)		
Barium (NPDWR)	1.00		
Barium (1/91 **)	* 2	* 2	
Beryllium (7/90)	* 0.001	* 0	
Cadmium (1/91)	0.005	0.005	
Chloride (NSDWR)			250
Chromium (1/91)	0.1	0.1	
Color (NSDWR)			15 color units
Copper (8/88)	* 1.3	* 1.3	1
Corrosivity (NSDWR)			Noncorrosive
Cyanide (7/90)	* 0.2	* 0.2	
Fluoride (4/86)	4.0		2.0
Foaming Agents (NSDWR)			0.5
Iron (NSDWR)			0.3
Lead (NPDWR)	0.050		
(8/88)	* 0.005	* 0	
(6/90)	0.015 (Action Level)		

* - Proposed MCL and MCLG

CHEMICAL	MCL (ppm)	MCLG (ppm)	SMCL (ppm)
Manganese (NSDWR)			0.05
Mercury (1/91)	0.002	0.002	
Nickel (7/90)	* 0.1	* 0.1	
Nitrite (as N) (1/91)	1	1	
Nitrate (as N) (1/91)	10	10	
Total (as N) (1/91)	10	10	
Odor (NSDWR)			3 threshold odor #
pH (NSDWR)			6.5 - 8.5
Selenium (1/91)	0.05	0.05	
Silver (1/91)			0.1
Sulfate (NSDWR)			250
Sulfate (7/90)	*400/500	*400/500	
Thallium (7/90)	* 0.002/0.001	* 0.0005	
Total Dissolved Solids (NSDWR)			500
Zinc (NSDWR)			5

* - Proposed MCL and MCLG

CHEMICAL	MCL (ppm)	MCLG (ppm)	SMCL (ppm)
ORGANICS			
Acrylamide (1/91)	TT	0	
Adipates [Di(ethylhexyl)adipate] (7/90)	* 0.5	* 0.5	
Alachlor (1/91)	0.002	0	
Aldicarb (1/91 **)	* 0.003	* 0.001	
Aldicarb sulfone (1/91 **)	* 0.003	* 0.002	
Aldicarb sulfoxide (1/91 **)	* 0.003	* 0.001	
Atrazine (1/91)	0.003	0.003	
Benzene (7/87)	0.005	0	
Carbofuran (1/91)	0.04	0.04	
Carbon Tetrachloride (7/87)	0.005	0	
Chlordane (1/91)	0.002	0	
2,4-D (1/91)	0.07	0.07	
Dalapon (7/90)	* 0.2	* 0.2	
Dibromochloropropane (DBCP) (1/91)	0.0002	0	
o-Dichlorobenzene (1/91,5/89)	0.6	0.6	0.01
p-Dichlorobenzene (7/87)	0.075	0.075	
p-Dichlorobenzene (1/91,5/89)			0.005
1,2-Dichloroethane (7/87)	0.005	0	
cis-1,2-Dichloroethylene (1/91)	0.07	0.07	
trans-1,2-Dichloroethylene (1/91)	0.1	0.1	
1,1-Dichloroethylene (7/87)	0.007	0.007	
Dichloromethane (Methylene chloride) (7/90)	* 0.005	* 0	
1,2-Dichloropropane (1/91)	0.005	0	
Diquat (7/90)	* 0.02	* 0.02	
Dinoseb (7/90)	* 0.007	* 0.007	
Endothall (7/90)	* 0.1	* 0.1	
Endrin (NPDWR)	0.0002		
Endrin (7/90)	* 0.002	* 0.002	

* - Proposed MCL and MCLG

CHEMICAL	MCL (ppm)	MCLG (ppm)	SMCL (ppm)
ORGANICS			
Epichlorohydrin (1/91)	TT	0	
Ethylbenzene (1/91,5/89)	0.7	0.7	0.03
Ethylene dibromide (EDB) (1/91)	0.00005	0	
Glyphosate (7/90)	* 0.7	* 0.7	
Heptachlor (1/91)	0.0004	0	
Heptachlor epoxide (1/91)	0.0002	0	
Hexachlorobenzene (7/90)	* 0.001	* 0	
Hexachlorocyclopentadiene[HEX] (7/90)	* 0.05	* 0.05	0.008
Lindane (1/91)	0.0002	0.0002	
Methoxychlor (1/91)	0.04	0.04	
Monochlorobenzene (1/91)	0.1	0.1	
Oxamyl [Vydate] (7/90)	* 0.2	* 0.2	
PAHs: (7/90)			
Benzo(a)pyrene	* 0.0002	* 0	
Benzo(a)anthracene	* 0.0001	* 0	
Benzo(b)fluoranthene	* 0.0002	* 0	
Benzo(k)fluoranthene	* 0.0002	* 0	
Chrysene	* 0.0002	* 0	
Dibenzo(a,h)anthracene	* 0.0003	* 0	
Indenopyrene	* 0.0004	* 0	

* - Proposed MCL and MCLG

CHEMICAL	MCL (ppm)	MCLG (ppm)	SMCL (ppm)
Pentachlorophenol (1/91 **,5/89)	* 0.001	* 0	0.03
Phthalates [Di(ethylhexyl)phthalate] (7/90)	* 0.004	* 0	
Picloram (7/90)	* 0.5	* 0.5	
Polychlorinated biphenyls(PCBs) (1/91)	0.0005	0	
Simazine (7/90)	* 0.001	* 0.001	
Styrene (1/91,5/89)	0.1	0.1	0.01
2,3,7,8-TCDD (Dioxin) (7/90)	* 5x10E-8	* 0	
Tetrachloroethylene (1/91)	0.005	0	
Toluene (1/91,5/89)	1	1	0.04
Toxaphene (1/91)	0.003	0	
2,4,5-TP Silvex (1/91)	0.05	0.05	
1,1,2-Trichlorethane (7/90)	* 0.005	* 0.003	
1,2,4-Trichlorobenzene (7/90)	* 0.009	* 0.009	
1,1,1-Trichloroethane (7/87)	0.20	0.20	
Trichloroethylene (7/87)	0.005	0	
Trihalomethanes (NPDWR)	0.100		
Vinyl Chloride (7/87)	0.002	0	
Xylenes (1/91,5/89)	10.00	10.00	0.02

* - Proposed MCL and MCLG

CHEMICAL	MCL (ppm)	MCLG (ppm)	SMCL (ppm)
MICROBIALS			
Coliform bacteria (6/89)	< 1/100 ml	0	
Giardia lamblia (6/89)	TT	0	
Heterotrophic bact. (6/89)	TT	0	
Legionella (6/89)	TT	0	
Viruses (6/89)	TT	0	
Turbidity	1 TU (up to 5 TU)	(units of turbidity)	
RADIONUCLIDES			
Beta particle and photon radioactivity	4 mrem	0	
Gross Alpha particles	15 pCi/l	0	
Radium-226 and Radium-228 (Total)	5 pCi/l	0	

* - Proposed MCL and MCLG

FOOTNOTES

11/85	50 Federal Register (FR), November 13, 1985
4/86	51 FR, April 2, 1987 - Final MCLs and SMCLs
7/87	52 FR, July 8, 1987 - Final MCLs and MCLGs
8/88	53 FR, August 18, 1988 - Proposed MCLs and MCLGs
5/89	54 FR, May 22, 1989 - Proposed SMCLs
6/89	54 FR, June 29, 1989 - Final MCLs and MCLGs
6/90	Action level for lead in drinking water, June 21, 1990, Memorandum from the Office of Emergency and Remedial Response and the Office of Waste Program Enforcement
7/90	55 FR, July 25, 1990 - Proposed MCLs, MCLGs, and SMCLs
1/91	56 FR, January 30, 1991 - Final MCLs, MCLGs, and Proposed SMCLs
1/91 **	56 FR, January 30, 1991 - Re-proposed MCLs and MCLGs

MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NPDWR	National Primary Drinking Water Regulation
NSDWR	National Secondary Drinking Water Regulation
PAHs	Polynuclear Aromatic Hydrocarbons
SMCL	Secondary Maximum Contaminant Level
TT	Treatment Technique

* - Proposed MCL and MCLG

Appendix B

STATEMENT OF WORK
FOR REMEDIAL DESIGN/REMEDIAL ACTION
EPA - Region IV

APPENDIX B

STATEMENT OF WORK FOR THE MAXEY FLATS DISPOSAL SUPERFUND SITE

FLEMING COUNTY, KENTUCKY

********** FINAL **********

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STATEMENT OF WORK FOR
REMEDIAL DESIGN AND REMEDIAL ACTION
AT THE MAXEY FLATS DISPOSAL SUPERFUND SITE

I. INTRODUCTION

This Statement of Work (SOW) outlines the Work Settling Defendants shall perform at the Maxey Flats Disposal Superfund Site in Fleming County, Kentucky ("the Site") to implement the remedy for the Site as described in the Record of Decision (ROD), dated September 30, 1991, and to achieve the cleanup levels and other Remedial Standards set forth in the ROD, Consent Decree, and this SOW. The requirements of this SOW will be further detailed in work plans and other documents Settling Defendants shall submit for approval as required in the Consent Decree and in this SOW. It is not the intent of this document to provide task-specific engineering or geological guidance. The terms defined in the Consent Decree shall have the same meanings when used in this SOW unless expressly provided otherwise herein.

The Work shall be performed in five tasks:

Task I	Project Planning
Task II	Initial Remedial Phase Remedial Design
Task III	Initial Remedial Phase Remedial Action
Task IV	Interim Maintenance Period, Final Closure Period and Associated Remedial Activities
Task V	Performance Monitoring

Except for the Commonwealth's Initial Remedial Phase Obligations, tasks I, II and III of the Work to implement the remedy required in the Consent Decree shall be performed by the Settling Private Parties[1]. Task IV of the Work shall be performed by the

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[1]As part of Task I, the Commonwealth shall prepare and submit to EPA for review and approval an Initial Remedial Phase Monitoring and Maintenance Plan which describes the Commonwealth's monitoring and maintenance obligations during the Initial Remedial Phase.

Commonwealth of Kentucky[2]. Task V will be performed by the Commonwealth , except as otherwise specified in Task V. The Settling Private Parties and the Commonwealth shall assist EPA in conducting oversight activities of their respective tasks.

EPA review or approval of a task or deliverable shall not be construed as a guarantee as to the adequacy of such task or deliverable. If EPA modifies a deliverable pursuant to Section XIV of the Consent Decree, such deliverable as modified shall be deemed approved by EPA for purposes of this SOW. A summary of the major deliverables that Settling Defendants shall submit for the Work is attached.

II. OVERVIEW OF THE REMEDY

The objectives of the remedy for the Site are to:

Prevent or mitigate the continued release of hazardous substances, pollutants and contaminants from the Site to underlying bedrock formations and groundwater aquifers;

Prevent or mitigate the continued release of hazardous substances, pollutants and contaminants from the Site to surface water bodies and sediments;

Reduce the risks to human health associated with direct contact with hazardous substances, pollutants or contaminants within the Site;

Eliminate or reduce the risks to human health from inhalation of hazardous substances, pollutants or contaminants from the Site;

Eliminate or minimize the threat posed to human health and the environment from current and potential migration of hazardous substances from the Site in the surface water, ground water, and subsurface and surface soil and rock;

Minimize the infiltration of rainwater and ground water into the trench areas and migration from the trenches;

Allow natural stabilization of the Site to provide a foundation for a final cap over the trench disposal area

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[2]In the event that, after EPA issuance of the Certificate of Completion of the Initial Remedial Phase but prior to 10 years after EPA issuance of the Certificate of Completion of the Initial Remedial Phase, EPA determines that a Horizontal Flow Barrier is necessary, the design and implementation of the Horizontal Flow Barrier shall be performed by the Settling Private Parties.

that will require minimal care and maintenance over the long term;

Minimize the mobility of trench contaminants by extracting trench leachate to the extent practicable and by solidifying the leachate in earth mounded concrete bunkers;

Control Site drainage and minimize the potential for erosion to protect against natural degradation;

Implement institutional controls to permanently prevent unrestricted use of the Site;

Implement a Site performance and environmental monitoring program.

III. REMEDY COMPONENTS

This Statement of Work shall include the following three categories of Remedial Standards which shall be achieved by the Settling Defendants in performing the Work: 1) "Remedial Measures[3]"; 2) "Construction Standards"; and, 3) "Performance Standards", as described below. In addition, the remedy shall achieve all ARARs. All ARARs expressed in dose or numeric concentrations of particular hazardous substances or radiation, as set forth in Section 8.0 of the Record of Decision, shall be Performance Standards.

A. SOURCE CONTROL

1. The major source control components of the remedy to be performed pursuant to the Consent Decree shall include:

Extraction of trench leachate for treatment and disposal pursuant to general dewatering guidelines for the Site such as described in Reference 29;

Solidification of extracted and stored trench leachate using a grout mix from a topical report that has been approved for commercial application by the U.S. Nuclear Regulatory Commission;

Disposal of solidified leachate in earth mounded concrete (EMC) bunkers, such as described in Reference 27, on-Site within the area of contamination;

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[3]Installation of remedial measures constitutes compliance with the "as low as reasonably achievable" (ALARA) principle of 902 KAR 100:015 Section 2.

Installation of an initial cap to prevent infiltration of precipitation into the trench disposal area. The initial cap will consist of compacted soil and a synthetic liner and shall be contoured to provide drainage, in conjunction with the alignment of perimeter drainage channels and pipes, to assure cap drainage and to eliminate channeled high velocity flows that could potentially cause a cap failure;

Installation of a final cap during the Final Closure Period (FCP) to minimize, to the extent practicable, water infiltration into the disposal area.

2. Treatment of contaminated liquids

Extracted leachate shall be treated as follows:

The solidification process shall commence upon accumulation of a sufficient volume of extracted trench leachate. Leachate shall be extracted simultaneously from multiple trench sumps and batched. Once batched in tanks (25,000 gallons or less in leachate volume) on-Site, representative samples of the batched leachate shall undergo testing that meets the process control program of the topical report. Once analyzed, the leachate shall be solidified using a grout mix from a topical report that has been approved for commercial application by the U.S. Nuclear Regulatory Commission.

Liquids containing radioactive contaminants, other than leachate extracted from existing trenches, may be released from the area of contamination without treatment if the release complies with the requirements of 10 CFR §§ 20.1301 and 20.1302 (902 KAR 100:015 Section 2 and 100:019 Sections 10 and 11 (as amended))[4]. If it does not, then the liquid will be treated in the manner described in the preceding paragraph.

3. Remedial Standards

All Remedial Standards related to source control shall be met. Those Remedial Standards that have been

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[4] The Record of Decision identifies the federal standards for protection against radiation in unrestricted areas as the governing ARARs, since at the time of issuance of the ROD those standards were more stringent than the corresponding Kentucky requirements. In early 1994, Kentucky amended its radiation protection standards to match the federal ones. For convenience, both regulations are cited.

identified are as follows:

a. Leachate Extraction:

Performance Standards

Trench leachate shall be extracted from all Site trenches where extraction is determined by EPA, after a reasonable opportunity for review and comment by the Commonwealth, to be necessary and technically feasible. The trench leachate extraction program shall, to the extent practicable, feasible and necessary as determined by EPA, after a reasonable opportunity for review and comment by the Commonwealth, and in keeping with general dewatering guidelines in Reference 29, mitigate continued releases of hazardous constituents to underlying bedrock and ground water aquifer formations.

b. Leachate Solidification:

Construction Standards

Extracted leachate shall be mixed with solidification agents to form a grout which meets the requirements of 902 KAR 100:021 Sections 6 and 7 (Kentucky Standards for the Disposal of Radioactive Material as amended) and 10 CFR Parts 61.55 - .56 (Federal Licensing Requirements for Land Disposal of Radioactive Waste as amended) and the NRC Branch Technical Position on Waste Form dated January 1991.

Solidified leachate shall be in a form that meets the requirements of 902 KAR 100:021 Section 8(2)(b). In no case shall the free-standing liquid in the solidified form exceed five-tenths percent of the volume of the waste when the waste is processed in stable form.

In keeping with 902 KAR 100:021 Section 8(2)(c) void spaces within the waste and between the waste and its package shall be reduced to the extent practicable.

c. Leachate Disposal:

Construction Standards

EMC bunkers constructed for the purpose of solidified leachate disposal shall meet the

requirements of 902 KAR 100:022, Sections 19, 20, 21, and 24(1) - (11) (Kentucky Licensing Requirements for Land Disposal of Radioactive Waste). These requirements specify that closure shall be designed to achieve long-term stability and isolation of the radioactive waste, to protect against inadvertent intrusion, and to eliminate, to the extent practicable, the need for on-going, active maintenance of the disposal Site so that only surveillance, monitoring, and minor custodial care is required. The EMC bunkers described in Reference 27 satisfy these regulatory requirements.

d. Initial Cap:

Remedial Measures

Upon completion of the leachate extraction, solidification, and disposal operation, an initial cap ("cap") shall be placed over the trench and EMC bunker disposal area. The initial cap shall be maintained and repaired during the Interim Maintenance Period so as to assure proper drainage away from the trenches and to provide an effective infiltration barrier. Cap maintenance shall include backfilling to maintain proper grade and repairing and replacing the synthetic liner, as needed.

Replacement of the synthetic liner shall be conducted as the liner condition requires. Any rips, tears or cracks shall be repaired promptly upon detection. Likewise, subsided areas, which may allow ponding on the cap, shall be repaired promptly upon detection.

Construction Standards

The design criteria presented in Reference 28 shall be applied to aid in the determination of the areal extent of the cap.

A soil fill of suitable quality compacted to approximately 85 percent ASTM Proctor density shall be placed over the trench disposal area. A synthetic liner shall be placed over this compacted soil having a minimum manufacturer's warranty of 20 years and a permeability no greater than 1×10^{-7} cm/sec. The synthetic liner shall be installed in accordance with the

manufacturer's specifications. The liner shall be tested in accordance with quality assurance procedures developed during the Remedial Design.

The initial cap shall be designed and constructed with drainage contouring, in conjunction with the alignment of perimeter drainage channels and pipes, to provide finished grades that assure cap drainage and eliminate channeled high velocity flows that could potentially cause a cap failure. The drainage contouring will be designed utilizing the criteria presented in Reference 28.

The cap will be designed to eliminate, to the extent practicable, the flow of ground water to the disposal trenches by extending the cap beyond the trench area and by contouring and vegetating the unlined ground surface at the perimeter of the cap to drain surface water away from the cap. This cap will be designed such that it intercepts the Lower Marker Bed along its north side (North Channel) unless there is a sound technical basis for not doing so.

Performance Standards

The cap shall cover the trench disposal area and adjacent areas and eliminate, to the extent practicable, recharge of the disposal trenches.

