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SEEPAGE AT THE INACTIVE FLYASH PILE AND SOUTH FIELD AREAS REMOVAL SITE EVALUATION - OCTOBR 11, 1994

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

SEEPAGE AT THE INACTIVE FLYASH PILE AND SOUTH FIELD AREAS

REMOVAL SITE EVALUATION

October 11, 1994

Prepared by

Fernald Environmental Restoration Management Corporation

1.0 Introduction

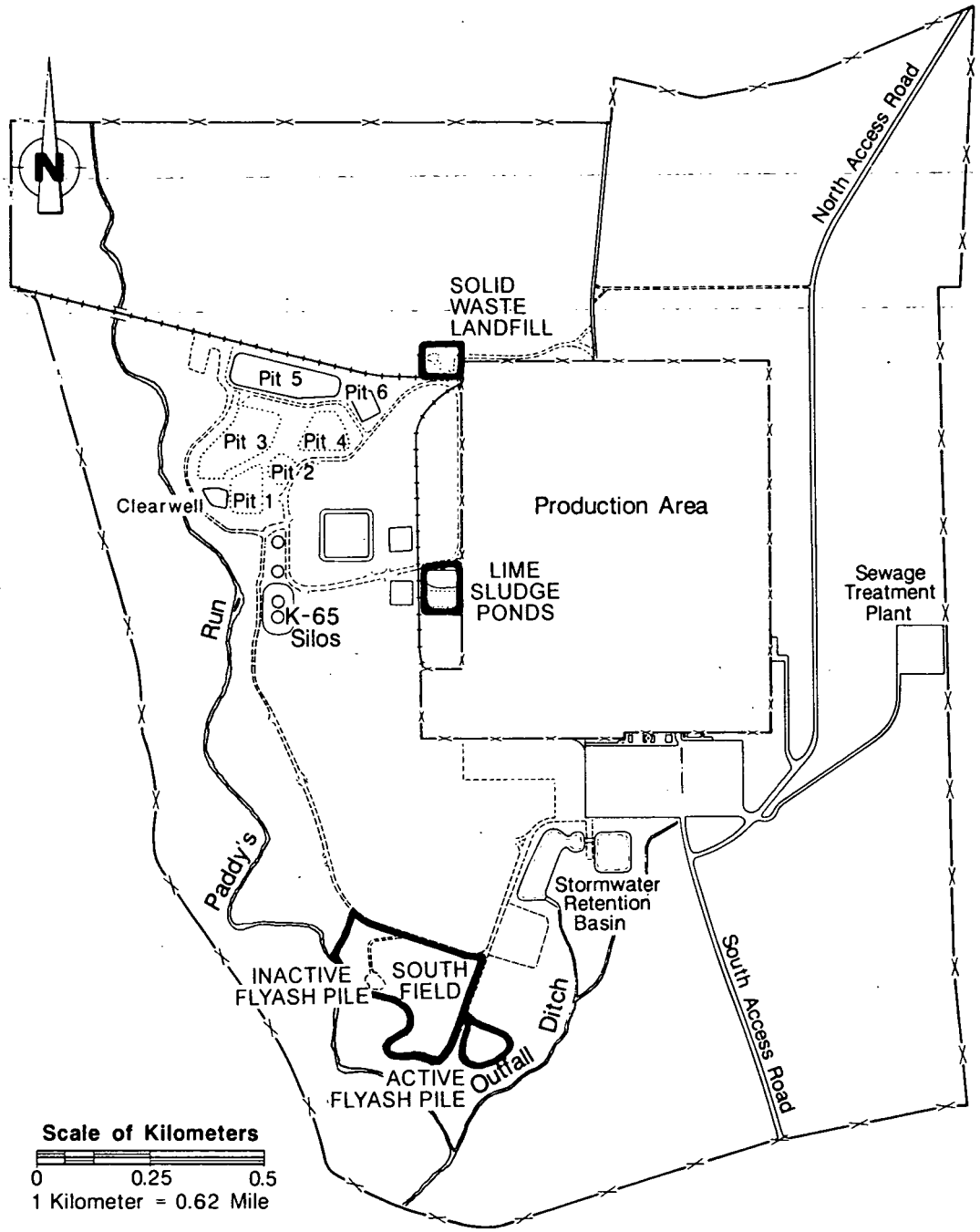
The Feed Materials Production Center, renamed on August 23, 1991 and hereinafter called the Fernald Environmental Management Project (FEMP), is a contractor-operated federal facility where purified uranium metal products were produced for the U.S. Department of Energy (DOE) between 1951 and 1989. The FEMP site is located on 1050 acres in a rural area of Hamilton and Butler counties, approximately 18 miles northwest of Cincinnati, Ohio.

The FEMP cleanup is being conducted under CERCLA and is grouped into five operable units to expedite remedial planning and implementation. Operable Unit 2 includes the Solid Waste Landfill, the North and South Lime Sludge Ponds, the Active Flyash Pile, the Inactive Flyash Pile, and the South Field. These waste areas were used for the storage/disposal of sanitary waste, spent lime sludge, flyash, and construction rubble. The primary characteristic of these waste areas is that they contain large volumes of waste with low concentrations of hazardous chemicals and/or radionuclides. Figure 1 shows the location and boundaries of Operable Unit 2.

