MODULE C3

FORM EQP 5111 MODULE C3
USE AND MANAGEMENT OF LANDFILL

This section provides information regarding use and management of the Landfill at the Dow Silicones Corporation (Dow Silicones) Midland Site as required by Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451); under Rules R299.9504, R299.9505, R299.9519, R299.9522 which incorporates 40 CFR 270.21 by reference. This description provides information on the landfill located at the Dow Silicones Facility.

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Appendix C3-5	Run-on and Runoff Capture Systems Capacity Evaluation

C3.A LANDFILL INFORMATION [MAC R 299.9504(8), 299.9505, 299.9619 – 299.9622; 40 CFR 270.21; Part 264, Subpart N]

The landfill is located in the 800 and 1000 Blocks of the facility (see facility layout map in Appendix A1-1 and Module A1, General Description). The landfill was constructed in the late 1940's to early 1950's and is therefore not subject to the requirements of 40 CFR 264.301(c) regarding design criteria for new landfills.

C3.A.1 List of Wastes [40 CFR 270.21(a)]

This landfill has been permitted for disposal of wastes exhibiting the characteristic of toxicity for lead (D008). Renewal of authorization to receive characteristic D008 wastes is not requested since Dow Silicones currently has no plans to dispose of any hazardous wastes in the landfill. If such disposal were to be resumed, the facility would first obtain approval from the Michigan Department of Environment, Great Lakes and Energy (EGLE). No wastes containing free liquids are disposed in the landfill and no lead contaminated (D008) hazardous wastes have been placed in the landfill since 1985.

Non-hazardous solid wastes not regulated as hazardous wastes under RCRA may be disposed in the landfill. Examples include: RCRA-empty containers; containers of non regulated gloves, rags, pieces of metal and glass and other debris; column packing; cleaned process equipment; asbestos; construction debris; solidified silicone sealants, rubber and gums; solidified polysiloxane gels; nonhazardous contaminated dirt; nonhazardous sandblast media and used office furniture.

C3.B Liner System Exemption Requests

C3.B.1 Exemption Based on Existing Portion [40 CFR 270.21(b)(1), 264.301(a)]

This landfill was constructed prior to January 29, 1992 and has had no horizontal expansions since that date. The landfill is therefore exempt from the requirements of 40 CFR 264.301(c) for use of a double synthetic liner and leak detection system.

C3.B.2 Exemption Based on Alternative Design [40 CFR 270.21(b), 264.301(d)]

Appendix C3-1, "Landfill Equivalency Program, provides an "Equivalency Program" developed in cooperation with the State of Michigan in 1982 to establish the safety and efficacy of the liner system in the existing landfill and its functional equivalency to liners meeting the requirements then in effect under the former Act 64, Rule 419(4) and 419(f).

C3.C Liner System [40 CFR 270.21(b)(1), 264.301(a) and (c), MAC R 299.9620]

The landfill has a liner that was designed, constructed, and installed to prevent any migration of hazardous wastes or hazardous waste constituents to surrounding soil, groundwater, or surface waters during the active life and closure period of the landfill. This section describes how the liner is constructed to achieve this.

C3.C.1 Liner System Description [40 CFR 270.21(b)(1), 264.301(a) & (b)]

Underlying the landfill is a natural clay strata with a minimum thickness of 25 feet. See Module B3, Hydrogeologic Report, and Appendix C3-1, "Landfill Equivalency Program", for detailed information on the location, thickness, and permeability of this natural clay layer.

A "ground truth" boring sample (Sample C-6, see Module B3, Hydrogeologic Report), taken through 25 feet of depth at the approximate center of the landfill, showed the following profile of the landfill floor:

Thickness of Unit (ft.)	Type of Soil	Permeability (cm/sec)
15	Clay (CL)	3×10^{-8}
1	Sandy clay (SM)	4.1×10^{-5}
4	Clayey-silt (ML)	1.5×10^{-7}
5	Clay-silt (CL)	1.2×10^{-6}

Resistivity studies showed that the clay base is uniform, continuous, and homogeneous. The conclusion of the equivalency report was that the existing clay base provides protection to human health and the environment equivalent to the requirements in effect at the time under the former Act 64, Rule 419(4) and 419(f).

A clay curtain wall surrounding the landfill was constructed in 1980 according to Act 64 standards to prevent horizontal migration of hazardous wastes, hazardous constituents, and landfill leachate. The construction of the curtain wall is shown on the drawing (Y1-31900) included in Appendix C3-4. The clay used for the curtain wall had an average permeability of 1.6×10^{-8} cm/sec. and was compacted to an average of 94% of its maximum density, based on the modified Proctor test. The walls were installed in one-foot lifts with a minimum lateral thickness of six feet,and were keyed into the natural clay base to prevent contaminant migration through the joints. The construction quality assurance report and field test results are provided in Appendix C3-2.

At final closure of the landfill, a cover of natural clay will be installed and keyed to the curtain wall to complete the encapsulation of the landfill contents. See Module A11, Closure and Postclosure Plans, for details of cover construction and installation.

C3.C(2) Resistance of Liner System to Loads and Wastes [40 CFR 270.21(b)(1), 264.301(a)(1)(i)]

In 1982, as part of the Landfill Equivalency Program, soil boring analysis was performed to determine the extent of contaminant migration through the landfill base after 30 years of unregulated operation. At that time, contamination was found to have penetrated only six inches into the underlying clay liner, indicating excellent resistance by the clay to chemical attack and permeation.

Resistance to hydraulic pressures from groundwater and runoff is provided by the leachate collection system within the landfill and the interceptor sewer on the outside of the curtain wall. Both systems serve to remove water which could otherwise exert pressures on the landfill base and curtain wall and are constructed of materials capable of withstanding the pressures and chemicals encountered in this application (see information in Appendix C3-3).

The collected liquids are drained to the wastewater sewer for treatment at Dow Chemical. Drawings of the landfill leachate collection system, the interceptor sewer system, and the connections to the wastewater sewer system are provided in Appendices C3-5 through C3-8.

C3.C(3) Liner System Coverage [40 CFR 270.21(b)(1), 264.301(a)(1)(iii)]

The natural clay base underlies the entire landfill area, which is also surrounded entirely by the clay curtain wall. No surrounding earth is likely to be in contact with waste or leachate.

C3.D Leachate Collection and Removal System [40 CFR 264.301(a)(2), MAC R 299.9619(4)]

See Appendix C3-4 (Drawing Y1-23606), for information on the design and construction of the leachate collection system. The leachate collection system is inspected weekly and after every major storm to ensure leachate flow is unobstructed, and maintenance is performed as necessary to remove obstructions.

C3.E Control of Run-on and Runoff

Systems for control of run-on and runoff are discussed in Appendix C3-5, "Run-on and Runoff Capture Systems, Capacity Evaluation".

C3.F Landfill Operations

<u>Construction of Lifts</u>

The landfill is currently permitted for a total disposal volume of 453 acre-feet of wastes. The active cells are located in the 1000 Block portion of the facility; see Appendix C3-4 (Drawing Y1-116550). The landfill was developed in phases, with placement of wastes taking place only to the active cells to reduce exposure of wastes, erosion, and accumulation of precipitation. Wastes are added to the active cell in 10-foot deep lifts over a 6-inch layer of sand to provide drainage for leachate. Once a lift is completed, if it will be exposed for longer than three months before construction of the next lift, it is covered with a one foot layer of compacted earth.

<u>Placement of Wastes</u>

Materials to be placed in the landfill are transported to the landfill by Dow Silicones employees or by contractors under the direction of Dow Silicones employees. All materials to be placed in the landfill are required to first be approved by designated facility personnel and to have this approval noted on a waste materials approval tag. All materials placed in the landfill are recorded in the landfill log, which is maintained in the waste tracking computer database, and this information is kept as part of the facility operating record.

Laboratory testing is conducted if a material cannot be adequately characterized as to its acceptability for disposal in the landfill based on information provided by the plant department or operations that generated the waste. The laboratory tests may include chemical analysis, Toxicity Characteristic Leachate Procedure (TCLP), the paint filter test for free liquids, or other such testing or analysis as necessary to evaluate acceptability of the waste for land disposal.

Daily Cover

As each lift is filled, soil is mixed with the wastes in order to form a physically stable mixture. If the disposed waste is susceptible to wind dispersal it is covered daily with a minimum of six inches of soil or other approved cover material that is nontoxic, non-putrescible, and provides sufficient stability to prevent blowing of landfilled material. Treated, solidified polysiloxane gels will not be used for daily cover unless approved by the State of Michigan. Containerized wastes and other inert materials placed in the landfill are covered so that no more than 1,000 square feet of top surface remains exposed at any time. Materials used for cover may be soils from on-site construction projects and may consist of topsoil, sand, gravel, or similar porous materials to allow precipitation to permeate to the leachate collection system; clay is not used for daily cover.

Inspection

The facility hazardous waste landfill is inspected daily for the following items:

- Active cells: Minimum of 6 inches daily cover maintained.
- Active cells: Maximum of 1,000 square feet of exposed waste at any time
- Sidewalls: No gaps, no material leaking from cells.

The results of these inspections are recorded on inspection log sheets, examples of which are provided in Module A5 (Inspection Schedules) of this application.

C3.G Surveying and Recordkeeping [40 CFR 264.309]

Dow Silicones maintains a record of wastes placed in the landfill and their location with respect to permanently surveyed benchmarks. An annual survey of the landfill is performed for the purpose of determining the amount of available disposal volume remaining. The results of this survey are submitted to EGLE in a written report.

C3.H Special Requirements for Ignitable or Reactive Wastes [40 CFR 264.312]

Ignitable or reactive wastes are not disposed in the landfill.

C3.I Special Requirements for Incompatible Wastes [40 CFR 624.313]

Incompatible wastes are not disposed in the landfill.

C3.J Special Requirements for Bulk and Containerized Liquids [40 CFR 264.314]

Bulk or containerized wastes containing free liquids are not disposed in the landfill. To determine whether a waste contains free liquids, U.S. EPA Method 9095, the "Paint Filter Test", as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (SW-846) is used.

If a waste containing free liquid, other than a lab pack, is to be disposed in the landfill it is first either decanted or otherwise drained of all free-standing liquid, or all free liquid has been absorbed or solidified using a sorbent or solidifying agent which is not biodegradable. These activities are generally carried out by the production building or other Dow Silicones location that generates the waste. Decanting and the addition of adsorbents or solidification agents may also be carried out at the 800 Block facility, at either the 804 Building truck wash slab or in the 809 container storage building. Since only non-RCRA regulated materials are landfilled, the hazards associated with these operations are minimal and will not cause release of hazardous constituents to the environment.

C3.K Special Requirements for Containers [40 CFR 264.315

Except for lab packs and very small containers such as ampoules, containers to be placed in the landfill are either crushed, shredded, or similarly reduced in volume to the maximum practical extent, or they must be at least 90% full.

C3.L Special Requirements for Lab Packs [40 CFR 264.316]

Small containers with free liquids may be placed in the landfill if they meet all of the following conditions:

1. They do not contain hazardous wastes.
2. They are overpacked within a metal open-head container not larger than 100 gallon capacity and meeting all applicable requirements of U.S. DOT packaging specifications.
3. The inner containers are tightly closed and also meet U.S. DOT requirements for inner packagings for the type of material contained.
4. The inner containers are packed in absorbent material which is not biodegradable, which is of sufficient quantity to absorb all free liquids in all the inner containers, and which will not react with the wastes.
5. All the wastes in all the inner containers in one overpack are chemically compatible with each other.

Dow Corning Corporation
Midland Plant Landfill
Equivalency Program

GENERAL DESCRIPTION

Midland, Michigan

February 1982

Dow Corning Corporation
Midland Plant Landfill
Equivalency Program

An Equivalency Program for the Midland Plant Landfill facility has been jointly developed by Dow Corning and the DNR, Resource Recovery Division, Geology Section. The purpose of this program is to establish that the existing facility as designed and constructed under approval of Act 641, P.A. of 1978 provides equivalent protection of the environment and human health as specified in Act 64, P.A. of 1979 in the following rules:

Rule 419 section (4)

(4) "The department may grant an exemption from subrules (1) and (2) of this rule if the applicant can demonstrate that equivalent protection of the environment and human health is provided without an early failure detection system."

and Rule 416 section (f)

(f) "Alternative liner designs and installations providing equivalent environmental and human health protection may be approved by the department. The applicant shall prove equivalency.

The Equivalency Program is based on demonstrating that after approximately 30 years of non-regulated landfilling, vertical migration of contamination has not occurred. The program designed to demonstrate this fact has two parts: (1) soil core sampling and analysis, and (2) resistivity analysis. A description of each analysis follows.

Soil Core Sampling and Analysis

To demonstrate that the existing insitu clay base of this facility is redirecting leachate flow horizontally, a core sampling test was developed.

It is hypothesized that the clay stratum under this facility exhibits characteristics that prevent leachate from continuing downward into possible ground water sources. Furthermore, if after 30 years of non-regulated operation, contamination doesn't exist below the clay surface, the upgraded facility will reduce this likelihood substantially.

To prove this hypothesis the following items were considered.

(1) The existing site has been operating for 30 years. The effects of this long term operation will provide a good prediction of leachate behavior on the clay and on its migration.

(2) Clay contours can be developed from the soil boring and horizontal leachate flow patterns mapped.

(3) Higher concentrations of contaminants will accumulate along leachate flow patterns.

(4) The depth of contamination into the clay surface will indicate the ability of this material to change the flow direction of leachate from vertical to horizontal.

(5) If a pitched sand seam exists under the facility, contamination will be evident at depths far below the clay interface. This geologic formation would have a very low probability as evidenced by the soil boring profiles.

To identify leachate contamination, core samples were taken along the flow pathways at various clay depths. The samples were analyzed for specific contaminates. A remote boring was done and core sample taken to act as a control and can be used for comparisons.

The results of the analysis of the core samples could show three potential contamination patterns which correlate to potential flow pathways. These contamination patterns are:

(1) If contamination depth at the clay surface is shallow, leachate during the past 30 years has not penetrated the clay formation and is being redirected horizontally along the surface of the clay.

(2) If contamination depths at the clay surface are great, then leachate during the past 30 years is penetrating the clay formation and is continuing downward. The clay formation does <u>not</u> have the ability to redirect flow.

(3) If contamination depth is not at the clay surface but rather at a depth far below this interface in a gravel or sand seam, then the clay formation is interrupted by a pitched permeable strata that is channelling leachate downward. This type of geology has a low probability of existing in this area and is not evidenced by existing soil borings.

Resistivity Analysis

To demonstrate that sand or gravel seams do not exist within the clay strata under this facility, electrical resistivity tests were developed.

It is hypothesized that the clay strata under this site is homogeneous and consistant. To determine if this hypothesis is correct without boring numerous holes into the strata or completely destroying the natural condition (both methods unfavorable), a non-destructive test was used.

In selecting this non-destructive test method the following items were considered.

(1) Electrical resistivities of existing soils can vary with moisture, contamination, temperature, procedure, etc.

(2) Use of this procedure in the existing landfill area would not provide appropriate data.

(3) Soil borings or "down the hole" truth must be used in interpreting the field data.

(4) The analysis of electrical resistivity tests can be completed by matching a field curve against a family of standard curves or by using a computer to generate a curve for given soil parameters.

The non-destructive test selected for this analysis used a Bison instrument and the Wenner configuration. In the test area (1000 Block of the Facility), a grid was established (see sketch) defining resistivity stations. At each station an apparent resistivity curve was generated.

To interprete the field curves a computer program was used to generate an apparent resistivity curve for a model soil profile which can be developed from ground truth (soil borings) or hypothetical constructed. The computer generated apparent resistivity curves are matched to the field curves. When the field curve is duplicated, a soil profile can be identified. This procedure was completed for representative stations and the results are supportive of the belief that the clay stratum is consistent and homogeneous.

Summary of Test Results

The soil core sampling and analysis results show that contamination penetrated the clay stratum to a depth of six (6) inches or less. The soil boring logs, the analysis results and procedures, profile sketches and location plots are included in this report.

The resistivity analysis results show that the clay stratum under this facility is continuous and homogeneous. The field data, procedures and a summary of the findings are included in this report.

Conclusions

The Dow Corning Midland Plant Landfill as defined, designed and constructed will provide equivalent protection of the environment and human health as specified in Act 64, P.A. of 1979. The equivalency is based on the following.

(1) This facility has been in operation for over 30 years and has established an environmentally acceptable performance record.

(2) The performance of the facility was verified by equivalency tests which demonstrate the capability of this facility to continue to protect the environment for the remainder of its life. The capability to provide environmental protection is based upon tests that used actual field data from this site.

(3) The facility will continue to operate for the purpose of disposing only Dow Corning Corporation by-products.

Dow Corning Corporation
Midland Plant Landfill
Equivalency Program

Test # 1 Soil Core Sampling And Analysis

Section 1 - Test Development

Section 2 - Test Procedures

Section 3 - Test Results

Soil Core Sampling And Analysis

Section 1 - Test Development

- Test Development Notes
- Clay Contour Sketch
- Soil Profile - Old Condition (1950-1980)
- Soil Profile - Existing Condition (1980-Present)

Soil Core Sampling And Analysis
Test Development Notes

1. The existing facility has been in operation for over 30 years. The projected life of the facility is for an additional 30 years.

2. An assessment of the performance of the facility over the past 30 years can be used to predict the expected performance for the remaining life of the upgraded facility.

3. By assessing leachate migration patterns and contamination levels at various depths near the facility, an evaluation of the site with respect to environmental protection can be made.

4. To verify that the underlying clay stratum is redirecting leachate flow from a vertical pattern to a horizontal pattern a clay contour map was made (attached). From the contours major flow channels can be identified. Along the major channels or pathways higher concentrations of contaminates will be deposited into the clay.

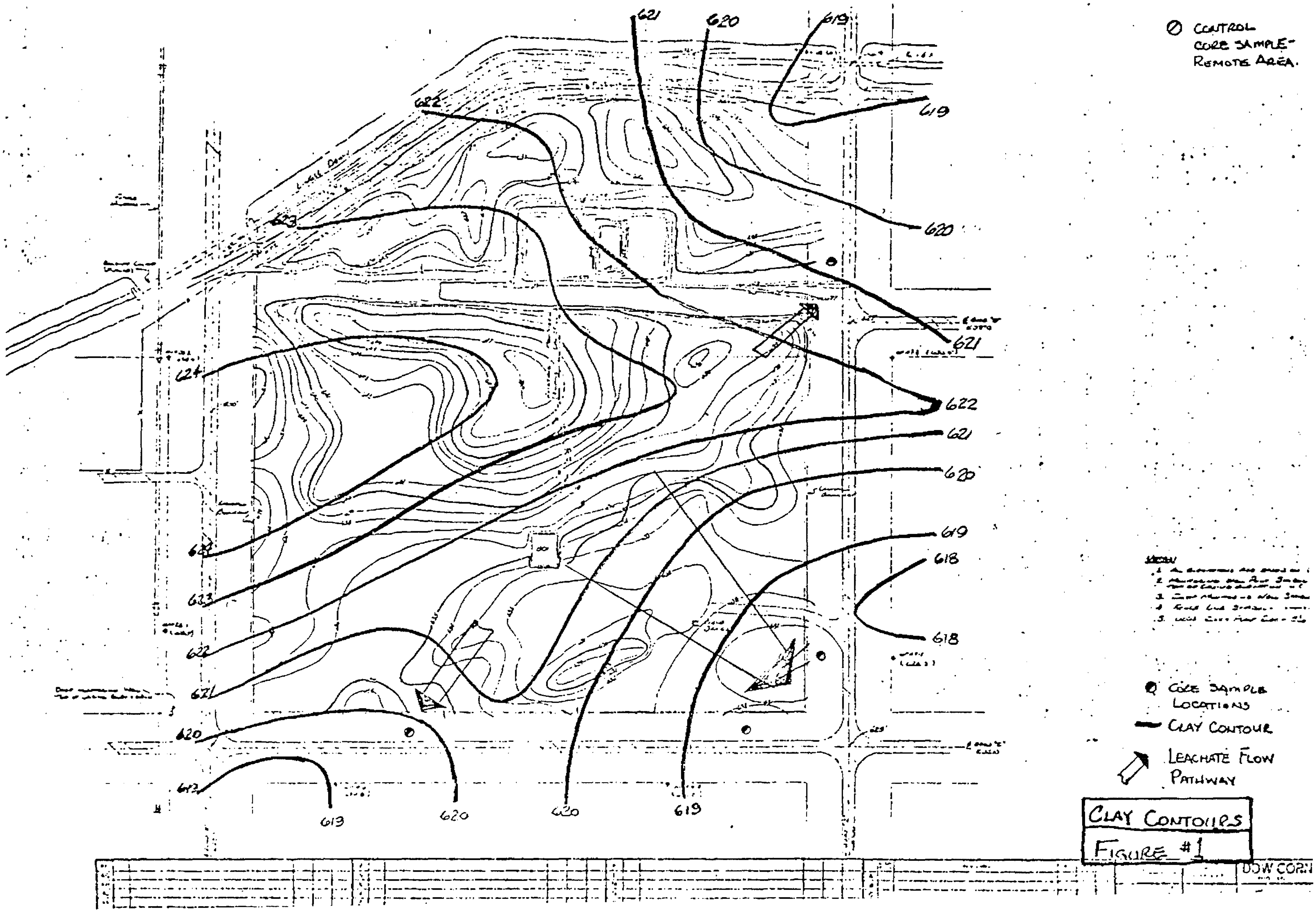
5. By taking core soil samples located along the flow pathways, contamination levels at various depths can be recorded. From this data an actual permeability of the clay soil can be calculated.

$$K_{(vertical)} = \frac{\text{Depth of contaminate penetration}}{\text{30 years}}$$

NOTE: (from the test results) $K_v = \frac{0.5ft}{30\ yrs.} = 1.61 \times 10^{-8}$ cm/sec

6. In addition to defining the clay characteristics exhibited at this site, these tests also show that the permeability of the natural clay is not increased by the leachate from this facility even after a 30 year exposure.

7. There are limitations of the soil core sampling test. The soil core samples cannot verify the consistency of the clay stratum under the site. Therefore a second non-destructing test was developed. The test designed to address this issue is a resistivity analysis which is defined later in this report.

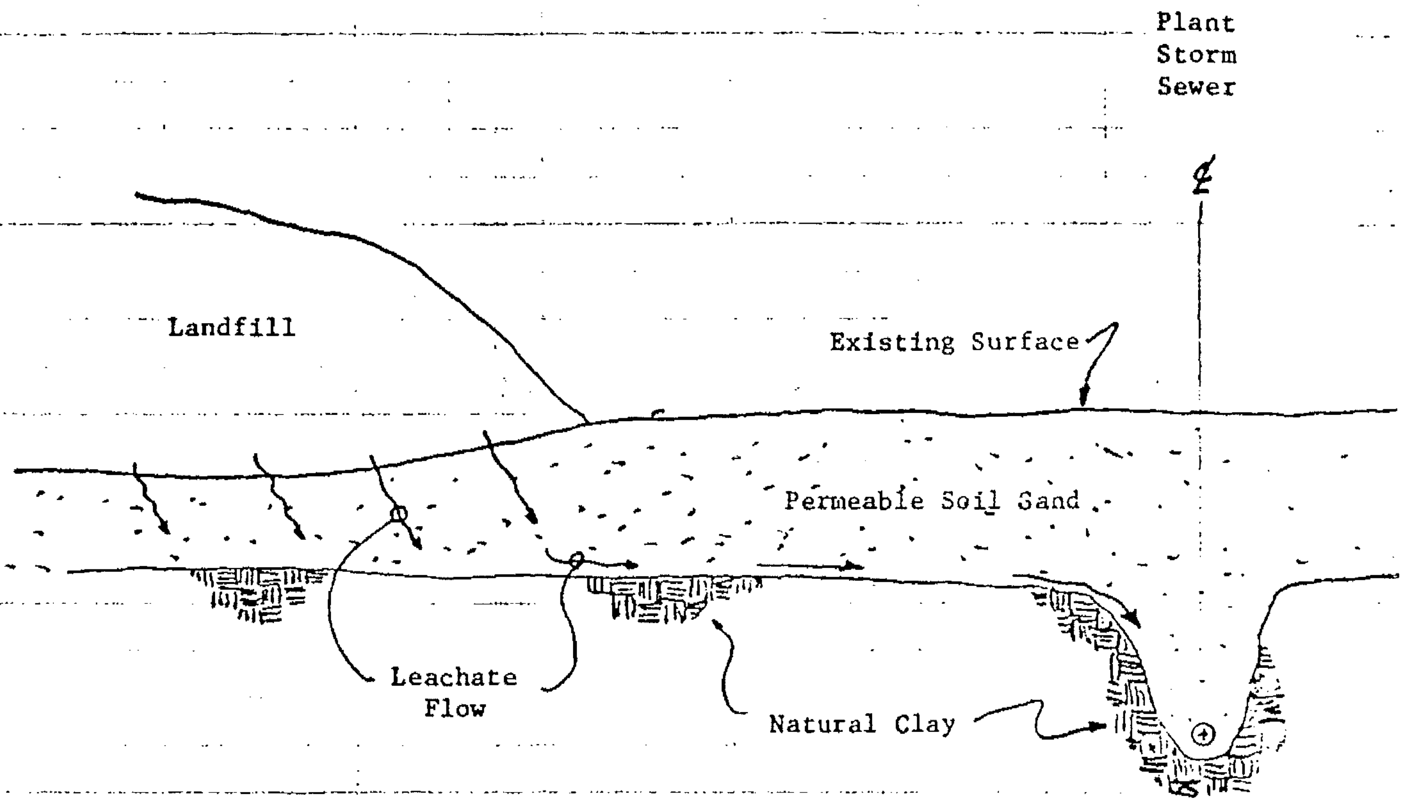


CLAY CONTOURS

FIGURE #1

DOW CORNING CORPORATION

MIDLAND PLANT LANDFILL

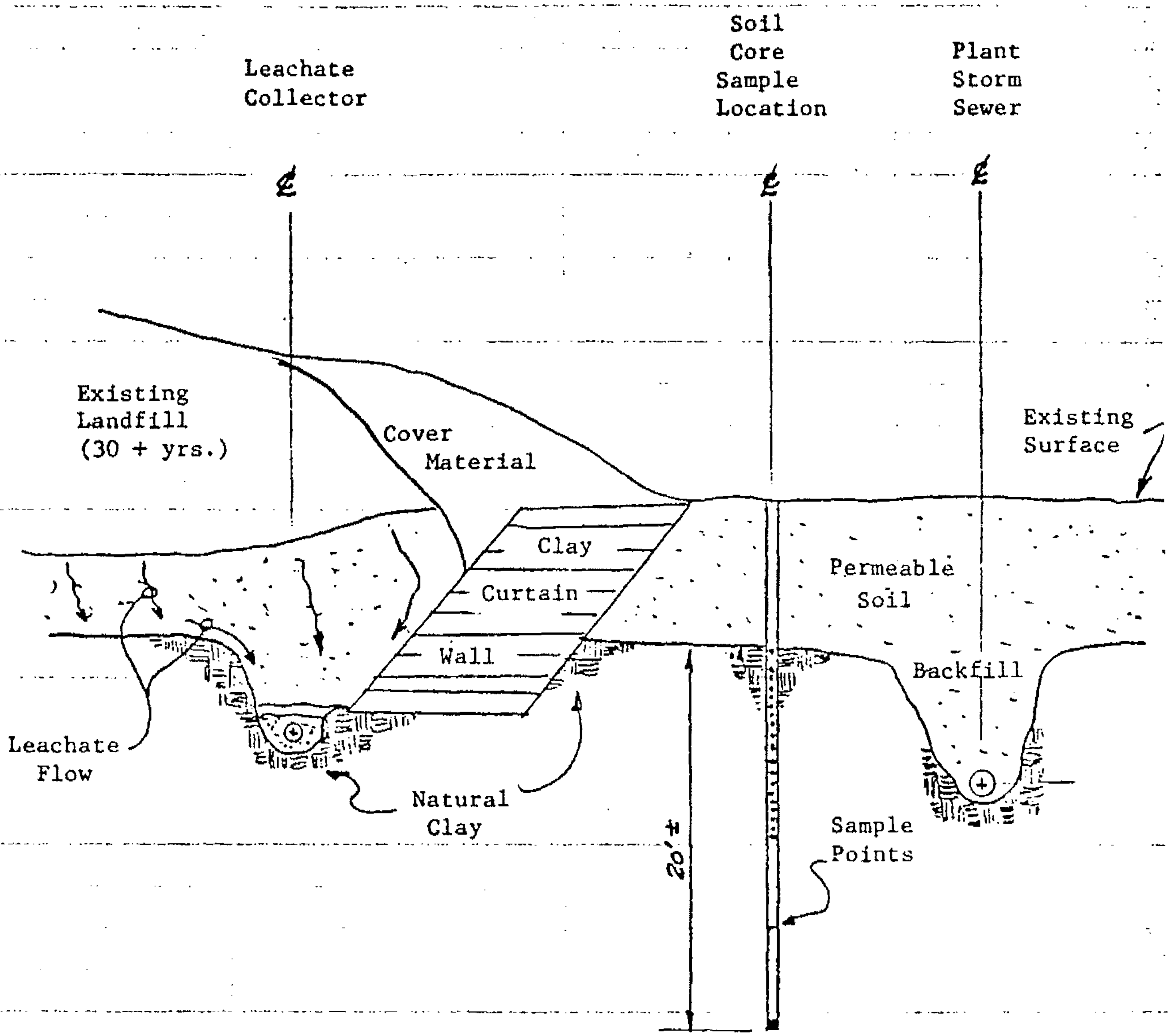


Soil Profile

Old Condition (1950 - 1980)

DOW CORNING CORPORATION

MIDLAND PLANT LANDFILL



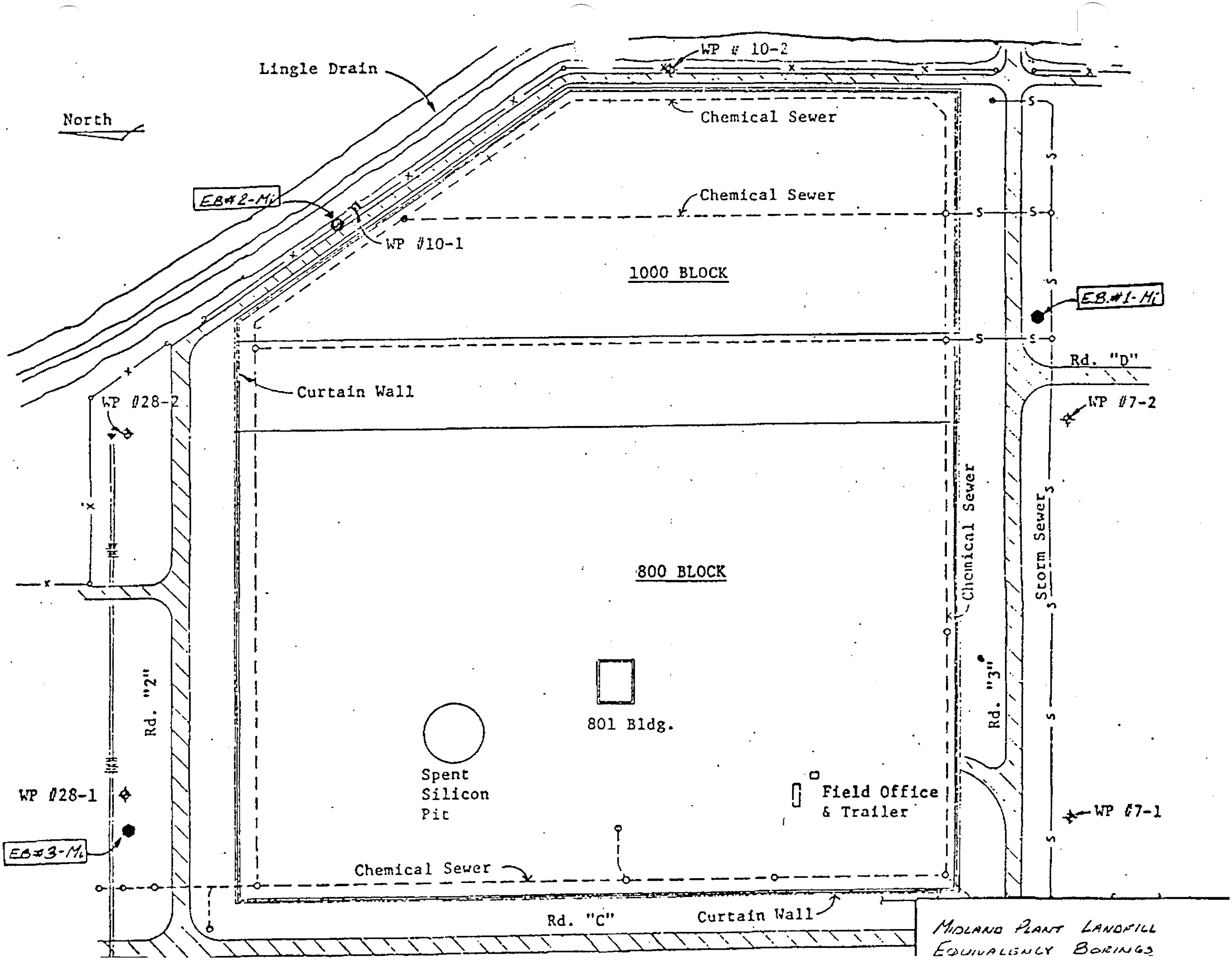
Soil Sampling Profile

Existing Condition (1980 - Present)

Soil Core Sampling And Analysis

Section 2 - Test Procedures

- Boring Location Plan
- Boring Logs
- Soil Analysis Methodology



Midland Plant Landfill
Equivalency Borings

LOG OF BORING NO. EB #1-M

PROJECT	SITE
EQUIVALENCY BORING	East of Fence (outside) South Side of Rd. "3"

BORING STARTED 11-4-81	COMPLETED 11-4-81	PROJECT NO. 81-127	SAMPLE TYPE S.S. ___ AUGER ___ SHELBY ___

DEPTH IN FEET	LEGEND	SAMPLES	DESCRIPTION OF MATERIAL (SURFACE ELEVATION)	SAMPLE NO.	STD. PENETRATION "N" BLOWS PER FOOT	UNIT NAT. WT LB./FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1, 2, 3, 4, 5) / PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)
0–5			Sand-brown, fine silty (SP)				
5–10		X	Clay-brown, dense with some sand (CH)	A			
10		X		B			
		X	-gray, firm (CL)	C			
		X		D			
20							
		X		E			
		X		F			
30			End of Boring at 27½ ft.				