The cap shall assure proper drainage away from the trenches.

e. Horizontal Flow Barrier:

Remedial Measures

Ground water modeling and analysis studies shall be performed during IRP Remedial Design to determine whether the cap extends far enough to minimize the likelihood that ground water will infiltrate the disposal trenches.

If it is determined that ground water is re-entering the disposal trenches in such significant amounts that a barrier to such recharge is required, a horizontal ground water flow barrier shall be installed to mitigate the flow of ground water to the trenches. The determination as to whether a horizontal flow barrier is necessary shall be made by EPA,

after a reasonable opportunity for review and comment by the Commonwealth, based on factors such as infiltration monitoring system data, trench water level data, historical trench leachate level monitoring data maintained by the Commonwealth, ground water modeling and criteria established during the Remedial Design. Such determination shall be made by EPA no later than 10 years after EPA issues the Certificate of Completion for the IRP.

Performance Standards

The Horizontal Flow Barrier, if constructed, shall mitigate the flow of ground water to the disposal trenches such that static trench leachate levels in trench sumps do not rise 25% or more of the level at the time of sump pumping termination, in accordance with the general trench dewatering guidelines in Reference 29, or other alternative Horizontal Flow Barrier Performance Standards as may be developed during the Initial Remedial Phase Remedial Design or Performance Standards as may be developed at the time the Horizontal Flow Barrier is designed.

f. Final Cap:

Remedial Measures

The trench stabilization criteria, to be defined in the Interim Maintenance Period Work Plan, shall be achieved. Upon achieving the trench stabilization criteria, a final cap shall be designed and constructed to optimize drainage away from the trench disposal area, to eliminate erosion of the cover to the extent practicable, and to eliminate trench leachate migration to the extent practicable.

Performance Standards

The final cap shall cover the trench disposal area and adjacent areas and eliminate, to the extent practicable, recharge of the disposal trenches.

The final cap shall assure proper drainage away from the trenches and provide an effective infiltration barrier.

The final cap shall be designed and constructed in

accordance with all ARARs.

4. Compliance Testing/Monitoring

The following testing, monitoring and review shall be conducted to ensure that all Construction and Performance Standards related to source control are met:

a. Waste form testing for criteria such as compressibility, leachability, free-standing liquids, and chemical and microbial degradation parameters to demonstrate compliance with the NRC Branch Technical Position on Waste Form dated January 1991;

b. Initial cap testing for physical soil properties such as gradation, moisture and maximum densities to demonstrate compliance with gradation, maximum density and moisture requirements;

c. Initial cap liner testing in accordance with the manufacturer's recommendations;

d. Final cap testing for physical soil properties such as permeability, gradation and maximum density and moisture requirements to demonstrate compliance with those requirements developed during the Balance of Remedial Phase, if applicable;

e. Surveillance monitoring to ensure detection of radionuclide releases within the Site boundary prior to release beyond the Site boundary as required by 902 KAR 100:022 Section 25(2);

f. Well monitoring at the base of the hillslopes surrounding the Site for chemical constituents or suitable indicators using appropriate data evaluation methods to ensure compliance with Kentucky Hazardous Waste Management Regulations (401 KAR Chapter 34:060) and chemical and radionuclide testing to determine compliance with Kentucky Drinking Water Standards - Maximum Contaminant Levels (401 KAR 6:015) and Federal Drinking Water Regulations (40 CFR Parts 141, 142, and 143). The Settling Private Parties will install 15 wells at the base of the hillslope for monitoring chemical and radiological constituents. The location of these wells will be established during the IRP Remedial Design. If it is determined that more than 15 wells should be

installed at the base of the hill, the Commonwealth will install any additional wells. The Commonwealth will be responsible for performing the chemical and radiological sampling and analysis at all of these wells, including those installed by Settling Private Parties;

g. Surface water and air monitoring at appropriate locations to demonstrate compliance with 10 CFR §§ 20.1301, 20.1302 and 10 CFR Part 20, Appendix B, Table II (902 KAR 100:019 Sections 10 and 11 and Table II of KAR Section 44 (as amended)) regarding general and isotope-specific radiation protection standards for individuals in unrestricted areas;

h. Surface water testing of waters of the Commonwealth as defined by 401 KAR 5:029 Section 1(kk), to determine compliance with Kentucky Surface Water Quality Standards (401 KAR 5:031) and the criteria established under Section 304(a)(1) of the Clean Water Act. Waters of the Commonwealth are Drip Springs Hollow, No Name Hollow, Rock Lick Creek and the discharge channel below the East Detention Basin. Samples will be taken within the defined banks of the stream. Intermittent streams will be sampled during those periods of time when discernible flows occur at least 30 minutes following rainfall of 0.1 inches;

i. Air monitoring to determine compliance with the 10 mrem/year effective dose equivalent standard contained in the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61);

j. Air, surface water, ground water and soil monitoring at the current licensed Site property boundary to determine compliance with the 25 mrem/year dose limit found in Section 18 of 902 KAR 100:022. (Monitoring will be performed to assess whether the combined effective dose equivalent from these pathways exceeds 25 mrem/year.)

B. <u>SURFACE WATER AND EROSION CONTROL</u>

1. <u>Surface water and erosion control measures shall include the following major components:</u>

a. Lined drainage ditches shall be incorporated in the initial cap to channel all surface water

runoff to the east detention basin (See Section III. A ("Source Control") of this SOW).

b. Improvements to and maintenance of the existing east main drainage channel shall also be performed as necessary. Measures for drainage channel stabilization shall include, but not be limited to:

The discharge flow from the east detention basin (and any other designed channel outlet) will be controlled to be equal to or less than the discharge for the pre-development condition for all storms up to and including the 100-year 24-hour design storm (100-year event). (The pre-development flows are discussed in Reference 28.) The outlet structure will be designed so that adjustments can be made in the discharge controls if deemed necessary during the Interim Maintenance Period.

From the discharge side of the east detention basin principal spillway at approximately elevation 1000 feet mean sea level (MSL) to the ledge rock at approximately elevation 975 feet MSL, the outlet channel (i.e., the east main drainage channel) will be designed to be rock-lined. Below elevation 975 feet MSL, the existing steeply-sloped, rock-paved outlet channel will not be disturbed and will serve as the design channel.

At approximately elevation 760 feet MSL, the potential for a concentrated overfall or headcut exists at the termination of the shale in the channel. The potential for this erosive condition will be mitigated by the installation of a small headwall structure across the channel at the termination of shale rock.

In the valley portion of the east main drainage channel, the existing sandstone armored channel will be used without modification to its existing condition except for approximately a 200-foot length that shall be improved in either of the following ways as determined during the IRP Remedial Design. From a point approximately 200 feet upstream from the confluence of the east main drain and No-Name Creek, the channel may be improved by either: (1) redirecting the channel to its previous natural course, if the natural course is determined to be stable; or (2) fully riprapping this 200-foot length of the

channel, if the natural course is determined to be unstable.

c. The existing east detention basin shall be enlarged and modified to provide for an increased volume of storm water runoff which will result from installation of the initial cap and to control the discharge to the east main drainage channel to flows less than pre-development flows (defined in Reference 28) for storms up to and including a 100-year event.

d. Permanent surface water and erosion control features to be installed during Remedial Action to control surface water runoff and to minimize hillslope and cap erosion shall include:

The flows from the drainage channels and pipes along the cap perimeter will be discharged into the east detention basin by the use of paved chutes, with energy dissipators, that carry the flows to the bottom of the basin and dissipate the flow energy to minimize soil erosion in the basin.

The east detention basin will be designed for all storms up through the 100-year event as tabulated in the U.S. Weather Bureau Technical Report No. 40. The hydrograph distribution will be the SCS Type II that includes short duration storms (such as 30 minutes, 1 hour, etc.) as specified in the U.S. Soil Conservation Service National Engineering Handbook, Section 4, Hydrology.

The east detention basin embankment design will consist of compacted soil fill and rock fill, or equivalent design, with a multi-stage reinforced concrete principal spillway. The structure will be designed for at least a 100-year life with minimal maintenance. The principal spillway will consist of a multi-stage rectangular drop inlet, pipe conduit, and an energy dissipation outlet structure. A means will be included in the principal spillway to measure discharge flows.

The emergency spillway crest elevation will be set at the routed basin water level for the 100-year event. The size of the emergency spillway will be based on the routing of the Standard Project Storm rainfall of 15 inches within a 24-hour duration (reference Army Corps of Engineers CE Bulletin 52-8) and the SCS Type II distribution.

2. Remedial Standards

All Remedial Standards related to surface water and erosion control shall be met. Those Remedial Standards that have been identified are as follows:

Performance Standards

The initial cap and surface water and erosion control features, such as the east detention basin and east main drainage channel, shall be designed and maintained such that the erosion of the trench disposal area and the surrounding hillslopes is eliminated to the extent practicable so that slope stability and the integrity of the remedy is maintained over the long term.

The initial cap and surface water and erosion control features, such as the east detention basin and east main drainage channel, shall be designed and maintained such that downslope surface water runoff velocities do not exceed pre-development velocities, and siltation is eliminated to the extent practicable throughout the Interim Maintenance Period. The detention basin shall be designed to detain storm water runoff which would result from a 100-year, 24-hour storm.

The existing west detention basin and the south weir shall be closed. Cap runoff shall primarily flow to the east detention basin for controlled release into the east main drainage channel at a rate that does not exceed pre-development flows from the area of the cap.

3. Compliance Testing/Monitoring

The following testing, monitoring and review shall be conducted to ensure that all Performance Standards related to surface water and erosion control are met:

a. General Erosion Monitoring:

Erosion control monitoring shall consist of implementing a formal program of measurements and observations to determine erosion of the east, west and south main drainage channels and mass material movement in the adjacent hillsides that drain toward the channels (hereinafter called "drainage basins"). The purpose of erosion control monitoring is to establish a data base for determining potential ramifications in the event there is (1) a statistically valid trend toward an unacceptable erosive condition and (2) a

statistically valid upward trend in the concentration of radioactive materials detected in soil or soil moisture samples within the area being monitored for erosion such that the 25 millirem site boundary release limit of 902 KAR 100:022 Section 18 may be exceeded.[5] If these two conditions exist, an engineering evaluation of the measured data and site conditions will be performed to determine if any adjustments to a drainage channel or associated drainage basin is warranted. The plans and procedures for the monitoring program shall be a part of the Initial Remedial Phase Remedial Design to be prepared in Task II.

Erosion control monitoring of the drainage channels shall include the installation of surveyed monuments to provide fixed points for measuring the drainage channel profile and cross sections. The number and location of the surveyed monuments shall be determined during the IRP Remedial Design. Erosion control monitoring of mass material movement shall include the placement of known reference points for detecting mass material movement in the drainage basins. In selected locations where radiological monitoring is performed with soil moisture collectors (lysimeters), a secondary function of the lysimeters will be to provide the known reference points. Alternative methods may be used to monitor mass material movement if the use of lysimeters at selected locations is determined to be inadequate. The number and location of the selected lysimeters, or other indicators of mass material movement, will be determined during the IRP Remedial Design. Monuments and mass material movement indicators shall be surveyed annually. The resulting data base shall be evaluated as part of each five-year review by comparing mass material movement indicator positions and drainage channel profile/cross section data with baseline measurements taken before the completion of the IRP Remedial Action.

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[5]"Site boundary " or "current licensed Site property boundary" means the area delineated in the map which serves as Appendix H to the Consent Decree.

b. East Main Drainage Channel and Drainage Basin:

Since the cap will be designed to drain all cap runoff to the east detention basin, the majority of the erosion control monitoring will be of the east main drainage channel and its associated basin. The east main drainage channel and drainage basin monitoring area shall extend from the outlet of the east detention basin to the confluence of the east main drainage channel with No-Name Creek.

c. West and South Drainage Channels and Drainage Basins:

Since only minimal runoff from the area of contamination will drain down the south and west hillsides, a formal, but less extensive program of measurements and observations will be performed along the principal drainage channels of these areas. Along the south drainage channel and its associated drainage basin, monitoring shall extend from the point where the drainage from the south perimeter road flows into the south drainage channel to the point where the south drainage channel crosses Rock Lick Creek Road.

On the west hillside, monitoring shall be performed along two drainage channels and their associated drainage basins. One channel extends from the west perimeter road of the restricted area, at a point adjacent to Trench 33, to the access road of the Lambert property in a direction approximately perpendicular to the west perimeter road[6]. The other channel extends from the outlet of the existing west detention basin to Drip Springs Creek on the Lambert property.

C. ACCESS CONTROL, SECURITY AND NOTIFICATION

1. The major components of access control, security and notification to be implemented by Settling Defendants shall include the following:

a. Access to the disposal area shall be physically controlled to prevent inadvertent intrusion onto the Site;

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[6] The Lambert property is Parcel #36 on Fleming County Property Identification Map No. 97, Revised June 1981.

b. Acquisition and establishment of a buffer zone adjacent to the Site, as described more fully in Section 10.0 of the ROD;

c. Installation of permanent surface monuments and markers warning against intrusion;

d. In conjunction with fulfillment of Section V.10 of the Consent Decree, notification of the approximate quantity and nature of the waste disposed of at the Site and general description of the Restricted Area shall be submitted to the Fleming County Judge/Executive within 15 days of entry of the Consent Decree and this SOW.

2. Performance Standards

Access control and buffer zone acquisition measures shall be implemented, as required by the ROD, Consent Decree and this SOW.

IV. TASKS AND DELIVERABLES

The specific scope of the Work to be performed by the Settling Defendants shall be documented in the Initial Remedial Phase Monitoring and Maintenance Plan, Initial Remedial Phase Remedial Design (IRP RD) Work Plan, Initial Remedial Phase Remedial Action (IRP RA) Work Plan, Interim Maintenance Period Work Plan, Final Closure Period Work Plan, Final Closure Period RA Work Plan, Institutional Control Work Plan, and Post-Institutional Control Work Plan. Plans, specifications, submittals, and other deliverables shall be subject to EPA review and approval in accordance with Section XIV of the Consent Decree. Upon approval, all deliverables and the approved schedules contained therein shall be deemed incorporated by reference into the Consent Decree and this SOW, as binding requirements upon the Settling Defendants.

In the interest of facilitating the timely implementation of the leachate removal/disposal (LR/D) activities, one or more portions of the IRP RD/RA deliverables, which are described in Tasks II and III below, may be submitted in advance of the complete deliverables. EPA will review and comment on or approve these deliverables as they are submitted.

Settling Defendants shall perform the following tasks:

TASK I - PROJECT PLANNING

A. IRP MONITORING AND MAINTENANCE PLAN

Within 45 days of the entry of the Consent Decree, the Commonwealth shall submit an IRP Monitoring and Maintenance Plan to EPA for review and approval. The IRP Monitoring and Maintenance Plan shall describe the specific tasks to be performed by the Commonwealth during the IRP RD and RA, frequency of task, and proposed location of sample collection. Sample collection procedures, laboratory identification, analysis procedures and designated Commonwealth personnel performing these tasks shall also be specified in the plan. This plan shall include, but not be limited to, the following tasks:

- Chemical and radiological monitoring of ground water and surface water
- Airborne radioactivity monitoring
- Gamma radiation monitoring
- Vegetation monitoring
- Colluvial soil monitoring
- Site surveillance
- Site maintenance activities such as grass cutting, ditch cleaning, fence repair, routine cap repair, and subsidence monitoring and repair
- Access control and security

B. SITE BACKGROUND

Settling Private Parties shall gather and evaluate the existing relevant information regarding the Site and shall conduct a visit to the Site, as necessary, to assist in planning the IRP RD/RA as follows:

1. Collect and Evaluate Existing Data and Document the Need for Additional Data

Before planning IRP RD/RA activities, relevant, existing Site data shall be thoroughly compiled and reviewed by Settling Private Parties. Specifically, this shall include the ROD, RI/FS, and other available data related to the Site. Based on this information, the Settling Private Parties shall prepare and submit a technical memorandum documenting any need, or lack thereof, for additional data needed for implementation of the IRP along with the proposed Data Quality Objectives (DQOs). Final decisions on the necessary data, DQOs and verification studies shall be made by EPA. Implementation of Task II below by Settling

Private Parties shall not be contingent upon EPA approval of the technical memorandum.

2. Conduct Site Visit

If determined to be necessary by EPA, Settling Private Parties shall visit the Site with the EPA Remedial Project Manager (RPM) during the project planning phase to assist in developing a conceptual understanding of the requirements for performing the IRP. Information gathered during this visit shall be utilized to plan the project and to determine the extent of the additional data necessary to implement the IRP.

C. PROJECT PLANNING

Once Settling Private Parties have collected and evaluated existing data and visited the Site, the specific project scope shall be planned in accordance with Task II below. Settling Private Parties shall meet with EPA during this evaluation regarding the remaining Work under this SOW.

TASK II - IRP REMEDIAL DESIGN

The IRP Remedial Design (IRP RD) shall provide the technical details for implementation of the IRP Remedial Action (IRP RA) in accordance with currently accepted environmental protection technologies and standard professional engineering and construction practices. The IRP RD shall include clear and comprehensive design plans and specifications.

A. IRP REMEDIAL DESIGN PLANNING

At the conclusion of the project planning activities, Settling Private Parties shall submit an IRP RD Work Plan, which shall include a Sampling and Analysis Plan (SAP). These two plans are described in more detail in Paragraphs 1 and 2 below, respectively. The IRP RD Work Plan shall include, but not be limited to:

- leachate removal
- leachate temporary storage
- leachate solidification
- solidified leachate disposal
- trench design and construction (for other than solidified leachate disposal)
- EMC bunker design and construction
- on-Site facilities for RD and RA data acquisition
- initial cap design and construction
- grading and contouring of initial cap to enhance surface water flow

- cap and hillslope surface water control and erosion control measures
- demolition and disposal of structures, equipment, and solid waste
- institutional control measures
- Site monitoring
- establishment of monitoring/surveillance systems

Upon approval of the IRP RD Work Plan, Settling Private Parties shall implement the IRP RD Work Plan in accordance with the design management schedule contained therein.

In the interest of facilitating timely implementation of the leachate removal/disposal (LR/D) activities, one or more portions of the IRP RD Work Plan may be submitted in advance of the complete IRP RD Work Plan. Should Settling Private Parties submit some deliverables in advance of the complete IRP RD Work Plan, Settling Private Parties shall submit the complete IRP RD Work Plan no later than 90 days following initiation of leachate removal and solidification.

In conjunction with each partial submittal of the IRP RD Work Plan, Settling Private Parties shall submit a corresponding partial Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP) and Health and Safety Plan (HASP), which shall be sufficient to cover the planned Work. The IRP RD Work Plan, HASP, SAP and the QAPP must be reviewed and approved by EPA, and a reasonable opportunity provided for review and comment by the Commonwealth, prior to the initiation of field activities. Plans, specifications, submittals, and other deliverables shall be subject to EPA review and approval in accordance with Section XIV of the Consent Decree. Review and/or approval of design submittals shall only permit Settling Private Parties to proceed to the next step of the design process. Approval does not imply acceptance of later design submittals that have not been reviewed, nor does it imply that the remedy, when constructed, will meet Performance Standards.