The Remedial Investigation (RI) and Feasibility Study (FS) reports for Operable Unit 2 have been approved by the EPA based on the incorporation of their comments. The schedule for remediation of the South Field and Inactive Flyash Pile is tentatively set to begin in the fall of 1997. This is dependent on the availability of the disposal facility and is based on the current design and construction schedule.

As a result of Operable Unit 2 RI programs, it was found that surface water in the drainage ditches on the western edge of the Inactive Flyash Pile and the northern and eastern edges of the South Field was contaminated. Seeps that contribute to this surface water have been identified on the subunit sides of these drainage ditches and the approximate locations of these seeps are shown in Figure 2. This surface water is migrating directly to Paddys Run or to the Great Miami Aquifer through infiltration. The contaminant detected in the surface water is primarily uranium, but thorium, metals, and organics have also been detected.

This Removal Site Evaluation (RSE) is being initiated by the Department of Energy under authority delegated by Executive Order 12580 under Section 104 of CERCLA and is consistent with Section



LEGEND

- Location of Operable Unit 2 Subunits
- Covered Pit
- Fence
- Railroad Spur
- Roadway

Figure 1: FEMP Site Map

GRAPHICS #2617

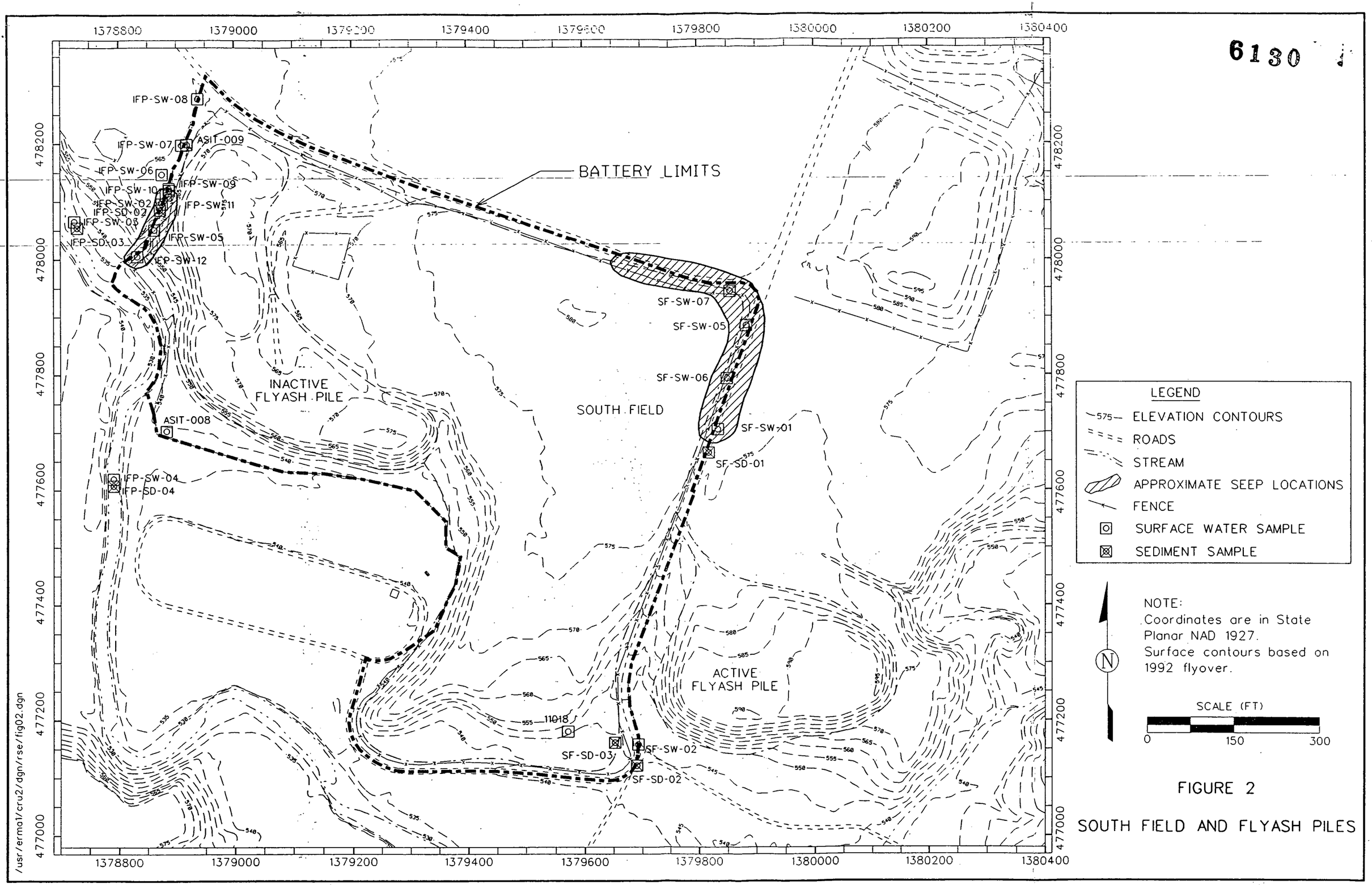


FIGURE 2

SOUTH FIELD AND FLYASH PILES

300.410 of the National Contingency Plan (NCP). The RSE is being conducted to determine whether conditions are present to warrant the implementation of a Removal Action to prevent seepage from affecting surface water and groundwater. This RSE will focus on determining the need for interim solutions that fit into the final remediation of the subunits.