WATER LEVEL OBSERVATIONS

W.L.

W.L.

SAMTEST, INC.
DRILLING & TESTING SERVICES

LOG OF BORING NO. EB#2-Mi

PROJECT	SITE
EQUIVALENCY BORING	Near Lingle Drain

BORING STARTED	COMPLETED	PROJECT NO.	SAMPLE TYPE
11-4-81	11-4-81	81-127	S. S. ___ AUGER ___ SHELBY ___

SURFACE ELEVATION

UNCONFINED COMPRESSIVE STRENGTH TONS/FT 2 (1, 2, 3, 4, 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)

DEPTH IN FEET	DESCRIPTION OF MATERIAL	SAMPLE NO.	STD. PENETRATION "N" BLOWS PER FOOT	UNIT NAT. WT LB./FT 3
0	Sand-brown, fine silty (SP)			
10	Clay-dense gray (CL)	A		
		B		
	-sandy gray	C		
	-brownish gray	D		
20		E		
		F		
	-brownish gray, silty (CH)	G		
30				
		H		
	End of Boring at 33½ ft.			
40				

WATER LEVEL OBSERVATIONS

W.L.

W.L.

SAMTEST, INC.
DRILLING & TESTING SERVICES

LOG OF BORING NO. E3#3-Mi

PROJECT	SITE
EQUIVALENCY BORING	North of Rd. "2"

BORING	PROJECT NO.	SAMPLE TYPE
STARTED 11-6-81 COMPLETED 11-6-81	81-127	S. S. ___ AUGER ___ SHELBY ___

DEPTH IN FEET	LEGEND	SAMPLES	DESCRIPTION OF MATERIAL (SURFACE ELEVATION —)	SAMPLE NO.	STD. PENETRATION "N" BLOWS PER FOOT	UNIT NAT. WT LB./FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5); PLASTIC LIMIT % ✕ — WATER CONTENT % ⊗ — LIQUID LIMIT % △ (10 20 30 40 50)
			Sand-brown, fine, silty (SP)				
			Clay-dense brown	A			
			-brownish gray, sandy	B			
10			-gray brown-firm	C			
			-gray, becoming less dense	D			
			-silty gray with 1" stones	E			
20			Silt-brownish gray, very soft	F			
			-greenish gray, silty				
				G			
30			End of Boring at 27 ft.				

WATER LEVEL OBSERVATIONS
W.L.
W.L.

SAMTEST, INC.
DRILLING & TESTING SERVICES

LOG OF BORING NO. B #4-Mi

PROJECT	SITE
EQUIVALENCY BORING	West Side of Rd. "C"

BORING	PROJECT NO.	SAMPLE TYPE
STARTED 11-5-81 COMPLETED 11-5-81	81-127	S. S. ___ AUGER ___ SHELBY ___

DEPTH IN FEET	LEGEND	SAMPLES	DESCRIPTION OF MATERIAL (SURFACE ELEVATION)	SAMPLE NO.	STD. PENETRATION "N" BLOWS PER FOOT	UNIT NAT. WT LB./FT3	UNCONFINED COMPRESSIVE STRENGTH TONS/FT 2 (1 2 3 4 5); PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)
			Sand-brown, fine, silty (SP)				
10			Clay-dense brown	A			
				B			
			-brown to light gray	C			
			-soft brown	D			
				E			
20							
			-grayish brown with pebbles	F			
30			-dk. gray with stones & pebbles	G			
			End of Boring at 30 ft.				

WATER LEVEL OBSERVATIONS

W.L.	
W.L.	

SAMTEST, INC.
DRILLING & TESTING SERVICES

LOG OF BORING NO. REFERENCE BORING - CONTROL

PROJECT	SITE
EQUIVALENCY BORING	WALDO & SALZBURG RDS.

BORING	PROJECT NO.	SAMPLE TYPE
STARTED 8-31-81 COMPLETED 8-31-81	81-127	S. S. ___ AUGER ___ SHELBY ___

DEPTH IN FEET	LEGEND	SAMPLES	DESCRIPTION OF MATERIAL (SURFACE ELEVATION ——)	SAMPLE NO.	STD. PENETRATION "N" BLOWS PER FOOT	UNIT NAT. WT LB./FT3	UNCONFINED COMPRESSIVE STRENGTH TONS/FT 2 (1 2 3 4 5); PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)
0			Clay-stiff, moist, brown silty-oxidized variegated				
5		X	-stiff moist, silty brown with oxidized streaks	A	14		
10		X	-stiff moist silty blue clay	B	16		
15		X		C	10		
20		X		D	8		
25		X	End of Boring at 26 ft.	E	12		

WATER LEVEL OBSERVATIONS

W.L.

W.L.

SAMTEST, INC.

DRILLING & TESTING SERVICES

SOIL ANALYSIS METHODOLOGY

HAZARDOUS WASTE LANDFILL

EQUIVALENCY ISSUE

February, 1982

The soil samples were analyzed for volatile organic priority pollutants by Mead CompuChem, Research Triangle Park, N.C. The analytical procedures uses for the priority pollutants are based on those promulgated by EPA. The analytical methods used by CompuChem have been included with this report.

The soil samples were dispersed in distilled deionized water and placed on a wrist action shaker for 4 hours. The soil dispersions were centrifuged and the clear supernatant was analyzed for chloride and copper. The chloride was determined by CTM* 0018 using silver nitrate as the titrant with a potentiometric end point. The copper was determined by atomic absorption (CTM 0616) with a carbon furnace.

* CTM refers to Dow Corning Corporate Test Method

ANALYTICAL METHODS, DEFINITIONS AND EXPLANATIONS

The CompuChem report contains not only the concentrations of the priority pollutant compounds identified but also additional supportive information which is useful in the review of this data. A complete report includes the following (if ordered):

Priority Pollutant Data
- GC/MS (VOA, B/N/P, Acid)
- Pesticides (Method 608)
- Inorganics

Other Analytical Data (EP Toxicity, etc.)
Conventional Permit Data

The GC/MS priority pollutant data is presented in summary form (concentration of each identified compound) along with the detection limits specified by EPA. In addition, a reconstructed total ion chromatogram (RIC) for each fraction and for the relevant instrument calibration (standards) runs are included.

Also included in the report are the spectra for all organic (except for certain pesticides) priority pollutant compounds identified above EPA specified detection limits, as well as a laboratory chronicle of completion dates.

To assist in the interpretation and utilization of this data, a Glossary of frequently used terms, a Compound Cross-Reference List and a typical Spectral Match Diagram with explanatory notation are also included.

If the Twenty Peak option has been ordered, the report also includes spectral match diagrams for as many as twenty (20) additional non-priority pollutant compounds with peaks greater than half the intensity of the internal standard (d_{10}-anthracene).

If the Quality Control option has been ordered, the report also includes BFB and DFTPP tuning data for the GC/MS instruments, a summary of surrogate spike recovery data and the following:

Matrix Spike Data
Duplicate Data
Method Blank Data

Also included with the method blank is an RIC for each fraction plus spectra and spectral match diagrams for any compounds identified with concentrations greater than EPA specified detection limits found in the blank.

If the Chain-of-Custody option has been ordered, this information is included in the section with the sample data.

ANALYTICAL METHODS

The analytical methods used by CompuChem for priority pollutant, RCRA and NPDES permit analyses are based on those promulgated by EPA. These methods have appeared in the Federal Register as noted below.

In summary, gas chromatography/mass spectrometry (GC/MS) is the analytical technique employed for the analysis of organic compounds while atomic absorption spectrophotometry (AAS) is used for the analysis of metals.

On occasion CompuChem also performs analyses for other parameters which are not on the priority pollutant list. In these cases also, EPA methods are used if available, and if not methods are developed and verified along guidelines suggested by EPA.

References for Methods

Volatile Organics	(Method 624)	Federal Register 12-3-79
Acid Extractables	(Method 625)	" " "
Base/Neutral/Pesticide Extractables	(Method 625)	" " "
Pesticides	(Method 608)	" " "
Inorganics	EPA: Analysis of Water & Waste Water (1974, 1979)	
RCRA	Federal Register 5-19-80	

GLOSSARY OF TERMS

ACID FRACTION

Those compounds which solvent extract from the sample when it is pH-adjusted acidic (pH<2).

BFB TUNING

Each GC/MS instrument dedicated to VOA analyses is certified according to protocol prior to each 8-hour shift by injecting BFB (bromofluorobenzene) and comparing relationships between ion abundances for certain key mass numbers. If the prescribed relative ion abundances are not present, the instrument is adjusted until the criteria are met. With the available QC option, these parameters are included in the report for the BFB analysis following the specific sample analyzed.

B/N/P FRACTION

Those compounds which solvent extract from the sample when it is pH-adjusted basic (pH>11). This includes the pesticides (P), bases (B) and since this step is performed first, the neutral (N) compounds.

DFTPP TUNING

Each GC/MS instrument dedicated to Base/Neutral or Acid analyses is certified according to protocol prior to each 8-hour shift by injecting DFTPP (decafluorotriphenylphosphine) and comparing the relationships between ion abundances for certain key mass numbers. If the prescribed relative ion abundances are not present, the instrument is adjusted until the criteria are met. With the available QC option, these parameters are included in the report for the DFTPP analysis following the specific sample analyzed.

INDISTINGUISHABLE ISOMERS

Compounds with essentially the same mass spectrum and which have the same elution time from the gas chromatograph. An example is anthracene and phenanthrene.

INTERNAL STANDARD

CompuChem uses the internal standard method of quantitation. The same amount of d_{10}-anthracene is added to both the calibration standard and the sample. All calculations are referenced to a signal produced by this compound. Then all results are automatically corrected for any change in instrument sensitivity.

MATRIX SPIKES

Actual priority pollutants which are added to a second aliquot of the sample to determine the effect, if any, of the sample matrix on the analytical procedure.

METHOD BLANK

A sample of organic-free laboratory water which undergoes exactly the same extraction procedure at the same time as the actual samples. This monitors for possible contamination from glassware, solvents, or the extraction procedure.

PERCENT RECOVERY (SURROGATES AND MATRIX SPIKES)

The formula for determining percent recovery is:

$$\% \text{ Recovery (Spike)} = \frac{\text{Conc. in Spike} - \text{Conc. in Sample}}{\text{Amount of Spike Added}} \times 100\%$$

$$\% \text{ Recovery (Surrogate)} = \frac{\text{Amount found}}{\text{Amount added}} \times 100\%$$

PURITY VALUE (sometimes abbreviated PUR)

A mathematically devised index which indicates the "goodness of fit" between the spectrum in the sample and a compound in the library. The maximum value is 1000, and values greater than 800 indicate a high probability that the identification is correct. Values from 500 to 800 are only tentative and values less than 500 are not reliable. Also important is the relationship between purity values for the best, second and third matches; ideally the second and third purity scores are much lower than the first.

RIC - RECONSTRUCTED ION CHROMATOGRAM

A plot of the total ion current of the mass spectrometer during the analysis. The plot is analogous to a gas chromatogram where a peak indicates that a compound was detected at that time. The vertical axis is intensity and the horizontal axis is time (both minutes and mass spectral scan marks are labelled).

RPD - RELATIVE PERCENT DIFFERENCE

An average used to compare duplicate analyses:

$$RPD = \frac{2\ (C_1-C_2)}{(C_1+C_2)} \times 100\%$$

where C1 and C2 are the concentrations found in two separate aliquots of the same sample.

SATURATED ION

If a compound is present at a high enough concentration in the sample, the intensity of the major ions is generally so strong that the detector is overloaded by the signal. This is a result of the instrument having been adjusted for maximum sensitivity in order to reach lower detection limits.

SPECTRAL MATCH DIAGRAM

A display of the mass spectrum of the sample followed by the mass spectra of the three compounds in the library which are most similar to the sample (see Purity Value)

SURROGATES

A surrogate compound is chemically similar to one of the priority pollutants except that it is deuterated or fluorinated or in some other manner distinguishable by GC/MS from the other compounds in the sample.

TWENTY (20) PEAK SEARCH

An available option in which up to 20 non-priority peaks larger than half the internal standard peak are identified by searching the NBS spectral library. Only an estimate of concentration can be given which is:

Low	<50 ug/l
Medium	50-200 ug/l
High	>200 ug/l

VOA - VOLATILE ORGANICS ANALYSIS

Those highly volatile compounds detected by introducing the sample directly into the GC/MS through a purge and trap apparatus.

Soil Core Sampling And Analysis

Section 3 - Test Results

- Test Boring E.B. # 1 Mi
- Test Boring E.B. # 2 Mi
- Test Boring E.B. # 3 Mi
- Test Boring E.B. # 4 Mi
- Control Test Boring
- Test Detection Limits

TEST BORING EB #1 MI

SAMPLE		A	B	C	D	E	G	H
	** SAMPLE DEPTH (Feet)	5½	7½	9½	11½	13½		
	VOLATILE ORGANICS	Conc. (UG/KG	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG		
1V.	ACROLEIN							
2V.	ACRYLONITRILE							
3V.	BENZENE							
4V.	BIS (CHLOROMETHYL) ETHER							
5V.	BROMOFORM							
6V.	CARBON TETRACHLORIDE							
7V.	CHLOROBENZENE							
8V.	CHLORODIBROMOMETHANE							
9V.	CHLOROETHANE							
10V.	2-CHLOROETHYLVINYL ETHER							
11V.	CHLOROFORM							
12V.	DICHLOROBROMOMETHANE							
13V.	DICHLORODIFLUOROMETHANE							
14V.	1,1-DICHLOROETHANE							
15V.	1,2-DICHLOROETHANE							
16V.	1,1-DICHLOROETHYLENE							
17V.	1,2-DICHLOROPROPANE							
18V.	1,3-DICHLOROPROPYLENE							
1[illegible]	ETHYLBENZENE							
[illegible]	METHYL BROMIDE							
[illegible].	METHYL CHLORIDE							
22V.	METHYLENE CHLORIDE	44	50	45	49	44		
23V.	1,1,2,2-TETRACHLOROETHANE							
24V.	TETRACHLOROETHYLENE							
25V.	TOLUENE							
26V.	1,2-TRANS-DICHLOROETHYLENE							
27V.	1,1,1-TRICHLOROETHANE							
28V.	1,1,2-TRICHLOROETHANE							
29V	TRICHLOROETHYLENE							
30V.	TRICHLOROFLUOROMETHANE							
31V.	VINYL CHLORIDE							
	**SAMPLE DEPTH (Feet)	7½	9½	11½	13½	15½	22½	27½
	CHLORIDE (ppm)	36	31	11	—	3	3	1
	COPPER (ppb)	<10	<10	<10	—	<10	<10	<10

** Sample depths shown in the above table is the distance measured from grade level to the sample. Sand-clay interface for EB #1 MI was 5½ feet.

TEST BORING EB #2 MI

	SAMPLE	A	B	C	D	E	F	G
	** SAMPLE DEPTH (Feet)	9½	11½	13½	15½	17½		
	VOLATILE ORGANICS	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG		
1V.	ACROLEIN							
2V.	ACRYLONITRILE							
3V.	BENZENE	89						
4V.	BIS (CHLOROMETHYL) ETHER							
5V.	BROMOFORM							
6V.	CARBON TETRACHLORIDE							
7V.	CHLOROBENZENE	16						
8V.	CHLORODIBROMOMETHANE							
9V.	CHLOROETHANE							
10V.	2-CHLOROETHYLVINYL ETHER							
11V.	CHLOROFORM							
12V.	DICHLOROBROMOMETHANE							
13V.	DICHLORODIFLUOROMETHANE							
14V.	1,1-DICHLOROETHANE							
15V.	1,2-DICHLOROETHANE							
16V.	1,1-DICHLOROETHYLENE							
17V.	1,2-DICHLOROPROPANE							
18V.	1,3-DICHLOROPROPYLENE							
	ETHYLBENZENE							
[illegible]	METHYL BROMIDE							
21V.	METHYL CHLORIDE							
22V.	METHYLENE CHLORIDE	120	35	83	19	81		
23V.	1,1,2,2-TETRACHLOROETHANE							
24V.	TETRACHLOROETHYLENE							
25V.	TOLUENE							
26V.	1,2-TRANS-DICHLOROETHYLENE							
27V.	1,1,1-TRICHLOROETHANE							
28V.	1,1,2-TRICHLOROETHANE							
29V	TRICHLOROETHYLENE							
30V.	TRICHLOROFLUOROMETHANE	11		12				
31V.	VINYL CHLORIDE							
	** SAMPLE DEPTH (Feet)	11½	13½	15½	17½	19½	21½	26½
	CHLORIDE (ppm)	153	65	–	20	8	2	3
	COPPER (ppb)	< 10	<10	–	<10	<10	<10	<10

** Sample depths shown in the above table is the distance measured from grade level to the sample. Sand-clay interface for EB #2 MI was 9½ feet.

TEST BORING EB #3 MI

	SAMPLE	A	B	C	D	E	F	G
	** SAMPLE DEPTH (Feet)	5	7	9	11	13		
	VOLATILE ORGANICS	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG		
1V.	ACROLEIN							
2V.	ACRYLONITRILE							
3V.	BENZENE							
4V.	BIS (CHLOROMETHYL) ETHER							
5V.	BROMOFORM							
6V.	CARBON TETRACHLORIDE							
7V.	CHLOROBENZENE							
8V.	CHLORODIBROMOMETHANE							
9V.	CHLOROETHANE							
10V.	2-CHLOROETHYLVINYL ETHER							
11V.	CHLOROFORM							
12V.	DICHLOROBROMOMETHANE							
13V.	DICHLORODIFLUOROMETHANE							
14V.	1,1-DICHLOROETHANE							
15V.	1,2-DICHLOROETHANE							
16V.	1,1-DICHLOROETHYLENE							
17V.	1,2-DICHLOROPROPANE							
18"	1,3-DICHLOROPROPYLENE							
	ETHYLBENZENE							
...	METHYL BROMIDE							
21V.	METHYL CHLORIDE							
22V.	METHYLENE CHLORIDE	65	140	80	100	84		
23V.	1,1,2,2-TETRACHLOROETHANE							
24V.	TETRACHLOROETHYLENE							
25V.	TOLUENE		24					
26V.	1,2-TRANS-DICHLOROETHYLENE							
27V.	1,1,1-TRICHLOROETHANE							
28V.	1,1,2-TRICHLOROETHANE							
29V	TRICHLOROETHYLENE							
30V.	TRICHLOROFLUOROMETHANE							
31V.	VINYL CHLORIDE							
	** SAMPLE DEPTH (Feet)	7	9	11	13	15	22	27
	CHLORIDE (ppm)	204	103	54	40	61	81	—
	COPPER (ppb)	<10	<10	<10	<10	<10	<10	—

** Sample depths shown in the above table is the distance measured from grade level to the sample. Sand-clay interface for EB #3 MI was 5 feet.

TEST BORING EB #4 MI

	SAMPLE	A	B	C	D	E	F	G
	** SAMPLE DEPTH (Feet)	8	10	12	14	16		
	VOLATILE ORGANICS	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG	Conc. UG/KG		
1V.	ACROLEIN							
2V.	ACRYLONITRILE							
3V.	BENZENE	44						
4V.	BIS (CHLOROMETHYL) ETHER							
5V.	BROMOFORM							
6V.	CARBON TETRACHLORIDE							
7V.	CHLOROBENZENE	16						
8V.	CHLORODIBROMOMETHANE							
9V.	CHLOROETHANE							
10V.	2-CHLOROETHYLVINYL ETHER							
11V.	CHLOROFORM							
12V.	DICHLOROBROMOMETHANE							
13V.	DICHLORODIFLUOROMETHANE							
14V.	1,1-DICHLOROETHANE							
15V.	1,2-DICHLOROETHANE							
16V.	1,1-DICHLOROETHYLENE							
17V.	1,2-DICHLOROPROPANE							
18V.	1,3-DICHLOROPROPYLENE							
[illegible]	ETHYLBENZENE							
[illegible]	METHYL BROMIDE							
21V.	METHYL CHLORIDE							
22V.	METHYLENE CHLORIDE	120	170	78	120	65		
23V.	1,1,2,2-TETRACHLOROETHANE							
24V.	TETRACHLOROETHYLENE							
25V.	TOLUENE							
26V.	1,2-TRANS-DICHLOROETHYLENE							
27V.	1,1,1-TRICHLOROETHANE							
28V.	1,1,2-TRICHLOROETHANE							
29V	TRICHLOROETHYLENE							
30V.	TRICHLOROFLUOROMETHANE							
31V.	VINYL CHLORIDE							

	A	B	C	D	E	F	G
** SAMPLE DEPTH (Feet)	10	12	14	16	18	25	30
CHLORIDE (ppm)	336	—	29	6	3	3	—
COPPER (ppb)	<10	—	<10	<10	<10	<10	—

** Sample depths shown in the above table is the distance measured from grade level to the sample. Sand-clay interface for EB #4 MI was 8 feet.

EXHIBIT II - COMPOUND LIST

5124 59 6'-0"
SAMPLE IDENTIFIER: 5124-59-10'-0" (CONTROL)
COMPUCHEM SAMPLE NUMBER: 8321

SAMPLE LOCATION: 5300 BLOCK, NEAR WALDO ROAD

	VOLATILE ORGANICS	6'-0" CONCENTRATION (UG/KG)	10'-0" CONCENTRATION (UG/KG)	DETECTION LIMIT (UG/KG)	SCAN NUMBER
1V.	ACROLEIN	BDL	BDL	100	
2V.	ACRYLONITRILE	BDL	BDL	100	
3V.	BENZENE	BDL	BDL	10	
4V.	BIS (CHLOROMETHYL) ETHER	BDL	BDL	10	
5V.	BROMOFORM	BDL	BDL	10	
6V.	CARBON TETRACHLORIDE	BDL	BDL	10	
7V.	CHLOROBENZENE	BDL	BDL	10	
8V.	CHLORODIBROMOMETHANE	BDL	BDL	10	
9V.	CHLOROETHANE	BDL	BDL	10	
10V.	2-CHLOROETHYLVINYL ETHER	BDL	BDL	10	
11V.	CHLOROFORM	BDL	BDL	10	
12V.	DICHLOROBROMOMETHANE	BDL	BDL	10	
13V.	DICHLORODIFLUOROMETHANE	BDL	BDL	10	
14V.	1,1-DICHLOROETHANE	BDL	BDL	10	
15V.	1,2-DICHLOROETHANE	BDL	BDL	10	
16V.	1,1-DICHLOROETHYLENE	BDL	BDL	10	
17V.	1,2-DICHLOROPROPANE	BDL	BDL	10	
18V.	1,3-DICHLOROPROPYLENE	BDL	BDL	10	
19V.	ETHYLBENZENE	BDL	BDL	10	
20V.	METHYL BROMIDE	BDL	BDL	10	
21V.	METHYL CHLORIDE	BDL	BDL	10	
22V.	METHYLENE CHLORIDE	65	84	10	199
23V.	1,1,2,2-TETRACHLOROETHANE	BDL	BDL	10	
24V.	TETRACHLOROETHYLENE	BDL	BDL	10	
25V.	TOLUENE	10	BDL	10	696
26V.	1,2-TRANS-DICHLOROETHYLENE	BDL	BDL	10	
27V.	1,1,1-TRICHLOROETHANE	BDL	BDL	10	
28V.	1,1,2-TRICHLOROETHANE	BDL	BDL	10	
29V	TRICHLOROETHYLENE	BDL	BDL	10	
30V.	TRICHLOROFLUOROMETHANE	BDL	10	10	252
31V.	VINYL CHLORIDE	BDL	BDL	10	

UG/KG = ppb

BDL=BELOW DETECTION LIMIT

NOTE:

All sample results including the control indicate the presence of methylene chloride. An investigation of this situation suggests that the detected methylene chloride is from using this material as a cleaning agent by the analytical laboratory (CompuChem). This laboratory has informed Dow Corning that they have experienced cross-contamination problems with methylene chloride on previous occasions and is attempting to correct it. A check of company records revealed that methylene chloride is purchsed only in pint bottles and is used in plant laboratories. All spent chemicals from laboratories are routinely incinerated thus effectively eliminating this source as the origin of the contamination.

	VOLATILE ORGANICS	DETECTION LIMIT (UG/KG)
1Y.	ACROLEIN	100
2Y.	ACRYLONITRILE	100
3Y.	BENZENE	10
4Y.	BIS (CHLOROMETHYL) ETHER	10
5Y.	BROMOFORM	10
6Y.	CARBON TETRACHLORIDE	10
7Y.	CHLOROBENZENE	10
8Y.	CHLORODIBROMOMETHANE	10
9Y.	CHLOROETHANE	10
Y.	2-CHLOROETHYLVINYL ETHER	10
11Y.	CHLOROFORM	10
12Y.	DICHLOROBROMOMETHANE	10
13Y.	DICHLORODIFLUOROMETHANE	10
14Y.	1,1-DICHLOROETHANE	10
15Y.	1,2-DICHLOROETHANE	10
16Y.	1,1-DICHLOROETHYLENE	10
17Y.	1,2-DICHLOROPROPANE	10
18Y.	1,3-DICHLOROPROPYLENE	10
19Y.	ETHYLBENZENE	10
20Y.	METHYL BROMIDE	10
21Y.	METHYL CHLORIDE	10
22Y.	METHYLENE CHLORIDE	10
23Y.	1,1,2,2-TETRACHLOROETHANE	10
24Y.	TETRACHLOROETHYLENE	10
25Y.	TOLUENE	10
26Y.	1,2-TRANS-DICHLOROETHYLENE	10
27Y.	1,1,1-TRICHLOROETHANE	10
28Y.	1,1,2-TRICHLOROETHANE	10
29Y	TRICHLOROETHYLENE	10
30Y.	TRICHLOROFLUOROMETHANE	10
31Y.	VINYL CHLORIDE	10

UG/KG = ppb

Dow Corning Corporation
Midland Plant Landfill
Equivalency Program

<u>Test # 2 Resistivity Analysis</u>

Section 1 - Summary of Test

Section 2 - Apparent Resistivity Curves - Field Data

Section 3 - Field Data Interpretion

Resistivity Analysis

Section 1 - Summary of Tests

- Procedures
- Interpretation of Resistivity Curves
- Results and Discussion

SAMTEST Inc.

P.O. BOX 1444 MIDLAND, MI 4
(517) 496-3610

February 23, 1982

Dow Corning Corporation
Building #205
Midland, MI 48640

Attn: G. Hamblin - Project Engineer

Re: Resistivity Survey-Midland Plant Landfill-1000 Block Addition-Midland Plant-Dow Corning Corporation

Gentlemen:

The resistivity survey for the above referenced facility has been completed. This work was authorized by your office as of December 8, 1981.

This report summarizes the field data and the follow-up analysis of the resistivity curves at representative stations based on two/three layer models and ground truth where that is known with some degree of certainty.

Please call if there are any questions or if we might be of additional service

Respectfully Submitted,

William A. Crozier, Ph.D.
SAMTEST, Inc.

WAC/ss

Enclosures

Introduction

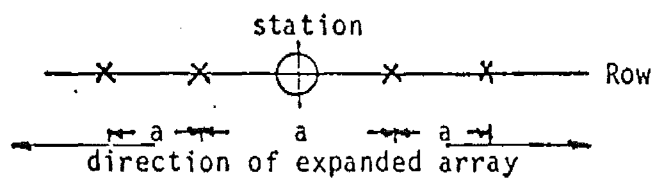
The resistivity survey for the Dow Corning Landfill, Proposed Expansion, Midland Plant is completed. Apparent resistivity values were measured at three (3) rows of stations as outlined by Mr. James Janiczek, Resource Recovery Division, Michigan Department of Natural Resources in his letter of 11-17-81 and designated rows B, C & D. Stations were set up every sixty feet (60 ft.) by Dow Corning personnel and the survey run about each station along the row line using a Wenner electrode configuration. The field data is summarized on the Table later in this report and reported in graphical form on log-log paper marked according to row and station.

At the time of this survey, (12-14-81 thru' 12-22-81), the site was excavated to near the clay bottom stratum but covered in most locations by from several inches to ten, (10), inches of medium fine sand. Although the proposed first cell had been previously excavated to the planned bottom elevation, it was filled with water and not accessible for this survey. The exterior clay barrier wall had also been constructed and represented the limit of this investigation.

The purpose of this investigation is to demonstrate from a vertical electrical sounding survey that the clay stratum which constitutes the lower barrier of the landfill does not contain any interbedded sand lens within the upper five feet (5 ft.), that would jeopardize the integrity of the landfill site for waste containment.

Field Testing Procedure

Field data for this survey were collected using a Bison Model 2350 Resistivity Meter and the Wenner electrode configuration. Each station along a given row was designated as the center of the electrode array and the first potential electrodes spaced at one and one half feet, (1 1/2 ft.) on either side of the station center. ("a" spacing of three feet) The spacing was increased by three feet for successing readings to a maximum of forty-eight feet, (48 ft.). This is represented graphically below as viewed from above the site:



Electrode length and the soil profile for the upper one to one and one half foot, (1 1/2 ft.), indicates good contact with the upper clay surface at all stations for the survey. Some variation in the surface clay quality was noted during the shallow surface soil profile evaluation and appears in the soil log presented on the appropriate row/station resistivity curve

This resistivity meter system uses heavy duty plug connection to the meter for the electrode wire with wire reel connections at each electrode stake to minimize spurious readings.

Interpretation of Resistivity Curves

The apparent resistivity data appear later in this report in tabular form and are plotted on log-log paper for uniformity and convenience in interpretation. Since concern is directed to the upper five to ten feet (5-10 ft.), of the soil profile as reflected in the electrode spacings, examination of the soil layer model is restricted primarily to the left hand side of the curve where a generalized two layer model appears to apply. The soil properties and layer thickness value are taken from the generalized log-log curves presented by Van Nostrand and Cook [1]. Several curves were evaluated using a three layer curve matching technique presented by Wetzel and McMurry [2]. These soil parameters are then used in conjunction with a computer program developed by Zohdy [3]. to construct apparent resistivity values for different Wenner electrode spacings. The generalized approach to the calculation of the apparent resistivity appears on Table #2.

This evaluation is performed for several typical stations along each of the B and C rows.

In conjunction with the above interpretation, the purpose of the survey and known ground truth from nearby perimeter borings, a multilayer model is constructed to try and clarify the sensitivity of the resistivity technique to detect an interbedded sand lens. This model and the results are superimposed on Row/Station C-8 figure #3.

No attempt was made to quantitatively interpret apparent resistivity curves for Row D-stations where a somewhat complex multilayer structure occurs.

