SUPPLEMENTAL
HYDROGEOLOGIC INVESTIGATION

LANCASTER SANITARY LANDFILL, INC.
ERIE COUNTY
LANCASTER, NEW YORK

Prepared by
WEHRAN ENGINEERING, P.C.
& RECRA RESEARCH, INC.

SUPPLEMENTAL

HYDROGEOLOGIC INVESTIGATION

Lancaster Sanitary Landfill

Town of Lancaster

Erie County, New York

for

LANCASTER SANITARY LANDFILL, INC.

2255 Bailey Avenue

Buffalo, New York 14211

Prepared By

Wehran Engineering, P. C.

and

Recra Research, Inc.

January 14, 1980

(WE Project #01339035)

WEHRAN ENGINEERING
Consulting Engineers

January 14, 1980

Mr. Mark Kahle
Lancaster Sanitary Landfill, Inc.
2255 Bailey Avenue
P. O. Box 1420, Station E.
Buffalo, New York 14211

RE: Supplemental Hydrogeologic Investigation
Lancaster Sanitary Landfill, Inc.
(WE Project #01339035)

Dear Mr. Kahle:

In accordance with our contract, we hereby submit the supplemental hydrogeologic investigation of the Lancaster Sanitary Landfill, which addresses the impact of the landfill on ground-water resources within and around the site.

An earth resistivity study conducted as part of the assessment of the existence and extent of ground-water contamination from the Landfill has indicated that large scale contamination of the ground-water resources has not occurred. This is, most probably, attributable to the very large degree of dispersion and dilution afforded by the aquifers within the outwash deposits and the semi-confined aquifer of the Onondaga Limestone.

It is recommended that we meet to discuss the contents of this report so that a mutually satisfactory monitoring program can be set up in conjunction with the Department of Environmental Conservation. If you have any questions, please feel free to contact us.

Very truly yours,

WEHRAN ENGINEERING CORPORATION

Richard L. Kraybill
Senior Hydrogeologist
Earth Sciences Division

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FOREWORD

This Hydrogeologic Investigation has been prepared by Wehran Engineering, P. C. of Middletown, New York and Recra Research, Inc, of Tonawanda, New York. Wehran Engineering's responsibilities focused upon the definition of the hydrogeologic conditions of the landfill, while Recra Research was responsible for the ground-water quality and subsequent analytical work. The complementary expertise of both firms was exercised in planning the study and assessing the extent of any environmental impacts.

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INTRODUCTION

The Lancaster Sanitary Landfill has been considered for a major expansion to increase its present design life to more than fifteen years. A hydrogeologic investigation conducted in the early part of 1979 focused on potential ground-water quality problems on the southeast portion of the site with consequent effects to the New York State Thruway's Clarence Service Center water supply well. That Hydrogeologic Investigation, dated June 21, 1979, suggested an expanded hydrogeologic investigation be conducted to fully assess contaminant migration and its effects to the environment or the public health. Of specific concern were ground-water conditions within and downgradient from the main portions of the landfill.

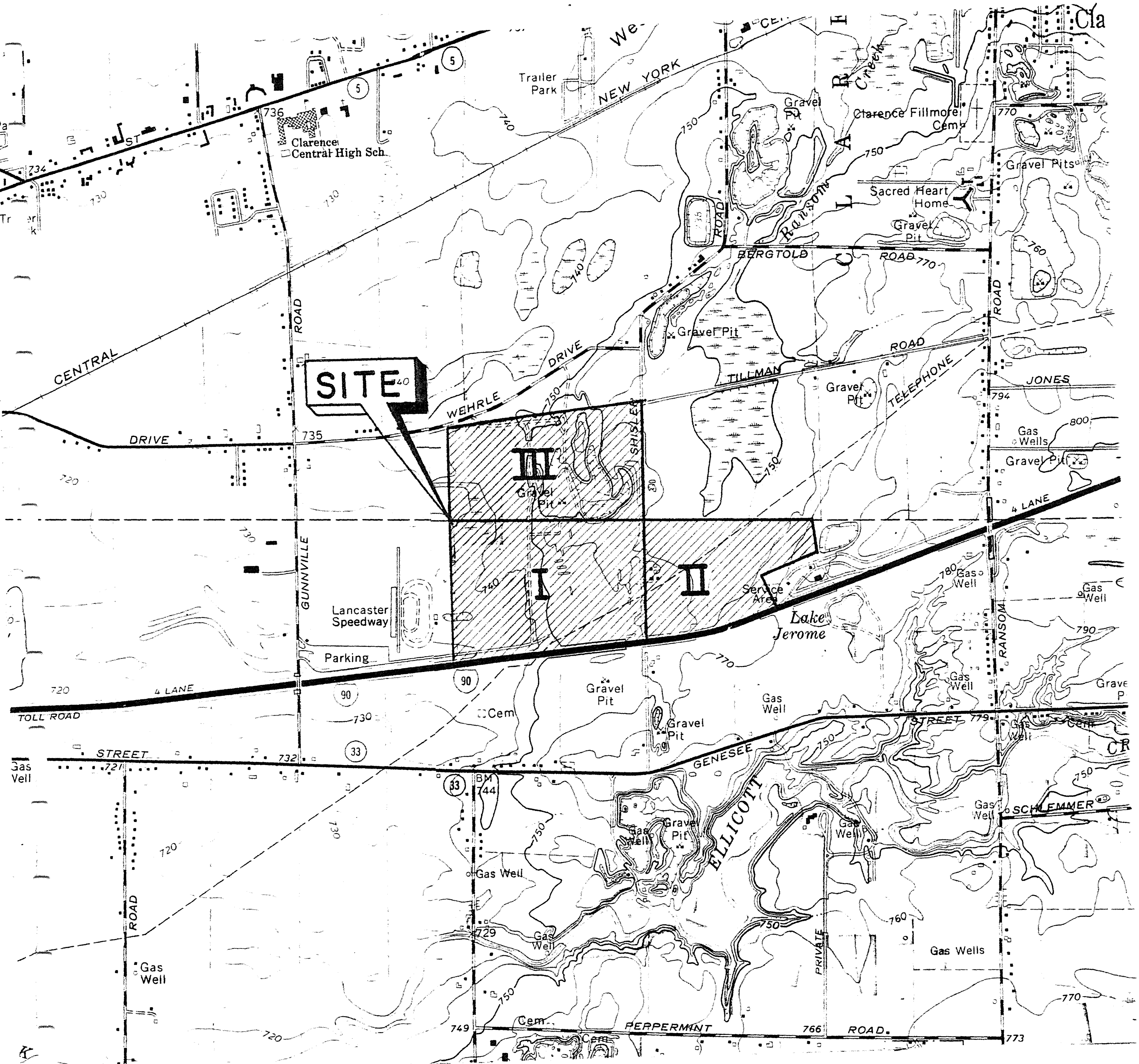
The New York State Department of Environmental Conservation (D.E.C.) has expressed their concern in defining the extent of ground-water quality problems. As a result of the June 21 Report and a July 13, 1979 meeting with the D.E.C., it was decided that the supplemental hydrogeologic investigation should address the actual or potential migration of contaminants from the older central and western sections of landfill and the potential impact on downgradient ground-water resources, primarily to the south and southwest of the site. To meet these objectives, the present hydrogeologic investigation involved the determination of ground-water use around the landfill, the estimation of the extent of contamination by geophysical methods, namely an earth resistivity study, the construction of additional monitoring points, the sampling and analyses of ground water from the additional monitoring points and further organic analyses of ground water in selected existing monitoring points.

Topographic Setting

The Lancaster Sanitary Landfill is located in the Towns of Lancaster and Clarence, in Erie County, New York. The existing landfill areas, known as Phase I and II, lie in the Town of Lancaster, just north of the New York State Thruway and west of the Thruway's Clarence Service Center. The location of the landfill is shown in Figure 1.

The site is centered at Latitude 42°56'58" and Longtitude 78°36'47". Elevations over the site range from 730 to over 780 feet above mean sea level (MSL). Surface drainage is primarily to the west and north. The southwestern portion of the site is on a topographic divide where drainage to the south to Ellicott Creek has been disrupted by the New York Thruway. The landfill occupies a former gravel pit. Other gravel pits are located north of the landfill. A designated wetlands area known as the Tillman Road Swamp bounds the site northeast of the main portion of the landfill complex and north of the Phase II area. Topography around the site is flat to gently rolling with approximately 50 feet of relief over the main landfill body. As indicated on Figure 1, topography rises along the Thruway from west to east from approximately 735 feet MSL, from the southwest portion of the site, to approximately 770 feet MSL, adjacent to the Clarence Service Center.

Except for the Thruway Service Center there is no development immediately adjacent to the landfill although residential development on the roads around the site is illustrated in Figure 1.



NOTE : TOPOGRAPHY TAKEN FROM THE CLARENCE, N.Y. (1965) AND LANCASTER, N.Y. (1965) USGS QUADRANGLES.

FIGURE 1

LOCATION MAP

LANCASTER SANITARY LANDFILL

TOWNS OF LANCASTER AND CLARENCE
ERIE COUNTY , NEW YORK

PROJECT NO. 01339035

SCALE : 1" = 2000'

Facilities

The Lancaster Landfill is approximately a 200 acre site of which nearly 130 acres have been used for municipal refuse disposal. The landfill accepts both municipal and commercial solid wastes. A limited amount of demolition debris is also accepted. The Lancaster Sanitary Landfill generally serves an area within 15 miles of the site. The City of Buffalo is the principal contributor of solid waste. Over 3000 cubic yards of refuse are disposed of at the landfill on a daily basis. The landfill is presently operated as an area fill method on the southwestern (Phase I) portion of the site.

Previous fill operations at the landfill site were conducted below the natural grade. The gravel and sand extraction from the site occurred discontinuously across the site and the depths of refuse are reported to vary significantly where native deposits were left in place. The locations of gravel walls and other subsurface changes in the base elevations of the original landfill body is uncertain. To determine this precisely now would take considerable effort and expense. However, an effort was made to further establish the general depth of filling sequences by drilling five borings into the landfill mass within the Phase I and II areas during this supplemental Hydrogeologic Investigation.

HYDROGEOLOGIC FIELD INVESTIGATION

The specific objectives of the supplemental hydrogeologic field investigation were to:

1. Determine the existence of active, or inactive, water supply wells in the vicinity of the landfill.
2. Determine the actual or potential leachate migration from the south and southwest portions of the site using a combination of earth resistivity study and conventional exploratory drilling.
3. Construct Well No. 3 as specified within the engineering plans to monitor ground-water quality in the bedrock aquifer on the southwest portion of the site.
4. Perform a limited boring program within the Phase I and II areas of the landfill to determine the nature and extent of the landfill body as well as determining concentrated leachate quality in zones of saturation within the fill materials.

The geologic field work for this investigation was carried out during August and September of 1979. Locations of all borings and resistivity measurement sites are illustrated on Maps 1 and 2 in the rear pocket of the report.

Boring Program

A total of eight test borings were drilled. Five of these borings, designated as B-18 through B-22 were located within the existing landfill area. Boring W-3 was drilled near the southwest corner of the landfill; Borings B-23 and B-24 were located on land owned by Pine Hill Concrete Mix Corporation, directly south of the N.Y.S. Thruway, and opposite the landfill. The logs of the borings are included in the Appendix.

Drilling of the exploratory borings and construction of the various piezometers was predicated on the following criteria:

1. Define the range of geologic conditions, including characterization of the underlying Onondaga Limestone, in the previously unexplored area south of the N.Y.S. Thruway.
2. Establish well points to monitor water quality and potentiometric levels at various points within and beneath the landfill body and in order to ascertain the extent of leachate migration and groundwater flow directions.
3. Install a 4 inch diameter PVC cased monitoring well in the Onondaga Limestone, located just outside the southwest corner of the landfill, where the top of bedrock is at shallow depth.

In drilling through the unconsolidated glacial soils and compacted refuse, split-spoon samples were collected at maximum five foot intervals. The samples so obtained were visually identified in the field and then stored in moisture-tight glass jars for possible further laboratory study. These samples and the rock cores are now available for inspection by interested parties at the offices of Wehran Engineering, P. C. Borings B-18 through B-22 were terminated in glacial outwash deposits, approximately ten feet below the base of the landfill. In the case of W-3, B-23 and B-24, the drilling proceeded entirely through the unconsolidated deposits to the top of the Onondaga Limestone, and were further extended approximately 20 feet into the rock by means of NX core-drilling. This permitted a characterization of the structure and lithology of the Onondaga Limestone, as well as permitting construction of piezometers within the rock.

Following the exploratory drilling, single piezometers were constructed in the completed boreholes for B-18 through B-22. The piezometers consist of 1 1/4 inch, wire-wound Johnson "Redhead" well points. Each 24-inch long well point was sand-packed and grouted to prevent preferential migration of ground waters through the annular space. At Borings B-23 and B-24, two piezometers were constructed in each completed hole, one in the Onondaga Limestone, and one in the unconsolidated glacial deposits. A bentonite seal was placed at the top of rock, isolating the individual piezometers so as to permit sampling of water quality and potentiometric level at their respective intervals within the geologic formations. At Boring W-3, an oversized "socket" was drilled into the upper 3 feet of the limestone; the 4" PVC casing was set in this socket, and the annulus was grouted with cement. A sketch illustrating the construction of the various piezometers is provided on each boring log.

All drilling and well construction was performed by Empire Soils Investigations, Inc. of Orchard Park, New York under the close supervision of Wehran Engineering.

Earth Resistivity Assessment

An earth resistivity survey was conducted during the week of August 20, 1979 to help define the existence or the extent, if any, of leachate migration in areas south and southwest of the Lancaster Sanitary Landfill. The study employed the services of a three person field crew composed of Wehran Engineering and Recra Research, Inc. personnel. All work was performed with a Bison Model 2350 earth resistivity meter. Resistivity investigations were conducted around and within the landfill complex with rather extensive investigations to the south and southwest of the landfill south of the New York State Thruway (Interstate 90).

Earth resistivity study is a technique for measuring the variations of subsurface geologic strata by passing successive electrical currents through the earth's surface in the area of interest and measuring resultant voltage drops between input and measuring electrodes. Earth resistivity readings vary, depending on the lithology, density, degree of saturation and nature of saturation of the geologic strata tested.

Where ground-water quality varies significantly with respect to total dissolved solids, and hence electrical conductivity, contrasts in ground-water quality can be discerned electrically. However, natural and artificial conditions affecting the conductivity/resistance of subsurface materials will often mask the existence of ground-water pollution. Therefore, its application is limited to those areas where significant variations in ground-water quality occur which can be differentiated from other changes in resistivity due to factors other than water quality. According to Stollar & Roux (1975) the following criteria are pertinent to the success of evaluating pollution migration by resistivity methods.

1. Contrast between the conductivities of contaminated and natural ground water.
2. Depth below land surface to the top of the contaminated ground-water body.
3. Thickness of the contaminated ground-water body.
4. Lateral variations in surficial geology.

Prior investigations suggested that the Lancaster Landfill might be a suitable setting for the use of resistivity to define pollution migration. A discussion of Earth Resistivity describing the basis for the work performed at the Landfill is contained in the Appendix of this report.

GEOLOGY

The character and hydrologic properties of all various geologic strata and formations encountered on the landfill property have been described in detail in Wehran Engineering's previous Hydrogeologic Investigation dated June 21, 1979. The full range of geologic conditions are illustrated on Figure 2 and the reader is referred to the June 21, 1979 report for detailed descriptions of each of the units encountered on the site.

The glacial till observed on the southeastern portion of the landfill was not encountered at two of the three locations where exploration was extended to the underlying limestone. At locations W-3 and B-23, all unconsolidated materials consisted of glacial outwash, predominantly fine sands with minor silt content. At Boring B-24, similar outwash deposits were disclosed overlying distinctly stratified, thin beds of fine sands, silts and silty clays. These strata, ranging to about 20 feet in thickness, suggest a glaciolacustrine deposition. Below these deposits, a three foot thick stratum of gravelly, sandy glacial till was encountered, unconformably overlying the Onondaga Limestone. The limestone, as revealed in the core-samples, had the same cherty, fissured, occasionally fractured characteristics as described in the June, 1979 report. The effects of the geology, especially the glaciolacustrine deposits containing clays, on the earth resistivity survey are discussed later in this report.

One of the objectives of the study was to establish the relationship of the landfill mass to the underlying geologic and ground-water conditions. Borings B-18 through B-22 were drilled in the refuse in the Phase I and II areas. Map 1 shows the boring locations.

PERIOD	EPOCH	FORMATION	COLUMNAR SECTION	APPROXIMATE THICKNESS IN FEET	CHARACTER
QUATERNARY	RECENT	FILL		0 - 19	COMPACTED SOLID WASTE
		UNCONFORMABLE			
	PLEISTOCENE (WISCONSIN)	GLACIAL OUTWASH		20 - 50	INTERBEDDED SAND, SILT, AND GRAVEL; OFTEN EXHIBITING CLASSIC DELTAIC STRUCTURE; TEXTURE IS HIGHLY VARIABLE, BUT GENERALLY GRADES FINER WITH DEPTH; VERY DENSE, PERMEABLE
		UNCONFORMABLE			
		GLACIAL TILL		0 - 10	SILTY, SANDY, GLACIAL TILL
		GREAT UNCONFORMITY			
DEVONIAN	MIDDLE DEVONIAN	ONONDAGA LIMESTONE		150*	GRAY CHERTY LIMESTONE; HIGHLY PERMEABLE, JOINTS ENLARGED THROUGH DISSOLUTION OF THE ROCK; PRODUCTIVE AQUIFER

*UPPER 20 FEET PENETRATED IN DRILLING

FIGURE 2

GEOLOGIC COLUMN

Borings B-18 through B-22 were drilled through a range of refuse from 24 to 40 feet. Table 1 indicates the elevations of the boundaries between refuse and outwash deposits and the elevations of the well points. It was originally intended to place the well points within the refuse mass to monitor gross leachate generation. During the boring program, however, continuous zones of saturation within the refuse were not obvious at the time of drilling. In the interest of obtaining water quality and level data, well points were placed where continually saturated conditions were evident. In the case of B-19, the well point was placed approximately 30 feet below the first reported zone of saturation which was 20 feet into the refuse mass. Continued augering to determine the refuse - outwash interface suggested that the well point in B-19 had to be set beyond 45 feet to assure an available supply of water.

Borings through refuse were drilled 10 to 15 feet beyond the refuse - glacial outwash interface. In all cases, the refuse was underlain by outwash deposits consisting of coarse to fine sand or gravel. In the case of B-18, auger refusal occurred at 45 feet, presumably bedrock. This was the only boring where refusal was encountered. In all cases, except possibly B-18, bedrock occurs at least 10 feet below the landfill body.

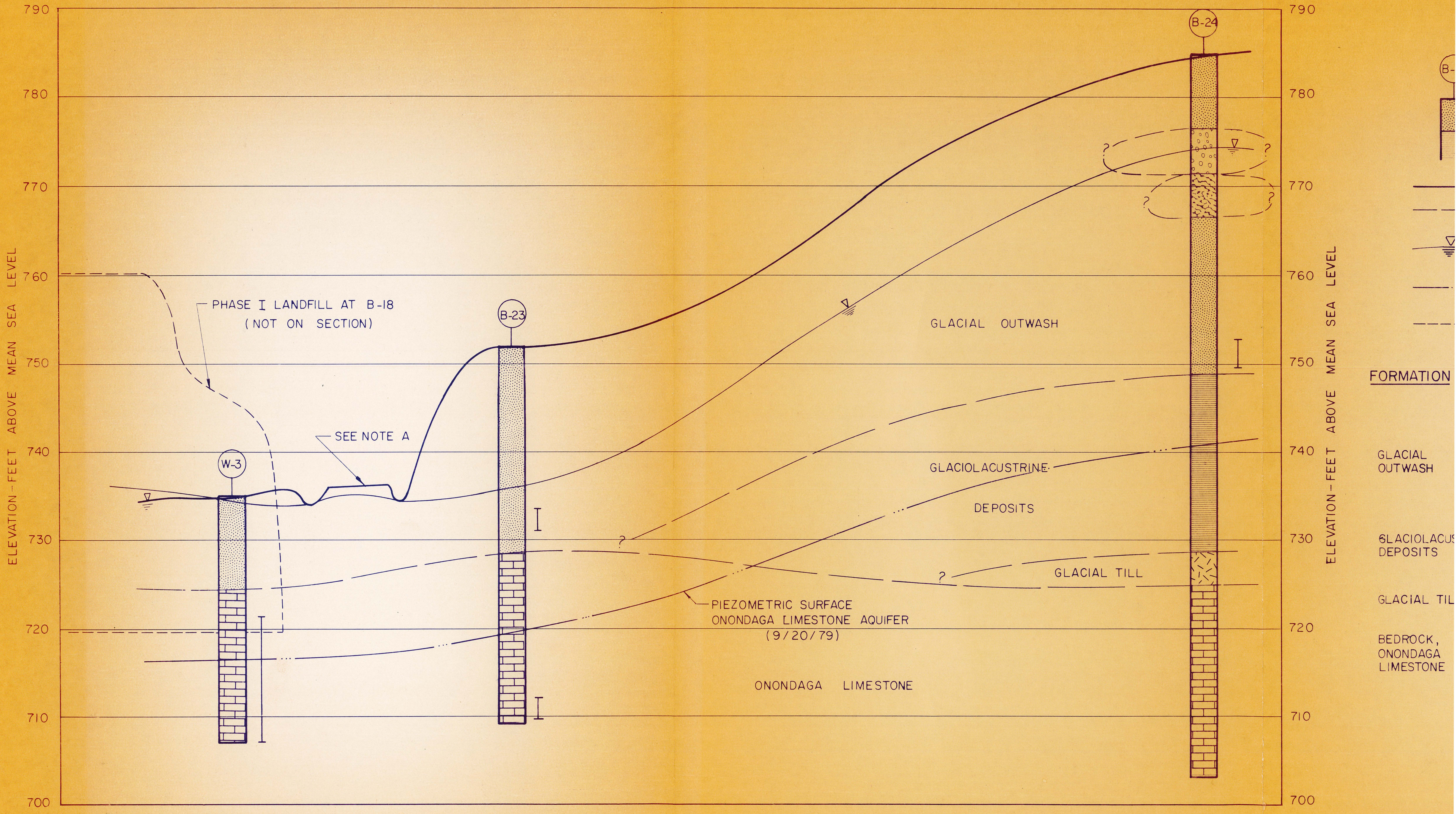
Most of the refuse encountered during drilling could be characterized as municipal garbage. Other than eight inches of fly ash or foundry sand encountered at 10 feet in B-18, no obvious industrial sludges were penetrated and collected in the split-spoon. Cross sections through the landfill were not drawn because of the similar findings from each boring. Additional borings into the refuse body would, presumably, not provide significant additional information on the subsurface geometry of the landfill based on the findings in B-18 through B-22.

TABLE 1
BORING ELEVATION DATA

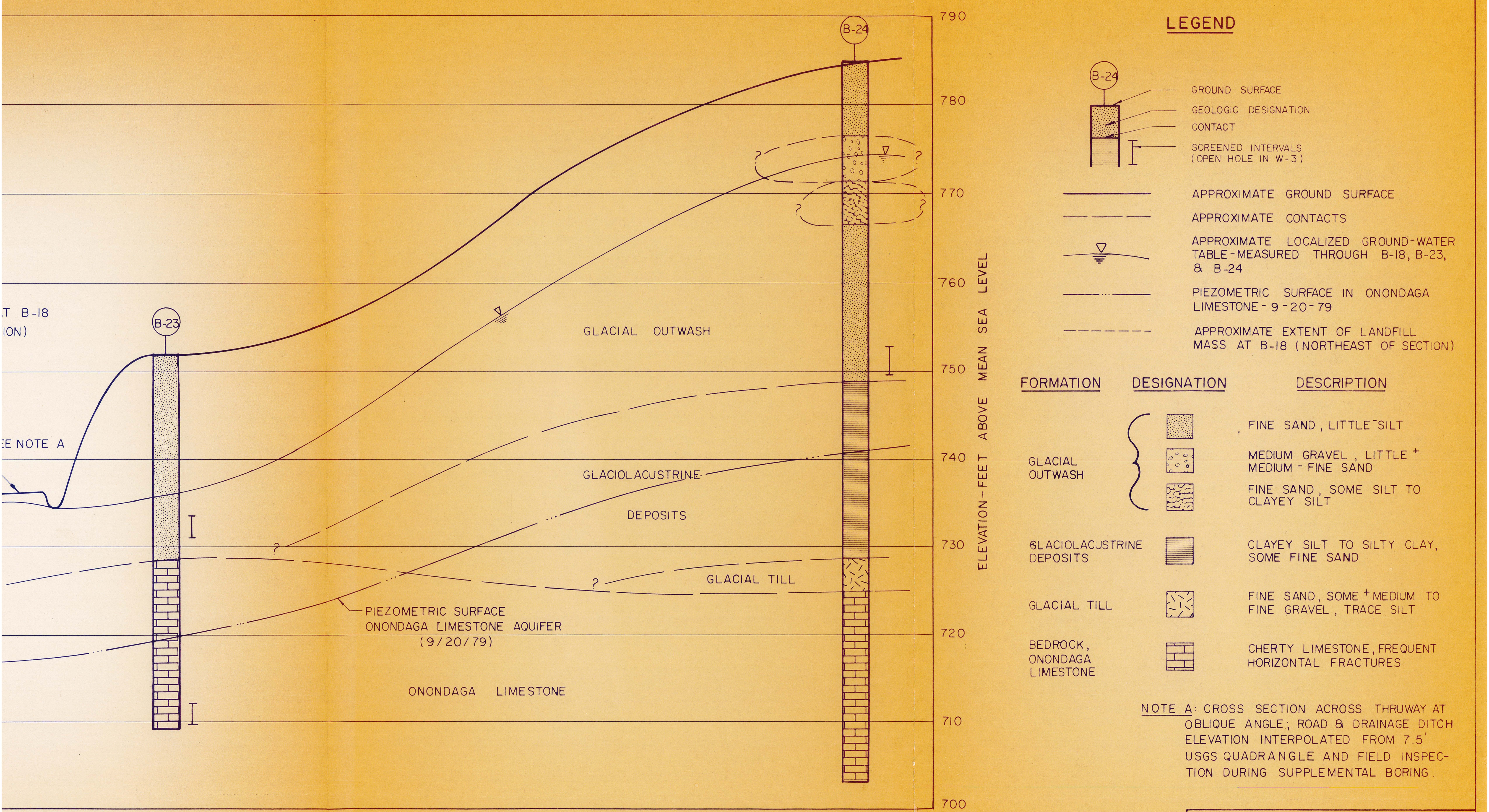
Boring Number	Surface Elevation (feet)	Elevation Top of Casing (feet)	Approximate Elevation of Refuse-Outwash Contact (feet)	Elevation of Well Point (feet)
B-18	760.1	763.92	720.1	716.1
B-19	773.8	776.57	735.8	723.8
B-20	779.4	782.85	740.9	732.4
B-21	766.0	769.34	742.0	735.5
B-22	772.3	774.67	735.3	736.8
			Elevation of Top of Bedrock (feet)	
W-3	734.9	737.70	724.4	open hole 721.4 to 707.6
B-23S shallow B-23D deep	752.0	754.45 754.71	928.5	731.1 709.5
B-24S shallow B-24D	784.8	787.30 787.42	724.6	749.8 702.9

NOTE: All elevations in feet above Mean Sea Level

The supplemental borings as well as the borings drilled for the June 21, 1979 Hydrogeologic Investigation, indicate that the outwash deposits form a thickening wedge from the west to the east of the landfill. Figure 3 illustrates the geologic conditions along the Thruway south of the landfill. Outwash and glaciolacustrine deposits are generally absent west of W-3 but extend to depths of 60 feet or more to the south and east sides of the landfill. Figure 3 indicates that the bedrock below the unconsolidated deposits represents a surface of very low relief; therefore, topographic relief primarily results from Pleistocene glacial deposition and man's recent activities. Figure 3 depicts the landfill mass at B-18 east of W-3; also shown is the road-cut of the New York State Thruway. Both features have modified original topography and can significantly affect local ground-water flow which is discussed in the following section of this report.



