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Characterization of Existing Surface Conditions at Sheffield Low-Level Waste Disposal Facility

Sheffield, Illinois
Final Report
July 10 - July 31, 1980

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Division of Waste Management
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CHARACTERIZATION OF EXISTING SURFACE CONDITIONS SHEFFIELD LOW-LEVEL WASTE DISPOSAL FACILITY SHEFFIELD, ILLINOIS

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PREFACE

This report presents results of the investigation to characterize the existing surface conditions at the Sheffield Low-Level Waste Disposal Facility, Sheffield, Illinois. The investigation is based on visual observations made in the field and detailed topographic surveying. The objectives of the investigation were as follows:

1) Analysis of trench caps

   Provide description of surface conditions and the ability of trench caps to minimize erosion and water infiltration into the trenches; and discuss possible remedial conditions that could be taken to minimize infiltration.

2) Identification of erosion areas

   Identify surface erosion areas, provide a description of the apparent causes of surface erosion, and discuss possible remedial actions that could be taken to minimize erosion.

3) Extent of vegetative cover

   Provide visual description of the types, location, and condition of vegetative cover.

4) Topographic survey

   Provide detailed topographic survey of the 20 acre site extending 200 feet beyond the site boundary.

The Sheffield low-level radioactive waste disposal site is located on 20 acres of rolling terrain about three miles southwest of Sheffield, Illinois. Burial of the radioactive waste was first authorized August 1, 1967. Since that time approximately three million cubic feet of waste containing about 60,000 curies of byproduct material, 55 kilograms of special nuclear material, and 600,000 pounds of source material have been buried in 21 trenches.

Nuclear Engineering Company, Inc. (NECO), the operator of the Sheffield Nuclear Waste Disposal Site, made application to the NRC and State of Illinois Department of Public Health (IDPH) to continue to operate the site and expand it. The renewal and site expansion application from 20 acres to 188 acres was filed with the NRC in 1976. Hearings on the

NRC application were requested. An Atomic Safety and Licensing Board (ASLB) was established and interveners and hearings were approved in early 1978. However, before all the issues in the case were sufficiently resolved so that the U.S. NRC could prepare its environmental impact statement on the application and hearings could be scheduled, NECO requested suspension of the licensing proceeding in December 1978. In March 1979, NECO attempted to unilaterally terminate both the State (Illinois Department of Public Health) license and lease and the NRC license and abandon the site. The ASLB allowed NECO to withdraw the application for expansion but not the application for renewal. Both the NRC and IDPH issued orders requiring NECO to return to the site. Following NECO's refusal to honor the orders, the IDPH filed suit in circuit court seeking judicial relief. The IDPH won a preliminary injunction ordering NECO back to the site while a final settlement was developed. This case is still pending. NECO signed an agreement with the U.S NRC to provide site security and to monitor and maintain the site until the legal issues are resolved. NECO has requested a hearing on the NRC order and the matter has been referred to the same ASLB.

In order to prepare for the hearing, the U.S. NRC requires detailed information of the surface conditions at the site. This information will be used to determine if the site, as it exists today, is meeting license requirements and if the site is acceptable for closure. Harding-Lawson Associates (HLA) was awarded contract No. NRC-02-80-057 by the U.S. NRC to prepare a report on the "Charaterization of Existing Surface Conditions, Sheffield Low-Level Waste Disposal Facility, Sheffield, Illinois."

The authors wish to express their appreciation to Russel Moore, Nuclear Engineering Company, Inc. (NECO) for his cooperation while we were on the site; and Donald Pretzsch, District Conservationist, U.S. Department of Agriculture, Soil Conservation Service, who discussed the characteristics of the soils in Bureau County, Illinois, and erosion control methods with us.

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July 30, 1980

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CHARACTERISTICS OF EXISTING SURFACE CONDITIONS SHEFFIELD LOW-LEVEL WASTE DISPOSAL FACILITY SHEFFIELD, ILLINOIS

I. INTRODUCTION

This report presents the results of the investigations to characterize the existing surface conditions at the Sheffield Low-Level Waste Disposal Facility in Sheffield, Illinois. The investigations included making visual observations pertaining to:

1) Analysis of trench caps

   This includes a description of the surface conditions and of the ability of the trench caps to minimize erosion and water infiltration into the trenches. Surface depressions and other areas of high infiltration potential have been noted. Possible remedial actions that could be taken to minimize infiltration are discussed.

2) Identification of erosion areas

   A detailed visual survey was made of areas at the site where erosion is occuring and a description of the apparent cause of surface erosion is discussed. Possible remedial measures that could be taken to minimize erosion are presented.

3) Extent of vegetative cover

   A detailed visual survey of the types, location, and condition of vegetative covers at the site was made.

4) Topographic survey

   A detailed topographic survey of the 20-acre site extending to 200 feet beyond the site boundary has been prepared. The topographic map (Plate 1) has 1 foot contours with an accuracy of plus or minus 0.5 feet. Third order surveying was

required with elevation points established at a minimum of 50-foot intervals. Each elevation point has an accuracy of plus or minus 0.1 foot. The final map has a scale of 1 inch equalls 50 feet.

The visual observations are presented in Chapter II, are documented in numerous photographs, and are plotted on Plates 3 and 4.

The field observations were made by Dr. George E. Heim and Michael V. Machalinski of Harding-Lawson Associates. Observations pertaining to the conditions of the trench caps were made on July 22 and 23, 1980. Observations regarding the drainage conditions and infiltration immediately following a rainstorm were made by M. V. Machalinski on July 9, 1980.

The topographic survey was performed by Randolph & Associates, Inc. on a subcontract to HLA. The field surveying was performed during the period July 9, 1980, through July 22, 1980. The results of the topographic survey are presented on Plate 1. The two benchmarks shown on this plate are located atop well casings which protrude approximately four feet above ground surface.

II. SURFACE CONDITIONS

A. GENERAL

The description of the surface conditions is based on visual observations made in the field and analysis of the topographic map. The discussion in this chapter presents a general overview of the site geology, vegetation, drainage, and erosion. This is followed by detailed descriptions of the surface conditions on each of the trench caps and in various areas at the site.

B. SITE GEOLOGY

The geology of the Sheffield site is described in Foster and Erickson, 1980, pages 6-21 (Ref. 1). In general, the stratigrphic sequence at the site consists of Wisconsinan loess underlain by Illinoian till, outwash, and lacustrine clay.

The loess deposits are up to 30 feet thick and it is this material that has been used as the uppermost backfill material throughout most of the site. The loess deposits consist primarily of silt with varying percentages of clay and very fine sand.

C. VEGETATION

Descriptions of the type of vegetation, density, and general condition in the vicinity of the trench caps and other selected areas within the site are presented in Chapter II, Section F and the density is summarized on Plate 3. In general, the vegetation at the site consists of grasses, alfalfa, clover, and weeds. The height of the grasses, alfalfa, and clover generally range from six inches to one foot, the height of the weeds reached a maximum of approximately two and one-half feet. Photographs showing the general types of vegetation present in the site area are shown in Fig. 15 (grass and clover), Fig. 7 (weeds), and Fig. 44 (trees). The trees which are present near the fenceline occur primarily in the southeast corner and in the northeast corner of the site area.

There are several areas where the vegetation cover is very thin (0 to 25%, Plate 3, and for example, Fig. 2) and many areas where it is dead. There are several other areas

where the cover is thick (for example, Fig. 4) indicating the soil can support good vegetative growth.

There is a mowing program in effect at the site and the mowing is done on a periodic basis. Vegetation is cut to a height of approximately four inches. It was noted during the mowing operation that the blade of the mowing machine often cut into local high spots leaving them devoid of vegetation. Also, when the tractor pulling the mowing machine turns, the tires cut into the soft surface soil and the vegetation is often destroyed in the tractor track (Fig. 42).

D. DRAINAGE

Observations pertaining to drainage include surface drainage conditions, general infiltration into the reworked loess which covers the trench caps, and areas which are susceptible to large amounts of infiltration.

D.1. Surface Drainage

The surface runoff occurs initially as unconfined sheetwash which gradually concentrates in small, poorly defined rills (Fig. 22 shows development of rills). The water in the rills generally flows into gullies (Fig. 20 and 26 are typical) or swales (Fig. 14 is typical). The rills and gullies on the trench caps generally occur on the side slopes and tend to be oriented at right angles to the swales. Areas of prominent rills and gullies are described in Chapter II, Section F and are shown on Plate 4. The majority of these features are too small to be identified by the topographic survey but they are important because they are the start of the erosion process. Water in the swales then follows the site topography and ultimately ends up in the well defined drainage channels at the northern end (DC-1, Plate 4) or southeastern end (DC-2, Plate 4) of the site. In many instances, the water in the drainage swales has eroded the swale and formed a well defined gully-type channel (Fig. 40). Swales which are experiencing erosion are identified on Plate 4.

It should also be noted that in many areas surface drainage has been concentrated in the elongate, shallow depressions formed by tire tracks. The tire tracks have a random orientation in the site area. Those tracks which trend up and down the side slopes of the trends often show evidence of concentrated flows which result in erosion.

Two well defined surface drainage channels are present on the site. These channels are herein referred to as DC-1, which is located at the northern end of the site, and DC-2, which is located at the southern end of the site (Plate 4). The flow in both channels is intermittent.

DC-1 enters the site near the northwest corner. It carries runoff from the adjacent chemical waste disposal site which is directed into this channel through the culvert shown in Fig. 46. Drainage flows generally eastward in the two-foot deep channel. It is suspected that this channel is flooded during wet periods. The channel exits the site on the north side, near the northeast corner.

DC-2 originates on the site near the center of the southern end and trends southeast. Several well developed gullies (G-6, G-7, and G-9) lead into the headwater area of this channel. The slope which forms the headwater area is semi-circular in shape, poorly vegetated, and is extensively rilled and gullied as shown in Fig. 52. The northern bank of DC-2 is also deeply gullied.

Surface drainage in the southwestern portion of the site occurs primarily as sheetwash type flow over a well vegetated slope (Fig. 43).

Along the western side of the site near the northern corner, surface drainage from the adjacent chemical disposal area flows eastward onto the Sheffield Low-Level Disposal Site property. Water is temporarily ponded along the western fenceline and when the level becomes high enough, it drains to the north to drainage channel DC-1.

A drainage diversion channel (Plate 4 and Figs. 48, 49, and 50) is currently under construction. We do not know the final design details of this channel. The channel cut passes very close to the ends of several of the trenches and gullying has started on the exposed slopes (Fig. 20).

D.2. General Infiltration

The reworked loess which is the near surface material throughout the site, is loose and pervious and allows rapid infiltration. Observations made within one half hour after a heavy rainfall indicate that surface water does not collect in any of the areas of the trenches. Water poured from a bottle onto the ground tended to flow a short distance and then soak completely into the ground.