Results and Discussions

Rows B and C, with all stations excluding the beginning and end stations for each row, cover the major protion of the proposed landfill barrier layer. Almost all of the resistivity curves can be represented by a two layer model where the value of resistivity in the upper clay layer p_1 is less then the resistivity, p_2, for the generalized lower layers ($p_1 < p_2$). A typical ratio for this is about $p_1:p_2::1:2$. This lower generalized resistivity is considerably less than the resistivity measured off site for the site excavated sands, ($p=1100\Omega$ft.), and is in line with what might be expected for the drier sandy clay till layer known to underly the site at about twenty-five feet, (25 ft.), (site el.$\sim$75'). Certainly, this p_2 value could represent a combination of an underlying clayey silt layer with the clay till basement

It is recognized that, as the apparent resistivity curve becomes flatter, approaches an asymptote, it is easier to reconstruct the curve from a soil model with variables having a rather wide variation in value. Generally, the solution then becomes less unique for deeper strata but still gives valuable information regarding shallow depths.

The multi-layer model was developed around a typical C row station (C-8) in order to generate the type of apparent resistivity curve that could be expected for a sand lens in the upper five feet, (5 ft.) of clay. The results of this model are presented on Figure #3, where a sand layer of one foot, (1 ft.), thickness appears at several locations within the clay layer. Generally, such a layer can be easily detected on this resistivity curve. However, when reduced to a six inch, (6 in.), or a 0.5 ft. layer occuring near the bottom of the clay barrier layer it could easily be undetected and represented by a new two layer model with the sand lens resistivity part of the combined lower layer resistivity.

Apparent resistivity curves observed for the D row stations are generally described as "H" type curves which can generally be described by a three layer model. Here the relative values for the resistivities is $p_1 > p_2 < p_3$. The clay dyke sand topsoil cover and adjacent road bed continually vary along this row. However, any lower lying sand layers, if present, are thin enough to be suppressed by the compacted clay wall resistivity.

Summary

Generally, based on the uniformity of the curves representing row B & C, interior to the proposed landfill addition there are no interbedded sand lenses thick enough to be detected by this method in the upper clay layer. Also, compared with ground truth for the perimeter of the site and the uniformity of the shallow depth portion of the resistivity curves, the clay stratum for the bottom of the site appears to provide adequate barrier under Act 64 requirements.

BIBLIOGRAPHY

1. Van Nostrand, R. G., and K. L. Cook, 1966, Interpretation of resistivity data: Professional Paper 499, United States Geological Survey, 310 pages.

2. Wetzel, W. W., and McMurry, H. V., 1937, A set of curves to assist in the interpretation of the three-layer resistivity problem: Geophysics, v. 2, p. 329-341. Resistivity. GA 4206

3. Zohdy, A. A. R., and Bisdorf, R. J., 1975, Computer programs for the forward calculation and automatic inversion of Wenner sounding curves: available only from U.S. Department of Commerce National Technical Information Services, Springfield, Virginia 22161 as PB-247 265.

TABLE #1

"B" ROW STATIONS - APPARENT RESISTIVITIES (OHM-FT)

			Stations													
Reading	"A" Space	AB/2	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14
1	3	2.25	17.7	25.1	43.2	30.9	46.2	46.8	60.9	60.9	56.4	93.6	72.6	110.1	102.0	90.0
2	6	4.5	21.9	30.7	47.5	38.6	60.0	56.3	74.4	79.2	55.6	102.0	88.8	115.8	115.2	107.4
3	9	6.75	36.4	38.5	53.6	48.8	69.6	72.9	84.9	90.0	70.8	115.2	100.4	122.4	126.9	119.7
4	12	9	36.3	42.1	63.6	57.0	80.0	87.5	95.4	101.2	85.3	124.8	118.1	126.0	128.4	132.0
5	15	11.25	24.9	49.4	71.2	62.2	89.9	101.7	106.4	107.5	91.2	131.2	129.4	133.9	139.5	145.6
6	18	13.5	38.2	57.2	75.1	68.4	94.9	103.7	112.3	110.9	91.3	140.0	135.2	136.6	144.7	150.5
7	21	15.75	47.3	49.3	79.4	75.6	102.9	106.5	118.0	106.3	106.4	142.4	138.4	145.7	147.4	154.1
8	24	18	76.8	49.0	83.3	76.6	108.5	111.4	125.3	116.9	112.6	145.9	141.6	150.5	152.2	155.8
9	27	20.25	89.1	57.8	88.3	66.2	109.9	114.2	127.7	126.9	116.1	148.2	145.8	140.9	156.6	148.2
10	30	22.5	84.6	54.9	88.2	71.7	111.9	118.2	132.9	129.0	120.6	150.6	150.0	156.0	159.6	148.5
11	33	24.75	91.7	53.8	91.1	93.1	115.2	123.8	133.0	136.6	123.1	151.5	152.1	156.8	165.0	151.8
12	36	27	93.9	56.5	105.5	97.6	117.4	130.7	134.3	142.2	125.6	151.6	153.4	160.9	166.3	155.9
13	39	29.25	99.0	58.5	109.6	94.8	117.8	128.7	136.5	147.4	132.2	158.3	155.6	165.0	166.1	162.2
14	42	31.5	76.9	54.2	108.8	107.1	120.1	130.2	139.0	152.5	135.3	163.0	158.3	166.7	168.8	168.0
15	45	33.75	107.1	-	110.7	105.3	126.4	131.0	142.2	154.8	137.7	164.2	159.8	169.7	173.3	175.5
16	48	36	109.4	69.6	112.3	107.5	130.1	133.4	144.9	156.5	139.2	168.0	161.8	171.8	173.8	180.0

Underline Apparent Resistivities: Field Noted
Change in Instrument Operation (I Variation)

"C" ROW STATIONS - APPARENT RESISTIVITIES (OHM-FT)

Reading	"A" Space	$\overline{AB}/2$	C-1	C-2	C-3	C-4	C-5	C-6 ✓	C-6	C-7	C-8	C-9	C-10	C-11	C-12
			Stations (East-West)												
1	3	2.25	-	-	58.8	67.5	98.4	97.8	94.5	96	99.9	93	105.0	-	94.8
2	6	4.5	-	-	54.2	75.6	114.0	110.4	105.0	114.6	112.8	106.2	112.8	114.0	106.8
3	9	6.75	-	-	69.4	91.8	129.6	122.4	124.2	126.9	125.1	118.8	121.5	128.7	120.6
4	12	9	78.0	62.5	80.0	103.2	136.8	140.4	129.6	135.6	134.4	126.0	133.2	141.6	136.8
5	15	11.25	73.5	74.1	91.2	114.9	140.7	143.4	138.3	140.4	137.7	136.2	140.5	148.5	146.1
6	18	13.5	78.1	79.9	101.9	119.3	142.8	149.8	149.2	142.9	147.6	143.5	148.0	157.1	152.1
7	21	15.75	81.3	83.6	106.5	121.6	142.8	151.6	152.0	147.4	152.0	147.8	155.2	164.0	157.9
8	24	18	87.4	90.7	110.2	124.8	126.0	153.1	151.4	151.7	157.9	154.6	158.6	168.7	162.7
9	27	20.25	97.2	95.0	116.1	128.0	145.0	158.2	151.7	155.0	160.1	159.8	163.9	175.0	171.2
10	30	22.5	98.4	99.0	115.5	132.3	147.9	157.2	156.0	159.9	164.1	162.3	168.3	178.5	174.3
11	33	24.75	101.9	104.6	120.4	135.6	148.2	161.4	155.4	160.7	166.7	166.6	169.6	180.5	181.2
12	36	27	106.6	81.7	120.3	138.6	150.8	162.0	156.2	162.4	167.4	166.3	172.4	182.9	190.4
13	39	29.25	110.4	108.8	125.2	120.1	155.2	166.1	159.1	163.8	171.2	168.4	176.7	186.0	198.9
14	42	31.5	115.9	108.8	124.3	140.7	154.1	169.3	159.6	165.1	173.9	171.4	179.8	187.7	205.4
15	45	33.75	117.9	115.2	125.1	142.6	154.4	153.4	160.2	166.5	175.5	172.4	180.9	189.4	212.4
16	48	36	120.9	117.1	130.1	143.0	155.5	156.5	160.3	168.0	176.2	173.3	181.4	191.0	210.2

"D" ROW STATIONS - APPARENT RESISTIVITY (OHM-FT)

Reading	"A" Space	$\overline{AB}/2$	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8
			Stations							
1	3	2.25	102.0	201.3	169.8	147.3	165.6	172.8	160.0	111.0
2	6	4.5	108.0	131.4	107.4	120.0	114.0	120.0	103.2	109.8
3	9	6.75	107.1	108.9	108.0	99.9	50.6	100.8	123.3	98.1
4	12	9	100.7	103.8	103.1	77.4	111.3	101.4	105.1	97.4
5	15	11.25	102.4	102.3	108.75	68.25	46.2	111.9	110.4	94.05
6	18	13.5	97.0	104.4	113.8	110.52	123.5	118.1	120.1	96.5
7	21	15.75	102.3	112.1	115.9	116.97	128.5	125.6	126.8	103.3
8	24	18	109.4	117.8	117.4	37.92	137.0	135.8	134.2	124.3
9	27	20.25	115.3	123.1	129.6	125.01	140.9	142.3	143.1	132.6
10	30	22.5	116.7	129.9	132.6	124.2	147.9	153.6	151.5	141.9
11	33	24.75	124.1	138.6	142.9	136.6	125.4	163.0	148.8	155.8
12	36	27	130.7	140.0	150.8	54.0	164.9	163.4	162.4	165.6
13	39	29.25	134.9	146.6	155.2	145.0	168.5	162.2	170.0	175.5
14	42	31.5	139.9	150.0	135.2	149.9	170.5	170.5	175.1	186.1
15	45	33.75	144.0	156.1	159.8	148.0	181.4	172.4	167.0	193.5
16	48	36	148.8	162.2	162.2	156	190.1	179.0	182.4	194.4

TABLE 2

Theoretical Wenner Vertical Electric Soundings

By: A.R. Zohdy and David L. Campbell
U.S. Geological Survey

This method computes theoretical vertical electrical sounding curves for the Wenner electrode arrays. The earth structure is assumed to be a horizontally layered medium comprised of 6 layers or less. The input data consist of layer resistivities, depths (or thicknesses), and an initial electrode spacing value (a=AB/3 for Wenner). The output is the coordinate values for the theoretical sounding curve computed at the rate of 3 points per logarithmic cycle.

TECHNIQUE: The convolution method is used with Ghosh's filters to compute sounding curves (Ghosh, 1971: Zohdy, 1973; Zohdy, 1974; Zohdy and Bisdorf, 1975). For each electrode spacing, the computations involve two steps. First, the kernel function B(x) is calculated from the layer thicknesses and resistivities at 9 (Schlumberger) or 10 (Wenner) abscissa values (x). These abscissa values which depend on the value of the particular electrode spacing are logarithmically equally spaced at the rate of 3 points per logarithmic cycle ($\Delta x = 10^{1/3}$). Each electrode spacing used is multiplied by Ghosh's shift factor 1.36 for the Wenner spacings. Second, B(x) is convolved with the appropriate Ghosh filter coefficients to compute the apparent resistivity at the given electrode spacing.

EQUATIONS:

1. Use Sunde's recursive formula to compute B(x) as follows:
   a. Initialize for bottom layer (half-space)

   $$B_n = 1$$

   b. Using the following recursive formula upward for all the layers for i = n to 2,

   $$R_i = B_i \rho_i$$

   $$K_i = (\rho_{i-1} - R_i) / (\rho_{i-1} + R_i)$$

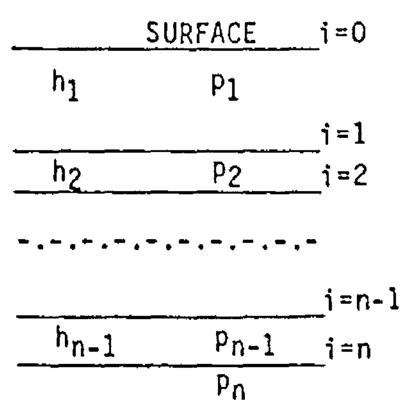
   $$M_i = -2h_{i-1}/f \cdot x \quad (f = \text{shift factor})$$

   $$Q_i = K_i \exp(M)$$

   $$B_{i-1} = (1-Q_i)/(1+Q_i)$$

   we get

   $$B(x) = B_1 \cdot \rho_1$$



2. Convolve B(x) with Ghosh coefficients, G_j to compute

$$\bar{\rho}_W(a) = \sum_{1}^{10} G_j \cdot B(x_j)$$

where $\bar{\rho}_W(a)$ = Wenner apparent resistivity at a.

REFERENCES:

Anderson, W. L., 1979, Numerical integration of related Hankel transforms of orders 0 and 1 by adaptive digital filtering: Geophysics, v. 44, p. 1287-1305.

Ghosh, D. P., 1971, Inverse filter coefficients for the computation of apparent resistivity standard curves for a horizontally stratified earth: Geophysical Prospecting (Netherlands), v. 19, no. 4, p. 769-775.

Zohdy, A. A. R., and Bisdorf, R. J., 1975, Computer programs for the forward calculation and automatic inversion of Wenner sounding curves: available only from U.S. Department of Commerce National Technical Information Services, Springfield, Virginia 22161 as PB-247 265.

Resistivity Analysis

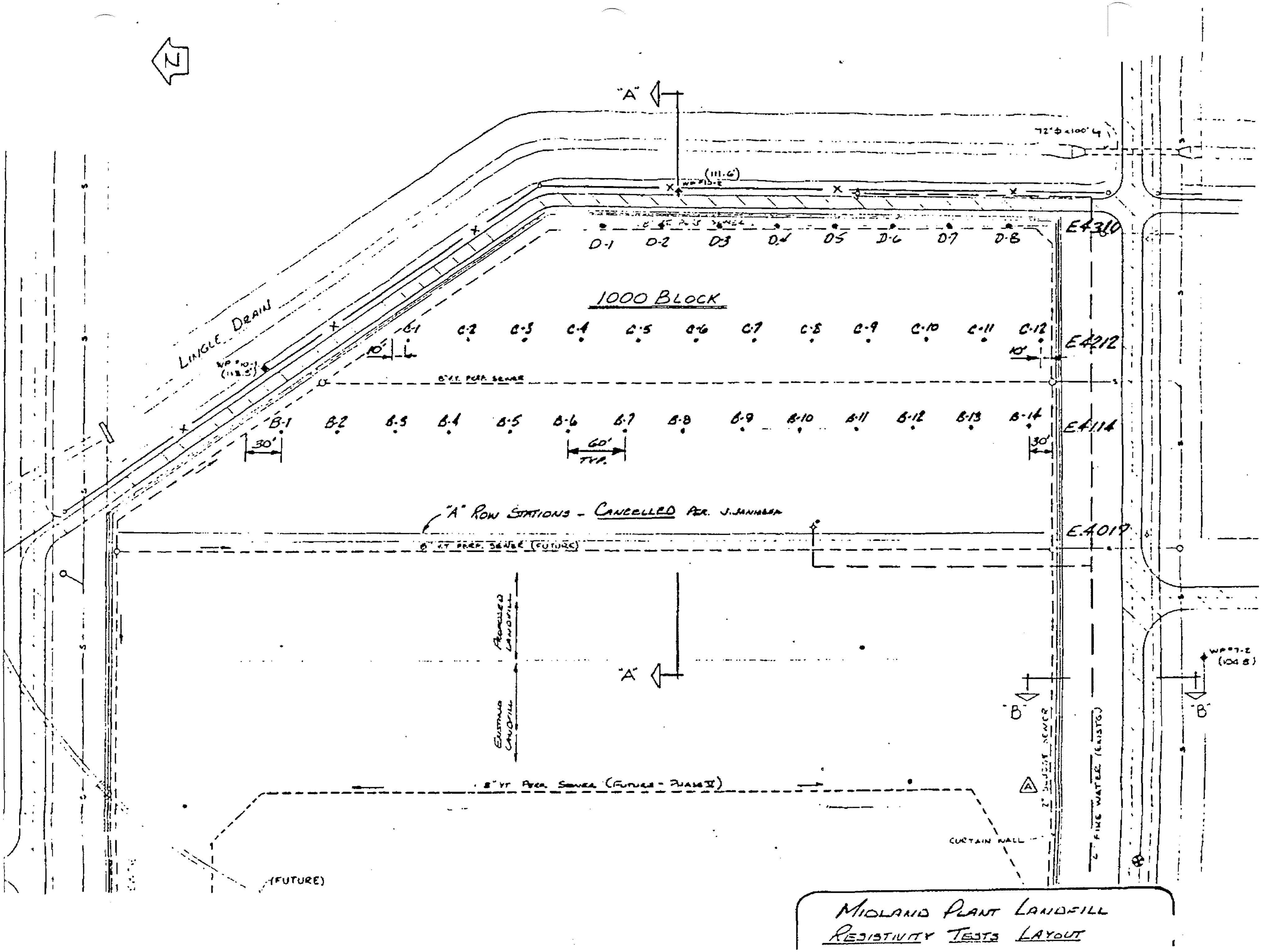
Section 2 - Field Data

- Resistivity Stations Plan
- Apparent Resistivity Plots - Stations

FIGURE #1

Apparent Resistivity Curves

Stations B, C & D

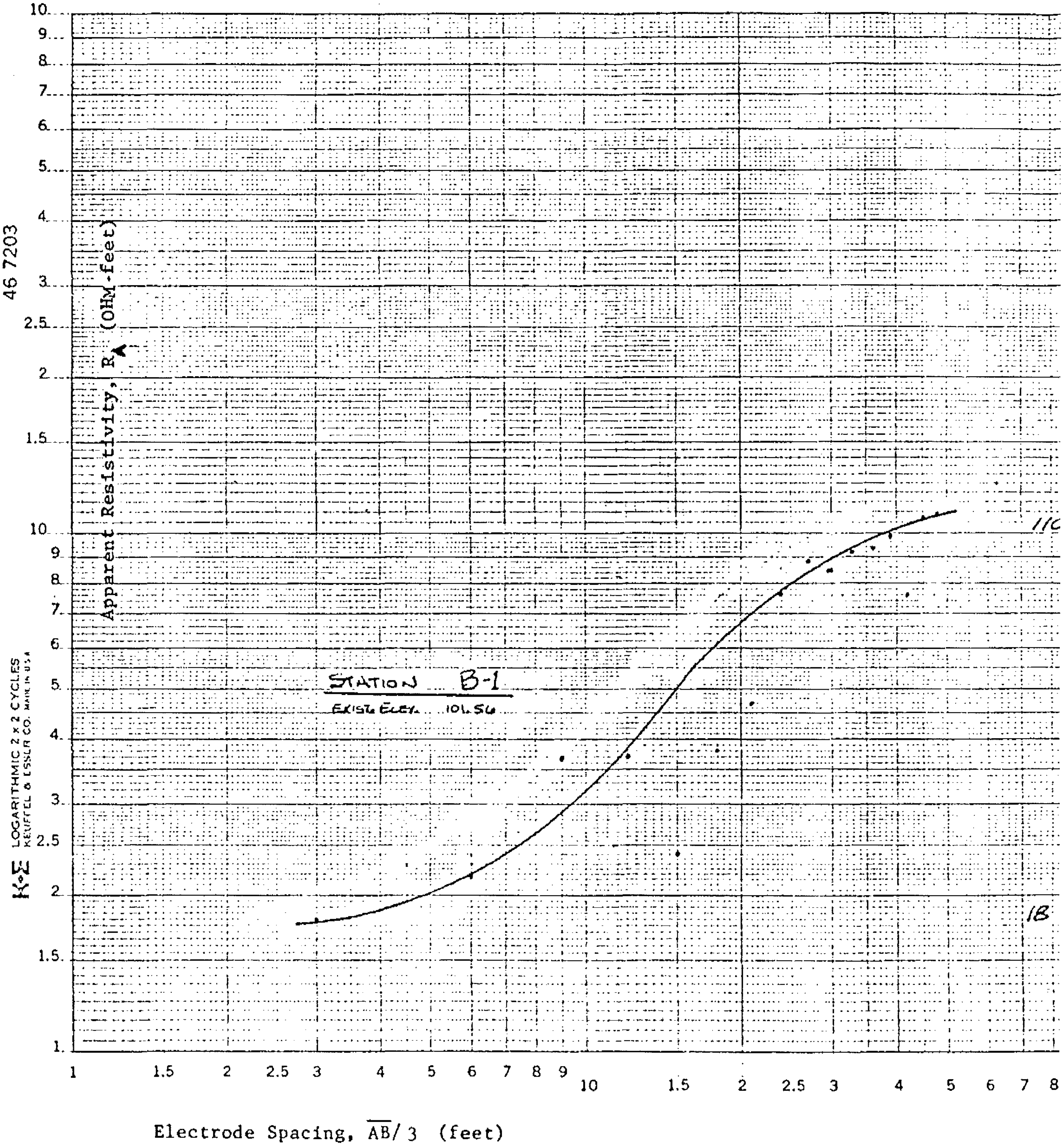


"A"
1000 BLOCK
D-1 D-2 D-3 D-4 D-5 D-6 D-7 D-8
C-1 C-2 C-3 C-4 C-5 C-6 C-7 C-8 C-9 C-10 C-11 C-12
B-1 B-2 B-3 B-4 B-5 B-6 B-7 B-8 B-9 B-10 B-11 B-12 B-13 B-14
E4310
E4212
E4114
E4019
10'
30'
60' TYP.
LINGLE DRAIN
"A" ROW STATIONS - CANCELLED PER. J. JANIGER
PROPOSED LANDFILL
EXISTING LANDFILL
"B"
CURTAIN WALL
FIRE WATER (EXISTG)
(FUTURE)
MIDLAND PLANT LANDFILL
RESISTIVITY TESTS LAYOUT

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

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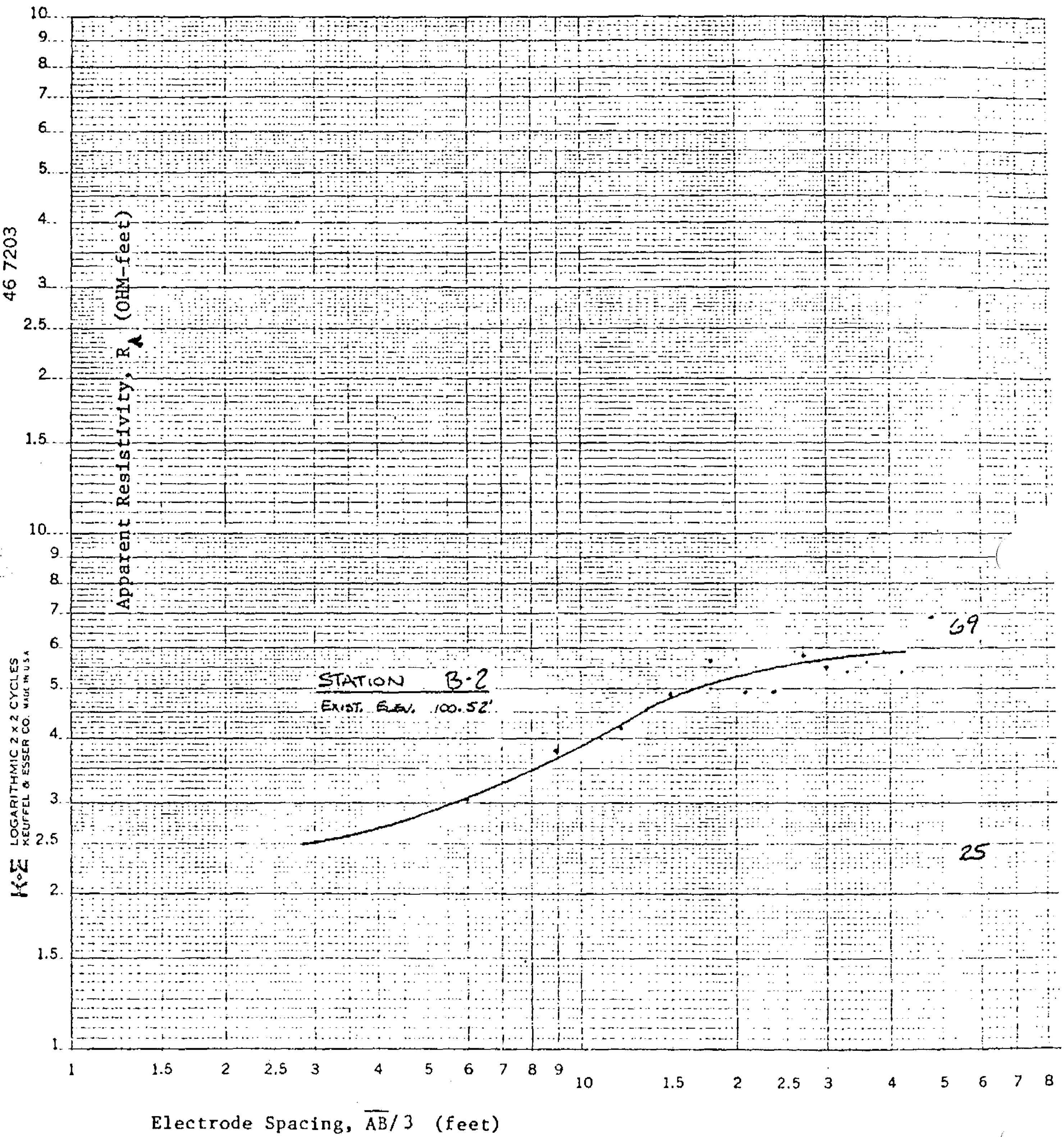

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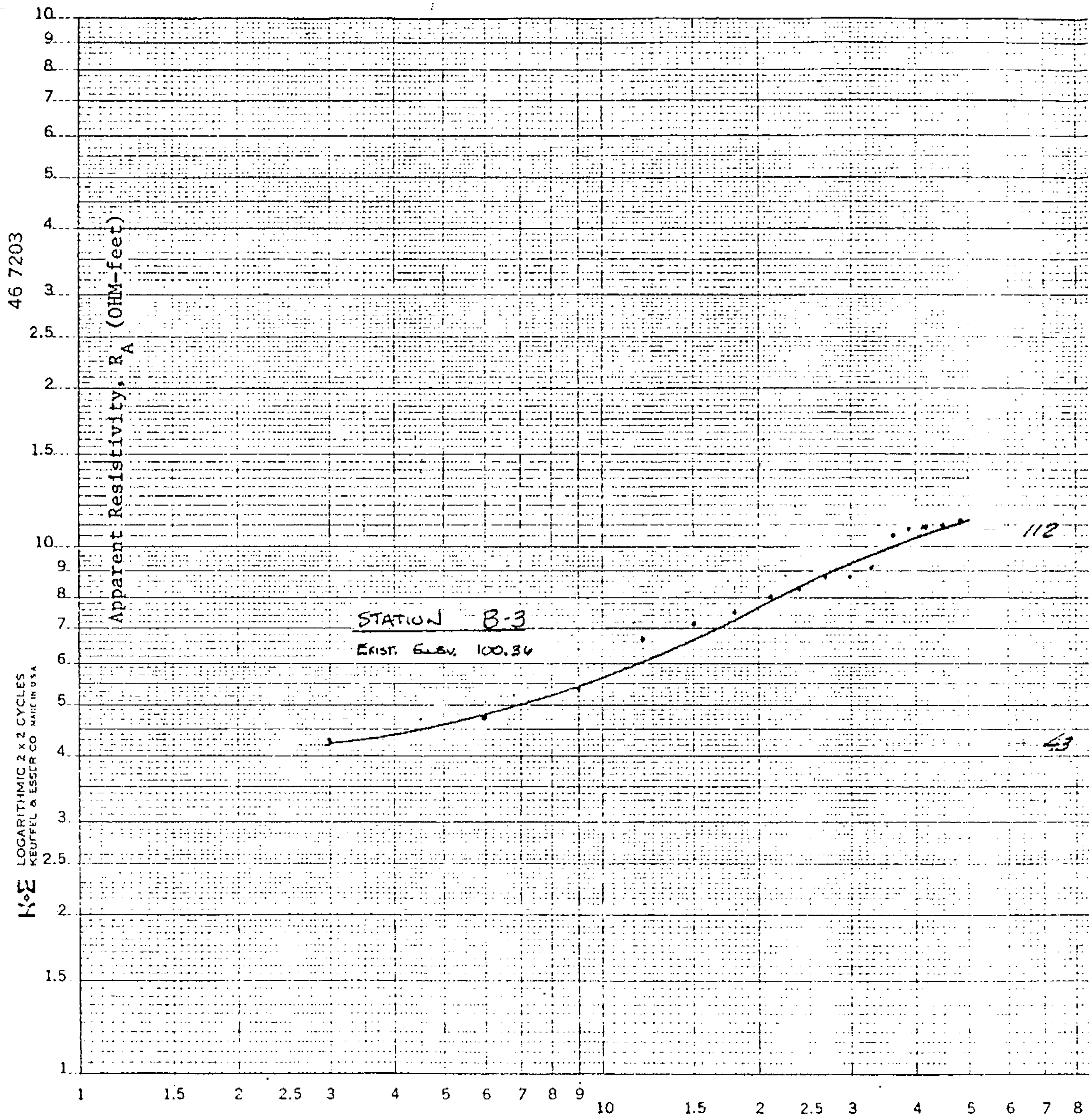
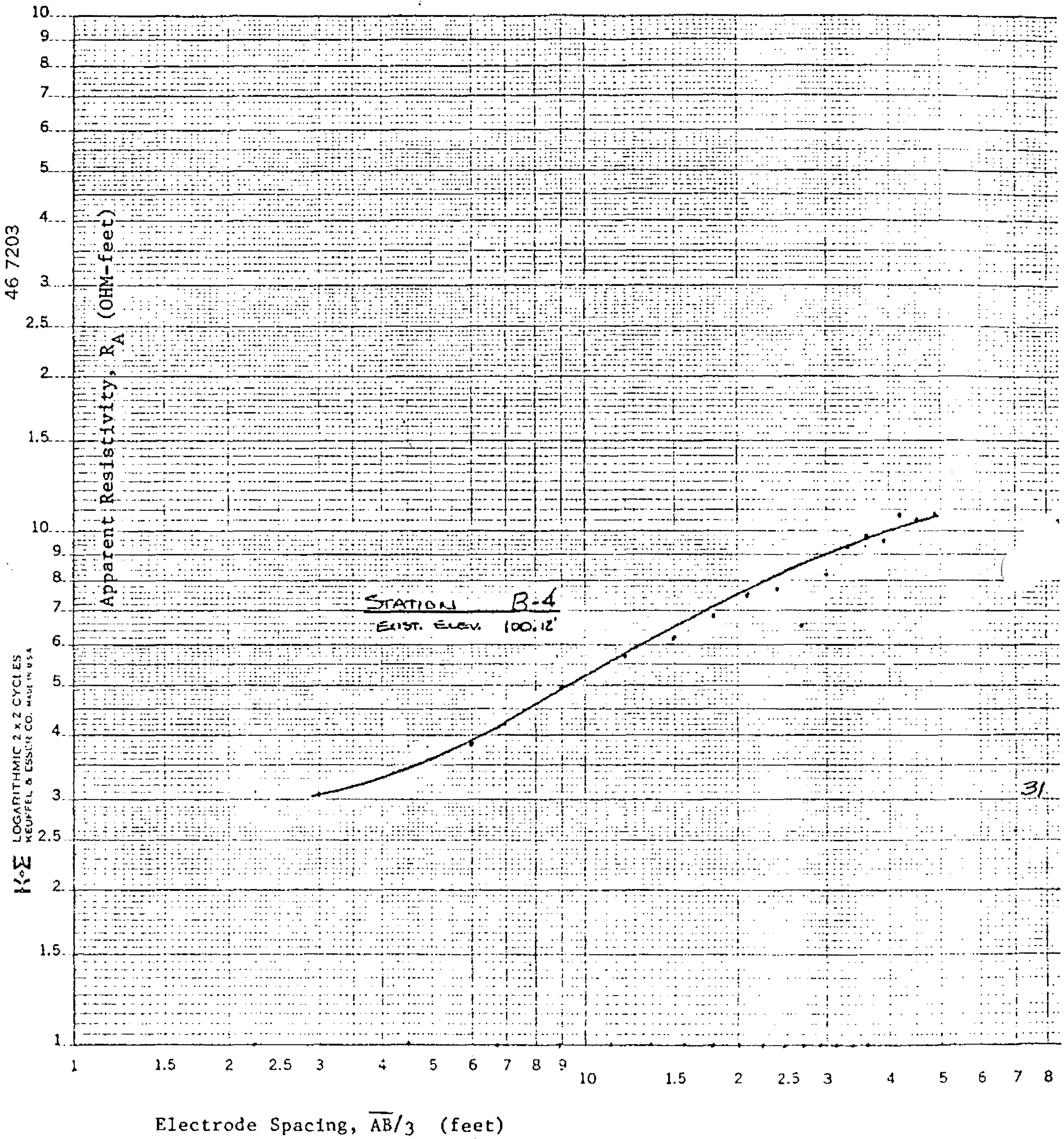


