US EPA RECORDS CENTER REGION 5
557258

LIMITED REMEDIAL INVESTIGATION

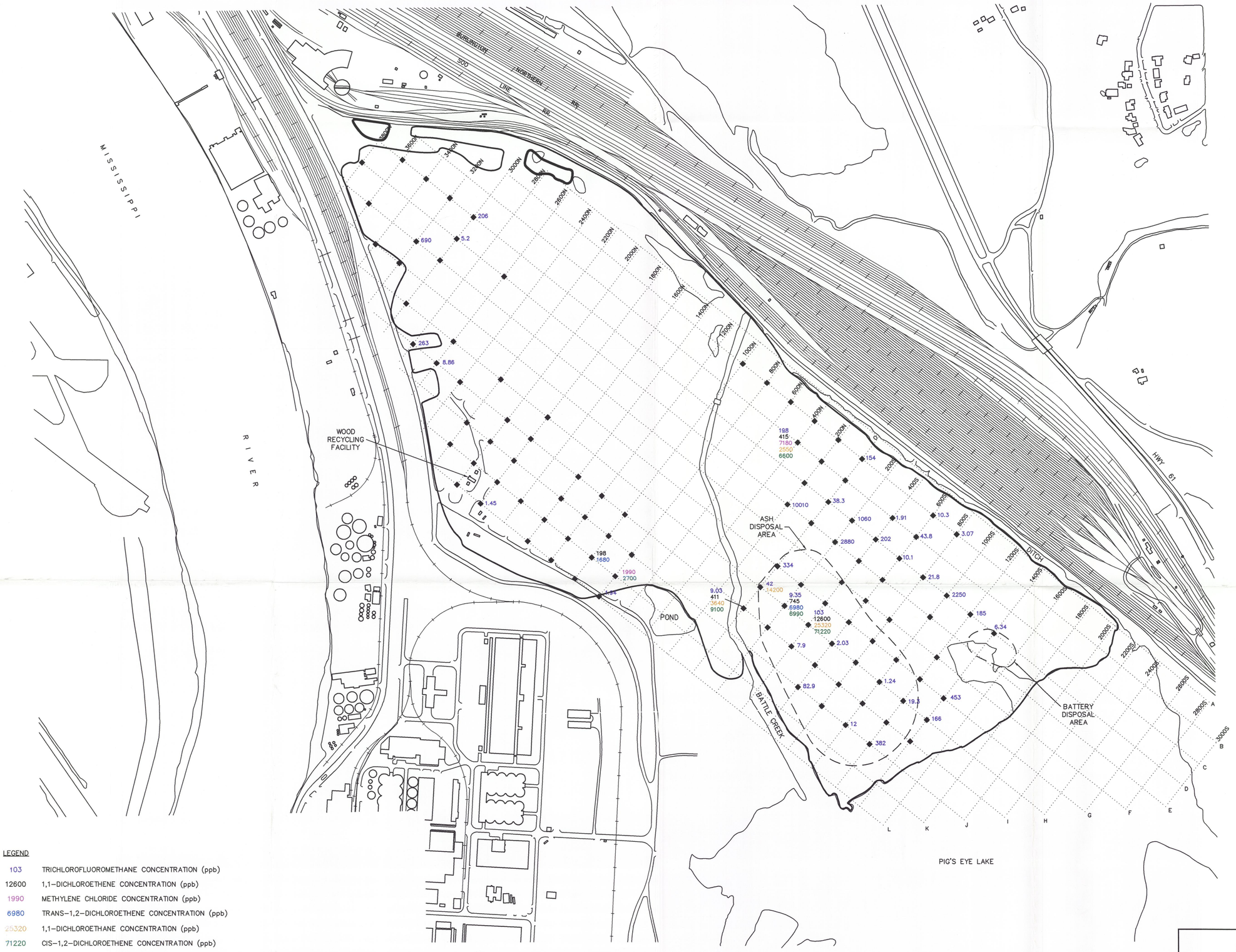
PIG'S EYE DUMP
RAMSEY COUNTY, MINNESOTA

VOLUME II
FINAL REPORT

Prepared for

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, Minnesota 55155

MPCA Contract Work Order No.	:	M6823
PRC Project No.	:	080-0004
Date Prepared	:	November 30, 1994
Prepared by	:	PRC Environmental Management, Inc.
PRC Project Manager	:	Thomas Wiberg
PRC Telephone No.	:	(612) 224-1149
MPCA Project Manager	:	Doug Beckwith
MPCA Telephone No.	:	(612) 296-6300



LEGEND

103	TRICHLOROFLUOROMETHANE CONCENTRATION (ppb)
12600	1,1–DICHLOROETHENE CONCENTRATION (ppb)
1990	METHYLENE CHLORIDE CONCENTRATION (ppb)
6980	TRANS–1,2–DICHLOROETHENE CONCENTRATION (ppb)
25320	1,1–DICHLOROETHANE CONCENTRATION (ppb)
71220	CIS–1,2–DICHLOROETHENE CONCENTRATION (ppb)
◆	SOIL GAS SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

150' 0 150' 300'
SCALE: 1" = 300'
NOTE: GRID MEASURES 180' X 200'.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

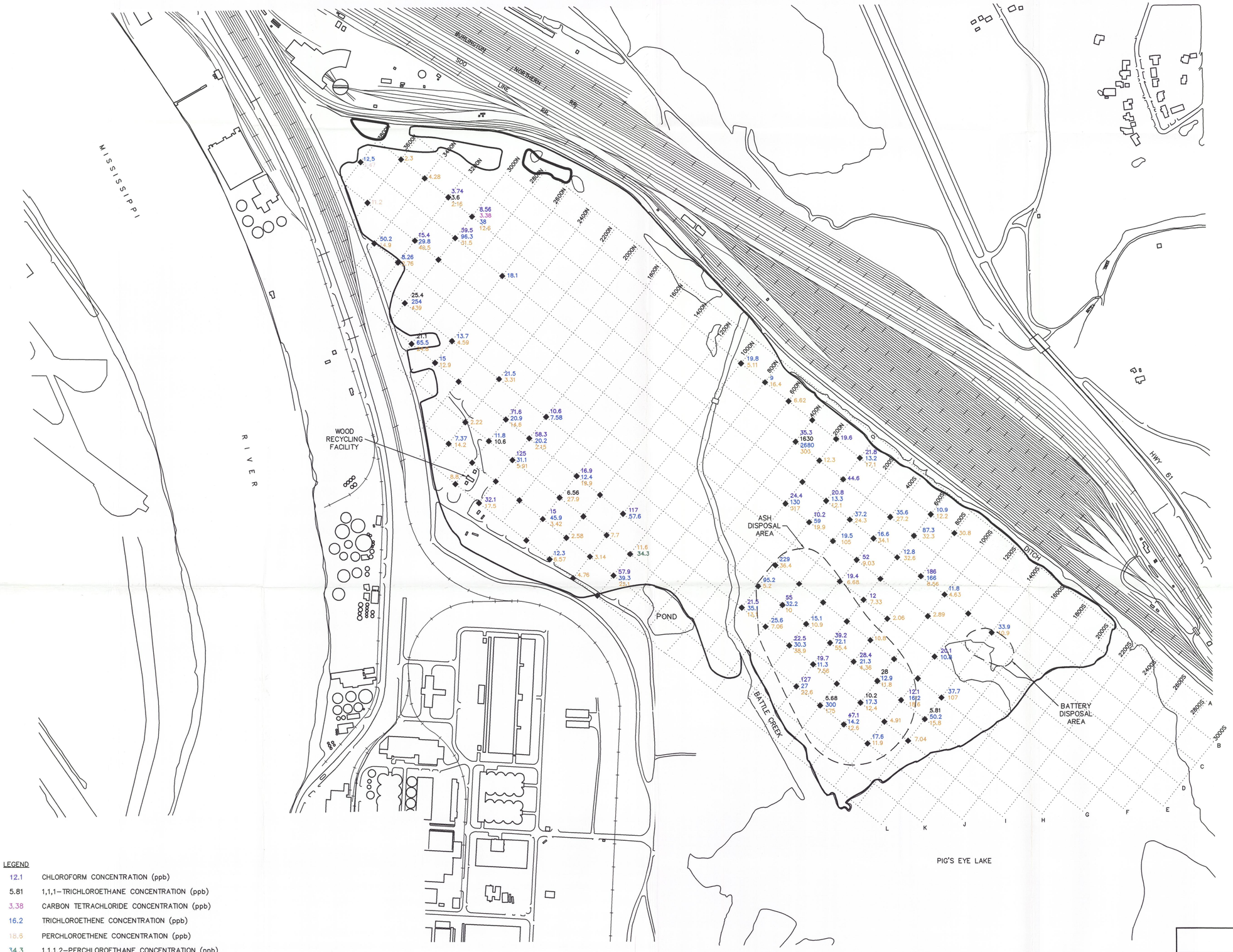
PIG–BASE.DWG – 11/23/94 – CFR – 080–000404

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-1A

CHLORINATED VOC CONCENTRATIONS DETECTED IN SOIL GAS

PRC ENVIRONMENTAL MANAGEMENT, INC.



LEGEND

12.1	CHLOROFORM CONCENTRATION (ppb)
5.81	1,1,1-TRICHLOROETHANE CONCENTRATION (ppb)
3.38	CARBON TETRACHLORIDE CONCENTRATION (ppb)
16.2	TRICHLOROETHENE CONCENTRATION (ppb)
18.6	PERCHLOROETHENE CONCENTRATION (ppb)
34.3	1,1,1,2-PERCHLOROETHANE CONCENTRATION (ppb)
◆	SOIL GAS SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

150' 0 150' 300'
SCALE: 1" = 300'
NOTE: GRID MEASURES 180' X 200'.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

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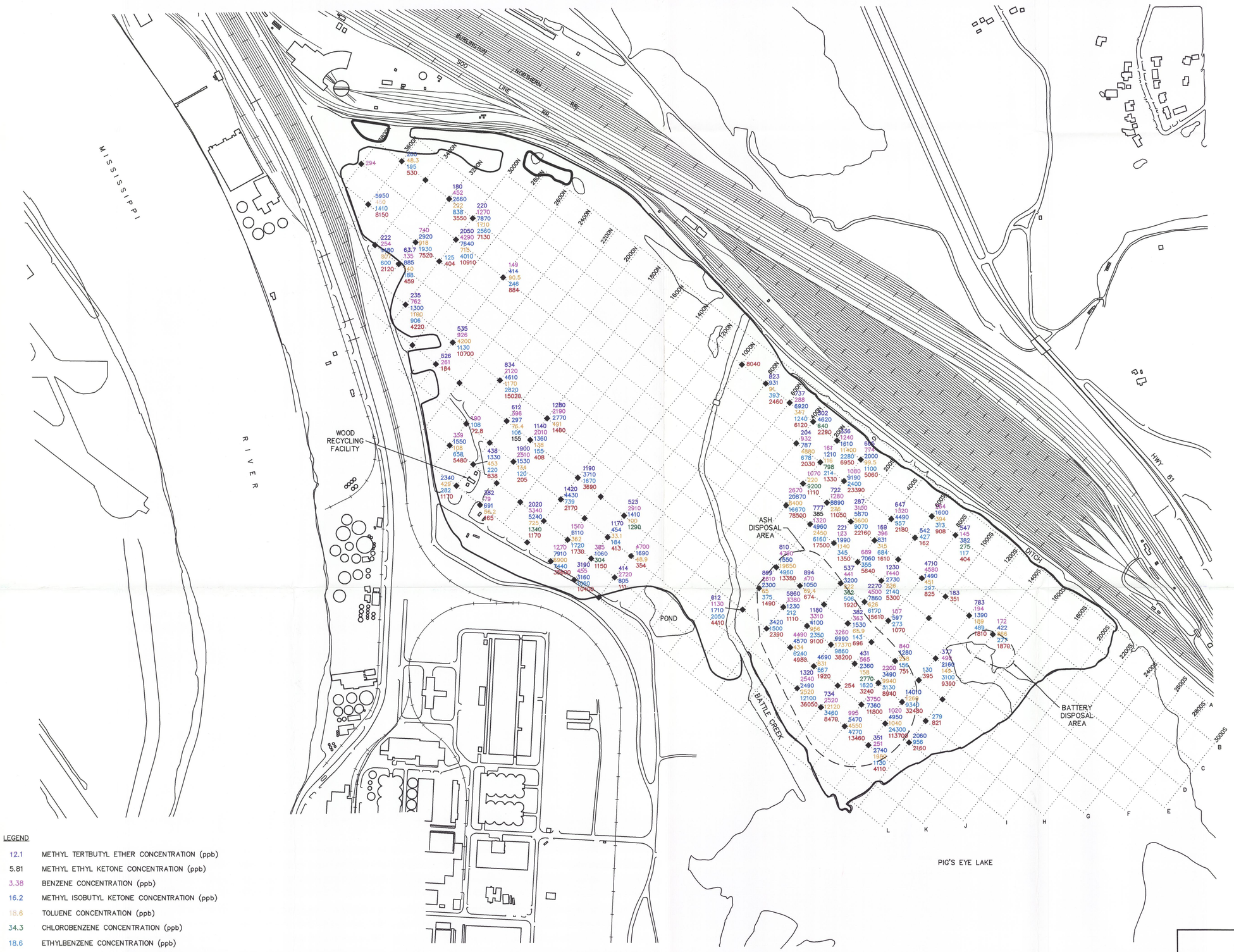
PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-1B

CHLORINATED VOC CONCENTRATIONS DETECTED IN SOIL GAS

PRC ENVIRONMENTAL MANAGEMENT, INC.



LEGEND

12.1	METHYL TERTBUTYL ETHER CONCENTRATION (ppb)
5.81	METHYL ETHYL KETONE CONCENTRATION (ppb)
3.38	BENZENE CONCENTRATION (ppb)
16.2	METHYL ISOBUTYL KETONE CONCENTRATION (ppb)
18.6	TOLUENE CONCENTRATION (ppb)
34.3	CHLOROBENZENE CONCENTRATION (ppb)
18.6	ETHYLBENZENE CONCENTRATION (ppb)
34.3	TOTAL XYLENES CONCENTRATION (ppb)
◆	SOIL GAS SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

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PIG'S EYE DUMP
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FIGURE 5-2

AROMATIC AND OTHER VOC CONCENTRATIONS DETECTED IN SOIL GAS

PRC ENVIRONMENTAL MANAGEMENT, INC.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

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PIG'S EYE DUMP
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FIGURE 5-3

BENZENE, 1,1-DICHLOROETHANE, TOTAL VOC, AND TOTAL TIC VOC CONCENTRATIONS DETECTED IN GEOPROBE™ GROUNDWATER SAMPLES-CLP DATA

PRC ENVIRONMENTAL MANAGEMENT, INC.

LEGEND

4.53	BENZENE CONCENTRATION (ppb)
17.2	1,4-DICHLOROBENZENE CONCENTRATION (ppb)
*	EXCEEDS MDH RAL
⊙	GEOPROBE™ SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-4

BENZENE AND 1,4-DICHLOROBENZENE CONCENTRATIONS DETECTED IN GEOPROBE™ GROUNDWATER SAMPLES-CSL DATA

PRC ENVIRONMENTAL MANAGEMENT, INC.

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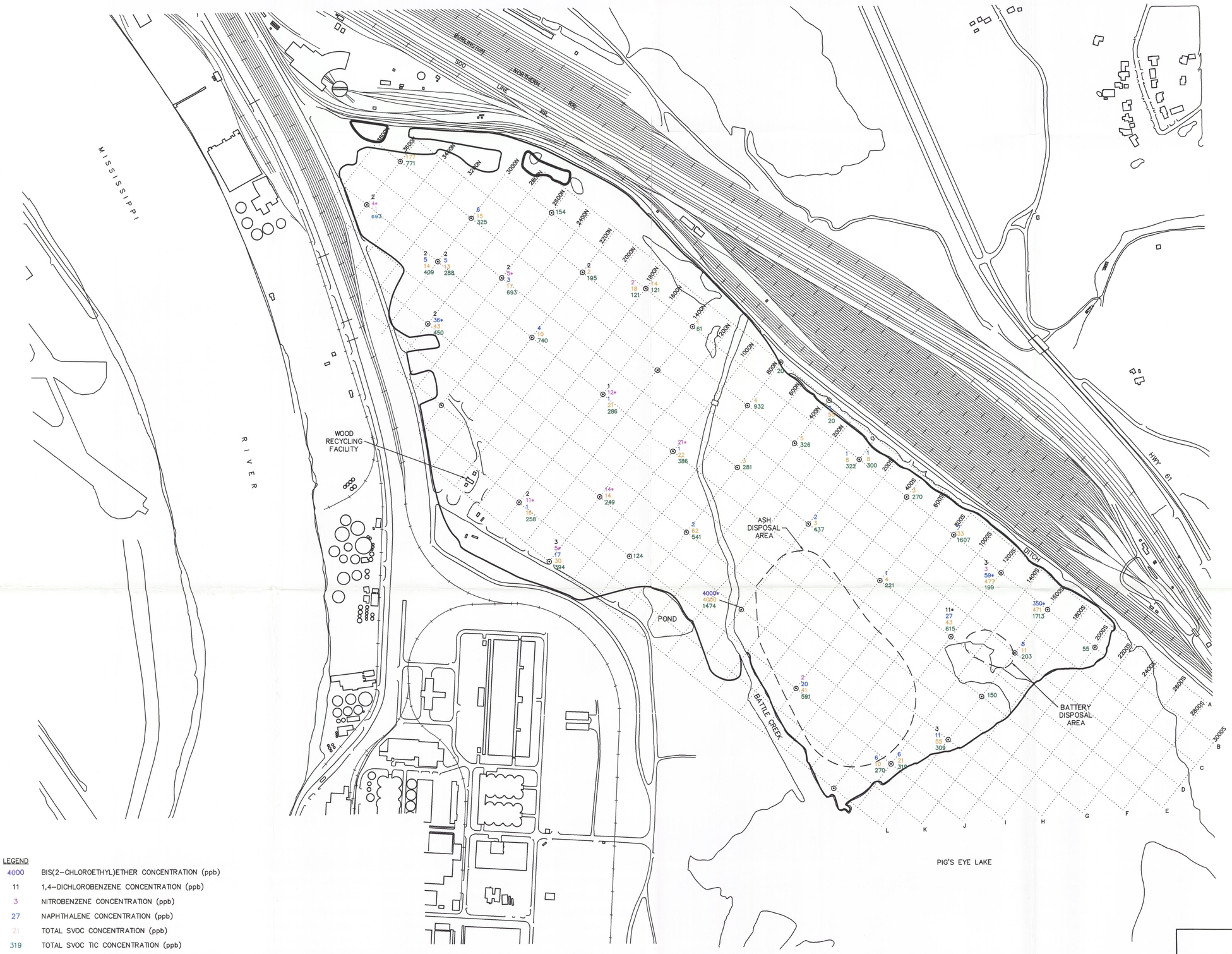


LEGEND

4000	BIS(2-CHLOROETHYL)ETHER CONCENTRATION (ppb)
11	1,4-DICHLOROBENZENE CONCENTRATION (ppb)
3	NITROBENZENE CONCENTRATION (ppb)
27	NAPHTHALENE CONCENTRATION (ppb)
21	TOTAL SVOC CONCENTRATION (ppb)
319	TOTAL SVOC TIC CONCENTRATION (ppb)
*	EXCEEDS MDH RAL
⊙	GEOPROBE™ SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

NOTE: FIGURE SHOWS ONLY THE CONCENTRATIONS OF SVOCs THAT EXCEEDED RALs AT A MINIMUM OF ONE SAMPLING LOCATION.