2.0 Source and Nature of The Threat of Release

A comprehensive site evaluation was performed during the Remedial Investigation (RI)/Feasibility Study (FS) in the Inactive Flyash Pile and South Field areas. RI/FS environmental sampling and analyses programs were designed and implemented to address the data needs of a RI. The RI/FS field programs were completed in two phases, Phase I was completed from 1988 to 1992, and Phase II was completed in 1993. Data previously published for the FEMP were also considered, particularly those gathered as a part of (1) the Environmental Survey in 1985 and 1986 and (2) the Characterization Investigation Study conducted in 1986 and 1987. Data from all of these sources were evaluated in the RI. Samples were collected from surface media (including soils, lime sludge residue, and/or flyash), subsurface soils, surface water, drainage sediments, groundwater, and biota.

SOUTH FIELD

An estimated volume for the fill and waste materials in the South Field is 120,081 cubic yards. Materials in soil samples and trenches in the South Field are comprised of fill and construction debris. Twenty four Contaminants of Concern (COCs) were found in surface soil as a result of the RI sampling, fate and transport, and risk assessment evaluation. These twenty four contaminants include 12 radionuclides, three metals, and nine organics. The most significant contaminants in the South Field are the radionuclides radium-226, radium-228, thorium-228, thorium-232, uranium-238, and the metal total uranium. These contaminants produce the majority of risk to potential receptors. Contaminant transport to surface water was modeled and assessed. The risk assessment determined that no COCs were significant to the surface water pathway on the South Field because surface water on the subunits is not considered a drinking water source or a secondary pathway for edible fish. However, two COCs, radium-226 and technetium-99, were transported by surface water from the subunit to the Great Miami River. Also, uranium concentrations in the surface water are significant enough that if surface water were to reach the Great Miami Aquifer, the resulting groundwater concentration would produce a significant risk. The reason why contaminants are COCs in the Great

Miami River and the Great Miami Aquifer after being transported by surface water, but not COCs in surface water, is a result of receptor definitions. The results of the RI indicate that uranium isotopes and total uranium are the COCs for groundwater. Because of the potential for surface water to contaminate the groundwater and other surface water bodies, the impacts to surface water in the South Field need to be considered. Because of the significance of uranium in the groundwater pathway, uranium is the focus of subsequent analysis in this evaluation.

There are no perennial sources of surface water in the South Field subunit. Samples were collected after rain events occurred and when flow was available in a drainage. Surface water drainage originating at the northeast corner of the South Field and flowing south along the east boundary of the South Field was observed for extended periods after rain events finished, and two seeps were observed upstream of location SF-SW-01 (See Figure 2). Table 1 lists the surface water sampling results for the South Field. Concentrations of total uranium and isotopic uranium in surface water samples collected from the South Field drainage after rain events ranged from 110 μg/L at the upstream location (SF-SW-07) to 540 μg/L collected from standing water at the farthest downstream location (SF-SW-02) at the southeast corner of the South Field. These values are in approximate agreement with groundwater samples collected from the glacial till monitoring Well 1941 (388 μg/L to 547 μg/L) and Well 1942 (320 μg/L) completed at the east side of the South Field. This indicates that the observed drainage is representative of perched groundwater and shallow interflow at the east side of the subunit, and that the South Field has an impact upon drainage water.

Sediment samples were collected from the drainage during Phase II, and analytical data were consistent with the fill samples on the South Field. This indicates that the source of the sediments is the South Field surface soils. Total uranium concentrations in the sediments ranged from 15,000 to 30,000 ppb. A comparison of sediment and surface water indicates that soluble constituents like chloride and fluoride were detected in water samples but not in the sediment. This suggests that the drainage water originated as groundwater because these constituents require relatively long contact time to leach out of geologic materials. Chloride and fluoride are present at trace amounts in precipitation and so a source other than rainfall is indicated. These data support the belief that drainage water samples containing elevated uranium are representative of perched groundwater.

TABLE 1

SUMMARY OF RADIOISOTOPE CONCENTRATION IN SURFACE DRAINAGE IN THE SOUTH FIELD

Sample	Data Collected	Activity or Concentration
SF-SW-07 farthest upstream	Sample 113666 collected 5/15/93 On-site analysis:	Total U = 110 μg/L
SF-SW-05 downstream of SW-07	Sample 113489 collected 5/6/93 On-site analysis:	Total U = 160 μg/L
SF-SW-06 downstream of SF-05	Sample 113490 collected 5/6/93 On-site analysis:	Total U = 250 μg/L
SF-SW-01 approximately midway along east side of South Field, downstream of SW-06	Sample 110422* and Sample 110424 collected 3/24/93 On-site analysis: Off-site analysis:	Total U = 400 μg/L U-234 = 110 pCi/L U-235/236 = 7.47 pCi/L U-238 = 136 pCi/L Total U = 340 μg/L
SF-SW-02 at southeast corner of South Field and most downstream of locations SW-07 to SW-01	Sample 110432* and Sample 110434 collected 3/25/93 On-site analysis: Off-site analysis:	Total U = 540 μg/L U-234 = 159 pCi/L U-235/236 = 7.4 pCi/L U-238 = 174 pCi/L Total U = 487 μg/L
11018 standing water at southeast corner of South Field after period of heavy rain. Sample is representative of accumulated surface drainage from South Field.	Sample 112633 collected 4/17/93 On-site analysis:	Total U = 560 μg/L

*Analyzed off site for full HSL, Rad.