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT



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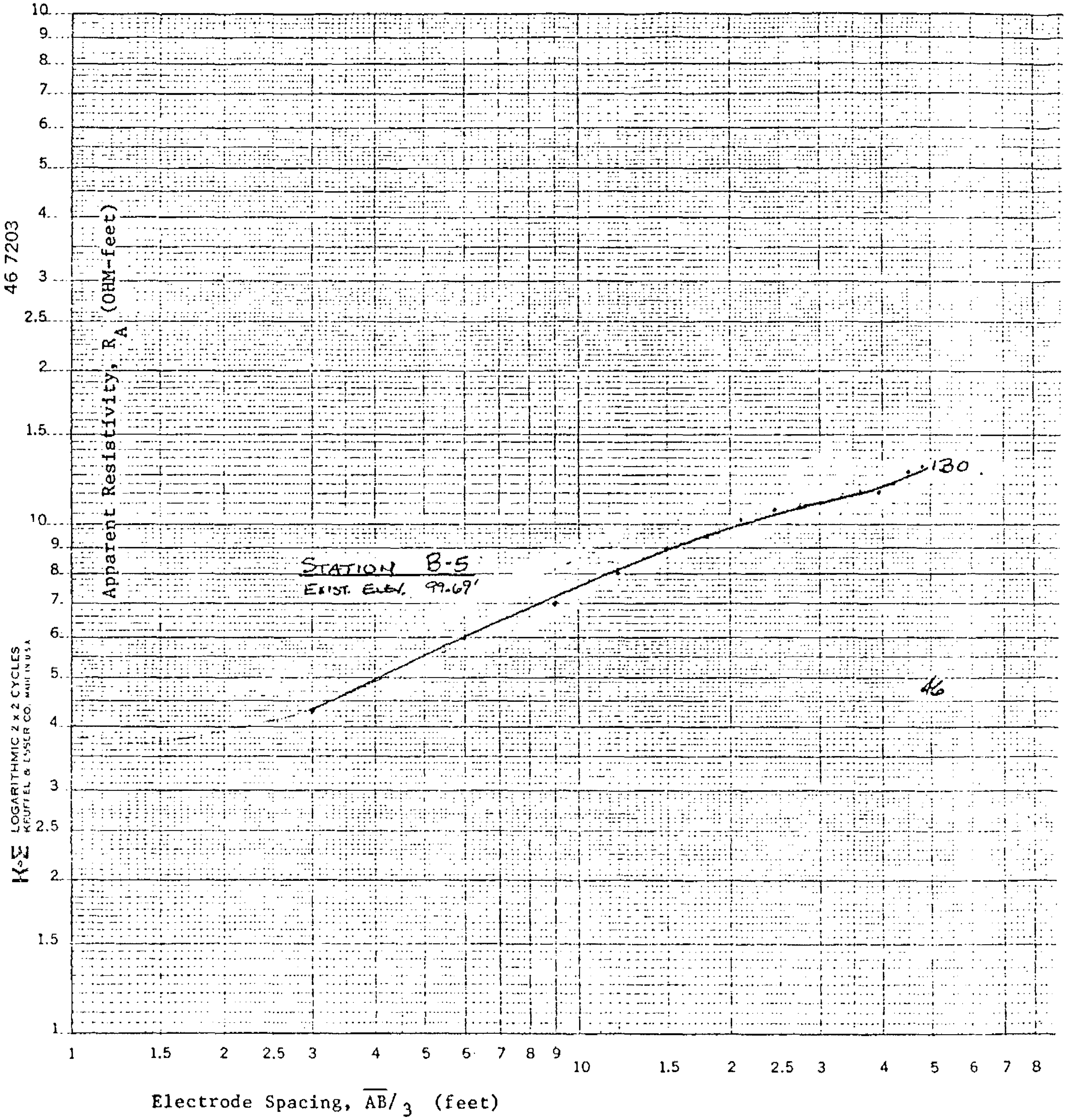

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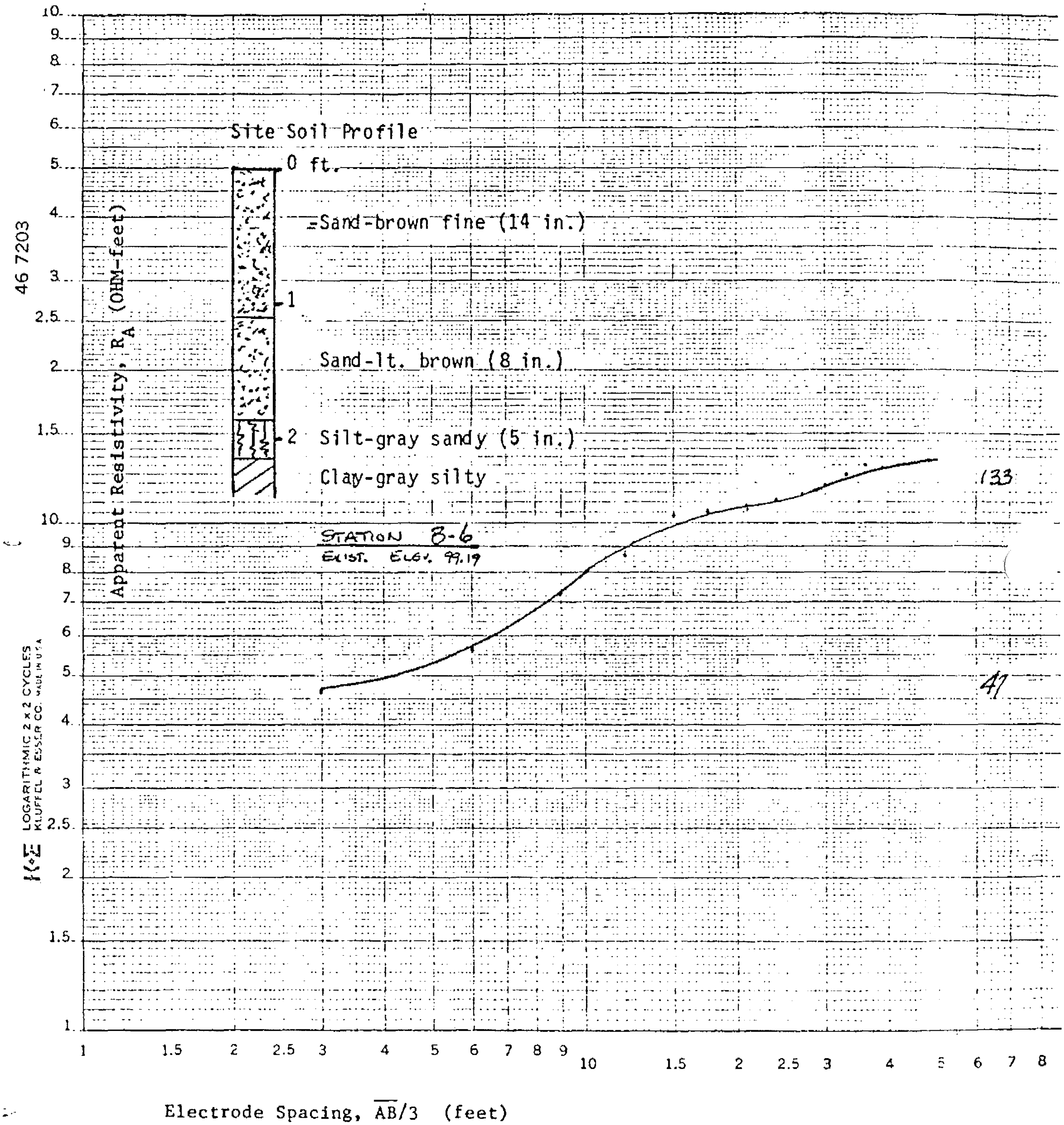

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EQUIVALENCY PROGRAM

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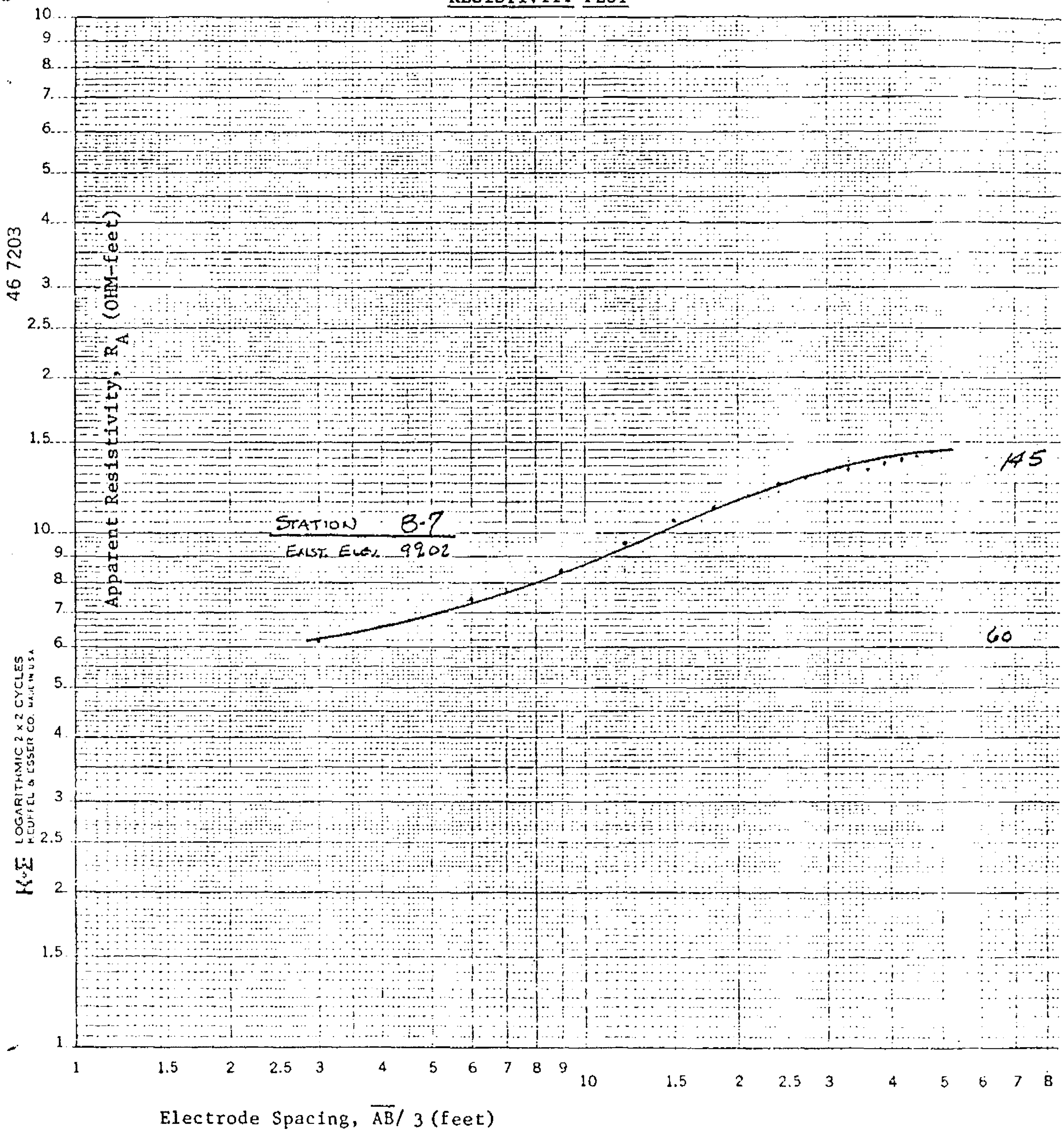

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EQUIVALENCY PROGRAM

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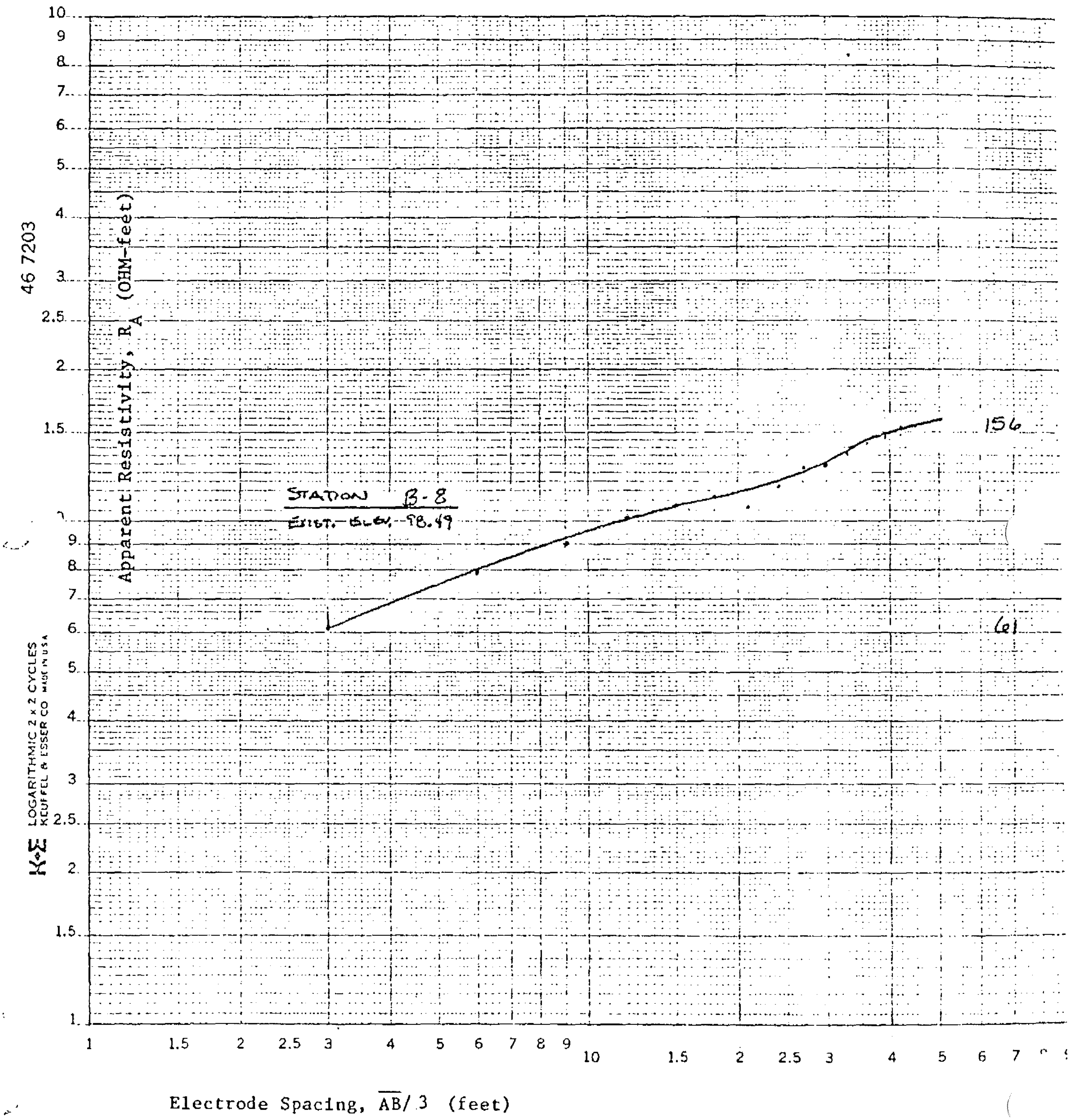

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EQUIVALENCY PROGRAM

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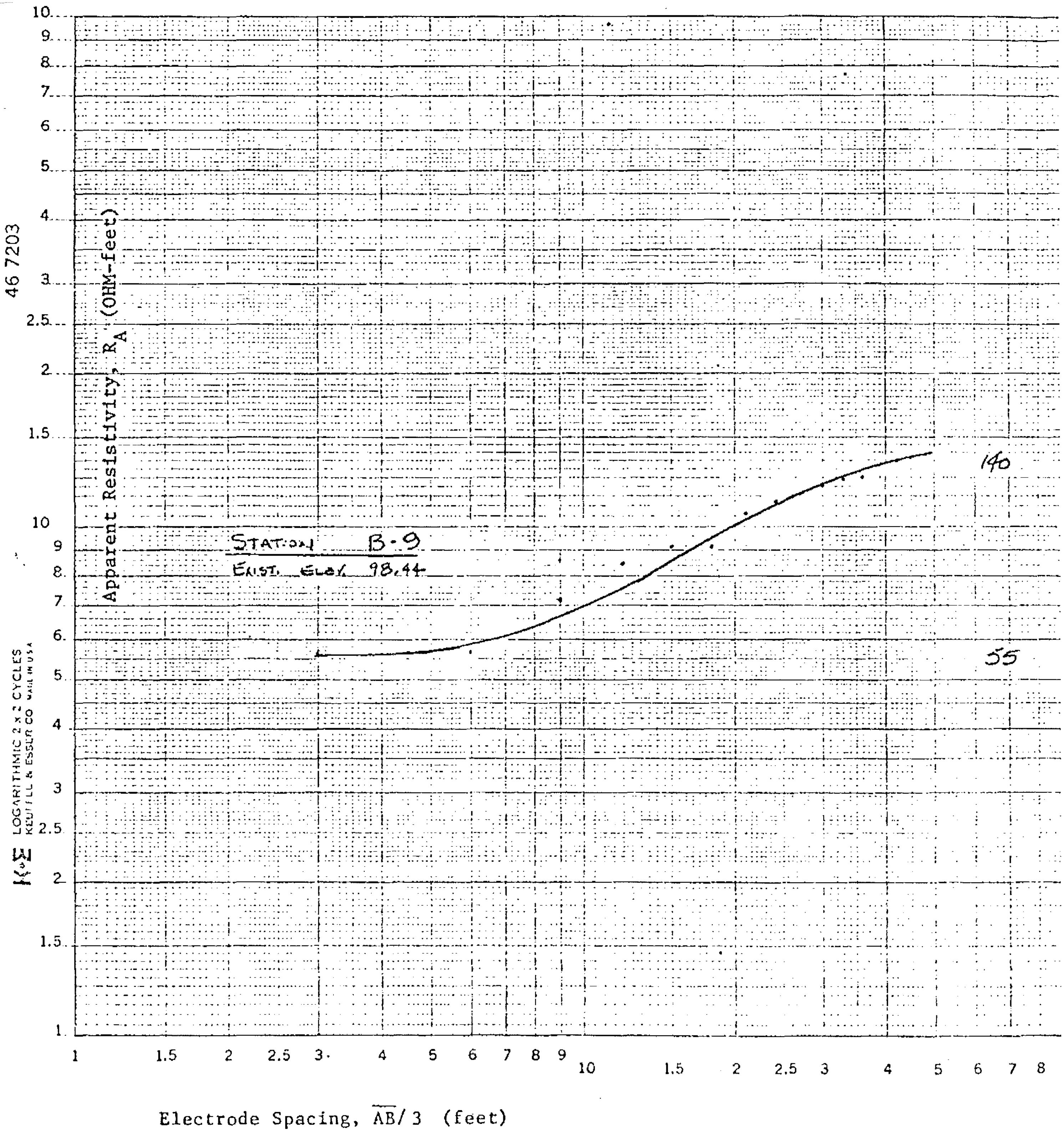

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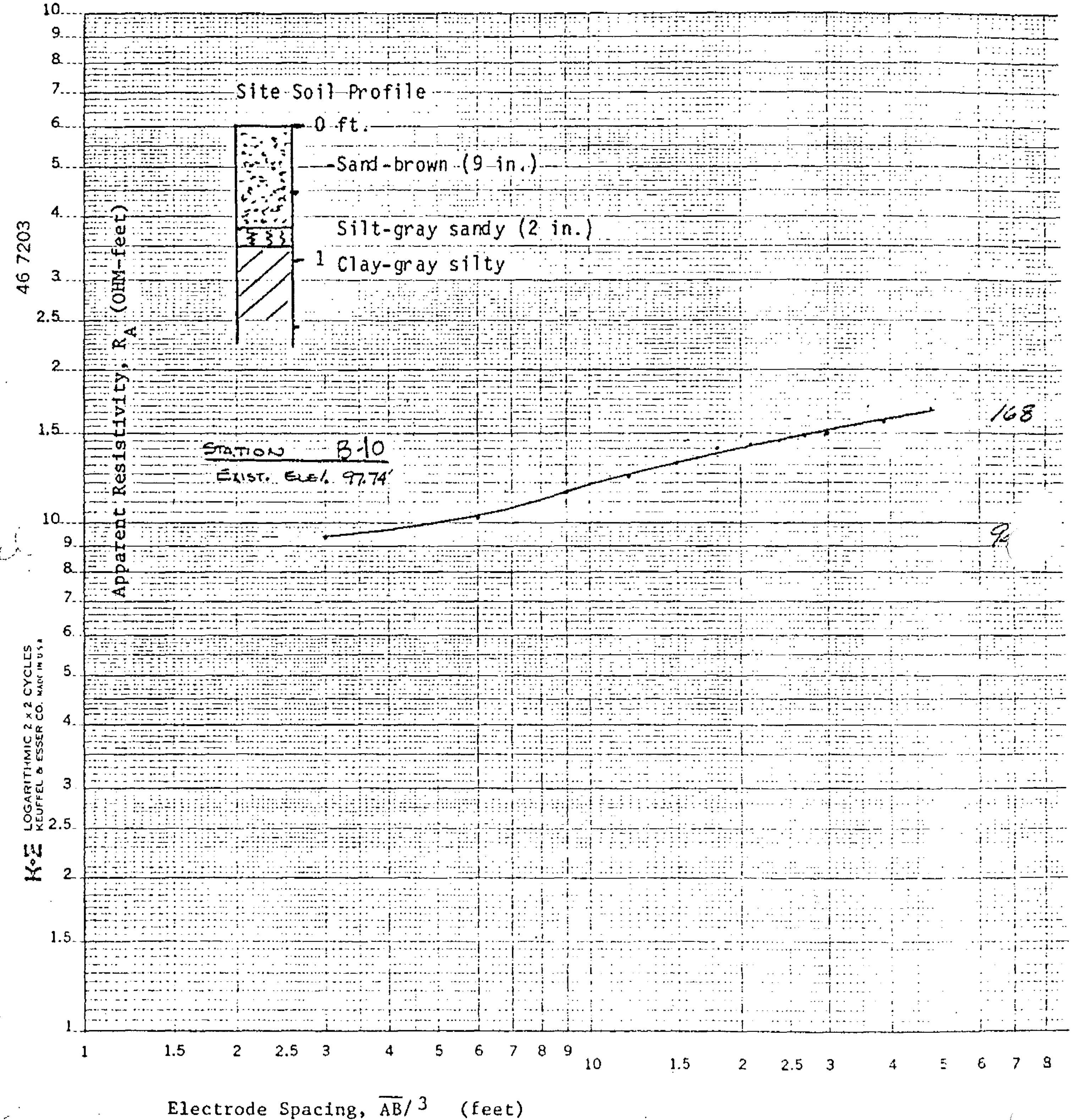
EQUIVALENCY PROGRAM

RESISTIVITY PLOT



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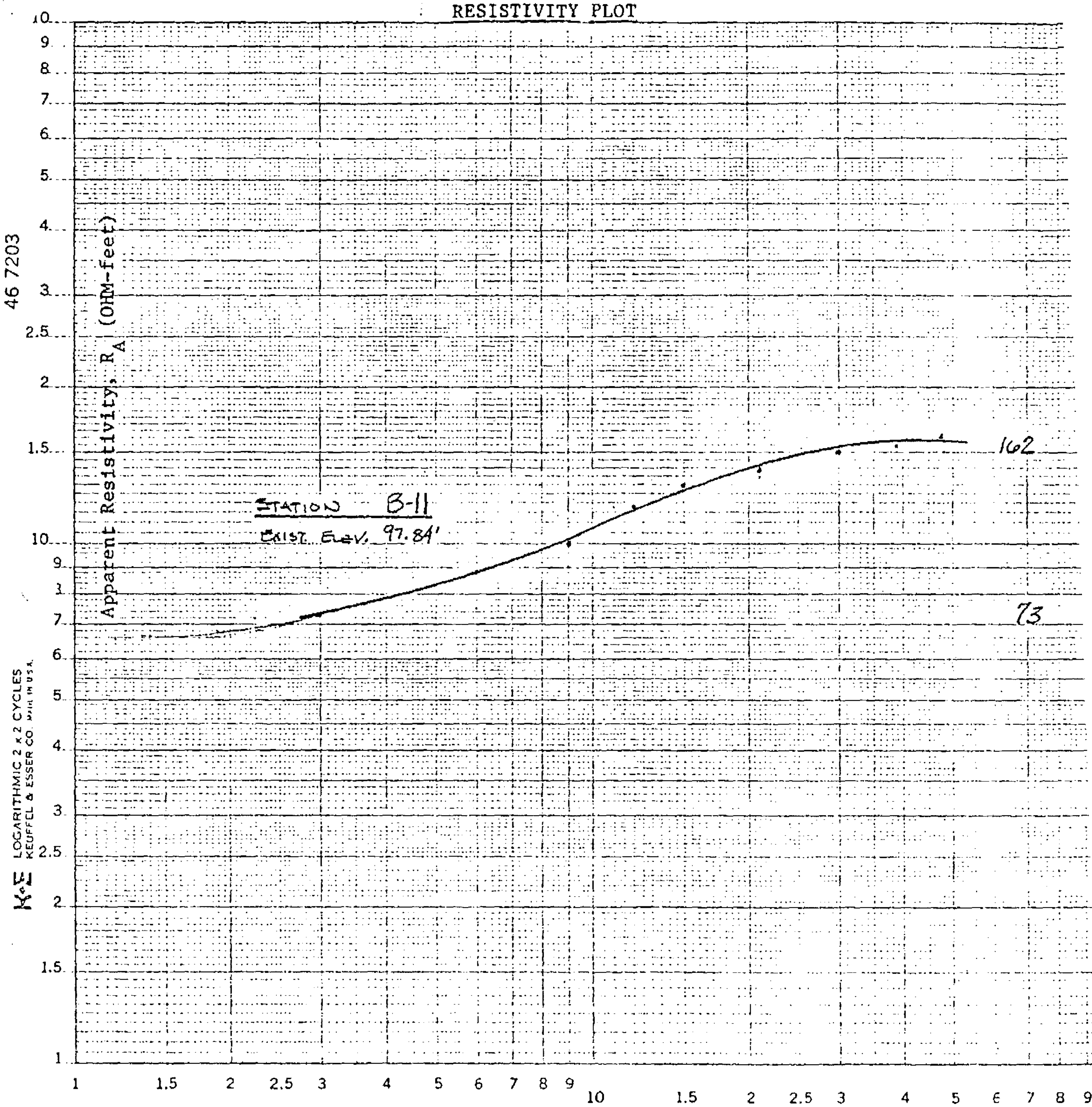
EQUIVALENCY PROGRAM

RESISTIVITY PLOT

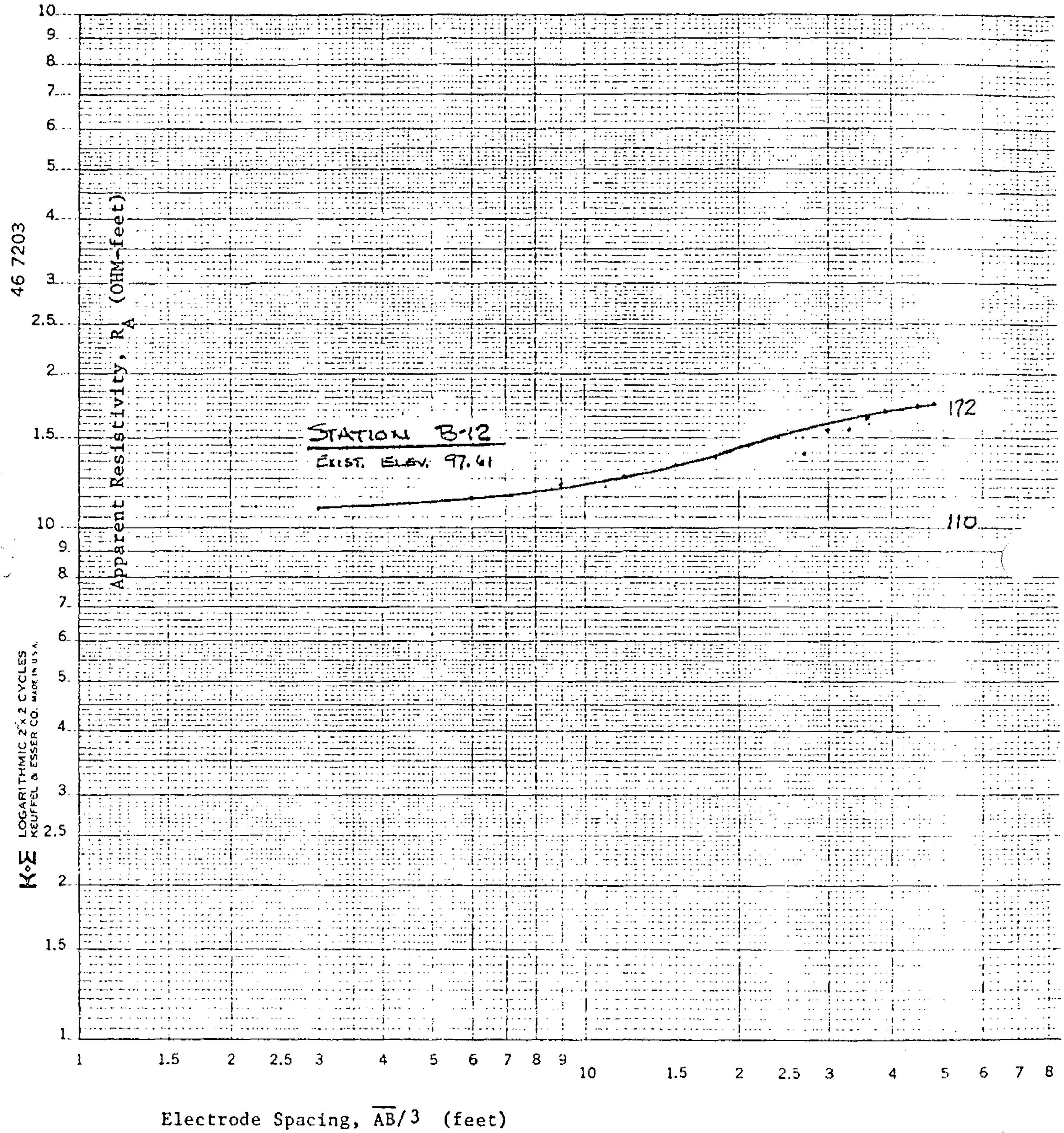


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

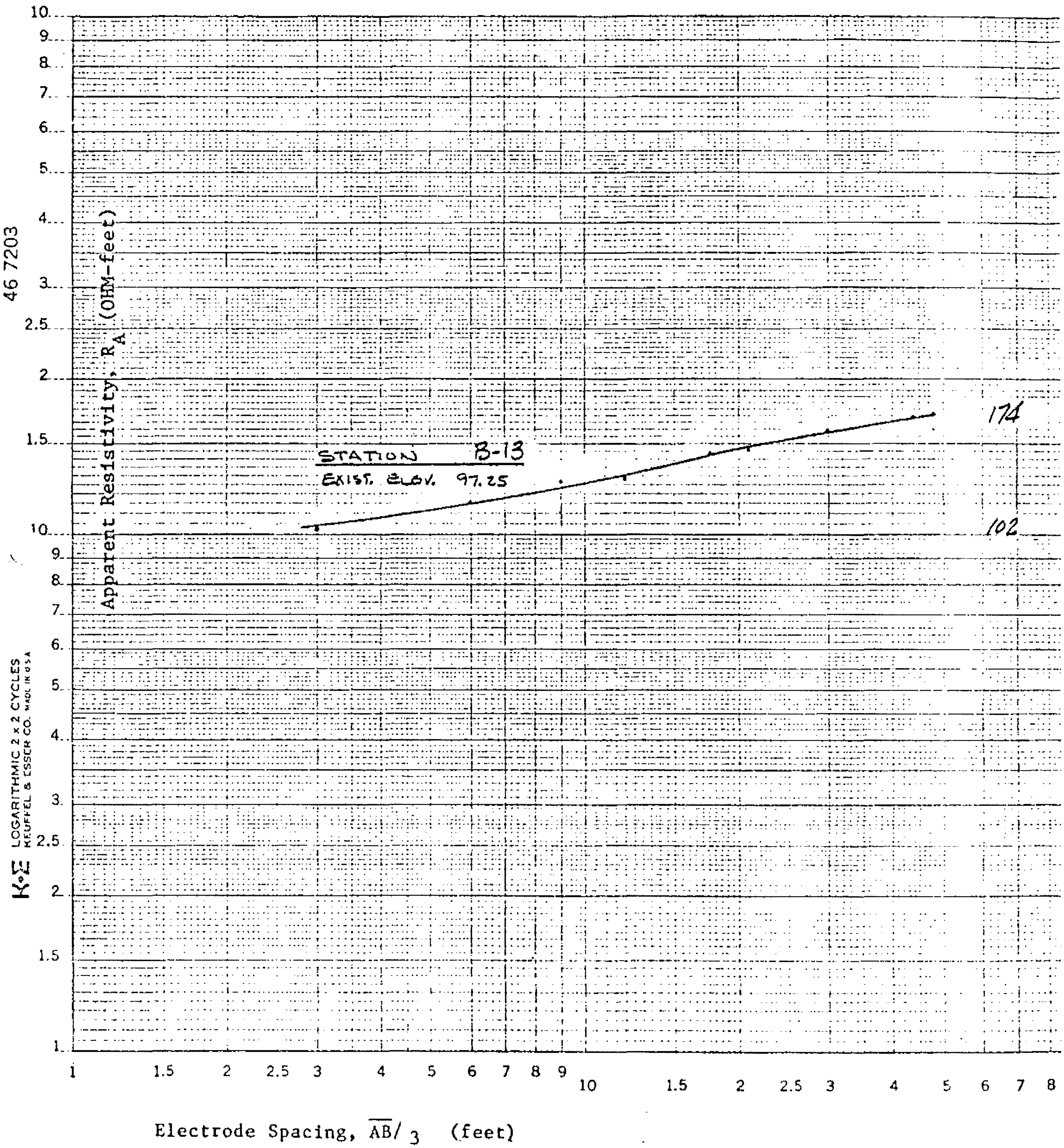
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT



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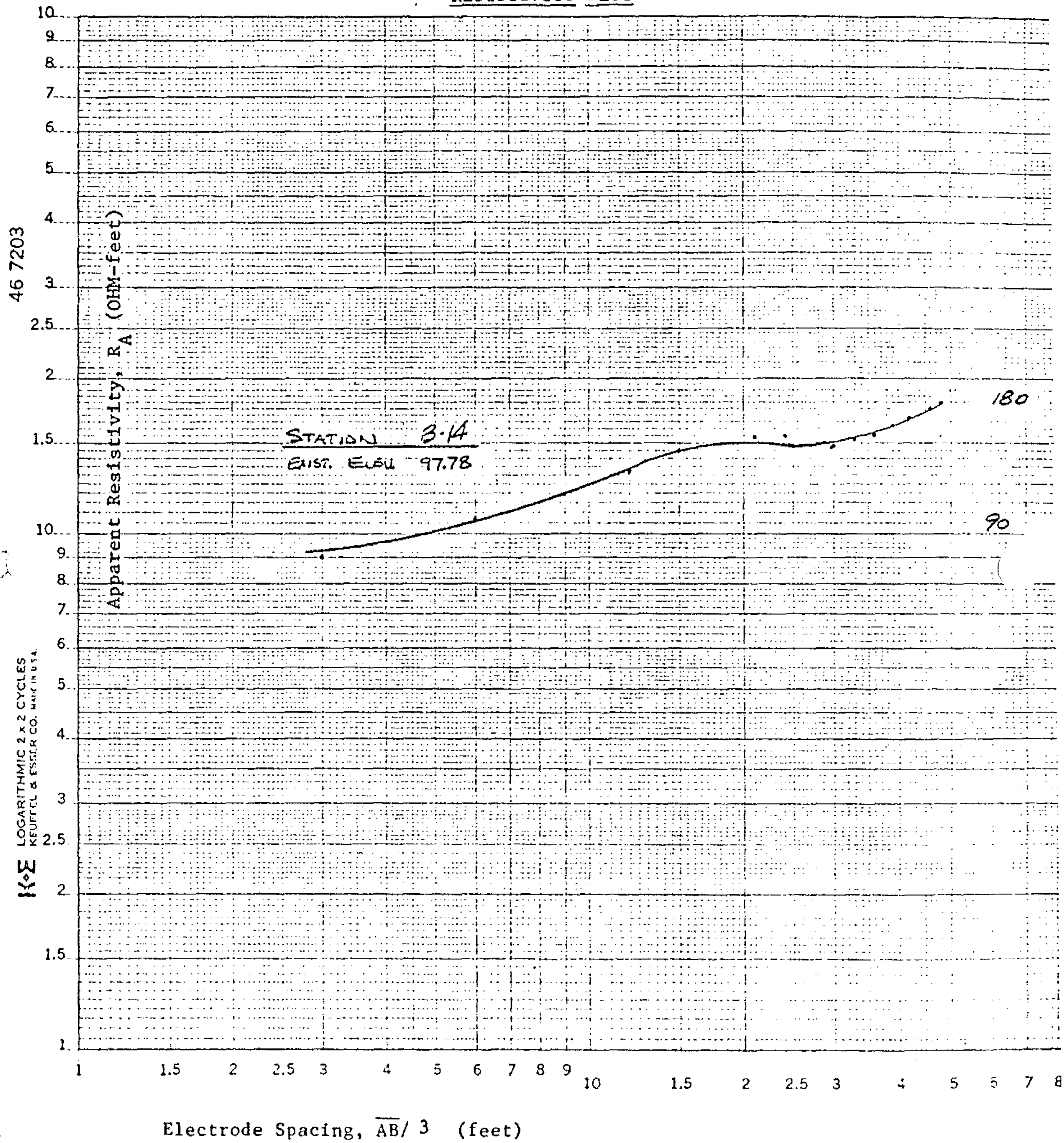
EQUIVALENCY PROGRAM

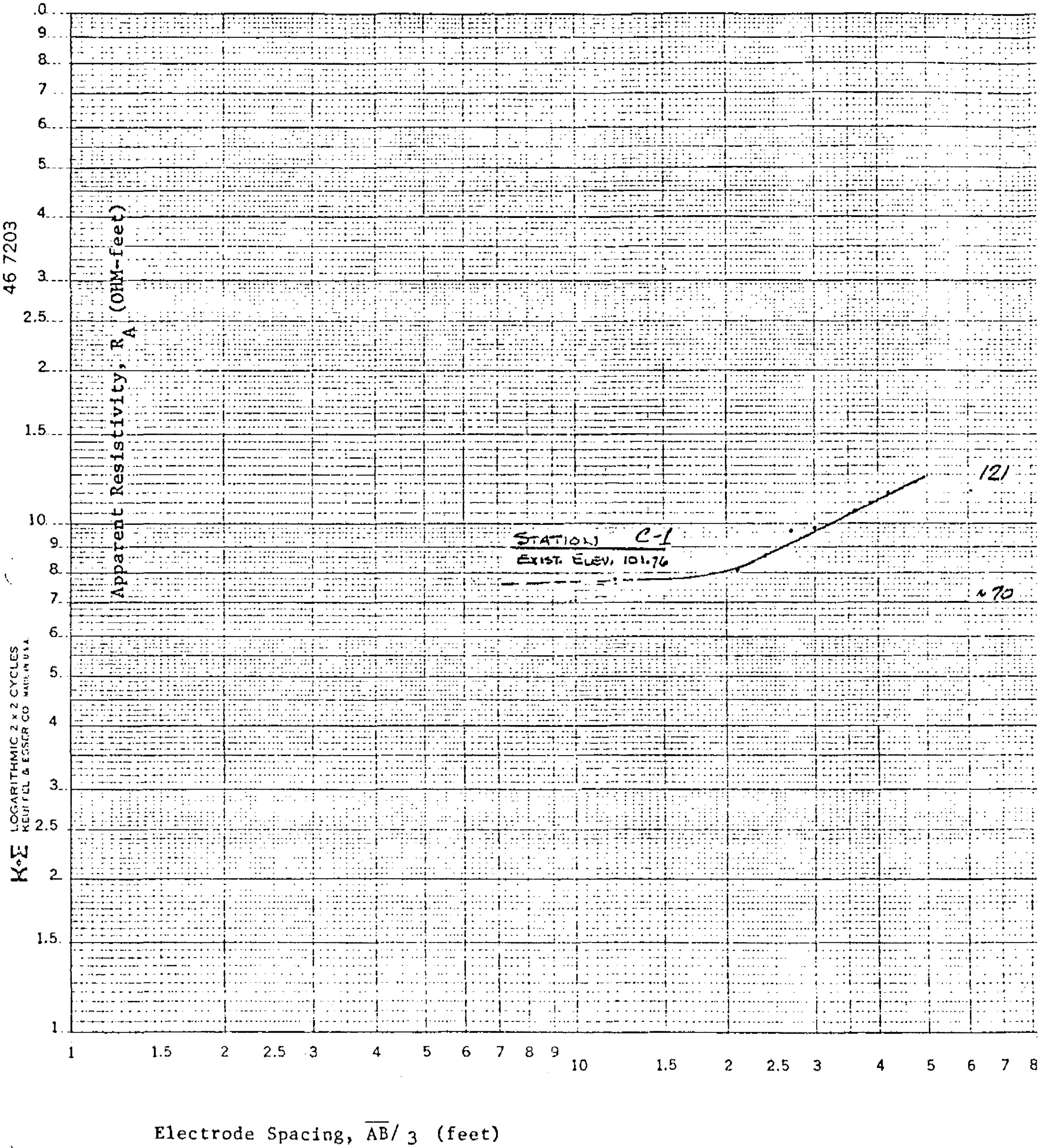
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

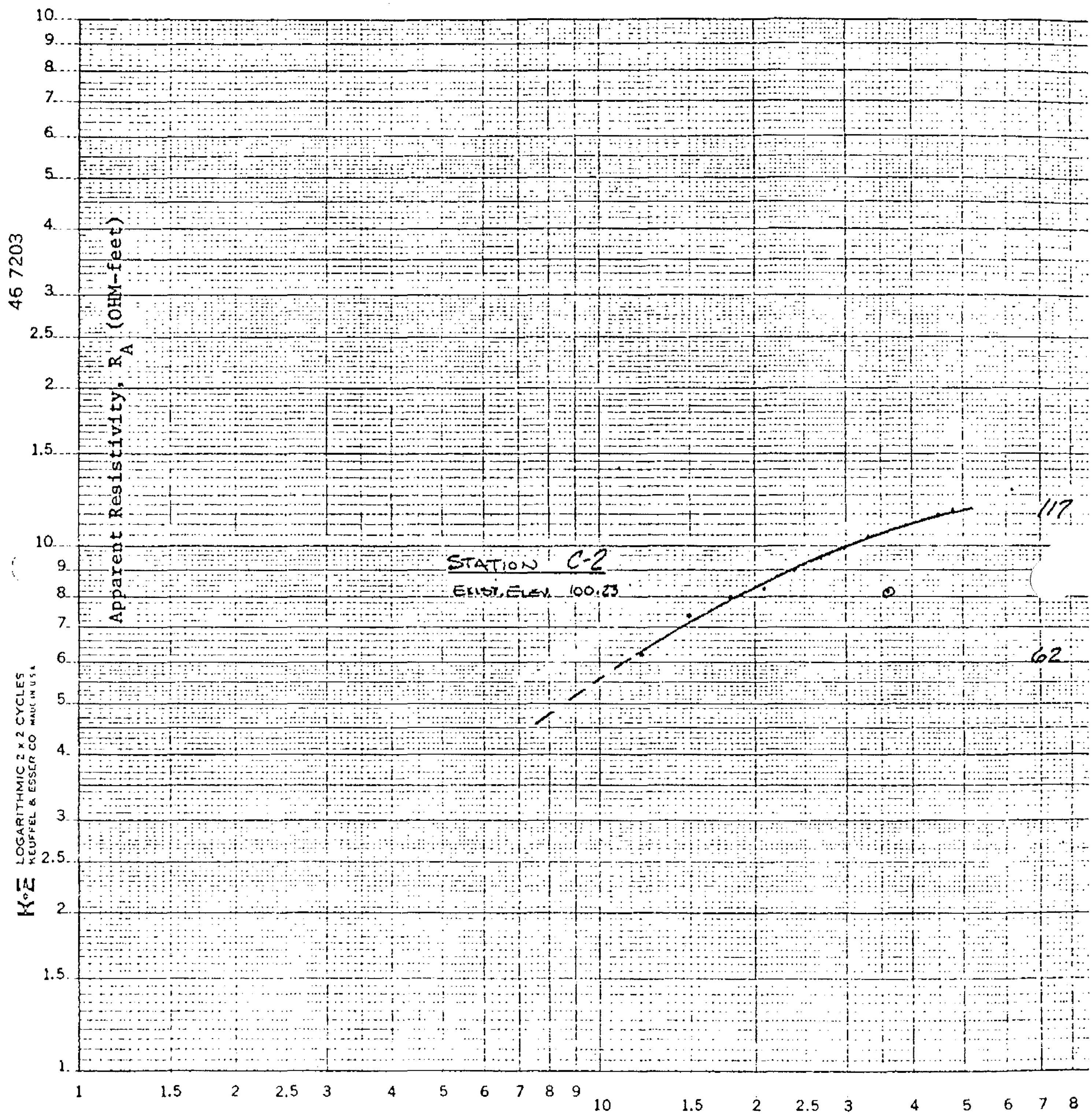
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

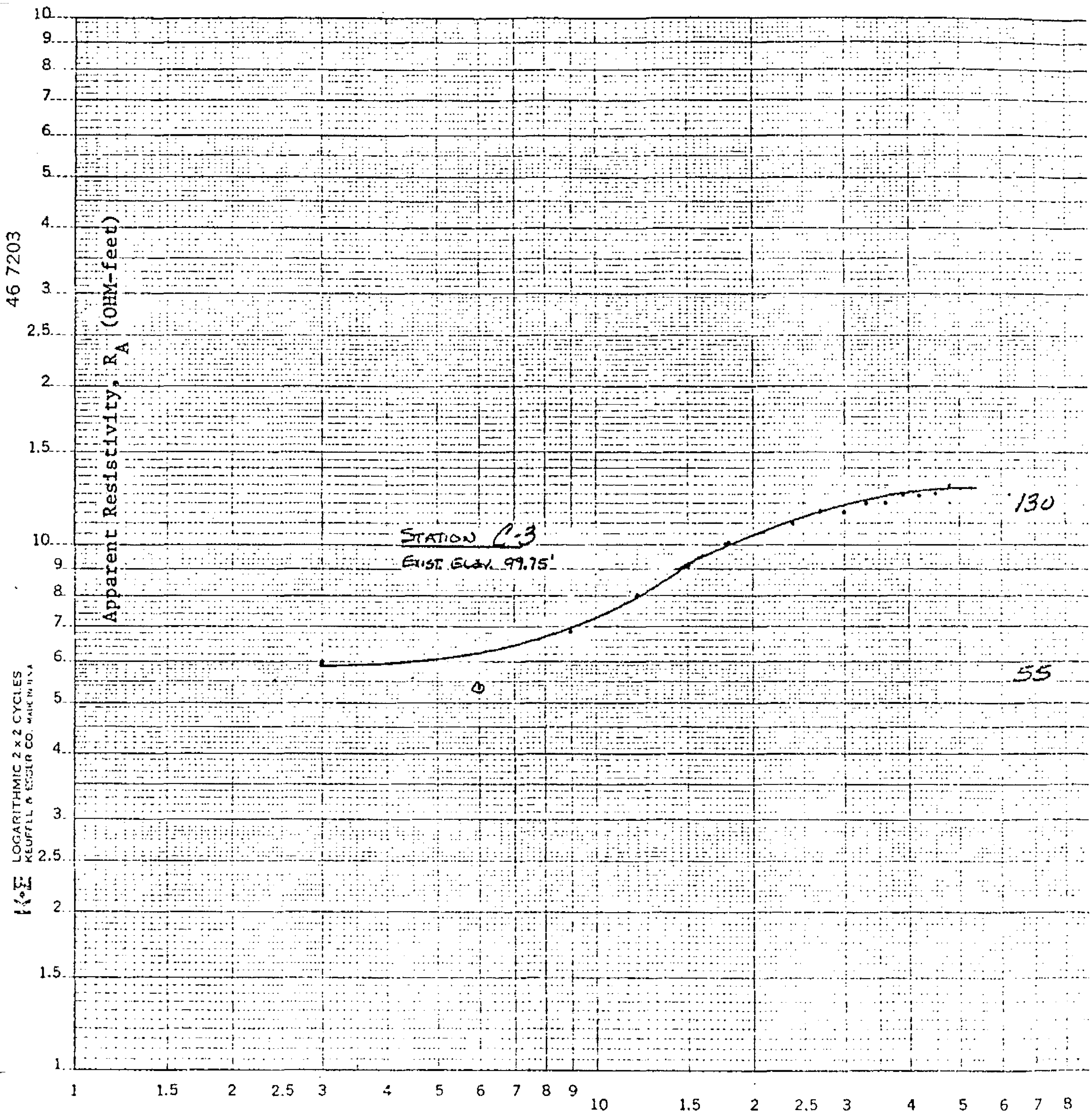


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

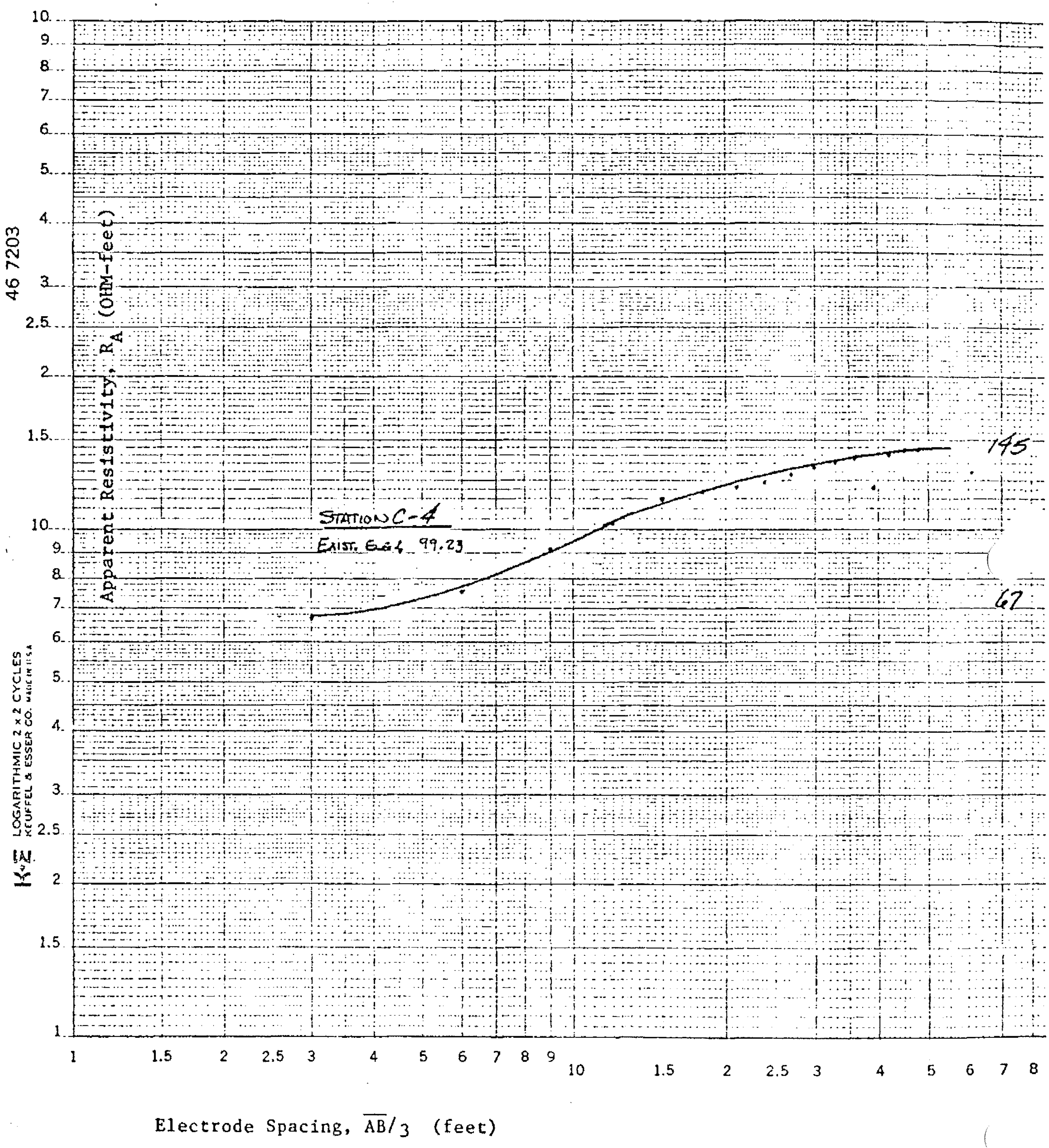


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

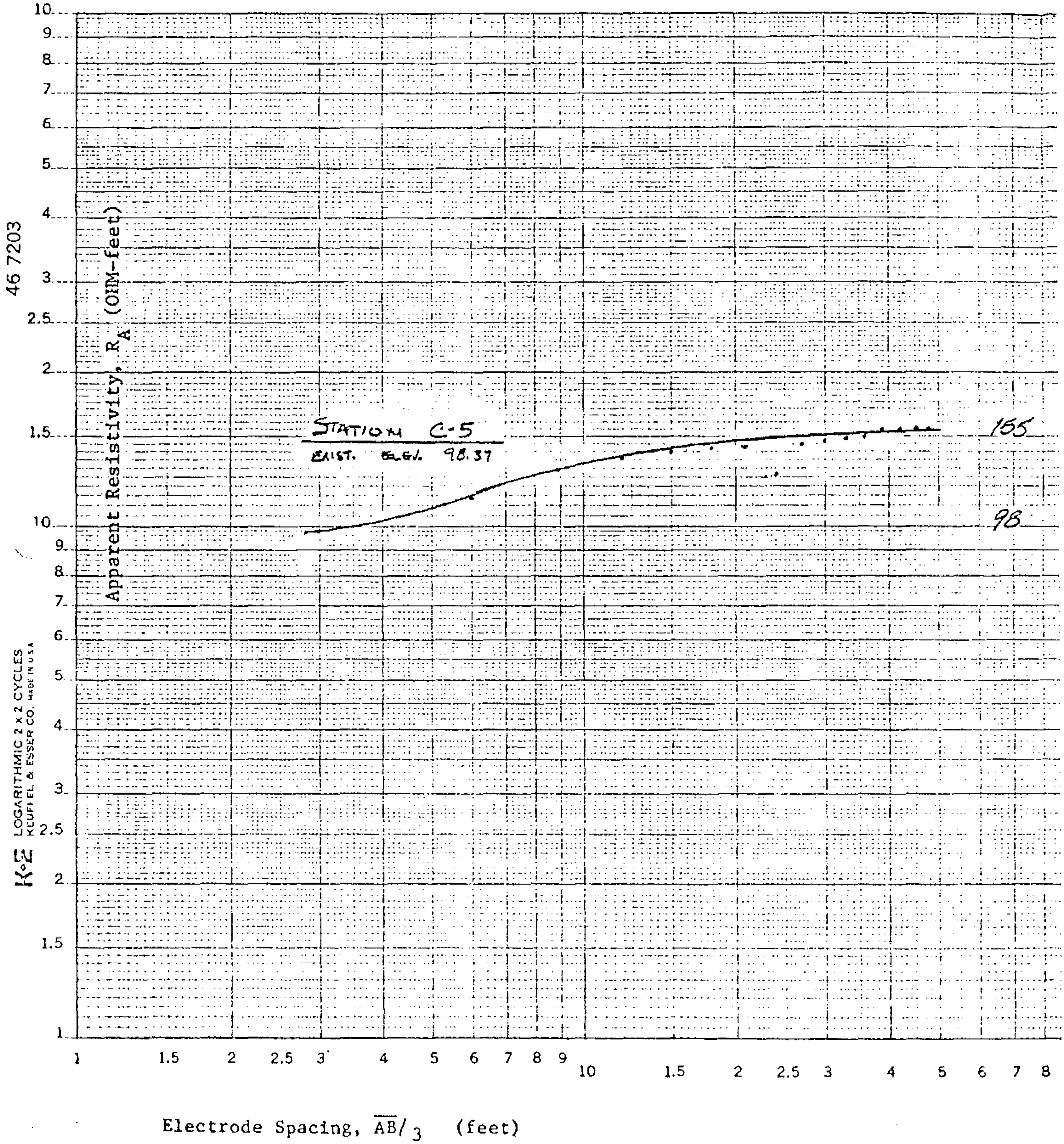
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

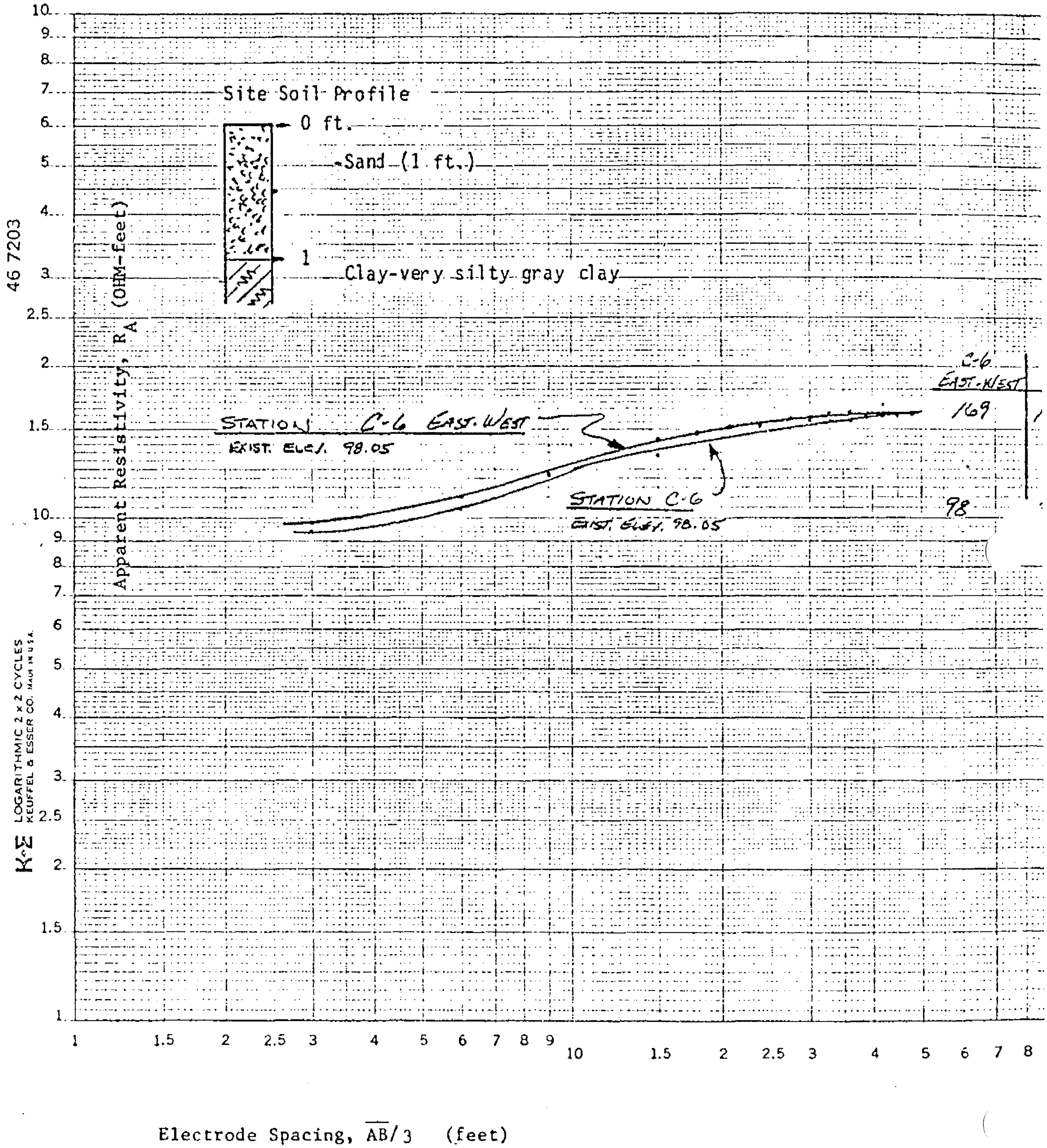
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

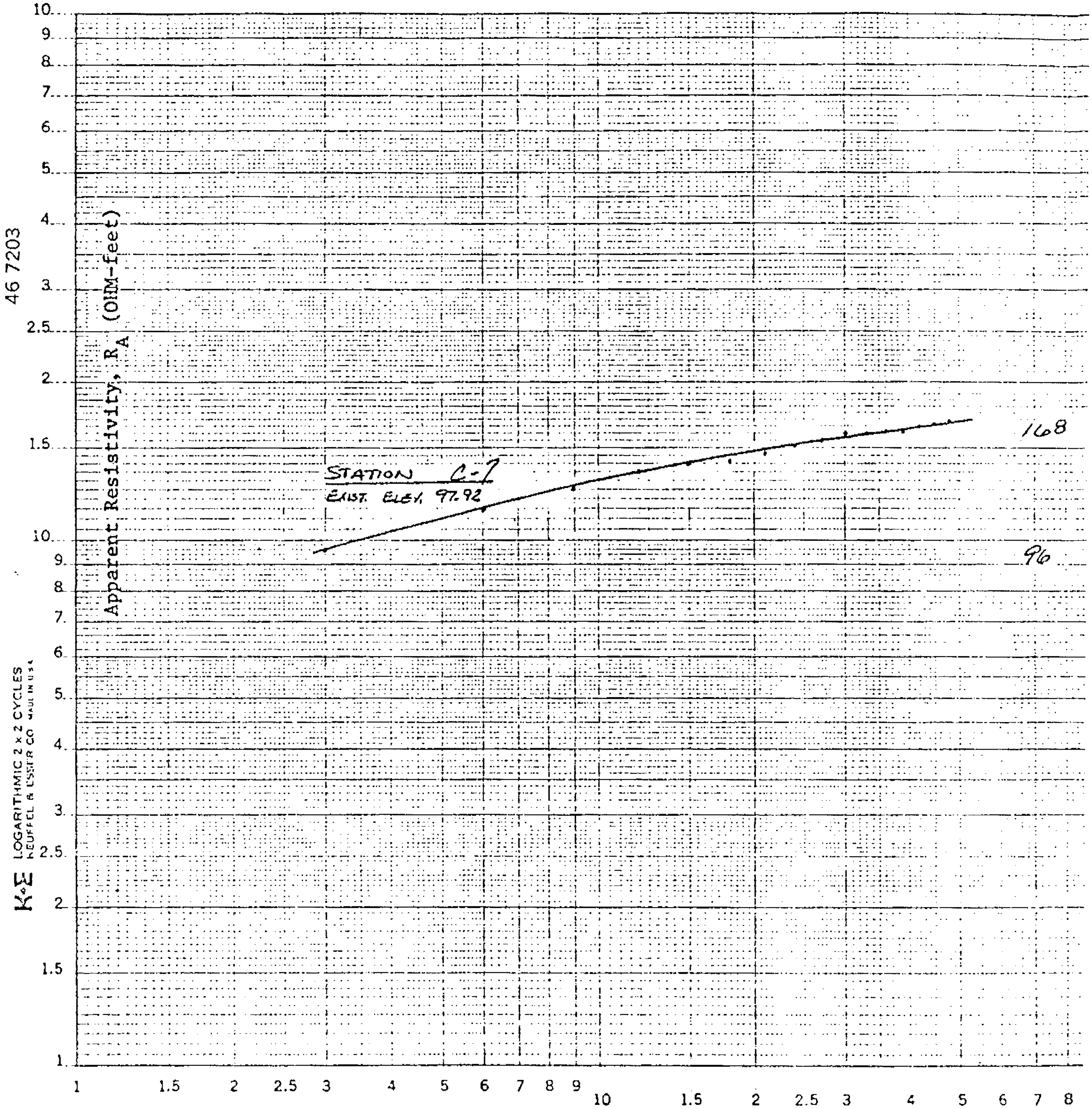
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