D'Appolonia drawings (Drawings No. 76-219-E12 and 76-219-E13) provided to HLA by the U.S. NRC (Ref. 2) indicate the construction of the cap at Trenches 14 and 14 A consists of a 3-foot thick clay seal overlain by earth fill ranging from three feet thick at the centerline of the trench to 0.5 feet at the edge of the trench. General infiltration into the trenchs would be reduced because of the 3-foot thick clay seal. However, it is not known if, during the actual construction of the trenches, this procedure was followed.

At Trench 4, plastic, which appeared to be a reinforced plastic container, was exposed at the ground surface (see Figs. 12 and 13). If this plastic is a container for buried waste, then the impervious cap material in that area is absent.

It is our understanding that the impervious backfill material was obtained by mixing clayey material with loess. If this is correct, great care would have to have been taken to obtain a homogeneous mixture. In the cut which was made for the drainage control channel soil, which was mixed, was exposed. It consisted of masses of lower permeability soil surrounded by remolded loess (see Fig. 51). If this is the nature of the material which forms the immediate trench cap, then water will be able to infiltrate the loessial soils which surround the lower permeability materials.

D.3. Areas of Potential Concentrated Infiltration

Three areas which are susceptible to concentrated infiltration were noted. These areas are identified as PCI-1, PCI-2, and PCI-3 on Plate 4.

PCI-1, located on Trench 3, is an apparent collapse structure (see Chapter II, Section F, Trench 3, and Figs. 8 and 9). It is approximately six feet in diameter and over one foot deep.

PCI-2 located on Trench 7, is an apparent animal borrow (see Chapter II, Section F, Trench 7 and Fig. 17). It is approximately nine inches in diameter and over 1.5 feet deep.

PCI-3 is located along the west end of the north facing transition slope from Trench 14A. It is a 105 foot long crack along the crest of the slope and parallel to the trench. It is open one to two inches. The crack may represent an opening along the contact between the trench wall and the outer backfill material or a slip surface. There was no evidence of sliding the day the observations were made.

D.4 Wells and Steel Pipes

There are numerous wells with PVC casing exposed throughout the site area (for example, Figs. 48 and 50). If any of these casings were broken off, a point of concentrated infiltration could result.

On the north side of Trench 1 there are three corregated steel pipes with concrete covers. These have been covered by steel barrels (Fig. 3). The function and design of these is unknown.

The final disposition of these wells should be determined. If they are allowed to remain, as a minimum protection steel pipes set in concrete should be placed around the wells.

E. EROSION

The reworked loess deposits which form the surficial material throughout the entire site area are highly susceptible to erosion both by wind and running water. Wind erosion does not appear to be a primary concern at the site. The erosion features associated with surface water runoff are herein classified as rills and gullies.

E.1. Rills

The rills are the first evidence of the concentration of sheetflow runoff. They are best developed on the side slopes of many of the trenches, but also occur on the ends of trenches and parallel to the long axis of some trenches. Those rills on side slopes and the ends of trenches have formed as a result of the natural concentration of sheetflow runoff. Those rills which are parallel to the long axis of the trench appear to have developed between rows of vegetation. The rills on the side slopes tend to form at the break in the slope from top of the relatively flat trench caps to the slope area. These features will develop on relatively flat slopes, that is, less than five degrees. Areas of extensive rilling are indicated on Plate 4. A photograph showing typical rills is presented in Fig. 22.

E.2. Gullies

The loose, reworked loessial soils are highly susceptible to gullying. The gullying has occurred on slopes which are

heavily vegetated, slopes which are essentially devoid of vegetation, and in ruts caused by vehicle wheels and tracks. The gullies tend to be as wide at their top as they are deep. In many instances, the head of the gully will be a vertical drop from a rill of six inches to one foot.

Several gullies which are over one foot deep are indicated on Plate 4 and were sketched in from field observations. Several gullies on the transition slope north of Trench 14A disappear into a subsurface channel on the side slope and reappear at a lower elevation. A repair of the lower portion gully G-9 was attempted by placement of crushed limestone along the gully (Fig. 55). The thickness of crushed stone ranges from one inch to four inches. Erosion subsequent to the placement of the stone has resulted in the formation of a one foot deep gully within the broader gully area (Fig. 56).

F. DETAILED DESCRIPTIONS

Detailed descriptions of vegetation, drainage, and erosion are presented for each of the trenches and for selected areas within the fenceline around the perimeter of the site. Photographs are also included which illustrate many of the features described. The descriptions are based upon visual observations and analysis of the topographic map (Plate 1). Estimates are included as to the percentage of vegetation present.

TRENCH 1

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 22, 1980

Dimensions

1) Length - 450 feet
2) Width - 40 feet
3) Depth - 20 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 1 is crowned from very slightly at its west end to on a 10^{o} slope at its east end.

2) Drainage from the west third flows to the recently formed drainage diversion channel. Drainage from the east two-thirds flows down the north trending slope to the north and to the east trending swale along side the roadway to the south.

Vegetation

1) West end to 14350E -- weeds and some grass; 25 to 50 percent cover; 6 to 30 inches high.

2) 14350E to 14450E -- clover, grass and weeds; 80 to 100 percent cover; 6 to 24 inches high.

3) 14450E to east end -- grass; 90 to 100 percent cover; 8 inches high.

TRENCH 1

Cap Erosion

1) Only minor rilling was noted.

Remarks

1) Three corrugated metal pipe piles capped with concrete lids and covered by steel drums were encountered at 12347N/14470E in the vicinity of Trench 1 (see Fig. 3).

FIGURE 1: Trench 1; looking west from its east monument.

FIGURE 2: Trench 1; looking northeast from its west monument; typical thin vegetative cover.

FIGURE 3: Three corrugated metal pipe piles, capped with concrete lids and covered by steel drums; located near 12347N/ 14470E.

TRENCH 2

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 460 feet
2) Width - 60 feet
3) Depth - 25 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 2 is crowned on up to 14° slope at its northeast corner.

2) Drainage from the west third flows to the recently formed drainage diversion channel. Drainage from the east two-thirds flows to east trending swales both north and south of the trench. The southern swale appears to be located 20 feet inside the trench at its east end.

Vegetation

1) West end to 14400E -- weeds; 25 to 75 percent cover; 6 to 18 inches high.

2) 14400E to east end -- grass, clover and weeds; 75 to 90 percent cover; (thinner along tire tracks); 6 to 9 inches high.

TRENCH 2

Cap Erosion

1) West end to 14400E -- primarily minor rilling. Erosion starting in tire tracks in the southwest corner. West of Trench 2: gullying; 2 inches deep; 0.5 foot spacing; trending west. Three 6 inch deep gullies are located in the latter area immediately west of the trench centerline.

2) 14400E to east end -- minor rilling with occasional 2 to 4 inch deep gullies.

Remarks

1) The roadway leading to the center of the site from the east is located at least partially within the north boundary of Trench 2. This roadway crosses Trench 2 near 14400E (see Fig. 5).

FIGURE 4: Trench 2; looking west from its east monument; typical thick vegetative cover.

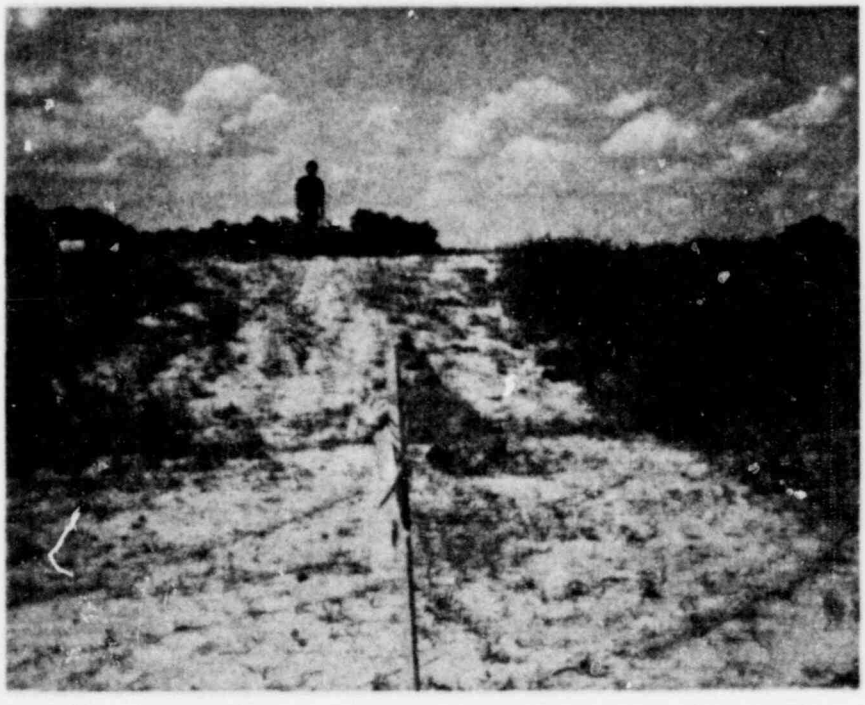

FIGURE 5: Roadway crossing of Trench 2; looking northeast from 12200N/14350E.

TRENCH 3

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 400 feet
2) Width - 55 feet
3) Depth - 25 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) West end to 14500E -- north half, relatively flat area drains to the northwest and the diversion ditch channel; south half drainage towards head of G-9 (see Fig. 7).

2) 14500E to east end -- north half, gentle slope to east trending swale; south half, drainage trends southwest to southeast on the up to 10° slope with a west trending swale located south of Trench 3 draining a portion of this flow to G-9.

Vegetation

1) West end to 14500E -- weeds and grass; 50 to 75 percent cover with thin areas; 6 to 18 inches high.

2) 14500E to east end -- primarily grass; 75 to 90 percent cover; 6 to 9 inches high.

TRENCH 3

Cap Erosion

1) West end to 14500E -- north half, minor rilling with erosion in tire tracks; south half, dense rilling and gullying, up to 12 inches deep, 4 to 12 inch spacing, trending towards the head of G-9.

2) 14500E to east end -- minor rilling.

Remarks

1) PCI-1 collapse structure encountered 12216N/14470E. It is 6 feet in diameter and a maximum of 16 inches deep at its western end (see Fig. 8 and 9).

FIGURE 6: Trench 3; looking west from its east monument.

FIGURE 7: Head of G-9; looking east from Trench 3 west monument; typical weed-vegetative cover.

FIGURE 8: PCI-1; clipboards mark the collapse structure limits.

FIGURE 9: PCI-1, western end; the folding ruler was stuck in the deepest part of the collapse structure.

TRENCH 4

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 22, 1980

Dimensions

1) Length - 280 feet
2) Width - 60 feet
3) Depth - 20 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 4 is located on a northwest to northeast trending, 5^{o} to 10^{o} slope.

2) An east trending swale is located along most of the north trench edge. Swale gullying begins at 14400E.

3) West of Trench 4 the slope trends west to the recently formed drainage diversion channel 1. Gullying here is 6 to 18 inches deep on 5 foot spacings.