150' 0 150' 300'
SCALE: 1" = 300'

NOTE: GRID MEASURES 180' X 200'.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

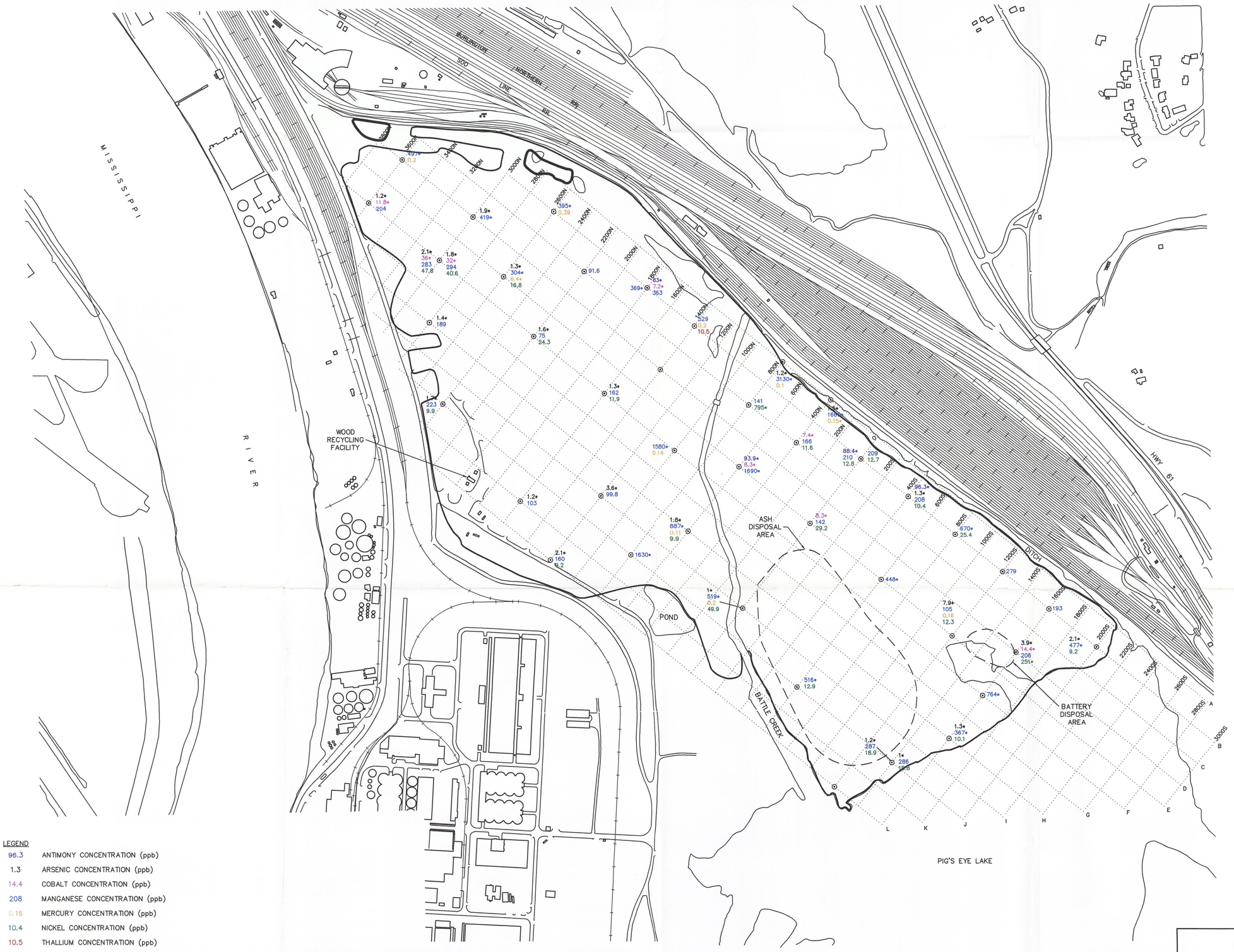
PIG-BASE.DWG – 11/23/94 – CFR – 080-000404

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-5

SVOC CONCENTRATIONS DETECTED IN GEOPROBE™ GROUNDWATER SAMPLES

PRC ENVIRONMENTAL MANAGEMENT, INC.



NOTE: FIGURE SHOWS ONLY THE CONCENTRATIONS OF METALS THAT EXCEEDED RALs AT A MINIMUM OF ONE SAMPLING LOCATION.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

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PIG'S EYE DUMP
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FIGURE 5-6

METAL CONCENTRATIONS DETECTED IN GEOPROBE™ GROUNDWATER SAMPLES

PRC ENVIRONMENTAL MANAGEMENT, INC.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-7

PESTICIDE CONCENTRATIONS DETECTED IN GEOPROBE™ GROUNDWATER SAMPLES

PRC ENVIRONMENTAL MANAGEMENT, INC.

PIG-BASE.DWG – 11/23/94 – CFR – 080-000404

LEGEND

5.4	AROCLOR 1221 CONCENTRATION (ppb)
1.1	AROCLOR 1242 CONCENTRATION (ppb)
0.72	AROCLOR 1254 CONCENTRATION (ppb)
6.7	AROCLOR 1260 CONCENTRATION (ppb)
⊙	GEOPROBE™ SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-8

PCB CONCENTRATIONS DETECTED IN GEOPROBE™ GROUNDWATER SAMPLES

PRC ENVIRONMENTAL MANAGEMENT, INC.

PIG-BASE.DWG – 11/23/94 – CFR – 080-000404

NOTE: GRID MEASURES 180' X 200'.

LEGEND

57	BENZENE CONCENTRATION (ppb)
69	TOTAL VOC CONCENTRATION (ppb)
89	TOTAL VOC TIC CONCENTRATION (ppb)
*	EXCEEDS MDH RAL
◆	MONITORING WELL SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG-BASE.DWG – 11/23/94 – CFR – 080-000404

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-9

BENZENE, TOTAL VOC, AND TOTAL VOC TIC CONCENTRATIONS DETECTED IN GROUNDWATER

PRC ENVIRONMENTAL MANAGEMENT, INC.

LEGEND

22	TOTAL SVOC CONCENTRATION (ppb)
224	TOTAL SVOC TIC CONCENTRATION (ppb)
◆	MONITORING WELL SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

150' 0 150' 300'
SCALE: 1" = 300'

NOTE: GRID MEASURES 180' X 200'.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG-BASE.DWG – 11/23/94 – CFR – 080-000404

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-10

TOTAL SVOC AND TOTAL SVOC TIC CONCENTRATIONS DETECTED IN GROUNDWATER

PRC ENVIRONMENTAL MANAGEMENT, INC.

NOTE: GRID MEASURES 180' X 200'.

LEGEND

96.3	ANTIMONY CONCENTRATION (ppb)
14.4	COBALT CONCENTRATION (ppb)
208	MANGANESE CONCENTRATION (ppb)
10.4	NICKEL CONCENTRATION (ppb)
0.16	SELENIUM CONCENTRATION (ppb)
10.5	THALLIUM CONCENTRATION (ppb)
10.5	ZINC CONCENTRATION (ppb)
*	EXCEEDS MDH RAL
◆	MONITORING WELL SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

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PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-11

METAL CONCENTRATIONS DETECTED IN GROUNDWATER

PRC ENVIRONMENTAL MANAGEMENT, INC.

LEGEND

6	TOTAL VOC CONCENTRATION (ppb)
3	TOTAL SVOC CONCENTRATION (ppb)
9	TOTAL VOC TIC CONCENTRATION (ppb)
175	TOTAL SVOC TIC CONCENTRATION (ppb)
◐	SURFACE WATER SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

NOTE: GRID MEASURES 180' X 200'.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

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PIG'S EYE DUMP
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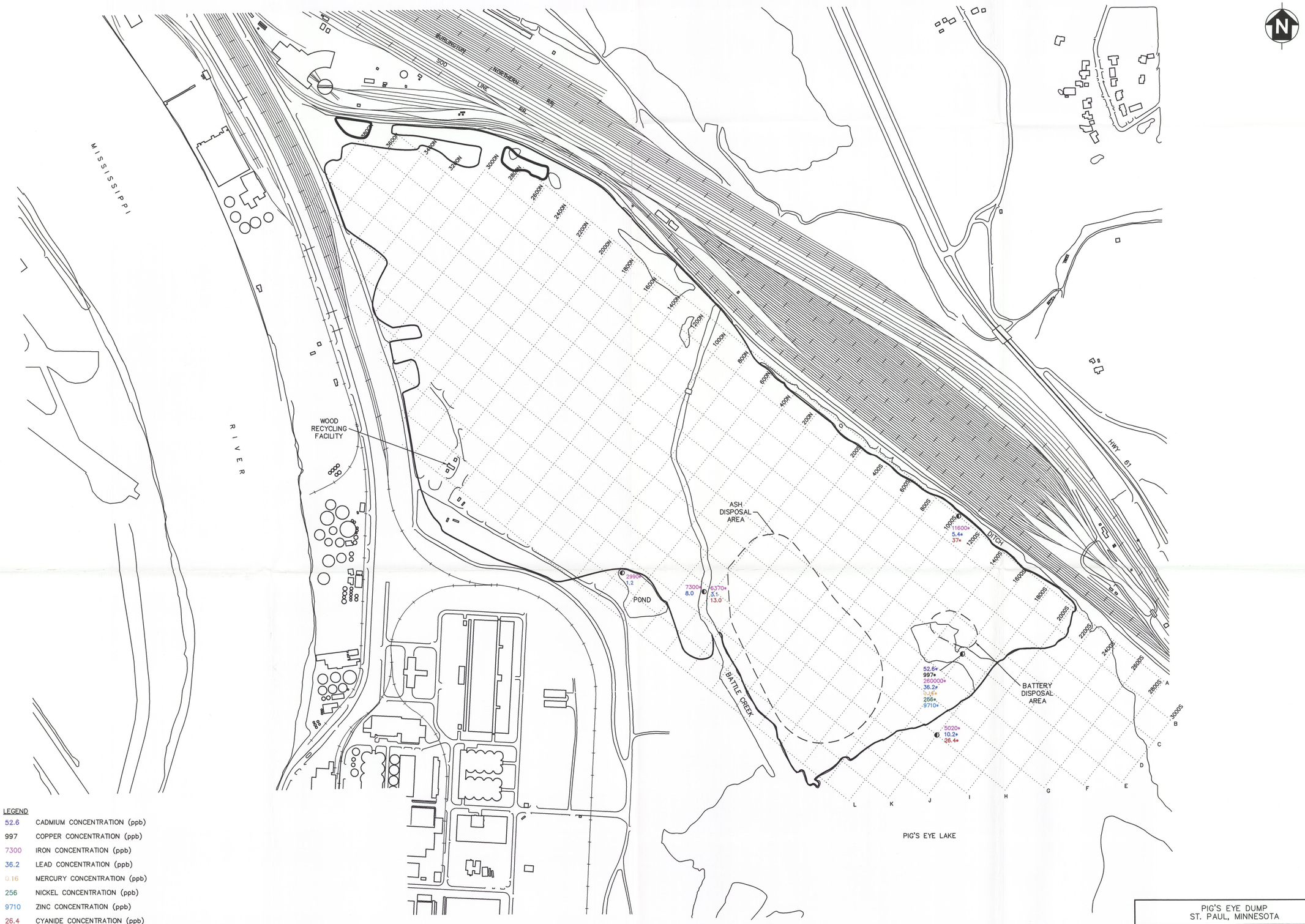
FIGURE 5-12

TOTAL VOC, TOTAL SVOC, TOTAL VOC TIC, AND TOTAL SVOC TIC CONCENTRATIONS DETECTED IN SURFACE WATER

PRC ENVIRONMENTAL MANAGEMENT, INC.



SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-13

METAL CONCENTRATIONS DETECTED IN SURFACE WATER

PRC ENVIRONMENTAL MANAGEMENT, INC.

LEGEND

15	TOTAL VOC CONCENTRATION (ppb)
129	TOTAL VOC TIC CONCENTRATION (ppb)
11380	TOTAL SVOC CONCENTRATION (ppb)
77000	TOTAL SVOC TIC CONCENTRATION (ppb)
○	SEDIMENT SAMPLING LOCATION
•	SAMPLE CONCENTRATION COLLECTED 9/14/94
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

150' 0 150' 300'
SCALE: 1" = 300'

NOTE: GRID MEASURES 180' X 200'.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG-BASE.DWG – 11/23/94 – CFR – 080-000404

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-14

TOTAL VOC, TOTAL SVOC, AND TOTAL SVOC TIC CONCENTRATIONS DETECTED IN SEDIMENT

PRC ENVIRONMENTAL MANAGEMENT, INC.

LEGEND

77.6	CADMIUM CONCENTRATION (ppm)
76.2	CHROMIUM CONCENTRATION (ppm)
60.6	LEAD CONCENTRATION (ppm)
⊙	SEDIMENT SAMPLING LOCATION
*	EXCEEDS CONCENTRATION AT WHICH LEACHABLE CONCENTRATIONS COULD POTENTIALLY EXCEED TCLP LIMITS
•	SAMPLE CONCENTRATION COLLECTED 9/14/94
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-15

TOTAL CADMIUM, CHROMIUM, AND LEAD CONCENTRATIONS DETECTED IN SEDIMENT

PRC ENVIRONMENTAL MANAGEMENT, INC.

LEGEND

5,7	4,4–DDE CONCENTRATION (ppb)
45	4,4–DDT CONCENTRATION (ppb)
3,1	4,4–DDD CONCENTRATION (ppb)
4,8	ALDRIN CONCENTRATION (ppb)
3,6	GAMMA CHLORDANE CONCENTRATION (ppb)
⊙	SEDIMENT SAMPLING LOCATION
———	APPROXIMATE BOUNDARY OF FILL MATERIAL (BASED ON GEOPHYSICAL SURVEY)

NOTE: GRID MEASURES 180' X 200'.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

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PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE 5-16

PESTICIDE CONCENTRATIONS DETECTED IN SEDIMENT

PRC ENVIRONMENTAL MANAGEMENT, INC.

APPENDIX A

LAND SURVEY REPORT

REPORT OF SERVICES PERFORMED AT PIG'S EYE DUMP SITE ST. PAUL, MINNESOTA

April, 1994

Submitted to:

PRC ENVIRONMENTAL MANAGEMENT, INC
444 Cedar Street
Suite 720
St. Paul, Minnesota 55101

Submitted by:

Enviroscience, Inc.
6474 City West Parkway
Eden Prairie, Minnesota 55344
(612)944-8486

ENVIROSCIENCE

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III. Methods and Equipment

IV. Summary of Daily Field Activities

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II. GENERAL PROJECT DESCRIPTION

This was a project to establish control lines to be used as a basis for locating geophysical transect lines and subsurface sampling points at the Pig's Eye Dump site.

The control lines were oriented parallel with a boundary line from a boundary description of the dump site which was provided to Enviroscience (See Exhibit A).

EXHIBIT A

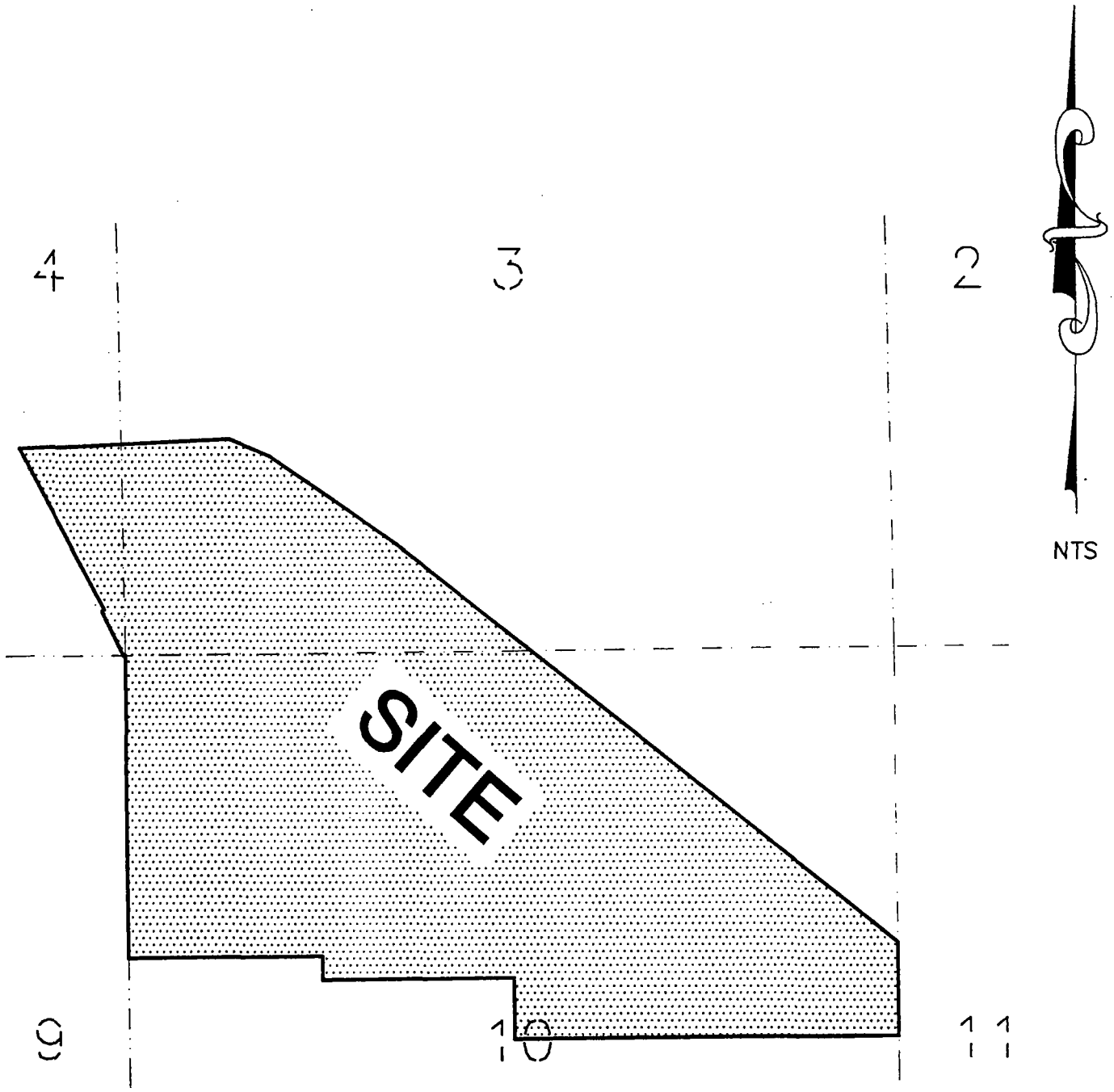
1920164

All those parts of Sections 3, 4 and 10 in T28N-R22W described as follows: Beginning at the east ¼ corner of said Section 10; thence north, along the east line of said Section 10, a distance of 630 feet; thence northwesterly, deflecting to the left 51 degrees, a distance of 4,350 feet; thence northwesterly, deflecting to the left 4 degrees, a distance of 1,070 feet; thence northwesterly, deflecting to the left 11 degrees, 30 minutes, a distance of 295 feet; thence westerly, deflecting to the left 25 degrees, 30 minutes, a distance of 1,430 feet; thence southeasterly, deflecting to the left 115 degrees, 30 minutes, a distance of 1,235 feet; thence southwesterly, deflecting to the right 78 degrees, 30 minutes, a distance of 20 feet; thence southeasterly, deflecting to the left 76 degrees, a distance of 570 feet more or less to the south line of said Section 4; thence easterly along the said south line to the southeast corner of said Section 4; thence southeasterly to the point of beginning.