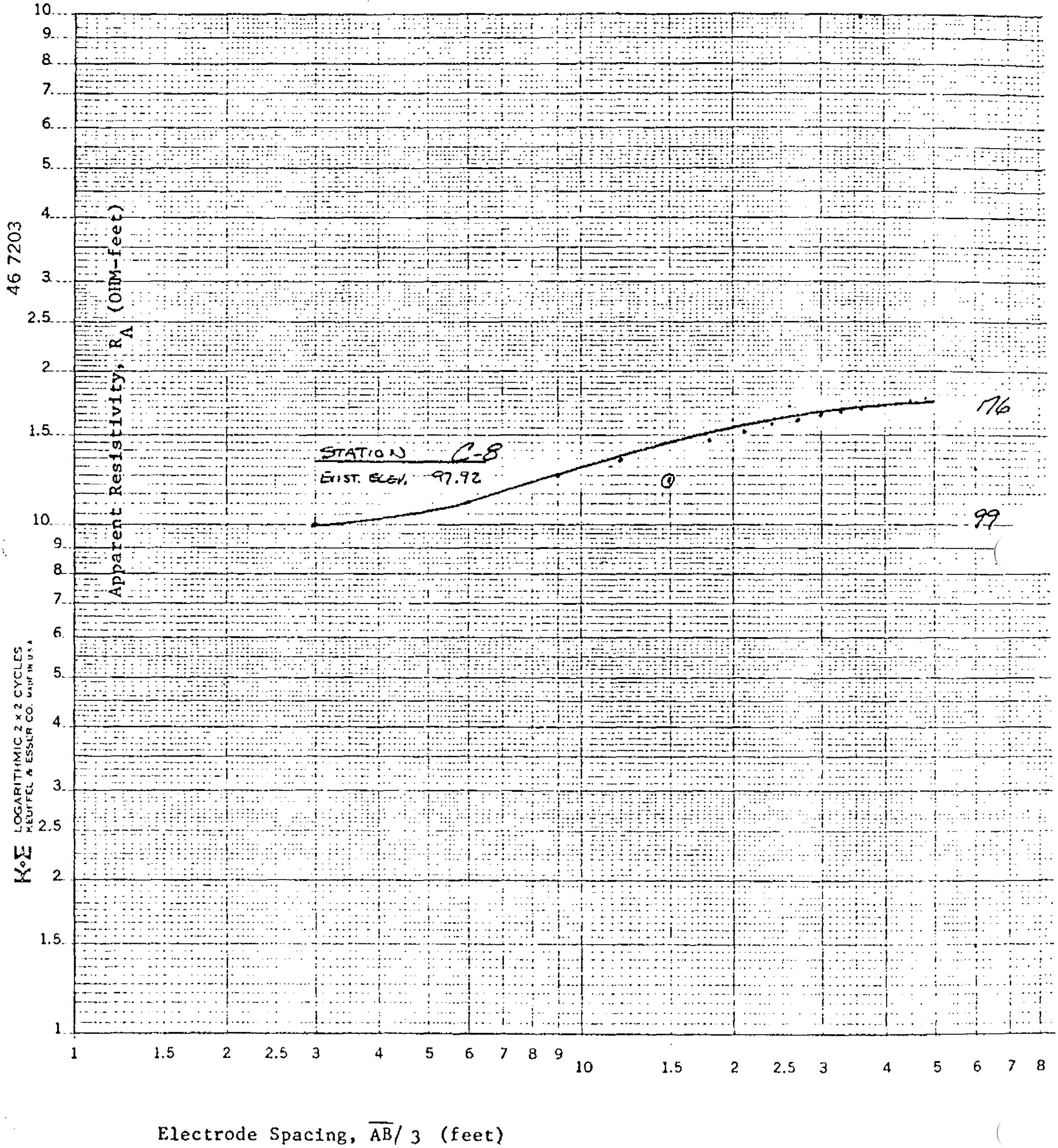


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

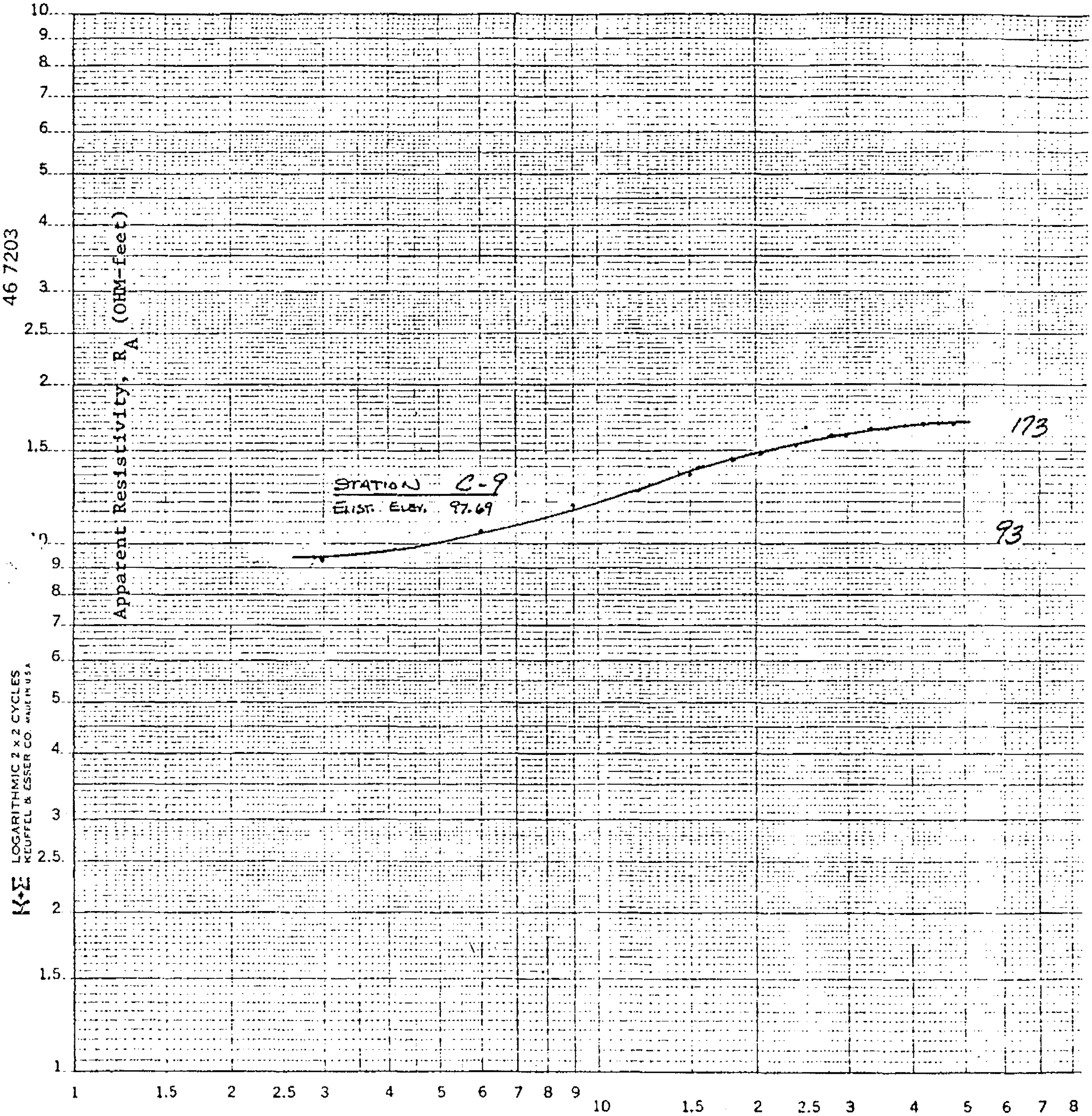
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

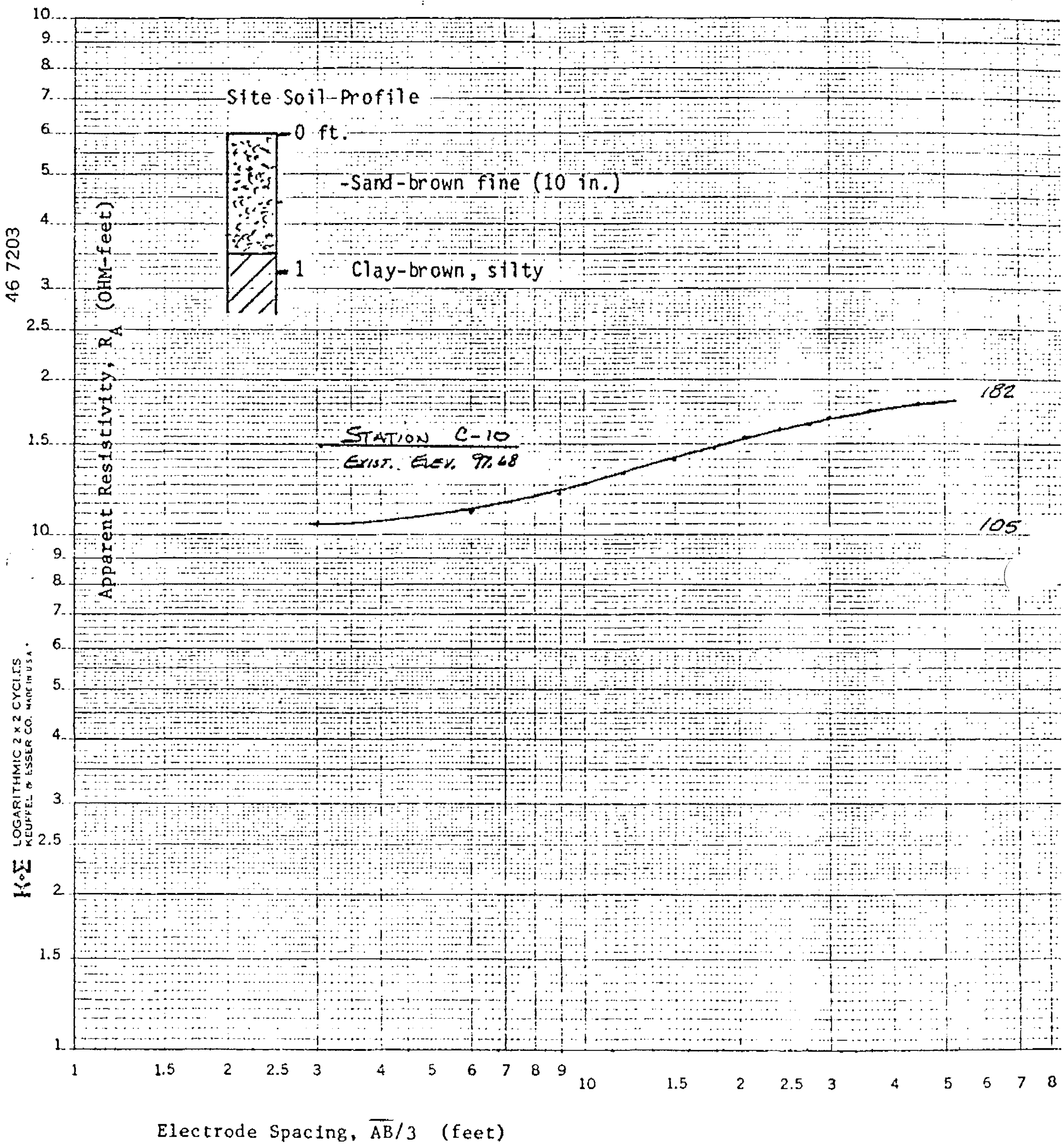


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

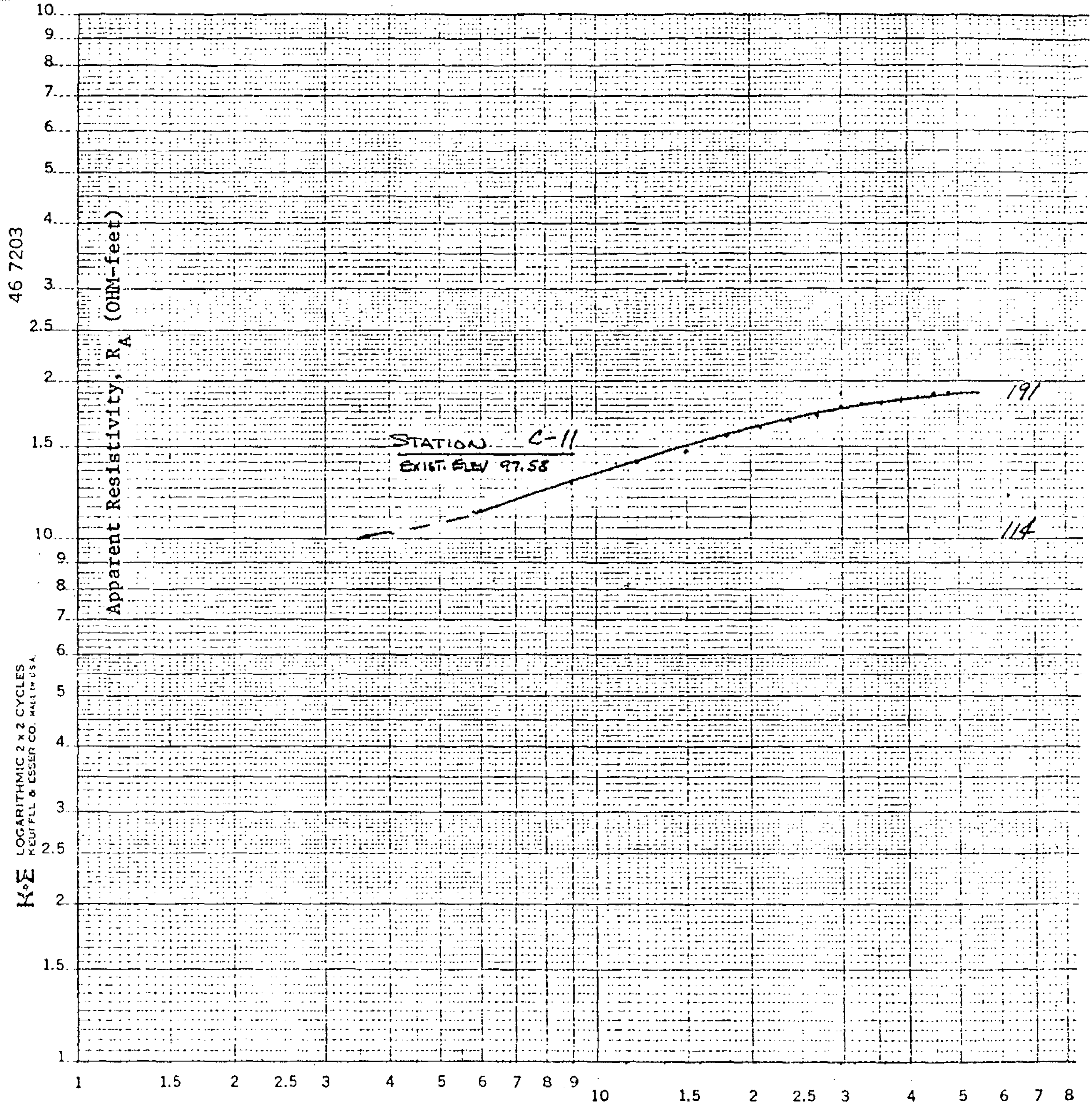
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

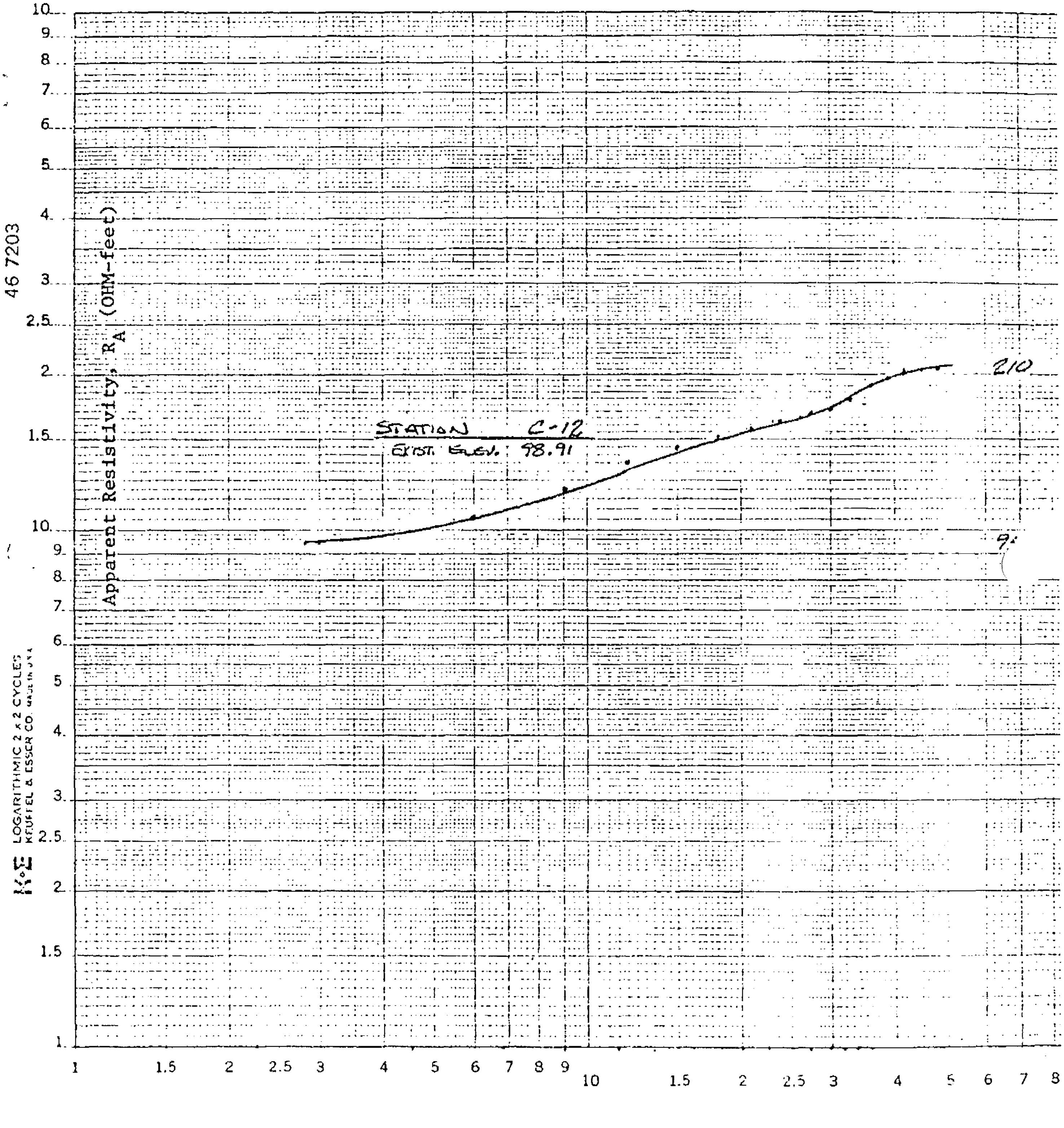


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

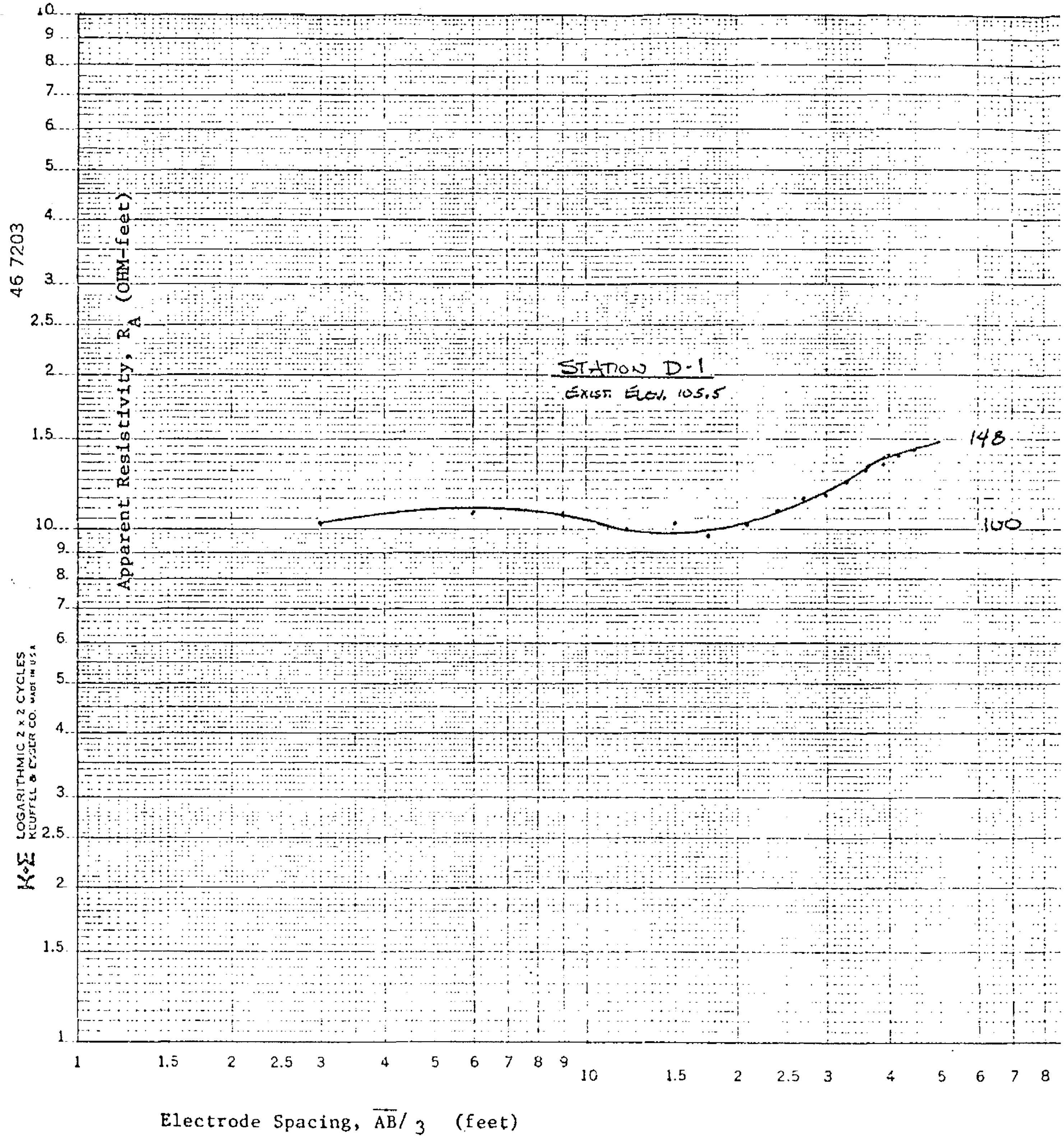
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

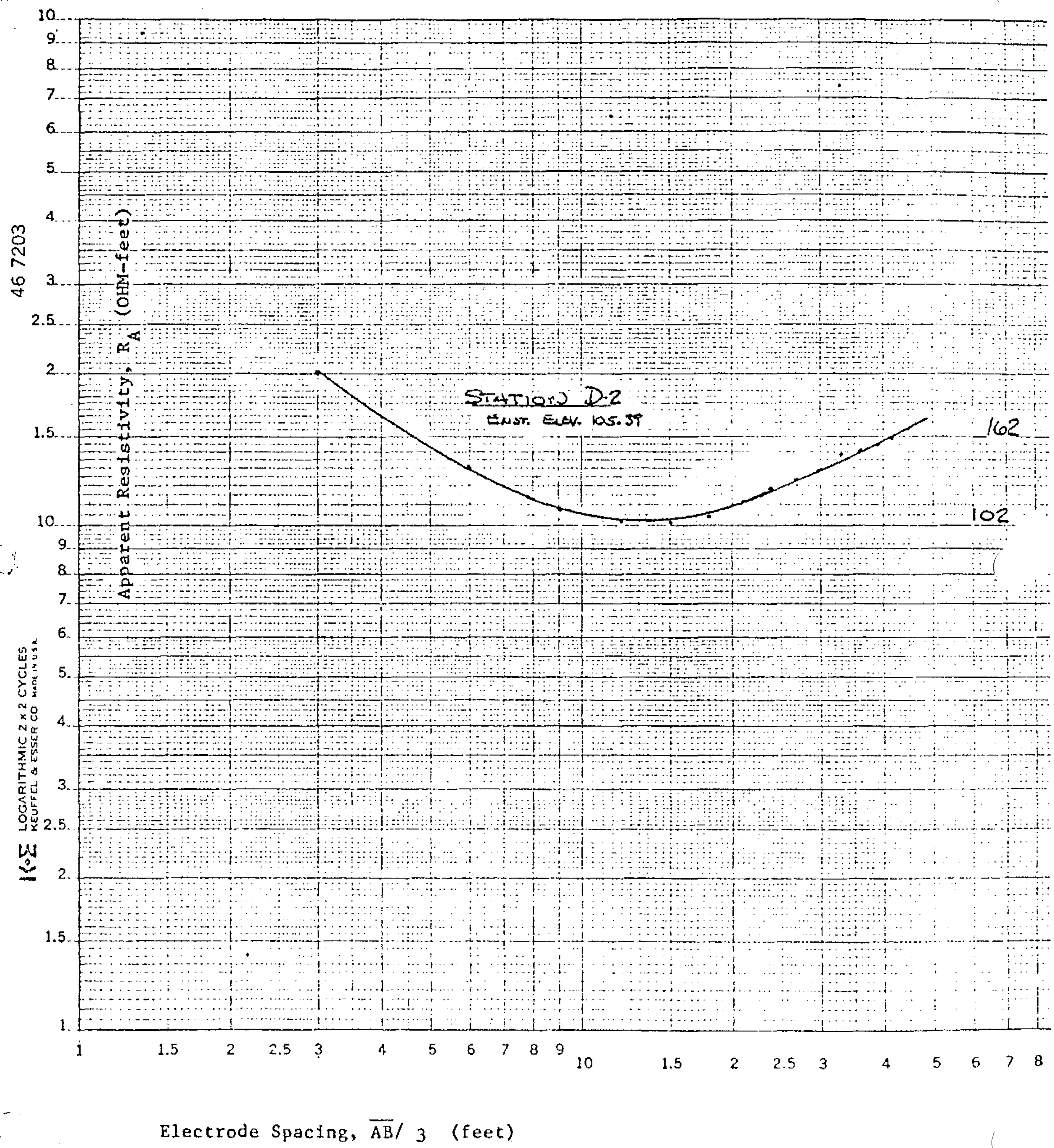
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

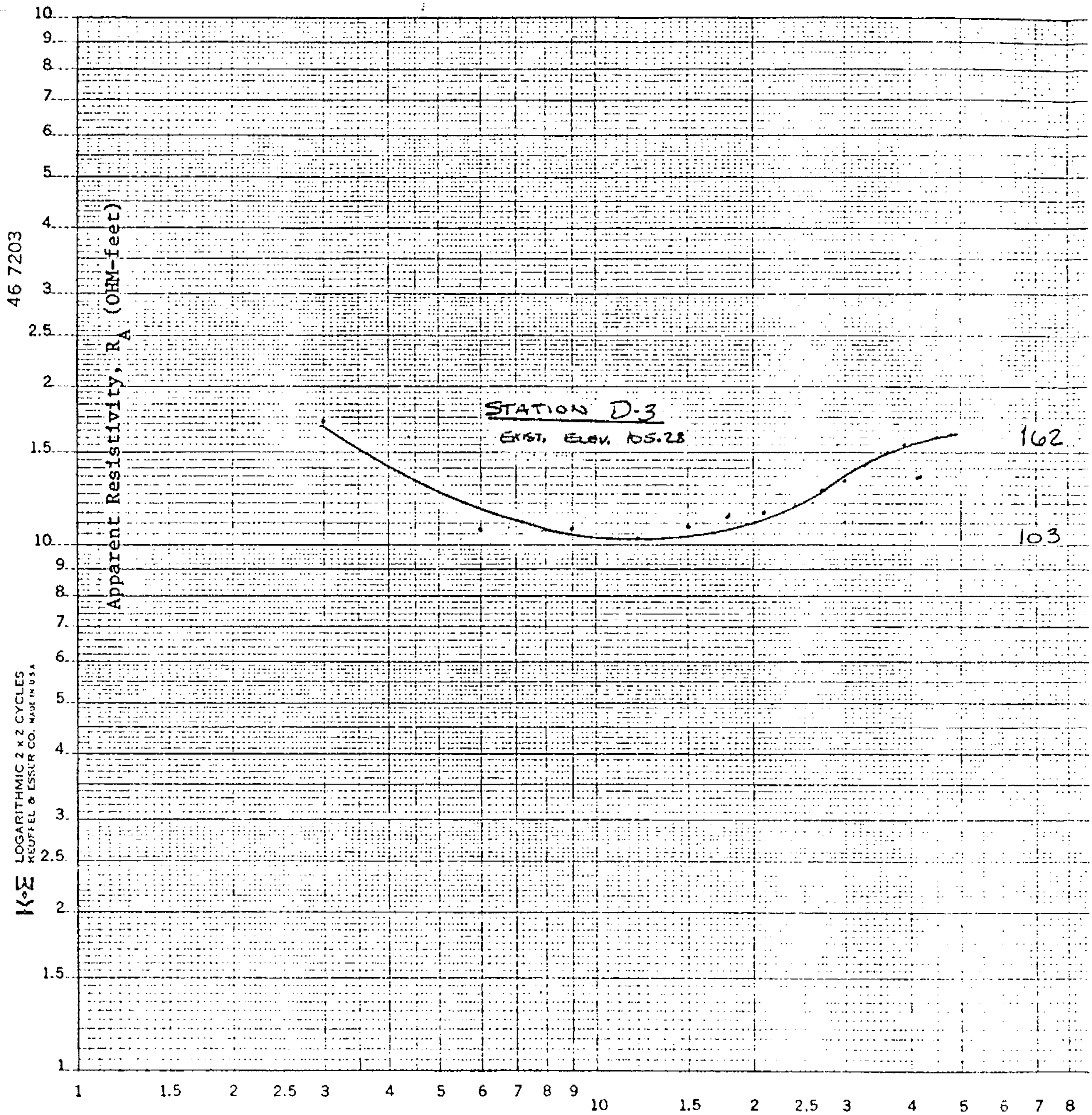
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