Vegetation

1) Northern half, west end to 14350E; southern half, west end to 14500E -- grass and weeds; 10 to 25 percent cover; 6 inches high.

TRENCH 4

2) Northern half, 14450E to east end; southern half, 14500 to east end -- primarily grass; 75+ percent cover; 6 to 10 inches high.

Cap Erosion

1) Gullying; 4 inches deep; 5 to 10 foot spacing, trending north to northwest. Rilling inbetween gullies at northern half, west end to 14350E.

Remarks

1) Plastic sacks were exposed at 12375N/14341E and 12370N/14342E (see Figs. 12 and 13 respectively).

FIGURE 10: Swale north of Trench 4; looking east from 14400E.

FIGURE 11: Trench 4; looking southeast from its west monument.

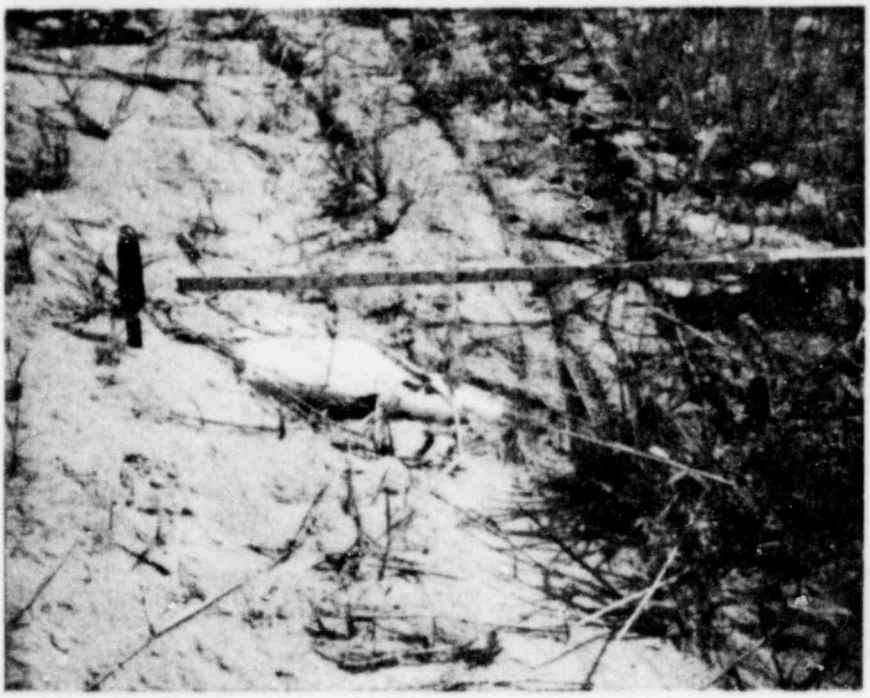

FIGURE 12: Exposed plastic bag; 12375N/14341E.

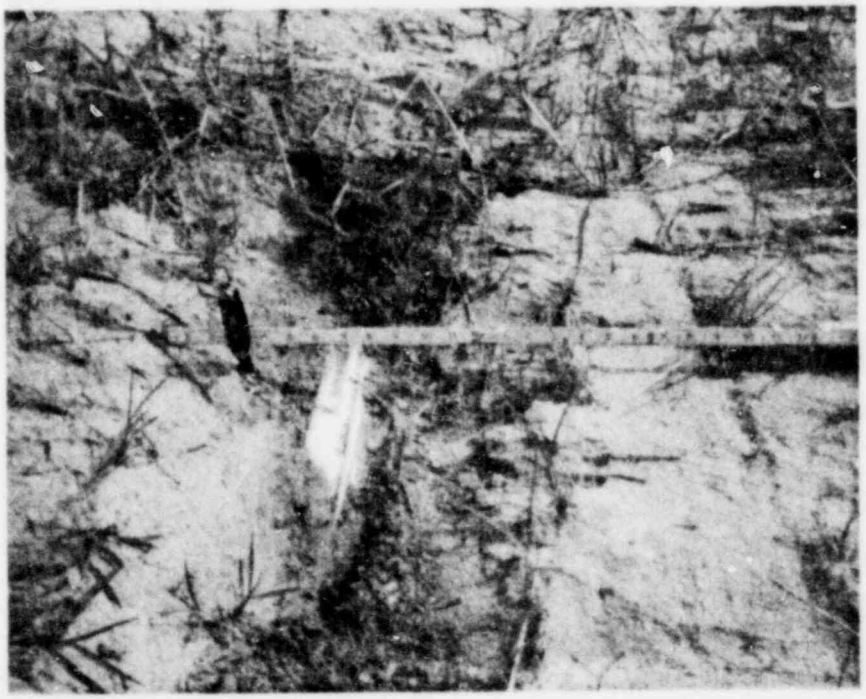

FIGURE 13: Exposed plastic bag; 123470N/14342E.

TRENCH 5

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 350 feet
2) Width - 50 feet
3) Depth - 20 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 5 is crowned 2 to 3 feet.

2) East trending swales are located north and south of Trench 5; these form the heads of the north and south branches of G-7.

3) Only at the far west end do the slope and swales trend west.

Vegetation

1) Grass; 75+ percent cover; thinned in areas scarred by the tractor; 4 inches high (recently mowed).

Cap Erosion

1) Minor rilling, sometimes in north-south trending tire tracks.

FIGURE 14: Trench 5; looking east from the west monument; typical swales located to either side of the cap crown.

TRENCH 6

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 390 feet
2) Width - 45 feet
3) Depth - 20 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 6 is crowned 2 to 3 feet.

2) The drainage swale to the north trends east, as does the east half of the relatively flat drainage swale to the south. The far west portion of the north drainage swale and the west half of the south drainage swale trend west.

Vegetation

1) Primarily grass with clover; 75+ percent cover; 4 inches high (recently mowed).

Cap Erosion

1) Minor rilling, sometimes in north-south trending tire tracks.

FIGURE 15: Trench 6; locking east from its west monument; typical grass and clover vegetative cover.

TRENCH 7

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 400 feet
2) Width - 19 to 41 feet
3) Depth - 17 to 23 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 7 is crowned 2 to 3 feet.

2) The drainage swale to the north trends east for its relatively flat east half, and west for its west half. Drainage to the south trends southwest and down the slople in that area.

3) Drainage from west trending swales passes immediately west of Trench 7. Gullying begins in this area at 11900N (southwest of trench corner).

Vegetation

1) Primarily grass; 75 to 100 percent cover (thin in areas scarred by the tractor); 4 inches high (recently mowed).

TRENCH 7

Cap Erosion

1) Minor rilling sometimes in north-south trending tire tracks.

Remarks

1) PCI-2, 9 inch diameter by 20 inch deep animal burrow; located at 11908N/14057E.

FIGURE 16: Trench 7; looking east from its west monument.

FIGURE 17: PCI-2; animal burrow located at 11908N/14057E.

FIGURE 16: Trench 7; looking east from its west monument.

FIGURE 17: PCI-2; animal burrow located at 11908N/14057E.

FIGURE 18: Trench 8; looking east from its west monument.

TRENCHES 8A AND 8B

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 22, 1980

Dimensions	8A	8B
1) Length	35 feet	51 feet
2) Width	8 feet	8 feet
3) Depth	18 feet	18 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) The trench area is relatively flat, draining to the north and west.

2) The slope angle increases at the trench area limits. West of Trench 8B the west trending slope to the drainage diversion channel has gullies 2 to 4 inches deep on 6 inch spacings. The area north of the trenches is the head for gullying on Trench 24.

Vegetation

1) Primarily grass with weeds; 25 to 50 percent cover; 6 inches high.

Cap Erosion

1) Minor rilling.

FIGURE 19: Trenches 8A and 8B; looking north from their southern limits.

FIGURE 20: Gullying west of Trenches 8A and 8B on slope trending towards the drainage diversion channels.

TRENCH 9

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 350 feet
2) Width - 58 feet
3) Depth - 22 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 9 is crowned 1 to 2 feet.

2) Drainage flows to swales located north and south of the trench. These swales are primarily east trending, being west trending at the west end of the trench. They both have relatively low bottom slopes.

Vegetation

1) Grass, clover and weeds; 50 to 75 percent cover; locally thin along tiremarks; 4 inches high (recently mowed).

Cap Erosion

1) Minor rilling.

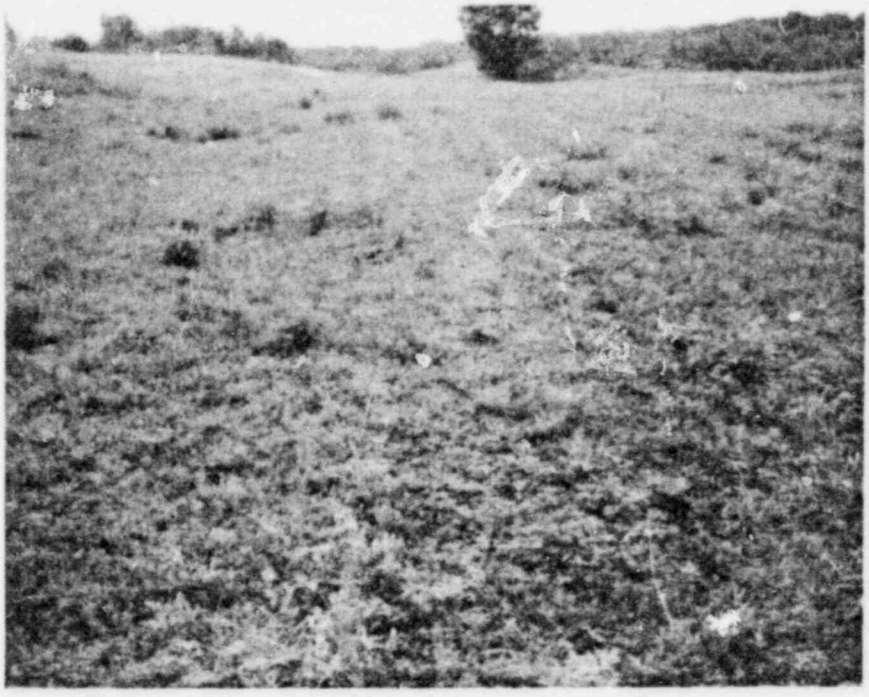

FIGURE 21: Trench 9; looking east from its west end.

TRENCH 10

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 130 feet
2) Width - 17 feet
3) Depth - 15 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 10 is crowned on a 6^{o} slope.

2) Drainage to the northeast flows downslope to DC-2. Drainage to the southwest flows to the flat area that forms the head of the southern branch of G-7 (north half), and to G-8 (south half).

Vegetation

1) Grass and weeds; 50 to 75 percent cover; 4 inches high (recently mowed).

Cap Erosion

1) Northeast side -- gullying; 2 to 3 inches deep; 2 to 4 foot spacings; trending east.