SCALE: HORIZONTAL: 1" = 500'
VERTICAL : 50X EXAGGERATION



SCALE: HORIZONTAL: 1" = 500'
VERTICAL: 50X EXAGGERATION

FIGURE 3

GEOLOGIC SECTION A-A

GROUND WATER

Ground-water occurrence and flow have been described in the June 21, 1979 Hydrogeologic Investigation for the southeastern portion of the landfill. That Investigation revealed disparities in apparent ground-water flow directions within the outwash deposits that were believed attributable to cyclical ground-water conditions. Differential rates of recharge were thought responsible for the reversed hydraulic gradients in the outwash deposits. Such factors as the specific yield variations between refuse and outwash and the cone of depression created by ground-water withdrawals from the Thruway well were also considered as part of the overall effects on ground-water gradients in the outwash.

Ground-Water Flow in Glacial Outwash

The initial Hydrogeologic Investigation reported that the principal flow direction of ground water in the outwash was vertically downward into the underlying Onondaga limestone. That finding was reconfirmed by the construction of cluster wells B-23 and B-24 and the measurement of static water levels on August 23 and September 20, 1979. The measurements are presented on Tables 2 and 3. Levels obtained from cluster well B-15 (Table 2) demonstrate that ground water in the outwash has a pronounced downward gradient. It is much less apparent, even from the supplemental borings, what the overall horizontal direction of flow in the outwash actually is. The difficulty is largely due to the fact that, under existing conditions, potentiometric levels in the outwash are dependent upon the depth of penetration into the saturated zone. Deeper wells in the outwash exhibit lower potentiometric surfaces. Therefore, correlating potentiometric levels in wells

TABLE 2
GROUND-WATER ELEVATIONS
SELECT POINTS FOR RESISTIVITY SURVEY

Well/Boring Number	Elevation of Land Surface (feet)	Elevation of Reference Point (Top of Casing) (feet)	Depth to Water Surface (feet)	August 23, 1979 Elevation of Ground Water (feet)
B-7	757.57	760.57	17.67	742.90
B-10	751.05	753.13	13.50	739.63
B-15 S	773.10	774.87	13.42	761.45
I	773.10	774.09	32.92	711.17
D	773.10	776.14	67.00	709.14
W-1	766.57	767.15	35.75	731.40
W-2	752.72	753.22	12.58	740.64

NOTE: All elevations in feet above Mean Sea Level

TABLE 3
GROUND-WATER ELEVATIONS

Well/Boring Number	Elevation of Land Surface (feet)	Elevation of Reference Point (Top of Casing) (feet)	Depth to Water Surface (feet)	September 20, 1979 Elevation of Ground Water (feet)
B-18	760.1	763.92	29.13	734.79
B-19	773.8	776.57	38.13	738.44
B-20	779.4	782.85	Dry to	< 740.6
B-21	766.0	769.34	26.42	742.92
B-22	772.3	774.67	34.50	740.17
B-23S (shallow)	752.0	754.45	18.54	735.91
B-23D (deep)		754.71	34.08	720.63
B-24S (shallow)	784.8	787.30	12.88	774.42
B-24D (deep)		787.42	46.04	741.38
W-3	734.9	737.70	21.50	716.20

NOTE: All elevations in feet above Mean Sea Level

penetrating different depths within the glacial outwash aquifer may yield incorrect interpretations of the actual flow directions. This problem is further complexed by water level data from well points established in Borings B-18 through B-22. Here, the principal objective was to locate the point in refuse or as near to the refuse body as hydrogeologic conditions permitted. As discussed in the initial Hydrogeologic Investigation, specific yield variations between refuse and outwash could cyclically affect hydraulic gradients. This is a result of differential responses from recharge of water levels in refuse as opposed to water levels in the glacial outwash. During periods of recharge, ground-water levels in the landfill would respond to recharge less than levels in the outwash. During periods of recharge, hydraulic gradients could be observed towards the landfill whereas during dryer periods hydraulic gradients from points in and around the fill body may indicate gradient reversals. Hydraulic gradients are very low, commonly less than .005 (ft/ft).

Map 1 indicates the elevations of ground water in outwash and refuse as measured in the supplemental borings constructed in August and September 1979. Hydraulic gradients to the west, southwest appear to be indicated by ground-water elevations within the landfill. However, the shallow well point, B-23S, on the south side of the Thruway has a higher static water level than that in B-18. This suggests that ground water in the outwash on the south side of the Thruway moves northerly towards the landfill. A northwesterly component to the hydraulic gradient in the outwash is further suggested by comparing the level measured in borings on the landfill.

Ground-Water Flow and the New York State Thruway

The New York State Thruway cuts through the outwash deposits on the south side of the site. As reported in the Geology Section of this report, the glacial outwash deposits form a thickening wedge from west to east. The Thruway roadcut has probably affected the local hydrology of these outwash deposits. The roadcut acts as a hydraulic barrier to ground-water flow in the shallow zones of saturation. The hydraulic gradient in the localized ground-water table between B-23S and B-18 (Figure 3) suggests that contaminant migration to B-23 is unlikely. However, because the outwash deposits thicken in an easterly direction and landfilling has, as illustrated in Figure 3, progressed below the grade of the New York State Thruway, the potential for landfill leachate contamination of the localized ground-water table south of the Thruway cannot be totally precluded.

The shallow well point within the glacial outwash, in B-23S, is at the approximate elevation of the drainage ditch on the south side of the Thruway and within 3.5 feet of the bedrock interface. Pollutants from the landfill at B-18 would most likely have to migrate vertically downward under the Thruway and then upward into B-23S in order to contaminate ground water in this zone. If this, indeed, were the case then ground water in the shallow bedrock aquifer as measured in the "deep" well point, B-23D, would be similarly contaminated. According to the later water quality discussion this is not the situation. The B-23S well point is probably in good communication with the drainage ditch on the south side of the Thruway. During periods of runoff, highway drainage could surcharge the outwash deposits and affect the shallow well point in B-23.

Ground-Water Conditions in the Landfill

Borings B-18 through B-22 were expressly drilled and outfitted with well points to determine the extent of refuse, its relationship to ground-water levels and water quality beneath the landfill mass.

The approximate elevations of the refuse-outwash contacts are, as previously discussed, shown on Table 1. Table 3 provides water level information for B-18 through B-22. A comparison of the two tables indicates that the base of the landfill is below the ground-water table. The ground-water table extends over 14 feet into the refuse mass at B-18, whereas, for B-19, B-21 and B-22 it ranges from one to five feet. In B-20, the well point was dry to an elevation of 740.6 feet which is approximately the base level of the refuse mass in this location. The 14 foot mound into refuse reported at the B-18 location may be erroneous. Base elevations of the refuse mass were determined by split spoon sampling at five foot intervals. If refuse caught in the hollow stem augers were picked up in the spoons, exaggerated results could be interpreted as to the extent of refuse. It has been our interpretation that refuse beneath B-18 extends 40 feet below land surface.

General flow directions of ground water in outwash and refuse are indicated on Map 1. These flow directions are subject to the interpretation limitations previously discussed.

Ground Water in the Onondaga Limestone

Borings B-23, B-24 and W-3 were extended into bedrock. Well points isolated in bedrock were established in the cluster wells. Well W-3 was constructed as a four inch PVC well isolated in bedrock.

Ground-water elevations in the bedrock aquifer are presented on Table 3. Flow in the bedrock aquifer is west, northwest based on the elevations obtained on September 20, 1979. Figure 3 illustrates in cross-Section the geologic and hydraulic relationship between W-3, B-23D and B-24D. Well W-3 is on the southwest corner of the landfill and hydraulically downgradient from a small portion of the site. Well W-3 is subject to leachate migration in the bedrock aquifer. Due to its hydraulic position the B-23D well point is not believed to be subject to leachate migration from the landfill; however the potential effect of the landfill on B-23D is less clear.

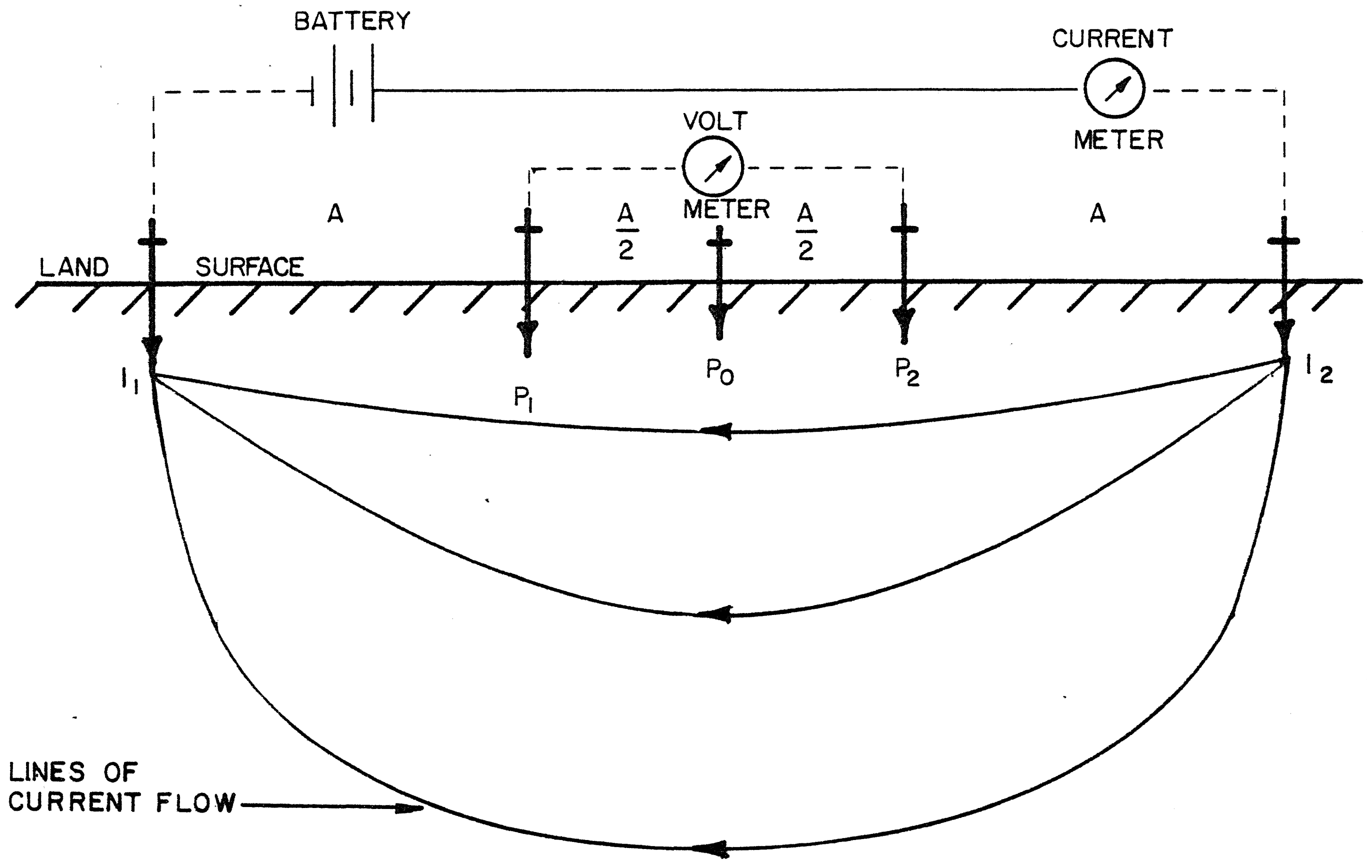
Since the data collected to date indicates the principal flow direction in the bedrock aquifer is to the west, northwest, the most likely potential for contaminant plume migration is somewhat north of W-3 in an area west, northwest of the main landfill body. However, the very low hydraulic gradients in the semi-confined aquifer, less than .005 (ft/ft) can result in the potential dispersal of contaminants over wide areas. Low gradients can also increase the dilution factor and, thereby, reduce the level of leachate concentration in the flow system.

Indication of plume migration to the west and northwest are discussed in the following section addressing the earth resistivity study.

EARTH RESISTIVITY SURVEY

Two resistivity procedures were used to evaluate leachate occurrence and migration at the Lancaster Sanitary Landfill. A "sounding survey" provided background information on variations in subsurface conditions with depth. Based upon the results of the soundings, and comparison with boring logs from the site, an electrical "profile survey" was conducted at two different depths or A-spacings to attempt a delineation of the extent of leachate contamination. For each procedure the Lee Modification of the Wenner Arrangement of Electrode Spacings was employed.

The electrode configuration or "array" is illustrated in Figure 4. The outer electrodes are the current (I) electrodes while the inner electrodes ($P_{1,2}$) are the potential, or receiving, electrodes. The Lee electrode (P_O) is placed at the center of the spread and allows successive readings on the right and left portions of the line (P_1P_O and P_OP_2). The Lee Modification was utilized to account for possible lateral changes in resistivity which could be misinterpreted as variation with depth since lateral changes in resistivity as the electrode spread increases is possible. For the sounding surveys, readings were taken along a line with the electrode spacing, or A-spacing, normally expanding at five (5) foot increments up to fifty (50) feet, at which time spacing was expanded to ten (10) and finally to twenty (20) foot increments to a maximum spacing of 100 feet. Resistivity readings were taken at each incremental change in the A-spacing. Raw data is included in the Appendix. Locations of soundings are illustrated on Maps 2 and 3 in the rear pocket of the report. Soundings S-1 and S-2 located on the north side of the site near Borings B-7 and B-10 respectively, were run to establish background data hydraulically upgradient from the



A -SPACING BETWEEN ELECTRODES
$I_{1,2}$ -CURRENT OR INPUT ELECTRODES
$P_{1,2}$ -POTENTIAL ELECTRODES
P_0 -LEE POTENTIAL ELECTRODE

FIGURE 4

WENNER ARRANGEMENT LEE MODIFICATION

PROJ. No. 01339035

landfill. Sounding S-3 was run on the south side of the landfill near Shisler Road. A completed sounding at the S-3 location was not conducted due to the extensive refuse deposits of extremely low resistive material short circuiting the input charges in the upper zones of rubbish. The S-3 sounding provides some insight into the very low apparent resistivities anticipated within the landfill body.

The S-4, S-5 and S-6 soundings were run to evaluate conditions with respect to depth on the west, south and east sides of the landfill. Prior reconnaissance work suggested that the Onondaga Limestone outcropped or was within several feet of land surface to the west of the landfill. Consequently, the S-4 sounding location was carefully selected to establish subsurface conditions as they related to bedrock occurrence. Sounding S-5 was run near Boring B-15 and the Thruway well to establish resistivity values in an area of known contamination .

Following the collection and field interpretation of the sounding data a profile survey was conducted over wide areas around the landfill site. Twenty two profile stations are illustrated on Maps 2 and 3 and, with the sounding stations, provide the data base for interpretation.

Sounding Data Results

Data results from the sounding survey were plotted up in several ways in order to assess changes in resistivity and identify the depths at which geologic boundaries occur. Plots of the data are included in the Appendix. The simplest method involved the plotting of apparent resistivity in ohm-feet (X-axis) versus electrode or A-spacing (Y-axis). Interpretation requires noting where breaks occur in the shape of the curve and then relating them to the A-spacing or depth in feet. The Lee Right and Lee Left electrode readings are also plotted on the linear graphs. Where they overlap no great lateral variations in resistivity are inferred between the right and left sides of the electrode array. Where they diverge, lateral variations may be a problem and the results, as interpreted on a depth basis, should be considered less reliable. Examples of each situation are illustrated in the Appendix. For example, sounding S-1 shows very good correlation between the Lee Left and Lee Right readings, and the plots overlap. This indicates that changes in resistivity readings are attributable to changes with depth rather than horizontal discontinuities as the A-spacing of the electrode array is expanded. Sounding S-6, however, diverges widely in the middle range of readings (20 to 50 feet). The wide variation in Lee Left and Lee Right readings suggest lateral discontinuities between the Right and Left halves of the electrode array. The Lee Right readings are significantly higher than the Lee Left which suggest more resistant materials, possibly a bedrock outcrop, beneath the Right position of the array. The overall plot of apparent resistivity versus depth for S-6 should, therefore, be taken as less reliable.

A second graphical method for analyzing the sounding data is also presented in the Appendix. This method, known as the Moore Cumulative Method, requires that readings be taken at equally spaced intervals. For each electrode interval the apparent resistivity reading is added cumulatively to the sum of all preceding readings. Cumulative readings are plotted against the A-spacing. Aligned points are connected by straight lines. The intersection of the straight lines are considered to be equal to the depths of the various geologic boundaries. Moore cumulative plots could not be graphed where the A-spacing was interrupted as in the case of S-2. Here, a gravel road interrupted the interval readings at a 35 foot A-spacing and a cumulative plot was not made.

Based upon a field review of the sounding plots previously discussed, A-spacings of 30 and 60 foot intervals were selected for the profile study. These spacings were selected by comparing the "breaks" in the graphs with known background information from previous investigations and water level measurements collected on August 23, 1979.

As can be seen in the apparent resistivity plot of S-1 versus electrode spacing no obvious breaks occur in the data. However, in the Moore Cumulative Plot of S-1, two points derived from the intersections of three lines can be discerned in the data. These points correspond to A-spacings or depths of approximately 28 and 43 feet respectively. In the case of S-2, a break is discernible in the apparent resistivity plot at about ten feet and again at thirty feet. The noted static water level on August 23, 1979, in B-10 adjacent to S-2 was eleven feet and depth to bedrock as represented in the boring log for B-10 was somewhat over 27 feet. The Lee Left and Lee Right electrode plots do not diverge. It is believed that the breaks accurately reflect the water-table surface and bedrock at the 11 and 27 foot depths (A-spacings) in the test data. Breaks noted in the Moore Cumulative Plot for S-4 indicate bedrock occurs at about 13 feet and saturation at about 28 feet. This corresponds to known information relative to bedrock and the water table.

Sounding S-5 was taken near Boring B-15. The plot of S-5 is presented in the Appendix. Definitive breaks in the normal plot occur at A-spacings (depths) of ten and twenty feet. The break noted at ten feet appears to correspond with the August 23 water level in the shallow well point of B-15 which was measured at approximately 11 feet 7 inches below land surface. As indicated in the June 21, 1979 hydrogeologic investigation, specific conductivities in this zone reflect gross leachate contamination. The normal plot reflects a drop in resistivity to moderately low readings of 260 to 280 ohm-feet between 20 and 35 feet (A-spacing). Resistivities rise beyond the 40 foot A-spacing, presumably as a result of such factors as leachate attenuation and dispersion as well as lithologic variations. The Moore Cumulative Plot for S-5, indicated a "break" at 30 feet.

The sounding data revealed sufficient subsurface variation to require two A-spacings for the profile survey. The shallow, 30 foot A-spacing was selected to assure readings within the upper zone of leachate saturation encountered on the southeastern portion of the site during the previous investigation. Topographic considerations such as the presence of the Thruway roadcut, did not warrant a shorter A-spacing. A 60 foot A-spacing was selected for the deeper profile investigation. The larger A-spacing assured that ground water encountered in the Onondaga Limestone would be measured. The larger A-spacing, however, measures the weighted average resistivity of the much larger body of earthen material through which the current passes. Therefore, rather large changes in water quality would have to be monitored before they would be measurable in terms of resistivity values. Interpretations of the readings from the larger A-spacing are consequently less precise as more factors can affect the readings of the larger volume of earthen materials.

Profile Data Results

Results of the profile survey are illustrated on Maps 2 and 3 in the rear pocket of the report. Resistivities measured at 30 and 60 foot A-spacings are reported in ohm-feet and iso-contours at variable intervals illustrate the high and low resistivity zones on and around the landfill body.

On both Maps 2 and 3, it is apparent that the landfill, as measured at P-15 and S-3, exhibits very low resistivity. Readings at both the 30 and 60 foot A-spacing for P-15 and S-3 are less than 50 ohm-feet. Areas measured outside of the landfill had wide variations ranging from 218 ohm-feet to 4770 ohm-feet in the 30 foot profile with somewhat higher readings for the 60 foot A-spacing.

Map 2 indicates areas of high resistivity (>2000 ohm-feet) on the west and southwest sides of the site which is attributable to bedrock at or near the surface. Monitoring well W-3 encountered bedrock at 10.5 feet and bedrock exposures were noted around the Lancaster Speedway west of the landfill. Bedrock "highs" are also apparent on the south side of the Thruway in the vicinity of P-4 through P-7. A second area of moderately high readings (1000 - 2000 ohm feet) at the 30 foot A-spacing is also depicted on Map 2. These higher readings in the area of Shisler Road on the south side of the Thruway are attributable to clean sands and gravels over limestone bedrock. The log for Boring B-23 located near P-3 supports this. Clean fine sands with only a trace of silt were encountered down to 23 feet below land surface directly overlying limestone bedrock. Several sand and gravel pits are located in and around profile stations P-3, P-8, S-6, and P-14. Clean sands and gravels typically have the resistivities measured at these profile stations.

Relatively low resistivities (200 - 500 ohm-feet) were measured at the 30 foot A-spacing profile stations on the south side of the Thruway southeast of the landfill. These readings were considerably lower than expected for clean outwash deposits. The lower readings seen on Maps 2 and 3 to the southeast of the site were of sufficient concern to drill an additional boring and construct a well cluster at the B-24 location.

The lower resistivities measured in this area were thought to result from one or a combination of the following factors:

1) Leachate migration from the landfill to the southeast with attendant reductions in the level of resistivity readings due to higher concentrations of total dissolved solids in ground water.

2) Salt contamination in ground water from highway de-icing operations on the Thruway.

3) High proportions of Silt and Clay in the outwash deposits resulting in lower natural levels of resistivity.

The possibility that natural variations in the outwash could account for the lower readings was considered early in the study. When background sounding S-1 was run, moderately low readings of less than 500 ohm-feet were obtained up to the 100 foot A-spacing. At the time, these results were of some concern since clean outwash was expected to yield results in the 1000+ ohm-foot range. The expected higher readings would have provided the necessary resistivity contrast to plot leachate plume migration. The lower "background" readings obtained further complicated interpretation of the results. The problem of high variations in readings due to factors other than leachate contamination of ground water have been stated. As a final check on natural variations in resistivity in the outwash, profile stations P-19 and P-20 were selected to compare "dirty" outwash with "clean" outwash. An abandoned sand and gravel pit north of the site was selected. Profile P-19 was set up near an area of observed "dirty" outwash containing high proportions of Silt and Clay. Profile P-20 was set up next to very clean outwash deposits. Both stations are within 200 feet of each other which reduces the chance of other factors affecting the results. At a ten foot A-spacing, the normal reading in the dirty outwash was 268.5 ohm-feet; in the clean outwash the reading was 2400 ohm-feet. As the A-spacing was expanded, the difference became less pronounced but still significant. This inherent variation of the outwash must be considered when discussing the interpretation of the results of this study.

Resistivity Interpretation

The high Resistivity Readings from areas west and southwest of the Lancaster Sanitary Landfill provide sharp contrasts to those readings within and immediately adjacent to the landfill body. Readings at Stations P-16 and S-5 suggest that ground water immediately adjacent to the landfill is affected by leachate. No indication of contamination is apparent from the high Resistivity Readings south and west of Shisler Road on the south side of the Thruway. The much lower readings on the east side of Shisler Road south of the Thruway prompted the installation of B-24.

The log for Boring 24, in the Appendix of this report, indicates that glaciolacustrine deposits occur in this area. The glaciolacustrine deposits contain significant proportions of silt and clayey silt. The SILTS and CLAY account for the much lower readings as previously discussed.

The data presented on Maps 2 and 3, therefore, does not indicate leachate migration to the south of the Thruway. Inherent variations in the nature of subsurface materials and the depth to bedrock could mask the presence of contaminants in ground water. This would reduce the effectiveness of the resistivity survey to detect low level ground-water contamination.

The resistivity method responds only to significant changes in the overall total dissolved solids concentration. The chlorinated organic contamination in B-23, whatever the source, was not identified by resistivity methods here.

Areas monitored to the west and northwest of the landfill had lower than expected resistivity readings. A "depressed" zone of lower resistivity is implied on Maps 2 and 3 in the area of Profile Station P-18. This may, in fact, be an area where plume migration has had an effect on resistivity levels beyond the landfill property lines.

In conclusion, it is our professional opinion that if major leachate migration were occurring from the landfill it would have been more obviously apparent from the profile investigation. High contrast in resistivity readings occur between stations such as P-16 next to the landfill and P 3 on the south side of the Thruway. This suggests that major salt transport from the landfill to the south and southwest is not a problem. Organic contamination of the ground water in both the glacial outwash and the Onondaga Limestone beyond the limits of the landfill is a possibility. The effects of dilution and dispersion of high total dissolved solids, characteristic of leachate, would reduce the effectiveness of earth resistivity techniques in detecting ground-water pollution. A further assessment of the actual presence of contaminants and pollutant migration in ground water is discussed in the Ground-Water Quality section of this report.

WATER QUALITY

A ground water sampling program was undertaken at the Lancaster Sanitary Landfill site to establish two objectives: 1) baseline water quality data and 2) assess the impact of past and current disposed operations at the site. The program involved analysis of waters from the different ground water regimes encountered on site. A detailed examination in early 1979 was made at the eastern end of the landfill due to its proximity to the New York State Thruway Service Area water supply wells.

An initial water quality assessment report was submitted on June 21, 1979. Based on this initial study it was decided to expand the assessment program to further define the quality of ground waters throughout the Phase 1 and 2 portions of the landfill, with emphasis on areas south of the site. The following sections of this report detail the results of this program.