1. IRP RD Work Plan

Settling Private Parties shall submit a IRP RD Work Plan to EPA for review and approval. The IRP RD Work Plan shall be developed in conjunction with the IRP Health and Safety Plan (HASP), IRP Sampling and Analysis Plan (SAP) and an IRP Quality Assurance Project Plan (QAPP), although each plan may be delivered under separate cover. The IRP RD Work Plan shall include a comprehensive description of the additional data collection and evaluation activities to be performed, and the plans and specifications to be

prepared pertaining to trench leachate removal, temporary leachate storage, leachate solidification, earth mounded concrete bunker design and construction, trench design and construction, solidified leachate disposal, on-Site facilities for RD and RA data acquisition, initial cap construction, grading and contouring of initial cap to enhance surface water flow, cap and hillslope surface water control features and erosion control measures, demolition and disposal of structures, equipment and solid waste, institutional controls, and monitoring systems and maintenance and surveillance activities. A comprehensive design management schedule for completion of these major activities shall also be included.

Specifically, the IRP RD Work Plan shall include the following:

a. A statement of the problems and potential problems posed by the Site and the objectives of the IRP phase of the RD/RA.

b. An updated version of the background summary in the RI Report, including:

- A brief description of the Site including the geographic location and the physiographic, hydrologic, geologic, demographic, ecological, and natural resource features;

- A brief synopsis of the history of the Site including a summary of past disposal practices and a description of previous responses that have been conducted by local, State, Federal, or private parties;

- A summary of the existing data, including physical, radiological and chemical characteristics of the contaminants identified and their distribution among the environmental media at the Site.

c. A list and detailed description of the tasks to be performed to complete the IRP, information needed for each task, information to be produced during and at the conclusion of each task, and a description of the Work products that shall be submitted to EPA and the Commonwealth in connection with those tasks. This description shall include the deliverables set forth in the remainder of Task II which are related to IRP

Activities.

d. A schedule with specific dates for completion of each required activity and submission of each deliverable required by the Consent Decree and this SOW for performance of the IRP. This schedule shall also include information regarding timing, initiation and completion of all critical path milestones for each such activity and/or deliverable.

e. A project management plan, including a data management plan, and provision for monthly reports to EPA and the Commonwealth, and meetings and presentations to EPA and the Commonwealth at the conclusion of each major phase of the overall IRP RD/RA. The data management plan shall address the requirements for project management systems, including tracking, sorting, and retrieving the data along with an identification of the software to be used, minimum data requirements, data format and backup data management. The plan shall address both data management and document control for all activities conducted during the IRP RD/RA.

f. A description of the on-Site office and facilities provided by Settling Private Parties for use by EPA and the Commonwealth during the IRP.

g. A description of the community relations support activities to be conducted during the RD. At EPA's request, Settling Private Parties shall assist EPA in preparing and disseminating information to the public regarding the RD Work to be performed.

2. Sampling and Analysis Plan (SAP)

The Sampling and Analysis Plan (SAP) required to be prepared by Settling Private Parties shall ensure that sample collection and analytical activities are conducted in accordance with technically acceptable protocols and that the data generated will meet the DQOs established in the SAP. The SAP shall include a Quality Assurance Project Plan (QAPP) for the portion of the RD/RA addressed by the SAP.

The SAP shall define in detail the sampling and data gathering methods that shall be used on the project. They shall include sampling objectives, sample locations (horizontal and vertical) and frequency, sampling equipment and procedures, and sample handling and analysis. The QAPP shall describe the project objectives and organization, functional activities, and quality assurance and quality control (QA/QC) protocols that shall be used to achieve the desired DQOs. The DQOs shall, at a minimum, reflect use of analytical methods for obtaining data of sufficient quality to meet National Contingency Plan (NCP) requirements as identified at 300.435(b) of the NCP. In addition, the QAPP shall address personnel qualifications, sampling procedures, sample custody, analytical procedures, and data reduction, validation, and reporting. All other procedures must be consistent with the Region IV Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual and the guidances specified in Section XI of the Consent Decree.

Settling Private Parties shall demonstrate in advance and to EPA's satisfaction that each laboratory it may use is qualified to conduct the proposed Work and meets the requirements specified in Section XI of the Consent Decree. EPA may require Settling Private Parties to submit detailed information to demonstrate that the laboratory is qualified including information on personnel qualifications, equipment and material specification, and laboratory analyses of performance samples (blank and/or spike samples). In addition, EPA may require submittal of data packages equivalent to those generated by the EPA Contract Laboratory Program (CLP). Laboratories conducting radionuclide analyses shall participate in the U.S. EPA cross-check program.

3. Health and Safety Plan

A HASP shall be developed for the remedial activities at the Site. The HASP shall be prepared in conformance with Settling Private Parties health and safety program, and in compliance with OSHA regulations and all Kentucky regulations relating to worker exposure to radiation. The HASP shall include a health and safety risk analysis, a description of monitoring and personal protective equipment, medical monitoring, and provisions for Site control. EPA, after a reasonable

opportunity for review and comment by the Commonwealth, will review and approve the HASP to ensure that all necessary elements are included and to ensure that all health and safety procedures are fully described and in compliance with OSHA and Commonwealth regulations relating to worker exposure to radiation and hazardous substances, including the Commonwealth's Site-specific safety training and monitoring requirements.

B. IRP REMEDIAL DESIGN FIELD DATA ACQUISITION

Prior to commencement of the IRP, and concurrent with performance of the IRP RD, Settling Private Parties shall conduct field data acquisition in accordance with the approved IRP RD Work Plan and Sampling and Analysis Plan described above. Field data shall include, but not be limited to:

1. Geophysical Surveys

   a. Prepare field survey specifications;
   b. Perform surveys.

2. Topographic Survey

   Prepare a topographic map from aerial photographs of the Site taken in March 1992.

3. Site Equipment Inventory

   Log the location, physical dimensions, radiological characteristics and condition of:

   - wells
   - trench sumps
   - lysimeters
   - buildings and structures
   - equipment
   - drummed waste and uncontained solid waste.

4. Baseline Radiological/Chemical Sampling and Analysis Program

   Sampling of:

   - trench leachate
   - food crops and trees
   - surface water, soil water, and ground water
   - stream sediment and soil
   - air

to the extent necessary to supplement information already available as a result of the Remedial Investigation and the Commonwealth's ongoing monitoring at the Site.

C. IRP PRELIMINARY REMEDIAL DESIGN

IRP Preliminary Remedial Design shall begin with initial design and shall end with the completion of approximately 30 percent of the design effort. At this stage, Settling Private Parties shall field verify, as necessary, the existing conditions of the Site. The technical requirements of the IRP RA shall be addressed and outlined so that they may be reviewed to determine if the final design will provide an effective remedy. Supporting data and documentation shall be provided with the design documents defining the functional aspects of the project. EPA, after a reasonable opportunity for review and comment by the Commonwealth, shall review and comment on the IRP Preliminary Remedial Design Report. In accordance with the design management schedule established in the approved IRP Remedial Design Work Plan, Settling Private Parties shall submit to EPA and the Commonwealth the IRP Preliminary RD which shall consist of the following:

1. Results of IRP Data Acquisition Activities

Data gathered during the project planning phase shall be compiled, summarized, and submitted along with an analysis of the impact of the results on remedial design activities. In addition, surveys conducted to establish topography, rights-of-way, easements, and utility lines shall be documented. Utility requirements and acquisition of access, through purchases or easements, that are necessary to implement the IRP shall also be discussed.

2. IRP Remedial Design Criteria Report

The concepts supporting the technical aspects of the remedial design shall be defined in detail and presented in this report. Specifically, the IRP Remedial Design Criteria Report shall include the preliminary design assumptions and parameters, including:

a. Batched leachate characterization
b. Pumping rate, volume, and storage capacity requirements
c. Waste form, mixing/pumping rate and volume
d. Earth mounded concrete bunker design,

quantity, and location
e. Trench design, quantity and location
f. Initial cap design parameters including cap materials, permeabilities, thicknesses and liner requirements and surface water and erosion control measures
g. Monitoring systems
h. Performance standards

3. IRP Preliminary Remedial Design Plans and Specifications

Settling Private Parties shall submit to EPA and the Commonwealth an outline of the required drawings, including preliminary sketches and layouts, describing conceptual aspects of the IRP RD, unit processes, etc. In addition, an outline of the required specifications, including Performance Standards, shall be submitted. Construction drawings shall reflect organization and clarity, and the scope of the technical specifications shall be outlined in a manner reflecting the final specifications.

D. IRP PREFINAL AND FINAL REMEDIAL DESIGN

Settling Private Parties shall submit the IRP Prefinal Remedial Design Report when it is approximately 90 percent complete in accordance with the approved design management schedule. Settling Private Parties shall address comments generated from the review of the IRP Preliminary Remedial Design Report and subsequent review comments in meetings and informal reviews by EPA and the Commonwealth and clearly show any modification of the design resulting from incorporation of the comments. The IRP Prefinal Remedial Design Report shall function as the draft version of the IRP Final Remedial Design Report. After EPA review and comment on the IRP Prefinal Remedial Design Report, Settling Private Parties shall submit the IRP Final Remedial Design Report along with a memorandum indicating how the IRP Prefinal Remedial Design Report comments were incorporated into the IRP Final Remedial Design Report. All IRP Final Remedial Design documents shall be certified by a Professional Engineer registered in the Commonwealth of Kentucky. EPA must approve the IRP Final Remedial Design Report before Settling Private Parties may initiate the IRP, unless specifically authorized by EPA. Settling Private Parties shall submit the following with, or as part of, the IRP Prefinal and Final Remedial Design Reports:

1. Complete Remedial Design Analyses

   The selected IRP RD along with an analysis supporting the IRP RD approach. Design calculations shall be included.

2. Final IRP RD Plans and Specifications

   A complete set of construction drawings and specifications which describe the selected remedial design.

3. Final IRP RA Construction Schedule

   A final IRP RA construction schedule for EPA approval.

TASK III - IRP REMEDIAL ACTION

The IRP Remedial Action performed by Settling Private Parties pursuant to the Consent Decree shall include the following components: trench leachate removal and solidification, trench construction, earth mounded concrete bunker construction, solidified leachate disposal, surface water and erosion control measures, initial cap construction, initial cap grading and contouring, demolition and disposal of structures and equipment and solid waste, and establishment of maintenance, monitoring and surveillance systems.

A. IRP REMEDIAL ACTION PLANNING

Concurrent with the submittal of the draft IRP final Remedial Design Report, Settling Private Parties shall submit a draft IRP RA Work Plan, an IRP Construction Management Plan, an IRP Construction Quality Assurance Plan, and an IRP Construction Health and Safety Plan/Contingency Plan for review and comment by EPA, and a reasonable opportunity provided for review and comment by the Commonwealth. Within 30 days after approval of the IRP Final Remedial Design Report, Settling Private Parties shall submit a final IRP RA Work Plan, IRP Construction Management Plan, IRP Construction Health and Safety Plan/Contingency Plan and IRP Construction Quality Assurance Plan for review and approval prior to initiation of the IRP Work.

Upon approval of the IRP Final Remedial Design Report and the IRP RA Work Plan, Settling Private Parties shall implement the IRP RA Work Plan in accordance with the approved construction management schedule. Significant field changes to the IRP as set forth in the IRP RA Work Plan and IRP Final Remedial Design Report shall not be undertaken without the approval of EPA, after a reasonable

opportunity for review and comment by the Commonwealth. The IRP shall be documented in enough detail to produce as-built construction drawings after the IRP is complete. Deliverables shall be submitted to EPA for review and approval in accordance with Section XIV of the Consent Decree. Review and/or approval of IRP submittals shall only permit Settling Private Parties to proceed to the next step of the remedial action process. Approval does not imply acceptance of later IRP submittals that have not been reviewed, nor does it imply that the remedy, when constructed, will meet Performance Standards.

1. IRP RA Work Plan

Settling Private Parties shall submit a Work Plan which provides a detailed plan of action for completing the IRP RA activities to EPA for review and approval. This Work Plan shall provide for the safe and efficient completion of the IRP. The Work Plan shall be developed in conjunction with the IRP Construction Management Plan, the IRP Construction Quality Assurance Plan, and the IRP Construction Health and Safety Plan/Contingency Plan, although each plan may be delivered under separate cover. The IRP RA Work Plan shall include a comprehensive description of the IRP activities to be performed and a construction schedule for completion of each major IRP activity and submission of each IRP deliverable.

Specifically, the IRP RA Work Plan shall include the following:

a. A detailed description of the IRP tasks to be performed and a description of the work products to be submitted to EPA, including the deliverables set forth in the remainder of Task III which pertain to IRP activities;

b. A schedule for completion of each required activity and submission of each IRP deliverable required by this Consent Decree, including those in this SOW;

c. A project management plan, including provision for monthly reports to EPA and the Commonwealth and joint meetings and presentations to EPA and the Commonwealth at the conclusion of each major phase of the IRP (EPA's Project Coordinator, the Settling Private Parties Project Coordinator and a representative of the Commonwealth will meet, at a minimum, on a quarterly basis, unless EPA determines that such meeting is unnecessary);

d. A description of the community relations support activities to be conducted during the IRP. At EPA's request, Settling Private Parties shall assist EPA in preparing and disseminating information to the public regarding the IRP to be performed.

e. A description of the strategy for delivering the project. This section shall address the management approach for implementing the IRP, including procurement methods and contracting strategy, phasing alternatives, and contractor and equipment availability concerns.

2. IRP Construction Management Plan

Settling Private Parties shall develop an IRP Construction Management Plan to indicate how the construction activities are to be implemented and coordinated with EPA and the Commonwealth during the IRP. Settling Private Parties shall designate a person to be an on-Site Project Coordinator and their representative on-Site during the IRP, and identify this person in the Construction Management Plan. The Construction Management Plan shall also identify other key project management personnel comprising the IRP Construction Project Team along with the lines of authority, and provide descriptions of the duties of the key personnel along with an organizational chart. In addition, a plan for the administration of construction changes and EPA review and approval of those changes shall be included.

3. IRP Construction Quality Assurance Plan

Settling Private Parties shall develop and implement an IRP Construction Quality Assurance Program to ensure, with a reasonable degree of certainty, that the completed IRP meets or exceeds all design criteria, plans and specifications, and Remedial Standards. At a minimum, the IRP Construction Quality Assurance Plan shall include the following elements:

a. A description of the quality control organization, including a chart showing lines of authority, identification of the members of the Independent Quality Assurance Team (IQAT), and acknowledgment that the IQAT will implement the control system for all aspects of the Work specified and shall report to the project coordinator and EPA. The IQAT members shall be representatives from testing

and inspection organizations and/or the Supervising Contractor and shall be responsible for the QA/QC of the IRP RA. The members of the IQAT shall have a good professional and ethical reputation, previous experience in the type of QA/QC activities to be implemented, and demonstrated capability to perform the required activities. They shall also be independent of the construction contractor.

b. The name, qualifications, duties, authorities, and responsibilities of each person assigned a QC function.

c. Description of the observations and control testing that will be used to monitor the construction and/or installation of the components of the IRP. This includes information which certifies that personnel and laboratories performing the tests are qualified and the equipment and procedures to be used comply with applicable standards. Any laboratories to be used shall be specified. Criteria for acceptance or rejection of laboratories shall be listed and plans for implementing corrective measures shall be addressed.

d. A schedule for managing submittals, testing, inspections, and any other QA functions (including those of contractors, subcontractors, fabricators, suppliers, purchasing agents, etc.) that involve assuring quality workmanship, verifying compliance with the plans and specifications, or any other QC objectives. Inspections shall verify compliance with all environmental requirements and include, but not be limited to, air quality and emissions monitoring records and waste disposal records.

e. Reporting procedures and reporting format for QA/QC activities including such items as daily summary reports, schedule of data submissions, inspection data sheets, problem identification and corrective measures reports, evaluation reports, acceptance reports, and final documentation. Documents prepared by IQAT members shall be made available to representatives of EPA, the Commonwealth and Settling Private Parties.

f. A list of definable features of the Work to be performed. A definable feature of Work is a task which is separate and distinct from other tasks and has separate control requirements.

4. IRP Construction Health and Safety Plan/Contingency Plan

Settling Private Parties shall prepare a IRP Construction Health and Safety Plan/Contingency Plan in conformance with Settling Private Parties' health and safety program, and in compliance with OSHA regulations as well as Kentucky regulations relating to worker exposure to radiation. The IRP Construction Health and Safety Plan/Contingency Plan shall include a health and safety risk analysis, a description of monitoring and personal protective equipment, medical monitoring, and Site control. EPA will review, and provide a reasonable opportunity for review and comment by the Commonwealth, the Construction Health and Safety Plan/Contingency Plan to ensure that all of the necessary elements are included and to ensure that all health and safety procedures are fully described and in compliance with OSHA and Commonwealth regulations relating to worker exposure to radiation and hazardous substances, including the Commonwealth's Site-specific safety training and monitoring requirements. This plan shall include a Contingency Plan and incorporate Air Monitoring and Spill Control and Countermeasures Plans. The Contingency Plan shall be written to ensure protection of on-Site construction workers and the local population potentially affected. It shall include the following items:

a. Name of person who will be responsible in the event of an emergency incident, as well as at least two alternates.

b. Plan for Site safety indoctrination and training for all employees, name of the person who will give the training and the topics to be covered.

c. Plan and date for meeting with the local community, including local, state and federal agencies involved in the cleanup, as well as the local emergency squads and the local hospitals.

d. A list of the first aid and medical facilities including location of first aid kits, names of personnel trained in first aid, a clearly marked map with the route to the nearest medical facility, all necessary emergency phone numbers conspicuously posted at the Site (i.e., fire, rescue, and the Kentucky Disaster Emergency Services (KDES)).

e. Plans for protection of public and visitors to the Site.

f. Air and Radiation Monitoring Plan which incorporates the following requirements:

- Air and radiation monitoring shall be conducted on-Site, at the restricted area boundary and at the Site boundary. The radiological constituents that were identified during the Risk Assessment shall serve as a basis of the sampling and measurement of pollutants in the atmosphere and radiological control areas. Settling Private Parties shall clearly identify these compounds along with the required detection and notification levels for the restricted and unrestricted areas. Air and radiation monitoring shall include personnel monitoring where applicable.

- Personnel monitoring shall be conducted according to 10 CFR §§ 20.1501 and 20.1502 (902 KAR 100:019 Sections 12 and 13), OSHA, NIOSH and NRC regulations (as amended).