2) Southwest side, north half -- minor rilling.

3) Southwest side, south half -- G-8 consists of a 4 inch deep gully which passes near the center of Trench 10 at its southeast end. Minor rilling leads to this gully.

FIGURE 22: Trench 10; looking southeast from its northwest end; typical rilling.

FIGURE 23: G-8 at the southeast end of Trench 10.

TRENCH 11

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 354 feet
2) Width - 40 feet
3) Depth - 20 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 11 is located on up to a 10° slope. This slope generally trends south to southeast at the trench east end.

2) At the northwest corner of the trench, a portion of the drainage flows north to the swale located south of Trench 3.

Vegetation

1) West end to 14700E -- weeds and dead grass; less than 25 percent cover; 12 inches high.

2) 14700E to 14750E -- grass and weeds; 50 to 60 percent cover; 6 to 18 inches high.

3) 14750E to east end -- grass and weeds; 75+ percent cover; 6 to 18 inches hgih.

TRENCH 11

Cap Erosion

1) West end to 14700E -- gullying; primarily 3 inches but up to 12 inches deep; 2 to 5 foot spacing; trending south.

2) 14700E to 14750E -- gullying; 3 to 6 inches deep; 3 to 5 foot spacing; trending south.

3) 14750E to east end -- gullying; up to 12 inches deep; 3 to 5 foot spacings; trending south to southeast.

FIGURE 24: Trench 11; looking east from its west end.

TRENCH 14

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 580 feet
2) Width - 54 feet
3) Depth - 25 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 14 is crowned 2 to 3 feet.

2) Drainage to the north is collected in a swale which trends east and to the head of the recently formed drainage diversion channel. Drainage to the south and across the far east end of the trench flows down a south trending transition slope to the swale north of Trench 9 and G-6.

3) Following is a general description of the transition slopes south of Trench 14:

   a) west end to 14000E -- 20° up to 5 foot high south trending slope; 75 percent cover of up to 30 inch high grass; gullying, 2 to 4 inches deep, 1 to 4 foot spacing; occasional small slope slides.

   b) 14000E to 14200E -- low mound seperates the north and south branches of G-6 in this area; north branch which is located south of Trench 14 is up to 20 inches deep; 50 percent cover of clover and weeds which is 6 inches high (recently mowed); minor rilling.

TRENCH 14

c) 14200E to east end -- 25° up to 8 foot high south trending slope; 75 percent cover of 24 inch high grass, some bare spots; general gullying, 3 to 6 inches deep, 1 foot spacing; G-5, 36 inch deep gully located 14280E (see Fig. 26).

Vegetation

1) Weeds and grass; 25 to 50 percent cover; up to 12 inches high.

Cap Erosion

1) Minor rilling with occasional 2 inch deep gullies; gullies in tire tracks.

2) West of Trench 14 on the west trending slope -- gullying; 2 to 4 inches deep; 0.5 to 1 foot spacing (see Fig. 29).

FIGURE 25: Trenches 14 and 14A; looking northwest from east end of Trench 14.

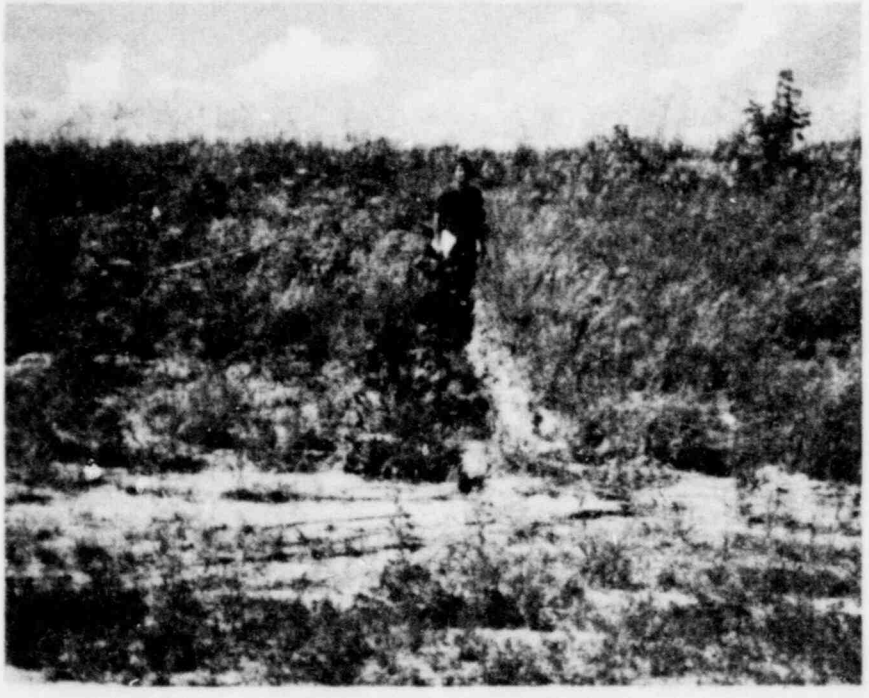

FIGURE 26: G-5; looking north at the transition slope south of the east end of Trench 14.

TRENCH 14A

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 475 feet
2) Width - 48 feet
3) Depth - 26 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 14A is crowned 2 to 3 feet (see Fig. 25).

2) Drainage to the south is collected in a swale which trends east to the head of the recently formed drainage diversion channel. Drainage to the north collects in small, east trending gullies which flow towards and down the north trending slope located north of Trench 14.

3) Following is a general description of the transition slope north of Trench 14A -- the slope extends along the entire length of the trench, and at its east end bends north and extends to the end of the drainage diversion channel at west of Trench 23; the steep part of the slope is over 20 feet high on a 20° angle (see Fig. 26); 75 percent cover of up to 30 inch high grass except at far north end (see Fig. 27, typical gullying on this slope); general gullying, 4 to 12 inches deep, 1 foot spacing; some gullies flow beneath the surface for short distances.

TRENCH 14A

4) Major gullies and a crack noted on the transition slope north of Trench 14A:

   a) G-2, 13880E, 6 inches wide and 36 inches deep.

   b) G-3, 13967E, several 12 inch deep gullies.

   c) G-4, at bend in transition slope, two 36 inch wide by 30 inch deep gullies trending northwest meet at 12400N/14200E.

   d) PCI-3, thin vertical crack at the top of the slope extends from 13862E to 13967E.

Vegetation

1) Grass and weeds; 0 to 25 percent cover; 6 to 12 inches high.

Cap Erosion

1) Minor rilling with occasional 2 inch deep gullies.

2) West of Trench 14A on the west trending slope -- gullying, 3 inches deep, 6 inch spacing (see Fig. 29).

FIGURE 27: Transition slope north of Trench 14A; figure standing near 12400N/14100E.

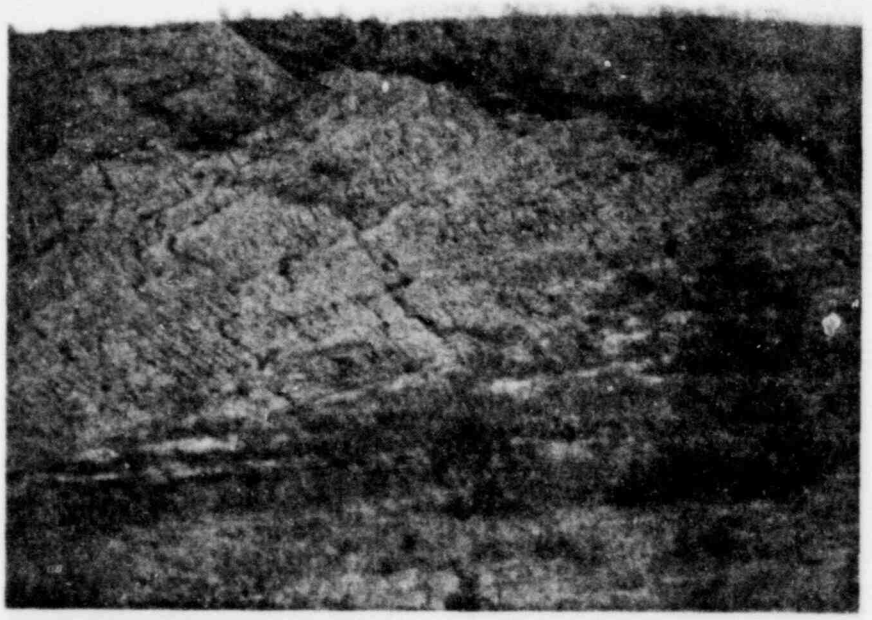

FIGURE 28: Transition slope, north bend, near 12600N; gullying in bare area typical of this slope.

TRENCH 18

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Dimensions

1) Length - 320 feet
2) Width - 70 feet
3) Depth - 18 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 18 is crowned 2 to 3 feet.

2) Drainage to the north flows as sheetwash or in various swales to DC-1, generally trending northeast. Drainage to the south collects in S-1 which flows east and north along the base of the transition slope north of trench 14A to DC-1.

Vegetation

1) Grass, clover and weed; generally 25 percent cover, but 50 percent in areas; 6 to 12 inches high.

Cap Erosion

1) Minor rilling with local gullying (2 to 4 inches deep on 5 to 10 foot spacing).

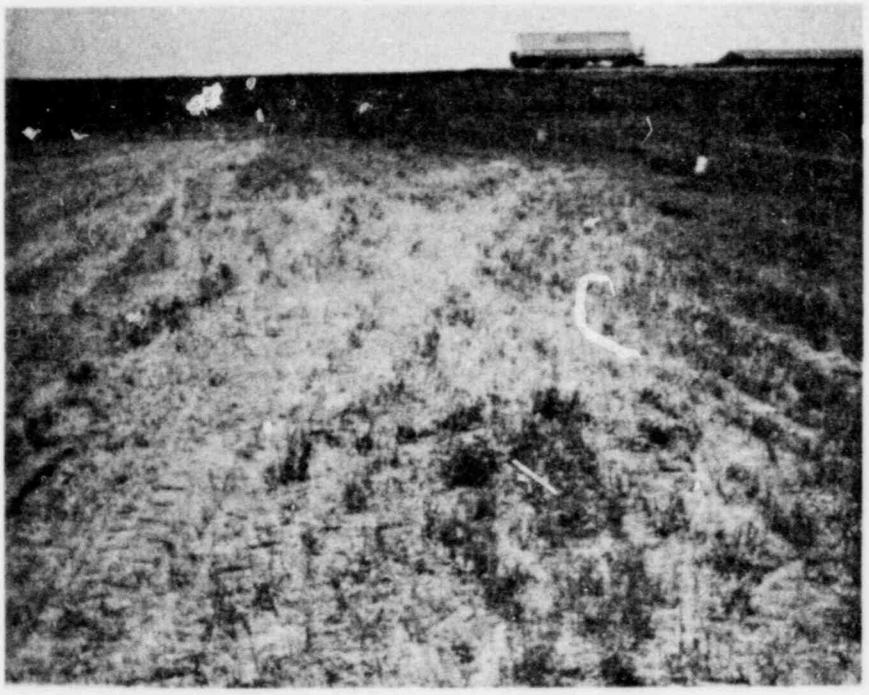

FIGURE 30: Trench 18, looking west from its east end.