Sampling Program

Personnel

Samples were collected at the landfill site by Recra Research, Inc. personnel on the following dates: September 21, 1979 and September 24, 1979. All samples were returned to Recra Research, Inc.'s laboratories in Tonawanda, New York for analysis. Information relating to the date on which a particular set of samples were collected is contained in Table 3.

Sample Points

The locations of sample points are depicted on Map 1. Samples were collected from monitoring well W-3 and piezometers: B-18; B-19; B-21; B-22; B-23S; B-23D; B-24S and B-24D for supplemental analytical studies to further qualify the constituents in the wells and piezometers. Previously sampled wells and piezometers were done as follows: W1 and W2 on three (3) occasions (March 14, 1979;

TABLE 4

SAMPLING INFORMATION

Samples (Phase 2)	Date Collected
Monitoring Well W-3	September 21 and 24, 1979
Piezometers B-18; B-19; B-21; B-22; B-23S, B-23D, B-24S, B-24D	September 21 and 24, 1979

March 29, 1979; and May 8, 1979), B13; B13A; B15S; B16S; B16I and B17 were sampled on two occasions March 14-15, 1979 and May 8, 1979. B7 and B-11 were sampled once (May 8, 1979) and surface water sample (SS1) was collected on one occasion (May 8, 1979) from the area near piezometer B7 and B11.

Monitoring well W-3 was constructed supplemental to the hydrogeologic investigation. Data is presented herein for these new monitoring points along with specific Gas Chromatography/Mass Spectrometry (GC/MS) performed on previously sampled well and piezometer points. The present discussion will concentrate on water quality in piezometers located throughout the site under investigation. As stated previously, this area lies in close proximity to the New York state Thruway Service Area water supply wells and hence, is more likely to present a problem in terms of ground water impact.

Full interpretive analysis of prior analytical data was presented in the June, 1979 report entitled "Hydrogeologic Investigation, Lancaster Sanitary Landfill, Town of Lancaster, Erie County, New York." Points B7 and B11 and surface point SS1 were used in Phase 1 as a means of establishing background data. These points are in Section III of the site, where waste disposal activities have not taken place.

Methodology

Prior to sampling ground waters, all wells and piezometers were subjected to extensive pumping and/or bailing. Piezometers were pumped with an ISCO Model 1680 Sampler equipped with Teflon sampling lines. To avoid cross-contamination, all sampling lines were thoroughly rinsed between sample points. Monitoring well W3 was sampled by using a bailer. If a well or piezometer could not be evacuated, a minimum of three volumes of water was removed prior to sampling to guarantee a representative sample. Separate bailers were provided for each well to prevent cross-contamination.

Water samples were collected in both plastic and glass bottles that had been scrupulously cleaned and rinsed. In addition to cleaning, bottles were rinsed three times with the sample prior to collection. All bottles for organic analyses contained foil or Teflon-lined caps.

Analytical Program

Parameters

Ground water samples collected on September 20, 21 and 24, 1979 from monitoring well W3 and piezometers: B-18; B-19; B-21; B-22 B-23S; B-23D; B-24S and B-24D, were analyzed for the parameters listed in Table 4. Data for these sample points are found in Table 5.

GC/MS analyses for samples collected on March 14-15, 1979 and March 29, 1979 can be found in Tables 6 through 11.

More specific analyses such as GC/MS were performed to provide more precise identification of constituents which comprised the THO values found in Phase 1 of the study.

Analytical Methods

Procedures utilized were in accordance with one or more of the following reference texts:

1.) Standard Methods for the Examination of Water and Wastewater, 14th Edition, APHA, AWWA, WPCR.

2.) Methods for Chemical Analysis of Water and Wastes, United States Environmental Protection Agency.

3.) Water Standards of the American Society for Testing and Materials (ASTM)

4.) Manual of Analytical Methods for the Analysis of Pesticide Residues in Human and Environmental Samples, U.S.E.P.A, 1974

5.) National Pollution Discharge Elimination System, Appendix A., Federal Register, V 38 No. 75 Part II. 1973

Analytical Results

All analytical data is presented in Tables 5-11. The complete GC/MS Report is contained in the Appendix.

TABLE 5

ANALYTICAL PROTOCOL

Ammonia
Chloride
Alkalinity
Specific Conductance
Total Organic Carbon (TOC)
Total Inorganic Carbon (TIC)
pH
Phenols
Soluble Manganese
Soluble Zinc
Soluble Nickel
Soluble Iron, total
Total Halogenated Organic Scan (THO)
Total Volatile Chlorinated Organic Scan (TVCO)
Nitrogen-phosphorous scan

Ground Water

Hydrogeologic investigations on the Lancaster Landfill site have revealed the presence of three distinct water bearing zones. These include:

a. an unconfined water table aquifer within the permeable glacial outwash deposits and the landfill, with a downward component of water movement along with a lateral southwesterly flow direction.

b. a semi-confined, or leaky artesian aquifer within the Onondaga Limestone with a west, northwest component of groundwater movement indicated by available data.

c. ground water held within the semi-confined bed or aquitard represented by the discontinuous glacial till stratum.

WATER QUALITY ASSESSMENT

As defined in the second phase of the project, six (6) samples were analyzed by Gas Chromatography/Mass Spectrometry (GC/MS) for characterization of organic constituents present in the following monitoring wells and piezometers: W-1, W-2, B-13A, B-13, B-15S and B-17. In addition, analytical testing was performed on samples from newly constructed piezometers and one additional monitoring well, these are: B-23S, B-23D, B-24S, B-24D, B-18, B-19, B-21, B-22 and W-3. Data for these analyses are found in Table 5. W-3 is a bedrock monitoring well. Piezometers B-23D and B-24D have their well points into the Onondaga Limestone whereas well points for piezometers B-18, B-19, B-21, B-23S and B-24S were emplaced either in the refuse layer or the glacial outwash.

Gas Chromatography/Mass Spectrometry Assessments

Data was obtained using the following methods:

The samples, which were previously extracted for Total Halogenated Organics (THO) analysis, were evaporated to 50µl via a stream of dry nitrogen. a 6µl portion of each sample was then, in turn, introduced into the GC/MS system

The GC/MS analysis involved a Model 3321 Finnigan GC/MS system interfaced with an INCOS data system operated in the electron impact mode.

Prior to sample extract injection, perfluortributylamine was introduced for calibration of the mass spectrometer and the INCOS data system.

GC/MS Conditions Included:

Carrier Gas: Chromatographic grade helium; 30 ml/min.

Column: glass 183.0 cm long x 2mm I.D. 1.5% SP-2250/1.95% SP-2401 on 100/200 mesh Supelcoport

Temperatures: Oven: Initial:50°C 4 mins.

Final: 250°C

Rate 10°C/min.

Injector: 250°C

Separator: 250°C

Transfer Line: 200°C

Multiplier Voltage : 1.300 KV

Source Voltage : 70 eV

Filament Current: 0.50 ma

Ground Water Monitoring Wells

Prior to installation of W-3, W1 and W2 were sampled and re-analyzed by GC/MS for specific characterization.

The initial analytical work performed showed W-2 to be of a higher quality than other samples collected although there was some evidence of contamination from the results of the total nitrogen phosphorous and volatile organic analyses.

Sample W-1 was found to contain hexachloro-1,3 butadiene, polynuclear aromatics, (PNA's), substituted aromatics, nitrogenous compounds, oxygenated compounds and aliphatic hydrocarbons. The hexachlorobutadiene is in part responsible for the previously reported THO concentration of 3.70μg/1. However, note that PNA's, oxygenated compounds and nitrogenous compounds also respond to the Electron Capture Detector (ECD), used in THO analysis. The presence of nitrogenous compounds was not unexpected because of the previously reported Total Organic Phosphorous Scan value of 9.8μg/1. Table 6 lists

TABLE 6

ANALYTICAL RESULTS

LANCASTER SANITARY LANDFILL
GROUNDWATER MONITORING

Report Date: 10/18/79
Sample Date: 9/20/79
9/24/79

PARAMETER	UNITS OF MEASURE	SAMPLE IDENTIFICATION (DATE) W-3 9/20/79	B-18 9/21/79	B-19 9/24/79	B-21 9/24/79	B-22 9/24/79
pH	Standard Units	7.67	7.32	6.33	6.25	6.19
Conductance	μmhos/cm	1,170	3,980	14,000	13,000	9,400
Chloride	mg/l	110	578	1,560	1,060	650
Ammonia	mg N/l	8.0	155	500	950	230
Phenols	mg/l	<0.005	0.093	6.9	6.5	30
Total Inorganic Carbon	mg/l	95.0	183	113	118	93.0
Total Organic Carbon	mg/l	25.5	278	6,150	5,850	3,880
Soluble Iron	mg/l	1.0	1.0	500	1,000	1,200
Soluble Manganese	mg/l	0.16	0.38	13.4	15.6	13.2
Soluble Nickel	mg/l	0.04	0.10	0.44	0.32	0.19
Soluble Zinc	mg/l	0.015	2.06	413	45	64
Halogenated Organic Scan	μg/l as Chlorine, Lindane Standard	2.4	<0.5	≤0.5	5.9	0.8
Total Volatile Chlorinated Organic Scan	μg/l as Chlorine, Carbon Tetrachloride Standard	440	360	4,900	139,000	91,000
Nitogen-Phosphorous Scan	μg/l as Dimethylaniline	9.6		3,700	6,200	6,100

COMMENTS: Comments pertain to data on one or both pages of this report. Samples were collected by Recra personnel on 9/20/79, 9/21/79 or 9/24/79. Values reported as "less than" indicate the working detection limit for the particular sample or parameter. All analyses were performed according to U.S. Environmental Protection Agency methodology. Total organic carbon results do not necessarily include the volatile organic fraction of the original sample since the samples are acidified and purged prior to final analyses. Nitrogen-Phosphorous scan results are based upon total chromatographic response to a nitrogen phosphorous specific detector. Results are calculated based upon the response factor of dimethylaniline but do not imply either the presence or absence of DMA itself.

TABLE 6

ANALYTICAL RESULTS

LANCASTER SANITARY LANDFILL
GROUNDWATER MONITORING

Report Date: 10/18/79
Sample Date: 9/21/79
9/24/79

PARAMETER	UNITS OF MEASURE	SAMPLE IDENTIFICATION (DATE)			
		B-23S 9/24/79	B-23D 9/24/79	B-24S 9/24/79	B-24D 9/21/79
pH	Standard Units	6.84	7.69	7.73	7.57
Conductance	umhos/cm	1,780	647	610	564
Chloride	mg/1	41.5	15.3	16.4	9.8
Ammonia	mg N/1	<1.0	<0.5	<0.5	<0.5
Phenols	mg/1	<0.005	0.006	<0.005	0.005
Total Inorganic Carbon	mg/1	36.5	47.0	26.5	22.5
Total Organic Carbon	mg/1	80.0	43.5	35.0	42.0
Soluble Iron	mg/1	0.67	0.18	0.70	0.04
Soluble Manganese	mg/1	3.5	0.08	0.44	0.11
Soluble Nickel	mg/1	0.03	<0.02	<0.02	0.04
Soluble Zinc	mg/1	2.31	0.488	0.267	0.017
Halogenated Organic Scan	ug/1 as Chlorine, Lindane Standard	3.8	<0.5	≤0.5	0.5
Total Volatile Chlorinated Organic Scan	ug/1 as Chloride, Carbon Tetrachloride Standard	39,000	95	1,660	22
Nitrogen-Phosphorus Scan	ug/1 as Dimethylaniline	5.1	2.8	31.2	100

COMMENTS: Differences in detectability for a given parameter are a function of varying sample volumes taken for analysis. Values reported as "less than or equal to" indicate the specific parameters may be present in trace quantities. Halogenated organic scan results are used for screening purposes only and are not designed for qualification or quantification of any specific organic compound. Results are calculated based upon the response factor of Lindane but do not imply either the presence or absence of Lindane itself. Halogenated organic scan results do not include volatile constituents. Total volatile chlorinated organic scan results are used for screening purposes only and are not designed for qualification or quantification of any specific organic compound. Results are calculated based upon the response factor of Carbon Tetrachloride but do not imply either the presence or absence of Carbon Tetrachloride itself. Samples were collected by Recra personnel on 9/24/79. Nitrogen-Phosphorous scan results are based upon total chromatographic response to a nitrogen phosphorous specific detector. Results are calculated based upon the response factor of dimethylaniline but do not imply either the presence or absence of DMA itself.

TABLE 7.

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-1
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
79	medium	dimethylhydrazonebutanal	interpreted as an oxygenated cyclohexane derivative
85	medium	N-pentylidene-ethanamine	confirmed as a nitrogenous compound
93	medium	2,3-dimethylheptane	confirmed as an aliphatic hydrocarbon
108	low	1,1′-methylenebis-pyrrolidine	confirmed on the basis of library fit
117	low	5-methylnonane	confirmed as containing an aliphatic hydrocarbon chain
124	medium	1-isocyanatopropane	interpreted as a cyclohexane derivative
132	medium	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
147	medium	4-ethyl-2-methylhexane	confirmed as an aliphatic hydrocarbon
158	low	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
165	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
170	medium	2-propyl-1-heptanol	confirmed as an aliphatic hydrocarbon, possibly oxygenated
182	medium	2-methylnonane	confirmed as an aliphatic hydrocarbon
203	medium	2-methylnonane	confirmed as an aliphatic hydrocarbon
223	low	4-methyldecane	confirmed as an aliphatic hydrocarbon
257	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
277	low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
297	low	2,2-dimethyl-1-octanol	confirmed as an aliphatic hydrocarbon, possibly oxygenated
309	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
325	low	4,8-dimethylundecane	confirmed as an aliphatic hydrocarbon
349	very low	4-methylundecane	confirmed as an aliphatic hydrocarbon
370	low	2,5-dimethyldodecane	confirmed as an aliphatic hydrocarbon
409	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
419	very low	1-heptadecane	confirmed as an aliphatic hydrocarbon
444	low	dodecane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE 7
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-1
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
452	very low	1-methyl-3-propylbenzene	confirmed as an alkyl substituted benzene isomer
455	very low	2-methyldodecane	confirmed as an aliphatic hydrocarbon
489	very low	2-ethenylhexahydro-1,3-benzodioxole	interpreted as an oxygenated aliphatic hydrocarbon
500	very low	3-methyloctane	confirmed as an aliphatic hydrocarbon
512	very low	hexachloro-1,3-butadiene	confirmed
519	very low	7-hexyltridecane	confirmed as an aliphatic hydrocarbon
526	very low	1-eicosene	confirmed as an aliphatic hydrocarbon
547	very low	azulene	confirmed in the absence of a standard
565	very low	2,5-dimethylundecane	confirmed as an aliphatic hydrocarbon
585	very low	eicosane	confirmed as an aliphatic hydrocarbon
621	very low	4,8-dimethylundecane	confirmed as an aliphatic hydrocarbon
645	very low	2,6,10,14-tetramethylheptadecane	confirmed as an aliphatic hydrocarbon
676	very low	2,5-dimethyltetradecane	confirmed as an aliphatic hydrocarbon
687	very low	(ethenyloxy)isooctane	confirmed as an oxygenated aliphatic hydrocarbon
706	very low	pentacosane	confirmed as an aliphatic hydrocarbon
724	very low	2-methyl-8-propyldodecane	confirmed as an aliphatic hydrocarbon
736	low	2,6-bis-(1,1-dimethylethyl)-2,5-cyclohexadiene	confirmed in the absence of a standard
756	very low	heptadecane	confirmed as an aliphatic hydrocarbon
770	very low	1-methyl-3-propylbenzene	confirmed as an alkyl substituted benzene isomer
827	very low	2,5-bis-(1,1-dimethylpropyl)-2,5-cyclohexadiene	confirmed in the absence of a standard
837	very low	2-dodecanone	confirmed as an oxygenated aliphatic hydrocarbon

Continued . . . .

TABLE 7
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-1
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
847	very low	2,3-dihydro-1,1,3-trimethyl-3-phenyl-1H-indene	confirmed as an aromatic hydrocarbon derivative
855	very low	pentacosane	confirmed as an aliphatic hydrocarbon
869	very low	tetradecanoic acid	confirmed as an oxygenated aliphatic hydrocarbon
885	very low	pentacosane	confirmed as an aliphatic hydrocarbon
903	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
928	very low	phenanthrene	confirmed as an polynuclear aromatic hydrocarbon, anthracene co-elutes with phenanthrene
948	low	docosane	confirmed as an aliphatic hydrocarbon
990	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1030	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1075	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1126	very high	3-methyleicosane	confirmed as an aliphatic hydrocarbon
1183	medium	hexatriacontane	confirmed as an aliphatic hydrocarbon
1256	medium	hexatriacontane	confirmed as an aliphatic hydrocarbon
1304	very low	11-(1-ethylpropyl)-heneicosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Bris

DATE 25 October 1979

types of compounds detected.

The sample identified as W-2 contained hexachloro-1,3-butadiene, napthalene and other PNA's, nitrogenous compounds, substituted aromatics, oxygenated compounds and aliphatic hydrocarbons. As with the previous sample, the expected ECD responsive compounds were found. Nitrogenous compounds were confirmed as previously reported via the Nitrogen Phosphorus Scan (5.6 μg/l). The compounds found in W-2 are listed in Table 7.

W-3's THO analysis was 2.4 μg/l, elevated above the other wells and piezometers examined. Further GC/MS analyses is recommended to ascertain which compounds are comprising the value of 440 μg/l obtained for the total volatile chlorinated organic analysis (TVCO). W-3's TVCO is higher than W-2 but lower than W-1 (Table 1, June 21, 1979 report). It seems that from the TVCO and nitrogen phosphorus analyses that some possible contamination of W-3 may have taken place.

Ground Water Quality in the Sanitary Landfill

Water in this zone is unconfined in the fill material which overlies the glacial outwash debris. This unit is in hydraulic continuity with the underlying glacial outwash.

Constituents of sample B-13 identified by GC/MS include hexachloro-1,3-butadiene, two trichlorobenzene isomers, naphthalene and other PNA's, substituted aromatics, aliphatic carboxylic acids, oxygenated compounds, aliphatic hydrocarbons and a nitrogenous compound. Again,the ECD responsive compounds account for a THO value of 0.65 μg/l. The nitrogenous compound may account in part for the Nitrogenous-Phosphorus Scan value of 14.6 μg/l. Table 8 is a summary of the compounds found in this sample. The low values reported do not preclude the possibility of low level contamination. The results are important because of the fact that the well point is in contact with the region which is generating the leachate(refuse material).

TABLE 8

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-2
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
83	low	1,2-dimethylazetidine	confirmed on the basis of library fit
104	medium	N-methylcyclohexanamine	confirmed as a nitrogenous aliphatic hydrocarbon
144	very low	5-amino-2,4-(1H,3H)-pyrimidine-dione	confirmed in the absence of a standard
159	very low	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
174	very low	3,4-dimethylheptane	confirmed as an aliphatic hydrocarbon
212	very low	1,3-dimethylbenzene	confirmed as an alkyl substituted benzene isomer
222	very low	3-ethyl-2-methylheptane	confirmed as an aliphatic hydrocarbon
237	very low	2,2,3,3-tetramethylbutane	confirmed as an aliphatic hydrocarbon
248	very low	ethylbenzene	confirmed as an alkyl substituted benzene isomer
271	very low	decane	confirmed as an aliphatic hydrocarbon
292	very low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
305	very low	(2-decylcodecyl)-benzene	confirmed as an alkyl substituted benzene isomer
312	very low	(1-methylethyl)-benzene	confirmed as an alkyl substituted benzene isomer
325	very low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
337	very low	1-ethyl-2-methylbenzene	confirmed as an alkyl substituted benzene isomer
348	very low	1-chlorododecane	interpreted as an alkyl substituted benzene isomer
355	very low	2,2-dimethylpropane	confirmed as an aliphatic hydrocarbon
368	very low	undecane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE 8
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-2
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
382	very low	1-ethyl-4-methylbenzene	confirmed as an alkyl substituted benzene isomer
394	very low	1-methyl-2-propylbenzene	confirmed as an alkyl substituted benzene isomer
419	very low	7-methyltridecane	confirmed as an aliphatic hydrocarbon
452	low	dodecane	confirmed as an aliphatic hydrocarbon
503	very low	2,2,4,6,6-pentamethylheptane	confirmed as an aliphatic hydrocarbon
515	very low	hexachloro-1,3-butadiene	confirmed
549	very low	naphthalene	confirmed
583	very low	2,5-dimethylheptane	confirmed as an aliphatic hydrocarbon
624	very low	2-methylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
647	very low	pentadecane	confirmed as an aliphatic hydrocarbon
676	very low	7-butyldocosane	confirmed as an aliphatic hydrocarbon
689	very low	9-octadecen-1-ol,(7)	confirmed as an oxygenated aliphatic hydrocarbon
706	very low	undecnae	confirmed as an aliphatic hydrocarbon
725	very low	octadecane	confirmed as an aliphatic hydrocarbon
735	low	2,6-bis(1,1-dimethylethyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of a standard
758	very low	octadecane	confirmed as an aliphatic hydrocarbon
790	very low	5,5-dimethylheptanal	confirmed as an aliphatic hydrocarbon derivative
827	very low	2,5-bis(1,1-dimethylpropyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of a standard

Confirmed . . . .

TABLE 8
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-2
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
846	very low	2,3-dihydro-1,1,3-trimethyl-3-phenyl-1H-indene	confirmed as an aromatic hydrocarbon derivative
858	very low	eicosane	confirmed as an aliphatic hydrocarbon
904	very low	pentacosane	confirmed as an aliphatic hydrocarbon
926	very low	anthracene	confirmed as a polynuclear aromatic hydrocarbon
953	very low	pentacosane	confirmed as an aliphatic hydrocarbon
994	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1031	medium	2-methylheptadecane	confirmed as an aliphatic hydrocarbon
1077	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon
1126	high	3-methyleicosane	confirmed as an aliphatic hydrocarbon
1185	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon, possibly oxygenated
1261	low	pentatriacontane	confirmed as an aliphatic hydrocarbon, possibly oxygenated
1462	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1611	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Bürli

DATE 25 October 1979

TABLE 9

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
64	medium	3-ethyl-2,4-pentanedione	confirmed as an oxygenated aliphatic hydrocarbon
69	medium	1,2-dimethylazetidine	confirmed on the basis of library fit
82	medium	3-ethyl-3-methylhexane	confirmed as an aliphatic hydrocarbon
94	medium	2,2,3,3-tetramethylcyclobutanone	confirmed in the absence of a standard
102	low	5-dodecanone	confirmed in the absence of a standard
108	medium	cyclopentanamine	confirmed in the absence of a standard
115	medium	3-methyl-2-propyl-1-pentanol	confirmed in the absence of a standard
128	medium	4-ethyl-2-methylhexane	confirmed as an aliphatic hydrocarbon
159	medium	2-methylnonane	confirmed as an aliphatic hydrocarbon
176	medium	4,8-dimethyltridecane	confirmed as an aliphatic hydrocarbon
193	low	3,3-dimethylpentane	confirmed as an aliphatic hydrocarbon
202	very low	4-methylundecane	confirmed as an aliphatic hydrocarbon
227	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
249	low	4,6,8-trimethyl-1-nonene	confirmed as an aliphatic hydrocarbon
271	low	7-methyltridecane	confirmed as an aliphatic hydrocarbon
285	low	2,2,4-trimethylhexane	confirmed as an aliphatic hydrocarbon
304	low	2-methylundecane	confirmed as an aliphatic hydrocarbon
320	very low	4-methylundecane	confirmed as an aliphatic hydrocarbon
331	very low	4-methylundecane	confirmed as an aliphatic hydrocarbon
354	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE 9
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
367	very low	4,6,8-trimethylnonene	confirmed as an aliphatic hydrocarbon
395	low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
401	very low	2,2,4-trimethylheptane	confirmed as an aliphatic hydrocarbon
435	low	dodecane	confirmed as an aliphatic hydrocarbon
449	very low	2,5-dimethylundecane	confirmed as an aliphatic hydrocarbon
477	very low	1,2,3,5-tetramethylbenzene	confirmed as an alkyl substituted benzene isomer
483	very low	pentacosane	confirmed as an aliphatic hydrocarbon
507	very low	hexachloro-1,3-butadiene	confirmed
517	low	1,3,5-trichlorobenzene	confirmed as a trichlorobenzene isomer
526	very low	2,2,3-trimethylhexane	confirmed as an aliphatic hydrocarbon
542	very low	naphthalene	confirmed
551	very low	1,2,4-trichlorobenzene	confirmed as a trichlorobenzene isomer
583	very low	hexadecane	confirmed as an aliphatic hydrocarbon
618	very low	1-methylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
632	very low	2-methylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
644	very low	hexadecane	confirmed as an aliphatic hydrocarbon
669	very low	1-methylpropylesterbutanoic acid	confirmed as an oxygenated aliphatic hydrocarbon
702	low	2-methyldecane	confirmed as an aliphatic hydrocarbon
724	low	eicosane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE 9
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
736	low	2,6-bis-(1,1-dimethylethyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of a standard
756	low	2-methylpentadecane	confirmed as an aliphatic hydrocarbon
771	very low	1,6,7-trimethylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
809	low	2-methylhexadecane	confirmed as an aliphatic hydrocarbon
827	low	2,5-bis-(1,1-dimethylpropyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of s standard
847	low	2,3-dihydro-1,1,3-trimethyl-3-phenyl-1H-indene	confirmed as an aromatic hydrocarbon derivative
858	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
891	low	2-methyloctadecane	confirmed as an aliphatic hydrocarbon
905	low	docosane	confirmed as an aliphatic hydrocarbon
926	low	anthracene	confirmed as a polynuclear aromatic hydrocarbon, phenanthrene co-elutes with anthracene
936	low	pentatriacontane	confirmed as a polynuclear aromatic hydrocarbon
950	low	10-methyleicosane	confirmed as a polynuclear aromatic hydrocarbon
966	very low	1-(1,2-dimethylpropyl)-1-methyl-2-nonylcyclopropane	the base peak of m/z 83 in the spectrum is indicative of a cyclohexene derivative
979	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
995	low	dedocane	confirmed as an aliphatic hydrocarbon
1036	very high	hexadecanoic acid	confirmed as an aliphatic carboxylic acid
1084	medium	hexacosane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE 9
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
1105	low	2-nonylcyclopropaneundecanal	the fragmentation pattern is more indicative of an aliphatic carboxylic acid
1130	high	octadecanoic acid, butylester	confirmed on the basis of library fit
1146	medium	2,6,10,14-tetramethylhexadecane	the fragmentation pattern resembles spectra of aliphatic carboxylic acid
1160	low	hexacosane	the fragmentation pattern resembles spectra of aliphatic carboxylic acid
1178	very low	1,2-dibromododecane	the fragmentation pattern resembles spectra of aliphatic carboxylic acid
1208	medium	hexacosane	confirmed as an aliphatic hydrocarbon
1235	low	1-tetradecanol	confirmed as an oxygenated aliphatic hydrocarbon
1265	low	1,1-\3-(2-cyclopentylethyl)-1,5-pentanediyl\bis-cyclopentane	the spectrum is more indicative of a cyclohexane derivative
1293	low	hexacosane	confirmed as an aliphatic hydrocarbon
1328	low	1-heptacosanol	the spectrum indicative of aliphatic carboxylic acid
1407	low	hexacosane	confirmed as an aliphatic hydrocarbon
1437	very low	2-methyl-6-propyldodecane	confirmed as an aliphatic hydrocarbon
1547	low	11-(1-ethylpropyl)-heneicosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Bili

DATE 25 October 1979

GC/MS analysis of sample B-13A demonstrated the presence of a PNA, a phenolic compound, substituted aromatics, aliphatic carboxylic acids, aliphatic alcohols and other oxygenated compounds, aliphatic hydrocarbons and nitrogenous compounds. This sample has more oxygenated components and a greater Reconstructed Ion Chromatograph (RIC) intensity. The elevated THO value of 8.2 μg/1 (previously reported) for this sample is therefore in agreement with the GC/MS data. A higher Nitrogen Phosphorus Scan value could also be expected for a sample with increased relative RIC intensity. However, the previously reported value of 123 μg/1 cannot in this case, be explained in terms of increased intensity alone. The higher Nitrogen-Phosphorus Scan result is believed to be primarily due to the relative response of benzothiazole, a compound peculiar to this sample. See Table 9 for a listing of the compounds in sample B-13A.