INACTIVE FLYASH PILE

The volume of flyash and waste material was estimated for the Inactive Flyash Pile as 95,891 cubic yards. Flyash was dumped off a steep till embankment near to Paddys Run and thereafter, worked by bulldozers. The southern portion of the Inactive Flyash Pile has an approximate 7-foot soil/fill cover with a moderate vegetative cover. The northern portion, as indicated by the soil boring logs, does not have a soil cover. However, the northern portion is covered with moderate vegetation and stands of deciduous trees. Waste materials identified in samples collected from soil borings in the subunit included localized sludge-like material, clay tile drain pipe, wood, nails, wire, construction debris, and flyash. Samples of flyash collected from borings detected dry to moist conditions but never detected saturated samples. Very moist to wet conditions were detected at the interface of the Inactive Flyash Pile and the native till surface. Flyash and fill are in contact with the Great Miami Aquifer in the western and southern portions under the Inactive Flyash Pile.

Six COCs were determined for surface soil the Inactive Flyash Pile. The six COCs include four radionuclides, one metal, and one organic. No COCs were determined for surface water either on the subunit or in the Great Miami River, but the pathway still exists for surface water to transport contaminants to the Great Miami Aquifer. The uranium isotopes and total uranium metal are Inactive Flyash Pile COCs for groundwater, due in part to surface water transport to the Great Miami Aquifer. Because of the significance of uranium in the groundwater pathway, uranium is the focus of subsequent analysis in this evaluation.

There are no perennial sources of surface water within the battery limits of the Inactive Flyash Pile, so surface water was not present at several of the proposed drainage sampling locations. Surface water samples were collected on an "as-possible" basis after rainstorms. Drainage within a channel at the west side of the flyash pile was observed to flow for several days after significant rain events, and samples were collected at multiple locations to characterize seeps from the Inactive Flyash Pile.

Total uranium analyses of surface water in the west drainage were used to define the location of possible springs or seeps contributing to drainage from the Inactive Flyash Pile. Table 2 lists the surface water sampling results for the Inactive Flyash Pile. Data suggest that seepage from the west edge of the Inactive Flyash Pile is surfacing in the drainage in at least one location (See Figure 2). One location of observed seepage was sampled at IFP-SW-11 on May 18, 1993, where 820 μg/L total

TABLE 2

INACTIVE FLYASH PILE
SUMMARY OF DETECTED ANALYTES IN PHASE II
SURFACE WATER AND SEDIMENT SAMPLES

OFF-SITE ANALYSES OF SEDIMENT AND SURFACE WATER

Location	Description	Sample Number	Collection Date	Analyses	
				Uranium-238	Total-Uranium
IFP-SW-02	West drainage Surface Water	111828	4-26-93	59.7 pCi/L	165 µg/L
IFP-SW-02		112022	4-30-93	257 pCi/L	820 µg/L
IFP-SD-02	Sediment from above location	111812	4-17/93	1.68 pCi/g	12 µg/g
IFP-SD-02		112021	4-30-93		12.3 µg/g
IFP-SW-03	Paddys Run upstream of West drainage Surface Water	111819	4-21-93	1.74 pCi/L	5.25 µg/L
IFP-SW-03		112027	5-01-93	2.13 pCi/L	5.03 µg/L
IFP-SD-03	Sediment	111813	4-17-93		
IFP-SD-03		116219	5-01-93	0.9 pCi/g	4.09 µg/g
IFP-SW-04	Paddys Run downstream of West drainage Surface Water	11820	4-21-93	2.26 pCi/L	5.87 µg/L
IFP-SW-04		112015	4-29-93	1.84 pCi/L	4.57 µg/L
IFP-SD-04	Sediment	111815	4-17-93	ND	ND
		112017	4-29-93	ND	9.9 µg/g

ON-SITE ANALYSES OF TOTAL URANIUM IN SEEPS AND DRAINAGES

Location	Description	Surface Water Sample Number	Collection Date	Total Uranium µg/L
IFP-SW-02	Collected below seep area (medium flow)	111829	4-26-93	160
IFP-SW-02	Collected below seep (low flow)	112024	4-30-93	830
IFP-SW-03	Collected from Paddys Run upstream of confluence with drainage	111824	4-21-93	6
IFP-SW-03	Collected from Paddys Run upstream of confluence with drainage	112026	5-01-93	5.5
IFP-SW-04	Collected from Paddys Run downstream of confluence with drainage	111822	4-21-93	6
IFP-SW-04	Collected from Paddys Run upstream of confluence with drainage	112019	4-29-93	5
IFP-SW-05	Collected downstream of seep (low flow)	112029	5-02-93	910
IFP-SW-06	Upstream of possible seep from East bank of drainage	112030	5-02-93	23
IFP-SW-06	Upstream of possible seep from East bank of drainage	112031	5-02-93	23
IFP-SW-07	At confluence of North road drainage channel and the East drainage	112032	5-02-93	20
IFP-SW-08	Farthest upstream, collected just below drain culvert under North access road	112033	5-02-93	11
IFP-SW-09	Collected from upstream of seep in drainage channel	112034	5-03-93	81
IFP-SW-10	Collected from mixing zone in drainage adjacent to seep	113491	5-07-93	280
IFP-SW-11	Collected at seep into drainage after recession in drainage after heavy rain	116459	5-18-93	820
IFP-SW-12	Collected at confluence of drainage and Paddys Run above sand unit where drainage recharges to the GMA	116460	5-18-93	370