TRENCH 23

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 22, 1980

Dimensions

1) Length - 440 feet
2) Width - 54 feet
3) Depth - 18 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 23 is located on a 7°, north trending slope.

2) Drainage is generally to the north towards the wooded area in the northeast corner of the site. At the far west end, drainage trends northwest. G-1 located here is 8 inches deep (see Fig. 32). At the far east end the trench is slightly crowned, and an east tending swale (S-2) has formed along the south limits of the trench.

Vegetation

1) Grass, alfalfa and clover (in banded areas); 50 to 75 percent cover; 6 to 12 inches high.

Cap Erosion

1) West end to 14400E -- gully along equipment tracks; up to 12 inches deep (thin vegetation here).

TRENCH 23

2) 14400E to 14600E -- occasional gullying; 6 inch deep by 30 foot long gully noted at 14465E.

3) 14600 to east end -- minor rilling at far east end only and gullying; 4 inches deep; 5 to 10 foot spacing.

FIGURE 31: Trench 23; looking east from 14400E.

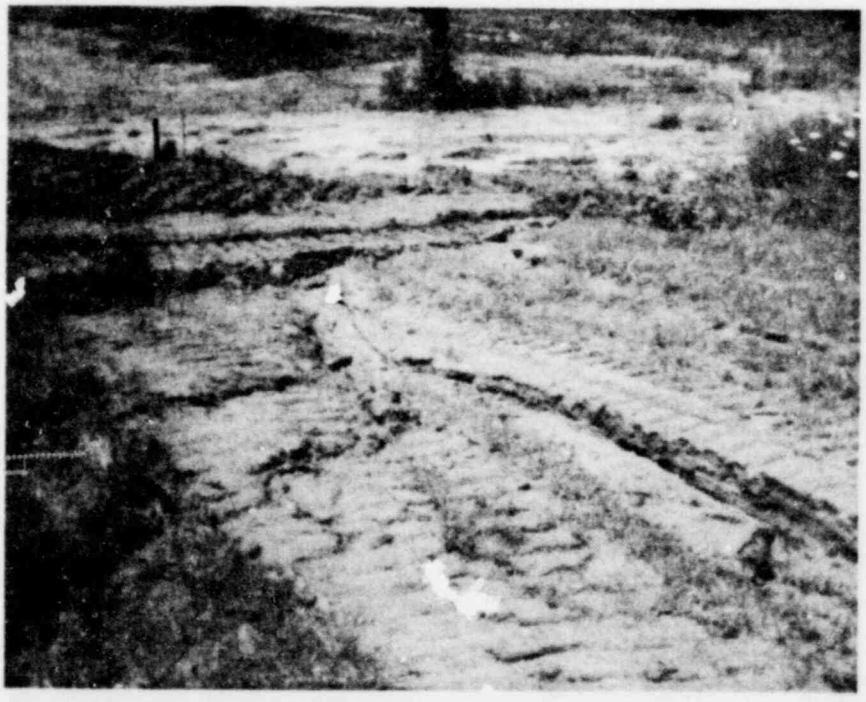

FIGURE 32: G-1; looking northwest from the west end of Trench 23.

TRENCH 24

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 22, 1980

Dimensions

1) Length - 455 feet
2) Width - 62 feet
3) Depth - 17 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 24 is located on a north trending 10° slope.

2) Drainage is generally to the north towards Trench 23. At the far east end the trench is slightly crowned, and on east trending swale (S-3) has formed within the south limits of the trench. S-2 intercepts north drainage in this area.

Vegetation

1) Grass, clover (patches) and alfalfa; 50 to 85 percent cover (thin at both ends); 6 to 12 inches high.

Cap Erosion

1) West end to 14420E -- gullying from the south to north ends of the trench; 8 to 12 inches deep; 5 foot spacing; north trending (see Fig. 34 close-up at T-24 west monument; and Fig. 35, general view).

TRENCH 24

2) 14420E to 14600E -- gullying from the middle to the north end of the trench; 4 inches deep; 2 to 3 foot spacing; north trending.

3) 14600E to east end -- densely rilled and gullied from S-3 north; 2 to 4 inches deep; 0.5 to 1 foot spacing; north trending (see Fig. 35).

FIGURE 33: Trench 24; looking east from its west end.

FIGURE 34: Erosion at Trench 24 west monument.

FIGURE 35: Trench 24; looking south from 14375E.

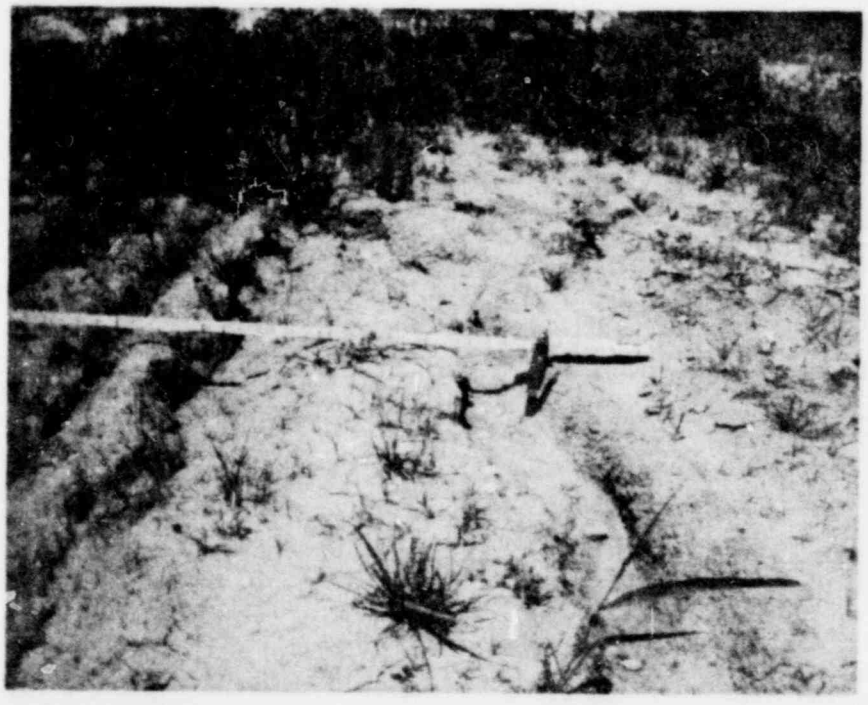

FIGURE 36: Trench 24; rilling and gullying at its northeast corner.

TRENCH 25

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 22, 1980

Dimensions

1) Length - 300 feet
2) Width - 8 feet
3) Depth - 18 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 25 is slightly crowned together with Trench 8. Drainage to east and south towards the head of S-4 except at the far west end where drainage trends west towards the recently formed drainage diversion channel.

Vegetation

1) End quarters -- primarily grass; 25 to 50 percent cover (0 to 24 in some areas); 3 to 6 inches high.

2) Middle half -- primarily grass; 40 to 75 percent cover with thin areas; 3 to 6 inches high.

Cap Erosion

1) Minor rilling trending primarily east. 2 inch deep rilling trend west at the far west end.

FIGURE 37: Trench 25; looking east from its west end.

TRENCH 25C

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 22, 1980

Dimensions

1) Length - 218 feet
2) Width - 35 feet
3) Depth - 18 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 24 is slightly crowned except at its east end which slopes northeast.

Vegetation

1) Grass and clover; primarily 50 percent cover, 50 to 75 percent in areas; 6 to 12 inches high.

Cap Erosion

1) West end to 14750E -- minor rilling trending north and south.

2) 14750E to east end -- gullying; 4 to 10 inches deep; 5 foot spacing; trending northeast.

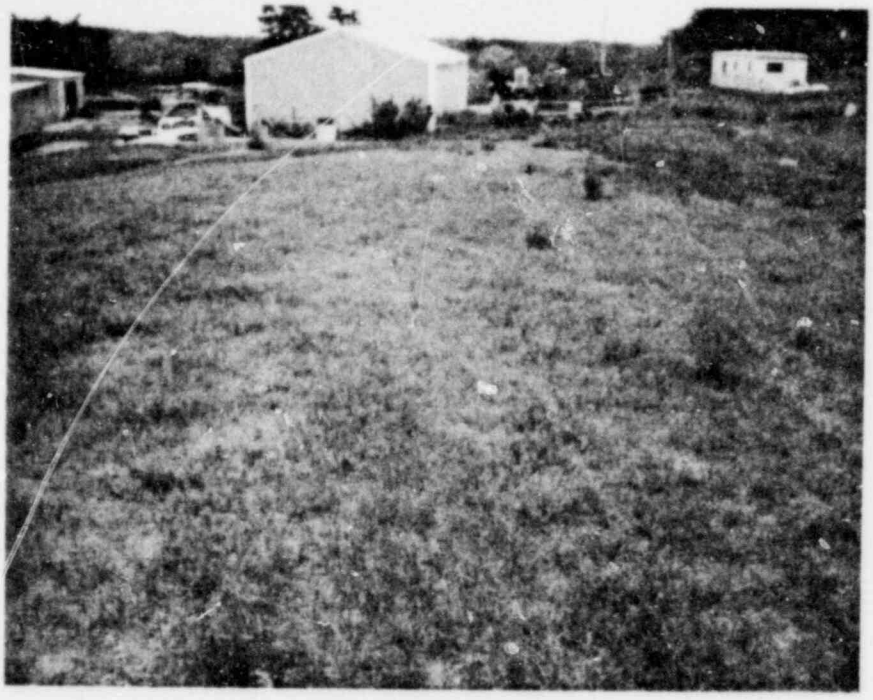

FIGURE 38: Trench 25C looking east from its west end.

TRENCH 26

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 22, 1980

Dimensions

1) Length - 180 feet
2) Width - 64 feet
3) Depth - 23 feet

Soil

1) The surface soils consist primarily of a reworked silt.

Drainage

1) Trench 26 is located on a generally northeast trending 8° slope.

2) Drainage is to the north to northeast, and is intercepted by S-4 at the north trench limits. This swale is gullied (see Fig. 40).

Vegetation

1) North third, entire trench; middle third, 14700E to east end -- weeds and alfalfa; 50 (east end) to 75 percent cover; 6 to 12 inches high.

2) Middle third, entire trench, west end to 14700E; south third, entire trench -- grass with some clover, 80 percent cover, 8 to 12 inches high.

TRENCH 26

Cap Erosion

1) North third, entire trench; middle third, 14700E to east end -- gullying; 4 to 6 inches deep; 1 to 3 foot spacing; trending north to northeast.