Phenol levels reported for samples taken within the refuse layer are generally low in concentration probably due to the biodegradibility of those compounds in nature. The source of phenols may have been foundry sands accepted at the site.

Reported values for the Nitrogen-Phosphorus Scan from piezometer B-13A (June 21, 1979 report) are probably reflective of chemical dye residues.

Previously reported methylene chloride for B-13A (54.3 μg/1) is probably the result of solvent-bearing waste products.

Ground Water in the Semi-Confined Aquifer of the Onondaga Limestone

Ground water quality information for this zone was derived by using analytical data from monitoring well W-3 and piezometers B-23D and B-24D. Data for these samples are located in Table 5. Piezometer B-24D was located far enough from the service area so as not to be affected by the pumping service well.

TABLE 10

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13A
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
70	very low	1,2,3-trimethylaziridine	confirmed on the basis of library fit
83	very low	3-ethyl-3-methylpentane	confirmed as an aliphatic hydrocarbon
100	very low	6-methyl-2,4-heptanedione	confirmed in the absence of a standard
105	very low	1-hexen-3-ol	confirmed in the absence of a standard
113	very low	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
124	very low	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
157	very low	6-methoxy-2-hexanone	confirmed as an oxygenated aliphatic hydrocarbon
260	low	1,2-diethylbenzene	confirmed as an aromatic hydrocarbon
333	medium	1-methyl-3-propylbenzene	confirmed as an aromatic hydrocarbon
360	low	1-methyl-2-(1-methylethyl)-benzene	confirmed as an aromatic hydrocarbon
374	very low	2-ethyl-1-hexanol	interpreted as an aliphatic hydrocarbon
385	very low	2-methyl-,sec-butylesterbutyric acid	confirmed in the absence of a standard
425	low	methyl(1-methylethenyl)benzene	confirmed as an aromatic hydrocarbon
436	low	dodecane	confirmed as an aliphatic hydrocarbon
447	medium	1,3,3-trimethylbicyclo\2.2.1\ heptan-2-ol	confirmed on the basis of library fit
467	low	2-methylphenol	confirmed on the basis of library fit
486	low	(3,3-dimethylcyclohexylidene)-acetaldehyde	non-confirmable due to high amount of co-elution
509	high	4-methyl-1-(1-methylethyl)-3-cyclohexen-1-ol	confirmed in the absence of a standard
519	low	1-methyl-1,4-cyclohexadiene	confirmed in the absence of a standard
532	high	α,α,-4-trimethyl-3-cyclohexene-1-methanol	confirmed on the basis of library fit

Continued . . . .

TABLE 10
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13A
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
547	medium	1-ethenyl-4-ethylbenzene	confirmed on the basis of library fit
587	low	2-methylbutylester	confirmed as an oxygenated aliphatic hydrocarbon
605	low	benzothiazole	confirmed on the basis of library fit
622	low	2-methylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
647	low	2,7-dimethyloctane	confirmed as an aliphatic hydrocarbon
662	low	1H-indole	confirmed as an aromatic hydrocarbon
702	low	undecane	confirmed as an aliphatic hydrocarbon
719	high	3-methyl-1H-indole	confirmed as an aromatic hydrocarbon
736	low	2,6-bis(1,1-dimethylethyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of a standard
756	medium	α,α-dimethylbenzeneethanol	confirmed in the absence of a standard
773	low	1-methyl-3-propylbenzene	confirmed in the absence of a standard
807	low	7-tridecanone	confirmed as an aliphatic hydrocarbon derivative
822	medium	1-methyl-3-propylbenzene	confirmed as an aromatic hydrocarbon
857	low	docosane	confirmed as an aliphatic hydrocarbon
869	low	1-methyl-3-propylbenzene	confirmed as an aromatic hydrocarbon
902	low	2-methylpentadecane	confirmed as an aliphatic hydrocarbon
915	low	1-ethyl-3,5-dimethylbenzene	confirmed as an aromatic hydrocarbon
930	very low	1-ethyl-4-(1-methylethyl)benzene	confirmed as an aromatic hydrocarbon
945	low	2-methylheptadecane	confirmed as an aliphatic hydrocarbon
958	low	2-isopropyl-2,5-dimethylcyclohexanone	confirmed as a cyclohexane derivative

Continued . . . .

TABLE 10
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13A
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
971	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
990	low	docosane	confirmed as an aliphatic hydrocarbon
1028	very high	eicosanoic acid	confirmed as an aliphatic carboxylic acid
1041	low	1-tetradecanol	confirmed as an oxygenated aliphatic hydrocarbon
1077	high	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1119	high	octadecanoic acid, butylester	confirmed as an oxygenated aliphatic hydrocarbon
1134	high	2-methyloctadecane	interpreted as an oxygenated aliphatic hydrocarbon
1156	very low	heptacosane	confirmed as an aliphatic hydrocarbon
1193	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1222	very low	2,6,10,15-tetramethylheptadecane	confirmed as an aliphatic hydrocarbon
1265	medium	11-(1-ethylpropyl)-heneicosane	confirmed as an aliphatic hydrocarbon
1369	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1423	very low	docosane	confirmed as an aliphatic hydrocarbon
1493	low	pentratriacontane	confirmed as an aliphatic hydrocarbon
1567	very low	2-methyltetradecane	confirmed as an aliphatic hydrocarbon
1650	low	octacosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Bulis

DATE 25 October 1979

Piezometer B-24S (screened in Glacial Outwash) demonstrated a TVCO of 1,660 μg/l while B-24D (screened in Onondaga Limestone) had a TVCO of 22 μg/l. THO values for both piezometers (B-24S and B-24D) were low. The shallow piezometer demonstrated elevated concentrations for the following additional parameters relative to values observed in the deep piezometer: soluble iron, soluble manganese, and soluble zinc. The same relationship was also observed for piezometer pair B-23S (screened in Glacial Outwash) and B-23D (screened in Onondaga Limestone) with the exception that the conductivity and THO values for B-23S were also elevated relative to B-23D. Hydrogeologic investigations on this site have demonstrated that the semi-confined aquifer of the Onondaga Limestone receives recharge from the overlying glacial outwash deposits. Concentrations obtained for the TVCO analyses indicate that constituents from the glacial outwash may have migrated into the bedrock aquifer.

Piezometer B-24D was constructed in such a manner as to be located essentially upgradient of both the landfill and monitoring well W-3. Consequently, a comparison of data between these two points will permit a partial assessment of the impact of the landfill on ground waters in the bedrock aquifer. Comparison of B-24D and W-3 showed higher concentrations for the following parameters: conductivity, chlorides, ammonia, soluble iron, THO Scan, and TVCO Scan.

Again, it appears that some migration of constituents from overlying deposits into the bedrock aquifer is occurring. Constituents observed appear to be related to parameter concentrations identified in ground water samples collected from piezometers screened in both the glacial outwash deposits and the landfill.

Groundwater in the Glacial Outwash

The initial Hydrogeologic Investigation reported that the principal flow direction of ground water in the outwash was vertically downward into the underlying Onondaga limestone. That finding was reconfirmed by the construction of cluster wells B-23 and B-24 and the measurement of static water levels on August 23rd and September 20, 1979. The measurements are presented in Tables 2 and 3 of this hydrogeologic report. Levels obtained from cluster well B-15 demonstrates that ground water in the outwash has a pronounced downward gradient. Piezometers screened in this zone or at the landfill/outwash interface include: B-15S; B-17; B-18; B-19; B-20; B-21; B-22; B-23S and B-24S.

GC/MS Analysis of Previously Collected Samples

GC/MS analysis of the sample identified as B-15S demonstrated the presence of one PNA, one aliphatic alcohol, several phenolic compounds, nitrogenous compounds and numerous aliphatic hydrocarbons. The same relative amount of ECD responding compounds were previously reported for this sample (June 21, 1979 Report). Note that the previously reported THO value of 2.4μg/l (June 21, 1979 Report) is in the same range as the THO values reported for samples at this time. The earlier Nitrogen-Phosphorus Scan value of 20μg/l indicated the possible presence of nitrogenous compounds. As anticipated, several nitrogen containing compounds were identified in this sample. The constituents of sample B-15S are listed in Table 10.

GC/MS analysis of sample B-17 demonstrated the presence of one PNA, oxygenated aliphatic hydrocarbons and aliphatic hydrocarbons. The PNA and the oxygenated compounds are offered in explanation of the THO value of 1.4μg/l that was previously reported. Although a Total Organic Nitrogen Phosphorus Scan value of 27μg/l was reported, nitrogenous compounds were not detected in this sample.

TABLE

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-15S
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
72	medium	5-ethylthiazole	unable to confirm due to co-elution
76	medium	2-isocyanatopropane	confirmed as a nitrogenous compound
90	medium	bis(1,1-dimethylpropyl)-diaziridinone	unable to confirm due to co-elution, possibly nitrogenous
104	low	N-nitro-N-propyl-1-butamine	unable to confirm due to co-elution, possibly nitrogenous
113	medium	5-dodecanone	unable to confirm due to co-elution
121	medium	3-(2,2-dichloro-3-methylcyclo-propyl)-pentane	unable to confirm due to co-elution
128	medium	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon on the basis of library fit
142	low	3-ethyl-2-methyl-heptane	confirmed as an aliphatic hydrocarbon on the basis of library fit
182	low	2-methylnonane	confirmed as an aliphatic hydrocarbon on the basis of library fit
203	low	undecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
225	low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
234	low	4-methylheptane	unable to confirm due to co-elution
247	low	2-ethyl-4-methyl-1-pentanol	unable to confirm due to low abundance and co-elution
260	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
281	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
301	very low	2-methyl-(S)-1-dodecanol	unable to confirm due to co-elution
312	very low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon on the basis of library fit

Continued . . . .

TABLE 11
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-15S
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
327	low	4,8-dimethylundecane	confirmed as an aliphatic hydrocarbon
344	very low	4-methylundecane	unable to confirm due to low abundance and co-elution
353	very low	4,8-dimethylundecane	confirmed as an aliphatic hydrocarbon
373	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
394	very low	2-ethyl-4-methyl-1-pentanol	interperated as an aliphatic hydrocarbon
411	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
435	very low	2,2,3,3-tetramethylbutane	confirmed as an aliphatic hydrocarbon
433	very low	2-methyl-(S)-1-dodecanol	unable to confirm due to low abundance and co-elution
447	very low	propanoate-2-decanol	unable to confirm due to low abundance and co-elution
458	very low	2,5-dimethylundecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
461	very low	N-pentylidene ethanamine	unable to confirm due to co-elution and low abundance
466	very low	2,2,3,3-tetramethylbutane	confirmed as an aliphatic hydrocarbon
486	very low	2,2,4-trimethylpentane	confirmed as an aliphatic hydrocarbon
489	very low	5-butylnonane	unable to confirm due to co-elution
671	very low	2,4-bis(1-methylethyl)-phenol	confirmed as an aliphatic substituted phenol
688	very low	2,4-bis(1-methylethyl)-phenol	confirmed as an aliphatic substituted phenol
707	very low	2,6-bis(1,1-dimethylethyl)-4-methylphenol	unable to confirm due to co-elution
718	very low	2,6-bis(1,1-dimethylethyl)-4-methylphenol	unable to confirm due to co-elution and low abundance

Continued . . . .

TABLE 11
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-15S
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
737	very low	2,6-bis(1,1-dimethylethyl)2,5-cyclohexadiene-1,4-dione	confirmed on the basis of library fit
757	very low	2,6,10,14-tetramethylheptadecane	confirmed as an aliphatic hydrocarbon
810	very low	octadecane	confirmed as an aliphatic hydrocarbon
837	low	pentatriacontane	unable to confirm due to co-elution
847	low	nonylphenol	unable to confirm due to co-elution, possible phenolic compound
857	very low	octadecane	confirmed as an aliphatic hydrocarbon
870	very low	4-(1,1,3,3-tetramethylbutyl)-phenol	unable to confirm due to co-elution
885	very low	ethenylester dodecnoic acid	insufficient spectral data to confirm
902	low	octadecane	confirmed as an aliphatic hydrocarbon
928	very low	anthracene	confirmed as a polynuclear aromatic on the basis of library fit
946	low	2-methylheptadecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
974	low	9H-carbazole	confirmed as a nitrogenous aromatic hydrocarbon
989	very low	docosane	confirmed as an aliphatic hydrocarbon
1029	high	hexadecanoic acid	unable to confirm due to co-elution
1041	low	acetate 1-hexadecanol	confirmed as an aliphatic alcohol
1054	low	7-hexyldocosane	insufficient spectral data to confirm
1075	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1124	very high	pentatricontane	confirmed as an aliphatic hydrocarbon on the basis of library fit

Continued . . . .

TABLE 11
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-15S
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
1154	low	9-octylheptadecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
1184	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1217	very low	tetratetracontane	confirmed as an aliphatic hydrocarbon
1256	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon
1346	medium	11-docyldocosane	confirmed as an aliphatic hydrocarbon
1406	very low	11-(1-ethylpropyl)-heneicosane	confirmed as an aliphatic hydrocarbon
1423	very low	pentatriacontane	confirmed as an aliphatic hydrocarbon
1470	low	pentatriacontane	confirmed as an aliphatic hydrocarbon
1495	very low	2,6,10,15,19,23-hexamethyl-2,6, 10,14,18,22-tetracosahexaene	confirmed as an aliphatic hydrocarbon
1503	very low	2,6,10,15,19,23-hexamethyl-2,6, 10,14,18,22-tetracosahexaene	confirmed as an aliphatic hydrocarbon
1548	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1627	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. Timothy R Baker
DATE 10-22-79

Evaluation of the chromatograph for the Nitrogen-Phosphorus Scan of this sample revealed that the response was obtained primarily from one peak/compound. The failure to identify a nitrogen and/or phosphorus compond in this particular sample may be due to decomponsition during storage and/or the masking of this constituent by other peaks in the RIC. The tables which list abundances are determined by comparison of peak heights, relative to the highest peak in the RIC. These are not meant to be taken as definitive quantification but essentially proportional to the on-column concentration of the individual compounds. The majority of constituents from the GC/MS analysis of sample B-17 are shown to be aliphatic and aromatic hydrocarbons (Table 11).

Piezometers B-18, B-19, B-21, B-22, B-23S and B-24S

Elevated values for ground water samples collected from the glacial outwash probably have their origin in overlying deposited landfill debris. Hydraulic continuity between the two zones seems apparent as indicated by the presence in both zones of similar compounds. Higher concentrations in the refuse material, are not unexpected in light of materials deposited there. Parameters that demonstrated elevated concetrations include: conductivity, chlorides, ammonia, phenols, total organic carbon, soluble iron, soluble manganese,soluble zinc, TVCO Scan, and Nitrogen-Phosphorus Scan.

Metal values obtained may reflect prior disposal of such materials as waste oils/sludges, various types of sands, various sludges, fly ash and incinerator ash within the landfill.

Phenolic compounds in samples examined from the new borings generally showed low values (B-22 being the exception) probably owing to their degradibility over time within the landfill. Historically, foundry sands have been disposed of at the Lancaster site. Formerly foundry sands used phenol as a binding agent.

Chemical dye residues are the most likely source for elevated nitrogen and phosphorus containing organics.

High values for the Total Volatile Chlorinated Organics (TVCO) probably

TABLE 12

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-17
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
776	very low	2,6,10,14-tetramethylheptadecane	confirmed as an aliphatic hydrocarbon
828	very low	5-propyltridecane	confirmed as an aliphatic hydrocarbon
883	very low	pentacosane	confirmed as an aliphatic hydrocarbon
943	very low	pentacosane	confirmed as an aliphatic hydrocarbon
967	very low	phenanthrene	confirmed as a polynuclear aromatic hydrocarbon, anthracene co-elutes with phenanthrene
997	low	pentacosane	confirmed as an aliphatic hydrocarbon
1052	low	pentacosane	confirmed as an aliphatic hydrocarbon
1096	medium	hexadecanoic acid	confirmed as an oxygenated aliphatic hydrocarbon
1102	low	octadecane	confirmed as an aliphatic hydrocarbon
1127	very low	hexadecane	confirmed as an aliphatic hydrocarbon
1150	high	pentacosane	confirmed as an aliphatic hydrocarbon
1176	very low	tridecane	confirmed as an aliphatic hydrocarbon
1191	medium	octadecanoic acid, butylester	confirmed as an aliphatic hydrocarbon, some indications of oxygenation
1203	very high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1231	very low	eicosane	confirmed as an aliphatic hydrocarbon
1262	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1296	very low	pentacosane	confirmed as an aliphatic hydrocarbon
1340	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon
1380	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1432	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon
1487	very low	octacosane	confirmed as an aliphatic hydrocarbon
1553	low	7-hexyleicosane	confirmed as an aliphatic hydrocarbon
1627	very low	pentacosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Briles

DATE 25 October 1979

reflect the disposal of degreasers, solvent containing wastes, and possibly sulfonated materials. The Interagency Task Force on Hazardous Wastes has indicated that both chlorinated and non-chlorinated waste solvents were disposed of at the Lancaster site.

For both sets of paired piezometers (B-23S,D; B-24S,D) concentrations for the parameters examined were elevated in the shallow wells (S designation) relative to the deep wells (D designation). This distinction was particularly evident for the TVCO Scan. Given the definite presence of a vertical hydraulic gradient between the fill, the glacial outwash and the bedrock aquifer, migration of contaminants is certainly a distinct possibility.

Summary

All six samples analyzed by GC/MS were found to contain at least polynuclear aromatic hydrocarbon (s), oxygenated hydrocarbon(s), and several aliphatic hydrocarbons. Hexachloro-1,3-butadiene was detected in samples W-1, W-2 and B-13. All samples, with the exception of B-17, contained nitrogenous compounds. Substituted aromatic hydrocarbons were found in W-1, W-2, B-13 and B-13A. Two trichlorobenzene isomers were detected in sample B-13. Carboxylic acid derivatives were found in B-13 and B-13A. Phenolic compounds were observed in B-13A and B-15S.

The presence of previously reported pesticidal materials could not be confirmed via GC/MS due to the low levels believed to be present and/or the masking of these low level responses by other constituents of the RIC. The sources could have been the spraying of pesticides along the Thruway.

The quality of the ground-water in the region of the landfill will be influenced by the leachate generated within the fill. Rates of recharge/discharge, transmissivity of the outwash material, and the permeability of Onondaga limestone will determine the extent of contaminant migration. Analytical data generated to date confirm hydrogeologic conclusions regarding ground-water flow. Constituents from materials disposed of at the landfill are migrating in a south-westerly direction in the glacial outwash. Thus it doesn't appear likely that high TVCO values obtained at B-24S are as a result of leachate migration from the landfill. Further investigations are necessary to determine the source of the high TVCO readings in both B-23S and B-24S both located on the south side of the New York State Thruway.

Elevated concentrations for parameters examined in ground water samples collected from piezometers screened in the glacial outwash or at the glacial outwash/landfill interface confirm hydrogeologic conslusions regarding the vertical movement of ground waters from the landfill into the glacial outwash. Given this vertical component of ground-water movement, the potential exists for the influx of landfill derived constituents into the semi-confined aquifer.

PRIVATE WATER SUPPLY WELLS

A survey was conducted in the vicinity of the Lancaster Landfill site in an attempt to identify private water supply wells. After investigating many sources of information several private water supply wells were found to exist on the property of homes on both sides of roads north, south, east and west of the landfill. (North-Wehrle Drive, Shisler Road, Bergtold Road and Tillman Road; South-Genesee Street; East - Ransom Road; West- Gunnville Road).

Mr. Robert Jones, an employee at the Lancaster Landfill site, supplied the location of seven wells that he personally knew existed in the study area. Three of the seven wells are on Genesee Street,one well is used on a private estate south of Genesee Street, two wells are on Ransom Road in the Town of Lancaster, (one of which is abandoned) and one well is used for the Clarence Thruway Service Area. Mr. Jones also suggested that houses on Tillman Road used private wells because of the lack of a water line.

The Erie-Niagara Basin Ground Water Resources Study done by the Erie-Niagara Basin Regional Water Resource Planning Board contained information on one well located on the property at 6240 Genesee Street which is in the vicinity of the landfill. A chemical analysis was performed for this well but was not of use in this study because other analyses on private wells in the area were impossible to obtain. Requests were made to the New York State Health Department and the Erie County Health Department to look into past records but were denied due to a considerable time factor involved in searching through numerous files.

The study area borders the Town of Clarence and the Town of Lancaster. The Clarence Water Authority, which serves the Town of Clarence, has meter books sectioned by street name and number. The house numbers listed in the book in the landfill vicinity amounted to approximately forty-three plus a housing subdivision, a nursing home and a residence for the nursing home. About twenty-three homes have no service connections and are assumed to be using a private water supply well.

The Erie County Water Authority, which serves the Town of Lancaster, has filed cards which diagram the service installation procedure thereby showing connections to the water lines. Approximately thirty-two houses and two businesses have service connections and about twenty homes are assumed to be using private water supply wells.

As demonstrated by the above figures, many homes in the landfill area still use private water supply wells. Further analyses would be necessary to determine water quality of the private wells. Survey information is contained on Map No. 1 .

CONCLUSIONS

1. The Lancaster Sanitary Landfill is underlain by permeable glacial outwash deposits consisting primarily of stratified sands, silts, and some interbedded gravels. To the southeast of the site, glacio-lacustrine deposits consisting of clayey silts with some fine sands, deposited in quiescent lake conditions during the Pleistocene Epoch, were encountered during the exploratory drilling program. Glacial till also occurs on the southeastern portion of the site although its thickness was generally found to be less than 10 feet and discontinuous. The unconsolidated deposits previously described, overlie the Onondaga Limestone which is a highly permeable, semi-confined aquifer.

2. The unconsolidated deposits form a thickening wedge from the west to the east of the landfill body. Outwash deposits are generally absent on the west side of the landfill site. The Onondaga Limestone outcrops at land surface, west of the landfill property in the vicinity of the Lancaster Speedway.

3. Ground-water through and under the site occurs under two conditions. A localized ground-water table in the outwash deposits moves vertically downward into the semi-confined aquifer of the Onondaga Limestone. Lateral gradients within the outwash and refuse body suggest a south-westerly component of flow north of the Thruway.

   Ground-water also occurs under semi-confined conditions in the Onondaga Limestone. The semi-confined aquifer receives recharge from the overlying outwash deposits. Ground-water flow in the Onondaga Limestone generally moves northwest as suggested by measurements on September 20, 1979, in bedrock wells in and around the landfill body. The localized ground-water table within the outwash and the piezometric level of the semi-confined aquifer of the Onondaga Limestone are both under very low hydraulic gradients. The extremely low hydraulic gradient of each of these aquifers enhances the potential for dispersion of leachate generated from the landfill.

4. Landfilling has been conducted in former sand and gravel pits so that refuse was placed in or within close proximity of the original ground-water table surface in the outwash deposits. Subsequent filling above grade may also have resulted in some ground-water mounding into the refuse. The recently conducted boring program indicated that ground-water interception into the refuse mass was generally less than 10 feet and in one case, B-18, it was 14 feet.

5. The earth resistivity study conducted in August and September 1979, to assess leachate migration in the glacial outwash deposits and the Onondaga Limestone, did not indicate extensive plume migration from the landfill. Factors complicating the interpretation of our resistivity results were:
   1. A highly variable level of resistivity readings within the glacial outwash and glaciolacustrine deposits encountered in and around the site.
   2. The variable depth of outwash deposits overlying the highly resistant Onondaga Limestone.
   3. The possibility that other sources of ground-water contamination, most notably the New York State Thruway, could mask results from

the landfill itself.

One area of concern was noted on the northwest side of the main landfill body which is considered to be hydraulically downgradient in the semi-confined aquifer. The resistivity readings in this area were lower than expected for near-surface bedrock conditions thus indicating the possibility of some leachate migration in a west/northwest direction. The moderately low resistivity readings observed on the southeast portion of the study area south of the Thruway suggested leachate migration in this direction. The construction of cluster well B-24, encountered significant deposits of silty clays representing glaciolacustrine deposits. These would account for the much lower readings. Test soundings set up on "clean" and "dirty" outwash, showed wide variation in the resistivities of each material, thereby, masking leachate occurrence in the zones being tested. It is possible that the lower readings on the west/northwest side of the Lancaster Landfill could be a result of natural geologic changes and not the result of a leachate plume.

6. Ground-water in the outwash under the landfill is impacted by leachate.

7. Large scale ground-water pollution resulting from and attributable to land-filling was not revealed south of the immediate landfill body.

8. Quantitative evidence of halogenated organic contamination south of the landfill was revealed in samples from W-3, B-23 and B-24. This contamination has not been qualified and its character and origin is speculative.

9. Earth resistivity investigation could not detect the organic contaminants beyond the landfill due to the low comparative concentrations in ground water.

10. Under static conditions, ground-water resources east, northeast and southeast of the landfill are hydraulically upgradient of the landfill operation and are predicted to be outside the influence of any contamination resulting from the landfill. Nearby pumping wells, most notably the Clarence Service Center well, can induce pollutant migration in these directions.