- On-Site area monitoring shall consist of continuous real-time monitoring performed immediately adjacent to any waste excavation areas, treatment areas, and any other applicable areas when work is occurring. Measurements shall be taken in the radiological control areas to include, but not be limited to: on-Site worker bioassays, contamination surveys, radiation surveys, high volume air sample surveys, and tritium air sample surveys. Additionally, the breathing zones of personnel immediately upwind and downwind of the work areas shall be surveyed for hazardous chemical constituents. Equipment shall include the following, at a minimum: self reading dosimeters, portable alpha, beta and gamma radiation survey meter, scintillation probes (alpha and gamma detector), hand probe (beta detector), tritium monitor, organic vapor meter, explosivity meter, particulate monitoring equipment, and on-Site windsock.

- Monitoring shall consist of monitoring airborne radiological contaminants at the boundary of the restricted area and

the Site boundary to determine whether harmful concentrations of toxic constituents are migrating off-Site. EPA approved methods shall be used for sampling and analysis of air. The results of the air monitoring and the on-Site meteorological monitoring shall be used to assess the potential for off-Site exposure to toxic materials. The air monitoring program shall include provisions for notifying nearby residents, local, state and federal agencies in the event that unacceptable concentrations of airborne contaminants are migrating off-Site. Settling Private Parties shall report detection of levels of airborne contaminants above the limits of 40 CFR Part 61 to EPA in accordance with Section XVIII of the Consent Decree.

g. A plan for instituting a medical surveillance program which shall address medical requirements for Site workers, physician examinations, personnel dosimetry records and summary reports, and transfer of personnel monitoring records to the appropriate state and federal agencies.

h. A Spill Control and Countermeasures Plan which shall include the following:

- Contingency measures for potential spills and discharges from materials handling and/or transportation.

- A description of the methods, means, and facilities required to prevent contamination of soil, water, atmosphere, and uncontaminated structures, equipment, or material by spills or discharges which could potentially occur during the pumping and solidification operations.

- A description of the equipment and personnel necessary to perform emergency measures required to contain any spillage and to remove spilled materials and soils or liquids that become contaminated due to spillage. This collected spill material must be properly disposed of.

- A description of the equipment and personnel to perform decontamination measures that may be required for previously

uncontaminated structures, equipment, or material.

B. PRECONSTRUCTION CONFERENCE

Settling Private Parties and federal, state and local government agencies shall hold a Preconstruction Conference which shall take place after selection of the construction contractor but before initiation of IRP construction. The Preconstruction Conference agenda shall include:

1. Defining the roles, relationships, and responsibilities of all parties;

2. Reviewing methods for documenting and reporting inspection data;

3. Reviewing methods for distributing and storing documents and reports;

4. Reviewing work area security and safety protocols;

5. Reviewing the approved construction schedules;

6. Conducting a Site reconnaissance to verify that the design criteria and the plans specifications are understood and to review material and equipment storage locations.

The Preconstruction Conference must be documented, including, at a minimum, names of people in attendance, issues discussed, clarifications made, special instructions issued.

C. IRP PREFINAL CONSTRUCTION INSPECTION

Upon preliminary completion of the IRP, Settling Private Parties shall notify EPA for the purpose of conducting a Prefinal Construction Inspection. Participants should include the Project Coordinators, Supervising Contractor, Construction Contractor, and other federal, state, and local agencies with a jurisdictional interest. The Prefinal Construction Inspection shall consist of a walk-through inspection of the entire project Site. The objective of the inspection is to determine whether the IRP is complete and consistent with the Consent Decree. Any outstanding construction items discovered during the inspection shall be identified and noted on a punch list. Additionally, monitoring equipment shall be operationally tested by Settling Private Parties. Settling Private Parties shall certify that the equipment has performed to effectively meet the purpose and intent of the specifications. Retesting

shall be completed where the initial testing reveals deficiencies. A Prefinal Construction Inspection Report shall be submitted by Settling Private Parties for the Prefinal Construction Inspection which outlines the outstanding construction items, actions required to complete the items, completion date for the items, and an anticipated date for the IRP Final Construction Inspection.

D. IRP FINAL CONSTRUCTION INSPECTION

EPA will perform a Final Construction Inspection for the IRP, consisting of a walk-through inspection of the entire project Site. Upon Settling Private Parties' completion of all outstanding construction items for the IRP, Settling Private Parties shall notify EPA for the purpose of conducting a Final Construction Inspection. The IRP Prefinal Construction Inspection Report shall be used as a checklist with the Final Construction Inspection focusing on the outstanding construction items identified in the Prefinal Construction Inspection. All tests that were originally unsatisfactory shall be conducted again. Confirmation shall be made during the IRP Final Construction Inspection that all outstanding items have been resolved. Any outstanding construction items discovered during the inspection still requiring correction shall be identified and noted on a punch list. If any items are found unresolved during the IRP Final Construction Inspection, then that inspection shall be considered to be a Prefinal Construction Inspection, requiring another IRP Prefinal Construction Inspection Report and subsequent IRP Final Construction Inspection.

E. IRP FINAL CONSTRUCTION INSPECTION REPORT

Within sixty (60) days following the conclusion of the IRP Final Construction Inspection, Settling Private Parties shall submit an IRP Final Construction Inspection Report for the IRP. EPA, after a reasonable opportunity for review and comment by the Commonwealth, will provide comments to Settling Private Parties. The IRP Final Construction Inspection Report shall include the following:

1. Brief description of how outstanding items noted in the Prefinal Inspection were resolved;

2. Explanation of modifications made during the IRP Work to the original IRP RD and IRP RA Work Plans and why these changes were made;

3. As-built drawings;

4. Synopsis of the construction work defined in the SOW and certification that the construction work has been completed.

F. IRP REMEDIAL ACTION REPORT

As provided in Section XVII of the Consent Decree, within 90 days after Settling Private Parties conclude that the IRP has been fully performed and the Performance Standards have been achieved, Settling Private Parties shall so certify to the United States and shall schedule and conduct a pre-certification inspection to be attended by EPA, the Commonwealth and Settling Private Parties. If after the pre-certification inspection Settling Private Parties still believe that the IRP has been fully performed and the Performance Standards have been achieved, Settling Private Parties shall submit an IRP RA Report to EPA in accordance with Section XVII of the Consent Decree. The IRP RA Report shall include the following:

1. A copy of the IRP Final Construction Inspection Report;

2. A synopsis of the Work defined in this SOW and a demonstration in accordance with the Performance Standards Verification Plan that Performance Standards have been achieved; and

3. Certification that the IRP has been completed in full satisfaction of the requirements of the Consent Decree.

After review by EPA, and after a reasonable opportunity for review and comment by the Commonwealth, Settling Private Parties shall address any comments and submit a revised report. As provided in Section XVII of the Consent Decree, the IRP shall not be considered complete until EPA approves the IRP RA Report.

TASK IV - INTERIM MAINTENANCE PERIOD, FINAL CLOSURE PERIOD, AND ASSOCIATED REMEDIAL ACTIVITIES

The remainder of the selected remedy includes the Interim Maintenance Period and Final Closure Period, collectively referred to as the Balance of Remedial Phase (BoRP). The BoRP contains two separate and distinct periods of action: 1) an Interim Maintenance Period (IMP), which commences upon issuance of the Certificate of Completion for the IRP and ends when EPA concludes, in consultation with the Commonwealth, that the trench stabilization criteria have been achieved. The IMP includes initial cap maintenance, trench leachate management, installation of a horizontal flow barrier, if necessary, and site maintenance and monitoring; and, 2) a Final Closure Period (FCP), which commences upon EPA determination that the trench stabilization

criteria, as defined in the IMP Work Plan, have been achieved and concludes when EPA issues the Certificate of Completion for the BoRP. The FCP includes installation of the final cap and burial of remaining Site waste and debris.

A. INTERIM MAINTENANCE PERIOD

Six months prior to completion of the IRP RA, the Commonwealth shall submit to EPA the Interim Maintenance Period (IMP) Work Plan. A copy of the IMP Work Plan shall also be provided to the Settling Parties. Settling Parties shall provide technical assistance to the Commonwealth in preparing the IMP Work Plan. Because of the 100-year period estimated for completion of the IMP, all work plans and schedules must be considered preliminary and tentative. All Work conducted during the IMP shall be based on the most appropriate technology then available. For example, it will be impossible to determine a schedule for subsidence repair, additional pumping, and cap replacement; therefore, all elements and schedules of the IMP Work Plan, if appropriate, shall be considered of a preliminary nature. All documents must be dynamic and clearly reflect current scientific and technical approaches required to protect human health and the environment. The IMP shall include, but not be limited to, the following activities:

- Periodic surveys and subsidence monitoring
- Initial cap maintenance and replacement as necessary
- Improvements to, and maintenance of, Site drainage and erosion control features, as needed
- Trench leachate management and monitoring
- Installation of a horizontal flow barrier (if necessary)
- Waste burial
- Maintenance and monitoring activities

Upon approval of the IMP Work Plan, the Commonwealth shall implement the IMP Work Plan. In the event EPA has not approved the IMP Work Plan before Certification of Completion of the IRP, the Commonwealth shall undertake the activities specified in the IMP Work Plan it submitted to EPA, until EPA approves an IMP Work Plan, and upon approval of the IMP Work Plan, shall continue such activities as finally approved in the IMP Work Plan.

In conjunction with submittal of the IMP Work Plan, the Commonwealth shall submit a IMP Quality Assurance Project Plan (IMP QAPP), IMP Sampling and Analysis Plan (SAP) and a IMP Health and Safety Plan (IMP HASP), all of which will essentially be revised versions of the Initial Remedial Phase QAPP and HASP. The IMP QAPP and SAP shall follow the format outlined in Section IV, Task II.A of

this SOW for SAPs and QAPPs and the IMP HASP shall follow the format for HASPs outlined in Section IV, Task III.A of this SOW. The IMP Work Plan and the IMP QAPP must be reviewed and approved by EPA and the IMP Health and Safety Plan must be reviewed and commented on by EPA. Plans, specifications, submittals, and other deliverables shall be subject to EPA review and approval in accordance with Section XIV of the Consent Decree. Review and/or approval of design submittals only allows the Commonwealth to proceed to the next step of the design process. Approval does not imply acceptance of later design submittals that have not been reviewed, nor does it imply that the remedy, when constructed, will meet Performance Standards.

1. Interim Maintenance Period Work Plan

Six months prior to scheduled completion of the IRP RA, the Commonwealth shall submit a IMP Work Plan to EPA for review and approval. The IMP Work Plan shall be developed in conjunction with the IMP QAPP, SAP and HASP. The IMP Work Plan shall include a description of the potential data collection and evaluation activities that may be necessary during the IMP. The IMP Work Plan should conceptually address IMP data acquisition and analysis, initial cap maintenance, leachate management, installation of a horizontal flow barrier (if determined to be necessary), equipment, and solid waste disposal, and improvements to, or construction of, permanent surface water and erosion control measures. The IMP Work Plan should also conceptually address maintenance, monitoring and surveillance systems.

The IMP Work Plan shall be revised, as necessary, as part of EPA's five-year review or more frequently if it is determined to be necessary. Modifications will be made to reflect the changing Site conditions and changes in available technologies. The IMP Work Plan should address the following:

a. A statement of the problems and potential problems posed by the Site following completion of the IRP RA and the objectives of the IMP;

b. An abbreviated background summary setting forth the following:

- A brief description of the Site after completion of the IRP;

- As-built drawings and documents from the IRP RA;

- A summary of the existing data including physical, radiological and chemical characteristics of the contaminants identified and their distribution among the environmental media at the Site.

c. A preliminary list of the tasks to be performed during the IMP, information needed for each task if available, information which may be produced during and at the conclusion of each task, and a description of Work products that will be submitted to EPA;

d. Because of the 100-year period of time estimated to implement the IMP, submission of deliverables will be established and/or adjusted by the Commonwealth, as approved by EPA, at the time of EPA's five-year reviews of the remedy.

e. Project management plans, including data management plans and provision for periodic reports to EPA, shall be revised at EPA's direction in conjunction with EPA five-year reviews. Data management plans shall address the requirements for project management including sorting and retrieving the data. The best available data analysis techniques will be utilized.

f. Community relations support activities to be conducted during the IMP should be addressed as part of each five-year review. The Commonwealth shall assist EPA in preparing and disseminating information to the public regarding IMP Work.

g. Methodologies included in the IMP Work Plan should be reviewed as part of the five-year review. Methodologies chosen at those times should describe start-up procedures, operation, troubleshooting, training, and evaluation activities to be carried out by the Commonwealth during the IMP;

h. The IMP Work Plan shall be a flexible document anticipating possible changes in scientific and technical information available throughout the estimated 100-year period of the IMP.

2. <u>Interim Maintenance Period Operations</u>

The initial IMP Work Plan shall also include start-up procedures, operations, troubleshooting,

training, and evaluation activities. The initial IMP Work Plan shall address the following elements:

a. Custodial care activities including grass cutting, ditch cleaning, fence repairing, and minor repair of the erosion control systems, trench cap, and monitoring instruments.

b. Equipment start-up and operator training:

- Technical specifications governing monitoring and erosion control systems;

- Requirements for providing appropriate visits by experienced personnel to oversee - installation, adjustment, start-up and operation of systems; and,

- Training personnel regarding appropriate operational procedures once start-up has been successfully completed.

c. Description of normal operation and maintenance:

- Description of tasks required for system operation;

- Description of tasks required for system maintenance;

- Description of prescribed treatment or operating conditions; and

- Frequency for each IMP operations task, if appropriate.

d. Description of potential operating problems:

- Description and analysis of potential operating problems;

- Sources of information regarding problems; and

- Common remedies or anticipated corrective actions.

e. Description of routine monitoring and laboratory testing:

- Description of monitoring tasks;

- Description of required laboratory tests and

their potential interpretation;

- Required QA/QC; and
- Monitoring frequency.

f. Description of alternate IMP procedures:

- Should systems fail, alternate procedures; and,
- Analysis of vulnerability of the system and a description of additional resource requirements should systems fail.

g. Safety Plan:

- Description of precautions to be taken and required health and safety equipment, etc., for personnel protection.

h. Description of equipment:

- Equipment identification;
- Installation of monitoring components;
- Maintenance of Site equipment; and
- Equipment replacement, as necessary, and its installation components.

i. Records and reporting:

- Daily field logs;
- Laboratory records;
- Database for Site records;
- Mechanisms for reporting emergencies;
- Database for personnel and maintenance records; and
- Yearly reports to state/federal agencies.

j. Description of access control, security and notification measures;

- Description of institutional control requirements to be performed during the IMP;

- Description of the legal procedures and mechanisms for administering deed and notice requirements of access control, security and notification requirements of this SOW as well as the location of storing legal notices and Site conditions.

B. FINAL CLOSURE PERIOD

1. Final Closure Period Remedial Design Work Plan

A Final Closure Period (FCP) Remedial Design Work Plan shall be developed by the Commonwealth and submitted to EPA within 60 days of EPA determination that the trench stabilization criteria have been achieved (the Interim Maintenance Period has concluded).

The FCP RD Work Plan shall be developed in conjunction with the FCP QAPP, SAP and HASP. The QAPP and SAP shall follow the format outlined in Section IV, Task II.A for SAPs and QAPPs and the IMP HASP shall follow the format for HASPs outlined in Section IV, Task III.A of this SOW. The FCP RD Work Plan shall include a description of the potential data collection and evaluation activities that may be necessary during the FCP. The FCP RD Work Plan should conceptually address FCP data acquisition and analysis, final cap maintenance, improvements to surface water and erosion control measures (as needed), leachate management, equipment, and solid waste disposal. The FCP RD Work Plan should also conceptually address maintenance, monitoring and surveillance systems.

The FCP RD Work Plan should address the following:

a. A statement of the problems and potential problems posed by the Site and the objectives of the Final Closure Period;

b. An abbreviated background summary setting forth the following:

- A brief description of the Site;

- As-built drawings and documents from the IRP;

- A summary of the existing data including physical, radiological and chemical characteristics of the contaminants identified and their distribution among the environmental media at the Site.

c. A preliminary list of the tasks to be performed during the Final Closure Period, information needed for each task if available, information which may be produced during and at the conclusion of each task, and a description of work products that will be submitted to EPA;

2. Final Closure Period Preliminary Design

FCP Preliminary Remedial Design shall begin with initial remedial design and shall end with the completion of approximately 30 percent of the remedial design effort. At this stage, the Commonwealth shall field verify, as necessary, the existing conditions of the Site. The technical requirements of the IRP shall be addressed and outlined so that they may be reviewed to determine if the final remedial design will provide an effective remedy. Supporting data and documentation shall be provided with the design documents defining the functional aspects of the project. EPA approval of the FCP Preliminary Remedial Design Report is required before the Commonwealth may proceed with further design work, unless specifically authorized by EPA. In accordance with the design management schedule established in the approved FCP RD Work Plan, the Commonwealth shall submit to EPA the FCP Preliminary Remedial Design Report which shall consist of the following:

a. Results of Data Acquisition Activities

Data gathered during the project planning phase shall be compiled, summarized, and submitted along with an analysis of the impact of the results on design activities.

b. Final Closure Period Preliminary Remedial Design Plans and Specifications

The Commonwealth shall submit to EPA an outline of the required drawings, including preliminary sketches and layouts, describing conceptual aspects of the design, unit processes, etc. In addition, an outline of the required specifications, including Performance Standards, shall be submitted. Construction drawings shall reflect organization and clarity, and the scope of the technical specifications shall be outlined in a manner reflecting the final specifications.

3. Final Closure Period Prefinal and Final Remedial Design

The Commonwealth shall submit the FCP Prefinal Remedial Design Report when the design work is approximately 90 percent complete in accordance with the approved design management schedule. Concurrent with submittal of the FCP Prefinal Remedial Design Report, the Commonwealth shall also submit an Institutional Control Work Plan and Institutional Control Operations and Maintenance Manual. The Commonwealth shall address comments generated from the FCP Preliminary Remedial Design Report review and subsequent comments in meetings and informal reviews by EPA and the Commonwealth and clearly show any modification of the design as a result of incorporation of the comments. The FCP Prefinal Remedial Design Report shall function as the draft version of the FCP Final Remedial Design Report. After EPA review and comment on the FCP Prefinal Remedial Design Report, the FCP Final Remedial Design Report shall be submitted along with a memorandum indicating how the Prefinal Remedial Design Report comments were incorporated into the Final Remedial Design Report. All FCP Final Remedial Design documents shall be certified by a Professional Engineer registered in the Commonwealth of Kentucky. EPA written approval of the FCP Final Remedial Design Report is required before initiating construction of the final cap, unless specifically authorized by EPA. The following items shall be submitted with or as part of the FCP Prefinal and Final Remedial Design Reports:

a. Complete Final Closure Period Design Analyses

The selected design shall be presented along with an analysis supporting the FCP design approach. Design calculations shall be included.

b. Final Closure Period Final Plans and Specifications

A complete set of construction drawings and specifications shall be submitted which describe the selected design.

c. Final Construction Schedule

A final construction schedule shall be submitted for EPA approval.

d. Final Overall Construction Cost Estimate

An estimate within +15 percent to -10 percent of

actual, overall remedial construction costs shall be submitted.