2) Middle third, west end to 14700E; south third, entire trench -- gullying; 4 inches deep; 5 to 10 foot spacing; trending north; animal burrows noted.

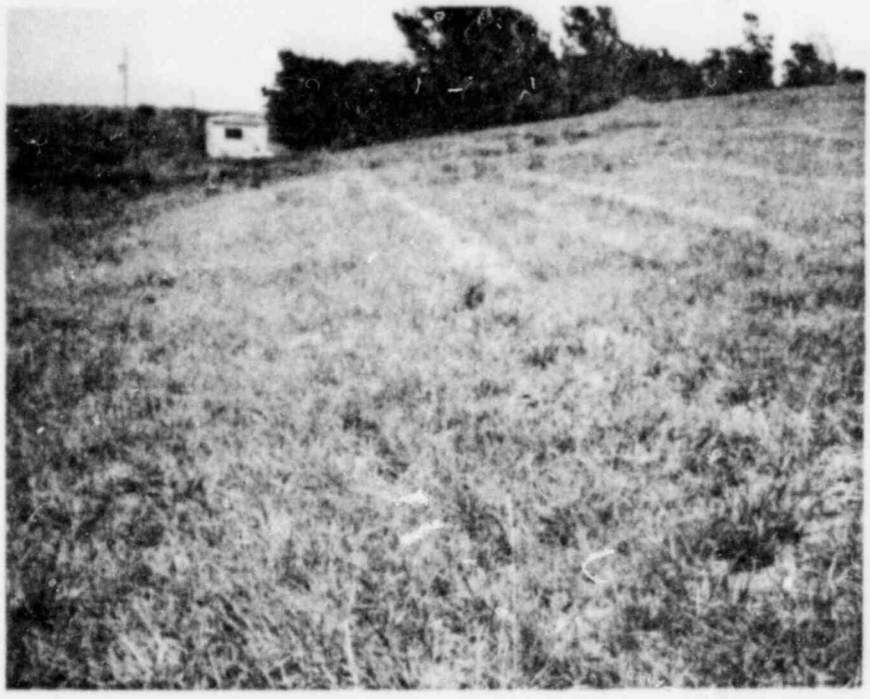

FIGURE 39: Trench 26; looking east from its west end.

FIGURE 40: S-4; looking west from the east end of Trench 26.

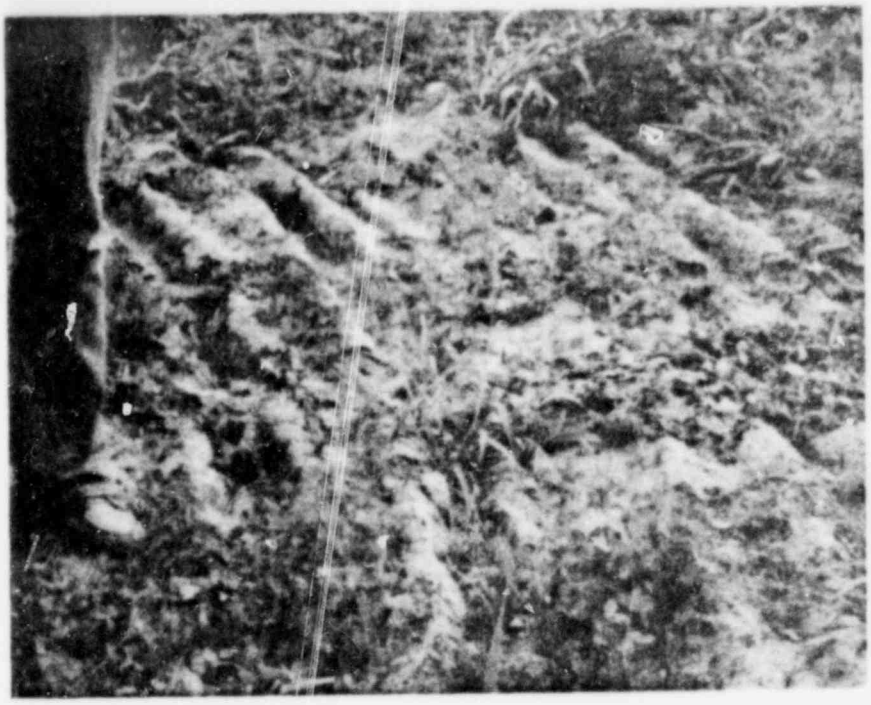

FIGURE 41: Trench 26; rills and gullies in its northeast corner.

SITE SOUTHWEST CORNER

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Figure 42 shows the tire tracks left by the tractor used to mow the site. The tracks shown are located north of the northwest corner of Trench 5, where the tractor turns around. As indicated, the tracks scar the vegetative cover and rut the surface.

Figure 43 shows the area located south of Trench 7. This southwest trending 10° slope is covered by a thick, grass vegetative cover, and has only minor rilling and occasional gullying. The trees shown are located outside the trench limits.

FIGURE 42: Tractor tire tracks located north of the northwest corner of Trench 5.

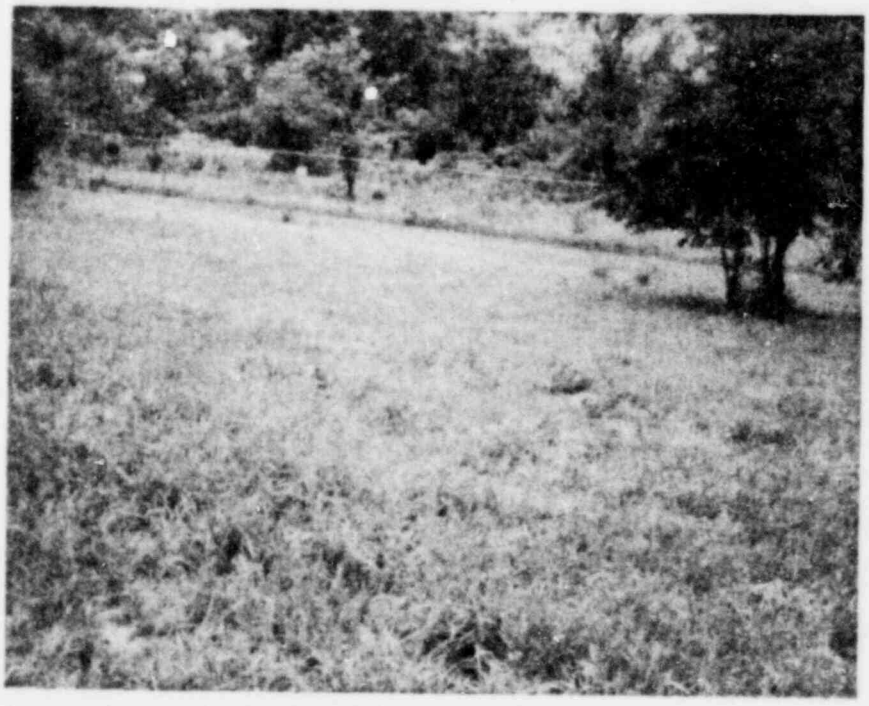

FIGURE 43: Slope at site southwest corner; looking southeast from the west end of Trench 7.

SITE NORTH SIDE

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Drainage from the site's north side generally flows towards the wooded area located in its northeast corner (see Fig. 44, background). This wooded area occupies a relatively flat area that trends northeast and offsite.

The site's northwest corner in the vicinity of Trench 18 is relatively low (see Fig. 45). DC-1 and S-1 which drain the areas north and south of Trench 18 respectively, both flow towards the wooded area discussed above. Vegetative cover between the trench and these drainageways is generally 25 to 50 percent, while beyond them it increases to nearer 75 percent.

DC-1 starts at a roadway culvert located northwest and outside of the northwest fence corner (see Fig. 46). This drainage channel then flows beneath the fence and along the north site limits (see Fig. 47).

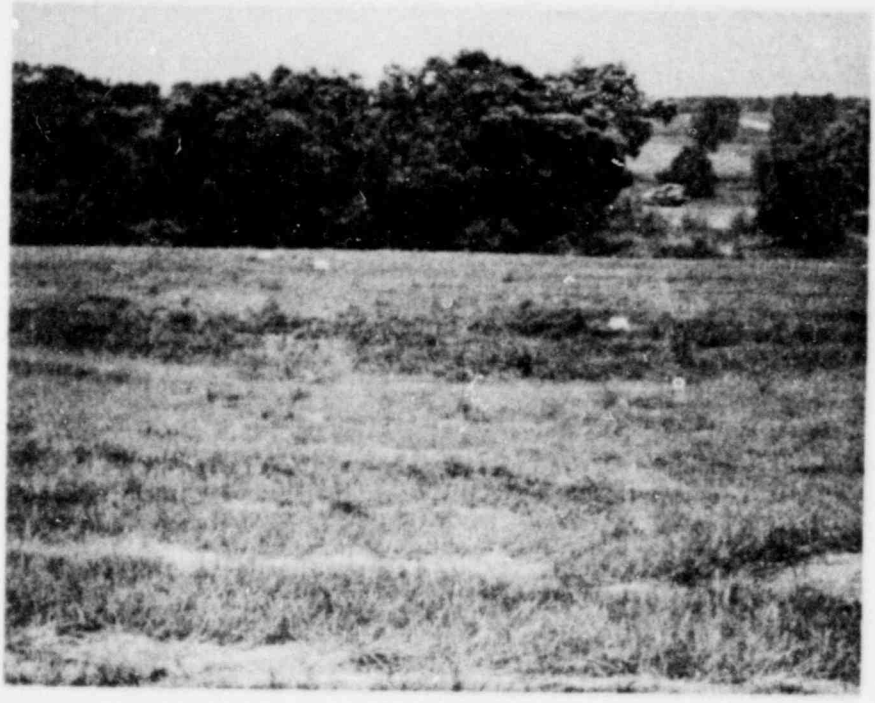

FIGURE 44: Site northeast corner; looking north from the middle of Trench 1.

FIGURE 45: Site northwest corner; looking northwest from the north bend in the transition slope north of Trench 14A.

FIGURE 46: Roadway culvert which forms the head of DC-1; looking northwest beyond the northwest fence corner.

FIGURE 47: DC-1; looking east from the northwest site corner.

DRAINAGE DIVERSION CHANNEL

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

During our site investigation a drainage diversion channel (DDC-1) was being formed to drain the center of the site to the north. This channel runs from 12200N/14300E to the southwest corner of the wooded area located in the site's northeast corner. It is 4 feet wide at the bottom with sloped sides (see Figures 48 through 50). Material exposed in its cuts consisted primarily of silty soils with some clay (see Fig. 51).

FIGURE 48: DDC-1; looking north from 12200N/14315E.

FIGURE 49: DDC-1; looking north from the red flagged stake at the right side of the channel bend shown in Fig. 48.

FIGURE 50: DDC-1; looking north from west of Trench 8B.