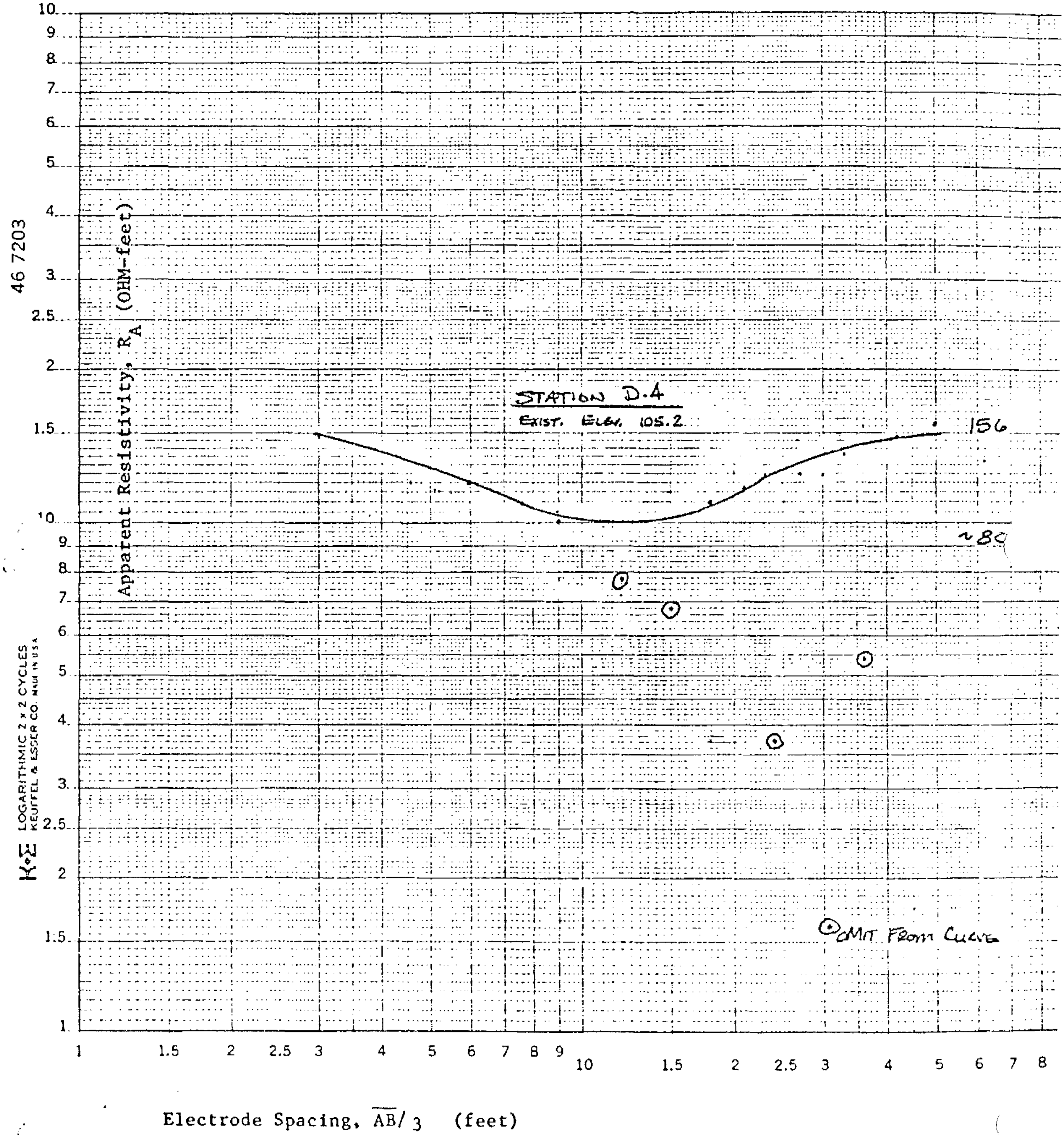


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

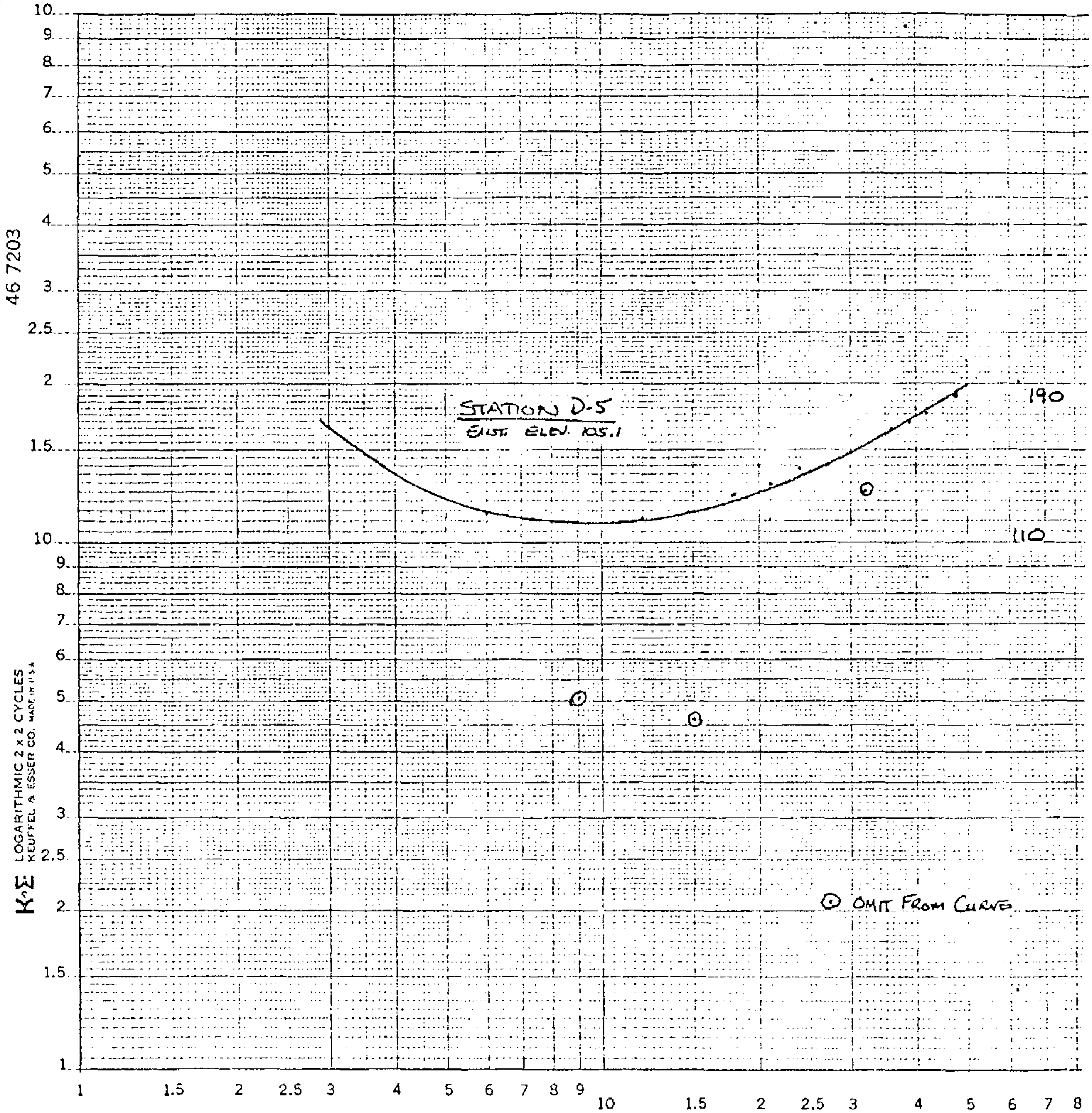
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

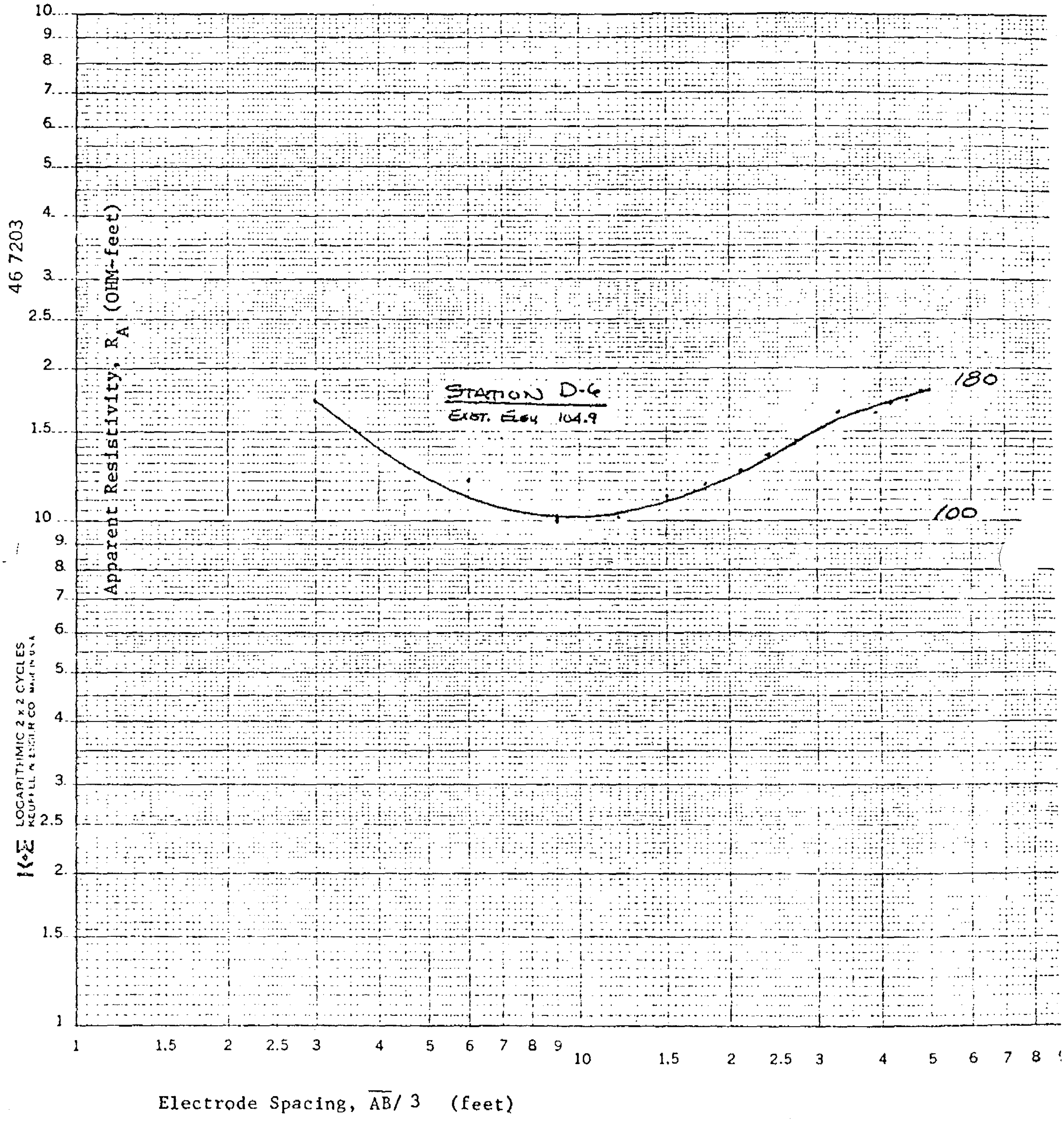


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

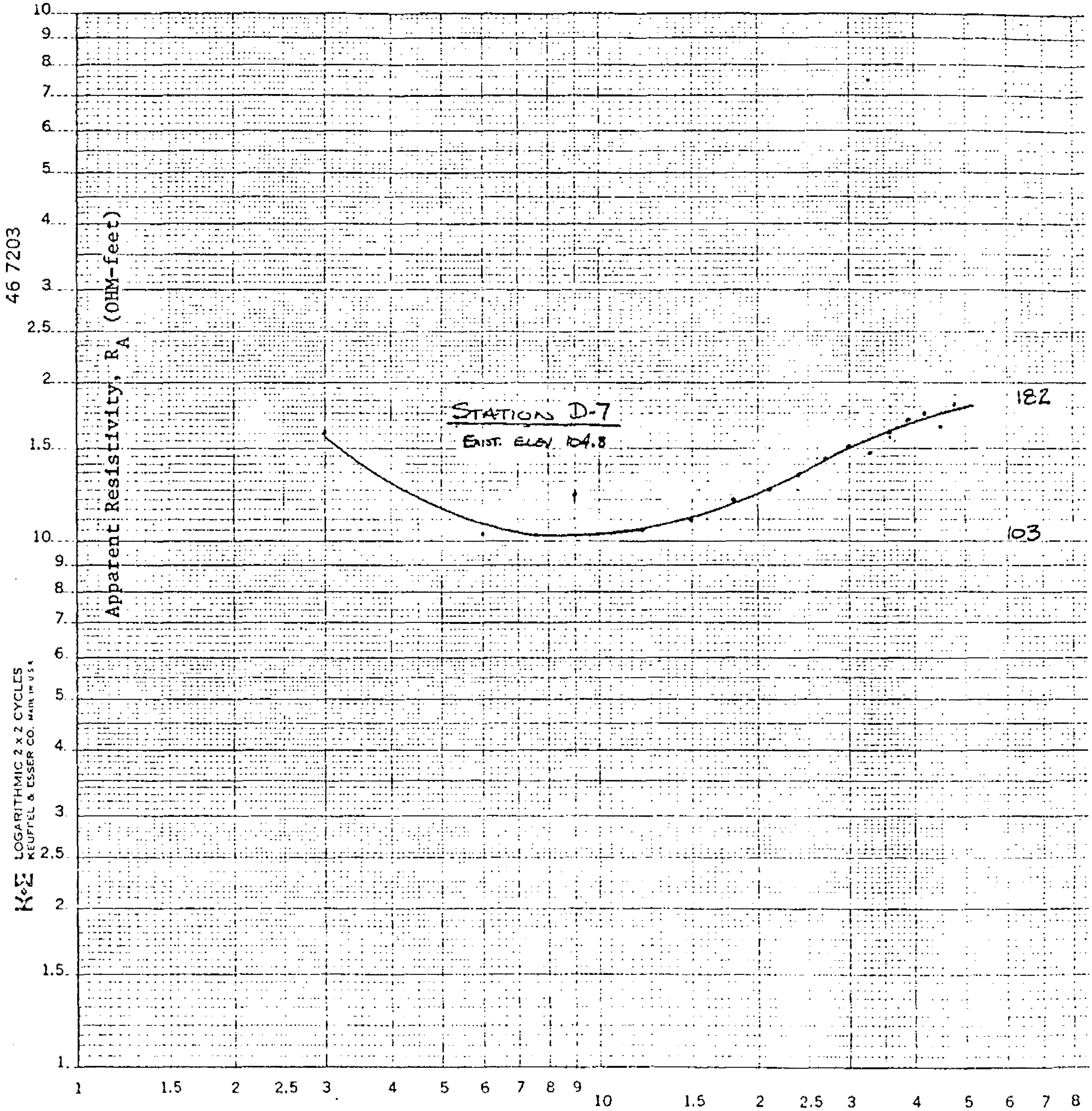
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

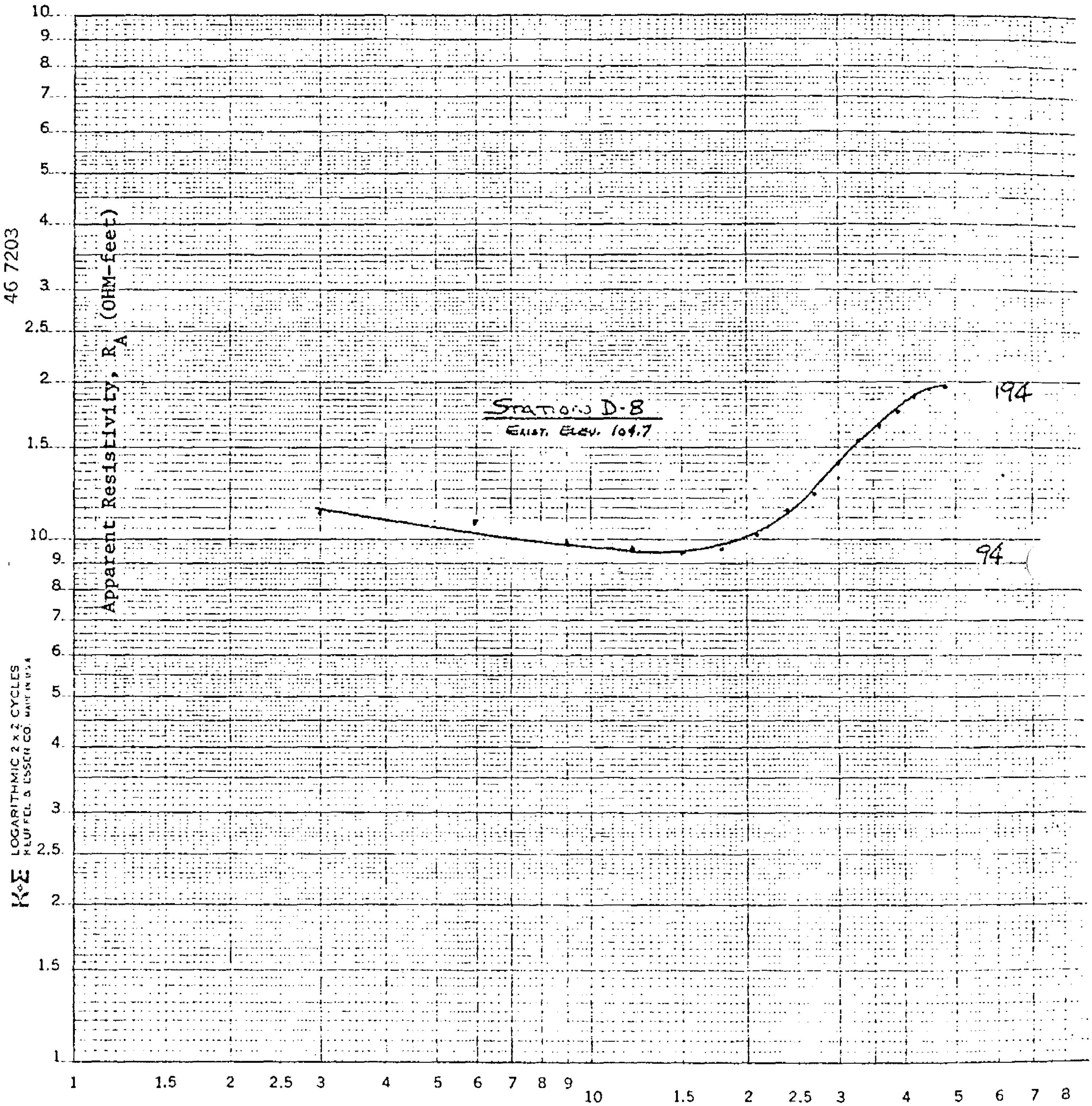


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT



Electrode Spacing, $\overline{AB}/3$ (feet)

Resistivity Analysis

Section 3 - Field Data Interpretation

- Calculated Apparent Resistivity Curves Based On Two And Three Layer Soil Models

- Calculated Vertical Electrical Sounding Curves For Sand Layers In Upper Clay Stratum

FIGURE #2

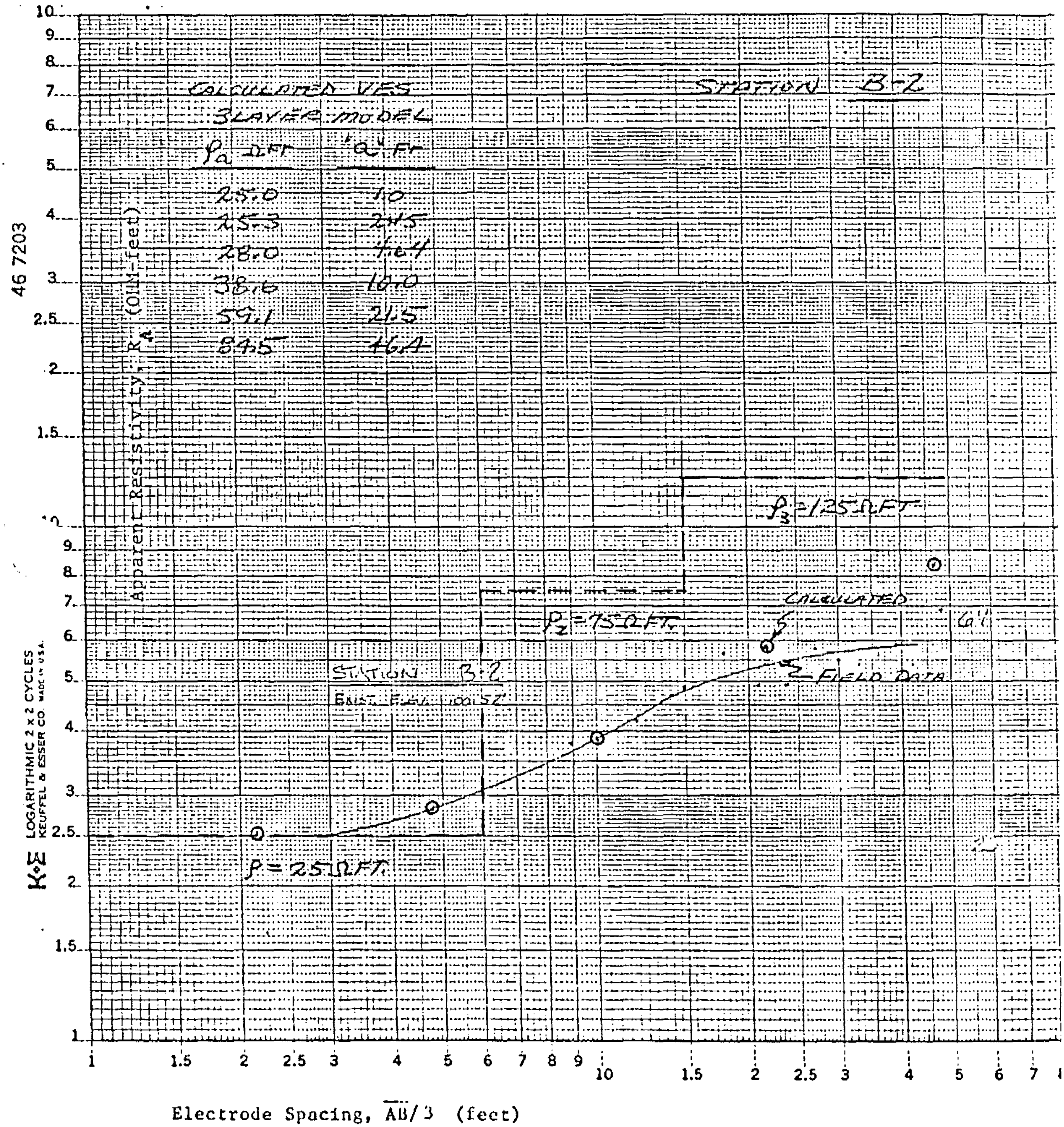
Vertical Electric Sounding Curves

Calculated Apparent Resistivity
Based on Two and Three Layer Soil Models

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

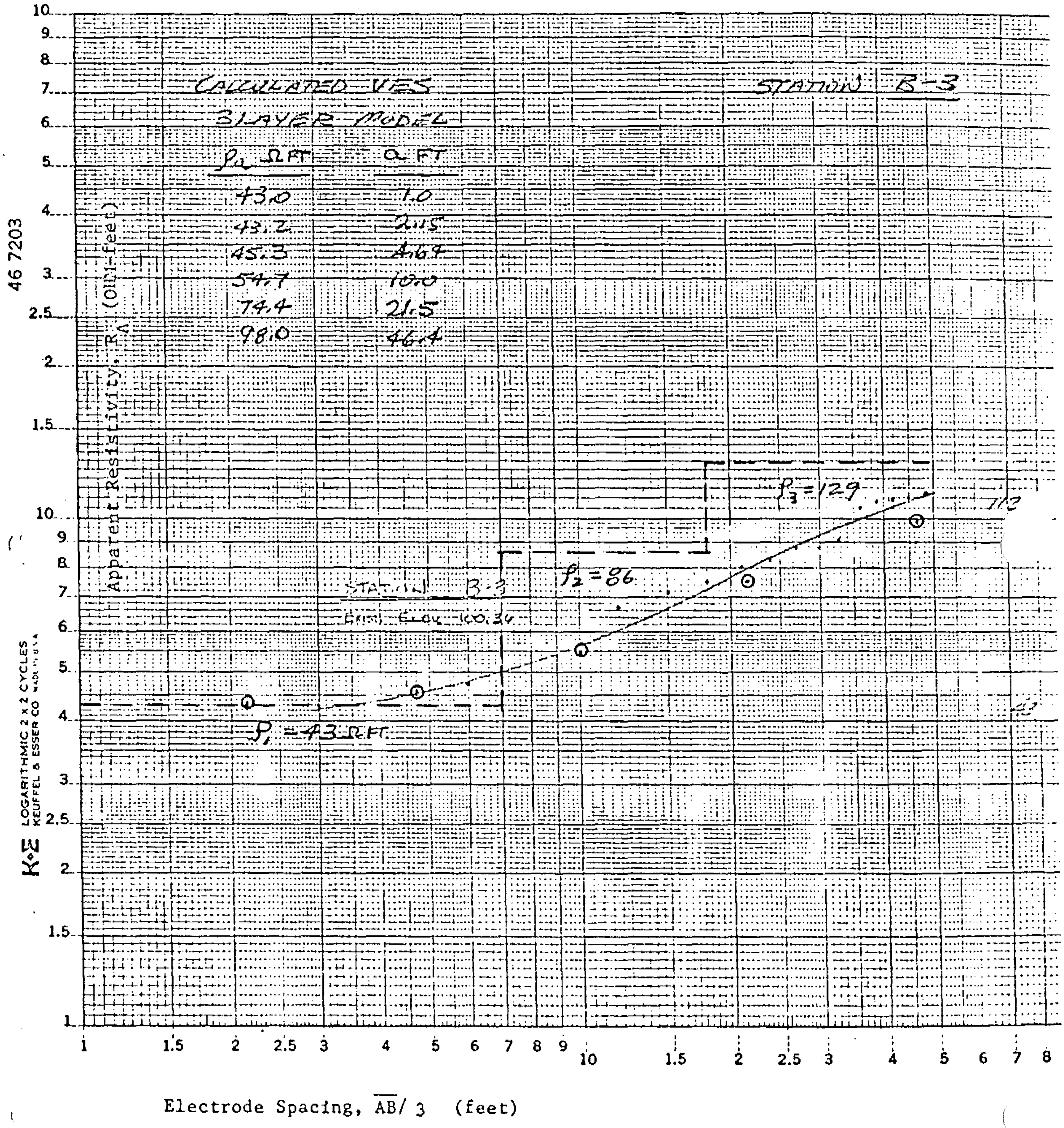
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

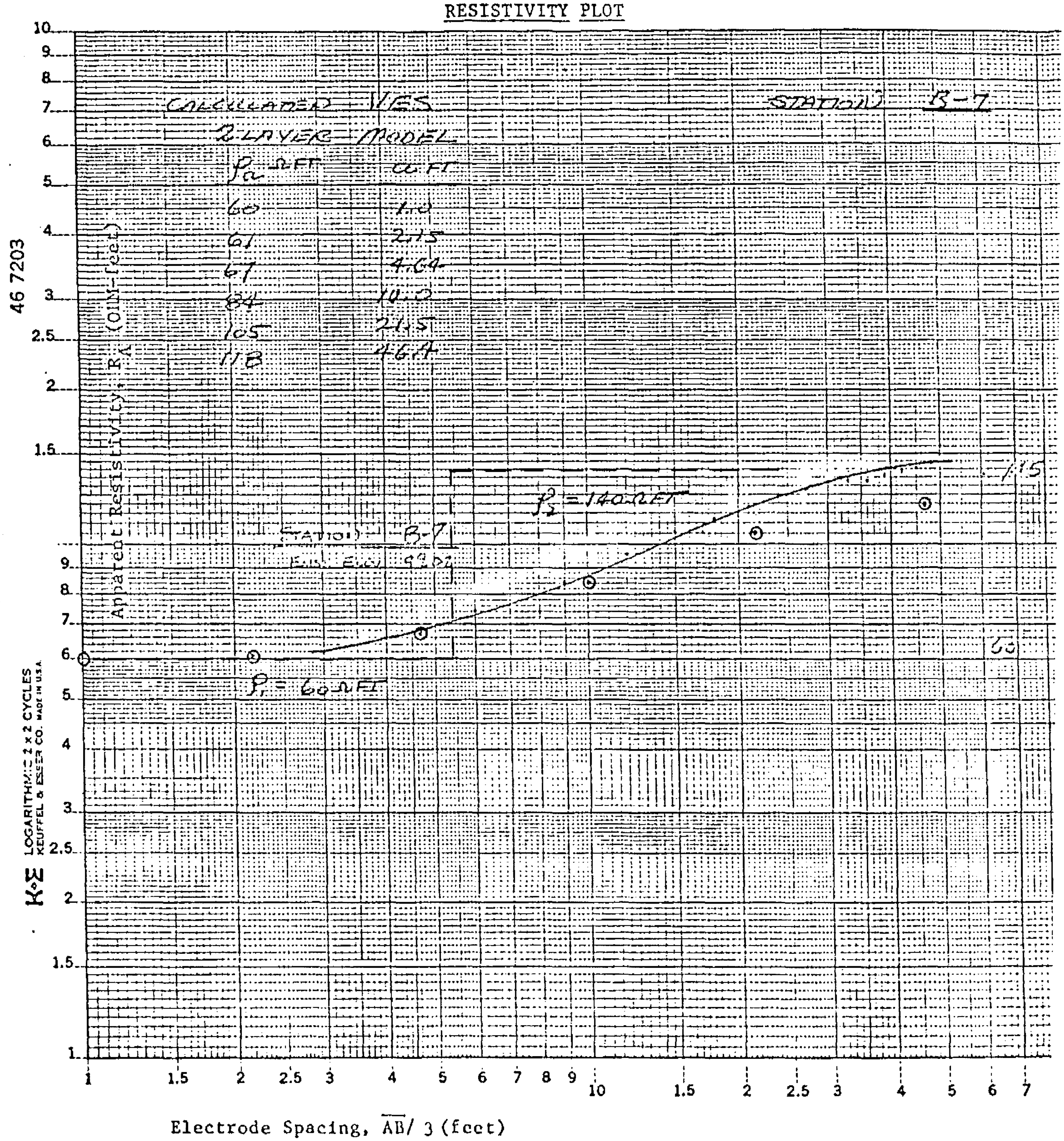
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

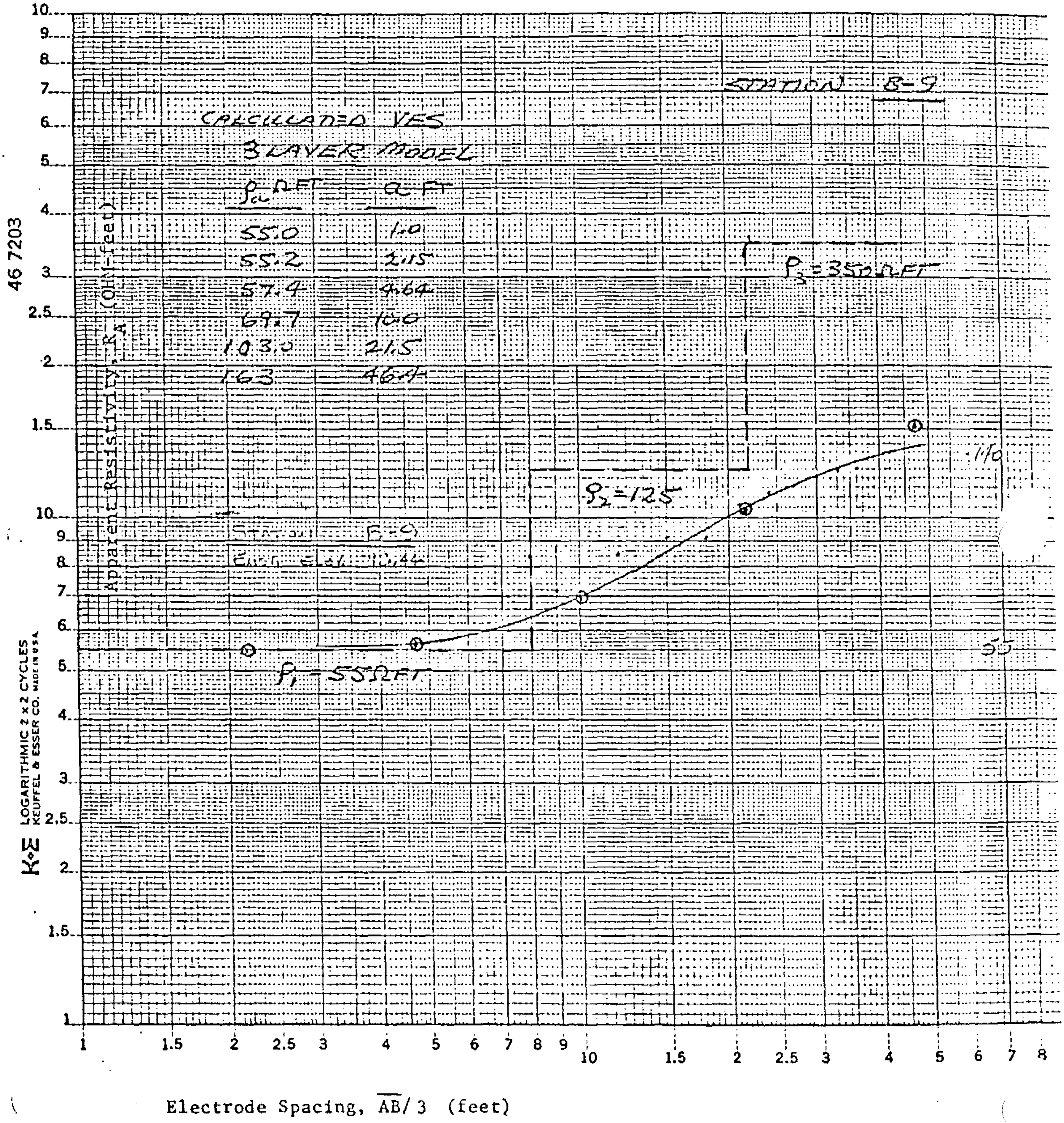
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