All that part of the north ½ of Section 10 - T28N-R22W lying southwesterly a line extending from the east ¼ corner of said Section 10 to the northwest corner of said Section 10, except the south 25 acres of the south ½ of the ~~NW ¼ of said Section 10 and except the south 5 acres of the west ½ of the~~ north 54.65 acres of the said south ½.

NOTE: Distances and deflection angles measured from: City of St. Paul Department of Public Works Maintenance Services, *Pig's Eye Landfill* 1971 Report, Topographic Map - reduced from 100 scale to 200 scale.

EXHIBIT A



ENVIROSCIENCE

6474 CITY WEST PARKWAY
EDEN PRAIRIE, MINNESOTA 55344
(612) 944-8486

SHEET 2 OF 2 SHEETS

III. METHODS AND EQUIPMENT

The location of the dump boundary was established from a boundary description provided to Enviroscience by PRC (Exhibit A). It was tied to the Minnesota State Plane Coordinate system using state plane coordinates established on Section corners by the Ramsey County Surveyor.

Nine (9) control lines, spaced 180 feet apart, were established by calculation to be southwesterly from and parallel with the first northeasterly line of the dump boundary description. The northeasterly boundary line was also used as a control line, for a total of ten (10) control lines. They were each given a letter identifier, beginning with "A" on the boundary line and ending with "J" on the most southwesterly line.

For the purpose of identifying points on each control line, the control lines were split between north and south by a line drawn perpendicular to the control lines from a point midway between the most northeasterly and the most southeasterly boundary corners. Points were established on each control line, by calculation, at an interval of 200 feet, beginning at the division line. Each point was described by a combination of its control line designation and its distance north or south from the division line, i.e. A 200 S (See Exhibit B).

On the dump site, traverse lines were run between the east quarter section corner, the north quarter section corner, and the monumented center of section corner of Section 10, using Topcon geodetic quality total station theodolites, direct reading to 1 arc second, in order to establish coordinates for field survey control points.

From the control points established in the traverse, points on each control line were located radially with the Topcon total stations and marked with a wooden hub and lath. The lath were marked with the point's location designation.

At the north end of the site miscellaneous points established by PRC's geophysical subcontractor were located (See Exhibit B, Detail) and their coordinate values established (See Appendix).

IV. SUMMARY OF DAILY FIELD SURVEY ACTIVITIES

March 25, 1994

A search for section corner monuments was made. The east quarter-section, north quarter-section and center of section monuments for Section 10 were found (1 crew).

A traverse between the found section corner monuments was performed (1 crew).

Lath and hubs marking points on control lines were set (2 crews).

Note: Mud from thawing ground made movement around the site very slow and difficult.

March 28, 1994

Points on control lines were set (2 crews)

Note: Mud from thawing ground made movement around the site very slow and difficult.

March 29, 1994

Points on control lines were set (2 crews)

Note: Trees in the area of control lines and snowy weather conditions slowed progress.

March 30, 1994

Points on control lines were set (1 crew)

Note: Trees in the area of control lines slowed progress.

March 31, 1994

Points on control lines were set (1 crew)

Note: Trees in the area of control lines slowed progress.

April 1, 1994

Points on control lines were set (1 crew)

Set supplemental control points outside of the described dump boundary at the request of Tom Wiberg.

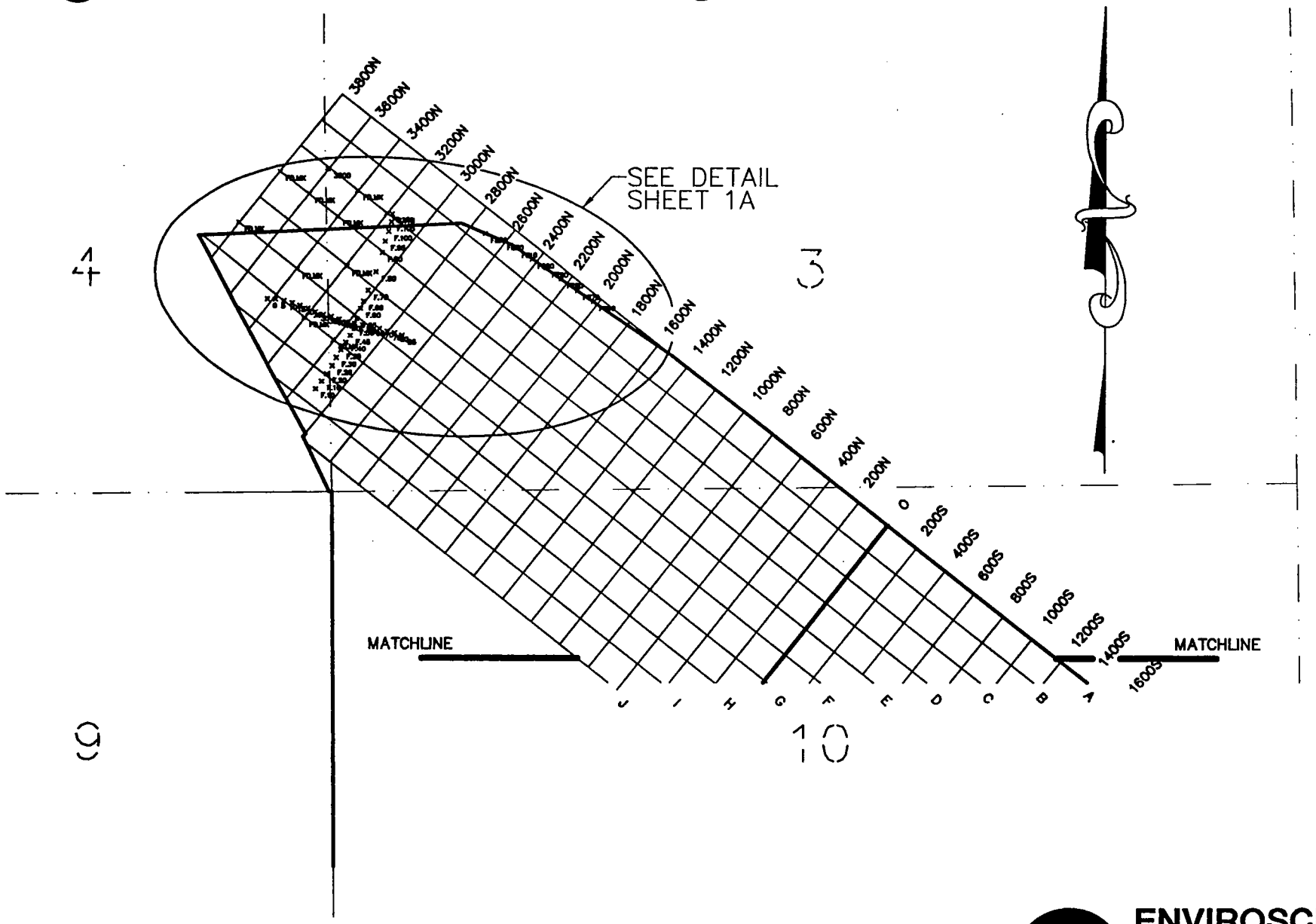
Note: Trees in the area of control lines slowed progress.

April 4, 1994

Walked the site to check for missing points on control lines.

Located additional points marked by PRC's geophysical subcontactors as requested by Tom Wiberg (See Detail, Exhibit B).

EXHIBIT B



GRAPHIC SCALE

800 0 400 800 1600 3200

(IN FEET)

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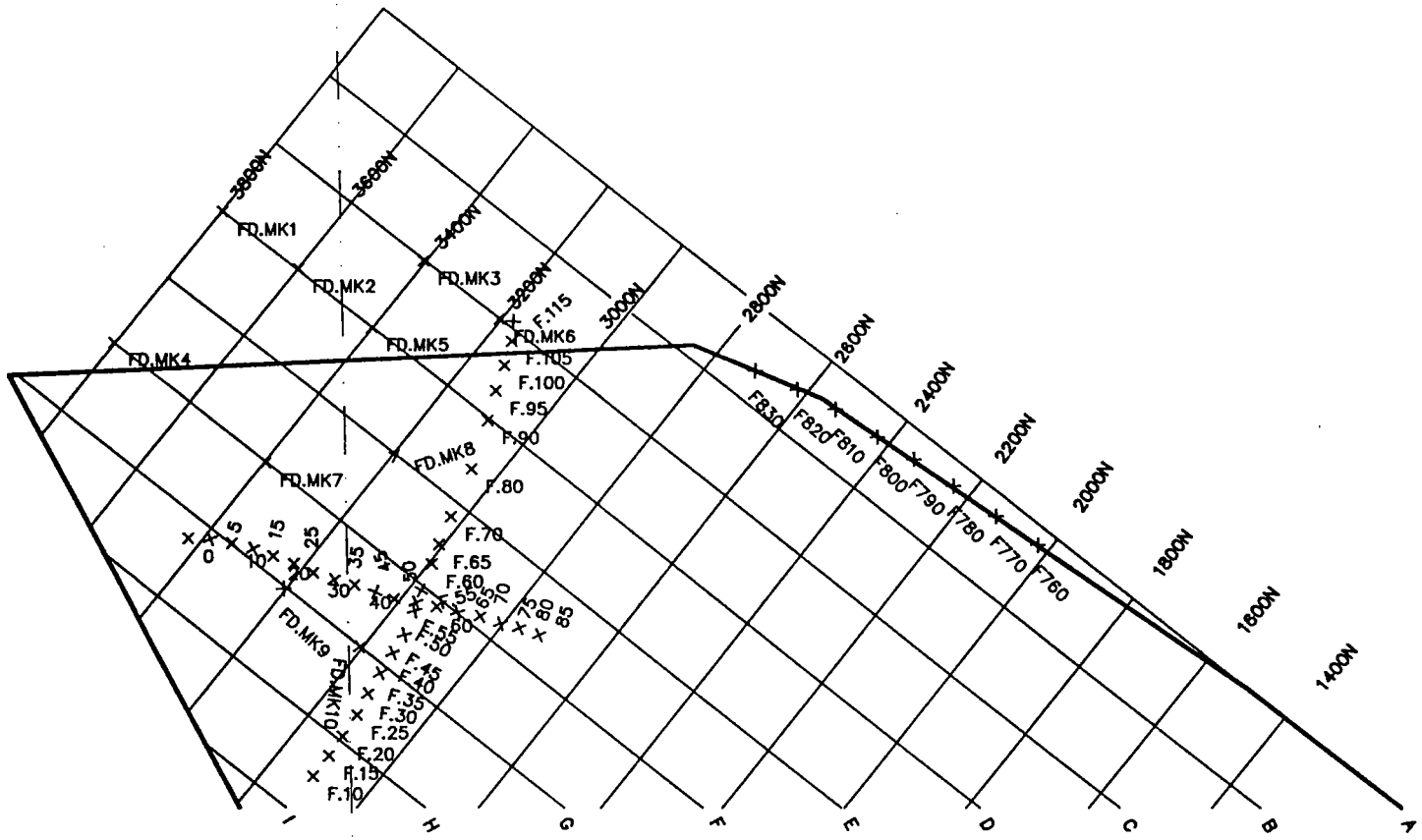
(612) 944-8486

SHEET 1 OF 2 SHEETS

EXHIBIT B
DETAIL



GRAPHIC SCALE

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(IN FEET)

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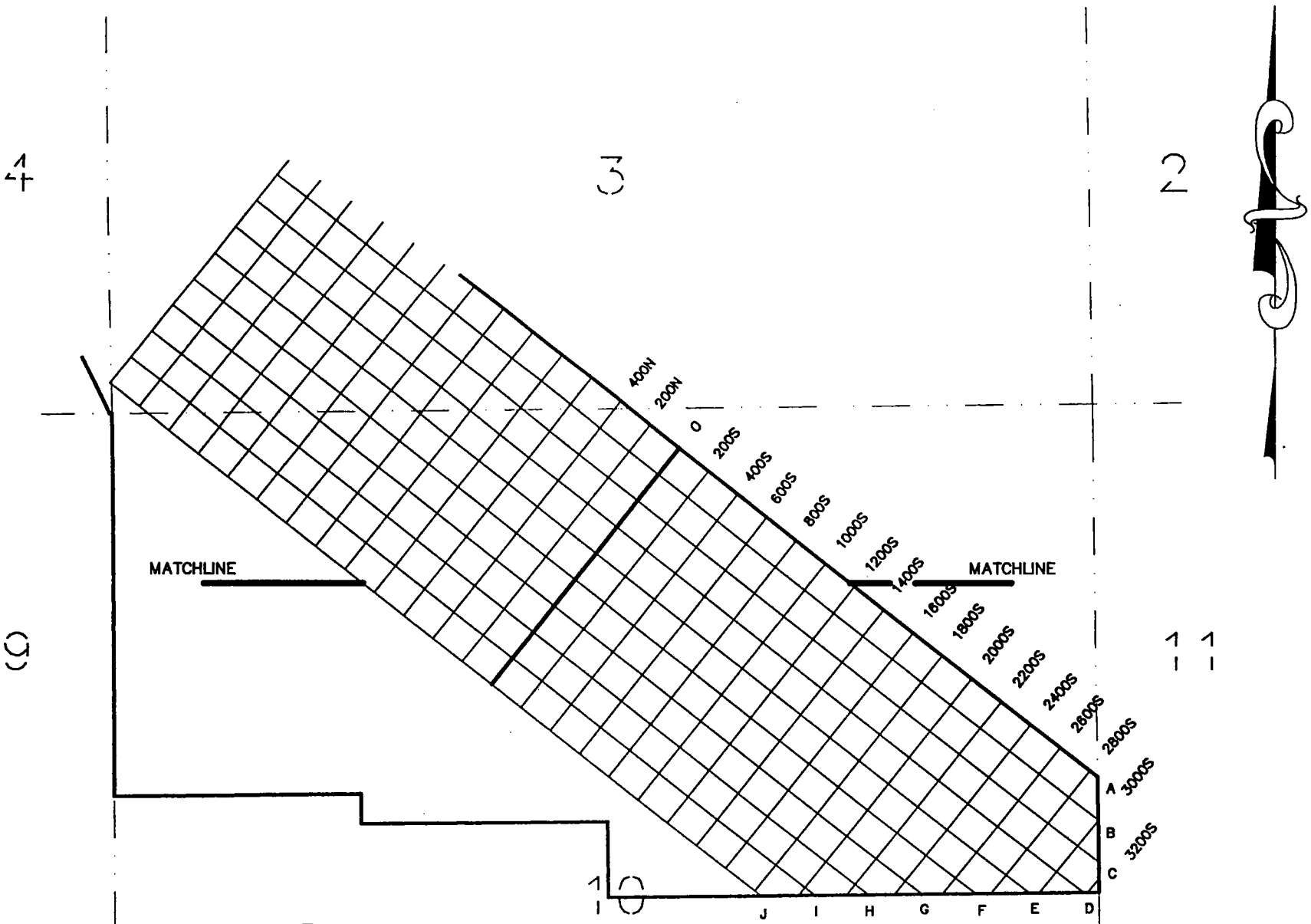
SHEET 1A OF 2 SHEETS

EXHIBIT B



GRAPHIC SCALE

(IN FEET)

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SHEET 2 OF 2 SHEETS

APPENDIX

PIGSEYE COORDINATES

Current Coordinate Listing (All)

Point	Northing	Easting	Elevation	Description
1	1037149.6690	2866639.8040	.	WSEC4
2	1037154.8140	2871837.2990	.	ESEC4
3	1037173.9420	2874465.9820	.	CSEC3
4	1037192.9400	2877094.2920	.	ESEC3
5	1034510.5710	2866698.8280	.	SWSEC4
6	1034508.7790	2869338.7790	.	SSEC4
7	1034526.4980	2871891.1560	.	SESEC4
8	1034553.4090	2874514.3070	.	SSEC3
9	1034580.0200	2877137.7670	.	SESEC3
10	1031897.4520	2871913.4410	.	WSEC10
11	1031922.9760	2874546.3050	.	CSEC10
12	1031948.5410	2877168.0200	.	ESEC10
13	1036537.5780	2866653.4940	.	MC1309
14	1034508.9560	2869079.3430	.	MC1311
15	1034508.2510	2870116.8290	.	MC1312
16	1034520.1440	2871273.3630	.	MC1313
17	1034522.0080	2871454.5320	.	MC1314
18	1034522.6770	2871519.6990	.	MC1315
19	1032303.6600	2875315.8870	.	SHORE
20	1032789.0720	2875076.8650	.	HILL
21	1034120.4443	2873852.0754	.	NOB
22	1034887.5820	2873037.6963	.	NOB
23	1034553.0082	2874514.6858	.	NOB
51	1032578.4994	2877160.7776	.	PROPCOR
52	1035276.9996	2873748.9458	.	PROPCOR
53	1035880.6098	2872865.4557	.	PROPCOR
54	1035995.1230	2872593.5886	.	PROPCOR
55	1035928.7910	2871165.1279	.	PROPCOR
56	1034839.9607	2871747.9429	.	PROPCOR
57	1034827.1964	2871732.5457	.	PROPCOR
58	1034526.3530	2871877.0647	.	PROPCOR
59	1032472.3345	2871908.5680	.	PROPCOR
60	1032485.4568	2873223.9355	.	PROPCOR
61	1032323.9105	2873225.6028	.	PROPCOR
62	1032336.6651	2874541.2727	.	PROPCOR

101	1032610.0329	2877120.9084	.	A2800S
102	1032734.1019	2876964.0426	.	A2600S
103	1032858.1709	2876807.1767	.	A2400S
104	1032982.2398	2876650.3109	.	A2200S
105	1033106.3088	2876493.4451	.	A2000S
106	1033230.3778	2876336.5793	.	A1800S
107	1033354.4468	2876179.7134	.	A1600S
108	1033478.5157	2876022.8476	.	A1400S
109	1033602.5847	2875865.9818	.	A1200S
110	1033726.6537	2875709.1159	.	A1000S
111	1033850.7227	2875552.2501	.	A800S
112	1033974.7916	2875395.3843	.	A600S
113	1034098.8606	2875238.5184	.	A400S
114	1034222.9296	2875081.6526	.	A200S
115	1034346.9986	2874924.7868	.	A00

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116	1034471.0675	2874767.9209	.	A200N
117	1034595.1365	2874611.0551	.	A400N
118	1034719.2055	2874454.1893	.	A600N
119	1034843.2745	2874297.3234	.	A800N
120	1034967.3434	2874140.4576	.	A1000N
121	1035091.4124	2873983.5918	.	A1200N
122	1035215.4814	2873826.7259	.	A1400N
123	1035334.0202	2873665.4861	.	A1600N
124	1035447.1200	2873499.9446	.	A1800N
125	1035560.2199	2873334.4030	.	A2000N
126	1035673.3197	2873168.8614	.	A2200N
127	1035786.4195	2873003.3198	.	A2400N
128	1035894.0800	2872833.4761	.	A2600N
129	1035974.6462	2872642.2029	.	A2800N
130	1035993.2476	2872553.2009	.	BN
131	1035942.7850	2872617.0030	.	B2800N
132	1035818.7160	2872773.8689	.	B2600N
133	1035694.6470	2872930.7347	.	B2400N
134	1035570.5780	2873087.6005	.	B2200N
135	1035446.5091	2873244.4664	.	B2000N
136	1035322.4401	2873401.3322	.	B1800N
137	1035198.3711	2873558.1980	.	B1600N
138	1035074.3021	2873715.0639	.	B1400N
139	1034950.2332	2873871.9297	.	B1200N
140	1034826.1642	2874028.7955	.	B1000N
141	1034702.0952	2874185.6614	.	B800N
142	1034578.0262	2874342.5272	.	B600N
143	1034453.9573	2874499.3930	.	B400N
144	1034329.8883	2874656.2589	.	B200N
145	1034205.8193	2874813.1247	.	B00
146	1034081.7503	2874969.9905	.	B200S
147	1033957.6814	2875126.8563	.	B400S
148	1033833.6124	2875283.7222	.	B600S
149	1033709.5434	2875440.5880	.	B800S
150	1033585.4744	2875597.4538	.	B1000S
151	1033461.4055	2875754.3197	.	B1200S
152	1033337.3365	2875911.1855	.	B1400S
153	1033213.2675	2876068.0513	.	B1600S
154	1033089.1985	2876224.9172	.	B1800S
155	1032965.1296	2876381.7830	.	B2000S
156	1032841.0606	2876538.6488	.	B2200S
157	1032716.9916	2876695.5147	.	B2400S
158	1032592.9226	2876852.3805	.	B2600S
159	1032468.8537	2877009.2463	.	B2800S
160	1032346.8980	2877163.4403	.	BS
161	1032115.2965	2877166.1029	.	CS