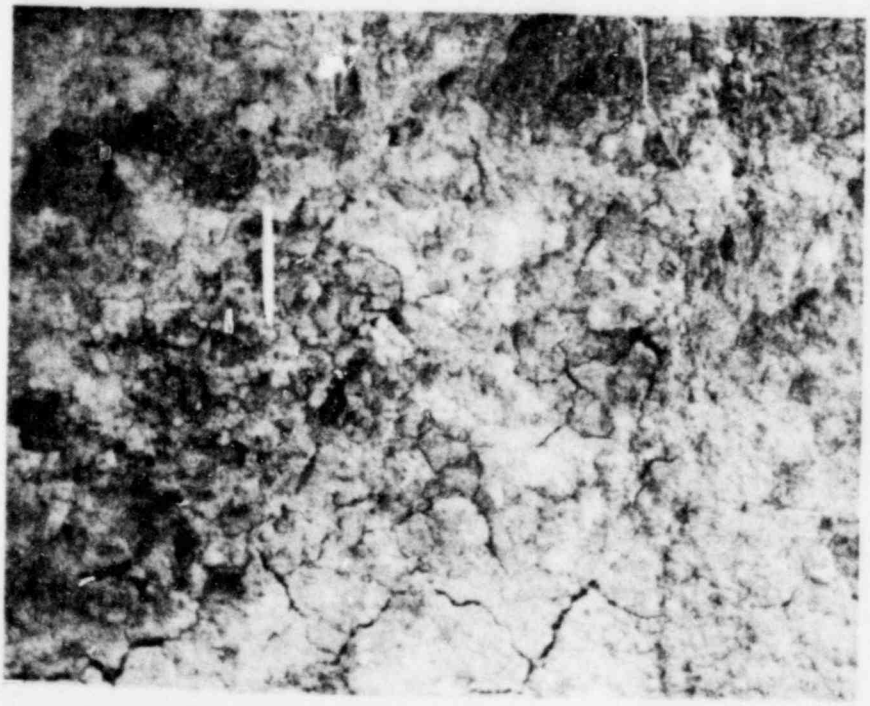

FIGURE 51: Cut face in DDC-1; east slope at 12570N/14300E; redder materials are clay soils.

SITE SOUTHEAST CORNER

Field Observations
Sheffield Low-Level Waste Disposal Facility
Sheffield, Illinois

Personnel: George E. Heim and Michael V. Machalinski
Date : July 23, 1980

Drainage from the site's southeast quarter generally flows towards the wooded area located in its southeast corner (DC-2). Gullying has occured along many of the drainageways flowing there as discussed below.

North of DC-2 and south of Trench 11 between G-9 and the east fence line is a south trending 15° slope. This slope has a 50 percent grass and clover cover. Gullying here is generally 2 to 10 inches deep on 2 foot spacing, with occasional 18 to 30 inch deep gullies at the slope's lower end.

West of DC-2 is a bowl-like depression which drains towards the head of DC-2. The limits of gullying in this area, which is up to 12 inches deep on up to 0.5 foot spacing, are shown on Plate 4 (see Fig. 52). The north quarter of this area has a zero to 10 percent grass and weed cover, the middle half a 50 percent grass and weed cover, and the southern quarter a 50+ percent grass and weed cover with thin areas.

G-6 and G-7 lead to DC-2 from the west, north of the above depression and south of the transition slope south of Trench 14. The south branch of G-6 and both branches of G-7 are generally 6 to 12 inches deep and up to 30 inches wide (see Fig. 53). The north branch of G-6 is generally 20 inches deep. There is a 50 to 75 percent grass cover in the area of the gullies.

G-9 extends from the southern limit of Trench 3 to the head of DC-2. Its north half is generally 24 inches deep and passes immediately west of Trench 11 (see Fig. 54). Its southern half is lined with 1 to 4 inch diameter gravel for a depth of 1 to 4 inches and a width of 17 feet (see Fig. 55, background). This gravel lined portion has an eroded channel 12 inches deep and 36 inches wide (Fig. 56).

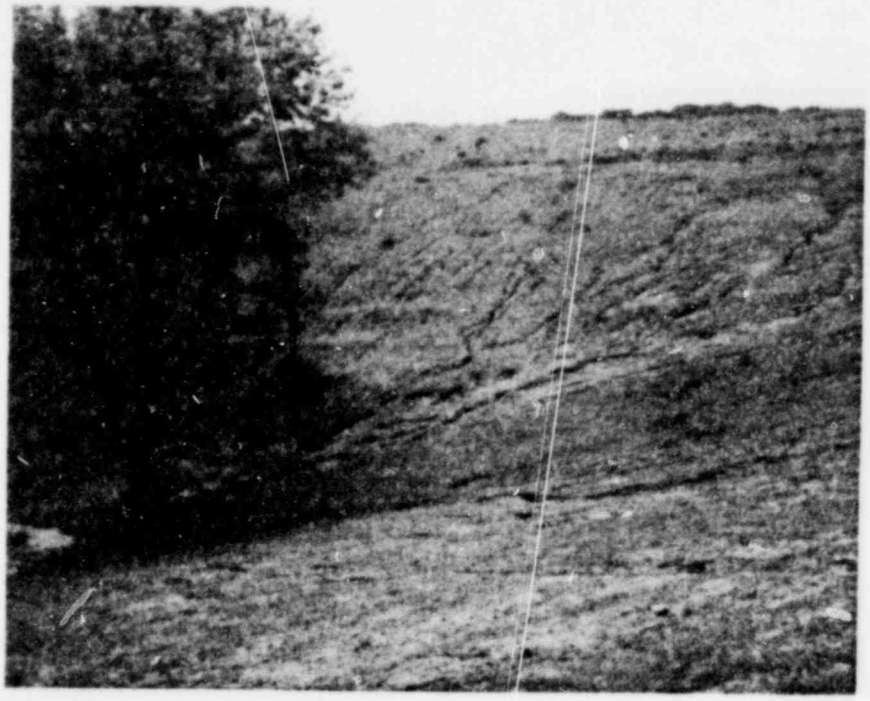

FIGURE 52: Bowl-like depression west of DC-2; looking southwest from the top of the gravel lined section of G-9.

FIGURE 53: G-7 north branch; looking northeast from southeast of Trench 9; G-6 in left background at base of slope.

FIGURE 54: G-9; looking south from 12155N/14440E.

FIGURE 55: Bowl-like depression west of DC-2, and G-9; looking northeast from the southeast end of Trench 10.

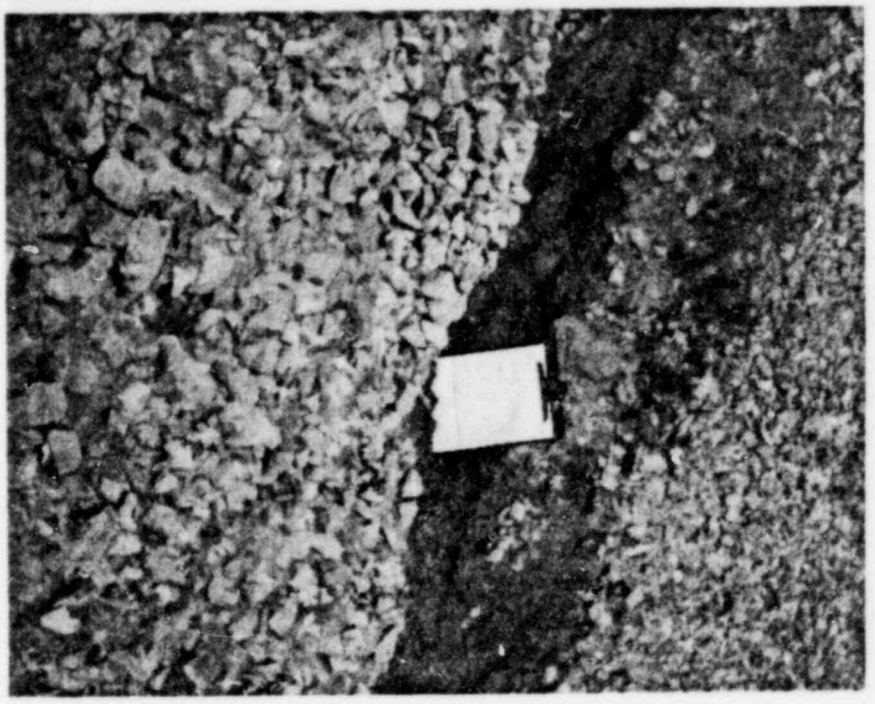

FIGURE 56: G-9; eroded gully in gravel lined section.

III - POSSIBLE REMEDIAL ACTION

A. INFILTRATION

A.1. General

The reworked loess which forms the surficial soil throughout the plant site area is an ineffective barrier to the direct infiltration of percipitation. It will be difficult to reduce the infiltration rates of this material without undertaking some major engineering measures. Measures which may be considered include:

1) Mixing the upper surface layer with bentonite.

2) Mixing the upper layer with cement to form a soil/cement mixture.

3) Using chemical additives.

4) Covering the upper surface with asphalt.

5) Covering the upper surface with a plastic liner.

Of these methods, mixing with bentonite or chemical additives is perhaps the most desirable because it enables one to inspect the area after application and detect the areas of erosion. The soil/cement, asphalt, or artificial liner material will form essentially impervious caps. However, if moisture does get through these materials, then channeling could develop underneath them and be undetected during visual inspections of the area.

It is well documented in the literature that loessial soils are susceptible to the development of internal drainage channels and caves. One such feature was noted on the north transition slope by Trench 14A.

According to Foster and Erickson, 1980, (Ref. 1) several of the trenches are constructed partially or entirely within the loess sequence at the site or in loess fill as shown on their figures:

Figure 5	Trench 18
Figure 6	Trench 14A Trench 14
Figure 8	Trench 5 Trench 9 Trench 11

Figure 9	Trench 14 Trench 1 Trench 26
Figure 10	Trench 6 Trench 7
Figure 12	Trench 25C Trench 26 Trench 1 Trench 2 Trench 3 Trench 11

It is our understanding that relatively impervious material was used to construct the trench floors, walls, and top. If this is correct, then in those areas where the impervious materials are in contact either with the natural loess in the site area or with backfilled loess, channelling could occur due to the concentration of moisture at those contacts. First visible evidence of such features would probably be a collapse of the surface. Feature PCI-1 may be the result of such a collapse. No such features were noted during this inspection with the possible exception of PCI-1. Undisturbed loess is subject to hydroconsolidation. This process was not noted in the site area but it could occur if drainage is directed to areas of undisturbed loess. Evidence of the occurance of this process would be the lowering of the ground surface where the loess has become saturated. This could cause changes in planned drainage patterns.

The surface water runoff which is collected in the swales between the trenches should not be a source of added infiltration if the impervious layer of backfill material was placed beneath the swales. However, if the impervious layer is absent, then infiltration may be greater in these areas. Such infiltration could be reduced by lining the swales with an impervious liner such as clay or plastic.