4. FCP RA Planning

Concurrent with the submittal of the FCP Prefinal Remedial Design Report, the Commonwealth shall submit a draft FCP RA Work Plan for review and comment by EPA. Within 30 days after approval of the FCP Final Remedial Design Report, the Commonwealth shall submit a final FCP RA Work Plan which must be reviewed and approved by EPA prior to construction of the final cap.

Upon approval of the FCP Final Remedial Design Report and the FCP RA Work Plan, the Commonwealth shall implement the FCP Work Plan in accordance with the approved construction management schedule. Significant field changes to the construction as set forth in the FCP RA Work Plan shall not be undertaken without the approval of EPA. The construction shall be documented in enough detail to produce as-built construction drawings after the construction is complete. Deliverables shall be submitted to EPA for review and approval in accordance with Section XIV of the Consent Decree. Review and/or approval of submittals only allows the Commonwealth to proceed to the next step of the remediation process. Approval does not imply acceptance of later project submittals that have not been reviewed, nor does it imply that the remedy, when constructed, will meet Performance Standards.

a. FCP RA Work Plan

The Commonwealth shall submit a Work Plan which provides a detailed plan of action for completing the FCP RA activities to EPA for review and approval. This Work Plan shall provide for the safe and efficient completion of the FCP. The Work Plan shall be developed in conjunction with the FCP Construction Management Plan, the FCP Construction Quality Assurance Plan, and the FCP Construction Health and Safety Plan/Contingency Plan, although each plan may be delivered under separate cover. The FCP RA Work Plan shall include a comprehensive description of the FCP activities to be performed and a construction schedule for completion of each major FCP activity and submission of each FCP deliverable.

Specifically, the FCP RA Work Plan shall include the following:

- A detailed description of the FCP tasks to be performed and a description of the work products to be submitted to EPA, including the deliverables set forth in the remainder of Task IV which pertain to FCP activities;

- A schedule for completion of each required activity and submission of each FCP deliverable required by the Consent Decree, including those in this SOW;

- A project management plan, including provision for monthly reports to EPA;

- A description of the community relations support activities to be conducted during the FCP. At EPA's request, the Commonwealth shall assist EPA in preparing and disseminating information to the public regarding the FCP to be performed.

- A description of the strategy for delivering the project. This section shall address the management approach for implementing the FCP, including procurement methods and contracting strategy, phasing alternatives, and contractor and equipment availability concerns.

b. FCP Construction Management Plan

The Commonwealth shall develop an FCP Construction Management Plan (Plan) to indicate how the construction activities are to be implemented and coordinated with EPA during the FCP. The Commonwealth shall designate a person to be an on-Site Project Coordinator and their representative on-Site during the FCP, and identify this person in the Work Plan. The Work Plan shall also identify other key project management personnel comprising the FCP Construction Project Team along with the lines of authority, and provide descriptions of the duties of the key personnel along with an organizational chart. In addition, a plan for the administration of construction changes and EPA review and approval of those changes shall be included.

c. FCP Construction Quality Assurance Plan

The Commonwealth shall develop and implement an FCP Construction Quality Assurance Program to ensure, with a reasonable degree of certainty, that the completed FCP meets or exceeds all design criteria, plans and specifications, and Performance Standards.

At a minimum, the FCP Construction Quality Assurance Plan shall include the following elements:

- The name, qualifications, duties, authorities, and responsibilities of each person assigned a quality control function.

- Description of the observations and control testing that will be used to monitor the construction and/or installation of the components of the FCP. This includes information which certifies that personnel and laboratories performing the tests are qualified and the equipment and procedures to be used comply with applicable standards. Any laboratories to be used shall be specified. Criteria for acceptance or rejection of laboratories shall be listed and plans for implementing corrective measures shall be addressed.

- A schedule for managing submittals, testing, inspections, and any other QA functions (including those of contractors, subcontractors, fabricators, suppliers, purchasing agents, etc.) that involve assuring quality workmanship, verifying compliance with the plans and specifications, or any other QC objectives. Inspections shall verify compliance with all environmental requirements and include, but not be limited to, air quality and emissions monitoring records and waste disposal records.

- Reporting procedures and reporting format for QA/QC activities including such items as daily summary reports, schedule of data submissions, inspection data sheets, problem identification and corrective measures reports, evaluation reports, acceptance reports, and final documentation.

- A list of definable features of the Work to be performed. A definable feature of Work is a task which is separate and distinct from other tasks and has separate control requirements.

d. <u>FCP Construction Health and Safety Plan/Contingency Plan</u>

The Commonwealth shall prepare a FCP Construction Health and Safety Plan/Contingency Plan in conformance with the Commonwealth's health and safety program administered under the Site license, and in compliance with OSHA regulations. The FCP Construction Health and Safety Plan/Contingency Plan shall include a health

and safety risk analysis, a description of monitoring and personal protective equipment, medical monitoring, and Site control. EPA will not approve the Commonwealth's FCP Construction Health and Safety Plan/Contingency Plan, but rather EPA will review it to ensure that all necessary elements are included and safety procedures are fully described. This plan shall include a Contingency Plan and incorporate Air Monitoring and Spill Control and Countermeasures Plans. The Contingency Plan shall be written to ensure protection of on-Site construction workers and the local population potentially affected. It shall include the following items:

- Name of person who will be responsible in the event of an emergency incident, as well as at least two alternates.

- Plan for Site safety indoctrination and training for all employees, name of the person who will give the training and the topics to be covered.

- Plan and date for meeting with the local community, including local, state and federal agencies involved in the cleanup, as well as the local emergency squads and the local hospitals.

- A list of the first aid and medical facilities including location of first aid kits, names of personnel trained in first aid, a clearly marked map with the route to the nearest medical facility, all necessary emergency phone numbers conspicuously posted at the Site (i.e., fire, rescue, and the Kentucky Disaster Emergency Services (KDES)).

- Plans for protection of public and visitors to the Site.

- Air and Radiation Monitoring Plan which incorporates the following requirements:

  i) Air and radiation monitoring shall be conducted on-Site, at the restricted area boundary and at the Site boundary. The radiological constituents that were identified during the Risk Assessment shall serve as a basis of the sampling and measurement of pollutants in the atmosphere and radiological control areas. Settling Private Parties shall clearly identify these compounds along with the required detection

and notification levels for the restricted and unrestricted areas. Air and radiation monitoring shall include personnel monitoring where applicable.

ii) Personnel monitoring shall be conducted according to 10 CFR §§ 20.1501 and 20.1502 (902 KAR 100:019 Sections 12 and 13), OSHA, NIOSH and NRC regulations (as amended).

iii) On-Site area monitoring shall consist of continuous real-time monitoring performed immediately adjacent to any waste excavation areas, treatment areas, and any other applicable areas when work is occurring. Measurements shall be taken in the radiological control areas to include, but not be limited to: on-Site worker bioassays, contamination surveys, radiation surveys, high volume air sample surveys, and tritium air sample surveys. Additionally, the breathing zones of personnel immediately upwind and downwind of the work areas shall be surveyed for hazardous chemical constituents. Equipment shall include the following, at a minimum: self reading dosimeters, portable alpha, beta and gamma radiation survey meter, scintillation probes (alpha and gamma detector), hand probe (beta detector), tritium monitor, organic vapor meter, explosivity meter, particulate monitoring equipment, and on-Site windsock.

iv) Monitoring shall consist of monitoring airborne radiological contaminants at the boundary of the restricted area and the Site boundary to determine whether harmful concentrations of toxic constituents are migrating off-Site. EPA approved methods shall be used for sampling and analysis of air. The results of the air monitoring and the on-Site meteorological monitoring shall be used to assess the potential for off-Site exposure to toxic materials. The air monitoring program shall include provisions for notifying nearby residents, local, state and federal agencies in the event that unacceptable concentrations of airborne contaminants are migrating off-Site. The Commonwealth shall report detection of levels of airborne contaminants above the limits of 40 CFR Part 61 to EPA in

accordance with Section XVIII of the Consent Decree.

- A plan for instituting a medical surveillance program which shall address medical requirements for Site workers, physician examinations, personnel dosimetry records and summary reports, and transfer of personnel monitoring records to the appropriate state and federal agencies.

- A Spill Control and Countermeasures Plan which shall include the following:

  i) Contingency measures for potential spills and discharges from materials handling and/or transportation.

  ii) A description of the methods, means, and facilities required to prevent contamination of soil, water, atmosphere, and uncontaminated structures, equipment, or material by spills or discharges which could potentially occur during the pumping and solidification operations.

  iii) A description of the equipment and personnel necessary to perform emergency measures required to contain any spillage and to remove spilled materials and soils or liquids that become contaminated due to spillage. This collected spill material must be properly disposed of.

  iv) A description of the equipment and personnel to perform decontamination measures that may be required for previously uncontaminated structures, equipment, or material.

5. Preconstruction Conference

The Commonwealth and federal, state and local government agencies shall hold a Preconstruction Conference prior to initiation of FCP construction. The Preconstruction Conference agenda shall include:

a. Defining the roles, relationships, and responsibilities of all parties;

b. Reviewing methods for documenting and reporting inspection data;

c. Reviewing methods for distributing and storing documents and reports;

d. Reviewing work area security and safety protocols;

e. Reviewing the approved construction schedules;

f. Conducting a Site reconnaissance to verify that the design criteria and the plans specifications are understood and to review material and equipment storage locations.

The Preconstruction Conference must be documented, including, at a minimum, names of people in attendance, issues discussed, clarifications made, special instructions issued.

6. Final Closure Period Prefinal Construction Inspection

Upon preliminary completion of the FCP construction, the Commonwealth shall notify EPA for the purpose of conducting a Prefinal Construction Inspection. Participants should include the Project Coordinators, Supervising Contractor, Construction Contractor, and other federal, state, and local agencies with a jurisdictional interest. The Prefinal Construction Inspection shall consist of a walk-through inspection of the entire project Site. The objective of the inspection is to determine whether the construction is complete and consistent with the Consent Decree. Any outstanding construction items discovered during the inspection shall be identified and noted on a punch list. Additionally, monitoring equipment shall be operationally tested by the Commonwealth. The Commonwealth shall certify that the equipment has performed to effectively meet the purpose and intent of the specifications. Retesting shall be completed where the initial testing reveals deficiencies. A Prefinal Construction Inspection Report shall be submitted by the Commonwealth for the Prefinal Construction Inspection which outlines the outstanding construction items, actions required to complete the items, completion date for the items, and an anticipated date for the Final Construction Inspection.

7. Final Closure Period Final Construction Inspection

EPA will perform a Final Construction Inspection for the FCP, consisting of a walk-through inspection of the entire project Site. Upon the Commonwealth's completion of all outstanding construction items, the Commonwealth shall notify EPA for the purpose of

conducting a Final Construction Inspection. The Prefinal Construction Inspection Report shall be used as a check list with the Final Construction Inspection focusing on the outstanding construction items identified in the Prefinal Construction Inspection. All tests that were originally unsatisfactory shall be conducted again. Confirmation shall be made during the Final Construction Inspection that all outstanding items have been resolved. Any outstanding construction items discovered during the inspection still requiring correction shall be identified and noted on a punch list. If any items are found unresolved during the Final Inspection, then that inspection shall be considered to be a Prefinal Construction Inspection, requiring another Prefinal Construction Inspection Report and subsequent Final Construction Inspection.

8. Final Closure Period Final Construction Inspection Report

Within sixty (60) days following the conclusion of the Final Construction Inspection, the Commonwealth shall submit a Final Construction Inspection Report for the FCP. EPA will review the draft report and will provide comments to the Commonwealth. The Final Construction Inspection Report shall include the following:

a. Brief description of how outstanding items noted in the Prefinal Construction Inspection were resolved;

b. Explanation of modifications made during the FCP construction to the original FCP Design and FCP Construction Work Plan and why these changes were made;

c. As-built drawings;

d. Synopsis of the construction work defined in the SOW and certification that the construction work has been completed.

C. BoRP REMEDIAL ACTION REPORT

As provided in Section XVII of the Consent Decree, within 90 days after the Commonwealth concludes that the Remedial Action has been fully performed and the Performance Standards have been achieved, the Commonwealth shall so certify to the United States and shall schedule and conduct a pre-certification inspection to be attended by EPA and the Commonwealth. If after the pre-certification inspection the Commonwealth still believes that the Remedial Action has been fully performed and the Performance

Standards have been achieved, the Commonwealth shall submit a BoRP RA Report to EPA in accordance with Section XVII of the Consent Decree. The BoRP RA Report shall include the following:

1. A copy of the BoRP Final Construction Inspection Report;

2. A synopsis of the Work defined in this SOW and a demonstration in accordance with the Performance Standards Verification Plan that Performance Standards have been achieved; and

3. Certification that the BoRP has been completed in full satisfaction of the requirements of the Consent Decree.

After review by EPA, the Commonwealth shall address any comments and submit a revised report. As provided in Section XVII of the Consent Decree, the BoRP shall not be considered complete until EPA approves the BoRP RA Report.

D. INSTITUTIONAL CONTROL PERIOD

1. Institutional Control Work Plan

An Institutional Control Work Plan shall be developed by the Commonwealth during the FCP and submitted to EPA for approval no later than six months prior to scheduled completion of FCP construction. Implementation of the Institutional Control Work Plan shall commence upon completion of the FCP Final Construction Inspection and EPA approval of the Institutional Control Work Plan. Operation and Maintenance activities under the Institutional Control Work Plan shall be conducted in accordance with the Institutional Control Operations and Maintenance Manual which shall be submitted in conjunction with the Institutional Control Work Plan. The Institutional Control O & M Manual will, in essence, be a revised version of the Interim Maintenance Period Operations specified in Section IV, Task IV.A.2 of this SOW. Operation and Maintenance under the Institutional Control Work Plan shall be conducted for 100 years following EPA issuance of the Certification of Completion of the Remedial Action. This period for Institutional control conforms to 902 KAR 100:022 Section 27. Work Plans for this period will be dynamic documents which shall reflect the most appropriate technologies then available.

E. POST-INSTITUTIONAL CONTROL PERIOD

1. Post-Institutional Control Work Plan

A Post-Institutional Control Work Plan shall be developed by the Commonwealth during the Institutional Control Period and submitted to EPA for approval no later than six months prior to conclusion of the Institutional Control Period. Implementation of the Post-Institutional Control Work Plan shall commence upon completion of the Institutional Control Period and EPA approval of the Post-Institutional Control Work Plan. Operation and Maintenance activities under the Post-Institutional Control Work Plan shall be conducted in accordance with the Post-Institutional Control Operations and Maintenance Manual which shall be submitted in conjunction with the Post-Institutional Control Work Plan. The Post-Institutional Control O & M Manual will, in essence, be a revised version of the Institutional Control O & M Manual specified above. Operation and Maintenance under the Post-Institutional Control Work Plan shall be conducted in perpetuity. Work Plans for this period will be dynamic documents which shall reflect the most appropriate technologies then available.

TASK V - PERFORMANCE MONITORING

Performance monitoring shall be conducted by the Commonwealth throughout the Initial Remedial Phase, Balance of Remedial Phase and Institutional Control Period to ensure that all Performance Standards are met.

A. PERFORMANCE STANDARDS VERIFICATION PLANS

The purpose of the Performance Standards Verification Plans is to provide a mechanism to ensure that both short-term and long-term Performance Standards for the Remedial Action are met. Guidances used in developing the Sampling and Analysis Plans during the Initial Remedial Phase Remedial Design and Balance of Remedy Phase shall be used. Settling Private Parties shall submit a Performance Standards Verification Plan with the Initial Remedial Phase Prefinal and Final Remedial Design Reports. The Commonwealth shall submit a Performance Standards Verification Plan with the Interim Maintenance Period Work Plan and with the FCP Prefinal and Final Remedial Design Reports. Once approved, the Performance Standards Verification Plans shall be implemented by the Commonwealth on the approved schedule. The Performance Standards Verification Plans shall include:

1. The Performance Standards Verification Field Sampling and Analysis Plan that provides guidance for all field work by defining in detail the sampling and data gathering methods to be used.

2. The Performance Standards Verification Quality Assurance/Quality Control Plan that describes the quality assurance and quality control protocols which will be followed in demonstrating achieving Performance Standards and that the remedy is expected to continue to achieve all Performance Standards.

3. Specification of those tasks to be performed to demonstrate compliance with the Performance Standards and a schedule for the performance of these tasks.

REFERENCES

The following list, although not comprehensive, comprises many of the regulations and guidance documents that apply to the RD/RA process.

1. "National Oil and Hazardous Substances Pollution Contingency Plan, Final Rule", Federal Register 40 CFR Part 300, March 8, 1990.

2. "Superfund Remedial Design and Remedial Action Guidance," U.S. EPA, Office of Emergency and Remedial Response, June 1986, OSWER Directive No. 9355.0-4A.

3. " Guidance on EPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties," U.S. EPA, Office of Emergency and Remedial Response, April, 1990, OSWER Directive No. 9355.5-01.

4. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final," U.S. EPA, Office of Emergency and Remedial Response, October 1988, OSWER Directive No. 355.3-01.

5. "A Compendium of Superfund Field Operations Methods," Two Volumes, U.S. EPA, Office of Emergency and Remedial Response, EPA/540/P-87/001a, August 1987, OSWER Directive No. 9355.0-14.

6. "EPA NEIC Policies and Procedures Manual," EPA-330/9-78-001-R, May 1978, revised November 1984.

7. "Data Quality Objectives for Remedial Response Activities," U.S. EPA, Office of Emergency and Remedial Response and Office of Waste Programs Enforcement, EPA/540/G-87/003, March 1987, OSWER Directive No. 9335.0-7B.

8. "Guidelines and Specifications for Preparing Quality Assurance Project Plans," U.S. EPA, Office of Research and Development, Cincinnati, OH, QAMS-004/80, December 29, 1980.

9. "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," U.S. EPA, Office of Emergency and Remedial Response, QAMS-005/80, December 1980.

10. "Users Guide to the EPA Contract Laboratory Program," U.S. EPA, Sample Management Office, August 1982.

11. "Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual," U.S. EPA Region IV, Environmental Services Division, February 1, 1991, (revised periodically).

12. "USEPA Contract Laboratory Program Statement of Work for Organics Analysis," U.S. EPA, Office of Emergency and Remedial Response, February 1988.

13. "USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis," U.S. EPA, Office of Emergency and Remedial Response, July 1988.

14. "Quality in the Constructed Project: A Guideline for Owners, Designers, and Constructors, Volume 1, Preliminary Edition for Trial Use and Comment," American Society of Civil Engineers, May 1988.