11. The difference in constituent concentrations between wells in outwash and bedrock may be attributable to the dilution effects of the Onondaga Limestone. The limestone aquifer has characteristically high transmissibilities and wells penetrating this aquifer generally have high specific capacities suggesting the possibility of significant dilution potential.

12. A selective, qualitative, survey of area ground-water resources should be considered by the D.E.C. to assure that local ground-water resources are protected.

13. Certain contaminants, for which Federal Drinking Water Standards limit concentrations to very low levels, could occur in ground water and be undetected by earth resistivity methods. This could be the situation at the B-23 and B-24 locations.

14. The high Total Volatile Chlorinated Organic value in B-24S is not believed to be attributable to the landfill as it is hydraulically upgradient from the southeastern portion of the landfill.

RECOMMENDATIONS

1. Three bedrock monitoring wells should be constructed on the north, west and east sides of the Landfill as permanent ground-water monitoring points. The additional wells, in conjunction with existing wells, will provide the capability to monitor water quality within the semi-confined aquifer of the Onondaga Limestone on the periphery of the landfill complex. The additional wells will also serve the dual function of enabling accurate definition of flow directions in the limestone aquifer.
2. A D.E.C. approved monitoring program should be established in select borings and wells to monitor ground-water quality in both the outwash and bedrock aquifers around the site. The effectiveness of the monitoring program should be formally evaluated after two years' use.
3. Based on the findings in this supplemental report, no further site hydrogeological investigations are warranted at this time.
4. Additional GC/MS analyses on samples from: Well 3, B-23 (S and D), B-24 (S and D), is recommended to characterize the constituents comprising the THO and TVCO scans.
5. Pending results of recommendation #4, select soil samples from B-23, B-24, and W-3 may be recommended for appropriate analyses.
6. The results of this supplemental investigation support the conclusions and recommendations of the original hydrogeologic investigation.

With reference to the operation of the Clarence Service Center well, it is important to reiterate that:

(a) The Clarence Service Center well is in close proximity to the eastern portion of the landfill and the evidence strongly suggests that landfill-derived contaminants are being induced toward that active water supply well. The landfill, it is concluded, poses a continued threat to that water supply.

(b) If not already implemented, a comprehensive analytical program should be undertaken with respect to the water quality in the Thruway Service Center well. A regular monitoring program should be established for key water quality parameters so that the public is assured a safe water supply.

7. The conclusions of the two hydrogeologic reports and earlier discussions with the DEC suggest that the only safe recourse may be an alternate source of water supply for the Thruway Service Center. This would not only eliminate the potential risks of continued consumptive use but would also reduce the effects resulting from induced contaminant migration from well pumping.

The Erie County Water Authority runs a service line approximately 2800 feet from the Thruway's main building (Map 1). Connecting to that supply or evaluating alternative water sources appears to be worth serious consideration.

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APPENDICES

DATA PRESENTATION

Resistivity Theory and Basis of Use in Field
Raw Data Results of Resistivity Survey
Sounding Data Plots

Key to Visual Soils Identification
Boring Logs

October 22, 1979 Analytical Report

RESISTIVITY THEORY & BASIS OF USE IN FIELD

The following discussion is derived largely from the "Earth Resistivity Manual" by Soil Test, Inc.

All materials have the property of resistivity. Resistivity varies depending on physical factors such as material composition and saturation. Instruments capable of introducing electrical currents into the ground can measure the resistivity of earthen materials at various depths. Resistivity is related to resistance by the following equation:

$p = RA/L$ where

p = Resistivity

A = Cross Sectional area (L^2) of the block of conductive material being measured

L = length of block of material being measured

Resistance is measured in ohms; resistivity is commonly measured in ohm-feet or ohm-centimeters as indicated by the above equation. Resistivity can be thought of as the reciprocal of conductivity. Resistivity is commonly measured by delivering an electric current (I) into the ground and then measuring the potential gradient (V) of the electrically resistant material between the input electrodes (I) and two measuring electrodes attached to a voltmeter. The resistivity instrument measures V/I which is the resistance of the material.

The volume of material through which the current passes is proportional to the distance between the four electrodes and, therefore, the depth of the survey is proportional to the space between electrodes. Intuitively, the spacing between electrodes equals the depth measured although this should be confirmed by boring or other field verification.

For this study the basic formula for resistivity is given as:

$$p = 2 A(V/I)$$

where A = the spacing between adjacent electrodes (referred to as the A-spacing)

Perfectly homogeneous earth materials are genuinely rare. Field applications of resistivity refer to "apparent resistivity" as the resistivity measured in the preceding equation. Variations in apparent resistivity readings permit one to distinguish one type of subsurface material from another. Apparent resistivity is essentially a weighted average of all the different true resistivities in the volume of earth measured.

For most earth material, the resistivity decreases with increasing water content or increasing salinity; that is, they become more conductive. Dense bedrock or other non-porous materials ordinarily exhibit high resistivity values. Some porous but unsaturated materials, such as a dry sand, will exhibit moderately high resistivity values. Even saturated clean sands and gravel containing low dissolved solids (salts) can exhibit moderately high resistivity, hence, low conductivity. Conversely, dirty gravels containing intermixed clays will exhibit lower resistivities due to the free ion content (salinity) of the charged clay particles.

Because clays and silts are capable of holding more water (above the water table) then clean sands and gravels they, predictably, exhibit lower resistivity. Soils in valleys where fine-grained sediments can accumulate in moist environments characteristically exhibit lower resistivity. Equal resistivity readings do not always signify similar materials if the survey is conducted where moisture contents vary appreciably. Therefore, periods of extended rainfall can create problems in the interpretation of data results.

Resistivity can be correlated with various materials. For dense rocks, expected values may range from several thousand to several tens of thousands of ohm-feet. Clean gravels range from several hundred to several thousand ohm-feet. Most soils, since they are moist, and contain clays with net ionic charges, have lower resistivities in the range of 20 to 200 ohm-feet.

Electrolyte concentration in ground water increases conductivities within the zone of saturation resulting in lower resistivity. In order to utilize resistivity equipment in the detection of ground-water contamination from leachate salts, there must be rather significant contrasts in the conductance/ resistance of uncontaminated zones surrounding the contaminated area. It can be seen from the preceding discussion that earthen materials exhibit wide ranges in resistivity values. It is, therefore, essential to determine the resistive properties of the background materials prior to interpreting the results as they relate to contamination of ground water.

PROFILE OR SOUNDING STATION NUMBER S-1

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	286.5	.1	143.25
5	R	144.5	.1	72.25
	L	140.0	.1	70.00
	N	148	.1	148.00
10	L	77	.1	77.00
	R	72	.1	72.00
	N	137	.1	205.5
15	L	68	.1	102.0
	R	68.5	.1	102.75
	N	113	.1	226.00
20	L	55.5	.1	111.00
	R	60.5	.1	121.00
	N	102	.1	255.00
25	L	49	.1	122.5
	R	55	.1	137.5
	N	102	.1	306.00
30	L	52	.1	156.00
	R	54	.1	162.00
	N	101.5	.1	355.25
35	L	51.0	.1	178.50
	R	52.5	.1	183.75
	N	958.0	.01	383.20
40	L	478.5	.01	191.40
	R	481.0	.01	192.40
	N	957.5	.01	430.875
45	L	470.0	.01	211.00
	R	485.0	.01	218.25
	N	923.5	.01	461.75
50	L	459.5	.01	229.75
	R	474.0	.01	237.00
	N	891.0	.01	534.60
60	L	452.5	.01	271.50
	R	444.0	.01	266.40

PROFILE OR SOUNDING STATION NUMBER S-2

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	164.5	.1	822.5
5	R	752.5	.1	376.25
	L	856.0	.1	428.00
	N	86.0	1.0	860.00
10	R	441.0	.1	441.00
	L	395.0	.1	395.00
	N	431.00	.1	646.50
15	R	210.0	.1	315.00
	L	213.5	.1	320.25
	N	320.5	.1	641.00
20	R	145.5	.1	291.00
	L	171.0	.1	342.00
	N	277.5	.1	693.75
25	R	127.5	.1	318.75
	L	148.0	.1	370.00
	N	236.5	.1	709.50
30	R	115.0	.1	345.00
	L	118.0	.1	354.00
SKIP 35 & 40, COULDN'T GET STAKE IN GROUND				
	N	246.5	.1	1109.25
45	R	132.0	.1	594.00
	L	111.5	.1	501.75
	N	250.0	.1	1250.00
50	R	132.5	.1	662.50
	L	113.0	.1	565.00
	N	239.0	.1	1434.00
60	R	125.5	.1	753.00
	L	110.5	.1	663.00
	N	235.0	.1	1645.00
70	R	127.5	.1	892.50
	L	106.0	.1	742.00
	N	236.0	.1	1888.00
80	R	127.0	.1	1016.00
	L	106.0	.1	848.00
	N	223.5	.1	2145.60
96	R	116.0	.1	1113.60
	L	105.0	.1	1008.00

PROFILE OR SOUNDING STATION NUMBER S-3

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	634.0	.01	31.7
5	L	361.5	.01	18.08
	R	268.0	.01	13.4
	N	400.5	.01	20.0
5	L	91.5	.01	4.58
	R	26.0	.01	1.30
BAD READING				
	N	131.5	.01	39.45
30	R	682	.001	20.46
	L	590	.001	17.70
	N	813.5	.001	40.68
50	R	451.5	.001	22.58
	L	357.0	.001	17.85

PROFILE OR SOUNDING STATION   Number S-4

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	253	.1	1265.0
5	R	107.5	.1	537.5
	L	142	.1	710.0
	N	224.5	1	2245.0
10	R	112.5	1	1125.0
	L	110.0	1	1100.0
	N	211.5	1	3172.5
15	R	115.0	1	1725.0
	L	92.0	1	1380.0
	N	186.5	1	3730.0
20	R	101	1	2020.0
	L	820	.1	1640.0
	N	168.5	1	4212.5
25	R	904.5	.1	2261.25
	L	746.5	.1	1866.25
	N	154	1	4620.0
30	R	828	.1	2484.0
	L	685	.1	2055.0
	N	144.5	1	5057.5
35	R	770	.1	2695.0
	L	642.5	.1	2248.75
	N	132	1	5280.0
40	R	707	.1	2828.0
	L	583.5	.1	2334.0
	N	128	1	5760.0
45	R	669.5	.1	3012.75
	L	592.5	.1	2666.25
	N	118.5	1	5925.0
50	R	621	.1	3105.0
	L	539	.1	2695.0
	N	114	1	6840.0
60	R	588	.1	3548.0
	L	501.5	.1	3009.0
	N	100	1	7000.0
70	R	515	.1	3605.0
	L	461.5	.1	3230.5

PROFILE OR SOUNDING STATION NUMBER S-4 (cont.)

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	934.5	.1	7476.0
80	R	468	.1	3744.0
	L	448.5	.1	3588.0
	N	769	.1	7690.0
100	R	389.5	.1	3895.0
	L	369.5	.1	3695.0

NUMBER S-4A

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	170	1.0	5100
30	R	841	0.1	2523
	L	809	0.1	2427
	N	119	1	5950
50	R	594	.1	2970
	L	571	.1	2855

PROFILE OR SOUNDING STATION NUMBER S-5

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	586.5	.1	293.25
5	R	273.0	.1	136.50
	L	310.5	.1	155.25
	N	298.5	.1	298.50
10	R	152.5	.1	152.50
	L	145.0	.1	145.00
	N	183	.1	274.50
15	R	97.5	.1	146.25
	L	838	.01	25.70
	N	131	.1	262.00
20	R	684	.01	136.80
	L	609.5	.01	1121.90
	N	105.5	.1	263.75
25	R	528.5	.01	132.125
	L	512.5	.01	128.125
	N	88.5	.1	265.50
30	R	428.5	.01	128.55
	L	442.5	.01	132.75
	N	760	.01	266.00
35	R	371	.01	129.85
	L	382	.01	133.70
	N	693.5	.01	277.40
40	R	332.0	.01	132.80
	L	355	.01	142.00
	N	623	.01	280.35
45	R	302.5	.01	136.125
	L	316.5	.01	142.425
	N	576	.01	288.00
50	R	277	.01	138.50
	L	296.5	.01	148.25
	N	516.5	.01	309.90
60	R	247.0	.01	148.20
	L	268	.01	160.80

PROFILE OR SOUNDING STATION NUMBER S-5 (cont.)

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	468.5	.01	327.95
70	R	219.5	.01	153.65
	L	247	.01	172.90
	N	422.5	.01	338.00
80	R	190	.01	152.00
	L	228.5	.01	182.80
	N	358	.01	358.00
100	R	155.5	.01	155.50
	L	201	.01	201.00

PROFILE OR SOUNDING STATION NUMBER S-6

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	258.5	1.0	1292.5
5	R	121	1.0	605
	L	134	1.0	670
	N	123.5	1.0	1235.0
10	R	625.5	.1	625.5
	L	607.5	.1	607.5
	N	737.5	.1	1106.25
15	R	402.5	.1	603.75
	L	327.5	.1	491.25
	N	581.5	.1	1163
20	R	327	.1	654
	L	252	.1	504
	N	525.5	.1	1313.75
25	R	311.5	.1	778.75
	L	210.5	.1	526.25
	N	467.5	.1	1402.5
30	R	287.5	.1	862.5
	L	174.5	.1	535.5
	N	403.5	.1	1412.25
35	R	250.5	.1	
	L	152	.1	
	N	378	.1	1512
40	R	238	.1	
	L	143	.1	
	N	337.5	.1	1518.75
45	R	214	.1	963.0
	L	121	.1	544.5
	N	313.0	.1	1565
50	R	202.5	.1	1012.5
	L	108	.1	540
	N	249.5	.1	1497
60	R	166.1	.1	196.6
	L	84	.1	501.3
		835.5	.01	

PROFILE OR SOUNDING STATION NUMBER P-1

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	101.5	.1	304.5
30	R	511	.01	
	L	501.5	.01	
	N	794.0	.01	
60	R	420.0	.01	476.4
	L	374.0	.01	

NUMBER P-2

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	112.5	.1	337.5
30	R	570	.01	
	L	546	.01	
	N	860	.01	516
60	R	443.5	.01	
	L	415.0	.01	

NUMBER P-3

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	673.5	.1	2020.5
30	R	351.0	.1	
	L	329.0	.1	
	N	416	.1	2496
60	R	207.5	.1	
	L	215	.1	

NUMBER P-4

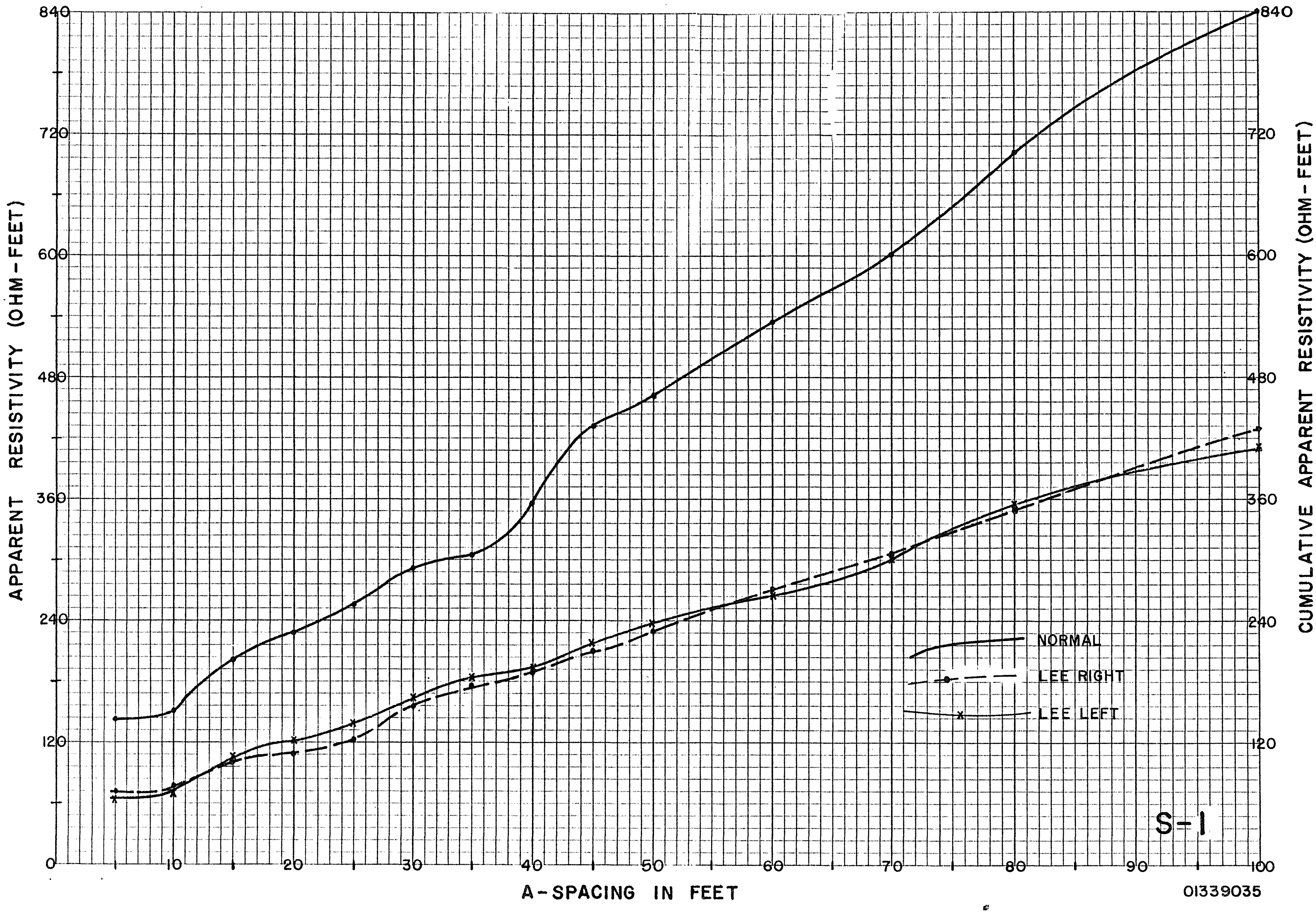
Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	314.5	.1	943.5
30	R	135.5	.1	
	L	178.0	.1	
	N	230	.1	1398
60	R	881.5	.01	
	L	231.5	.1	

NUMBER P-5

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	695.0	.1	2085
30	R	354.5	.1	
	L	336.0	.1	
	N	462.5	.1	2775
60	R	234.5	.1	
	L	227.0	.1	

PROFILE OR SOUNDING STATION **NUMBER P-6**

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	790.0	.1	2370
30	R	389.0	.1	
	L	393.0	.1	
	N	508.0	.1	3048
60	R	243.0	.1	
	L	260.5	.1	
	NUMBER P-7			
	N	159	1.	4770
30	R	673	.1	
	L	873	.1	
	N	113.5	1.	6810
60	R	497.5	.1	
	L	631.5	.1	
	NUMBER P-8			
	N	371.5	.1	1114.5
30	R	237.0	.1	
	L	137.5	.1	
	N	254.0	.1	1524.0
60	R	168.0	.1	
	L	893.0	.01	
	NUMBER P-9			
	N	145.5	.1	436.5
30	R	658.0	.01	
	L	783.0	.01	
	N	832.5	.01	499.5
60	R	404.5	.01	
	L	429.5	.01	
	NUMBER P-10			
	N	134.0	.1	402.0
30	R	649.5	.01	
	L	690.0	.01	
	N	778.5	.01	467.1
60	R	376.5	.01	
	L	401.0	.01	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CUMULATIVE APPARENT RESISTIVITY (OHM-FEET)
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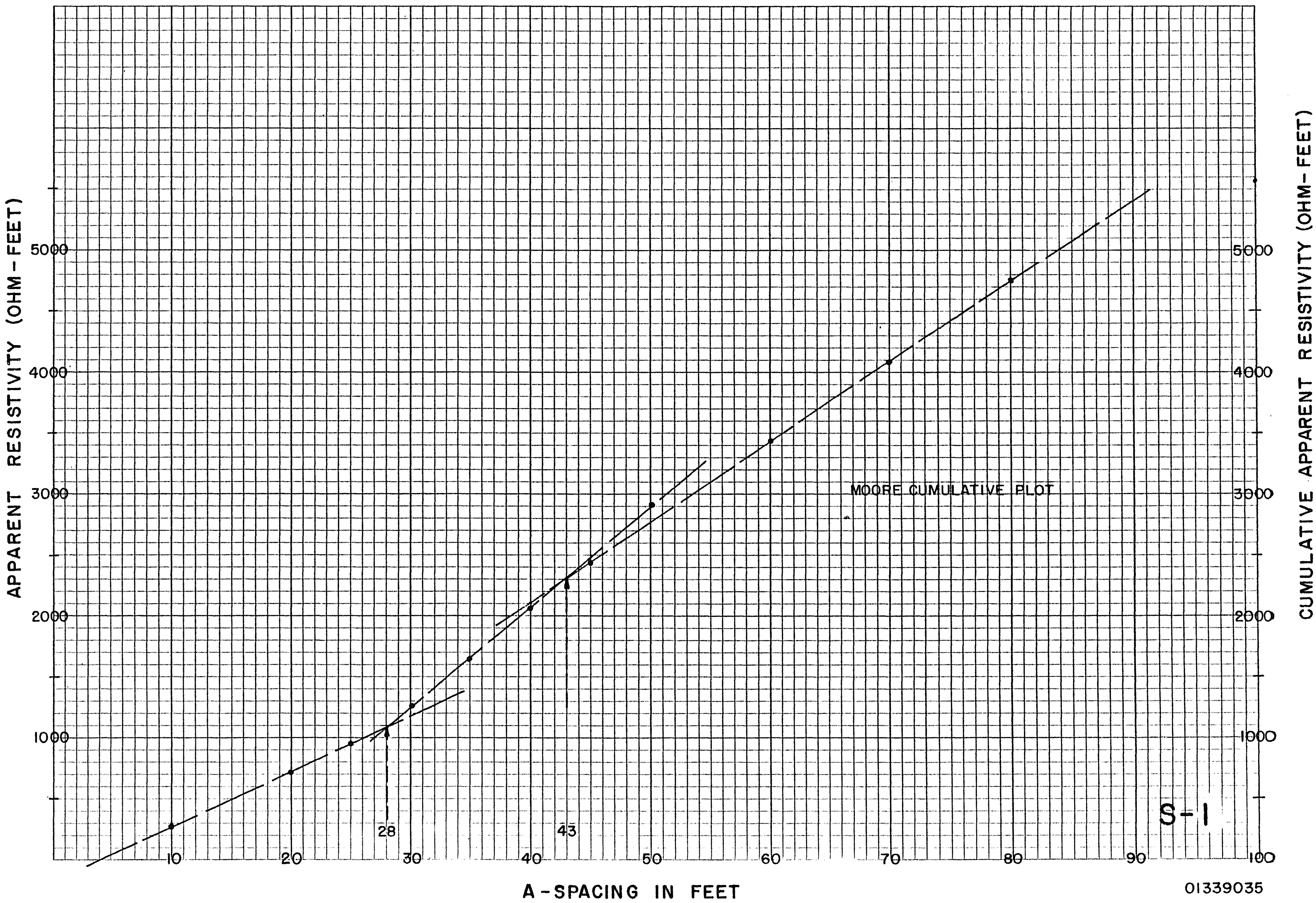
720
600
480
360
240
120
0
10
20
30
40
50
60
70
80
90
100
A-SPACING IN FEET
NORMAL
LEE RIGHT
LEE LEFT
S-1

01339035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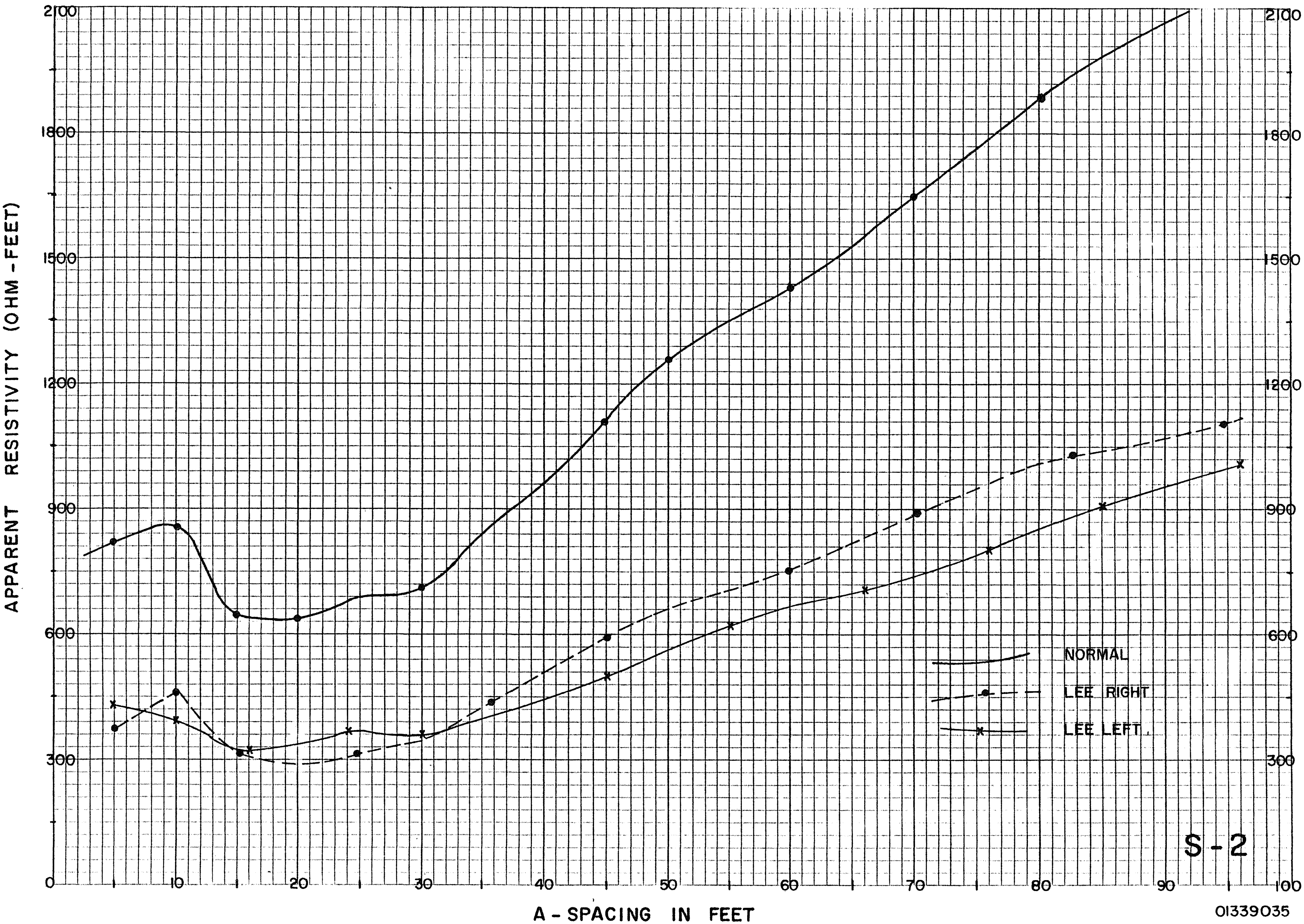
CUMULATIVE APPARENT RESISTIVITY (OHM - FEET)
5000
4000
3000
2000
1000
MOORE CUMULATIVE PLOT
28
43
10
20
30
40
50
60
70
80
90
100
A - SPACING IN FEET
S-1