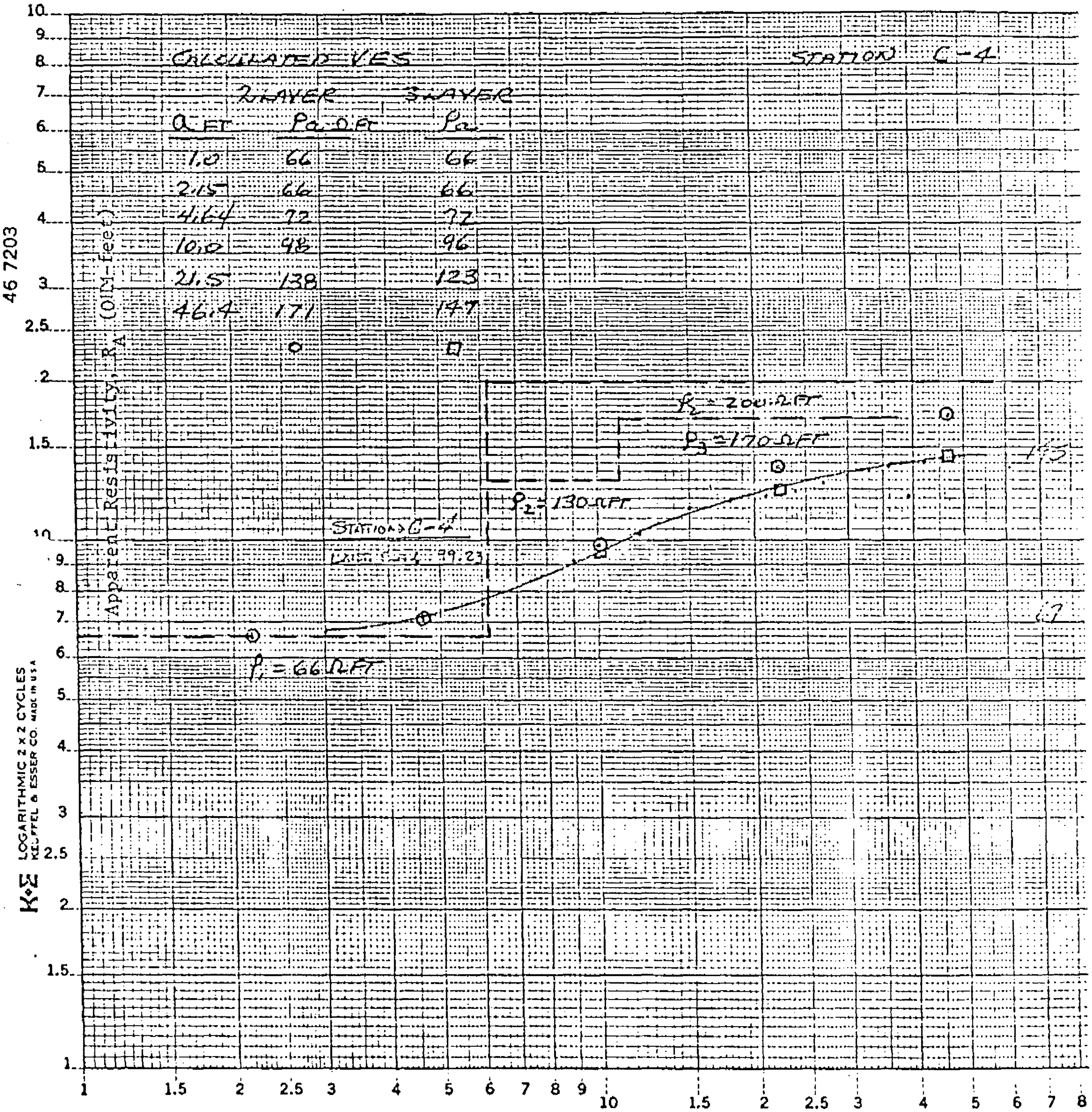
RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

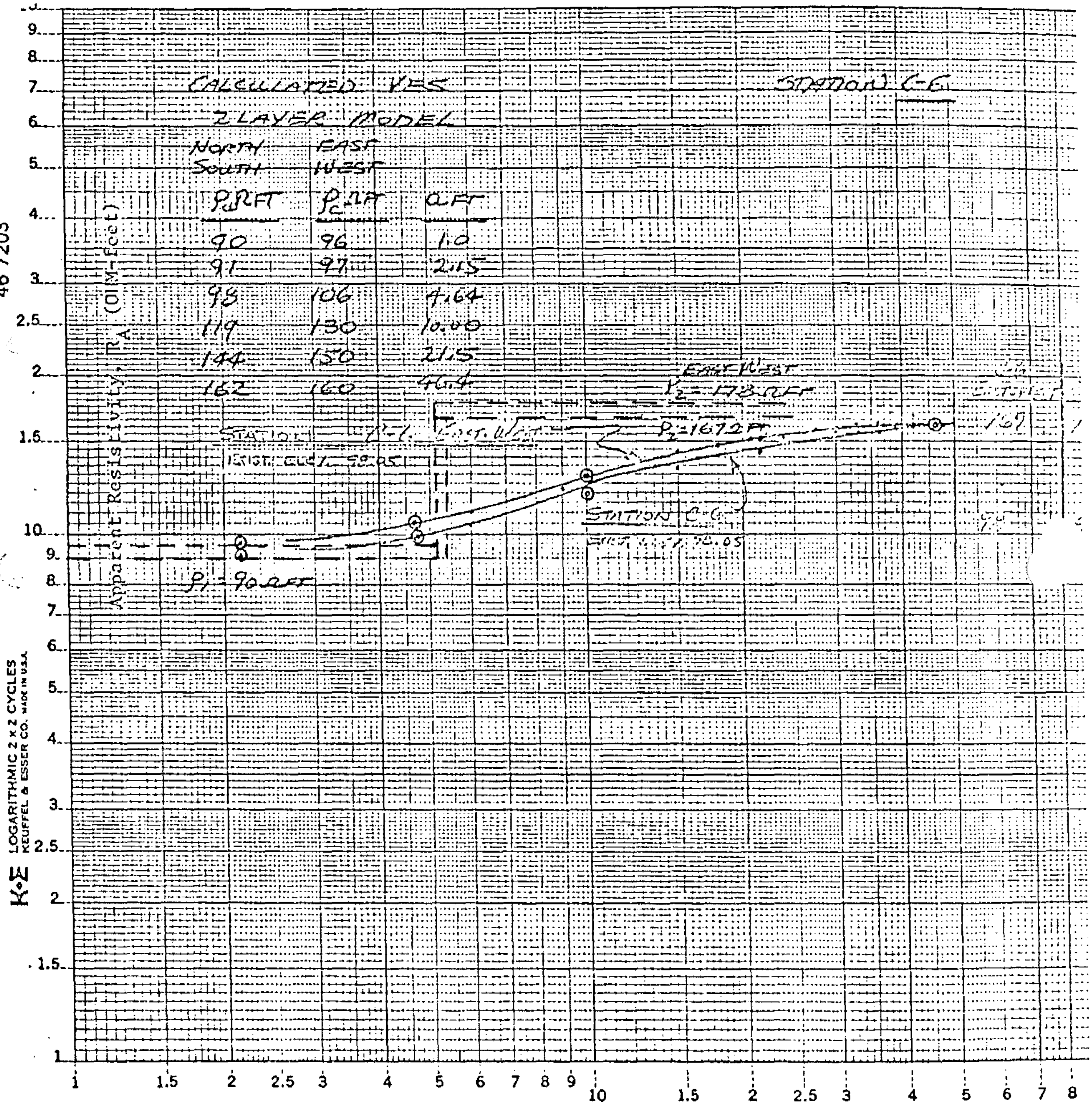


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

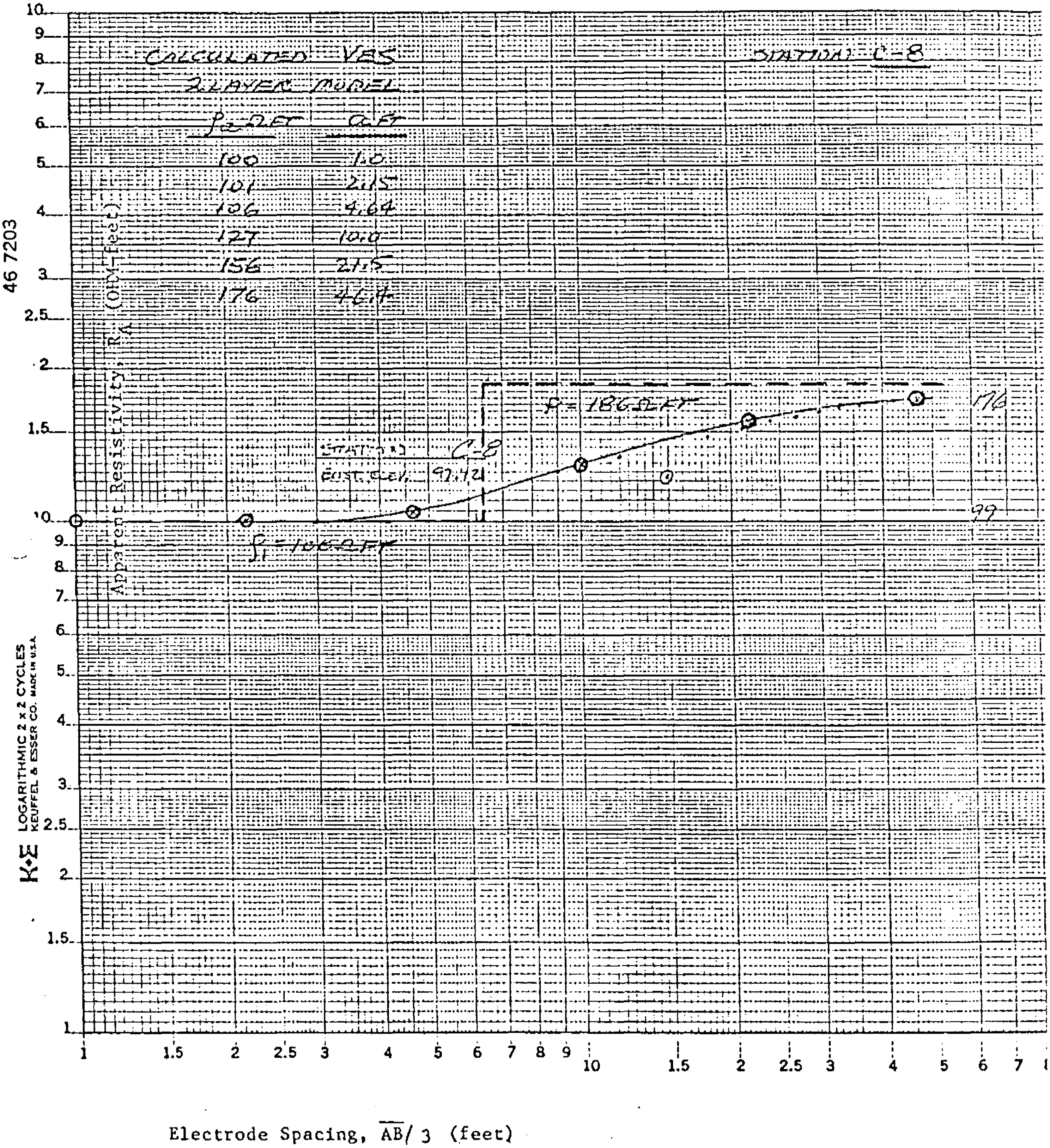


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT



MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

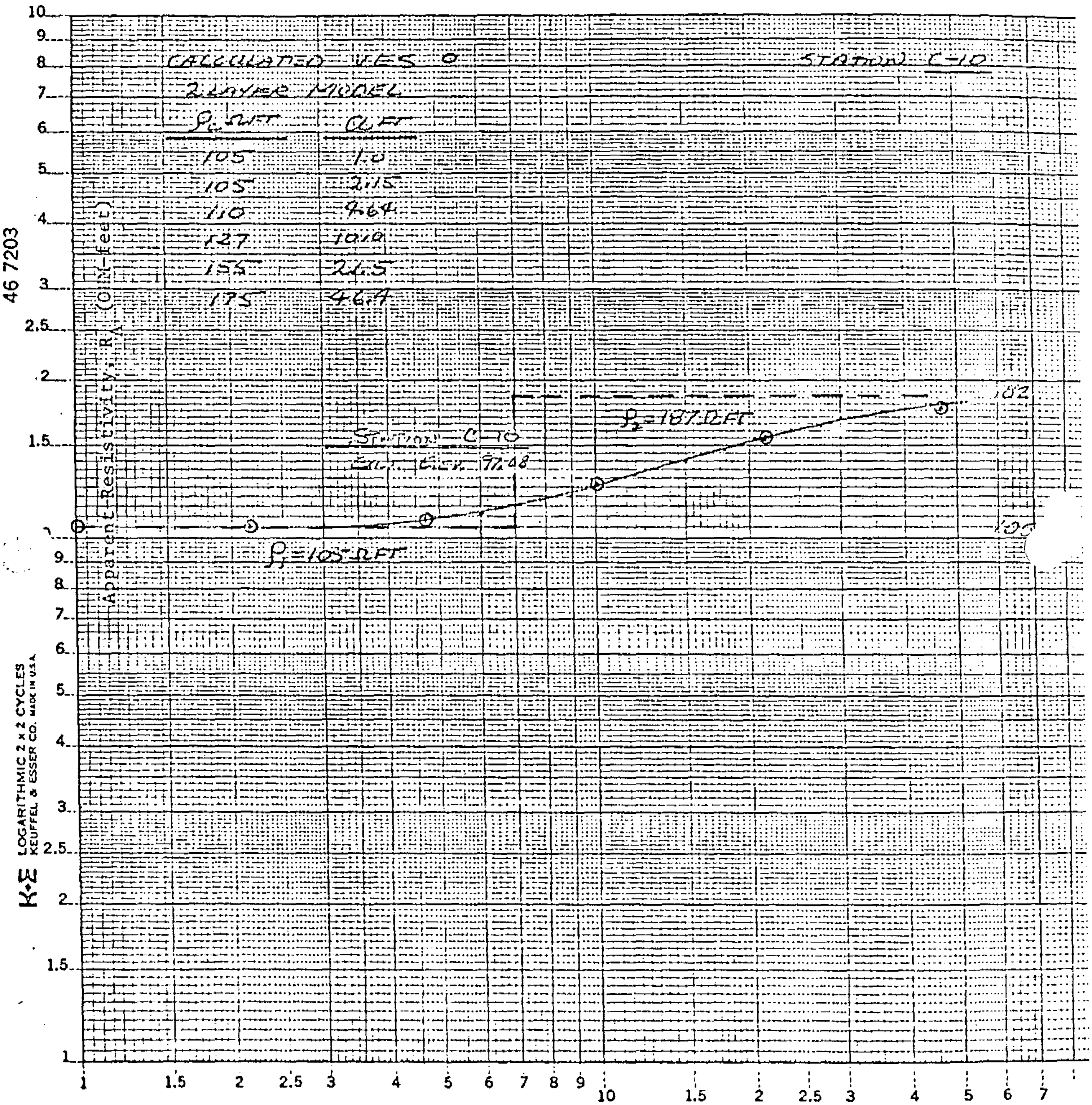


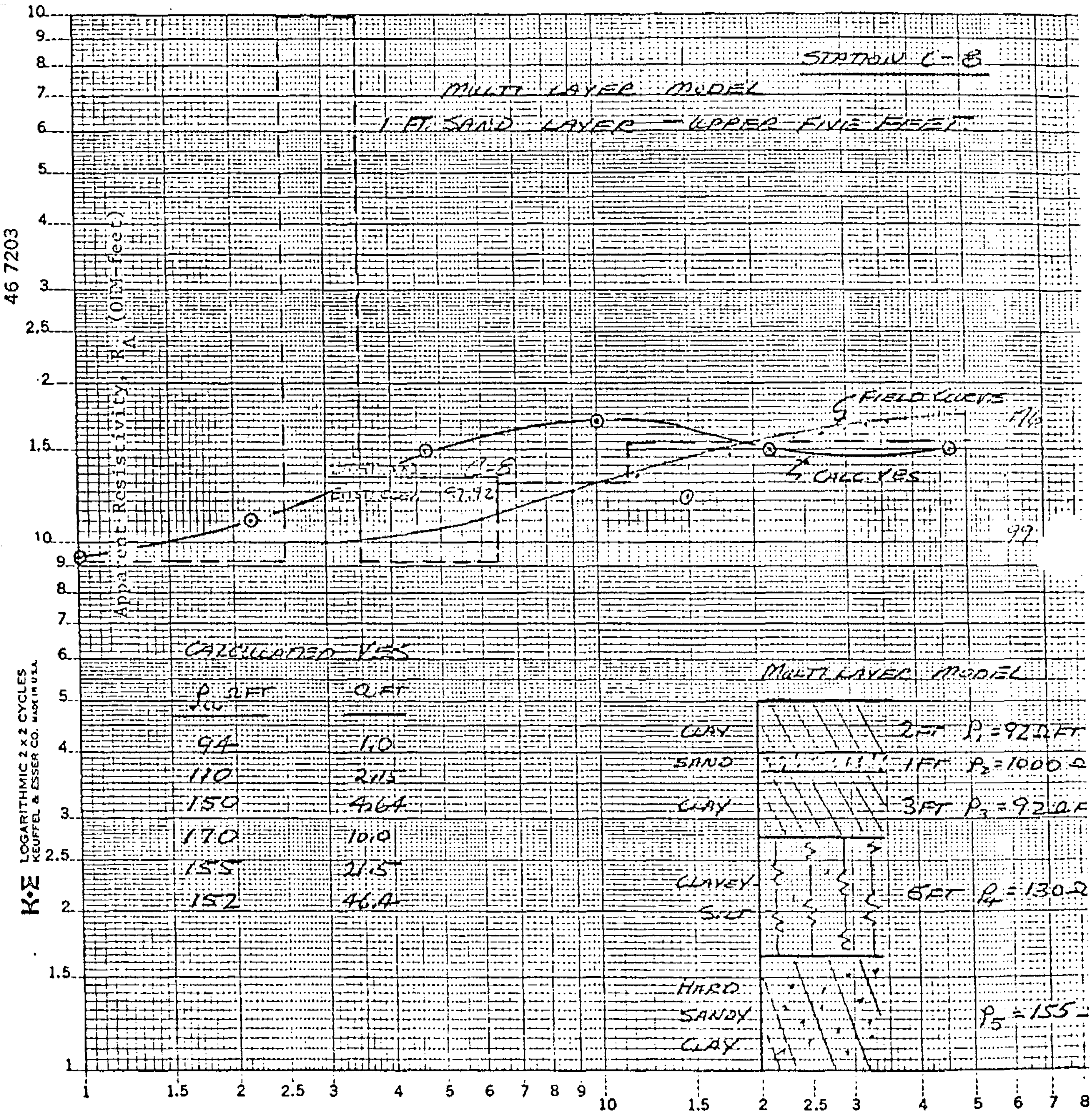
FIGURE #3

Calculated Vertical Electrical Sounding Curves For Sand Layers in Upper Clay Stratum

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT

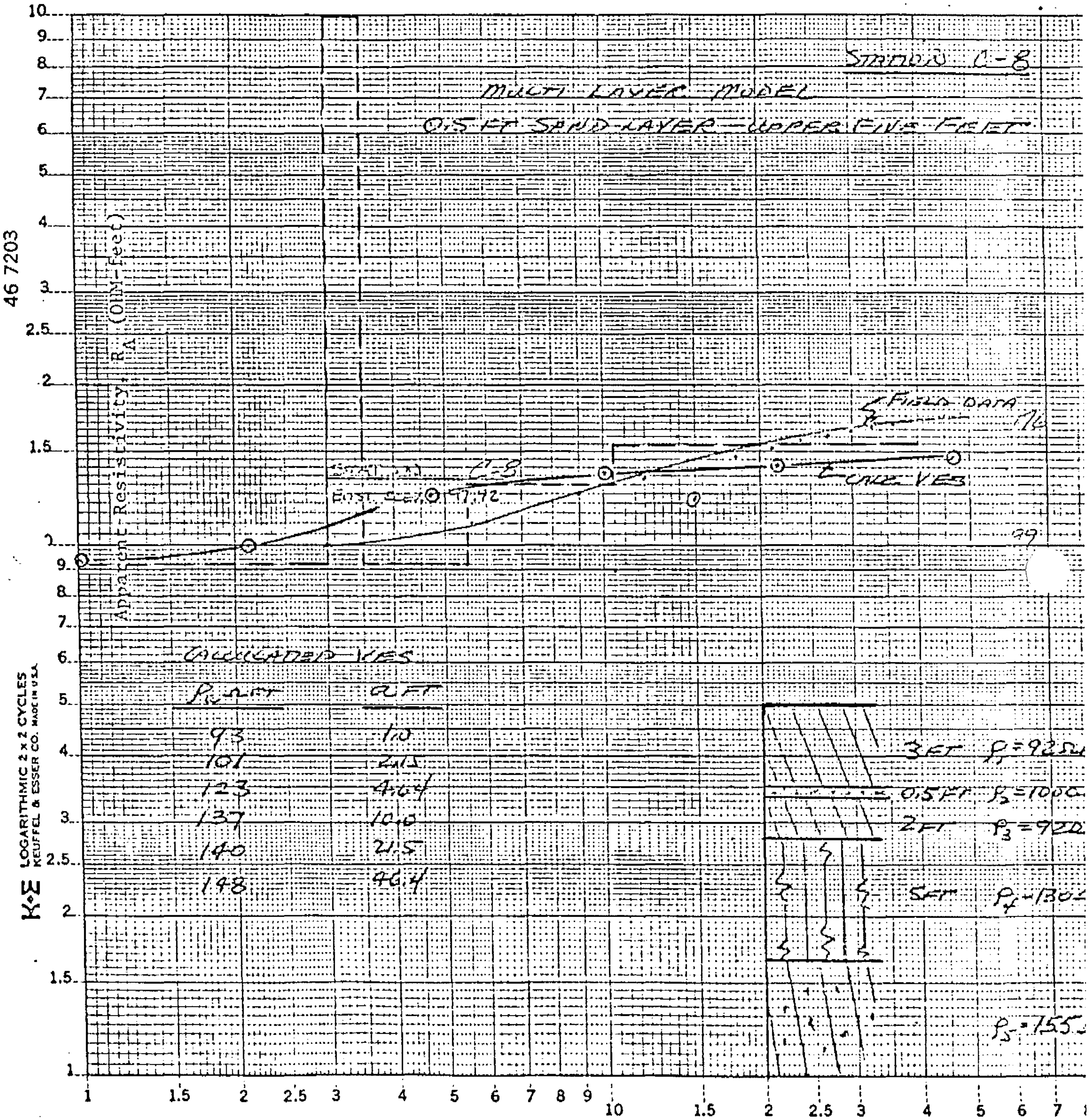


Electrode Spacing, $\overline{AB}/3$ (feet)

MIDLAND PLANT LANDFILL

EQUIVALENCY PROGRAM

RESISTIVITY PLOT



Electrode Spacing, $\overline{AB}/3$ (feet)

NOTE: THIS DRAWING SHOWS CONDITIONS AS OF 1986. FOR CURRENT LANDFILL CONDITIONS SEE APPLICABLE LANDFILL DRAWINGS. LINGLE DRAIN WAS BURRIED UNDERGROUND IN SPRING 1990. SEE DWG. YI-79423.

V	GEN	UPDATE FOR C.B. IN 800 BLK., 'REFERENCE ONLY'	RJF	3/1/93	PC			
K	GM-2	ADDED STORM SEWER W/MANHOLES & C.B.	CAE	9-19-83				
L	G-2	ADDED 802 PUMPING SLAB W/MANHOLE	MPB	12-1-83	MPB			
M	GEN	GENERAL REVISIONS SWRS-WELLS 807	KAB	6-8-84				
N	GEN	GENERAL REVISIONS SWRS & SECTIONS	JLV	11-1-84				
P	D-6	ADDED C.B. # 10-6	MJB	3-7-85				
Q	E1,F2	ADDED SEN. S. FOR ASBESTOS TRAILER & AROUND SMW G-2	JKL	3-25-85				
R	G-4	ADDED STORM SEWER AND CATCH BASIN #8-11	JVM	4-15-85				
S	G-D6	ADDED C.B.'s & M.H.'s	JKL	6-17-86				
T	B-8	ADDED NOTE	MCC	9-6-90	FC			
U	GEN	ADDITIONAL DRAINAGE IN 800 BLOCK	RJF	1-24-92	PC			

	LOCATION	REVISIONS	BY	DATE	APP.
A	GEN.	MOVED SLUDGE SEWER, CHANGED SLOPE ON WALL	RJF	12-13-78	
B	K-2	REVISED CURTAIN WALL - SECTION 'B-B'	RJF	12-27-78	
C	GEN.	REMOVED BENTONITE LINER	RJF	2-20-79	
D	GEN	CHANGE PHASE NUMBERS & GENL UPDATE	SMH	12-6-79	
E	GEN	RELOCATE CB'S FROM 800 BLOCK TO 1000 BLK.			
F	H-2 GEN	ADD METERING MANHOLE			
G	GEN	ADDED SHALLOW MONITOR WELLS (SMW)		7-13-82	
H	B 2-5	ADDED ROAD 2 SLUDGE SEWER		6-9-83	
J	GEN	ADDED C.O. MANHOLES AND CATCH BASINS			

SEE NOTE AT UPPER LEFT CORNER.

SITE

DESIGNED G. M. HAMBLIN DATE 17 JULY '78
DRAWN R. J. FORTIER DATE 24 JULY '78
CHECKED W. PLAVLJANICK
APPROVED R C REED

CROSS REFERENCE: YI-31750, YI-31100, YI-34778, YI-23604

DOW CORNING CORPORATION
MIDLAND • MICHIGAN

GENERAL PLANT LANDFILL DEVELOPMENT SITE PLAN

SCALE 1" = 80'

YI-31900

K	GEN	ADDED M.H.'s 6-31, 8-14, 28-5, C.B 8-23	RJF	9/14/92	P.C.
L					
M					
N					
P					
Q					
R					
S					
T					
U					

	LOCATION	REVISIONS	BY	DATE	APP
A	C-7	ADDED 8" V.T. SLUDGE - SOUTH OF M.H.# 10-3	RJF	1-21-80	GMH
B	A-7	REMOVED CB# 28-1 & 28-2	GMH	3-14-80	[illegible]
C	A-7	ADDED 12" TO EAST OF M.H.# 28-1	RJF	6-10-83	[illegible]
D	F-6	ADDED SANITARY S. FOR ASBESTOS TRAILER	JKL	3-25-85	[illegible]
E	J-6	ADDED SANITARY S. AROUND SMW #6-2	JKL	3-25-85	[illegible]
F	F-7	REPLACED C.B. #8-5 ADDED SEWER, C.W., N_2 LINES	JKL	4-16-86	[illegible]
G	B-7	REVISED 8" V.T. ELEVATIONS	JKL	6-17-86	
H	K-7	ADDED 8" V.T. TO CONTAINER CONT. SPILL POND	JKL	1-15-86	
J	B-3	ADDED 6" HDPE CHEMICAL SEWER TO 802 SLAB	RLC	9/11/09	

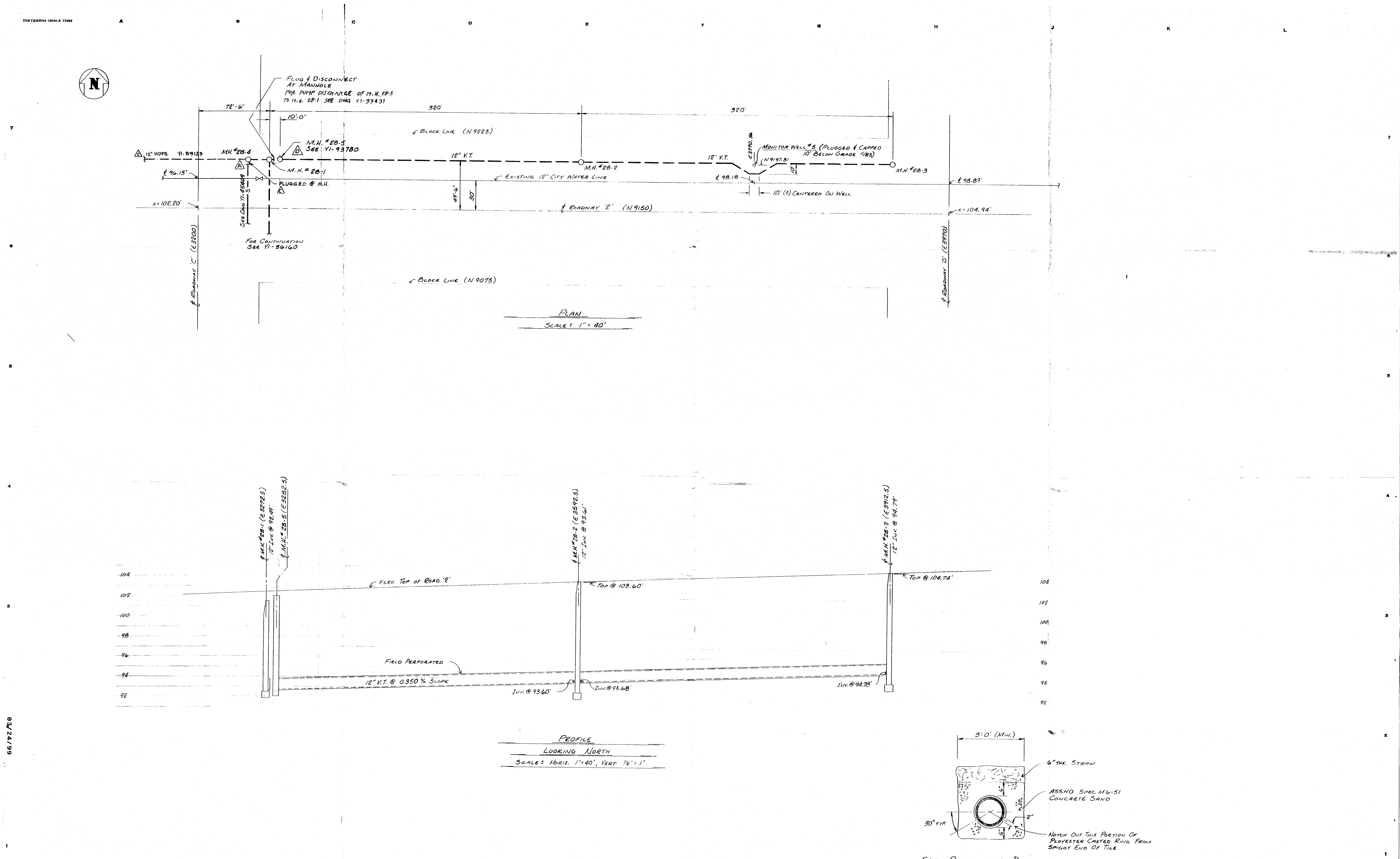
DESIGNED: G.M. HAMBLIN — DATE: DEC. 18, 1978
DRAWN: R.J. FORTIER — DATE: DEC. 22, 1978
CHECKED: G.BARTOS
APPROVED: J. MUSTE

CROSS REFERENCE: YI-31750, YI-31909, YI-36778, YI-23606

DOW CORNING CORPORATION
MIDLAND • MICHIGAN

CHEMICAL SEWER
ROADWAY 'C' - BETWEEN ROADS '2' & '3'
PLAN & PROFILE

SCALE: AS NOTED — YI-36160



	LOCATION	REVISIONS	BY	DATE	APP
A	B-7	Added Diversion To Storm Sewer	RJF	7-24-84	
B	L-1	Added 2800 Block To Title Block	RJF	12/6/89	RJF
C	B-7	Added 12" HDPE, Plugged Diversion	JKL	6/17/91	
D	B-7	Added M.H. #28-5	RJF	9/14/92	P.C.
E					
F					
G					
H					
J					

DESIGNED G.M. Hamblin DATE 7 June 1983
DRAWN R.J. Fortier DATE 9 June 1983
CHECKED G. Bartos; W. Plavljanich
APPROVED D. Autio 6/9/83

CROSS REFERENCE

DOW CORNING CORPORATION
MIDLAND • MICHIGAN

CHEMICAL SEWER 2800 BLK.
ROADWAY '2' - BETWEEN ROADS 'C&D'
PLAN & PROFILE

SCALE: As Noted — Y1-31749

K	C-6	REMOVED SEWER DIVERSION FROM M.H.#7-10	RJF	10DEC92	P.C.	A	GEN.	RELOCATED CHEMICAL SEWER LINE	RJF	12-14-78		
L	D-7	ADDED C.B. # 8-14 AND 8-18	P.C.	1MAR93	P.C.	B	H-7	ADDED 8" SLUDGE TO PHASE II	RJF	1-21-80		
M	L-6	ADDED C.B.#9-2; STORM TO LINGLE DRAIN	RJF	9/6/96	SFH	C	L-7	ADDED CB#10-2		3-14-80		
N	H-5,6	~~RE-ROUTED M.H.#9-2 TO CHEM SEWER~~	JKL	10/6/95	SFH	D	L-7	ADDED M.H.#10-5	GB	3-22-83		
P						E	GEN.	ADDED DIVERSION @ M.H. 7-1 (1983)	RJF	7-25-84		
Q												

LOCATION | REVISIONS | BY | DATE | APP

DESIGNED G.M. HAMBLIN DATE 30 OCT. 1978
DRAWN R.J. FORTIER DATE 2 NOV. 1978
CHECKED

CROSS REFERENCE
Y1-31750
Y1-31900
Y1-36160

DOW CORNING CORPORATION
MIDLAND • MICHIGAN

CHEMICAL & STORM SEWER
ROADWAY '3' - BETWEEN 'C' & 'D'
PLAN & PROFILE