15. "Interim Guidance on Compliance with Applicable or Relevant and Appropriate Requirements," U.S. EPA, Office of Emergency and Remedial Response, July 9, 1987, OSWER Directive No. 9234.0-05.

16. "CERCLA Compliance with Other Laws Manual," Two Volumes, U.S. EPA, Office of Emergency and Remedial Response, August 1988 (Draft), OSWER Directive No. 9234.1-01 and -02.

17. "Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites," U.S. EPA, Office of Emergency and Remedial Response, (Draft), OSWER Directive No. 9283.1-2.

18. "Guide for Conducting Treatability Studies Under CERCLA," U.S. EPA, Office of Emergency and Remedial Response, Pre-publication Version.

19. "Health and Safety Requirements of Employees Employed in Field Activities," U.S. EPA, Office of Emergency and Remedial Response, July 12, 1981, EPA Order No. 1440.2.

20. "Standard Operating Safety Guides," U.S. EPA, Office of Emergency and Remedial Response, November 1984.

21. "Standards for General Industry," 29 CFR Part 1910, Occupational Health and Safety Administration.

22. "Standards for the Construction Industry," 29 CFR 1926, Occupational Health and Safety Administration.

23. "NIOSH Manual of Analytical Methods," 2d Edition. Volumes I - VII, or the 3rd Edition, Volumes I and II, National Institute of Occupational Safety and Health.

24. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," National Institute of Occupational Safety and Health/Occupational Health and Safety Administration/United States Coast Guard/ Environmental Protection Agency, October 1985.

25. "TLVs - Threshold Limit Values and Biological Exposure Indices for 1987 - 88," American Conference of Governmental Industrial Hygienists.

26. "American National Standards Practices for Respiratory Protection," American National Standards Institute Z88.2-1980, March 11, 1981.

27. R.G. Cockrell, "Selection of a Method for Disposing of Grout Made with Trench Leachate at the Maxey Flats Disposal Site", prepared for the Maxey Flats Steering Committee and submitted to EPA Region IV, Reference No. TC-828, June 30, 1992.

28. R.G. Cockrell, "Conceptual Design of the Initial Closure Cap for the Maxey Flats Disposal Site", prepared for the Maxey Flats Steering Committee and submitted to EPA Region IV, Reference No. TC-855, October 1992.

29. R.G. Cockrell, "Guidelines for Trench Dewatering at the Maxey Flats Disposal Site", prepared for the Maxey Flats Steering Committee and submitted to EPA Region IV, Reference No. TC-871, September 1993.

SUMMARY OF THE MAJOR DELIVERABLES FOR THE REMEDIAL DESIGN AND REMEDIAL ACTION AT THE MAXEY FLATS DISPOSAL SUPERFUND SITE

DELIVERABLE	EPA RESPONSE
TASK 1 PROJECT PLANNING	
Initial Remedial Phase Monitoring and Maintenance Plan	Review and Approve
Recommendations for additional data needs and refinement of RD/RA tasks	Review and Approve
TASK II IRP REMEDIAL DESIGN	
Initial Remedial Phase (IRP) RD Work Plan	Review and Approve
- IRP Sampling and Analysis Plan	Review and Approve
- IRP Health and Safety Plan	Review and Approve
- IRP Quality Assurance Project Plan	Review and Approve
IRP Preliminary Remedial Design Report	Review and Comment
IRP Prefinal and Final Remedial Design Reports	Review and Approve
TASK III IRP REMEDIAL ACTION	
IRP RA Work Plan	Review and Approve
- IRP Construction Health and Safety Plan/Contingency Plan	Review and Approve
- IRP Construction Quality Assurance Plan	Review and Approve
- IRP Construction Management Plan	Review and Approve
IRP Prefinal Construction Inspection Report	Review and Approve
IRP Final Construction	

Inspection Report	Review and Approve
IRP Remedial Action Report	Review and Approve
TASK IV INTERIM MAINTENANCE PERIOD, FINAL CLOSURE PERIOD, AND ASSOCIATED REMEDIAL ACTIVITIES	
Interim Maintenance Period (IMP) Work Plan (7)	Review and Approve
- IMP Sampling and Analysis Plan	Review and Approve
- IMP Quality Assurance Plan	Review and Approve
- IMP Health and Safety Plan	Review and Comment
Final Closure Period (FCP) Work Plan	Review and Approve
- FCP Sampling and Analysis Plan	Review and Approve
- FCP Health and Safety Plan	Review and Comment
- FCP Quality Assurance Project Plan	Review and Approve
FCP Preliminary Remedial Design Report	Review and Approve
FCP Prefinal and Final Remedial Design Reports	Review and Approve
FCP RA Work Plan	Review and Approve
- FCP Construction Health and Safety Plan/Contingency Plan	Review and Comment
- FCP Construction Management Plan	Review and Approve
- FCP Construction Quality Assurance Plan	Review and Approve
FCP Prefinal Construction Inspection Report	Review and Approve
FCP Final Construction Inspection Report	Review and Approve
BoRP Remedial Action Report	Review and Approve
Institutional Control Work Plan	Review and Approve

Institutional Control Operations and Maintenance Manual	Review and Approve
Post-Institutional Control Work Plan	Review and Approve
Post-Institutional Control Operations and Maintenance Manual	Review and Approve

TASK V PERFORMANCE MONITORING

Performance Standards Verification Plan	Review and Approve

NOTE: Unless specifically authorized by EPA, seven copies of each of the specified deliverables shall be submitted to EPA by Settling Defendants, one copy shall be unbound, the remainder shall be bound. Work Plan companion deliverables (i.e., HASP, QAPP, SAP, etc.) may be submitted either as appendices to the Work Plan or under separate cover .

Appendix C

APPENDIX C

SETTLEMENT AGREEMENT BETWEEN THE FEDERAL AGENCIES AND THE SETTLING PRIVATE PARTIES

A. This Settlement Agreement ("Agreement" or "Settlement Agreement") is made between the Settling Private Parties ("Settling Private Parties") and the Federal Agencies listed on Attachment 1 ("Federal Agencies"), respecting the initial remedial phase to be taken at the Maxey Flats Disposal Site ("Site"), Fleming County, Kentucky and the allocation of their respective liabilities for obligations imposed or reserved under the Consent Decree entered for the Site.

B. A low level radioactive waste disposal site, the Maxey Flats Disposal Site, is owned by the Commonwealth of Kentucky and was operated from 1963 until the present by the Commonwealth of Kentucky through its contractors.

C. The United States Environmental Protection Agency ("EPA") has alleged that there is a release or threatened release of a hazardous substance at the Site and has notified all potentially responsible parties ("PRP") that it intends to have remedial action performed at the Site pursuant to its authority under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 ("CERCLA") as amended by the Superfund Amendments and Reauthorization Act of 1986 ("SARA").

D. On September 30, 1991, EPA entered a Record of Decision ("ROD") selecting a remedy for the Site pursuant to CERCLA. On June 30, 1992, EPA sent a notice letter to various PRPs demanding payment of $5,837,721 for EPA's alleged incurrence of past

response costs and inviting the PRPs to engage in settlement discussions. On March 17, 1993, the Maxey Flats Steering Committee and Federal Agencies submitted a joint offer which was determined by EPA to be a good faith offer. As a result of settlement negotiations, EPA, Settling Private Parties, the Federal Agencies and the Commonwealth of Kentucky have entered into a Consent Decree ("Decree") for performance of remedial design ("RD") and remedial action ("remedial action" or "RA") at the Site. Under this Decree, the Settling Private Parties will be responsible for performing the initial remedial phase ("IRP") as specified in the ROD and Statement of Work and the Settling Private Parties and Federal Agencies will be responsible for financing the IRP and for reimbursing certain costs under Section XIX of the Consent Decree, in the manner specified and as allocated under this Settlement Agreement.

E. Each Settling Private Party listed in Attachment 1 has been identified by the EPA as a PRP for the Site pursuant to Section 107(a) of CERCLA. Settling Private Parties have entered into an agreement ("Participation Agreement") to form the Maxey Flats Steering Committee ("Committee" or "Steering Committee") and established thereunder a limited liability company for the purposes of conducting any activities or measures necessary for the performance of design and construction for the initial remedial phase at the Site. As used herein, the term "Committee" or "Steering Committee" shall include any limited liability company established pursuant to the Participation Agreement and

the terms "Operating Committee," "Technical Committee," or "other successor Committee" shall include any board, committee, or other unit of the limited liability company performing a function similar to those Committees.

F. Each Federal Agency listed in Attachment 1 has also been identified by the EPA as a PRP for the Site pursuant to Section 107(a) of CERCLA.

G. The Settling Private Parties and Federal Agencies have claims against each other under Sections 107 and 113 of CERCLA and some Settling Private Parties have claims against certain Federal Agencies based on contractual and various other theories of relief.

H. Each Federal Agency has authority to enter into and perform this Agreement and the person signing the Agreement for such agency is a representative of the Federal Agency who is duly authorized to enter into this Agreement on behalf of the Federal Agency. This Agreement has been reviewed and approved by the United States Department of Justice as part of the settlement embodied in the Decree.

I. The Settling Private Parties and the Federal Agencies deny any responsibility or liability to the EPA or to any other person or entity under any act, regulation or rule of common law for any claim, including any claim for removal, remedial action and/or any other response action, cleanup costs, or natural resource damages at, from or appertaining to the Site. By entering into or complying with this Agreement, the Settling

Private Parties and the Federal Agencies do not admit any fact or liability or admit any statement in the administrative record and reserve their rights to raise any defense and to challenge any allegation of fact or liability. The execution of this Agreement shall not be construed to be an acknowledgement by the Settling Private Parties that the alleged release or threatened release is cognizable under CERCLA or constitutes an imminent and substantial endangerment to the public health or welfare or the environment.

J. In the interest of concluding certain claims and avoiding the expense of litigation with EPA and each other, the Settling Private Parties and the Federal Agencies are willing to satisfy their respective obligations imposed or reserved under the Consent Decree by implementing and financing the IRP, by reimbursing certain costs under Section XIX of the Consent Decree, and by determining their shares of any future liability, all as specified and allocated in this Agreement.

K. This Settlement Agreement has been negotiated and executed in good faith and is a compromise of claims which were contested, denied, or disputed as to validity and amount, and represents a fair, reasonable, and equitable settlement of the matters addressed herein.

NOW THEREFORE, in consideration of the foregoing, the parties mutually agree as follows:

1. Purpose of Agreement

The purpose of this Agreement is to set forth the

terms and conditions which control the manner and means by which:

a. the obligations of the Settling Private Parties and Federal Agencies under the Decree are performed and financed;

b. work undertaken at the Site pursuant to this Agreement occurs in a manner that is consistent with the NCP, CERCLA and SARA, protects public health and the environment, and is done in a cost-effective manner; and

c. Expenses as defined herein are allocated among the Federal Agencies and the Settling Private Parties.

2. Matters Excluded from the Agreement

This Agreement does not control the manner and means by which the Settling Private Parties or Federal Agencies may negotiate, comment on, or assist in development of generic standards that may be applied to the Site or the handling of confidential matters, such as decisions about settlement, litigation, dispute resolution, or enforcement.

3. Meetings

a. The Federal Agencies will be advised pursuant to paragraph 13 herein of all meetings of all Committees, including telephone conference calls, held pursuant to the Participation Agreement with at least as much advance notice as is required for Member Entities of the Steering Committee ("Member Entities" or "Members"). The requirement that notice be given before the date of such meeting may be waived in exceptional or emergency circumstances. To the extent feasible,

such notice shall include the issues to be voted on at the upcoming meeting. The minutes of each meeting shall be furnished to the representatives of the Federal Agencies at the same time they are furnished to Committee Members. The Federal Agencies will have ten (10) working days after receiving the minutes to object to or correct their content.

b. Representatives of the Federal Agencies may attend all meetings of all Committees, except that they may be excused from some or all of any meeting during which a Committee is discussing settlement, litigation, dispute resolution, enforcement, or other confidential matters excluded from the scope of this agreement. Regardless of whether a Federal Agency representative is present at a meeting, any action concerning matters identified in paragraph 1 which is taken by the Steering, Executive, and Technical Committees or any successor Committees (except when they have been excused) at a meeting shall be considered final with regard to the Federal Agencies only if the Federal Agencies make no objection or comment on the matter within ten (10) working days of their receipt of the minutes or other notice of such action pursuant to paragraph 13 herein. The Federal Agencies will make a good faith effort to advise the Steering, Executive, and Technical Committees or any successor Committee of any concerns or problems at such meeting if an agenda describing the issues to be discussed is provided pursuant to paragraph 13 herein at least 10 days in advance of the meeting.

c. Any Federal Agency objections or comments concerning the matters identified in paragraph 1 that are not subsequently agreed to by the Committee shall be resolved in accordance with paragraph 4.

4. Voting Power

a. The Committee and the Federal Agencies shall attempt to make decisions by consensus on all matters within the scope of this Agreement (which does not include, inter alia, matters relating to settlement, litigation, dispute resolution, or enforcement by the Settling Private Parties). However, if a consensus cannot be reached on any matter outside the scope of the Decree or on a choice of alternative procedures acceptable to EPA under the Decree, the matter will be presented for a vote by a joint group consisting of the Settling Private Parties and the Federal Agencies. Votes shall be according to the percentage of funding provided for the joint effort.

b. The Committee shall promptly notify the Federal Agencies of any new requirement or change in the Decree imposed by EPA. The Committee and the Federal Agencies shall attempt to make decisions regarding the EPA action by consensus. If, however, a consensus cannot be reached, and to the extent consistent with the schedule provided in the Decree, the Federal Agencies shall have an opportunity, with the Committee or independently, to negotiate with the EPA as to whether the matter is required by the Decree, and the required performance.

c. Nothing contained herein shall direct, cause

or contribute to a violation of the Decree.

5. Financial Contribution

a. Allocation of Responsibility and Sources of Funding.

(1) The Settling Private Parties and the Federal Agencies listed on Attachment 1 will divide all Expenses at the Site, as specifically set forth on Attachment 1 which has been developed from available waste-in records. Except with regard to claims reserved by a Settling Private Party under Paragraph 7, the parties agree that this division of Expenses as set forth on Attachment 1 represents a fair and equitable allocation of the respective alleged liability of each of the Settling Private Parties and these Federal Agencies, takes account of all equitable factors cognizable under section 113(f) of CERCLA which are relevant under the circumstances at this Site, and represents the equitable contribution of each of the Settling Private Parties and each of these Federal Agencies to the Expenses as provided in section 113(f) of CERCLA. In the event that after the effective date of this agreement a Federal Agency indemnifies or assumes responsibility, in whole or in part, for a Settling Private Party's share as a result of a contractual relationship or otherwise, the share of such Federal Agency for Expenses shall be increased thereafter to reflect such indemnification or assumption of responsibility and the share of the Settling Private Party shall be correspondingly decreased. In the event of a Settling Private Party's share becoming an

orphan share through bankruptcy, insolvency, dissolution, permanent failure to pay, or otherwise, the share of the party shall be distributed pro rata among the remaining Settling Private Parties and Federal Agencies. If any of the events identified in the prior two sentences occur, Attachment 1 will be revised to reflect the revised percentage allocation among the Settling Private Parties and Federal Agencies.

In the event of a Settling Private Party's temporary failure or refusal to pay, the share of such party shall be temporarily distributed among the remaining Settling Private Parties and Federal Agencies based on Attachment 1, and the temporary increase in the shares of the Federal Agencies will be financed from the funds which are available from the Judgment Fund or from the appropriations of the Department of Defense and the Department of Energy. The remaining Settling Private Parties and the Federal Agencies may seek enforcement of this Agreement and the Decree against and may seek reimbursement from the Settling Private Party which has temporarily failed or refused to pay its share as provided under this Agreement. Should a temporary failure or refusal to pay become permanent through judicial process or otherwise, the remaining Settling Private Parties and the Federal Agencies shall proceed as provided in the immediately preceding paragraph.

(2) It is expected that the Judgment Fund will pay the share of the Expenses attributable to the following Federal Agencies: the Department of the Air Force, the

Department of the Army, the National Aeronautics and Space Administration, the National Institute of Health, and the shares of the Department of the Navy and the Department of Energy not attributable to reimbursement obligations as set forth in Attachment 2. It is also expected that the Judgment Fund will pay the de minimis cashout amount specified on Exhibit 1 of the De Minimis Consent Decree for the federal agencies identified on Attachment 3 of this Agreement in the manner provided more specifically in the De Minimis Consent Decree. Within 20 days of entry of the Consent Decree, the Federal Agencies will cause to be certified to the General Accounting Office an initial obligation of $6,875,000 million from the Judgment Fund. The Judgment Fund or the Federal Agencies, as appropriate, will pay the amounts due from those Federal Agencies as soon as practicable after entry of the Consent Decree. The payment made on behalf of the Federal Agencies listed on Attachment 1 for the shares not attributable to reimbursement obligations will be made to a trust or account in a manner mutually agreed by the Committee and those Federal Agencies, and the monies available in the trust or account will be paid to the Settling Private Parties for the shares of Expenses of the Federal Agencies as set forth on Attachment 1. It is agreed by the parties that the payment on behalf of the Federal Agencies listed on Attachment 1 for shares not attributable to reimbursement obligations is an initial payment based on a calculation of ninety percent (90%) of those agencies' shares of the currently estimated present value of the

anticipated Expenses. When Expenses equaling eighty percent (80%) of this initial obligation have been incurred and it is estimated that the share of the Expenses for which those Federal Agencies are responsible hereunder will exceed the initial obligation, the Federal Agencies will cause a certification to be submitted to the General Accounting Office for an amount to be paid from the Judgment Fund for those Federal Agencies' share of the Expenses which are then estimated to complete the IRP and to comply with any other requirements imposed on the Settling Private Parties and Federal Agencies under the Consent Decree. Those Federal Agencies will, as needed, cause additional certifications to be made to the General Accounting Office until full payment has been made of their shares payable from the Judgment Fund of all Expenses incurred or payable hereunder.