ND = Not detected

uranium was detected. Upstream and downstream concentrations were 23 μg/L (IFP-SW-06) and 910 μg/L (IFP-SW-05), respectively, on May 2, 1993. Surface water drainage was traced downstream to where it soaked through the bottom of the sandy stream channel. Total uranium in a sample collected slightly upstream of this location was 370 μg/L (IFP-SW-12) on May 18, 1993. Field observations, therefore, indicate that recharge to the regional aquifer occurs by surface water from the west drainage. Analytical data indicate that the recharge water has elevated concentrations of uranium.

One sediment sample collected during Phase I detected total uranium in the drainage ditch upstream of the Inactive Flyash Pile at 5,000 ppb. One Phase II sediment sample collected in the drainage ditch detected total uranium at 12,300 ppb. Total uranium and other constituents detected in the sediment samples are consistent with surface soil samples on the Inactive Flyash Piles. Sediment samples in Paddys Run upgradient and downgradient of the drainage ditch indicate that the drainage from the Inactive Flyash Pile has contributed contaminated sediment to Paddys Run.

3.0 Evaluation of The Magnitude of The Potential Threat

Surface water and sediment with above background concentrations of uranium have been detected in the drainage ditches on the western edge of the Inactive Flyash Pile, and the northern and eastern edges of the South Field. The source of surface water containing above background concentrations of uranium is either from surface water runoff that erodes contaminated materials or seepage through contaminated materials. Because the surface water samples were taken a few days after rainfall events and the areas are well vegetated, the source of contaminated water is thought to more likely be seepage. There is a potential threat to humans and the environment from seeps and sediment in these areas.

Seeps along the north and east boundaries of the South Field empty into a drainage ditch that borders the South Field and flows south to a shallow depression. Once in this depression the surface water evaporates and infiltrates into the soil. This drainage channel flows intermittently during and after rainfall events. Sediments in this ditch have above background concentrations of total uranium. The sediments are in contact with surface water, allowing some of the uranium to leach out of the sediments and into the water, depending on the time of contact and the soil/water partitioning coefficient. The sediments are also washed down into the depression at the base of the South Field

where they sit over the Great Miami Aquifer and in contact with pooled surface water. The transportation of surface water occurs more rapidly then the transportation of groundwater and the transport of contaminated surface water to a recharge point for the Great Miami Aquifer at the southeast corner of the South Field spreads the contaminants wider than would occur from vertical leaching. A profile and cross section of this drainage ditch are shown in Figure 3 and 4. The profile and cross section of this drainage ditch indicates that the drainage ditch is not deep enough to intercept the interstitial sand layer and does not intercept the Great Miami Aquifer until it reaches the depression into which it drains. Figure 5 shows contours of uranium in a cross section from the drainage ditch on the eastern edge of the South Field.

Seeps along the steep slope of the western side of the Inactive Flyash Pile run into a drainage channel that flows southwest toward Paddys Run. The drainage channel flows intermittently after storm events. Low flows in the channel infiltrate into a low area at the base of the Inactive Flyash Pile. Moderate or fast flow during a storm event discharges into Paddys Run. The transportation of surface water occurs more rapidly then the transportation of groundwater and the transport of contaminated surface water to a recharge point for the Great Miami Aquifer at the southwest corner of the Inactive Flyash Pile spreads the contaminants over a broader area than would occur from vertical leaching. A profile and cross section of the drainage channel is shown in Figures 3 and 4. The profile and cross section indicates that the drainage channel intercepts both an interstitial sand layer and the Great Miami Aquifer. The seeps identified in this drainage feature enter the ditch along the side of the Inactive Flyash Pile where the interstitial sand layer exists.

Sediments were sampled in the ditch and were slightly above background, but the slope of the ditch is much steeper then for the drainage ditch in the South Field, and the bottom of the ditch is erosional rather then depositional. Sediments are carried down the drainage ditch and deposited in a low area where intermediate and low flows seep vertically into the Great Miami Aquifer. Sediments in this low area have above background concentrations of total uranium. The sediments are in contact with surface water, allowing some of the uranium to leach out of the sediments and into the water, depending on the time of contact and the soil/water partitioning coefficient. Figure 5 shows contours of uranium in a typical cross section of the drainage ditch along the Inactive Flyash Pile.

LEGEND

- 575 — EXISTING ELEVATION CONTOURS
- EXISTING ROADS
- EXISTING STREAM
- EXISTING FENCE
- 3-B ● REFERENCE POINT
- CROSS SECTION

NOTE:
Surface contours based on 1992 flyover.