01339035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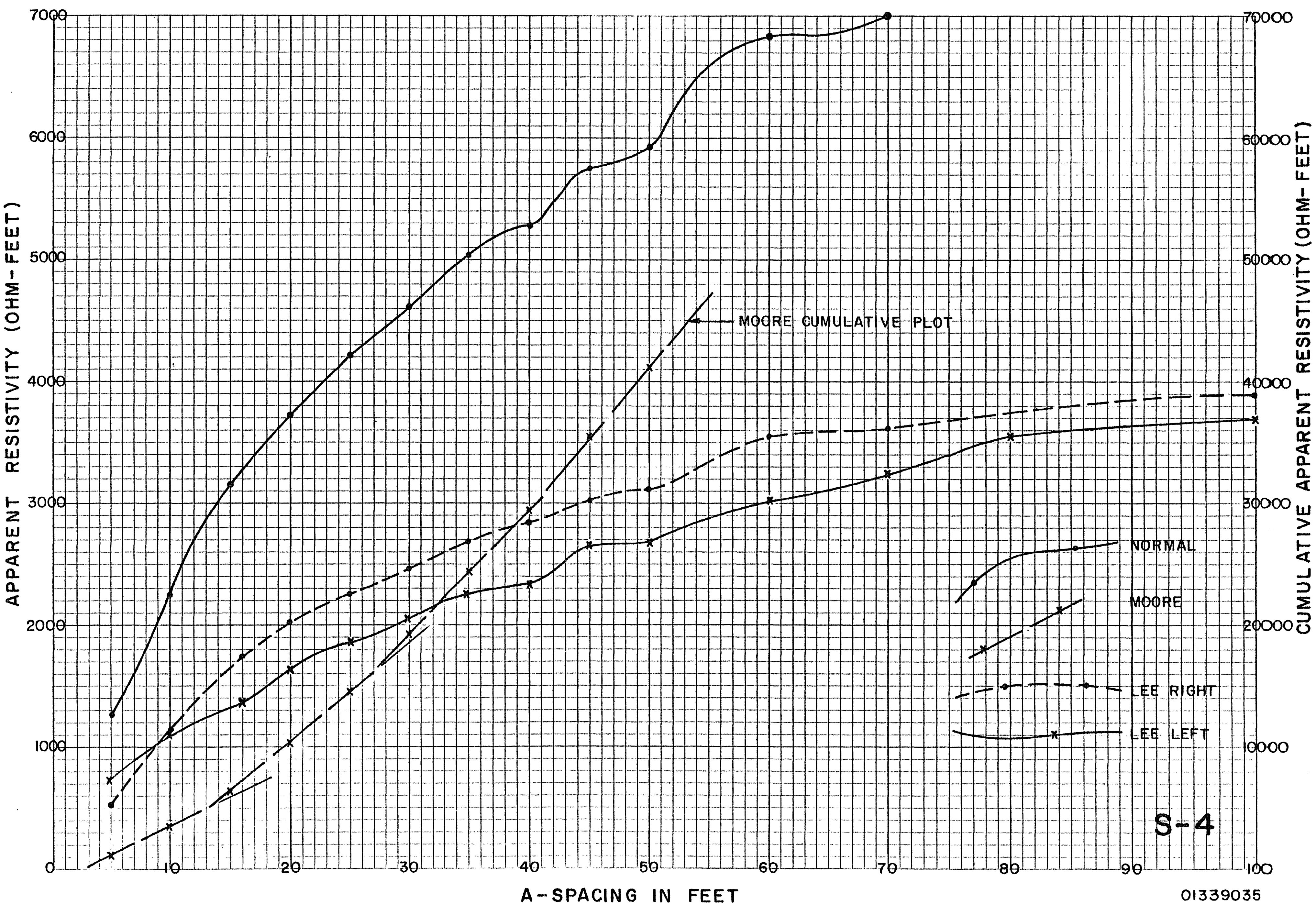
0
300
600
900
1200
1500
1800
2100
10
20
30
40
50
60
70
80
90
100
A-SPACING IN FEET
NORMAL
LEE RIGHT
LEE LEFT.
S-2

01339035

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 0703



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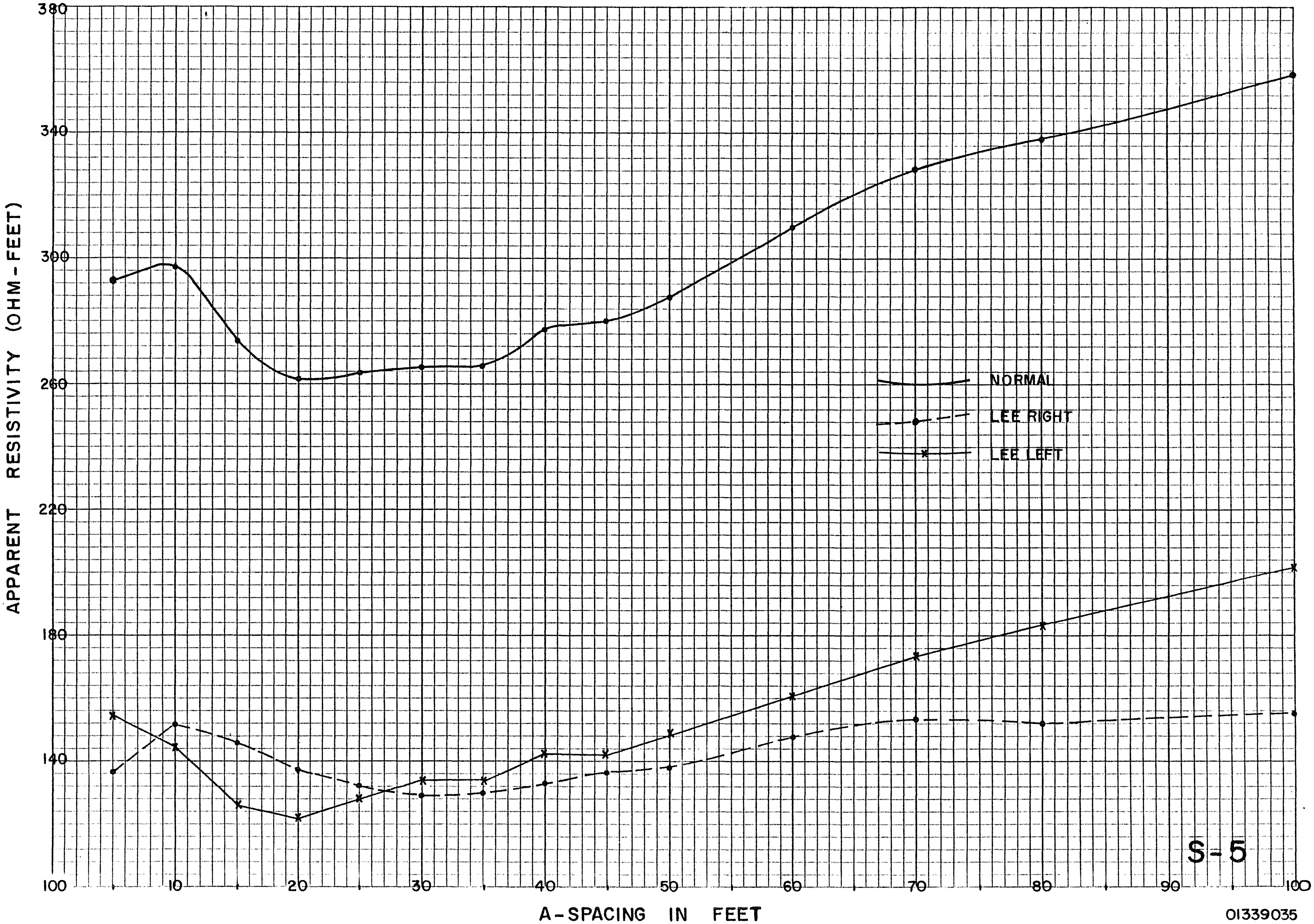
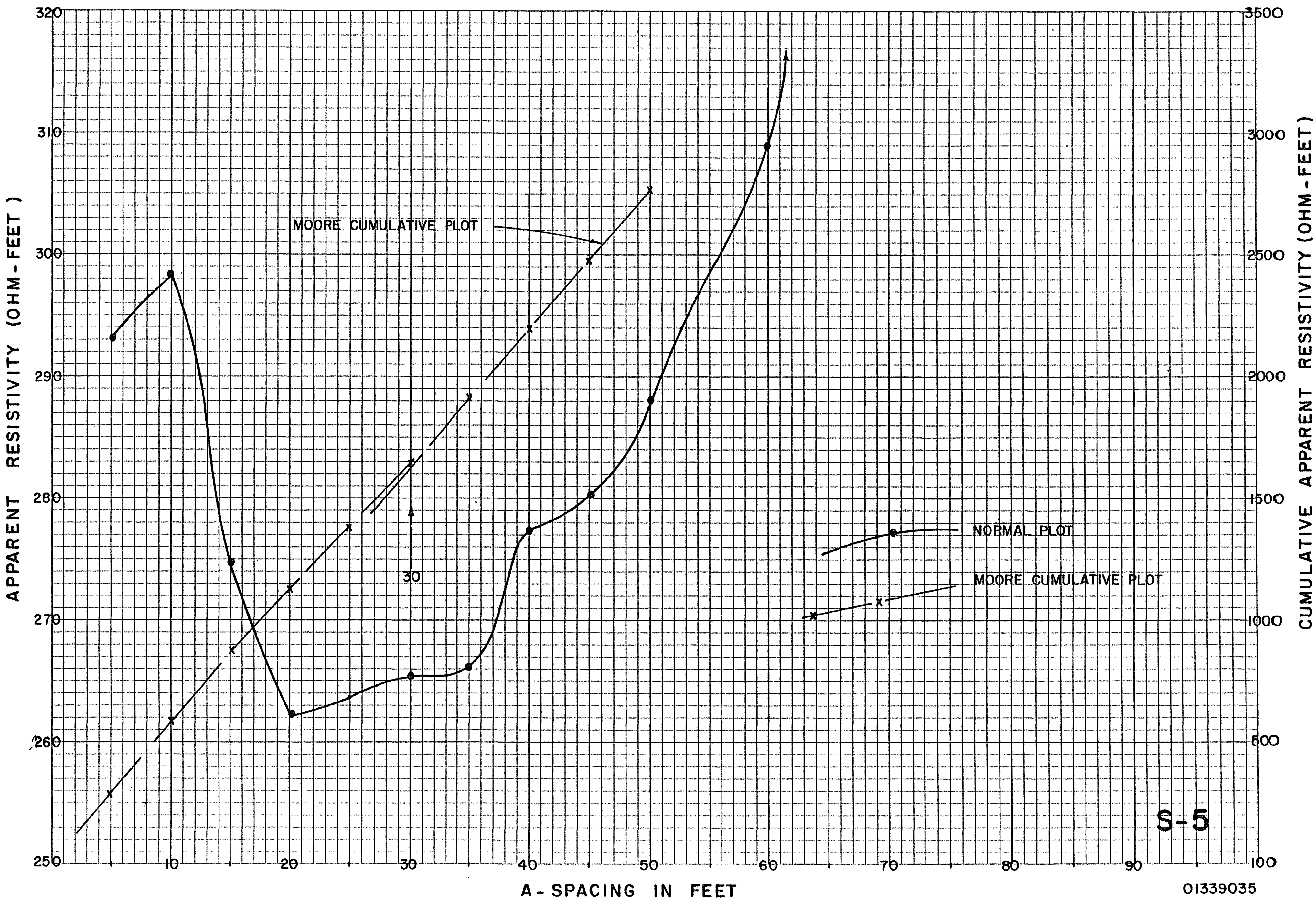
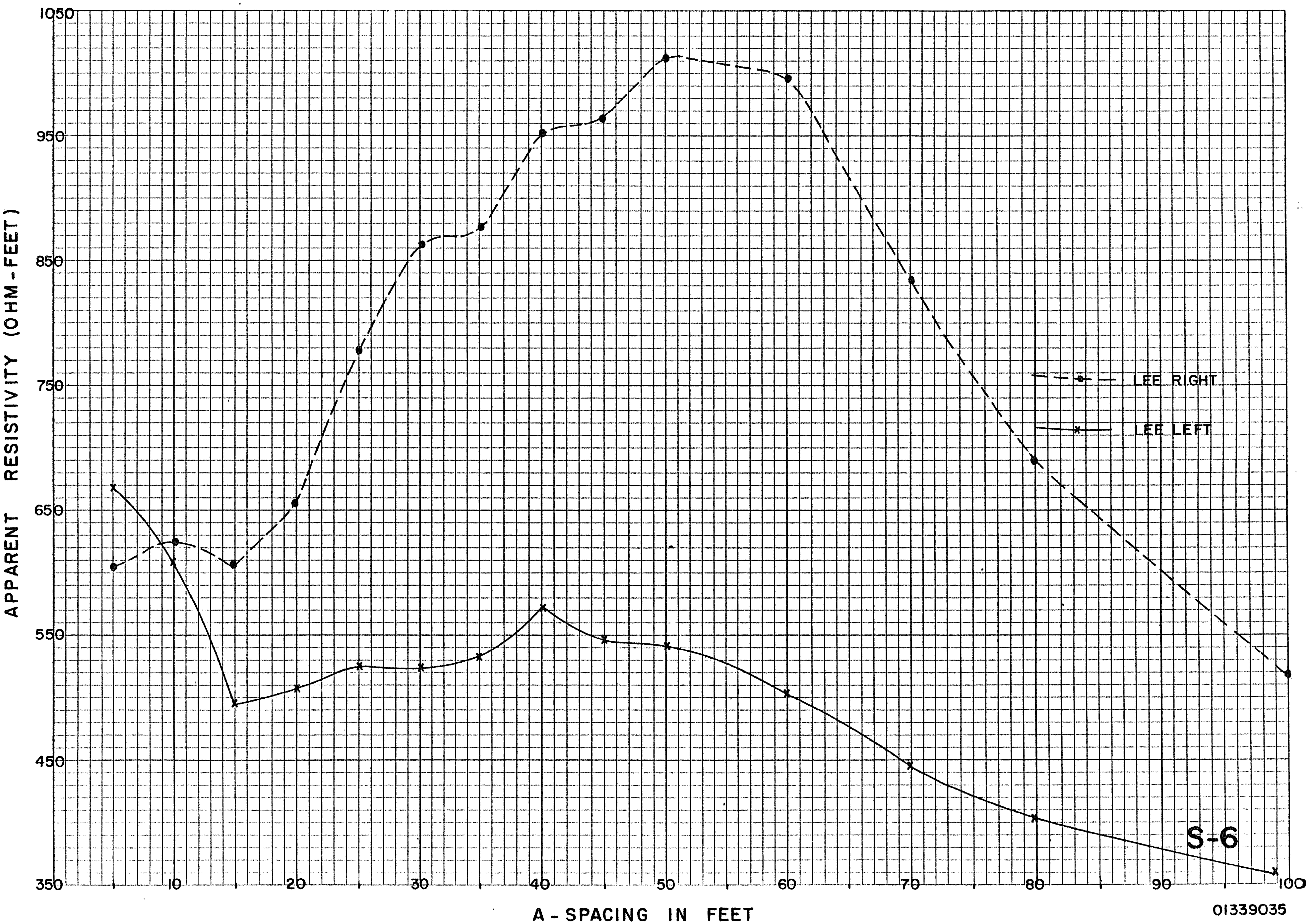

380
340
300
260
220
180
140
100
APPARENT RESISTIVITY (OHM - FEET)
NORMAL
LEE RIGHT
LEE LEFT
S-5
10
20
30
40
50
60
70
80
90
100
A-SPACING IN FEET

01339035


APPARENT RESISTIVITY (OHM-FEET)
CUMULATIVE APPARENT RESISTIVITY (OHM-FEET)
A-SPACING IN FEET
MOORE CUMULATIVE PLOT
NORMAL PLOT
MOORE CUMULATIVE PLOT
30
S-5
250
260
270
280
290
300
310
320
100
500
1000
1500
2000
2500
3000
3500
10
20
30
40
50
60
70
80
90

01339035

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 0703



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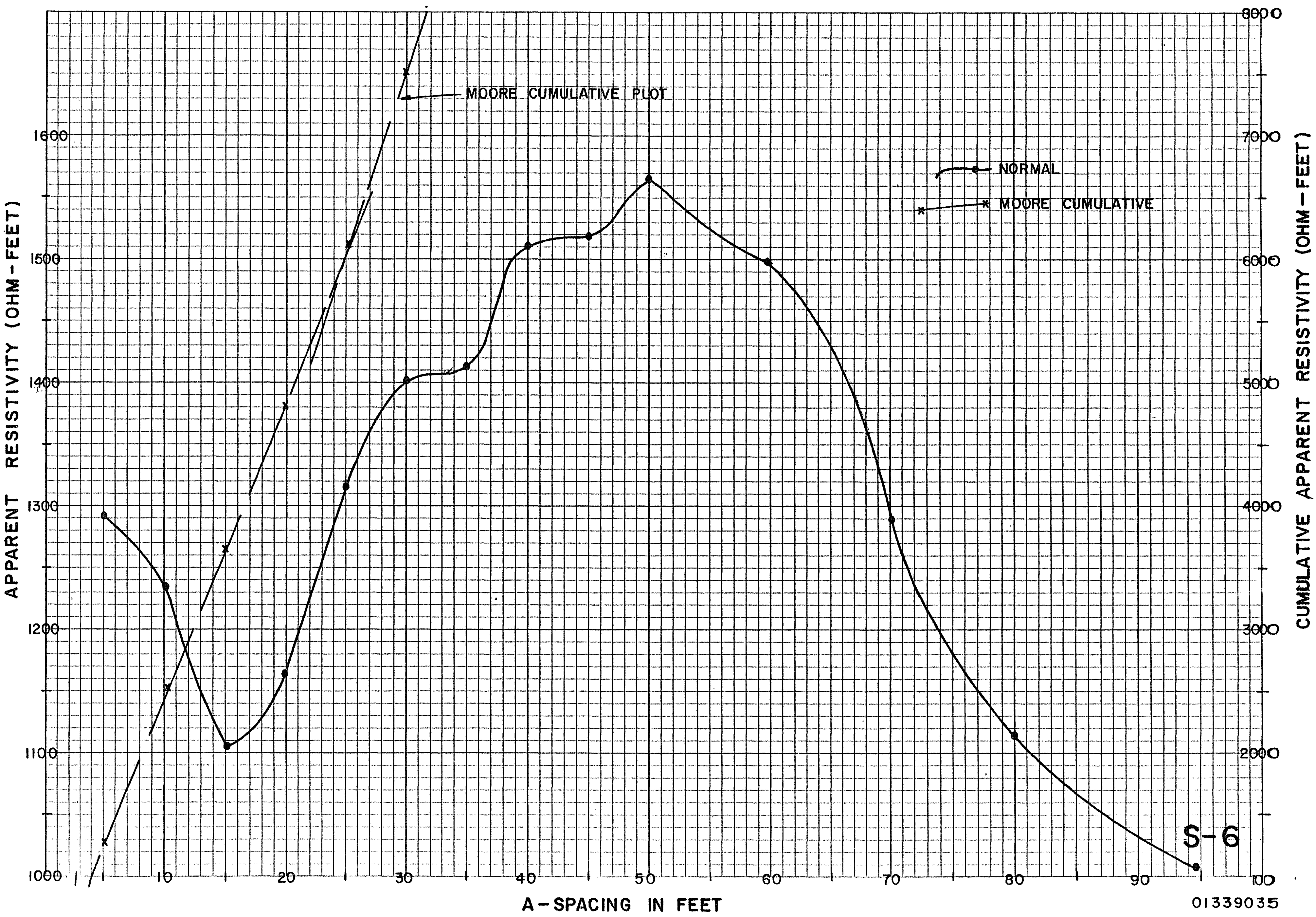

MOORE CUMULATIVE PLOT
NORMAL
MOORE CUMULATIVE
APPARENT RESISTIVITY (OHM-FEET)
CUMULATIVE APPARENT RESISTIVITY (OHM-FEET)
1000
1100
1200
1300
1400
1500
1600
100
2000
3000
4000
5000
6000
7000
8000
10
20
30
40
50
60
70
80
90
A-SPACING IN FEET
S-6

01339035

PROFILE OR SOUNDING STATION NUMBER P-11

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	119.5	.1	358.5
30	R	613.0	.01	
	L	591.0	.01	
	N	858.0	.01	514.8
60	R	438.0	.01	
	L	423.5	.01	

NUMBER P-12

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	729.5	.01	218.85
30	R	379.0	.01	
	L	347.0	.01	
	N	533.0	.01	319.80
60	R	271.0	.01	
	L	261.0	.01	

NUMBER P-13

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	991.0	.01	297.3
30	R	495.5	.01	
	L	494	.01	
	N	642	.01	385.2
60	R	322.5	.01	
	L	319.0	.01	

NUMBER P-14

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	746.5	.1	2239.5
30	R	412.5	.1	
	L	334	.1	
	N	282	.1	1692
60	R	157.5	.1	
	L	125	.1	

NUMBER P-15

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	112.2	.01	33.6
30	R	429.0	.001	
	L	666.0	.001	
	N	907.5	.001	22.74
60	R	379.0	.001	
	L	526.5	.001	

PROFILE OR SOUNDING STATION NUMBER P-16

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	883.5	.01	265.05
30	R	420.5	.01	
	L	464.0	.01	
	N	568.5	.01	341.1
60	R	278.5	.01	
	L	288.5	.01	

NUMBER P-17

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	436.5	.1	1309.5
30	R	223.5	.1	
	L	211.0	.1	
	N	391.0	.1	2346
60	R	224.0	.1	
	L	163.5	.1	

NUMBER P-18

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
	N	255.0	.1	765
30	R	112.5	.1	
	L	144.5	.1	
	N	164.5	.1	987
60	R	812.5	.01	
	L	858.0	.01	

NUMBER P-19

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
5	N	483	.1	241.50
	R	245.5	.1	122.75
	L	232.5	.1	116.25
10	N	268.5	.1	268.50
	R	133.5	.1	133.50
	L	135	.1	135.00
30	N	140	.1	420.00
	R	697	.01	209.10
	L	691	.01	207.30
60	N	119	.1	714.00
	R	604	.01	362,40
	L	577	.01	346.20

PROFILE OR SOUNDING STATION NUMBER P-20

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
5	N	503	1	2515.00
	R	249	1	1245.00
	L	260	1	1300.00
10	N	240	1	2400.00
	R	102	1	1080.00
	L	137.5	1	1275.00
30	N	330	.1	990.00
	R	160.5	.1	481.50
	L	185.5	.1	541.50
60	N	178	.1	1068.00
	R	944	.01	566.40
	L	855		513.00

NUMBER P-21

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
5	N	276	.1	138.00
	R	143.5	.1	71.75
	L	135	.1	67.50
10	N	173	.1	173.00
	R	894.5	.01	89.45
	L	851	.01	85.10
30	N	115.5	.1	346.50
	R	596	.01	178.80
	L	570.5	.01	171.15
60	N	982	.01	589.20
	R	494.5	.01	296.70
	L	491.5	.01	294.90

NUMBER P-22

Electrode Spacing (A-Spacing) in feet	Configuration	Dial Reading	Multiplier	Apparent Resistivity
5	N	334	.1	167.00
	R	174	.1	87.00
	L	159.5	.1	79.75
10	N	160	.1	160.00
	R	831.5	.01	83.15
	L	770.5	.01	77.05
30	N	489.5	.01	146.85
	R	252	.01	75.60
	L	237	.01	71.10
60	N	283.5	.01	170.10
	R	138	.01	82.80
	L	146	.01	87.60

KEY TO VISUAL SOILS IDENTIFICATION

A. Granular Soils - Particle Size Classification

Material		Symbol	Fractions	Sieve Limit	
				Upper	Lower
BOULDERS	Material retained on the 9 in. sieve	Bldr			9 in.
COBBLES	Material passing the 9 in. sieve and retained on the 3 in. sieve	Cbl		9 in.	3 in.
GRAVEL	Material passing the 3 in. sieve and retained on the No. 10 sieve	G	coarse (c) medium (m) fine (f)	3 in. 1 in. 3/8 in.	1 in. 3/8 in. No. 10
SAND	Material passing the No. 10 sieve and retained on the No. 200 sieve	S	coarse (c) medium (m) fine (f)	No. 10 No. 30 No. 60	No. 30 No. 60 No. 200
SILT	Material passing the No. 200 sieve that is non-plastic in character and exhibits little or no strength when air-dried	$		No. 200	

B. Clay Soils - Plasticity Classification

Material*	Symbol	Degree of Over-all Plasticity	Overall Plasticity Index Sand - Silt - Clay Components
Clayey SILT	Cy $	Slight	1 to 5
SILT & CLAY	$ & C	Low	5 to 10
CLAY & SILT	C & $	Medium	10 to 20
Silty CLAY	$y C	High	20 to 40
CLAY	C	Very high	40 and greater

*Soils passing the No. 200 sieve which can be made to exhibit plasticity and clay qualities within a certain range of moisture content, and which exhibits considerable strength when air-dried.

C. Terms Identifying Gradation of Sand & Gravel Soils

Written	Symbol	Defining Proportions by Weight
No modifier		Approximately equal amounts of coarse, medium, and fine components
medium to fine	mf	Somewhat more medium than fine, less than 10 percent coarse
fine to medium	fm	Somewhat more fine than medium, less than 10 percent coarse
coarse to medium	cm	Somewhat more coarse than medium, less than 10 percent fine
medium to coarse	mc	Somewhat more medium than coarse, less than 10 percent fine
fine	f	Predominantly fine, less than 10 percent medium and coarse
medium	m	Predominantly medium, less than 10 percent fine and coarse
coarse	c	Predominantly coarse, less than 10 percent fine and medium

D. Terms Identifying Composition of Soil

Written*	Symbol	Defining Range of Percentage by Weigh
and	a	35 to 50
some	s	20 to 35
little	l	10 to 20
trace	t	0 to 10

*Plus (+) or minus (-) sign used after identifying term denotes extremes of range; e.g., "some (-) Gravel" indicates 20 to 24 percent Gravel; "some (+) Gravel" indicates 31 to 35 percent Gravel.