A.2. Areas of Potential Concentrated Infiltration

Three areas of potential concentrated infiltration were noted during the field inspection. These areas are identified on Plate 4 as PCI-1 on Trench 3, PCI-2 on Trench 7, and PCI-3 on the north transition side slope to Trench 14A, and are discussed in Chapter II, Section F. It is recommended that each of these areas be carefully hand excavated. Each of the excavations should be monitored continuously by a trained

geotechnical person. Photographs should be taken to document the nature of these features. The excavation for PCI-1 and PCI-2 should extend at least three feet beyond the outer limits of the feature and to a depth of at least three feet below the last evidence of the feature unless the evidence of the feature terminates at the contact of impervious backfill. The final decision should be made by the geotechnical person monitoring the excavation. Feature PCI-3 should be excavated to a width which can be safely entered by the excavating crew and the representative monitoring the excavation. The excavation should extend at least three feet below the point of obvious opening of the crack. It should be determined if the hairline crack extends below the open crack. Such a feature could indicate that this crack represents a slide surface and that the entire mass may be unstable.

Backfilling requirements for the excavation will depend upon the observations made during excavation. As a minimum it is recommended that a layer of bentonite at least one foot thick after tamping be placed at the base of the excavations. The material overlying the bentonite should also be tamped. Another one foot thick tamped layer of bentonite should be placed two feet below grade elevation. The upper two feet should then be backfilled with reworked loess.

A.3. Wells and Steel Pipes

It is recommended that wells and steel pipes desined for abandonment have casings cut-off two feet below ground surface, be backfilled with concrete using the tremie method, capped, backfilled above the cap with six inches of concrete which extends a minimum of two feet from the well or pipe, place a six inch layer of tamped bentonite over the concrete, and place one foot of reworked loess in the remaining portion of the hole to bring the excavation back to grade level. The area should then be fertilized and seeded.

B. EROSION

B.1. Rills

Rills are the result of initial channellization of surface runoff. Areas that are heavily rilled should be regraded by a vehicle that can drag a chain mat to remove any impressions caused by the vehicle wheels or tracks. Grading should be along the contour. Areas that are regraded should be fertilized, seeded, and mulched as quickly as possible.

In all likelihood it would be impossible to stop rilling completely. Periodic inspection of the site should identify those areas where rilling is developing. Depending upon the degree of development and orientation of these features, some regrading or reseeding may be necessary on a periodic basis.

Generally the rilling is concentrated on the side slopes and end slopes of the trench caps. Those trenches which have well developed rills are: 1, 2, 4, 11, 14, 14A, 23, 24, 25, and 26.

B.2. Gullies

There are several prominent gullies developed on the site and many lesser gullies. The promenient gullies are those identified on Plate 4. These gullies should be backfilled with soil material that is tamped into place. The area immediately above the head of the gully should be inspected to determine if some regrading is necessary to direct the surface runoff away from the area so as to prevent concentration of flow in the gully area. The backfilled material should be fertilized, reseeded, and mulched.

Gullies G-1, G-6, G-7, and G-9 appear to be fairly well defined drainageways that have developed at the site. We recommend that these gullies be hand cleaned, removing irregularities and any vegetation that may be present. The gully floor should then be tamped and backfilled with crushed rock. The thickness of crushed rock should equal the depth of the gully.

B.3. Swales

Swales S-1, S-2, S-3, and S-4 should be cleared of vegetation, reshaped as necessary, tamped, and backfilled with at least six inches of crushed rock. The width of the backfill material should be a minimum of three feet.

B.4. Slopes

The following slopes are steep and therefore very susceptible to erosion by surface runoff: transition slope north of Trench 14A (this includes the northtrending portion of the slope at the eastern end up to the western end of Trench 23) and the transition slopes south of Trench 14 at the eastern and western ends of the trench.

It is recommended that these slopes either be regraded or backfilled and regraded so that the final slope is 4:1. Final slopes should be fertilized, seeded, and mulched.

Severe gullying is occurring along the natural slope at the south end of the site adjacent to DC-2. It is recommended that a gravel lined drain be constructed near the crest of the slope to intercept surface water. The drain should be graded to lead into DC-2. The interception will reduce the rate of development of the gullies.

B.5. Trench 4

The area where plastic is exposed at the surface should be hand excavated to determine if this plastic is a container of low level radio active waste. If it is found that the plastic is a low level waste container then the loess cover on this trench should be removed and the trench cap should be reconstructed in accordance with specifications. If the plastic does not represent a storage container, it should be removed so vegetation will grow in this area.

B.6. Vegetation

Vegetation may be used to control erosion in the site area. Vegetation, however, will not completely prevent erosion, therefore periodic inspections and repairs should be anticipated.

Discussions regarding vegetation were held with Donald Pretzsch, District Conservationist, U.S. Department of Agriculture, Soil Conservation Service, Princeton, Illinois (815-879-5251). Mr. Pretzsch stated:

1. The soils should be analyzed to determine fertilizing requirements. The pH should be about 6.5. Limestone should be added if required. Minimum fertilizer per acre should be 120 pounds each of nitrogen, potassium, and potash.

2. Fertilizer should be incorporated into the soil by discing.

3. The seed bed should be properly placed. The seed should be tamped one quarter to one half inch deep. This can be accomplished with a Brillion seeder. If rills are left after seeding they should be removed by dragging a chain mat.

4. Planting should be done in the late spring or early fall.

5. Cool season grasses are recommended. These include: Brome, Fescule, and Blue Grass. These grasses sprout early in spring, have relatively shallow roots, and are relatively inexpensive.

6. Warm season grasses, which appear later in the year, probably should be avoided because of their deep root systems. These types of grasses may develop roots up to ten feet deep.

7. After planting seed, mulching is required. Mulch may consist of straw or wood chips, possibly in asphalt mix.

8. Vegetation which is properly placed and fertilized should be well established within one year.

9. Bare spots should be refertilized, reseeded, and mulched.

10. There is no reason to mow this site other than for aesthetics. It is recommended that mowing be done perhaps on a two-year cycle. Thich should be enough to keep out the shrubs and small trees. Mowing should be to a minimum height of one foot.

11. Planting on the site should be done under the direction of a landscaper.

There are several landscaping and seeding techniques which can be employed to reduce erosion and to avoid rutting of the ground by vehicle wheels or tracks. Grading and seeding specifications should state what is desired for the final product.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. SURFACE DRAINAGE

The overall surface drainage at the site could be improved through the development of an integrated drainage plan. Such a plan should be designed to intercept surface water runoff in designed channels and lead it away from the site as quickly as possible. This would reduce both infiltration and erosion.

It is our understanding that the swales were constructed between trenches to intercept the water running off the side slopes. At the present time, many of the swales have very low gradients and many appear to discharge on natural slopes rather than into a designed channel. The low gradient swales have a limited ability to rapidly drain the area and many of those swales which discharge directly on the natural slope have resulted in the formation of gullies. An integrated drainage plan should be designed to improve this situation.

B. INFILTRATION

It will be difficult and costly to reduce the general infiltration which results when rain falls on the loose, permeable surface loessial soils. It may be desirable to determine if the impervious backfill material extends beneath the swales that have been constructed between the trenches. If such impervious materials are not present, then the swale areas could be a source of infiltration that should be controlled.

Specific recommendations regarding areas of infiltration are:

1) Hand excavate, inspect, and backfill areas of potential concentrated infiltration PCI-1, PCI-2, and PCI-3 (see Chapter III, Section A.2.).

2) The wells and steel pipes designated to be abandoned should have the casing cut-off below ground level, casings should be plugged, and an engineered seal should be placed over the top of the casing (see Chapter III, Section A.3.).

C. EROSION

Surface erosion from runoff has resulted in the formation of rills and gullies. Many of these features are less than one foot deep. However, if the surficial cover of reworked loess was placed as shown on D'Appolonia Drawing No. 76-219-E13, the thickness of this cover at the edge of the trench is only six inches. Therefore, many of the gullies near the trench margins may be cutting into the "impervious" cap.

To provide for long term stability of the site, the following specific recommendations are made:

1) Regrade the site to eliminate areas of extensive rilling and gullying (see Chapter III, Section B.1.). Extreme caution must be observed during any regrading because of the potential thinness of the loess backfill material. It may actually be advisable to place additional borrow material prior to grading.

2) Repair gullies G-2, G-3, G-4, G-5, and G-8 by backfilling, fertilizing, seeding, and mulching (see Chapter III, Section B.2.).

3) Reshape and place crushed rock in gullies G-6, G-7, and G-9 (see Chapter III, Section B.2.).

4) Reshape the transition slope north of Trench 14A and south of Trench 14 to a minimum of 4:1 (see Chapter III, Section B.4).

5) Construct a gravel lined interceptor ditch near the crest of the northern slope leading into drainage channel DC-2 (see Chapter III, Section B.4.).

6) Repair swales S-1, S-2, S-3, and S-4 by clearing vegetation, reshape as necessary to provide proper grade, tamp, and backfill with crushed rock (see Chapter III, Section B.3.).

7) Hand excavate around exposed plastic at Trench T-4. If this plastic is a container for low-level waste, then the cap should be redesigned (see Chapter III, Section B.5.).

D. VEGETATION

Bare areas, repaired areas, and regraded areas should be fertilized, seeded, and mulched. A healthy, dense growth of grasses will provide considerable protection against erosion. It is recommended if such a program is undertaken, the services of an experienced and qualified agronomist or landscape architect be retained to direct the program. Detailed discussion is presented in Chapter III, Section B.4.

E. LONG-TERM MAINTAINANCE

Maintainance of the site should be anticipated and performed on a regularly scheduled basis. Specific recommendations are:

1) Establish a program of scheduled inspections. Inspections should be performed by qualified and experienced personnel.

2) Consider development of an interior road system which can be used for bringing in equipment and backfill material for routine maintenance.

3) Wheeled and tracked vehicles should be prohibited from driving over the final graded and seeded site.

4) Require repairs of areas reported during an inspection within a specified period of time.

5) Consider cutting undesirable vegetation, such as small trees, by hand.

6) Stop mowing operations. This will alleviate the damage caused by the tractor and mowing machine.

REFERENCES CITED

1. Foster, J. B. and Erickson, J. R., Preliminary report on the hydrogeology of a low-level radioactive-waste disposal site near Sheffield, Illinois, U.S. Geological Survey open-file report 79-1545, January, 1980.

2. U.S. NRC, 1980, Letter from Gale P. Turi, U.S. NRC to Michael V. Machalinski, HLA, dated July 8, 1980. Letter transmitted information pertaining to Sheffield Low-Level Waste Disposal Facility.

GLOSSARY

RILL — A small erosion channel herein defined as up to two inches deep.

GULLY — A long, narrow erosion channel herein defined as being over two inches deep and up to three feet deep.

SWALE — A long, narrow, generally shallow, trough-like depression.

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