N

SCALE (FT)
0 150 300

FIGURE 3
SITE PLAN
REMOVAL SITE EVALUATION
SEEPAGE CONTROL

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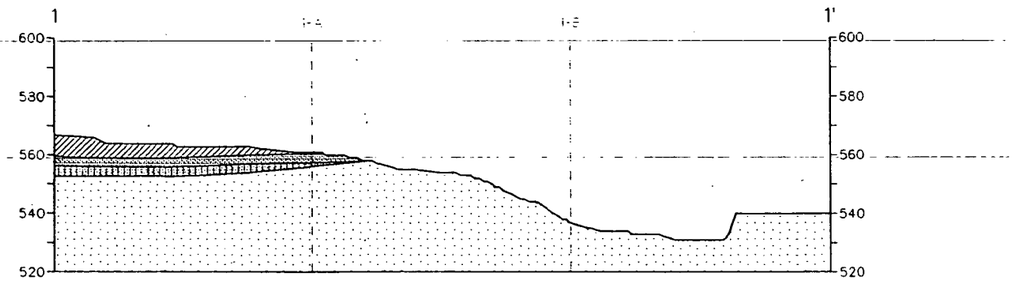

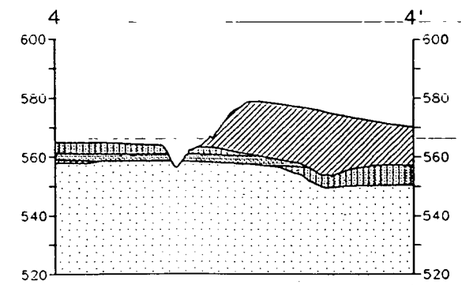

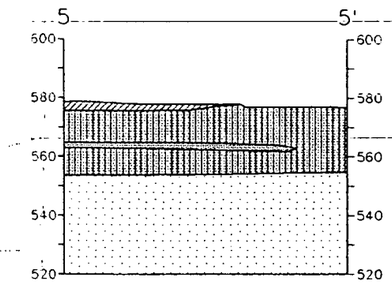

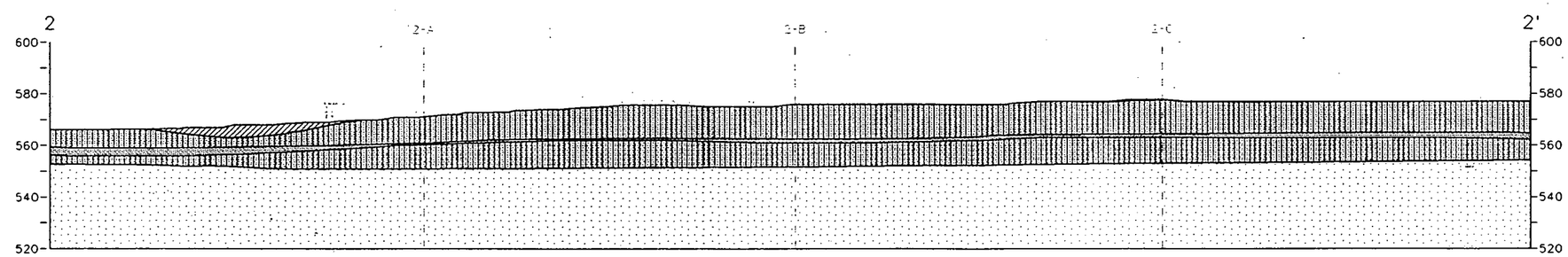

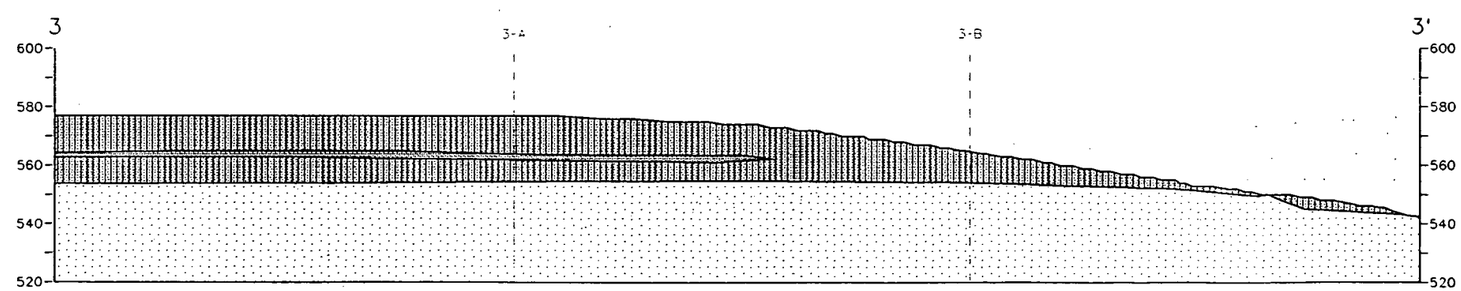

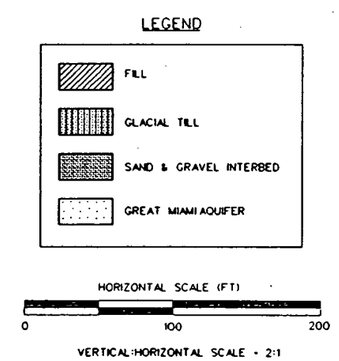

FIGURE 4
CROSS SECTIONS AND PROFILES
OF THE DRAINAGES FOR THE
SOUTH FIELD AND INACTIVE FLYASH PILE

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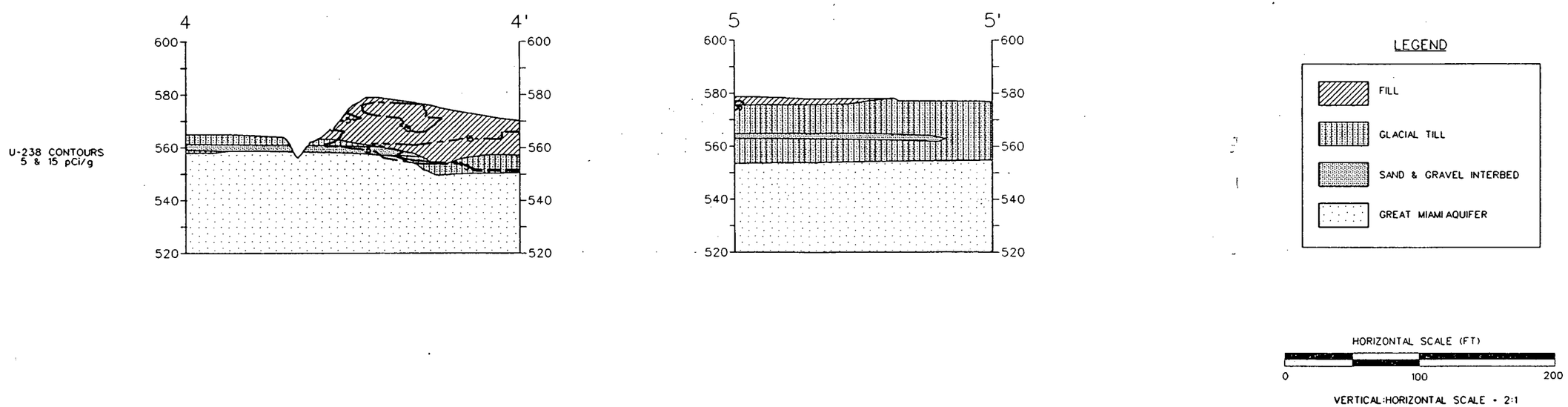

FIGURE 5
U-238 CONCENTRATIONS ALONG THE DRAINAGE CHANNELS IN THE INACTIVE FLYASHPILE AND SOUTH FIELD

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Figure 6 presents the topography of the South Field and Inactive Flyash Pile, and indicates the drainage area for the South Field and Inactive Flyash Pile drainage ditches. The shaded area represents the portion of the subunit that could contribute to the seeps and surface water flowing in the ditches. Most of the sediments in the ditches are not likely to have resulted from recent surface runoff due to the vegetative cover on the South Field and Inactive Flyash Pile. The contaminated sediments are more likely to be remnants from deposition that occurred when the South Field and Inactive Flyash Pile were active.

Total uranium concentrations in surface water near the seeps are greater than 500 ppb in the South Field and 800 ppb in the Inactive Flyash Pile. Sediment concentrations in the South Field and Inactive Flyash Pile are greater than 50,000 ppb and 10,000 ppb respectively. Uranium concentrations in groundwater downgradient of the surface water discharge locations are greater than 300 ppb in the South Field and 1800 ppb in the Inactive Flyash Pile. The drinking water standard for concentrations of uranium is 20 ppb. The analytical data suggests that the seeps from the Inactive Flyash Pile and South Field are contributing to total uranium contamination in the Great Miami Aquifer that exceeds the regulatory limit for drinking water. The