162	1032203.6054	2877054.4501	.	C3000S
163	1032327.6744	2876897.5843	.	C2800S
164	1032451.7434	2876740.7184	.	C2600S
165	1032575.8124	2876583.8526	.	C2400S
166	1032699.8813	2876426.9868	.	C2200S
167	1032823.9503	2876270.1209	.	C2000S
168	1032948.0193	2876113.2551	.	C1800S
169	1033072.0883	2875956.3893	.	C1600S
170	1033196.1572	2875799.5234	.	C1400S
171	1033320.2262	2875642.6576	.	C1200S
172	1033444.2952	2875485.7918	.	C1000S
173	1033568.3642	2875328.9259	.	C800S
174	1033692.4331	2875172.0601	.	C600S
175	1033816.5021	2875015.1943	.	C400S

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176	1033940.5711	2874858.3284	.	C200S
177	1034064.6401	2874701.4626	.	C00
178	1034188.7090	2874544.5968	.	C200N
179	1034312.7780	2874387.7309	.	C400N
180	1034436.8470	2874230.8651	.	C600N
181	1034560.9160	2874073.9993	.	C800N
182	1034684.9849	2873917.1334	.	C1000N
183	1034809.0539	2873760.2676	.	C1200N
184	1034933.1229	2873603.4018	.	C1400N
185	1035057.1919	2873446.5360	.	C1600N
186	1035181.2608	2873289.6701	.	C1800N
187	1035305.3298	2873132.8043	.	C2000N
188	1035429.3988	2872975.9385	.	C2200N
189	1035553.4678	2872819.0726	.	C2400N
190	1035677.5367	2872662.2068	.	C2600N
191	1035801.6057	2872505.3410	.	C2800N
192	1035925.6747	2872348.4751	.	C3000N
193	1035980.5209	2872279.1307	.	CN
194	1035967.7941	2872005.0605	.	DN
195	1035908.5644	2872079.9472	.	D3200N
196	1035784.4954	2872236.8130	.	D3000N
197	1035660.4265	2872393.6789	.	D2800N
198	1035536.3575	2872550.5447	.	D2600N
199	1035412.2885	2872707.4105	.	D2400N
200	1035288.2195	2872864.2764	.	D2200N
201	1035164.1506	2873021.1422	.	D2000N
202	1035040.0816	2873178.0080	.	D1800N
203	1034916.0126	2873334.8739	.	D1600N
204	1034791.9436	2873491.7397	.	D1400N
205	1034667.8747	2873648.6055	.	D1200N
206	1034546.1072	2873802.5615	.	D1000N
207	1034419.7367	2873962.3372	.	D800N
208	1034295.6677	2874119.2030	.	D600N
209	1034171.5988	2874276.0689	.	D400N
210	1034047.5298	2874432.9347	.	D200N
211	1033923.4608	2874589.8005	.	D00
212	1033799.3918	2874746.6664	.	D200S
213	1033675.3229	2874903.5322	.	D400S
214	1033551.2539	2875060.3980	.	D600S
215	1033427.1849	2875217.2639	.	D800S
216	1033303.1159	2875374.1297	.	D1000S
217	1033179.0470	2875530.9955	.	D1200S
218	1033054.9780	2875687.8614	.	D1400S
219	1032930.9090	2875844.7272	.	D1600S
220	1032806.8400	2876001.5930	.	D1800S
221	1032682.7711	2876158.4588	.	D2000S

222	1032558.7021	2876315.3247	.	D2200S
223	1032434.6331	2876472.1905	.	D2400S
224	1032310.5641	2876629.0563	.	D2600S
225	1032186.4952	2876785.9222	.	D2800S
226	1032062.4262	2876942.7880	.	D3000S
227	1031947.7584	2877087.7675	.	DS
228	1031944.9635	2876801.1401	.	ES
229	1032045.3159	2876674.2601	.	E2800S
230	1032169.3849	2876517.3943	.	E2600S
231	1032293.4539	2876360.5284	.	E2400S
232	1032417.5228	2876203.6626	.	E2200S
233	1032541.5918	2876046.7968	.	E2000S
234	1032665.6608	2875889.9309	.	E1800S
235	1032789.7298	2875733.0651	.	E1600S

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236	1032913.7987	2875576.1993	.	E1400S
237	1033037.8677	2875419.3334	.	E1200S
238	1033161.9367	2875262.4676	.	E1000S
239	1033286.0057	2875105.6018	.	E800S
240	1033410.0746	2874948.7359	.	E600S
241	1033534.1436	2874791.8701	.	E400S
242	1033658.2126	2874635.0043	.	E200S
243	1033782.2816	2874478.1385	.	E00
244	1033906.3505	2874321.2726	.	E200N
245	1034030.4195	2874164.4068	.	E400N
246	1034154.4885	2874007.5410	.	E600N
247	1034278.5575	2873850.6751	.	E800N
248	1034402.6264	2873693.8093	.	E1000N
249	1034526.6954	2873536.9435	.	E1200N
250	1034650.7644	2873380.0776	.	E1400N
251	1034774.8334	2873223.2118	.	E1600N
252	1034898.9023	2873066.3460	.	E1800N
253	1035022.9713	2872909.4801	.	E2000N
254	1035147.0403	2872752.6143	.	E2200N
255	1035271.1093	2872595.7485	.	E2400N
256	1035395.1782	2872438.8826	.	E2600N
257	1035519.2472	2872282.0168	.	E2800N
258	1035643.3162	2872125.1510	.	E3000N
259	1035767.3852	2871968.2851	.	E3200N
260	1035891.4542	2871811.4193	.	E3400N
261	1035955.0674	2871730.9903	.	EN
262	1035942.3407	2871456.9200	.	FN
263	1035874.3439	2871542.8914	.	F3600N
264	1035750.2749	2871699.7572	.	F3400N
265	1035626.2059	2871856.6231	.	F3200N
266	1035502.1370	2872013.4889	.	F3000N
267	1035378.0680	2872170.3547	.	F2800N
268	1035253.9990	2872327.2206	.	F2600N
269	1035129.9300	2872484.0864	.	F2400N
270	1035005.8610	2872640.9522	.	F2200N
271	1034881.7921	2872797.8181	.	F2000N
272	1034757.7231	2872954.6839	.	F1800N
273	1034633.6541	2873111.5497	.	F1600N
274	1034509.5851	2873268.4155	.	F1400N
275	1034385.5162	2873425.2814	.	F1200N
276	1034261.4472	2873582.1472	.	F1000N
277	1034137.3782	2873739.0130	.	F800N
278	1034013.3092	2873895.8789	.	F600N
279	1033889.2403	2874052.7447	.	F400N
280	1033765.1713	2874209.6105	.	F200N
281	1033641.1023	2874366.4764	.	F00

282	1033517.0333	2874523.3422	.	F200S
283	1033392.9644	2874680.2080	.	F400S
284	1033268.8954	2874837.0739	.	F600S
285	1033144.8264	2874993.9397	.	F800S
286	1033020.7574	2875150.8055	.	F1000S
287	1032896.6885	2875307.6714	.	F1200S
288	1032772.6195	2875464.5372	.	F1400S
289	1032648.5505	2875621.4030	.	F1600S
290	1032524.4815	2875778.2689	.	F1800S
291	1032400.4126	2875935.1347	.	F2000S
292	1032276.3436	2876092.0005	.	F2200S
293	1032152.2746	2876248.8664	.	F2400S
294	1032028.2056	2876405.7322	.	F2600S
295	1031942.1685	2876514.5127	.	FS

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296	1031939.3735	2876227.8853	.	GS
297	1032011.0954	2876137.2043	.	G2400S
298	1032135.1643	2875980.3384	.	G2200S
299	1032259.2333	2875823.4726	.	G2000S
300	1032383.3023	2875666.6068	.	G1800S
301	1032507.3713	2875509.7410	.	G1600S
302	1032631.4402	2875352.8751	.	G1400S
303	1032755.5092	2875196.0093	.	G1200S
304	1032879.5782	2875039.1435	.	G1000S
305	1033003.6472	2874882.2776	.	G800S
306	1033127.7161	2874725.4118	.	G600S
307	1033251.7851	2874568.5460	.	G400S
308	1033375.8541	2874411.6801	.	G200S
309	1033499.9231	2874254.8143	.	G00
310	1033623.9920	2874097.9485	.	G200N
311	1033748.0610	2873941.0826	.	G400N
312	1033872.1300	2873784.2168	.	G600N
313	1033996.1990	2873627.3510	.	G800N
314	1034120.2679	2873470.4851	.	G1000N
315	1034244.3369	2873313.6193	.	G1200N
316	1034368.4059	2873156.7535	.	G1400N
317	1034492.4749	2872999.8876	.	G1600N
318	1034616.5438	2872843.0218	.	G1800N
319	1034740.6128	2872686.1560	.	G2000N
320	1034864.6818	2872529.2901	.	G2200N
321	1034988.7508	2872372.4243	.	G2400N
322	1035112.8198	2872215.5585	.	G2600N
323	1035236.8887	2872058.6926	.	G2800N
324	1035360.9577	2871901.8268	.	G3000N
325	1035485.0267	2871744.9610	.	G3200N
326	1035609.0957	2871588.0951	.	G3400N
327	1035733.1646	2871431.2293	.	G3600N
328	1035857.2336	2871274.3635	.	G3800N
329	1035929.6140	2871182.8498	.	GN
330	1035556.5411	2871364.3810	.	HN
331	1035467.9164	2871476.4331	.	H3400N
332	1035343.8474	2871633.2989	.	H3200N
333	1035219.7785	2871790.1647	.	H3000N
334	1035095.7095	2871947.0306	.	H2800N
335	1034971.6405	2872103.8964	.	H2600N
336	1034847.5715	2872260.7622	.	H2400N
337	1034723.5026	2872417.6281	.	H2200N
338	1034599.4336	2872574.4939	.	H2000N
339	1034475.3646	2872731.3597	.	H1800N
340	1034351.2956	2872888.2256	.	H1600N
341	1034227.2266	2873045.0914	.	H1400N

342	1034103.1577	2873201.9572	.	H1200N
343	1033979.0887	2873358.8231	.	H1000N
344	1033855.0197	2873515.6889	.	H800N
345	1033730.9507	2873672.5547	.	H600N
346	1033606.8818	2873829.4206	.	H400N
347	1033482.8128	2873986.2864	.	H200N
348	1033358.7438	2874143.1522	.	H00
349	1033234.6748	2874300.0180	.	H200S
350	1033110.6059	2874456.8839	.	H400S
351	1032986.5369	2874613.7497	.	H600S
352	1032862.4679	2874770.6155	.	H800S
353	1032738.3989	2874927.4814	.	H1000S
354	1032614.3300	2875084.3472	.	H1200S
355	1032490.2610	2875241.2130	.	H1400S

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356	1032366.1920	2875398.0789	.	H1600S
357	1032242.1230	2875554.9447	.	H1800S
358	1032118.0541	2875711.8105	.	H2000S
359	1031993.9851	2875868.6764	.	H2200S
360	1031936.5785	2875941.2580	.	HS
361	1031933.7836	2875654.6306	.	IS
362	1031976.8748	2875600.1485	.	I2000S
363	1032100.9438	2875443.2826	.	I1800S
364	1032225.0128	2875286.4168	.	I1600S
365	1032349.0817	2875129.5510	.	I1400S
366	1032473.1507	2874972.6851	.	I1200S
367	1032597.2197	2874815.8193	.	I1000S
368	1032721.2887	2874658.9535	.	I800S
369	1032845.3576	2874502.0876	.	I600S
370	1032969.4266	2874345.2218	.	I400S
371	1033093.4956	2874188.3560	.	I200S
372	1033217.5646	2874031.4901	.	I00
373	1033341.6335	2873874.6243	.	I200N
374	1033465.7025	2873717.7585	.	I400N
375	1033589.7715	2873560.8926	.	I600N
376	1033713.8405	2873404.0268	.	I800N
377	1033837.9094	2873247.1610	.	I1000N
378	1033961.9784	2873090.2951	.	I1200N
379	1034086.0474	2872933.4293	.	I1400N
380	1034210.1164	2872776.5635	.	I1600N
381	1034334.1854	2872619.6976	.	I1800N
382	1034458.2543	2872462.8318	.	I2000N
383	1034582.3233	2872305.9660	.	I2200N
384	1034706.3923	2872149.1002	.	I2400N
385	1034830.4613	2871992.2343	.	I2600N
386	1034954.5302	2871835.3685	.	I2800N
387	1035078.5992	2871678.5027	.	I3000N
388	1035158.5566	2871577.4090	.	IN
389	1034793.5920	2871748.6886	.	JN
390	1034689.2820	2871880.5722	.	J2600N
391	1034565.2130	2872037.4381	.	J2400N
392	1034441.1441	2872194.3039	.	J2200N
393	1034317.0751	2872351.1697	.	J2000N
394	1034193.0061	2872508.0356	.	J1800N
395	1034068.9371	2872664.9014	.	J1600N
396	1033944.8682	2872821.7672	.	J1400N
397	1033820.7992	2872978.6331	.	J1200N
398	1033696.7302	2873135.4989	.	J1000N
399	1033572.6612	2873292.3647	.	J800N
400	1033448.5922	2873449.2306	.	J600N
401	1033324.5233	2873606.0964	.	J400N

402	1033200.4543	2873762.9622	.	J200N
403	1033076.3853	2873919.8281	.	J00
404	1032952.3163	2874076.6939	.	J200S
405	1032828.2474	2874233.5597	.	J400S
406	1032704.1784	2874390.4256	.	J600S
407	1032580.1094	2874547.2914	.	J800S
408	1032456.0404	2874704.1572	.	J1000S
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411	1032083.8335	2875174.7547	.	J1600S
412	1031959.7645	2875331.6205	.	J1800S
413	1031930.9886	2875368.0032	.	JS
420	1035747.3090	2871700.7173	.	FD.MK7
421	1035484.1773	2871738.9926	.	FD.MK9

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422	1035363.5762	2871897.1511	.	FD.MK10
423	1035091.9102	2871801.1695	.	F.10
424	1035135.2357	2871834.1880	.	F.15
425	1035175.8768	2871862.1146	.	F.20
426	1035220.7147	2871891.9589	.	F.25
427	1035266.2350	2871914.4762	.	F.30
428	1035309.0169	2871939.8793	.	F.35
429	1035350.9282	2871966.2463	.	F.40
430	1035388.1975	2871990.3534	.	F.45
431	1035438.4334	2872011.2361	.	F.50
432	1035455.0910	2872014.1964	.	F.55
433	1035480.8595	2872025.0369	.	F.55
434	1035536.0328	2872046.9384	.	F.60
435	1035576.4227	2872062.5023	.	F.65
436	1035634.2720	2872087.1660	.	F.70
437	1035733.9078	2872129.8834	.	F.80
438	1035836.5716	2872163.7843	.	F.90
439	1035897.6657	2872180.4124	.	F.95
440	1035951.5459	2872198.6474	.	F.100
441	1036003.4574	2872213.8721	.	F.105
442	1036046.2614	2872217.1973	.	F.115
443	1035588.3661	2871539.9287	.	0
444	1035587.2590	2871585.8196	.	5
445	1035578.4833	2871630.7201	.	10
446	1035566.8929	2871674.8031	.	15
447	1035552.1764	2871716.6837	.	20
448	1035536.2297	2871759.7029	.	25
449	1035517.3304	2871799.9601	.	30
450	1035502.7505	2871843.4775	.	35
451	1035491.8870	2871886.0110	.	40
452	1035477.0900	2871929.2573	.	45
453	1035462.6295	2871968.8010	.	50
454	1035446.7735	2872057.5735	.	60
455	1035435.4195	2872100.8943	.	65
456	1035426.9441	2872148.3412	.	70
457	1035411.5004	2872190.6059	.	75
458	1035402.7161	2872230.5575	.	80
459	1035388.0101	2872271.5459	.	85
460	1036000.2421	2871384.6232	.	FD.MK4
461	1035761.8106	2871971.6315	.	FD.MK8
462	1036032.7580	2871921.6012	.	FD.MK5
463	1036279.2256	2871610.7899	.	FD.MK1
464	1036158.2396	2871768.7185	.	FD.MK2
465	1036293.2249	2871869.1038	.	3600
466	1036174.7726	2872029.9002	.	FD.MK3
467	1036051.1531	2872187.8185	.	FD.MK6

468	1035939.8561	2872724.1671	.	F830
469	1035900.7537	2872812.6717	.	F820
470	1035859.7391	2872892.6471	.	F810
471	1035801.0962	2872979.9266	.	F800
472	1035754.5013	2873056.9127	.	F790
473	1035697.8785	2873139.3325	.	F780
474	1035635.3682	2873228.0778	.	F770
475	1035575.4300	2873315.2766	.	F760

APPENDIX B

GEOPHYSICAL SURVEY REPORT

Report on the Electromagnetic Survey Conducted

at the

Pig's Eye Landfill
Saint Paul, Minnesota

for

PRC Environmental Management, INC.
St. Paul, Minnesota

by

Fromm Applied Technology
Mequon, Wisconsin
April 20, 1994

ABSTRACT

An electromagnetic survey was conducted at the abandoned Pig's Eye Landfill in Saint Paul, Minnesota. The survey was conducted to determine the extent of the landfill material. The visible fill boundary along the western, southern, and eastern extents was confirmed by the EM31 survey. With the exception of a few isolated regions, the remaining portion of the site was bound by roads, which may have been constructed after the landfill operations had ceased.

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INTRODUCTION

Background

During the period of March 28 through April 2, 1994, an electromagnetic survey was conducted at the Pig's Eye Landfill, St. Paul, Minnesota. Portions of the site are known to have been previously marshy low lands, which were later used as a depository for municipal landfill material. The unconsolidated surface material was thought to consist of fine sedimet, sand and gravel, and organic deposits of Slackwater origin.

Objectives

The objective of the electromagnetic survey was to map subsurface apparent electrical conductivities and to differentiate zones of high conductivity from zones of low conductivity. It was anticipated that the conductivity of the native soils would differ significantly from the conductivity of the landfill material. Hence, the extent of landfill operations would be defined by electrical conductivity X-Y plots and contour maps. The objectives of the survey did not include characterizing the fill material, such as, the presence of buried metal. However, comments are provided on several of the anomalous zones within the interior of the landfill. Characterizing the fill material would have required transect lines much closer together than the spacing used in this survey and was considered outside the scope of this study.

INSTRUMENTATION AND THEORY

The electromagnetic survey employed a Geonics' EM31 conductivity system. The EM31 system was operated in the vertical dipole mode and all measurements were electronically stored on the attached data logger. A brief introduction to electromagnetic theory is presented in **Appendix A: Overview of Electromagnetic Surveys**.