E. Miscellaneous Descriptive Terms

Color	Soil Deposition	Size	Miscellaneous
rd - red	vvd - varved	lge - large	veg - vegetation
br - brown	ptg - parting	sm - small	Ss - sandstone
bk - black	pkt - pocket	thk - thick	Sh - shale
gy - gray	lyr - layer	thn - thin	fr - fragment
or - orange	lns - lens		jnk - junk
tn - tan	mtld- mottled		F - fill
yl - yellow			org - organic
dk - dark			Ts - topsoil
lt - light			occ - occasional
			desic-desiccated

NOTE: In writing soil description, the primary soil component is placed first and is capitalized; lesser components have first letter only capitalized; e.g., "rd br fm S, l $, t G, occ Bldr" indicates red-brown fine to medium SAND, little Silt, trace Gravel, occasional Boulder.

WEHRAN ENGINEERING

TEST BORING LOG

Project No. 9035 Client Lancaster Sanitary Landfill Boring No. B-18

Project ______ Date Start 8-23-79

Location Lancaster, Erie County, New York Date Finish 8-27-79

Type of Rig CME Auger Driller Empire Soils Inspector KGZ

Depth	Elevation 3.8' SU	Casing Blows/ft	Sample No.	Type	Spoon blows 6" Penetr.		Average Blows/ft	Log	Classification "O" Elev. = 760.1	Remarks
cement plug		18" rec	1	ss	1 / 9	3 / 8	12		Top 5" is topsoil, then 10" of SAND, trace Gravel	
									Refuse begins @ 15" - consists of assortment of: Plastic, rubber, wood, paper, organics (plants), glass, metal fiber, etc.	Dry
5		1" rec	2	ss	62 / 6	12 / 5	18			
10		12" rec	3	ss	8 / 12	9 / 10	21		At 10' - 8" of fly ash-like material	Dry-moist
15		6" rec	4	ss	5 / 3	4 / 4	7			Moist
20	1 1/4" steel pipe	No rec	5	ss	24 / 8	13 / 8	21			
25		11" rec	6	ss	10 / 7	11 / 10	18			Wet
30		9" rec	7	ss	12 / 8	7 / 6	15			
35		8" rec	8	ss	8 / 33	15 / 27	48		At 35.5': Refuse mixed with f-c Gravel.	

WEHRAN ENGINEERING

TEST BORING LOG

Project No. 9035 Client Lancaster Sanitary Landfill Boring No. B-18

Project Date Start 8-23-79

Location Lancaster Erie County, New York Date Finish 8-27-79

Type of Rig CME Auger Driller Empire Soil Inspector KGZ

Depth	Elevation	Casing Blows/ft	Sample No.	Sample Type	Spoon blows 6" Penetr.		Average Blows/ft	Log	Classification "O" Elev. = 760.1	Remarks
	Johnson Red Head Well Pt.	11" rec	9		15 7	11 14	18		At 40'-top 3"-refuse, gravel, running mud. Then 8" of c-f SAND Auger Refusal at 45.0'-(Bedrock?)	Saturated
45									End of Boring	
									Installed well-point at 44.0', encountered running sand at 42' until 34'. Fill with clean sand, 2' cement plug to surface.	
0										
5										
0										
5										
0										
5										

WEHRAN ENGINEERING

TEST BORING LOG

Project No. 9035 **Client** Lancaster Sanitary Landfill **Boring No.** 19

Project **Date Start** 8/29/79

Location Lancaster, Erie County, New York **Date Finish** 8/29/79

Type of Rig CME Auger **Driller** Empire Soils **Inspector** KGZ

Depth	Elevation (2.8' SU)	Casing Blows/ft	Sample No.	Sample Type	Spoon blows 6" Penetr.		Average Blows/ft	Log	Classification "O" Elev. = 773.8	Remarks
0	Cement plug	10"	1	ss	2	5			Top 4" - light brown c-f SAND, little Gravel, trace Silt. Mixed refuse - recently deposited.	Moist
5		NO Rec			100/2"		600			
10		10" Rec	2	ss	12 10	10 15	20		At 10':3" of grass with soil, underneath is decayed refuse mixed in mud, including: paper, metal, glass, wood, fabric.	Wet
15		2" Rec	3	ss	105 27	47 8	74			
20		3" Rec	4	ss	27 29	15 9	44			Saturated
25	1 1/4" Steel pipe	7" Rec	5		47 100/2"	17	317			
30		12" Rec	6	ss	9 29	25 16	54		3" clay in between decomposed refuse (@30')	
35		18" Rec	7		9 6	74 13	80		2"-3" coarse sandy material in between decomposed refuse (@35')	
~38									Interface at ~38.0' (between refuse & underlying material)	

WEHRAN ENGINEERING

TEST BORING LOG

Project No. 9035 **Client** Lancaster Sanitary Landfill **Boring No.** 19

Project ____ **Date Start** 8/29/79

Location Lancaster, Erie County, New York **Date Finish** 8/29/79

Type of Rig CME Auger **Driller** Empire Soils **Inspector** KGZ

Depth	Elevation	Casing Blows/ft	Sample No.	Sample Type	Spoon blows 6" Penetr.		Average Blows/ft	Log	Classification "O" Elev. = 773.8	Remarks
		21" Rec	8	ss	45 88	66 87	149		At 40' - 2" Brown-Gray Silty fine SAND; then decayed wood and paper.	Saturated
45	Johnson Red Hex Well Point	20" Rec	9	ss	21 29	25 30	54			
50		14" Rec	10	ss	68 116	76	192		Same sand to bottom End of Boring 50.5'	
									Set well point at 50.0', backfill with clean silica sand; cement grout plug 2' to surface 2.8' stick up.	
5										
0										
5										
0										
5										

WEHRAN ENGINEERING

TEST BORING LOG

Project No. 9035 **Client** Lancaster Sanitary Landfill **Boring No.** B-20

Project ______ **Date Start** 8/30/79

Location Lancaster, Erie County, New York **Date Finish** 8/30/79

Type of Rig CME-Auger **Driller** Empire Soils **Inspector** KGZ

Depth	Elevation (3.5' su)	Casing Blows/ft	Sample No.	Sample Type	Spoon blows 6" Penetr.		Average Blows/ft	Log	Classification "O" Elev. = 779.4	Remarks
cement plug		12"	1	ss	1	10	22		Top 2" - Clean top soil Next 9" - Brown fine SAND, some Clayey Silt, trace fine Gravel	Moist (recent rain)
		Rec			12	23				
5		12"	2	ss	21	7	33		Bottom 1" - glass & paper AUGER REFUSAL - moved rig 3'-5' At 5': refuse (little decay) including: wood, plastic, fiber, paper, glass	
		Rec			26	13				
10		NO	Rec		100/0"					Dry
15		24"	3	ss	100/.4"		300			Moist
		Rec								
20	1 1/4" steel pipe	6"	4	ss	40	40	58			
		Rec			18	20				
25		6"	5	ss	9	11	22			
		Rec			11	7				
30		24"	6	ss	120/.3'		480		Refuse continues to interface with SAND @ ~38.5'	
		Rec								
35		6"	7	ss	6	19	31			Wet
		Rec			12	15				

WEHRAN ENGINEERING

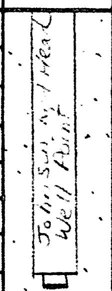
TEST BORING LOG

Project No. 9035 Client Lancaster Sanitary Landfill Boring No. B-20

Project ________ Date Start 8/30/79

Location Lancaster, Erie County, New York Date Finish 8/30/79

Type of Rig CME-Auger Driller Empire Soils Inspector KGZ

Depth	Elevation	Casing Blows/ft	Sample No.	Sample Type	Spoon blows 6" Penetr.	Spoon blows 6" Penetr.	Average Blows/ft	Log	Classification "O" Elev. = 779.4	Remarks
		22" Rec	8	ss	45 83	66 87	149		Brown Silty fine SAND	Wet
45		24" Rec	9	ss	21 29	25 30	54			
									Sand continues to bottom	Saturated
50		24" Rec	10	ss	68 116	76	192		End of Boring at 51.5'	
5									Backfill with clean silica sand; set well-point at 47.0', continue to fill with sand; cement grout 2' to surface.	
0										
5										
0										
5										

WEHRAN ENGINEERING

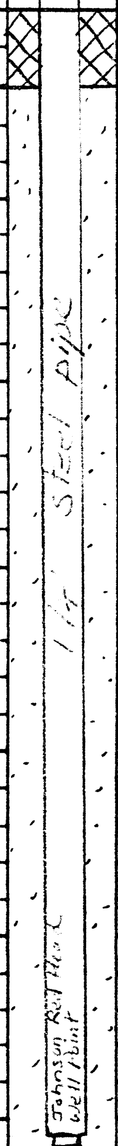
TEST BORING LOG

Project No. 9035 **Client** Lancaster Sanitary Landfill **Boring No.** B-21

Project ______ **Date Start** 8/28/79

Location Lancaster, Erie County, New York **Date Finish** 8/28/79

Type of Rig CME Auger **Driller** Empire Soils **Inspector** KGZ



Depth	Elevation	Casing Blows/ft	Sample No.	Type	Spoon blows 6" Penetr.		Average Blows/ft	Log	Classification "O" Elev. = 766.0	Remarks
0		4" Rec	1	ss	4 10	7 10	17		Pebbles at surface - Brown m-f SAND, some Silt & Clay.	Moist (flash rain storm)
5		8" Rec	2	ss	13 7	6 9	13		Assorted Refuse - including: wood, paper, plastic, glass, al. foil, etc.	Moist
10		5" Rec	3	ss	13 8	15 14	23			
15		5" Rec	4	ss	7 7	9 4	16			
20		6" Rec	5	ss	170/6"		340		Refuse/Sand interface at ~24.0'	
25		18" Rec	6	ss	31 72	56 99	128		Gray brown Silty fine SAND (to bottom)	Saturated
30		22" Rec	7	ss	13 76	60 98	136			
35		24" Rec	8	ss	15 41	23 62	64		End of Boring 37.0'	

Running sand backfilled, set well point at 30.5', backfill with clean silica sand. Cement grout plug 2' to surface. Stick up 3.3'

SHEET 1 OF 1

WEHRAN ENGINEERING

TEST BORING LOG

Project No. 9035 **Client** Lancaster Sanitary Landfill **Boring No.** B-22

Project ____ **Date Start** 8/27/79

Location Lancaster Erie County, New York **Date Finish** 8/28/79

Type of Rig CME Auger **Driller** Empire Soils **Inspector** KGZ

Depth	Elevation (2 1/4" Su)	Casing Blows/ft	Sample No.	Sample Type	Spoon blows 6" Penetr.		Average Blows/ft	Log	Classification "O" Elev. = 772.3	Remarks
	cement plug	8" Rec	1	ss	9 / 15	24 / 66	39		Sand and Gravel mixed with Refuse at surface	Dry
										to
5		4" Rec	2	ss	150/4"		450		Newspaper	Moist
10	1 1/4" steel pipe	5"	3	ss	75	180/2"	615		Paper, cardboard, plastic, tin	
15		NO Rec		ss	very hot &smoking					
20		4" Rec	4	ss	9 / 7	6 / 5	13		1" void pocket - methane gas vented out. Some refuse	Moist
25		8" Rec	5	ss	8 / 23	14 / 7	37		Foam rubber, fabric, wood	
30	Johnson Kit Head Well Point	4" Rec	6	ss	160/4"		480		Wood, Paper	Wet
35		8" Rec	7	ss	10	5 / 13	15		Decaying refuse - interface with sand at ~37.0'	

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TEST BORING LOG

Project No. 9035 Client Lancaster Sanitary Landfill Boring No. B-22

Project ______ Date Start 8/27/79

Location Lancaster Erie County, New York Date Finish 8/27/79

Type of Rig CME Auger Driller Empire Soils Inspector KGZ

Depth	Elevation	Casing Blows/ft	Sample No.	Sample Type	Spoon blows 6" Penetr.		Average Blows/ft	Log	Classification "O" Elev. = 772.3	Remarks
		24" Rec	8	ss	12 56	41 73	97		Tan-gray f-m SAND little (-) Silt	Saturated
45		18" Rec	9	ss	21 85	36	121		End of Boring 46.5'	
									Backfill with clean silica sand; set well point at 35.5', continue to backfill with remaining sand. Cement grout plug 2' to surface. Stick up 2.4'	
0										
5										
0										
5										
0										
5										

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TEST BORING LOG

Project No. 9035 Client LANCASTER SANITARY LANDFILL, INC. Boring No. 23S

Project ______ Date Start 9/7/79

Location Lancaster, Erie County, New York Date Finish 9/11/79

Type of Rig CME Auger Driller Empire Soils Inspector WJS

Depth	Elevation (SW 2.8', 2.5')	Casing Blows/ft	Sample No.	Type	Spoon blows 6" Penetr.	Average Blows/ft	Log	Classification "O" Elev. = 752.0	Remarks
	cement plug		1	ss	2, 3, 3	6		Dark brown fine SAND, little Silt, w/few fine roots	moist med-dense
5	1 1/4" steel pipe		2	ss	5, 6, 5	11		@3'± grading Brown fine SAND, trace Silt.	moist med-dense
10			3	ss	11, 12, 17	29		@ 13 ±, becoming light brown and gray fine SAND, trace Silt	wet very dense
15	Johnson Red Head Well Point		4	ss	34, 61	61+			
20	pipe; bentonite seal		5	ss	40, 80; 5%	80+		Auger and spoon refusal at 23.5' ——23.5'——	saturated & very dense
25	1 1/4" steel		R-1		4.4' Run; 4.4' Rec.; 100%			Gray Limestone - cherty Occ. irreg. horizontal & vertical fissures - broken zone, 27.3 to 27.9', w/clay seam filling grading w/more frequent vertical and diagonal fissures below 28'	core barrel jammed at 27.9'
30			R-2		5.0' Run; 4.8' Rec.; 96%			- broken zone, 29' to 31' grading sounder, below 38'	
35			R-3		5.0' Run; 5.0' Rec.; 100%			- no vertical fissures or broken zones	
40	Johnson Red Head Well Point		R-4		5.0' Run; 5.0' Rec			1/2" seam of weathered rock @ 41.5' 42.9' Bottom of Boring	

*West end of property, south of NYS Thruway

SHEET 1 OF 1

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TEST BORING LOG

Project No. 9035 Client LANCASTER SANITARY LANDFILL, INC. Boring No. 24S*

Project ______ Date Start 9/12/79

Location Lancaster, Erie County, New York Date Finish ______

Type of Rig CME Auger Driller Empire Soils Inspector WSP

Depth	Elevation (S.U. 2.4 / 2.5)	Casing Blows/ft	Sample No.	Type	Spoon blows 6" Penetr.		Average Blows/ft	Log	Classification "O" Elev. = 784.8	Remarks
	cement plug		1	ss	1 / 4	3	7		Dark brown fine SAND, little Silt, trace (-) fine Gravel w/few roots	med.dense moist
5	1¼" steel pipe		2	ss	18 / 41	32	73		@3'±, grading Light brown fine SAND, trace Silt, trace (-) fine Gravel 8.0'	very dense moist
10			3	ss	34 / 36	30	66		Brown & Gray med. GRAVEL little (+) fine-med. Sand, trace (-) Silt. -Gravel 13.0'	very dense wet to saturated
15			4	ss	7 / 13	12	25		Reddish-brown fine SAND, some Silt to Clayey Silt w/occ. irreg. 1/8" seams of red-brown Silty Clay 18.0'	Dense Saturated
20			5	ss	40	78	78+		Brown fine SAND, trace Silt Stratified	very dense saturated
25	1¼" steel pipe		6	ss	33	80	80+			
30	Johnson Ret Head Well Pt		7A/B	ss					@30.5', 2" zone of red-brown varied Silty CLAY, 1 piece coarse gravel	
35			8A/B	ss	6 / 14	8	22		36.0' Reddish brown Clayey SILT some fine Sand.	dense saturated

*East end of property, South of NYS Thruway

SHEET 1 OF 2

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TEST BORING LOG

Project No. 9035 Client LANCASTER SANITARY LANDFILL, INC. Boring No. 24S

Project ______ Date Start 9/12/79

Location Lancaster, Erie County, New York Date Finish ______

Type of Rig CME Auger Driller Empire Soils Inspector WSP

Depth	Elevation	Casing Blows/ft	Sample No.	Type	Spoon blows 6" Penetr.	Average Blows/ft	Log	Classification "O" Elev. = 784.8	Remarks
			9A B					Reddish-brown Clayey SILT, little fine Sand w/occ 1/8" layers br. m-f Sand 41.0	saturated
45			10A B C		18 62 74	136		41'-41.5': laminated red-br. Silty CLAY (1/8-1/16" layers) @45': 6" gray br. Clayey Silt some fine Sand 5" red-br Silty CLAY 4" gray fine SAND, trace Silt 2" red-br Silty CLAY	moist saturated moist sat. (very dense 41-56')
50			11A B		42 80	80+		@50': 4" red-br Clayey SILT, some fine Sand 2" red-br Silty CLAY 6" gray fine SAND, and SILT	sat. moist moist
55			12A B		10 32 30	62		@55': red-br SILT, little fine Sand thinly layered-irreg. 56.0'	Saturated
60	bentonite seal		13		100/2'			Gray & brown fine SAND, some + med-fine Gravel, trace Silt. 59.0'±	Saturated
65			R-1		5.0' Run 4.8' Rec. 96%			Dark gray weathered Limestone 62.2'	spoon refusal 60.2 Auger refusal 62.2
70			R-2		5.0' Run 4.9' Rec. 98%			Gray Limestone-cherty occ. irreg. horizontal fissures grading, more frequent horizontal fissures-some with "hairline" brown fine Sand filling	no return of wash water below 65'
75	bedrock		R-3		4.9' Run 4.9' Rec. 100%			frequent horizontal fissures no sand filling noted	
80	Johnson Red Head Well Plat		R-4		4.8' Run 4.6' Rec. 96%			frequent horizontal fissures - @80-81.9': 2 1"thick fractured zones w/weathered limestone filling 81.9'	core wedged in barrel at 81.9
								End of Boring	

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TEST BORING LOG

Project No. 9035 **Client** LANCASTER SANITARY LANDFILL, INC. **Boring No.** W-3

Project ____________ **Date Start** ______

Location Lancaster, Erie County, New York **Date Finish** 9/17/79

Type of Rig CME Auger **Driller** Empire Soils **Inspector** WSP

"0" Elev. = 734.9

Depth	Elevation	Casing Blows/ft	Sample No.	Type	Spoon blows 6" Penetr.	Average Blows/ft	Log	Classification	Remarks
0–10.5'	cement plug; 4" PVC casing							Brown Silty fine SAND grass & roots at top Rock fragments at 10'	moist
10.5'	cement grout		R-1		3.0' Run 3.0' Rec. 100%			Dark gray Limestone-cherty occ. irreg. horizontal fissures broken rock zone 1.3 to 1.6'	
15			R-2		5.0' Run 4.8' Rec. 96%			infrequent vertical fissures	No return of wash water below 14'
20			R-3		1.3' Run 1.0 Rec.	77%		frequent horizontal, vertical & diagonal fissures	core wedged in barrel @19.8' & @ 23.3'
			R-4		3.5' Run 3.5 Rec. 100%			broken rock at 22.3' and 23.3'	
25			R-5		4.0' Run 2.1' Rec. 52.5%			horizontal fissures, broken rock zones, some seams w/Clayey Silt and fine Sand filling 27.3'	

END OF BORING

NOTE: After coring Run-1 w/ n-x barrel, the hole in rock was enlarged with 5 3/4" outside diameter roller bit to provide "socket" for grouting in 4 3/8" outside diameter. PVC casing continued w/ n-x core drilling to 27.3'

ANALYTICAL REPORT

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY
QUALITATIVE ORGANIC ANALYSIS

Prepared For:

Lancaster Sanitary Landfill
P. O. Box 11120
Station E
Buffalo, New York 14211

Prepared By:

Recra Research, Inc.
111 Wales Avenue
Tonawanda, New York 14150

Date: 10/22/79

RECRA RESEARCH, INC. P.O. Box 448 / Tonawanda, New York 14150 / (716) 838-6200
TOTAL CHEMICAL WASTE MANAGEMENT THROUGH APPLIED RESEARCH

ANALYTICAL REPORT

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY
QUALITATIVE ORGANIC ANALYSIS

Sample Date: 5/8/79

Report Date: 10/22/79

EXECUTIVE SUMMARY:

On September 28, 1979 a qualitative Gas Chromatography/Mass Spectrometry (GC/MS) analysis concerning six previously extracted and Total Halogenated Organics analyzed samples was requested. These samples were collected on 5/8/79.

The extracts were concentrated and qualitatively analyzed by GC/MS. The GC/MS technique of rapid repetitive scanning in the electron impact mode was employed.

The resultant data indicated polynuclear aromatics, oxygenated hydrocarbons and aliphatic hydrocarbons in each sample. Some of the samples were also found to contain hexachlorobutadiene, trichlorobenzene, nitrogenous compounds, substituted aromatic hydrocarbons, phenolic compounds and carboxylic acid derivatives.

FOR RECRA RESEARCH, INC. Timothy R Baker

DATE 10-22-79

RECRA RESEARCH, INC. P.O. Box 448 / Tonawanda, New York 14150 / (716) 838-6200
TOTAL CHEMICAL WASTE MANAGEMENT THROUGH APPLIED RESEARCH

ANALYTICAL REPORT

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY
QUALITATIVE ORGANIC ANALYSIS

Sample Date: 5/8/79

Report Date: 10/22/79

INTRODUCTION:

On September 28, 1979 a request was made for qualification of six samples by Gas Chromatography/Mass Spectrometry (GC/MS). These samples, dated 5/8/79 were already in storage at Recra, having been previously analyzed by Gas Chromatography (GC) with an Electron Capture Detector. They are identified as: W-1, W-2, B-13, B-13A, B-15S and B-17. This report will concern itself with the results of the GC/MS analyses.

METHODS:

The samples, which were previously extracted for Total Halogenated Organics (THO) analysis, were evaporated to 50 µl via a stream of dry nitrogen. A 6 µl portion of each sample was then, in turn, introduced into the GC/MS system.

The GC/MS analysis involved a Model 3321 Finnigan GC/MS system interfaced with an INCOS data system operated in the electron impact mode.

Prior to sample extract injection, perfluorotributylamine was introduced for calibration of the mass spectrometer and the INCOS data system.

GC/MS Conditions Included:

Carrier Gas: chromatographic grade helium; 30 ml/min.

Column: glass 183.0 cm long x 2 mm I.D. 1.5% SP-2250/1.95% SP-2401 on 100/120 mesh Supelcoport

Temperatures: Oven: Initial: 50°C 4 mins

Final: 250°C

Rate: 10°C/min.

Injector: 250°C

Separator: 250°C

Transfer Line: 200°C

Multiplier Voltage: 1.300 KV

Source Voltage: 70 eV

Filament Current: 0.50 ma

RESULTS AND DISCUSSIONS:

Operating under the previously defined conditions, sample W-1 was found to contain hexachloro-1,3-butadiene, polynuclear aromatics (PNA's), substituted aromatics, nitrogenous compounds, oxygenated compounds and aliphatic hydrocarbons. The hexachlorobutadiene is in part responsible for the previously reported THO concentration of 3.70 µg/l. However, note that PNA's, oxygenated compounds and nitrogenous compounds also respond to the Electron Capture Detector (ECD), used in THO analysis. The presence of nitrogenous compounds was not unexpected because of previously reported Total Organic Nitrogen Phosphorus scan value of 9.8 µg/l. Table I lists the types of compounds detected.

The sample identified as W-2 contained hexachloro-1,3-butadiene, naphthalene and other PNA's, nitrogenous compounds, substituted aromatics, oxygenated compounds and aliphatic hydrocarbons. As with the previous sample, the expected ECD responsive compounds were found. Nitrogenous compounds were confirmed as previously reported via the Nitrogen Phosphorus Scan (5.6 μg/l). The compounds found in W-2 are listed in Table II.

The constituents of sample B-13 are hexachloro-1,3-butadiene, two trichlorobenzene isomers, naphthalene and other PNA's, substituted aromatics, aliphatic carboxylic acids, oxygenated compounds, aliphatic hydrocarbons and a nitrogenous compound. Again, the ECD responsive compounds account for a THO value of 0.65 μg/l. The nitrogenous compound could also account for the Nitrogenous Phosphorus Scan value of 14.6 μg/l. Table III is a summary of the compounds found in this sample.

Sample B-13A was found to contain a PNA, a phenolic compound, substituted aromatics, aliphatic carboxylic acids, aliphatic alcohols and other oxygenated compounds, aliphatic hydrocarbons and nitrogenous compounds. This sample has more oxygenated components and a greater Reconstructed Ion Chromatograph (RIC) intensity. The elevated THO value of 8.2 μg/l for this sample is therefore in agreement with the GC/MS data. A higher Nitrogen Phosphorus Scan value could also be expected for a sample with increased relative RIC intensity. However, the reported value of 123 μg/l can not, in this case, be explained in terms of increased intensity alone. The higher Nitrogen Phosphorus Scan result is believed to be primarily due to the relative response of benzothiazole, a compound peculiar to this sample. See Table IV for a listing of the compounds in sample B-13A.

The sample identified as B-15S contained one PNA, one aliphatic alcohol, several phenolic compounds, nitrogenous compounds and numerous aliphatic hydrocarbons. The same relative amount of ECD responding compounds are present in this sample. Note that the previously reported THO value of 2.4 μg/l is in the same range as the THO values of the other samples. In addition, the earlier Nitrogen Phosphorus Scan value of 20 μg/l indicates the possible presence of nitrogenous compounds. As previously noted, several nitrogen containing compounds were found in this sample. The constituents of sample B-15S are listed in Table V.

Sample B-17 was found to contain one PNA, oxygenated aliphatic hydrocarbons and aliphatic hydrocarbons. The PNA and the oxygenated compounds are offered in explanation of the THO value of 1.4 μg/l that was previously reported. Although a Total Organic Nitrogen Phosphorus Scan value of 27 μg/l was reported, nitrogenous compounds were not detected in this sample. Evaluation of the chromatograph for the Nitrogen Phosphorus Scan of this sample revealed that the response was obtained primarily from one peak/compound. The failure to identify a nitrogen and/or phosphorus compound in this particular sample may be due to decomposition during storage and/or the masking of this constituent by other peaks in the RIC.

None of the priority pollutant pesticides detected in the prior analysis were found. The levels previously reported are below the detectability of the GC/MS in the rapid repetitive scanning mode.

The relative abundances listed in Tables I - VI are determined according to peak heights, relative to the most abundant peak in the Reconstructed Ion Chromatogram. These are related (proportional) to the on-column concentration of the constituents found but are not to be misinterpreted as an attempt at specific quantification.