impact to groundwater is one to two orders of magnitude above the drinking water standard. The range of detected concentrations of total uranium in the Inactive Flyash Pile and South Field wastes is 1050 to 3,580,000 ppb. The large volume of waste and the high concentrations of uranium indicate that the release of uranium through seepage and contaminated sediments could continue at the present concentration until the subunits are remediated.

4.0 Assessment of The Need for a Removal Action

As outlined in Section 40 CFR 300.415, eight factors are to be considered when determining the appropriateness of a removal action. The consideration of those factors is presented in the table below.

Factor	Applicable to this Removal Action?		Comment
	Yes	No	
Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants	✓		The contaminated seepage drains into Paddys Run and areas that recharge the Great Miami Aquifer. This results in the potential for human consumption of the groundwater as well as direct contact by wildlife.
Actual or potential contamination of drinking water supplies or sensitive ecosystems	✓		The contaminated seepage drains to areas that recharge the Great Miami Aquifer.
Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers, that may pose a threat of release		✓	Neither the seepage nor the source material is in bulk storage containers.
High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate		✓	The levels have been measured in the range of 110 to 910 ug/L in the seepage water.
Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released	✓		While wet weather leads to the development of the seepage, it does not of itself result in a major release.
Threat of fire or explosions		✓	Neither the source material nor the seepage are thought to be flammable.
The availability of other appropriate federal or state response mechanisms to respond to the release		✓	No other response mechanisms (other than site remediation) have been identified.
Other situations or factors that may pose threats to public health of welfare or the environment		✓	None have been identified.