(3) The following agencies will pay out of appropriated funds the shares of the Expenses associated with their contractors as set forth on Attachment 2 ("reimbursement obligation"): the Department of the Navy and the Department of Energy. The Department of the Navy may pay a lump sum covering its share of the currently estimated present value of anticipated Expenses into a trust or account established under subparagraph 5.a.(2) and will supplement this amount, as necessary, to assure the full payment of its share of all Expenses incurred or payable hereunder, following the procedures and requirements of subparagraph 5.a.(2). Alternatively, the Department of the Navy may fund its share of the Expenses on an annual basis out of its

appropriations subject to the requirements of this subparagraph. The Department of Energy will fund its share of the Expenses on an annual basis out of its appropriations subject to the requirements of this subparagraph, and for fiscal year 1995, the Department of Energy has identified $2.2 million for payments of reimbursement obligations under this Agreement. It is the expectation of the parties that all additional obligations of the Federal Agencies under this Agreement will be fully funded. With regard to any future amounts which are not payable from the Judgment Fund, each Federal Agency or its successor or assign shall use its best efforts through its agency budgetary process to obtain timely funding to meet all obligations under this Agreement. Subject to subparagraph 5.g., each Federal Agency or its successor or assign whose share is not paid by the Judgment Fund agrees to allocate and obligate such amounts as are necessary in each fiscal year to pay its respective share set forth in Attachment 1 from those amounts that are appropriated to each agency and not legally prohibited from use for such purpose. As soon as practicable after each annual appropriation is made, the Department of the Navy shall obligate the amount necessary to pay its share of anticipated Expenses for the entire fiscal year (which shall be determined based on estimates submitted by the Settling Private Parties). As soon as practicable but in no event more than 30 days after each annual appropriation is made, the Department of Energy shall obligate the amount necessary to pay its share of anticipated Expenses for the entire fiscal year

(which shall be determined based on estimates submitted by the Settling Private Parties). In the event that the amount of Expenses actually incurred during a fiscal year exceeds the amount of anticipated Expenses for that fiscal year, each Federal Agency agrees to allocate, obligate, and transfer to the federal payment coordinator such additional amounts as are necessary to pay its respective share set forth in Attachment 1 from the amounts that have been appropriated to the agency and not legally prohibited from use for such purpose. From the amounts available under subparagraph 5.a.(2) and this subparagraph, the federal payment coordinator shall pay or authorize payment to the Settling Private Parties the shares of the Federal Agencies as set forth on Attachment 1 of all Expenses incurred or payable hereunder in the manner provided under subparagraph 5.d.

b. Expenses. Expenses are defined as all response costs, natural resource damages, and other amounts payable under section 107 of CERCLA, including all those categories of expenses set forth more specifically herein. These expenses shall be payable regardless of any subsequent judicial or regulatory change in the definition of response costs. Expenses include:

(1) the cost of hiring and retaining specialists to conduct technical studies at the Site to develop accurate information on the quantity and quality of waste present, its effect on surrounding areas, and methods of remedial action and the cost of any oversight related thereto;

(2) the cost of employing engineers, scientists, medical or health professionals, financial analysts or planners, and associated personnel to perform fieldwork, undertake studies or assessments, develop plans or specifications, perform cost estimates and associated financial and investment analysis, provide technical, cost, and financial information to EPA, the Commonwealth of Kentucky, or the community, and give advice or perform work in furtherance of the planning or performance of the obligations undertaken by Settling Private Parties at the Site (including, but not limited to, the cost of insurance for liabilities arising from work performed at the site and work regarding the appropriate health, environmental, and design standards to be utilized, vendor capabilities, and work plans);

(3) the cost of maintenance of records regarding the Site and regarding joint efforts of the Committee and the Federal Agencies within the scope of the Consent Decree and this Agreement;

(4) the cost of maintaining, programming, utilizing and producing different versions of a waste-in list, shipment reports, and associated data bases for the allocation of costs among Settling Private Parties and Federal Agencies unless such activity is directed primarily at increasing the share of the Federal Agencies vis a vis the Settling Private Parties or at developing or supporting defenses to the Settling Private Parties' liability;

(5) the cost of arrangements for meeting rooms, and expenses related to holding meetings, taking minutes, distributing minutes and correcting minutes; except that such costs will not be chargeable to the Federal Agencies for meetings during which the Federal Agencies were excused for more than fifty (50%) of the length of the meeting;

(6) the necessary cost of fund management, trust management, management of the limited liability company, and accounting related to performance of obligations under the Consent Decree or this Agreement;

(7) the cost of distribution of correspondence, records and notices;

(8) other similar administrative expenses related to operation of the Committee in the performance of the obligations in the Consent Decree and this Agreement;

(9) the costs paid by the Settling Private Parties or the Federal Agencies to discharge EPA's claims for past or future response or oversight costs and associated interest;

(10) any attorneys fees or fees of paralegals or other legal employees incurred in connection with the negotiation or administration of contracts for the performance of the obligations under the Consent Decree, the undertaking or administration of the IRP, the performance under or administration of the Consent Decree, and the administration of the Steering Committee and its respective Committees related to

the performance of the obligations of the Settling Private Parties and Federal Agencies under the Consent Decree or this Agreement;

(11) all other costs incurred by Settling Private Parties or the Federal Agencies arising in the course of complying with the Consent Decree (except those borne by the Federal Agencies under Section XVI of the Consent Decree), including the costs of obtaining access, EPA or State oversight, future response action, or the costs of performing or paying for any response action required under the clauses of the Consent Decree entitled "Additional Response Action," "Periodic Review," "Emergency Response," "Certification of Completion," and "Covenant Not to Sue by Plaintiff";

(12) the costs of paying for or performing any response actions, natural resource damages, or other liability under CERCLA, and any Expenses identified herein, required pursuant to any reopener or reservation of rights provided to the United States or the Commonwealth in the Consent Decree;

(13) any stipulated penalties accruing subsequent to enactment of a statute in which Congress expressly waives sovereign immunity for civil penalties under CERCLA for federal agency actions at non-federally owned facilities.

Expenses do not include:

(i) attorney fees incurred by Settling Private Parties or the Committee whether from common counsel or

other counsel, except as provided above;

(ii) costs connected with publicity or public relations activities, except for the costs imposed by paragraph 12 and the costs of the community relations plan and activities required by the Decree;

(iii) costs connected with the participation in public hearings or negotiations with the EPA or NRC regarding the establishment of generic standards which may be utilized at the site;

(iv) costs connected with comments or preparation of responses on public rulemakings or proposed rules;

(v) the costs of indemnifying EPA pursuant to Article XX of the Consent Decree;

(vi) the cost of any internal corporate or Federal Agency review of matters pertaining to the Site; and

(vii) the cost of reimbursing the Commonwealth for acquisition of the buffer zone; this cost, which will not exceed $750,000, will be the sole obligation of the Settling Private Parties under the Consent Decree and this Agreement.

In the event that the Federal Agencies are obligated to make payment under Section XVI of the Consent Decree, the amounts paid by the Federal Agencies shall not be considered Expenses under this Agreement and will be the sole obligation of the Federal Agencies under the Consent Decree and this Agreement, and the Federal Agencies covenant not to sue the Settling Private Parties

under CERCLA, this Agreement, or otherwise for any of these amounts.

In the event that the Commonwealth of Kentucky fails to perform or pay for any response action required or reserved under the Consent Decree (including Articles IX, X, XVIII, or XXIV) and EPA seeks performance or payment from the Settling Private Parties or the Federal Agencies of any obligation or amount for which the Federal Agencies are not obligated under Section XVI of the Consent Decree, the costs of any such response action performed or paid by the Settling Private Parties or Federal Agencies shall qualify as an Expense under subparagraph 5.b.(12) which is subject to the division between the Settling Private Parties and Federal Agencies as set forth on Attachment 1.

c. De Minimis Proceeds. The federal agencies identified on Attachment 3 intend to proceed as cash out settlors under the terms offered in the De Minimis Consent Decree entered between EPA, the Settling Private Parties, the non-federal de minimis parties and the federal agency de minimis parties. Under the terms of the De Minimis Consent Decree, the federal de minimis parties will pay the amounts specified on Exhibit 1 thereto in a manner mutually agreed by the Settling Private Parties and the Federal Agencies listed on Attachment 1 of this Agreement, and the non-federal de minimis parties will pay the amounts specified on Exhibit 4 of the De Minimis Consent Decree to the Maxey Flats De Minimis Trust in satisfaction of their alleged liability. The Steering Committee will promptly direct

the trustee or other payee of the funds to apply all proceeds received from the federal agency de minimis parties and the non-federal de minimis parties to pay for the Expenses as defined herein.

d. Payment of Expenses and Accounting. The Federal Agencies will receive a monthly accounting of Expenses governed by this Agreement. Such accounting will include a request for the shares of the Federal Agencies as specified on Attachment 1 of all the Expenses incurred or billed during the previous month or payable under the Consent Decree and will be sent to the federal payment coordinator. In the event the Federal Agencies do not dispute the amount of an expense or whether an expense is payable hereunder, payment of the Federal Agencies' shares as specified on Attachment 1 of all undisputed amounts shall be made to the Committee within thirty (30) days after receipt of the invoice or other request for payment, and interest accruing daily at the rate specified in the vendor's contract or, absent such rate, at the rate specified in section 107 of CERCLA shall be payable beginning on the 31st day after receipt of the invoice or the request for payment on amounts which have not been timely paid. If necessary to make full and timely payment of the shares of the Federal Agencies as specified on Attachment 1, the federal payment coordinator shall use or authorize the use of any and all amounts which are available in the trust or account established in subparagraph 5.a.(2) above and which are appropriated and obligated by the Department of

Energy or the Department of the Navy pursuant to subparagraph 5.a.(3) above. The federal payment coordinator may, in his discretion, decide to pre-pay the amount anticipated to be due from one or more Federal Agencies during the entire fiscal year by paying, or authorizing payment, of the full amount of one or more invoices for one or more billing periods or by other suitable means agreed upon by the Committee. With respect to the costs which must be paid to EPA under Section XIX of the Consent Decree, Federal Agencies shall pay their share of such costs directly to EPA within 120 days of the entry of the Consent Decree. In the event that the Settling Private Parties are required to pay the Federal Agencies' share of such costs and any accrued interest because the Federal Agencies have failed to make timely payment under Section XIX of the Consent Decree, the Federal Agencies shall reimburse the Settling Private Parties for the payment of costs and accrued interest made on their behalf by the Settling Private Parties, plus the interest on that total amount accruing daily at the rate specified in section 107 of CERCLA from the date Settling Private Parties made the payment on behalf of the Federal Agencies until the date of repayment by the Federal Agencies to the Settling Private Parties. In the event the Federal Agencies dispute the amount of an expense or whether an expense is payable hereunder, the Federal Agencies shall notify the Committee no later than the date payment is due. The Committee and the Federal Agencies shall attempt to resolve the dispute informally but if an informal resolution is not achieved

within 21 days after the issuance of the Federal Agencies' notice, the Chairman of the Committee or his representative and the Federal Agencies' representative shall schedule a meeting to attempt to reach a resolution of the dispute. In the event a resolution is not reached, the Committee, Settling Private Parties or the Federal Agencies may file an action in the United States District Court for the Eastern District of Kentucky for an order to resolve the dispute, to construe, modify, or enforce this Agreement, or to declare the rights of the parties.

e. Contractor Relations.

(1) The Federal Agencies retain no right to select the contractor(s) who will carry out the IRP at the Site, but the Federal Agencies reserve the right to reject a contractor proposed by the Steering Committee, such right to be exercised consistent with the schedule imposed by the Decree or within fifteen (15) days of the Federal Agencies' receipt of notice of the Steering Committee's choice of contractor, whichever is earlier. However, the Federal Agencies may not reject a proposed contractor on the ground that the proposed contractor is, or is affiliated with, a Settling Private Party. The Committee agrees that it will select contractors who will perform and be required to perform at the Site according to standard engineering practice, consistent with the reasonable direction and requirements of the EPA for such projects, and that the selection of the contractor(s) will be made from commercially available firms, free of corrupt influence, fraud, or duress. The

Committee agrees to use due diligence in the selection of contractors and contract administration.

(2) The Committee and the Federal Agencies shall be simultaneously furnished copies of all contractor and subcontractor submittals, including documents, reports, data, studies, plans, surveys, drawings, and other written and electronically stored materials. The Committee and the Federal Agencies shall simultaneously review all such written submissions by any contractor or subcontractor for technical adequacy and completeness. Technical reviews shall be coordinated between the technical representatives designated by the Committee and Federal Agencies.

(3) The Federal Agencies may forward to the Committee written comments, including but not limited to any concurring or dissenting views, on any required submission to EPA. The Federal Agencies will use their best efforts to submit their comments on a timely basis for consideration by the Committee and any contractor. If the Federal Agencies and Committee cannot agree, then the Federal Agencies reserve the right to forward their comments directly to EPA. Any Federal Agency comments received after formal submission to EPA has been made will, upon request by the Federal Agencies, be immediately forwarded to EPA.

(4) The parties agree that the Federal Agencies have the right, consistent with the approved health and safety plan and the requirements of the Decree, to send qualified

representatives to visit the Site during normal working hours to review the work completed and in progress, including but not limited to physical inspection of the Site, to review and copy any non-confidential documents and other written materials maintained on the Site, and to share information thus obtained with any persons participating in the supervision, funding, or enforcement of matters relating to the Site.

(5) During the performance of any obligations of the Settling Private Parties or Federal Agencies under the Consent Decree, the Committee or any contractor(s) retained by it shall preserve and maintain, subject to review, inspection, and copying by the Federal Agencies, all records, including but not limited to documents, reports, data, studies, plans, purchase orders, invoices, surveys, bids, drawings and designs, proposals, accounting records and other written or electronically stored materials, relating to the planning and execution of the IRP at the Site. After completion of the IRP, the Committee and its contractors shall provide the Federal Agencies with an opportunity to copy these records at the Federal Agencies' cost. This section does not require the production of documents that are privileged or protected under federal, state or local law.

f. Federal Agency In-Kind Contributions. Should the need arise in the performance hereunder, it is the intent of the parties that in kind services may be provided by the Federal Agencies with concurrence of the Committee and credited towards

the respective shares of the Expenses borne by the Settling Private Parties and Federal Agencies. If such services are provided, they shall be coordinated with any contractor retained by the Committee and all proper notices and permissions shall be sought from EPA. All such work shall be conducted in accordance with the terms of the Decree.

g. Anti-Deficiency Act. The Federal Agencies' ability to pay under this Agreement is subject to the availability of appropriated funds. No provision of this Agreement shall be interpreted as or constitute a commitment or requirement that the Federal Agencies obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. §§ 1301, 1341, 1342, 1349-51, and 1511-19.

6. Committee Membership

Subject to the terms of this Agreement, the Federal Agencies' representatives will be listed on the membership roll of the Technical Committee or any successor Committee and be entitled to all rights and responsibilities thereunder. If the Technical Committee or its successor and the Federal Agencies are unable to reach a consensus and the issue is within the scope of this Agreement, the issue will be presented to the Executive Committee or its successor and the Federal Agencies for resolution. If the Executive Committee or its successor and the Federal Agencies are unable to reach a consensus, the issue will be presented for a vote pursuant to paragraph 4.a. herein.

7. Mutual Release and Covenant Not to Sue

a. In consideration of the settlement between the parties and the terms set out in this Agreement, the Settling Private Parties and the Federal Agencies identified on Attachment 1 hereby release, discharge, and covenant not to sue each other and all the past and present officers, directors, trustees, shareholders, employees, successors, including successors by merger, and assigns of each of them, with respect to any claim for contribution or other liability or financial payment with respect to Agreed Matters. Agreed Matters are defined as any civil claim, demand, liability, or cause of action, administrative or judicial, in law or equity, for or pertaining to any response costs or other expenses previously incurred by the Settling Private Parties or the Federal Agencies, to any Expense covered by this Agreement, to any payment by the Federal Agencies pursuant to Section XVI of the Decree, or to the undertaking or implementation of the IRP, RD/RA, other response action which is covered by the Decree, or any response action or natural resource damages imposed pursuant to a reopener or reservation of rights provided to the EPA or the Commonwealth in the Consent Decree. However, notwithstanding the foregoing or any contribution protection authorized under the Decree, section 113(f)(2) of CERCLA, or any amendments of CERCLA: (1) the Settling Private Parties reserve, and this Agreement is without prejudice to, actions under CERCLA Sections 107 or 113 against a Federal Agency which fails to make a payment to the Settling

Private Parties required hereunder as a result of the Anti-Deficiency Act; (2) the Settling Private Parties reserve, and this Agreement is without prejudice to, actions under CERCLA Sections 107 or 113 against the Federal Agencies in the event the EPA institutes an action or issues an administrative order against one or more Settling Private Party seeking performance or payment which is not included within the definition of Expenses herein and the Federal Agencies reserve, and this Agreement is without prejudice to, actions by the Federal Agencies under CERCLA Sections 107 or 113 against the Settling Private Parties in the event EPA institutes an action or issues an administrative order against one or more Federal Agencies seeking performance or payment which is not included within the definition of Expenses herein; (3) the Settling Private Parties reserve, and this Agreement is without prejudice to, actions under CERCLA Sections 107 or 113 against Federal Agencies for reimbursement of any costs paid or payable by Settling Private Parties to the United States as a result of the indemnification provided to EPA under Article XX of the Consent Decree (Indemnification and Insurance); and (4) the Settling Private Parties identified on Attachment 4 reserve, and this Agreement is without prejudice to, actions against Federal Agencies based on contractual indemnity, assumption of liability, reimbursement claims, other contractual claims, extracontractual relief, or claims under CERCLA Sections 107 or 113 asserted by such Settling Private Parties prior to execution of this Agreement and which have not been resolved

prior to the entry of the Consent Decree. With respect to the claims reserved in subparagraph 7(a)(4), the Settling Private Parties and Federal Agencies agree not to assert as a defense or otherwise any contribution protection authorized under the Decree, section 113(f)(2) of CERCLA, or any subsequent amendments to CERCLA. Provided, however, that this Release and Covenant Not to Sue shall not bar any claim or proceeding by either the Settling Private Parties or the Federal Agencies to resolve disputes arising under this Agreement or any action to enforce this Agreement or the Consent Decree or any claim of negligence in the performance of the duties under this Agreement.

b. In consideration of the payments that will be made and the covenants given to the Settling Private Parties by federal de minimis agencies listed on Attachment 3 by the terms of the De Minimis Consent Decree, and except as specifically provided in this paragraph, the Settling Private Parties covenant not to sue any federal de minimis party for any and all civil liability attributable to its volumetric percentage for reimbursement of response costs, injunctive relief, contribution, or indemnification pursuant to Sections 106, 107, or 113 of CERCLA, 42 U.S.C. §§ 9606, 9607, or 9613, Section 7003 of RCRA, 42 U.S.C. § 6973, State law, and the common law with regard to the Site. This covenant not to sue is expressly conditioned on the continued existence and effectiveness of the covenant not to sue provided by the federal de minimis parties to the Settling Private Parties in the De Minimis Consent Decree, and should the

current covenant not to sue provided by the federal de minimis parties be conditioned, abrogated, limited, withdrawn, or otherwise restricted, the covenant of the Settling Private Parties contained herein shall be of no force and effect to the extent of any such restriction of the covenant currently provided by the federal de minimis parties. Notwithstanding the foregoing covenant or any contribution protection authorized under the De Minimis Consent Decree, Sections 113(f)(2) or 122(g)(5) of CERCLA, or any amendments to CERCLA, the Settling Private Parties and the United States agree that the Settling Private Parties reserve, and this Consent Decree is without prejudice to, all rights against a federal de minimis party with respect to all other matters, including, but not limited to, the following:

(1) claims based on failure to make the payments required in accordance with the De Minimis Consent Decree;

(2) criminal liability;

(3) liability for injury to, destruction of, or loss of natural resources for which there are federal trustees;

(4) liability for response costs that have been or may be incurred by the United States Department of Interior or the United States Department of Agriculture in their role as natural resource damage trustees; and

(5) liability for response costs or natural resource damages, to the extent a federal de minimis party is not

afforded contribution protection under the De Minimis Consent Decree based on the discovery of new information.

c. In consideration of the payments that will be made and the covenants given to the Federal Agencies by non-federal de minimis parties executing the De Minimis Consent Decree, and except as specifically provided in this paragraph, the Federal Agencies covenant not to sue each such non-federal de minimis party for any and all civil liability attributable to its volumetric percentage for reimbursement of response costs, injunctive relief, contribution, or indemnification pursuant to Sections 106, 107, or 113 of CERCLA, 42 U.S.C. §§ 9606, 9607, or 9613, Section 7003 of RCRA, 42 U.S.C. § 6973, State law, and the common law with regard to the Site. This covenant not to sue is expressly conditioned on the continued existence and effectiveness of the covenant not to sue provided by the non-federal de minimis parties to the Federal Agencies in the De Minimis Consent Decree, and should the current covenant not to sue provided by the non-federal de minimis parties be conditioned, abrogated, limited, withdrawn, or otherwise restricted, the covenant of the Federal Agencies contained herein shall be of no force and effect to the extent of any such restriction of the covenant currently provided by the non-federal de minimis parties. Notwithstanding the foregoing covenant or any contribution protection authorized under the De Minimis Consent Decree, Section 113(f)(2) of CERCLA, or any amendments to CERCLA, the Federal Agencies reserve, and this Consent Decree is

without prejudice to, all rights against such non-federal de minimis parties with respect to all other matters, including, but not limited to, the following:

(1) claims based on failure to make the payments required in accordance with the De Minimis Consent Decree;

(2) criminal liability;

(3) liability for injury to, destruction of, or loss of natural resources for which there are federal trustees;

(4) liability for response costs that have been or may be incurred by the United States Department of Interior or the United States Department of Agriculture in their role as natural resource damages trustees; and

(5) liability for response costs or natural resource damages, to the extent a non-federal de minimis party is not afforded a covenant not to sue or contribution protection under the Consent Order based on the discovery of new information.

d. Nothing in this Agreement shall create any right, claim, cause of action or demand in law and equity on behalf of any contractor against the Committee, Settling Private Parties, or the Federal Agencies related in any way to the Site.

e. Except as expressly provided in this Section with respect to non-federal and federal de minimis parties signing the De Minimis Consent Decree, nothing in this Agreement

is intended or shall be construed to release any individual or entity not a party to this Agreement from liability for past, present, or future response and/or remediation costs, or from liability for damages for injury to, destruction of, or loss of natural resources arising from the release or threatened release of any hazardous waste or hazardous substances at the Site.

8. Confidentiality

a. The Federal Agencies shall not have the right to demand or receive any privileged or confidential documents prepared by any common counsel. Any documents received by the Federal Agencies will be released to third parties only to the extent required by law. All documents received by the Federal Agencies will be available to the United States Department of Justice or EPA if requested by those departments.

b. All documents or information received by the Committee or Settling Private Parties from the Federal Agencies pursuant to the provisions of this Agreement shall be treated in the same manner as confidential information between Members of the Committee.

9. Modification and Termination

a. This Agreement can be modified by mutual written agreement of the Settling Private Parties and Federal Agencies at any time, followed by entry by the Court. Discussion of a modification will begin within 30 days of a written proposal to modify.

b. This Agreement shall continue in full force

and effect until all of the obligations of the Settling Private Parties and Federal Agencies under the Consent Decree have been satisfied or until there are no further Expenses incurred by the Settling Private Parties or Federal Agencies, whichever is later.

10. Government Contracts

Except as reflected on Attachment 2, this Agreement, its negotiation, execution and implementation, does not represent a decision or acceptance on the part of the Federal Agencies regarding claims by PRPs, whether Settling Private Parties or not, for indemnification or reimbursement of government contractors. All issues and claims involving the relationship of the Federal Agencies and their respective contractors which have not been satisfactorily resolved and reflected in Attachment 2 are wholly outside the scope of this Agreement. A Federal Agency does not represent or speak for contractors performing work under agency contracts who may have contributed waste to the Site unless the Federal Agency has stated in writing to the contractor that the agency is representing the contractor in subsequent negotiations.

11. Documents

Except as provided in paragraphs 3.b. and 8 herein, the Federal Agencies will receive copies of all minutes of meetings; public statements; allocation rankings; financial accounting for costs covered by this Agreement; technical reports; work plans, designs, or specifications; and letters sent to or received from EPA, the Commonwealth of Kentucky or any regulatory body.

12. Public Affairs

The Federal Agencies will be apprised in advance of any and all formal public statements to be made regarding the Committee's actions and will be offered the opportunity to join in the public statement or offer a separate contemporaneous statement.

13. Notice

Whenever notice is required by the Agreement to be given, unless otherwise specified, notice will consist of a written notice addressed to:

FEDERAL PAYMENT COORDINATOR

Office of Environmental Management
1000 Independence Avenue, S.W.
Trevion II (EM-451)
Washington, D.C. 20585-0002
Attn: Paul Beam
Telephone: 301/427-1000

DEPARTMENT OF JUSTICE

Chief, Environmental Defense Section
Environment and Natural Resources Division
United States Department of Justice
10th and Constitution, N.W.
Washington, D.C. 20530
Telephone: 202/514-2219

SETTLING PRIVATE PARTIES

Lee B. Zeugin, Esq.
Hunton & Williams
2000 Pennsylvania Avenue, N.W.
9th Floor
Washington, DC 20006
Telephone: 202/955-1535

Unless otherwise specified the Federal Agencies will receive a minimum of five (5) working days notice whenever notice is

required.

14. Contact with Regulatory Agencies

The Federal Agencies will be apprised of all formal correspondence or other formal communications between the Committee and State or Federal regulatory agencies, including EPA and the Nuclear Regulatory Commission, regarding the Site.

15. Additional Provisions

a. This Settlement Agreement applies to and is binding upon the Federal Agencies, the Settling Private Parties, and their successors and assigns. Any reorganization, abolition, size reduction, transfer of function, or any change in the existence or authority of a Federal Agency or any change in ownership or corporate status of a Settling Private Party, including but not limited to, any transfer of assets or real or personal property, shall in no way alter that Federal Agency's or that Settling Private Party's responsibilities under this Settlement Agreement.

b. The execution of this Agreement by the Settling Private Parties and the Federal Agencies is not, and cannot be construed as, an admission of liability for conditions at the Site under CERCLA or any other federal, state, or local law or the common law. Nothing in this Agreement shall limit any party's rights to individually defend itself or to bring suit on its behalf concerning any matter not addressed in this Agreement.

c. This Agreement is to be interpreted and enforced under federal law.

d. Solely for purpose of interpreting, modifying, or enforcing this Agreement, the Settling Private Parties and Federal Agencies waive all objections and defenses that they may have with regard to jurisdiction and venue in the United States District Court for the Eastern District of Kentucky.

e. The provisions of paragraphs 7, 8, and 11, and this Paragraph shall survive the termination of this Agreement.

f. This Agreement may be executed in multiple counterparts, each of which shall be deemed an original, but all of which shall constitute one and the same agreement. This Agreement shall become effective upon entry of the Consent Decree.

THE UNDERSIGNED PARTY enters into this Settlement Agreement relating to the Maxey Flats Disposal Site Superfund Site.

FOR THE DEPARTMENT OF THE NAVY

Date: 1 June 1995

[Name] Robert B. Pirie, Jr.
Assistant Secretary of the Navy (I&E)
Authorized Representative of the
Department of the Navy

THE UNDERSIGNED PARTY enters into this Settlement Agreement relating to the Maxey Flats Disposal Site Superfund Site.

FOR THE DEPARTMENT OF ENERGY

Date: _____

Thomas P. Grumbly
Assistant Secretary for
Environmental Management
U.S. Department of Energy
1000 Independence Ave., S.W.
Washington, D.C. 20585

THE UNDERSIGNED PARTY enters into this Settlement Agreement relating to the Maxey Flats Disposal Site Superfund Site.

FOR THE DEPARTMENT OF THE AIR FORCE

Date: April 11, 1995 AD McCann

[Name]

Authorized Representative of the Department of the Air Force

THE UNDERSIGNED PARTY enters into this Settlement Agreement relating to the Maxey Flats Disposal Site Superfund Site.

FOR THE DEPARTMENT OF THE ARMY

Date: 6/19/95 Lewis D. Walker
[Name]

Authorized Representative of the Department of the Army

THE UNDERSIGNED PARTY enters into this Settlement Agreement relating to the Maxey Flats Disposal Site Superfund Site.

FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

Date: 3/30/95

[Name] Robert E. Hammond
Director, Environmental Management Division
Authorized Representative of the National Aeronautics and Space Administration
NASA Headquarters
Washington, D.C. 20546

THE UNDERSIGNED PARTY enters into this Settlement Agreement relating to the Maxey Flats Disposal Site Superfund Site.

FOR THE NATIONAL INSTITUTES OF HEALTH

Date: 3/21/95

[Name]

Authorized Representative of the National Institute of Health

U.S. DEPARTMENT OF JUSTICE

Date: July 3 1995

LOIS J. SCHIFFER
Assistant Attorney General
Environment and Natural
Resources Division

Date: July 3, 1995

DANIEL W. PINKSTON
Trial Attorney
Environmental Defense Section
Environment and Natural Resources
Division
P.O. Box 23986
Washington, DC 20026-3986

Counsel for Federal Agencies

ATTACHMENT 1

Percentage of Shared Costs to be Paid
by Each of the Settling Private Parties
and Federal Agencies[1/]

	PRP	Percentage
1.	AlliedSignal	1.8167
2.	Amax Corp.	.5236
3.	Arkansas Power & Light Co.	.0541
4.	Atcor, Inc.	.7660
5.	Atlantic Richfield Co.	.0168
6.	Babcock & Wilcox Co.	1.5757
7.	Battelle	.3200
8.	Boston Edison Company	.9729
9.	Carolina Power & Light Co.	1.0989
10.	Chem-Nuclear Systems, Inc.	.0679
11.	Combustion Engineering, Inc.	.4520
12.	Commonwealth Edison Company	.9799
13.	Consolidated Edison Co. of New York, Inc.	.7894
14.	Consumers Power Co.	.6223
15.	Dow Chemical Co.	.3223
16.	E. I. duPont de Nemours & Co.	.6357
17.	General Dynamics	.5145
18.	General Electric	1.3586
19.	Ingalls Shipbuilding	.0000
20.	Iowa Electric Light and Power Co.	.5367
21.	Jersey Central Power & Light Co.	1.8212
22.	Metropolitan Edison Co.	.6086
23.	Minnesota Mining & Manufacturing Co.	.7460
24.	NASA +	1.4893
25.	National Institute of Health +	.3689
26.	NDL Organization, Inc.	.4345
27.	New York Power Authority	.6596
28.	Newport News Shipbuilding/Newport News Industrial Corp.	.0000
29.	Niagara Mohawk Power Corp.	1.5270
30.	NL Industries, Inc.	.0754
31.	Northeast Utilities Service Co.	2.4194
32.	Nuclear Fuel Services, Inc.	.1867
33.	Nuclear Metals, Inc.	.1328
34.	NUMEC (Arco)	.4513
35.	NUMEC (Babcock & Wilcox)	.9422
36.	PECO Energy Co.	1.2615
37.	Rochester Gas & Electric Corp.	.3721
38.	Safety Light Corp. (for U.S. Radium Corp.)	.5381
39.	Saxton Nuclear Experimental Corp.	.2348
40.	SmithKline Beecham Corp.	.3701
41.	Union Carbide Corp. +	.2487
42.	United States Air Force +	1.2876
43.	United States Army +	2.9189

1/ The percentages for DOE and the Navy include the resolved indemnifications of their government contractors.

44.	United States Dept. of Defense +	.1603
45.	United States Dept. of Energy +	44.6780
46.	United States Navy +	12.7541
47.	US Ecology, Inc.	3.9024
48.	Vermont Yankee Nuclear Power Corp.	.3708
49.	Virginia Power	.6708
50.	Westinghouse Electric Corp.	4.8348
51.	Whittaker Corp.	.0868
52.	X-Ray Industries, Inc.	.0231
	TOTAL	100.0000

ATTACHMENT 2
GOVERNMENT CONTRACTORS WITH
RESOLVED CLAIMS

PRP	DOE SHARE [Cubic Feet]	DOE % OF SHARED COSTS	NAVY SHARE [Cubic Feet]	NAVY % OF SHARED COSTS
ARCO - NUMEC	76,913.49	1.8053		0.0000
Argonne National Laboratory	119.07	0.0028		0.0000
Babcock & Wilcox	42,866.00	1.0061		0.0000
Babcock & Wilcox - NUMEC	56,000.00	1.3144		0.0000
Battelle	54,532.97	1.2800		0.0000
Brookhaven National Lab	12,029.45	0.2824		0.0000
Carnegie-Mellon University	26,393.83	0.6195		0.0000
Chesapeake Park, Inc.	18,942.62	0.4446		0.0000
Dairyland Power Cooperative	1,090.78	0.0256		0.0000
Duquesne Light Co.	37,611.10	0.8828		0.0000
Fermi National Accelerator Lab	35.40	0.0008		0.0000
General Dynamics - Electric Boat Div.		0.0000	91,460.33	2.1467
General Electric - Evendale	113,053.65	2.6536		0.0000
General Electric - Knolls	36,154.37	0.8486		0.0000
Gulf Nuclear Fuel Co. (Chevron)	25,808.25	0.6058		0.0000
Hallam Nuclear Power Station	4,088.52	0.0960		0.0000
Ingalls Shipbuilding		0.0000	2,964.12	0.0696
Martin-Marietta Corp.	11,583.05	0.2719		0.0000
Mound Laboratories	837,160.08	19.6497		0.0000
National Lead of Ohio	6,206.56	0.1457		0.0000
Newport News Shipbuilding/Newport News Industrial Corp.		0.0000	107,715.95	2.5283
Nuclear Fuel Services, Inc.	45,072.60	1.0579		0.0000
Piqua Nuclear Power	17,472.53	0.4101		0.0000
Reactive Metals, Inc.	13,662.49	0.3207		0.0000
Rensselaer Polytechnic Institute	165.64	0.0039		0.0000
Rural Electric Power Cooperative	3,185.47	0.0748		0.0000
United Nuclear Corp.	83,515.96	1.9603		0.0000
United Power Association	553.95	0.0130		0.0000
University of Rochester	746.03	0.0175		0.0000
Westinghouse - Atomic Power Div.	4,664.30	0.1095		0.0000
Westinghouse - Bettis	371,320.93	8.7156		0.0000
Westinghouse - Waltz Mill	1,706.00	0.0400		0.0000
Total:	1,902,655.09	44.6589	202,140.40	4.7446

ATTACHMENT 3

Federal Agencies Below .25%

PRP:	Vol. %
Dept. of the Interior	.0028
- National Marine Water Quality	
EPA	.0106
- Primates and Pesticides Effects Lab	
National Institute of Mental Health	.0032
National Institute for Standards & Testing	.0779
NIOSH	.0126
- Bureau of Occupational Safety & Health	
- Robert A. Taft Sanitary Engineering Services	
Smithsonian Institute	.0012
U.S. Bureau of Mines	.0006
U.S. Department of Agriculture	.0038
- Forest Service	
U.S. Food & Drug Administration	.0046
U.S. Geological Survey	.0007
U.S. Public Health Service	.2018
- Health Education & Welfare Dept., Cincinnati	
- Southeastern Radiological Health	
Veterans Administration Hospital	.1088
TOTAL	.4286

ATTACHMENT 4

GOVERNMENT CONTRACTORS
RESERVING CLAIMS

A. Settling Private Parties

PRP	Claims Against DOE (Cubic feet)	% of Shared Costs	Claims Against Other Fed Agencies (Cubic feet)	% of Shared Costs
AlliedSignal	19,401.80	0.4553		
Amax, Inc.	22,309.62	0.5236		
Combustion Engineering, Inc.	2,479.74	0.0582		
General Dynamics			21,919.28	0.5145
General Electric - Atomic Motor Prod.	10,552.80	0.2477		
NL Industries, Inc.	3,210.94	0.0754		
Westinghouse - Astronuclear			25,662.27	0.6023
Westinghouse - Cheswick			10,033.37	0.2355
Westinghouse - Nerva			405.00	0.0095
Subtotal	**57,954.90**	**1.3602**	**58,019.92**	**1.3618**

B. De Minimis

PRP	Claims Against DOE (Cubic feet)	Waste-In Percentage
Diamond Alkali	1,760.63	0.0352
Kerr-McGee Corp.	5,636.19	0.1126
Subtotal	**7,396.82**	**0.1478**

Appendix D

APPENDIX D

Settling Federal Agencies

NASA
National Institute of Health
United States Air Force
United States Army
United States Dept. of Defense
United States Dept. of Energy
United States Navy

Appendix E

Settling Private Parties

AlliedSignal
Amax, Inc.
Arkansas Power & Light Co.
Atcor, Inc.
Atlantic Richfield Co. (for itself and NUMEC)
Babcock & Wilcox Co. (for itself and NUMEC)
Battelle Memorial Institute
Boston Edison Company
Carolina Power & Light Co.
Chem-Nuclear Systems, Inc.
Combustion Engineering, Inc.
Commonwealth Edison Company
Consolidated Edison Co. of New York, Inc.
Consumers Power Co.
Dow Chemical Co.
E. I. duPont de Nemours & Co.
General Dynamics Corp.
General Electric Co.
Ingalls Shipbuilding
Iowa Electric Light & Power Co.
Jersey Central Power & Light Co.
Metropolitan Edison Co.
Minnesota Mining & Manufacturing Co.
NDL Organization, Inc. (The)
New York Power Authority
Newport News Shipbuilding/Newport News Industrial Corp.
Niagara Mohawk Power Corp.
NL Industries, Inc.
Northeast Utilities Service Co.
Nuclear Fuel Services, Inc.
Nuclear Metals, Inc.
PECO Energy Co.
Rochester Gas & Electric Corp.
Safety Light Corp. (for U.S. Radium Corp.)
Saxton Nuclear Experimental Station
SmithKline Beecham Corp.
Union Carbide Corp.
US Ecology, Inc. (for Nuclear Engineering Co.)
Vermont Yankee Nuclear Power Corp.
Virginia Power
Westinghouse Electric Corp.
Whittaker Corporation
X-Ray Industries, Inc.