CONCLUSION:

All six samples were found to contain at least polynuclear aromatic hydrocarbon(s), oxygenated hydrocarbon(s) and several aliphatic hydrocarbons. Hexachloro-1,3-butadiene was detected in samples W-1, W-2 and B-13. All samples, with the exception of B-17, contained nitrogenous compounds. Substituted aromatic hydrocarbons were found in W-1, W-2, B-13 and B-13A. Two trichlorobenzene isomers were detected in sample B-13. Carboxylic acid derivatives were found in B-13 and B-13A. Phenolic compounds were observed in B-13A and B-15S.

The presence of previously reported pesticidal materials could not be confirmed via GC/MS due to the low levels believed to be present and/or the masking of these low level responses by other constituents of the RIC.

Respectively Submitted,

RECRA RESEARCH, INC.

Timothy R Baker

Timothy R. Baker
GC/MS Analyst

TRB/df

TABLE I

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-1
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
79	medium	dimethylhydrazonebutanal	interpreted as an oxygenated cyclohexane derivative
85	medium	N-pentylidene-ethanamine	confirmed as a nitrogenous compound
93	medium	2,3-dimethylheptane	confirmed as an aliphatic hydrocarbon
108	low	1,1′-methylenebis-pyrrolidine	confirmed on the basis of library fit
117	low	5-methylnonane	confirmed as containing an aliphatic hydrocarbon chain
124	medium	1-isocyanatopropane	interpreted as a cyclohexane derivative
132	medium	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
147	medium	4-ethyl-2-methylhexane	confirmed as an aliphatic hydrocarbon
158	low	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
165	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
170	medium	2-propyl-1-heptanol	confirmed as an aliphatic hydrocarbon, possibly oxygenated
182	medium	2-methylnonane	confirmed as an aliphatic hydrocarbon
203	medium	2-methylnonane	confirmed as an aliphatic hydrocarbon
223	low	4-methyldecane	confirmed as an aliphatic hydrocarbon
257	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
277	low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
297	low	2,2-dimethyl-1-octanol	confirmed as an aliphatic hydrocarbon, possibly oxygenated
309	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
325	low	4,8-dimethylundecane	confirmed as an aliphatic hydrocarbon
349	very low	4-methylundecane	confirmed as an aliphatic hydrocarbon
370	low	2,5-dimethyldodecane	confirmed as an aliphatic hydrocarbon
409	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
419	very low	1-heptadecane	confirmed as an aliphatic hydrocarbon
444	low	dodecane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE I
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-1
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
452	very low	1-methyl-3-propylbenzene	confirmed as an alkyl substituted benzene isomer
455	very low	2-methyldodecane	confirmed as an aliphatic hydrocarbon
489	very low	2-ethenylhexahydro-1,3-benzo-dioxole	interpreted as an oxygenated aliphatic hydrocarbon
500	very low	3-methyloctane	confirmed as an aliphatic hydrocarbon
512	very low	hexachloro-1,3-butadiene	confirmed
519	very low	7-hexyltridecane	confirmed as an aliphatic hydrocarbon
526	very low	1-eicosene	confirmed as an aliphatic hydrocarbon
547	very low	azulene	confirmed in the absence of a standard
565	very low	2,5-dimethylundecane	confirmed as an aliphatic hydrocarbon
585	very low	eicosane	confirmed as an aliphatic hydrocarbon
621	very low	4,8-dimethylundecane	confirmed as an aliphatic hydrocarbon
645	very low	2,6,10,14-tetramethylheptadecane	confirmed as an aliphatic hydrocarbon
676	very low	2,5-dimethyltetradecane	confirmed as an aliphatic hydrocarbon
687	very low	(ethenyloxy)isooctane	confirmed as an oxygenated aliphatic hydrocarbon
706	very low	pentacosane	confirmed as an aliphatic hydrocarbon
724	very low	2-methyl-8-propyldodecane	confirmed as an aliphatic hydrocarbon
736	low	2,6-bis-(1,1-dimethylethyl)-2,5-cyclohexadiene	confirmed in the absence of a standard
756	very low	heptadecane	confirmed as an aliphatic hydrocarbon
770	very low	1-methyl-3-propylbenzene	confirmed as an alkyl substituted benzene isomer
827	very low	2,5-bis-(1,1-dimethylpropyl)-2,5-cyclohexadiene	confirmed in the absence of a standard
837	very low	2-dodecanone	confirmed as an oxygenated aliphatic hydrocarbon

Continued . . . .

TABLE I
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-1
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
847	very low	2,3-dihydro-1,1,3-trimethyl-3-phenyl-1H-indene	confirmed as an aromatic hydrocarbon derivative
855	very low	pentacosane	confirmed as an aliphatic hydrocarbon
869	very low	tetradecanoic acid	confirmed as an oxygenated aliphatic hydrocarbon
885	very low	pentacosane	confirmed as an aliphatic hydrocarbon
903	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
928	very low	phenanthrene	confirmed as an polynuclear aromatic hydrocarbon, anthracene co-elutes with phenanthrene
948	low	docosane	confirmed as an aliphatic hydrocarbon
990	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1030	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1075	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1126	very high	3-methyleicosane	confirmed as an aliphatic hydrocarbon
1183	medium	hexatriacontane	confirmed as an aliphatic hydrocarbon
1256	medium	hexatriacontane	confirmed as an aliphatic hydrocarbon
1304	very low	11-(1-ethylpropyl)-heneicosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Burks

DATE 25 October 1979

TABLE II

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-2
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
83	low	1,2-dimethylazetidine	confirmed on the basis of library fit
104	medium	N-methylcyclohexanamine	confirmed as a nitrogenous aliphatic hydrocarbon
144	very low	5-amino-2,4-(1H,3H)-pyrimidine-dione	confirmed in the absence of a standard
159	very low	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
174	very low	3,4-dimethylheptane	confirmed as an aliphatic hydrocarbon
212	very low	1,3-dimethylbenzene	confirmed as an alkyl substituted benzene isomer
222	very low	3-ethyl-2-methylheptane	confirmed as an aliphatic hydrocarbon
237	very low	2,2,3,3-tetramethylbutane	confirmed as an aliphatic hydrocarbon
248	very low	ethylbenzene	confirmed as an alkyl substituted benzene isomer
271	very low	decane	confirmed as an aliphatic hydrocarbon
292	very low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
305	very low	(2-decylcodecyl)-benzene	confirmed as an alkyl substituted benzene isomer
312	very low	(1-methylethyl)-benzene	confirmed as an alkyl substituted benzene isomer
325	very low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
337	very low	1-ethyl-2-methylbenzene	confirmed as an alkyl substituted benzene isomer
348	very low	1-chlorododecane	interpreted as an alkyl substituted benzene isomer
355	very low	2,2-dimethylpropane	confirmed as an aliphatic hydrocarbon
368	very low	undecane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE II
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-2
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
382	very low	1-ethyl-4-methylbenzene	confirmed as an alkyl substituted benzene isomer
394	very low	1-methyl-2-propylbenzene	confirmed as an alkyl substituted benzene isomer
419	very low	7-methyltridecane	confirmed as an aliphatic hydrocarbon
452	low	dodecane	confirmed as an aliphatic hydrocarbon
503	very low	2,2,4,6,6-pentamethylheptane	confirmed as an aliphatic hydrocarbon
515	very low	hexachloro-1,3-butadiene	confirmed
549	very low	naphthalene	confirmed
583	very low	2,5-dimethylheptane	confirmed as an aliphatic hydrocarbon
624	very low	2-methylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
647	very low	pentadecane	confirmed as an aliphatic hydrocarbon
676	very low	7-butyldocosane	confirmed as an aliphatic hydrocarbon
689	very low	9-octadecen-1-ol,(?)	confirmed as an oxygenated aliphatic hydrocarbon
706	very low	undecnae	confirmed as an aliphatic hydrocarbon
725	very low	octadecane	confirmed as an aliphatic hydrocarbon
735	low	2,6-bis(1,1-dimethylethyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of a standard
758	very low	octadecane	confirmed as an aliphatic hydrocarbon
790	very low	5,5-dimethylheptanal	confirmed as an aliphatic hydrocarbon derivative
827	very low	2,5-bis(1,1-dimethylpropyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of a standard

Confirmed . . . .

TABLE II
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, W-2
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
846	very low	2,3-dihydro-1,1,3-trimethyl-3-phenyl-1H-indene	confirmed as an aromatic hydrocarbon derivative
858	very low	eicosane	confirmed as an aliphatic hydrocarbon
904	very low	pentacosane	confirmed as an aliphatic hydrocarbon
926	very low	anthracene	confirmed as a polynuclear aromatic hydrocarbon
953	very low	pentacosane	confirmed as an aliphatic hydrocarbon
994	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1031	medium	2-methylheptadecane	confirmed as an aliphatic hydrocarbon
1077	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon
1126	high	3-methyleicosane	confirmed as an aliphatic hydrocarbon
1185	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon, possibly oxygenated
1261	low	pentatriacontane	confirmed as an aliphatic hydrocarbon, possibly oxygenated
1462	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1611	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Bisli

DATE 25 October 1979

TABLE III

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
64	medium	3-ethyl-2,4-pentanedione	confirmed as an oxygenated aliphatic hydrocarbon
69	medium	1,2-dimethylazetidine	confirmed on the basis of library fit
82	medium	3-ethyl-3-methylhexane	confirmed as an aliphatic hydrocarbon
94	medium	2,2,3,3-tetramethylcyclobutanone	confirmed in the absence of a standard
102	low	5-dodecanone	confirmed in the absence of a standard
108	medium	cyclopentanamine	confirmed in the absence of a standard
115	medium	3-methyl-2-propyl-1-pentanol	confirmed in the absence of a standard
128	medium	4-ethyl-2-methylhexane	confirmed as an aliphatic hydrocarbon
159	medium	2-methylnonane	confirmed as an aliphatic hydrocarbon
176	medium	4,8-dimethyltridecane	confirmed as an aliphatic hydrocarbon
193	low	3,3-dimethylpentane	confirmed as an aliphatic hydrocarbon
202	very low	4-methylundecane	confirmed as an aliphatic hydrocarbon
227	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
249	low	4,6,8-trimethyl-1-nonene	confirmed as an aliphatic hydrocarbon
271	low	7-methyltridecane	confirmed as an aliphatic hydrocarbon
285	low	2,2,4-trimethylhexane	confirmed as an aliphatic hydrocarbon
304	low	2-methylundecane	confirmed as an aliphatic hydrocarbon
320	very low	4-methylundecane	confirmed as an aliphatic hydrocarbon
331	very low	4-methylundecane	confirmed as an aliphatic hydrocarbon
354	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE III
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
367	very low	4,6,8-trimethylnonene	confirmed as an aliphatic hydrocarbon
395	low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
401	very low	2,2,4-trimethylheptane	confirmed as an aliphatic hydrocarbon
435	low	dodecane	confirmed as an aliphatic hydrocarbon
449	very low	2,5-dimethylundecane	confirmed as an aliphatic hydrocarbon
477	very low	1,2,3,5-tetramethylbenzene	confirmed as an alkyl substituted benzene isomer
483	very low	pentacosane	confirmed as an aliphatic hydrocarbon
507	very low	hexachloro-1,3-butadiene	confirmed
517	low	1,3,5-trichlorobenzene	confirmed as a trichlorobenzene isomer
526	very low	2,2,3-trimethylhexane	confirmed as an aliphatic hydrocarbon
542	very low	naphthalene	confirmed
551	very low	1,2,4-trichlorobenzene	confirmed as a trichlorobenzene isomer
583	very low	hexadecane	confirmed as an aliphatic hydrocarbon
618	very low	1-methylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
632	very low	2-methylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
644	very low	hexadecane	confirmed as an aliphatic hydrocarbon
669	very low	1-methylpropylesterbutanoic acid	confirmed as an oxygenated aliphatic hydrocarbon
702	low	2-methyldecane	confirmed as an aliphatic hydrocarbon
724	low	eicosane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE III
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
736	low	2,6-bis-(1,1-dimethylethyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of a standard
756	low	2-methylpentadecane	confirmed as an aliphatic hydrocarbon
771	very low	1,6,7-trimethylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
809	low	2-methylhexadecane	confirmed as an aliphatic hydrocarbon
827	low	2,5-bis-(1,1-dimethylpropyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of s standard
847	low	2,3-dihydro-1,1,3-trimethyl-3-phenyl-1H-indene	confirmed as an aromatic hydrocarbon derivative
858	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
891	low	2-methyloctadecane	confirmed as an aliphatic hydrocarbon
905	low	docosane	confirmed as an aliphatic hydrocarbon
926	low	anthracene	confirmed as a polynuclear aromatic hydrocarbon, phenanthrene co-elutes with anthracene
936	low	pentatriacontane	confirmed as a polynuclear aromatic hydrocarbon
950	low	10-methyleicosane	confirmed as a polynuclear aromatic hydrocarbon
966	very low	1-(1,2-dimethylpropyl)-1-methyl-2-nonylcyclopropane	the base peak of m/z 83 in the spectrum is indicative of a cyclohexene derivative
979	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
995	low	dedocane	confirmed as an aliphatic hydrocarbon
1036	very high	hexadecanoic acid	confirmed as an aliphatic carboxylic acid
1084	medium	hexacosane	confirmed as an aliphatic hydrocarbon

Continued . . . .

TABLE III
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
1105	low	2-nonylcyclopropaneundecanal	the fragmentation pattern is more indicative of an aliphatic carboxylic acid
1130	high	octadecanoic acid, butylester	confirmed on the basis of library fit
1146	medium	2,6,10,14-tetramethylhexadecane	the fragmentation pattern resembles spectra of aliphatic carboxylic acid
1160	low	hexacosane	the fragmentation pattern resembles spectra of aliphatic carboxylic acid
1178	very low	1,2-dibromododecane	the fragmentation pattern resembles spectra of aliphatic carboxylic acid
1208	medium	hexacosane	confirmed as an aliphatic hydrocarbon
1235	low	1-tetradecanol	confirmed as an oxygenated aliphatic hydrocarbon
1265	low	1,1-\3-(2-cyclopentylethyl)-1,5-pentanediyl\bis-cyclopentane	the spectrum is more indicative of a cyclohexane derivative
1293	low	hexacosane	confirmed as an aliphatic hydrocarbon
1328	low	1-heptacosanol	the spectrum indicative of aliphatic carboxylic acid
1407	low	hexacosane	confirmed as an aliphatic hydrocarbon
1437	very low	2-methyl-6-propyldodecane	confirmed as an aliphatic hydrocarbon
1547	low	11-(1-ethylpropyl)-heneicosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Bilis

DATE 25 October 1979

TABLE IV

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13A
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
70	very low	1,2,3-trimethylaziridine	confirmed on the basis of library fit
83	very low	3-ethyl-3-methylpentane	confirmed as an aliphatic hydrocarbon
100	very low	6-methyl-2,4-heptanedione	confirmed in the absence of a standard
105	very low	1-hexen-3-ol	confirmed in the absence of a standard
113	very low	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
124	very low	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon
157	very low	6-methoxy-2-hexanone	confirmed as an oxygenated aliphatic hydrocarbon
260	low	1,2-diethylbenzene	confirmed as an aromatic hydrocarbon
333	medium	1-methyl-3-propylbenzene	confirmed as an aromatic hydrocarbon
360	low	1-methyl-2-(1-methylethyl)-benzene	confirmed as an aromatic hydrocarbon
374	very low	2-ethyl-1-hexanol	interpreted as an aliphatic hydrocarbon
385	very low	2-methyl-,sec-butylesterbutyric acid	confirmed in the absence of a standard
425	low	methyl(1-methylethenyl)benzene	confirmed as an aromatic hydrocarbon
436	low	dodecane	confirmed as an aliphatic hydrocarbon
447	medium	1,3,3-trimethylbicyclo\2.2.1\heptan-2-ol	confirmed on the basis of library fit
467	low	2-methylphenol	confirmed on the basis of library fit
486	low	(3,3-dimethylcyclohexylidene)-acetaldehyde	non-confirmable due to high amount of co-elution
509	high	4-methyl-1-(1-methylethyl)-3-cyclohexen-1-ol	confirmed in the absence of a standard
519	low	1-methyl-1,4-cyclohexadiene	confirmed in the absence of a standard
532	high	α,α,-4-trimethyl-3-cyclohexene-1-methanol	confirmed on the basis of library fit

Continued . . . .

TABLE IV
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13A
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
547	medium	1-ethenyl-4-ethylbenzene	confirmed on the basis of library fit
587	low	2-methylbutylester	confirmed as an oxygenated aliphatic hydrocarbon
605	low	benzothiazole	confirmed on the basis of library fit
622	low	2-methylnaphthalene	confirmed as a polynuclear aromatic hydrocarbon
647	low	2,7-dimethyloctane	confirmed as an aliphatic hydrocarbon
662	low	1H-indole	confirmed as an aromatic hydrocarbon
702	low	undecane	confirmed as an aliphatic hydrocarbon
719	high	3-methyl-1H-indole	confirmed as an aromatic hydrocarbon
736	low	2,6-bis(1,1-dimethylethyl)-2,5-cyclohexadiene-1,4-dione	confirmed in the absence of a standard
756	medium	α,α-dimethylbenzeneethanol	confirmed in the absence of a standard
773	low	1-methyl-3-propylbenzene	confirmed in the absence of a standard
807	low	7-tridecanone	confirmed as an aliphatic hydrocarbon derivative
822	medium	1-methyl-3-propylbenzene	confirmed as an aromatic hydrocarbon
857	low	docosane	confirmed as an aliphatic hydrocarbon
869	low	1-methyl-3-propylbenzene	confirmed as an aromatic hydrocarbon
902	low	2-methylpentadecane	confirmed as an aliphatic hydrocarbon
915	low	1-ethyl-3,5-dimethylbenzene	confirmed as an aromatic hydrocarbon
930	very low	1-ethyl-4-(1-methylethyl)benzene	confirmed as an aromatic hydrocarbon
945	low	2-methylheptadecane	confirmed as an aliphatic hydrocarbon
958	low	2-isopropyl-2,5-dimethylcyclohexanone	confirmed as a cyclohexane derivative

Continued . . . .

TABLE IV
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-13A
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
971	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
990	low	docosane	confirmed as an aliphatic hydrocarbon
1028	very high	eicosanoic acid	confirmed as an aliphatic carboxylic acid
1041	low	1-tetradecanol	confirmed as an oxygenated aliphatic hydrocarbon
1077	high	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1119	high	octadecanoic acid, butylester	confirmed as an oxygenated aliphatic hydrocarbon
1134	high	2-methyloctadecane	interpreted as an oxygenated aliphatic hydrocarbon
1156	very low	heptacosane	confirmed as an aliphatic hydrocarbon
1193	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1222	very low	2,6,10,15-tetramethylheptadecane	confirmed as an aliphatic hydrocarbon
1265	medium	11-(1-ethylpropyl)-heneicosane	confirmed as an aliphatic hydrocarbon
1369	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1423	very low	docosane	confirmed as an aliphatic hydrocarbon
1493	low	pentratriacontane	confirmed as an aliphatic hydrocarbon
1567	very low	2-methyltetradecane	confirmed as an aliphatic hydrocarbon
1650	low	octacosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Bulia

DATE 25 October 1979

TABLE V

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-15S
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
72	medium	5-ethylthiazole	unable to confirm due to co-elution
76	medium	2-isocyanatopropane	confirmed as a nitrogenous compound
90	medium	bis(1,1-dimethylpropyl)-diaziridinone	unable to confirm due to co-elution, possibly nitrogenous
104	low	N-nitro-N-propyl-1-butamine	unable to confirm due to co-elution, possibly nitrogenous
113	medium	5-dodecanone	unable to confirm due to co-elution
121	medium	3-(2,2-dichloro-3-methylcyclo-propyl)-pentane	unable to confirm due to co-elution
128	medium	3,3,5-trimethylheptane	confirmed as an aliphatic hydrocarbon on the basis of library fit
142	low	3-ethyl-2-methyl-heptane	confirmed as an aliphatic hydrocarbon on the basis of library fit
182	low	2-methylnonane	confirmed as an aliphatic hydrocarbon on the basis of library fit
203	low	undecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
225	low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
234	low	4-methylheptane	unable to confirm due to co-elution
247	low	2-ethyl-4-methyl-1-pentanol	unable to confirm due to low abundance and co-elution
260	low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon
281	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
301	very low	2-methyl-(S)-1-dodecanol	unable to confirm due to co-elution
312	very low	2,6-dimethyloctane	confirmed as an aliphatic hydrocarbon on the basis of library fit

Continued . . . .

TABLE V
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-15S
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
327	low	4,8-dimethylundecane	confirmed as an aliphatic hydrocarbon
344	very low	4-methylundecane	unable to confirm due to low abundance and co-elution
353	very low	4,8-dimethylundecane	confirmed as an aliphatic hydrocarbon
373	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
394	very low	2-ethyl-4-methyl-1-pentanol	interperated as an aliphatic hydrocarbon
411	very low	2,6,11-trimethyldodecane	confirmed as an aliphatic hydrocarbon
435	very low	2,2,3,3-tetramethylbutane	confirmed as an aliphatic hydrocarbon
433	very low	2-methyl-(S)-1-dodecanol	unable to confirm due to low abundance and co-elution
447	very low	propanoate-2-decanol	unable to confirm due to low abundance and co-elution
458	very low	2,5-dimethylundecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
461	very low	N-pentylidene ethanamine	unable to confirm due to co-elution and low abundance
466	very low	2,2,3,3-tetramethylbutane	confirmed as an aliphatic hydrocarbon
486	very low	2,2,4-trimethylpentane	confirmed as an aliphatic hydrocarbon
489	very low	5-butylnonane	unable to confirm due to co-elution
671	very low	2,4-bis(1-methylethyl)-phenol	confirmed as an aliphatic substituted phenol
688	very low	2,4-bis(1-methylethyl)-phenol	confirmed as an aliphatic substituted phenol
707	very low	2,6-bis(1,1-dimethylethyl)-4-methylphenol	unable to confirm due to co-elution
718	very low	2,6-bis(1,1-dimethylethyl)-4-methylphenol	unable to confirm due to co-elution and low abundance

Continued . . . .

TABLE V
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-15S
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
737	very low	2,6-bis(1,1-dimethylethyl)2,5-cyclohexadiene-1,4-dione	confirmed on the basis of library fit
757	very low	2,6,10,14-tetramethylheptadecane	confirmed as an aliphatic hydrocarbon
810	very low	octadecane	confirmed as an aliphatic hydrocarbon
837	low	pentatriacontane	unable to confirm due to co-elution
847	low	nonylphenol	unable to confirm due to co-elution, possible phenolic compound
857	very low	octadecane	confirmed as an aliphatic hydrocarbon
870	very low	4-(1,1,3,3-tetramethylbutyl)-phenol	unable to confirm due to co-elution
885	very low	ethenylester dodecnoic acid	insufficient spectral data to confirm
902	low	octadecane	confirmed as an aliphatic hydrocarbon
928	very low	anthracene	confirmed as a polynuclear aromatic on the basis of library fit
946	low	2-methylheptadecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
974	low	9H-carbazole	confirmed as a nitrogenous aromatic hydrocarbon
989	very low	docosane	confirmed as an aliphatic hydrocarbon
1029	high	hexadecanoic acid	unable to confirm due to co-elution
1041	low	acetate 1-hexadecanol	confirmed as an aliphatic alcohol
1054	low	7-hexyldocosane	insufficient spectral data to confirm
1075	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1124	very high	pentatricontane	confirmed as an aliphatic hydrocarbon on the basis of library fit

Continued . . . .

TABLE V
(Continued)

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-15S
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
1154	low	9-octylheptadecane	confirmed as an aliphatic hydrocarbon on the basis of library fit
1184	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1217	very low	tetratetracontane	confirmed as an aliphatic hydrocarbon
1256	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon
1346	medium	11-docyldocosane	confirmed as an aliphatic hydrocarbon
1406	very low	11-(1-ethylpropyl)-heneicosane	confirmed as an aliphatic hydrocarbon
1423	very low	pentatriacontane	confirmed as an aliphatic hydrocarbon
1470	low	pentatriacontane	confirmed as an aliphatic hydrocarbon
1495	very low	2,6,10,15,19,23-hexamethyl-2,6,10,14,18,22-tetracosahexaene	confirmed as an aliphatic hydrocarbon
1503	very low	2,6,10,15,19,23-hexamethyl-2,6,10,14,18,22-tetracosahexaene	confirmed as an aliphatic hydrocarbon
1548	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1627	low	11-decyldocosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. Timothy R Baker

DATE 10-22-79

TABLE VI

LANCASTER SANITARY LANDFILL
GAS CHROMATOGRAPHY/MASS SPECTROMETRY CHARACTERIZATION

Sample Identification: Water Sample, B-17
Report Date: 10/19/79

SCAN #	ABUNDANCE	NBS LIBRARY CHOICE	COMMENT
776	very low	2,6,10,14-tetramethylheptadecane	confirmed as an aliphatic hydrocarbon
828	very low	5-propyltridecane	confirmed as an aliphatic hydrocarbon
883	very low	pentacosane	confirmed as an aliphatic hydrocarbon
943	very low	pentacosane	confirmed as an aliphatic hydrocarbon
967	very low	phenanthrene	confirmed as a polynuclear aromatic hydrocarbon, anthracene co-elutes with phenanthrene
997	low	pentacosane	confirmed as an aliphatic hydrocarbon
1052	low	pentacosane	confirmed as an aliphatic hydrocarbon
1096	medium	hexadecanoic acid	confirmed as an oxygenated aliphatic hydrocarbon
1102	low	octadecane	confirmed as an aliphatic hydrocarbon
1127	very low	hexadecane	confirmed as an aliphatic hydrocarbon
1150	high	pentacosane	confirmed as an aliphatic hydrocarbon
1176	very low	tridecane	confirmed as an aliphatic hydrocarbon
1191	medium	octadecanoic acid, butylester	confirmed as an aliphatic hydrocarbon, some indications of oxygenation
1203	very high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1231	very low	eicosane	confirmed as an aliphatic hydrocarbon
1262	high	pentatriacontane	confirmed as an aliphatic hydrocarbon
1296	very low	pentacosane	confirmed as an aliphatic hydrocarbon
1340	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon
1380	very low	11-decyldocosane	confirmed as an aliphatic hydrocarbon
1432	medium	pentatriacontane	confirmed as an aliphatic hydrocarbon
1487	very low	octacosane	confirmed as an aliphatic hydrocarbon
1553	low	7-hexyleicosane	confirmed as an aliphatic hydrocarbon
1627	very low	pentacosane	confirmed as an aliphatic hydrocarbon

COMMENT: Abundances are based on relative peak heights in the Reconstructed Ion Chromatogram

FOR RECRA RESEARCH, INC. George M. Briles

DATE 25 October 1979