METHODOLOGY

The rectangular coordinate system referenced at the site was established by a subcontractor hired by PRC Environmental Management, Inc. During data acquisition, portions of the grid system were extrapolated out to the furthest accessible areas of the site. The local coordinate system, measured in distance north and east, was established with the local north pointing approximately 52 degrees west of magnetic north. This local north direction paralleled a large set of railroad tracks that trended 52 degrees west of magnetic north. **In this report, only the local coordinate system is referenced.** The X-axis is measured in distance east and extends from approximately -900 East to approximately 1800 East. The Y-axis is measured in distance north and extends from -2000 North to 4120 North.

An additional temporary labeling system was also established by the land surveyors. The temporary labels are not used in this report, but are mentioned, to reduce the possibility of confusion for the reader with regards to data presented in other reports pertaining to this project. Coordinates representing distance north are consistent with both labeling systems. However, the labeling of distance east requires clarification. The following list should provide a clear conversion between the two systems: 1980E and 1800E have no alternate labels, 1620E=Line A for most of the site, 1440E=Line B, 1260E=Line C, 1080E=Line D, 900E=Line E, 720E=Line F, 540E=Line G, 360E=Line H, 180E=Line I, 0E=Line J, -180E=Line K, -360E=Line L, -540E=Line M, and -720E=Line N.

With respect to the local coordinate system, the finalized survey area was generally bound to the west by the present day Pig's Eye Lake Road, to the east by a water channel and an unnamed local road, which is reference as "Soo Road," to the north at a point where Pig's Eye Lake Road and "Soo Road" converge together, and to the south by water.

With the exception of the area south of a line cutting across the site from approximately -640E 610N to 1780E 1960N, readings were obtained on formally gridded transect lines that started or ended with expected fill conditions, roadways, railroad tracks, or bodies of water. The west and north regions of the site north of 610N were geophysically surveyed on transect lines spaced 90 feet apart. These transect lines started with 610N and incremented by 90 feet to 4120N. Along the boundary of the east side of the site from 1960N to 2860N transect lines were spaced 180 feet apart, which was based on site conditions and previously acquired data. The land survey stakes were used to place these transect lines. Readings were recorded at stations spaced approximately 10 feet apart on each transect.

Due to site conditions and apparently obvious fill boundaries in the southern portion of the site, transect lines were strategically placed to confirm fill and non-fill conditions. In contrast with the northern portion of the site where the fill boundaries were not clearly visible, the approach used to survey the southern portion assumed the rapid change in topography represented the landfill boundary. Hence, data collected along the expected fill boundary should indicate fill whereas data collected adjacent to the expected fill boundary should indicate non-fill conditions. A map for the southern portion of the site is presented in **Figure 1: Pig's Eye Landfill--Approximate Locations of Informal Transect Lines,** which incorporates two scanned photographs obtained from the nearby sewer treatment plant. The location of the informally placed transect lines are shown in this figure and are color coded. Along the five transect lines a flag was placed every tenth station. With the exception of LINE BPERM1, the distance between the stations was approximately ten feet. The station spacing on LINE BPERM1 varied in an effort to mirror the position of each station on LINE APERM1 from station 20 to station 100, which is located on the east side of Battle Creek. An accurate position for each flagged station can be obtained from the land survey.

At each EM31 station both conductivity and inphase measurements were obtained. The site contained many surface features near the wood chipping facility, from approximately 1510N to about 2140N, that were potential sources of cultural interference. The EM31 survey was conducted with the intent of methodologies defined in the Department of Energy document DOE/HWP-100, Geophysical SOPS, attached as **Appendix B**.

Geophysical Assumptions

In a geophysical site characterization like the one performed at the Pig's Eye Landfill, it was understood from the beginning that no one method would clearly answer all the questions about the site. However, as an initial cost effective approach focused on delineating the boundary of the approximately 320 acre landfill site, it was determined with a high level of confidence that EM31 measurements would delineate the boundaries of the fill areas, assuming minimal cultural interference (i.e. buildings, railroad tracks, and buried utilities).

This decision was based on the assumption that a detectable electrical contrast exists between non-fill areas and low land areas now containing fill material. In addition, buried metal is assumed to be near the surface, approximately less than ten feet, considered a component of the fill material, and large enough for the EM31 to detect. The lack of detectable buried metal and the electrical contrast of the fill with non-fill conditions should yield desirable results.

It is worth noting the methodology used in presenting the isopleth maps. In each of the isopleth plots, one will note areas have been "blanked out." This minimizes the effect of computer extrapolated contour lines that extend into unsurveyed areas. Areas that have

questionable validity are not intentionally addressed in this report. Computer extrapolated areas were blanked out to the extent possible and any remaining non-blanked areas can be found by determining where contour lines may have extended beyond surveyed areas. Generally, the extent of the contours in each map represents the boundaries of the acquired data. Because contouring may distort the field data **the location and extent of any anomaly should be substantiated by referencing the original data set** (see appendices).

RESULTS

Transect Lines

The contoured EM31 data is tabulated by station location and attached as **Appendix D:Pig's Eye Landfill -- EM31 Data**. Data presented in X-Y plots is posted in each diagram and is not presented in a table, as shown in **Figure 2:Pig's Eye Landfill--Transect ASWMP1 Apparent Conductivity (East to West on 200S)**. The location of this transect line is shown in blue in Figure 1.

Transect line ASWMP1 started at the edge of Battle Creek and followed the 200S line until the present day Pig's Eye Lake Road was reached. It was anticipated that this transect started in fill material and ended in non-fill conditions. The visible edge of the landfill was at approximately station 27. A drainage ditch was noted at station 35 and two 6 to 12 inch pipes crossed the transect at station 66. The inphase response for this transect line is shown in **Figure 3:Pig's Eye Landfill--Transect ASWMP1 Inphase Response (East to West on 200S)**.

On line ASWMP1 the conductivity and inphase data exhibits an erratic behavior for approximately the first 35 stations. Stations 35 to 40 appear to be a transitional zone from

readings that vary from station to station to a zone that is relatively quite and steady. With the exception of the anomaly associated with station 66, the data appears to decrease in conductivity from about 27 millimhos per meter (mmhos/m) to approximately 20 mmhos/m from station 40 to station 78. The increase in conductivity at station 80 with the rapid decrease towards the end of the transect is thought to be associated with the construction of the more recently constructed Pig's Eye Lake Road. For the first 35 stations, the same erratic behavior is noted in the inphase response as seen in Figure 3. Then, the inphase response decreases from about 3 parts per thousand (ppt) at station 40 to approximately -2 ppt at the end of the transect. Assuming the landfill boundary is in the vicinity of station 27, an initial interpretation of the EM data suggests that data collected from within the fill material will vary rapidly from station to station while data collected from outside the fill area will remain relatively constant.

The location of line BSWMP1 is shown in Figure 1 as a light blue line and the data is plotted in **Figure 4:Pig's Eye Landfill--Transect BSWMP1 Apparent Conductivity (Follows Edge of Berm)**. This transect started at the point where the remnants of the old Pig's Eye Lake Road and 400N intersect. The transect followed the edge of the lagoon and reached the northern most extent at approximately station 37. The transect continued southward crossing 600N at station 44, 400N at station 63, 200N at station 83, and station 25 on line ASWMP1, which is 200S, at station 126 on transect BSWMP1. The southern most extent of the transect was approximately station 147. From station 147 the transect headed towards the north and eventually ended at the point where the west shore line of Battle Creek and 200S intersect. It was anticipated that this line started outside of fill material and ended in fill conditions. The inphase response for this transect line is shown in **Figure 5:Pig's Eye Landfill--Transect BSWMP1 Inphase Response (Follows Edge of Berm)**.

In Figure 4, the conductivities vary but are generally stable from stations 0 to 20. From stations 21 to 33 the conductivities increase quickly and from stations 34 to 160 the readings are unstable and vary greatly. From station 160 to the end of the line, the conductivities are stable at approximately 35 mmhos/m. The inphase response, Figure 5, is relatively stable for the first 25 stations. From station 26 to the end of the line measurements are unstable and vary greatly from station to station. Apparently the transect entered a fill area near station 26 and essentially remained in fill material thereafter.

The location of line BPERM1 is shown in Figure 1 as a light red line and the conductivity data is plotted in **Figure 6:Pig's Eye Landfill--Transect BPERM1 Apparent Conductivity (Follows West Side of Battle Creek)**. This transect line mirrors the transect line APERM1 from stations 20 to 100 on the west side of Battle Creek, which was assumed to be clear of fill material. The inphase response for this transect line is shown in **Figure 5:Pig's Eye Landfill--Transect BSWMP1 Inphase Response (Follows Edge of Berm)**. The signatures seen in Figures 6 and 7 are interpreted to represent the average variance expected to be seen in an area adjacent to fill. The slight variances and elevated measurements seen in Figures 6 and 7 from station 30 to about station 65 is thought to be associated with the narrowing of the river channel, which allowed measurements to be obtained relatively close to substantial amounts of fill material.

The location of line APERM1 is shown in Figure 1 as a red line and the data is plotted in four segments: **Figure 8:Pig's Eye Landfill--Transect APERM1 Apparent Conductivity (Follows Edge of Berm Stations 0 to 100), Figure 9:Pig's Eye Landfill--Transect APERM1 Apparent Conductivity (Follows Edge of Berm Stations 100 to**

210), Figure 10:Pig's Eye Landfill--Transect APERM1 Apparent Conductivity (Follows Edge of Berm Stations 210 to 326), and Figure 11:Pig's Eye Landfill--Transect APERM1 Apparent Conductivity (Follows Edge of Berm Stations 326 to 679). This transect line starts at 0E 200S at the edge of fill and follows within approximately 50 feet from the visible outline, which was typically bounded by water. Portions of the transect can not be followed in Figure 1 because the aerial photographs did extend far enough towards the southeast. However, the following stations and land coordinates describe the general path: station 17 at -100E 400S, station 36 at -200E 600S, station 53 -250E 800S, station 72 at -340E 1000S, station 87 at -400E 1200S, station 110 at -360E 1340S, station 121 at -75E 1400S, station 130 at 0E 1490S, station 168 at 360E 2100S, station 200 at 720E 1800S, station 221 at 800E 1600S, station 263 at 820E 1200S, station 270 at 900E 1220S, station 357 at 1260E 2000S, station 392 at 1620E 1970S, station 408 at 1620E 1800S, station 426 at 1620E 1600S, station 444 at 1620E 1400S, station 498 at 1620E 800S, station 665 at 1620E 1000N, and station 676(the end of the line) at 1620E and the south side of Battle Creek. The inphase response for this transect line is shown in **Figure 12:Pig's Eye Landfill--Transect APERM1 Inphase Response (Follows Edge of Berm Stations 0 to 100), Figure 13:Pig's Eye Landfill--Transect APERM1 Inphase Response (Follows Edge of Berm Stations 100 to 210), Figure 14:Pig's Eye Landfill--Transect APERM1 Inphase Response (Follows Edge of Berm Stations 210 to 326), and Figure 15:Pig's Eye Landfill--Transect APERM1 Inphase Response (Follows Edge of Berm Stations 326 to 679)**.

The electromagnetic response, seen in Figures 8 through 15, does not cluster around any particularly stable range of values. Thus, confirming the presence of fill material. Approximately the last ten stations in Figure 15 are starting to approach a more stable state. Considering that the data collected for Figures 8 and 9 was obtained from the east

side of Battle Creek and the data collected from Figures 6 and 7 was recorded along the same positions as Figures 8 and 9, but on the west side of Battle Creek, would imply that background or non-fill conditions should resemble the data presented in Figures 6 and 7, which is expected.

Contour Plots

For the region north of 610N, color coded contour maps of the measured electrical conductivities are presented. In the figures representing apparent conductivities, the green contour lines represent conductivities of 10 millimhos per meter (mmhos/m) or less, the blue contour lines represent conductivities between 15 and 40 mmhos/m, and the red contour lines are for conductivities greater than or equal to 45 mmhos/m. Grouping **Figure 16: Pig's Eye Landfill--Contour Plot of Conductivities From 610N to 1780N (West Side)**, **Figure 17: Pig's Eye Landfill--Contour Plot of Conductivities From 1780N to 2950N (West Side)**, and **Figure 18: Pig's Eye Landfill--Contour Plot of Conductivities From 2950N to 4120N** together leads to the following results.

The interior of the landfill area is characterized by a central zone of high conductivities, the red lines in Figures 16, 17, and 18. In areas that extend beyond fill conditions, the high conductivity central zone is bordered by a zone of intermediate conductivities, the blue contour lines in Figures 16, 17, and 18. Intermediate values from 35 to 45 mmhos/m are interpreted to represent a transition between fill and non-fill conditions. Strong electromagnetic indications of buried metal, negative trending conductivities, have been contoured in green. The northern and southern extent of anomalies indicating buried metal can not be determine because of the large spacing between transect lines. However, all of the anomalies contoured in green are thought to be associated with buried metal.

The change in conductivities from background values of approximately 45 millimhos per meter or less to interior landfill values well above 50 millimhos per meter is a large increase. The material represented by contour lines greater than 50 millimhos per meter differs significantly from the material outside of the interpreted landfill boundary. The high values of conductivity observed within the landfill are interpreted to result from an increase in clay, the possible presence of contaminated water, changes in fill thickness, and/or the presence of metal in the fill material. It is not possible, on the basis of the conductivities alone, to isolate the individual contributions of the above effects. However, the areas contoured in red, in Figures 16, 17, and 18, should represent most of the significant landfill activity. The highest conductivities recorded at the site were in the vicinity of -440E 1600N with a radius of 150 feet.

Color coded contour maps of the measured inphase response were generated for the same regions as the conductivity data. In these figures, representing the inphase response, the green contour lines represent inphase values of -12 parts per thousand (ppt) or less, the blue contour lines represent inphase values between -9 and 6 ppt, and the red contour lines are for inphase values greater than or equal to 12 ppt. Combining **Figure 19: Pig's Eye Landfill--Contour Plot of Inphase Response From 610N to 1780N (West Side)**, **Figure 20: Pig's Eye Landfill--Contour Plot of Inphase Response From 1780N to 2950N (West Side)**, and **Figure 21: Pig's Eye Landfill--Contour Plot of Inphase Response From 2950N to 4120N** together leads to the following results.

The inphase values, measured in parts per thousand directly from the instrument, are derived by a comparison of the primary and induced electromagnetic fields as outlined in **Appendix A**. These measurements can be of value in detecting metal and serve as general quality control. In the presence of metal, the inphase response is normally associated with values abnormally above or below background values. Outside of the landfill, the

background inphase response for the site is interpreted to approach -3 ppt. Within the landfill area outlined by the electrical conductivity, Figures 16, 17, and 18, the inphase response is often greater than -3 ppt. This suggests the presence of buried metal throughout the major portion of the site. Due to the composition of the fill material, the inphase results did not yield as clear of an interpretation of the fill boundary as one would expect. However, it appears to support the interpretation presented for the conductivities.

East Side of the Site

The area north of 1960N to 2860N from 1440E to "Soo Road," on the east side of the site, was surveyed slightly different than the previously described results. Initially along the north side of the site, ground control was not established east of 1620E. Thus, a transect line, labeled DPERM1, was established that followed the land survey from 1620E and the north side of Battle Creek to 1470E 2860N. This line was intended to be a continuation of Line APERM1. The results of the EM survey conducted along DPERM1 are shown in **Figure 22: Pig's Eye Landfill--Transect DPERM1 Apparent Conductivity (Follows Edge of Berm Station 689 to 840)** and **Figure 23: Pig's Eye Landfill--Transect DPERM1 Inphase Response (Follows Edge of Berm Station 689 to 840)**. Other than the first six stations at the beginning of transect line potentially indicating non-fill conditions, the entire transect appears to confirm the presence of fill.

Towards the end of the geophysical survey, the data for this transect line and the site conditions for this region were evaluated. Considering wetlands existed between the fill area and "Soo Road," transect line DPERM1 confirmed the presence of fill, and elevations increased rapidly towards the fill material, additional transect lines were placed 180 feet apart from 1960N to 2860N. For this region color coded contour maps of the measured electrical conductivities and inphase response are presented. The color coding used in

these figures is the same as Figures 16 through 21. The results are shown in **Figure 24: Pig's Eye Landfill--Contour Plot of Conductivities From 1960N to 2860N (East Side)** and **Figure 25: Pig's Eye Landfill--Contour Plot of Inphase Response From 1960N to 2860N (East Side)**. Other than a small region towards the northeast corner of this plot, colored in blue, it appears that the entire area electromagnetically surveyed is indicating the presence of fill. The inphase response is relatively low and provides no additional information.

Conclusions

The intent of the survey was to define the landfill's boundary. It is apparent from the data that the conductivities of the fill material vary greatly. This erratic behavior is predominate within the fill material. The signature of the EM data for the non-fill areas maintains a relatively constant value between 20 and 45 mmhos/m without large deviations between stations. In general, it appears that conductivities less than 45 mmhos/m are indicating non-fill conditions. The transition from 35 to 45 mmhos/m may contain a certain amount of fill material. Thus, the bulk of the landfill is interpreted to be characterized by the region containing rapidly varying conductivities and/or values greater than or equal to 45 mmhos/m.

With the exception of a few isolated areas, nearly the entire surveyed area appears to be covered with fill material. An interpretation of the electromagnetic data strongly agrees with the visible limits of the fill boundary for the region south of a line cutting across the site from approximately -640E 610N to 1780E 1960N. For the region north of this dividing line, the roadways appear coincident with the fill boundaries. However, the construction of the roads may have inhibited the detection of fill material that may have extended beyond the electromagnetically detected limits.

Four anomalous zones were identified. These zones appeared as small pockets of non-fill, which contradicted the analysis that fill extended out to the roadways. These zones are colored in blue, seen in Figures 16 through 18, and are approximately located 1) southwest of a line extending from -450E 880N to -340E 610N (east of this area is thought to be transitional), 2) centered at -60E 2500N with a radius of approximately 100 feet, 3) 480E 3310N with a radius of approximately 150 feet, and 4) approximately a 50 foot wide strip starting at 1460E 3220N and ending a 860E 3940N. The northwest end of anomaly 4) opens up into an approximately 100 foot diameter anomaly. In addition, anomaly 4) may extend down to 1720E 2680N, on the basis of Figure 24.

As with any geophysical interpretation, the assumptions used to analyze the data are often based on known site conditions. As the site becomes physically better defined, a more accurate correlation between the geophysical data and the site may be derived. Hence, geophysical data should be compared to known site conditions. An investigation of the source material should be accomplished by excavation. Drilling should be avoided due to the relatively small diameter of a drill bit possibly missing the presence of fill material.