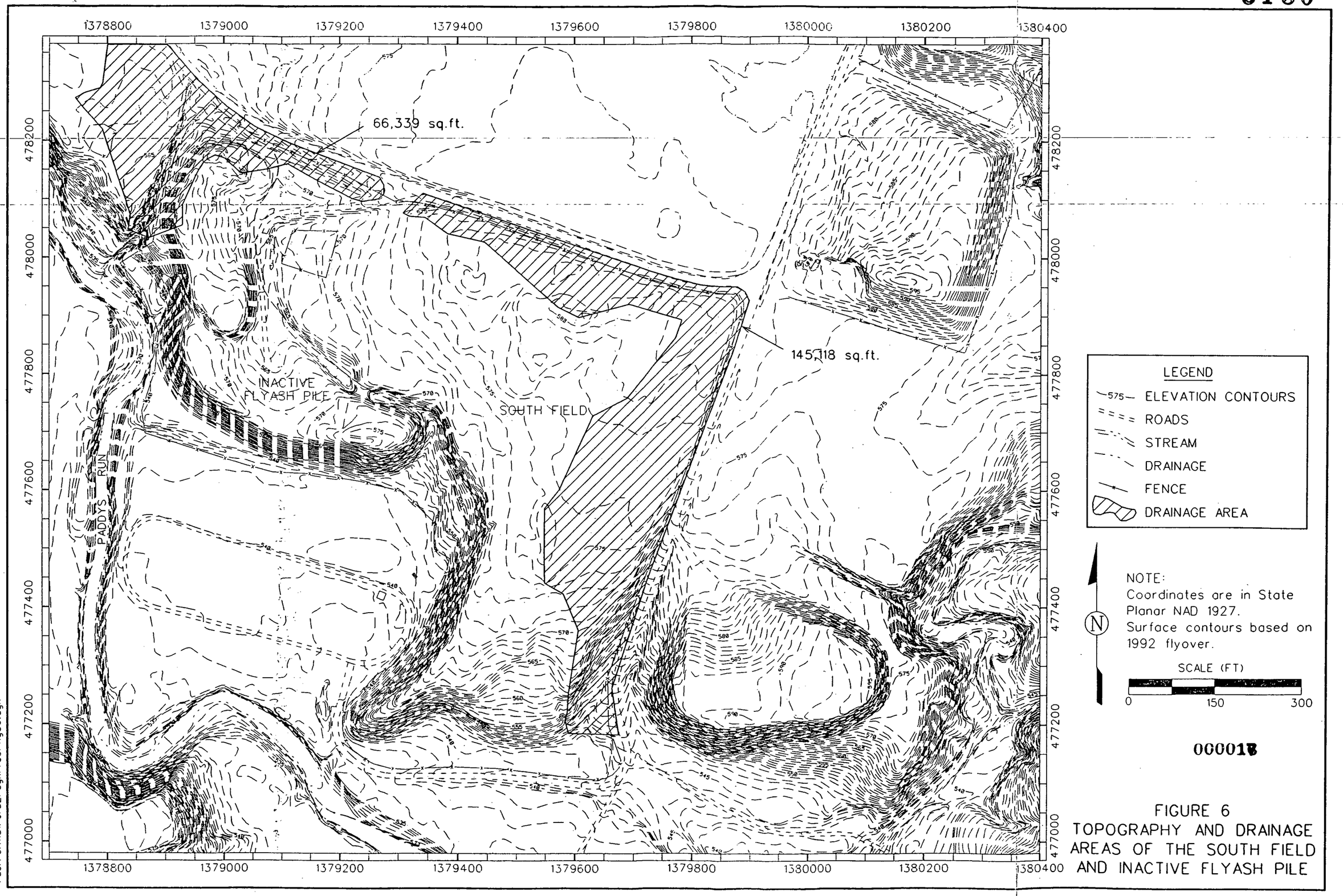

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FIGURE 6
TOPOGRAPHY AND DRAINAGE AREAS OF THE SOUTH FIELD AND INACTIVE FLYASH PILE

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As noted in the table, the seeps result in potential exposure to humans and animals as well as contamination of the Great Miami Aquifer. This is somewhat mitigated by the fact that no human receptors are currently known to be affected by the release of uranium in surface water.

5.0 Appropriateness of a Response

If it is determined that a response is appropriate due to the potential exposure to and on-going release of contamination in the IFP/SF seeps, a removal action to address the seepage from the fill material and the presence of contaminated sediments should be undertaken.

DOE will evaluate the appropriateness of a response action and will prepare an Action Memorandum. If DOE concurs that an action is appropriate, they will issue an Action Memorandum that will describe the selected response and provide supporting documentation for the decision.

If it is determined that a planning period of greater than six months exists prior to initiation of a response, DOE will issue an Engineering Evaluation/Cost Analysis approval memorandum. This memorandum is to be used to document the threat to public health and the environment and to evaluate viable alternative response actions.

Based on the evaluation of the factors described in earlier sections of this document, it has been determined that seepage and contaminated sediments pose a potential threat to environmental and human receptors. The seeps and sediments serve as a mechanism for rapid surface transport of contaminants that in turn infiltrate to the Great Miami Aquifer. There is also a potential that this surface water pathway is contributing to the off-site contaminant plume. While addressing only a subset of the total threat posed by the materials in the IFP and SF, control of these mechanisms would prevent contaminated seeps and surface water from recharging the Great Miami Aquifer. Such controls would need to prevent or intercept seepage, and prevent surface water from leaching uranium from contaminated sediments and then infiltrating into the Great Miami Aquifer. Though remediation of the South Field and Inactive Flyash Pile will be first priority in Operable Unit 2 remedial actions, remedial activities are at least three years away. The implementation of a removal action prior to remediation would prevent the continued spread of contamination by seeps and surface water and would not conflict with the final remediation of the subunits.