QUALITY CONTROL

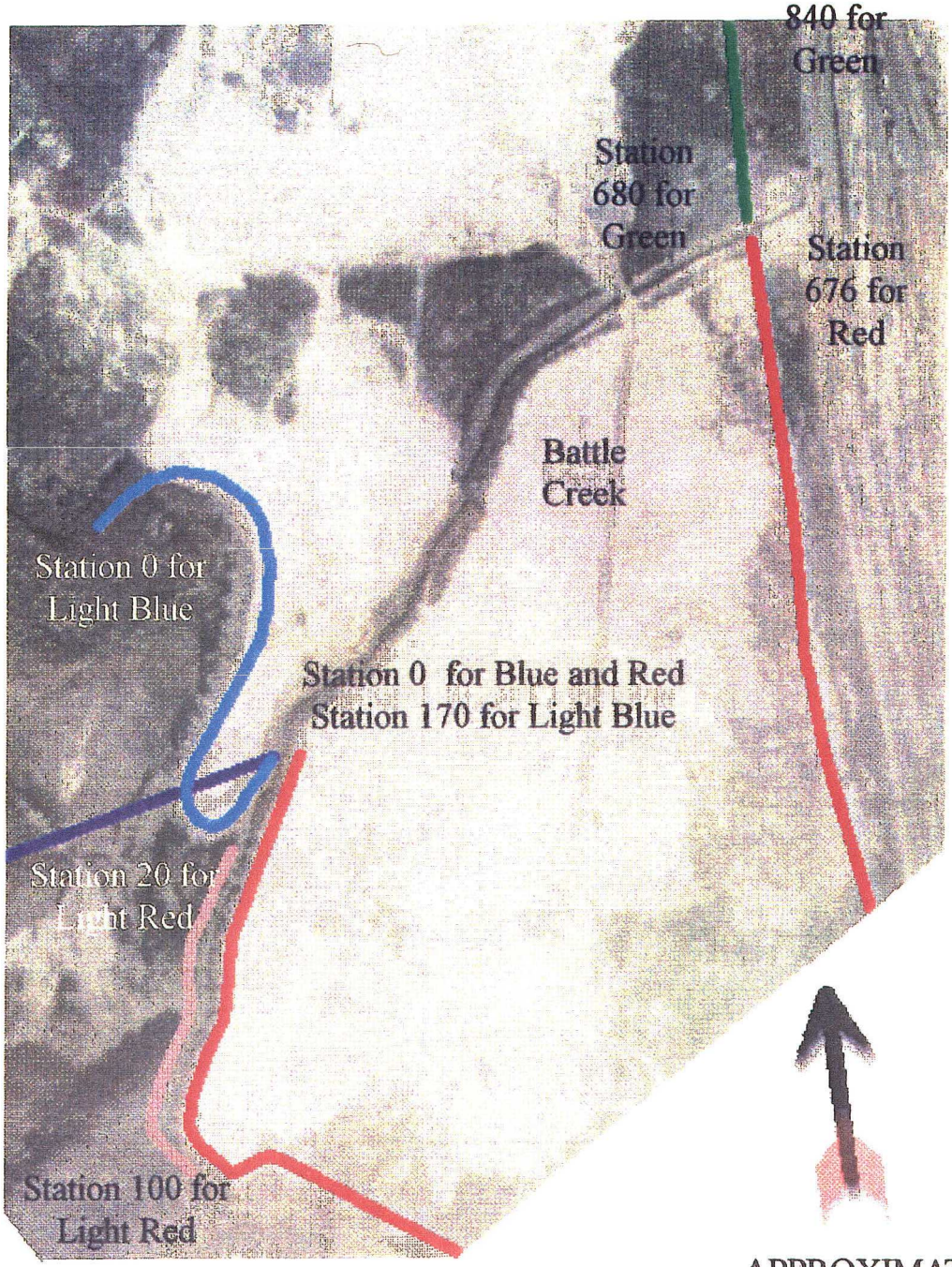
The quality of the electromagnetic data was ensured through extreme care during the field measurements and by repeated measurements at a calibration station established at 400E and the center of Old Pig's Eye Lake Road. The operator of the EM31 conductivity meter obtained all measurements with the long axis of the instrument aligned parallel to the road. The instrument was returned periodically to the calibration station. The EM31 measurements at the calibration station varied by less than 1 millimho per meter throughout the surveys duration.

STANDARD DISCLAIMER

The objective of any geophysical survey is to define the existence and configuration of features at depth. However, these features may bear a highly complex relationship to the geophysical measurements recorded. Therefore, conclusions drawn, no matter how logically deduced, should not be misconstrued as fact. We shall not and will not, except in the case of gross or willful negligence on our part, be liable or responsible for any losses, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, employees and agents or by anyone else not related to Fromm Applied Technology who might base interpretations and opinions on our geophysical surveys.

Geophysical Figures

Figure 1:Pig's Eye Landfill--Approximate Locations of Informal Transect Lines



APPROXIMATE DIRECTION OF GRID NORTH

BLUE = LINE ASWMP1
LIGHT BLUE = LINE BSWMP1
LIGHT RED = LINE BPERM1
RED = LINE APERM1
GREEN = LINE DPERM1

This diagram has been created from two aerial photographs. The scale and location of objects are not expected to be accurate.

Figure 2:Pig's Eye Landfill--Transect ASWMP1
Apparent Conductivity (East to West on 200S)

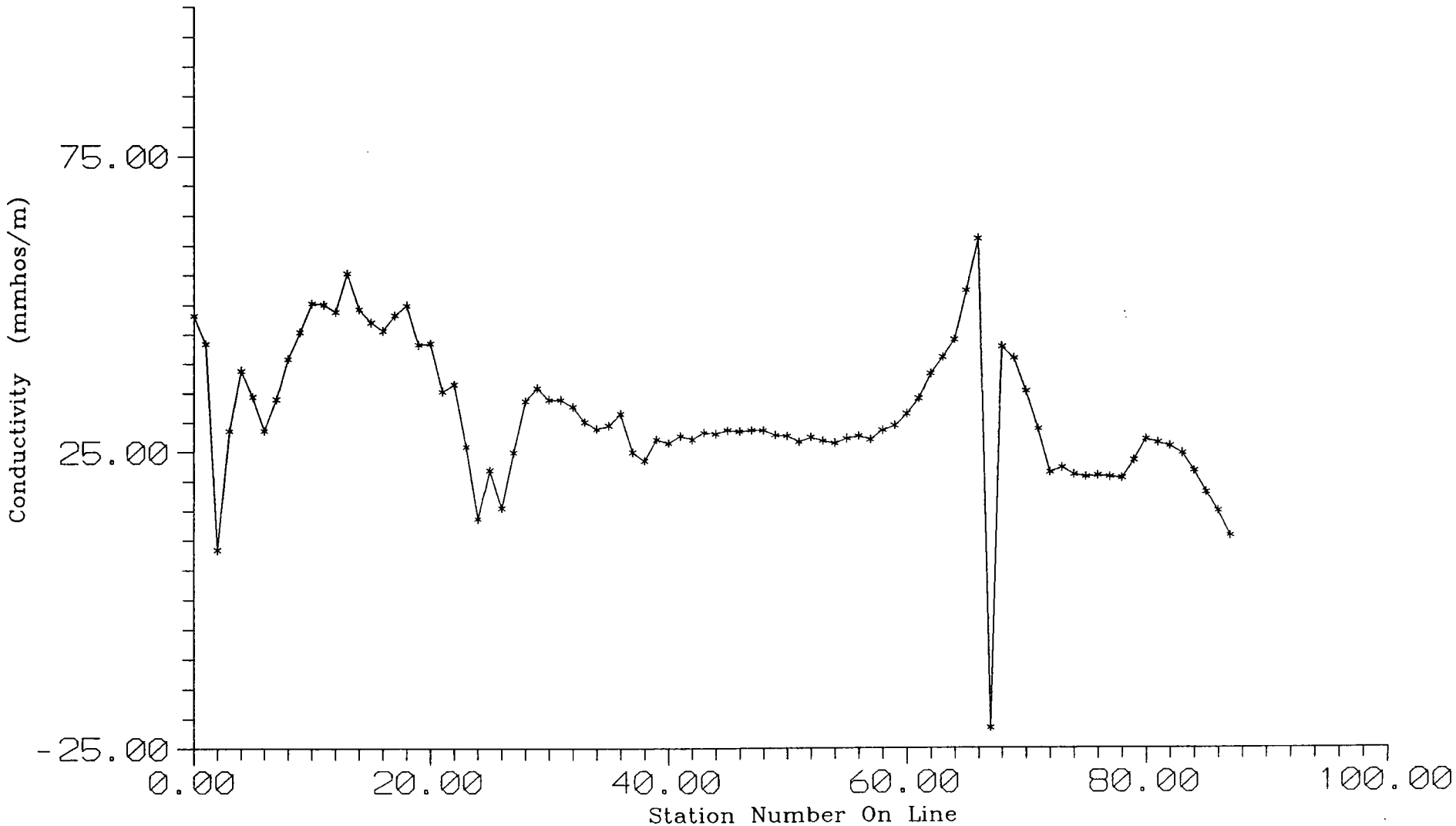


Figure 3:Pig's Eye Landfill--Transect ASWMP1
Inphase Response (East to West on 200S)

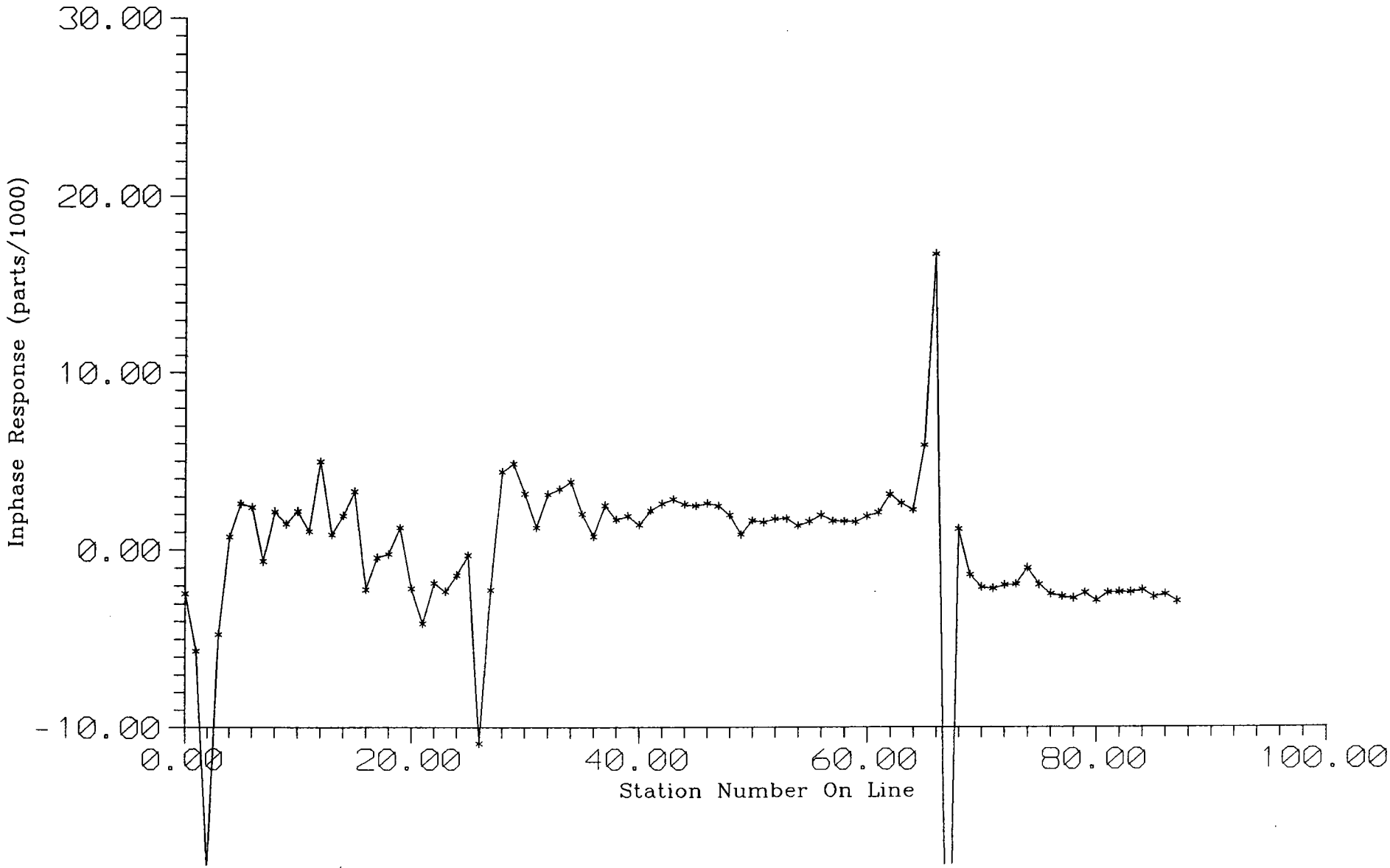


Figure 4:Pig's Eye Landfill--Transect BSWMP1
Apparent Conductivity (Follows Edge of Berm)

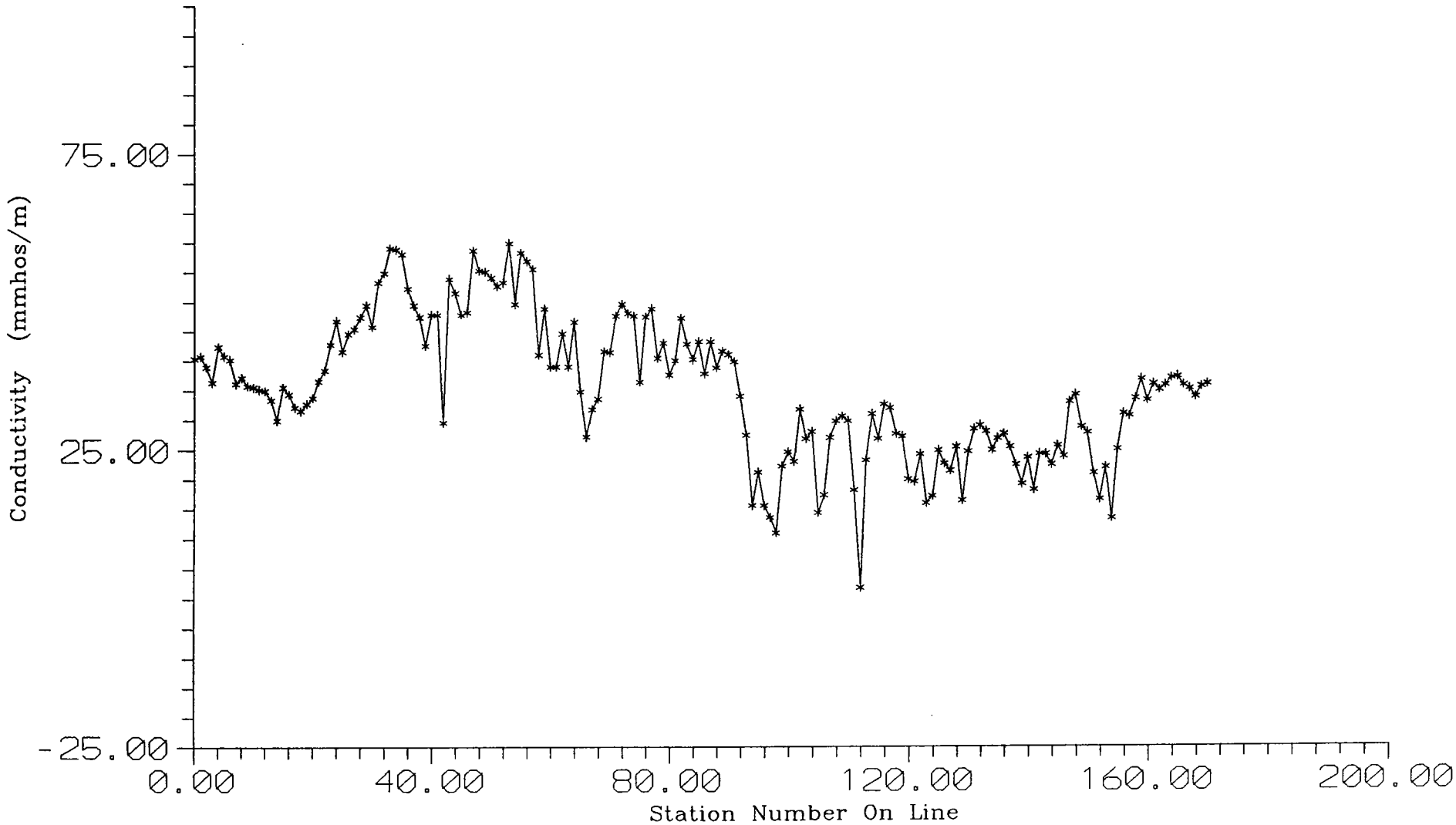


Figure 5:Pig's Eye Landfill--Transect BSWMP1
Inphase Response (Follows Edge of Berm)

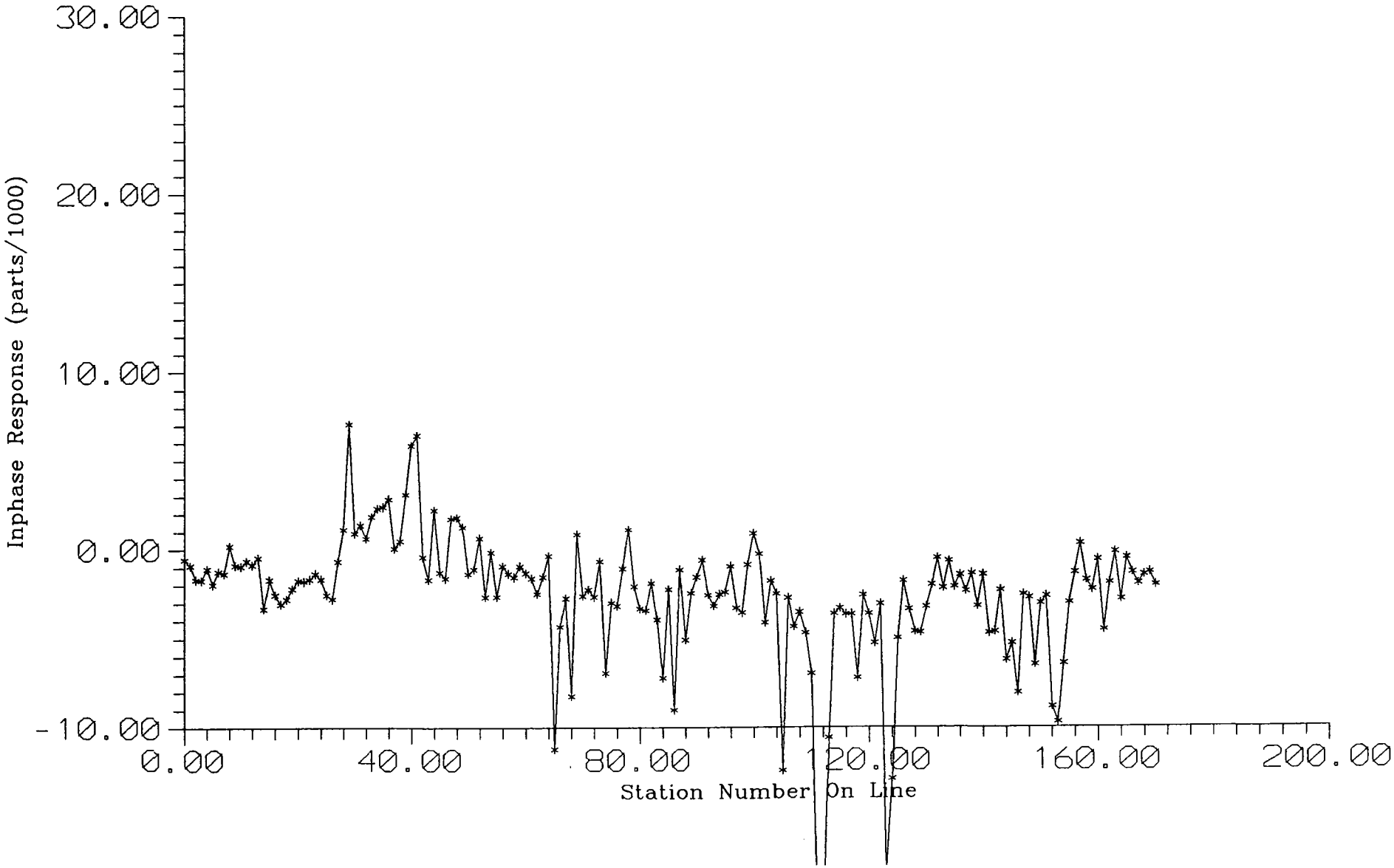


Figure 6:Pig's Eye Landfill--Transect BPERM1
Apparent Conductivity (Follows West Side of Battle Creek)

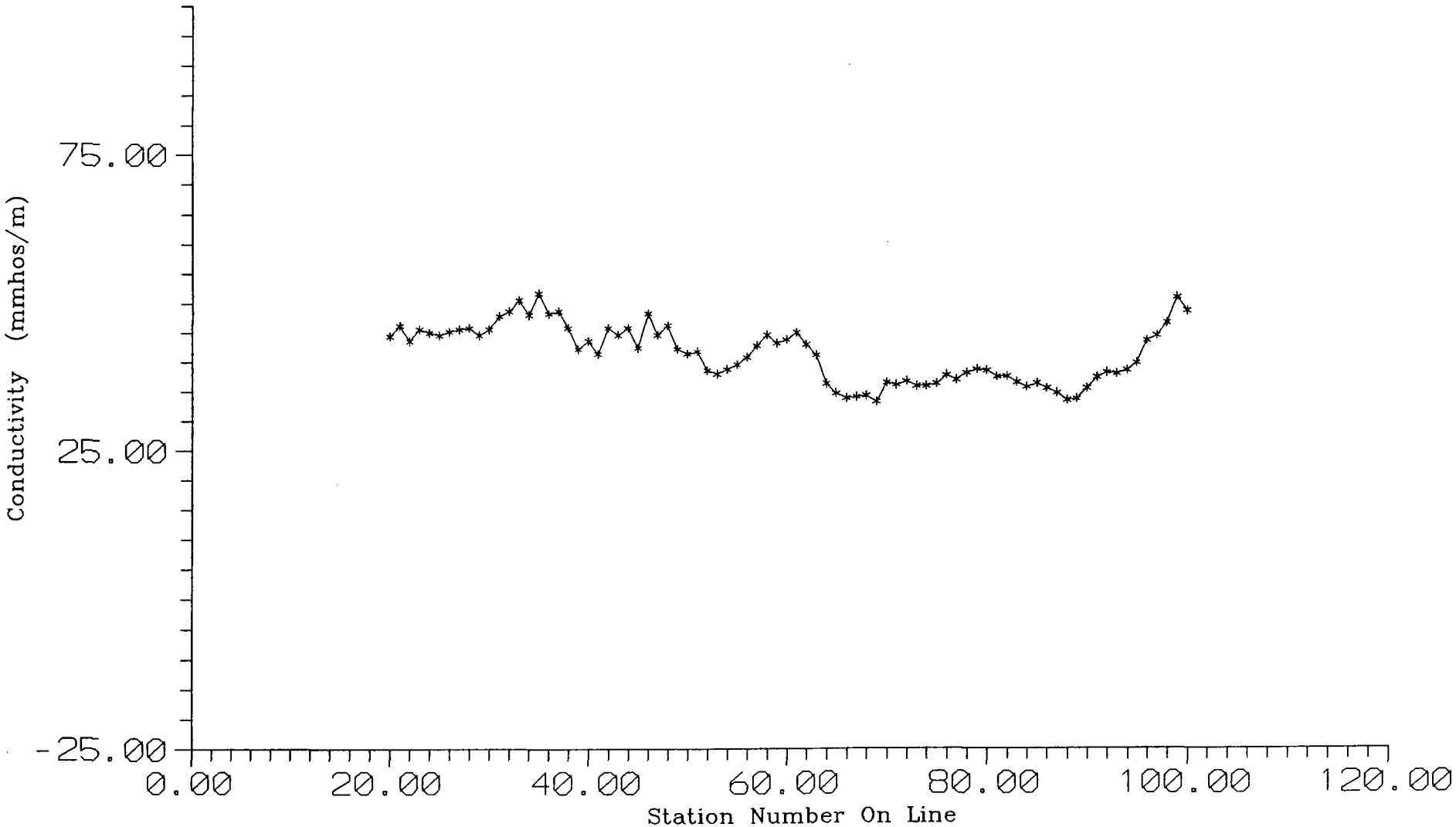


Figure 7:Pig's Eye Landfill--Transect BPERM1
Inphase Response (Follows West Side of Battle Creek)

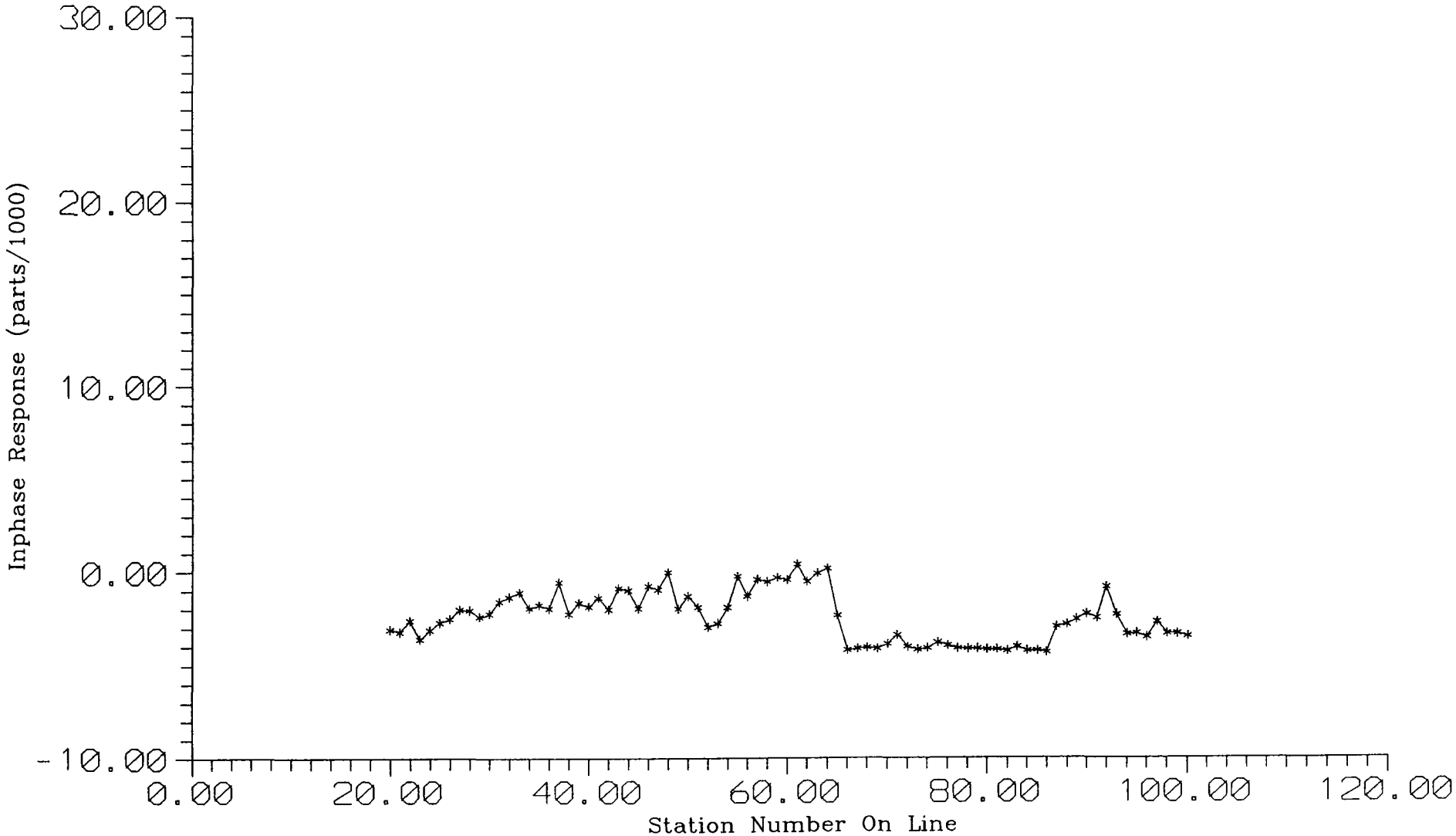


Figure 8:Pig's Eye Landfill--Transect APERM1
App. Cond. (Follows Edge of Berm Stations 0 to 100)

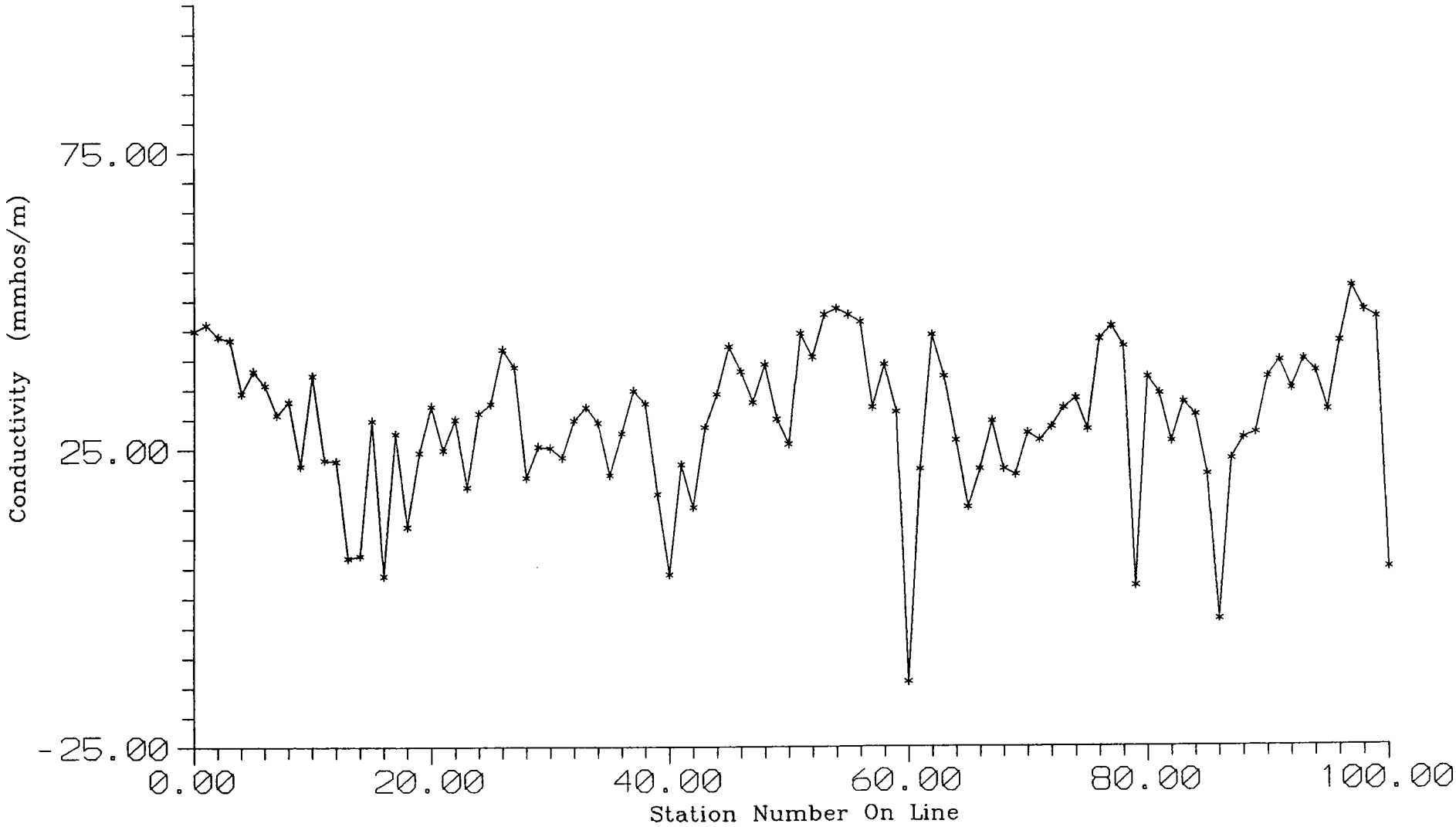


Figure 9:Pig's Eye Landfill--Transect APERM1
App. Cond. (Follows Edge of Berm Stations 100 to 210)

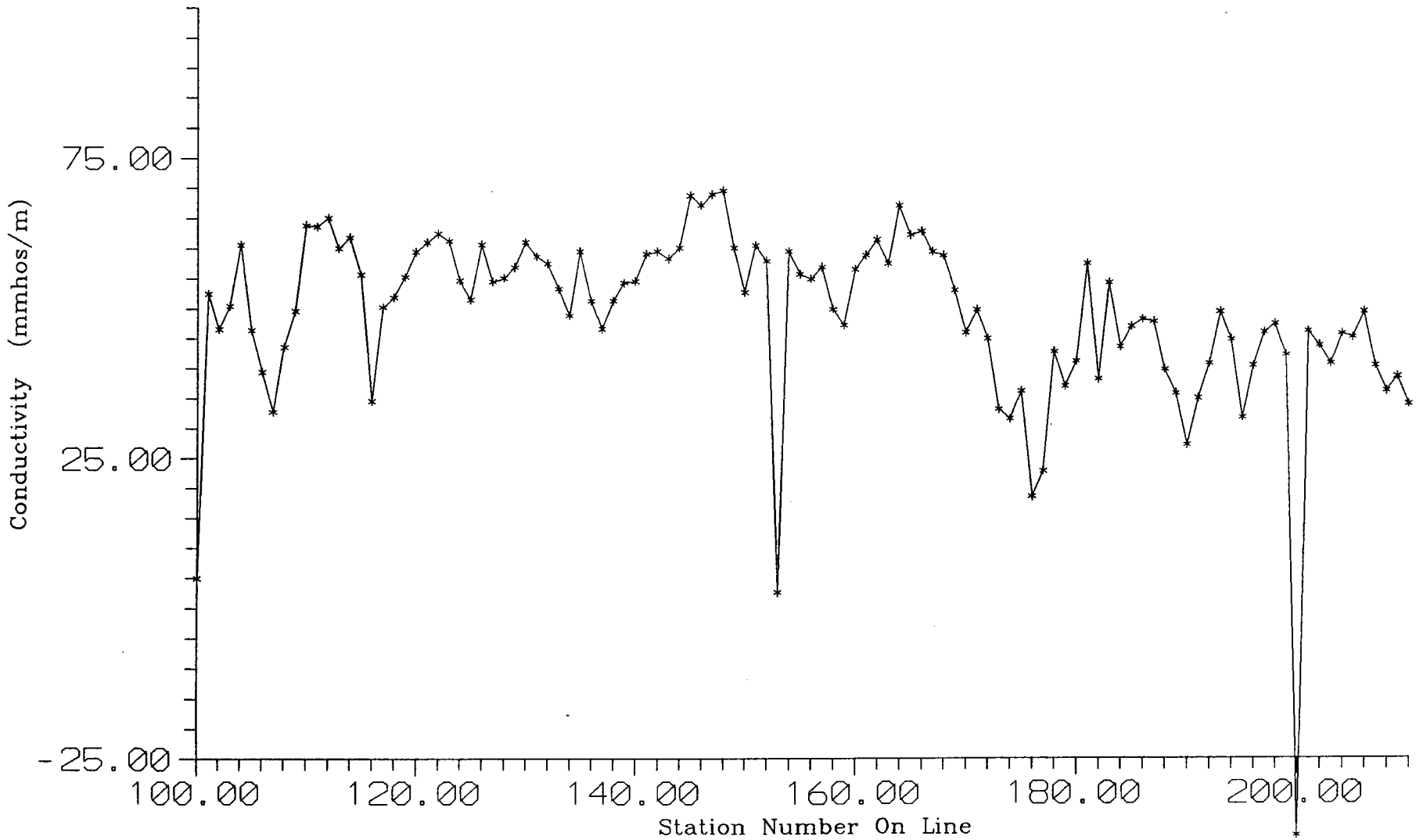


Figure 10:Pig's Eye Landfill--Transect APERM1
App. Cond. (Follows Edge of Berm Stations 210 to 326)

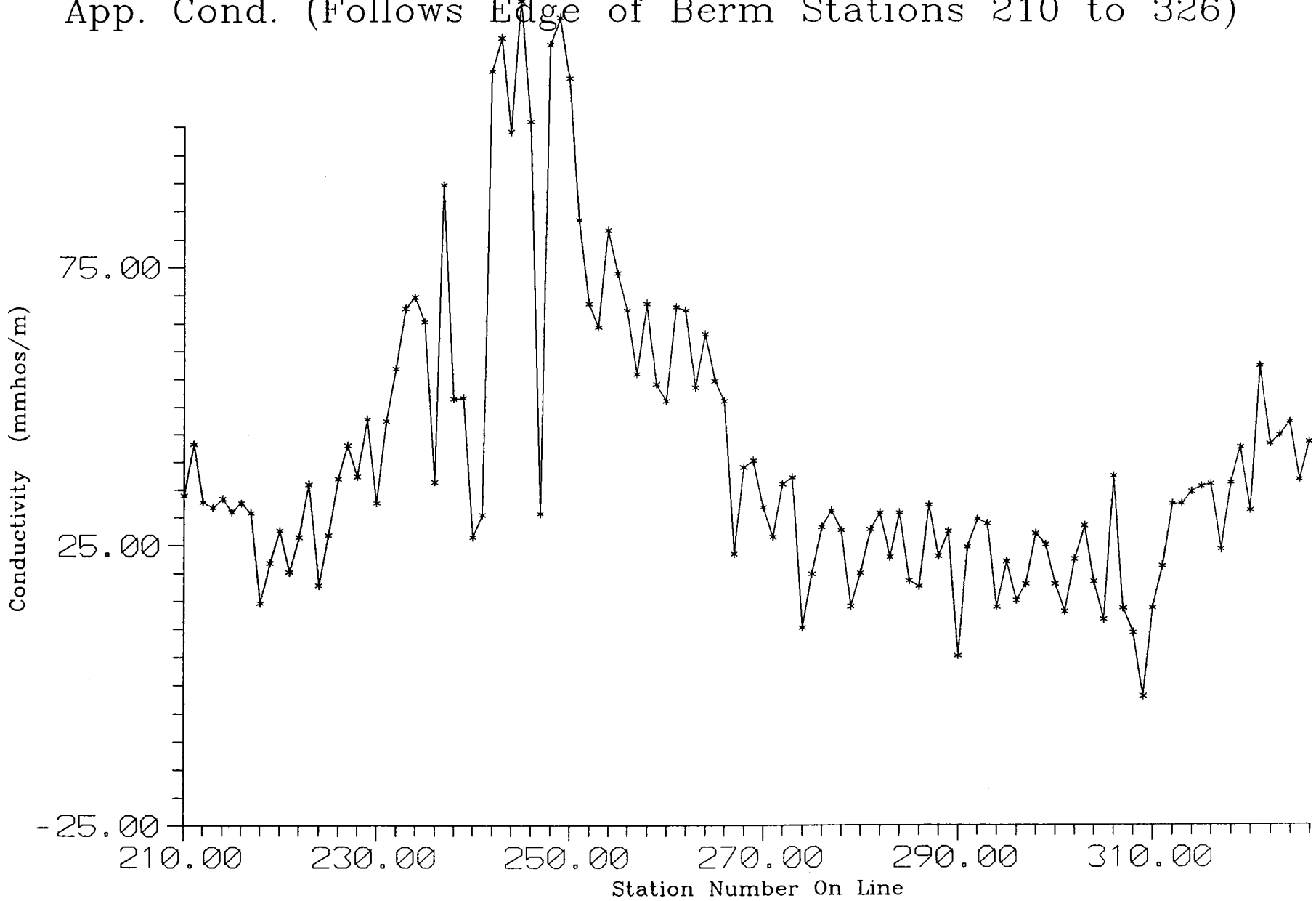


Figure 11:Pig's Eye Landfill--Transect APERM1
App. Cond. (Follows Edge of Berm Stations 326 to 679)

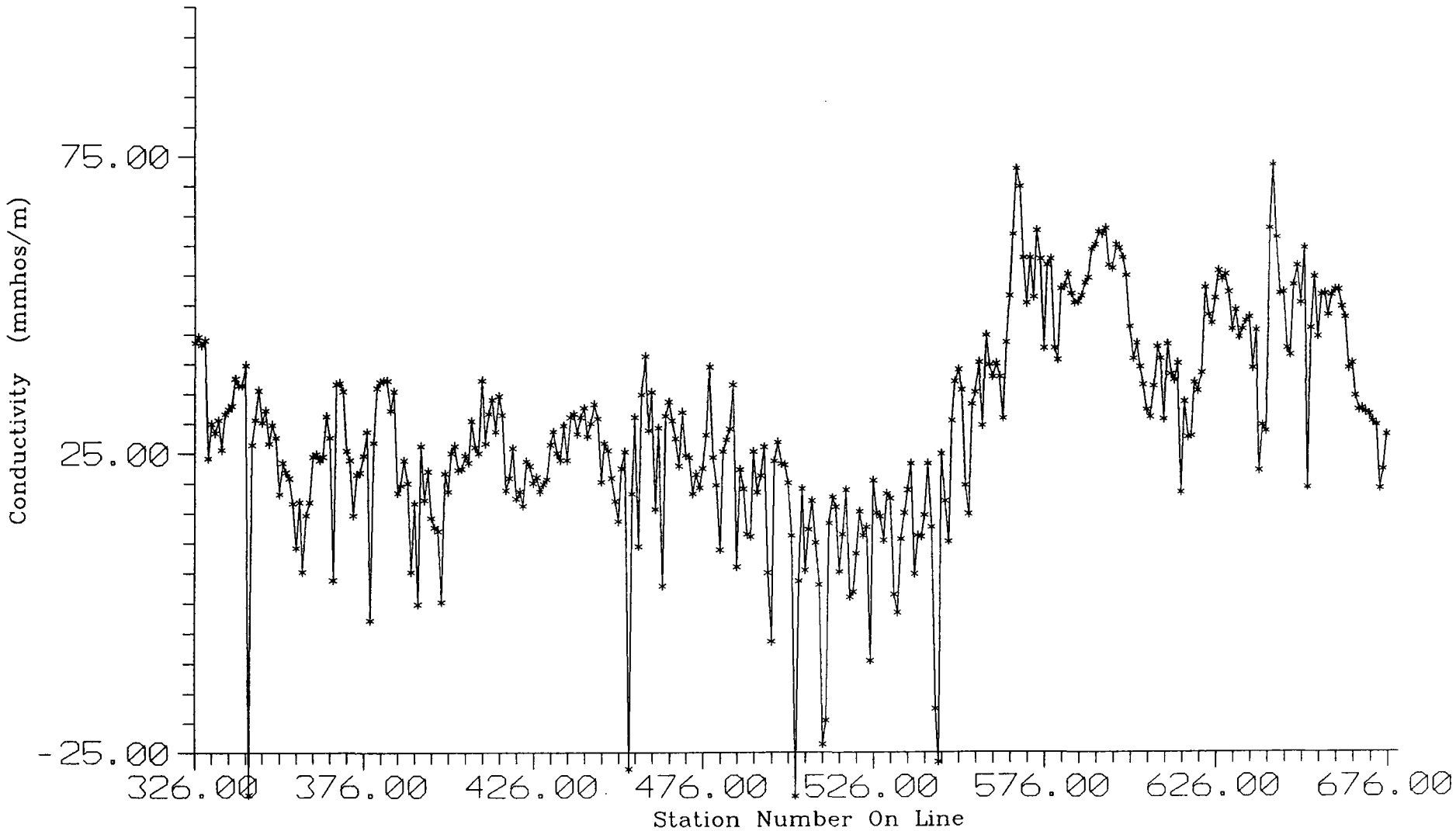


Figure 12:Pig's Eye Landfill--Transect APERM1
Inphase Response (Follows Edge of Berm Stations 0 to 100)

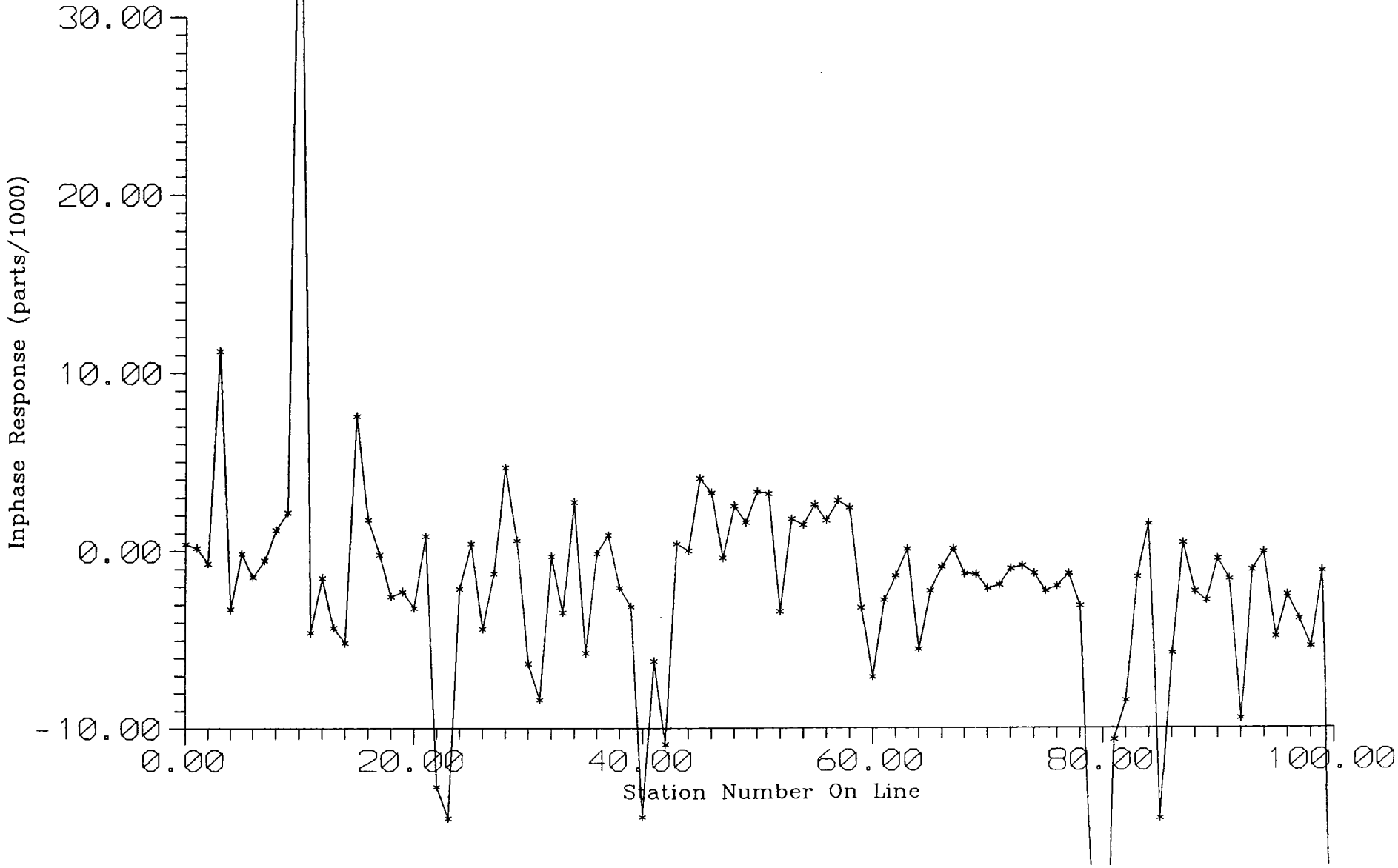


Figure 13:Pig's Eye Landfill--Transect APERM1
Inphase Response (Follows Edge of Berm Stations 100 to 210)

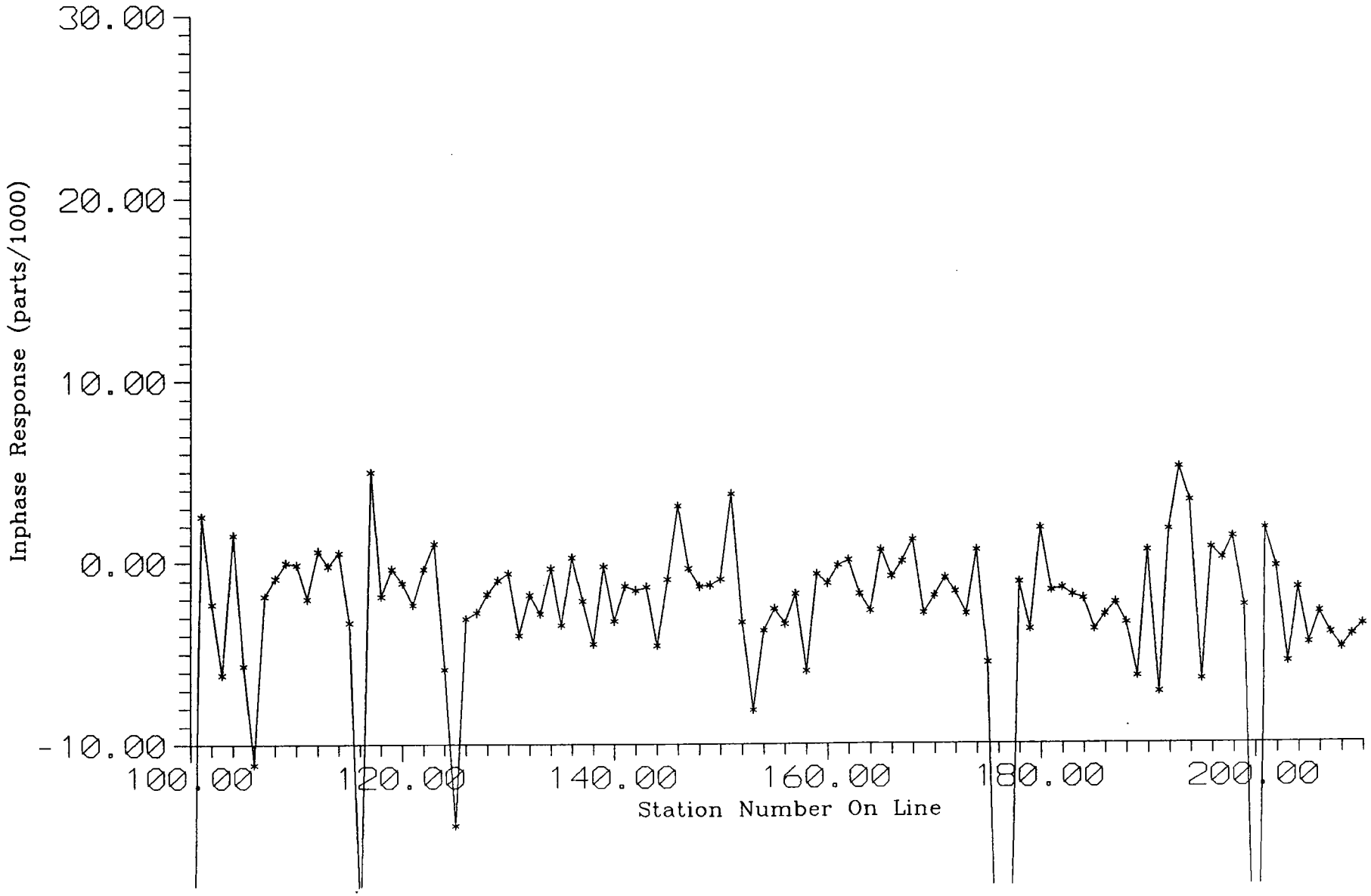


Figure 14:Pig's Eye Landfill--Transect APERM1
Inphase Response (Follows Edge of Berm Stations 210 to 326)

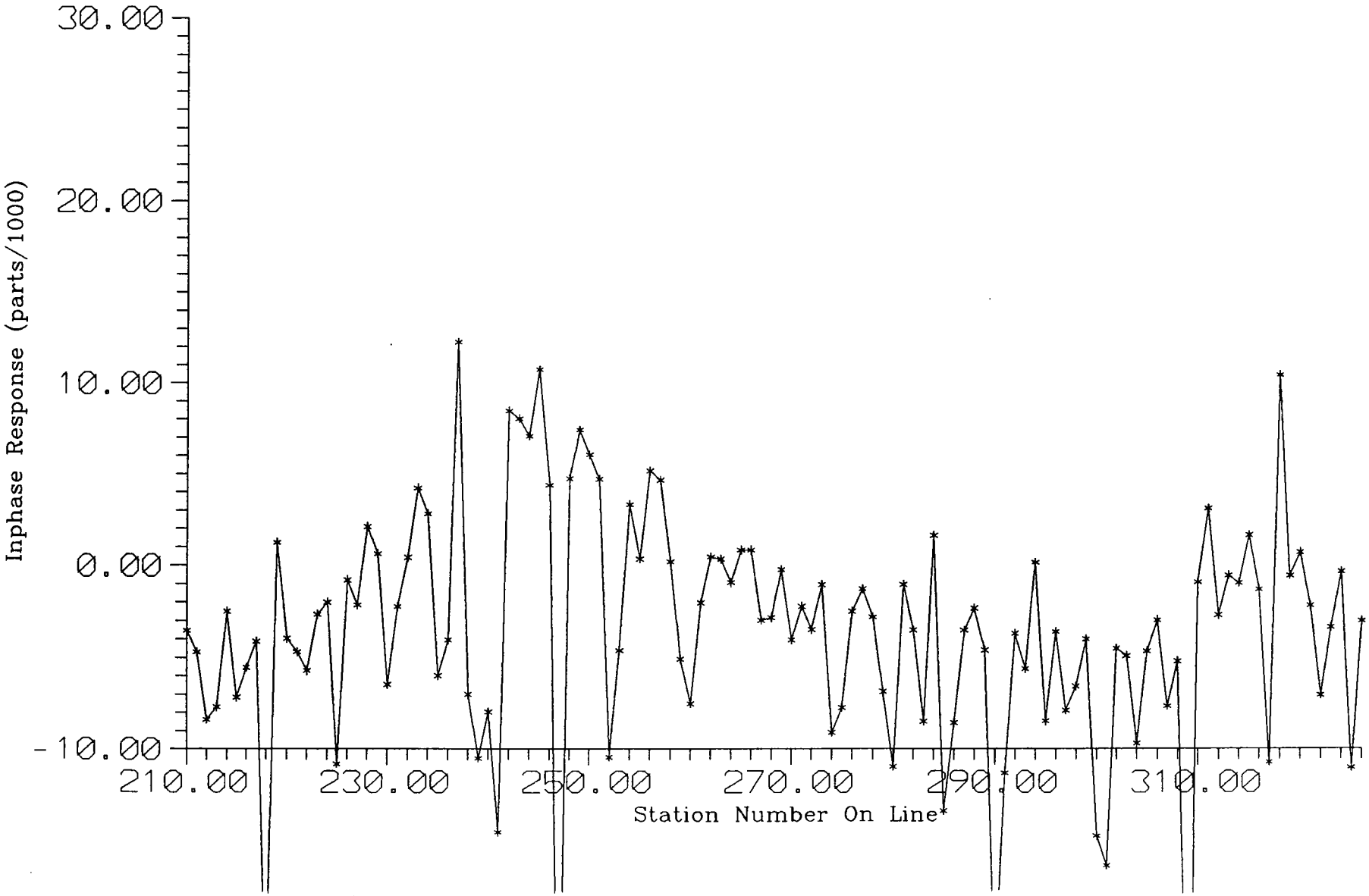


Figure 15:Pig's Eye Landfill--Transect APERM1
Inphase Response (Follows Edge of Berm Stations 326 to 679)

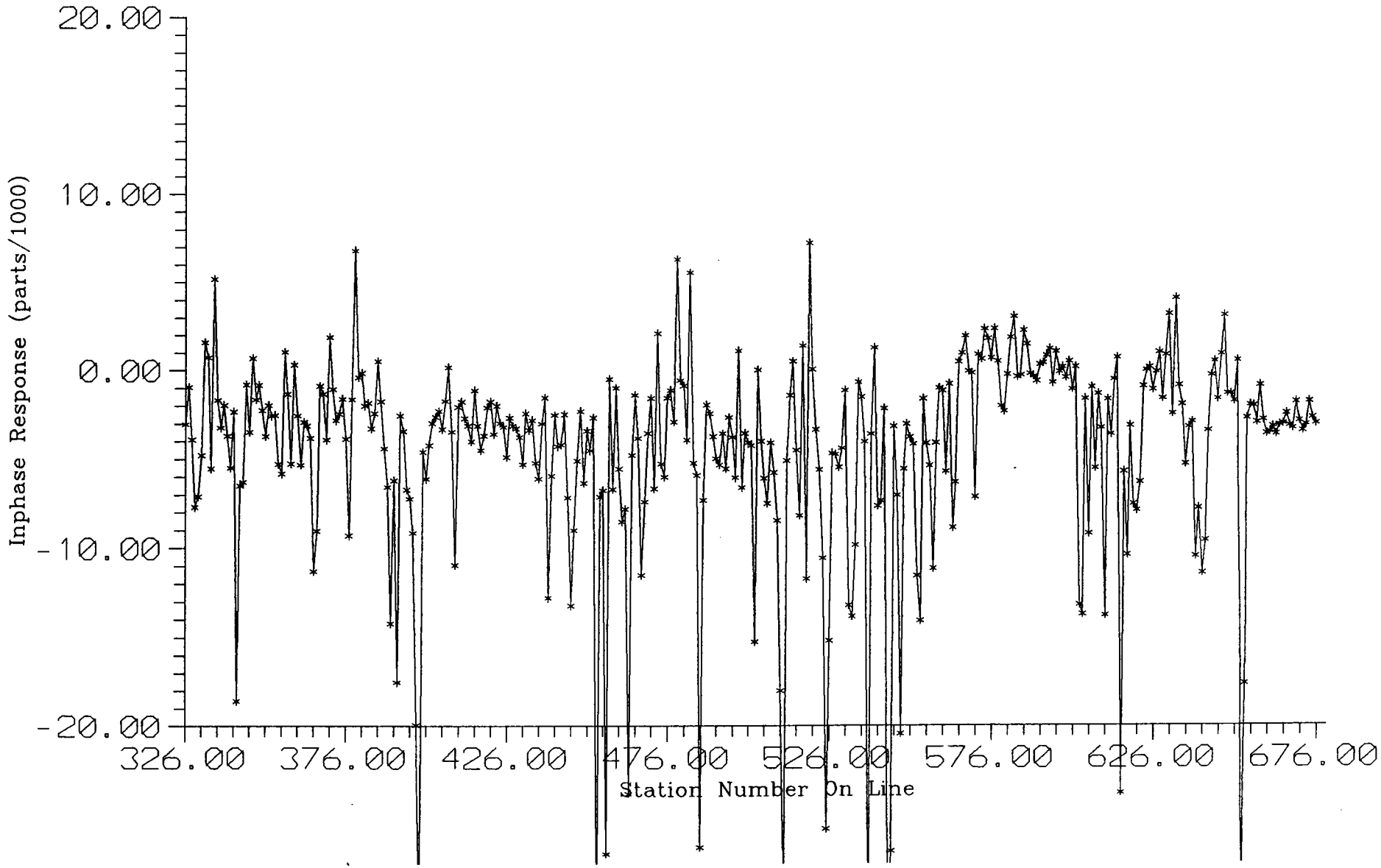


Figure 16: Pig's Eye Landfill--Contour Plot of Conductivities From 610N to 1780N(West Side)

Contour Interval = 5 and 25 millimhos per meter

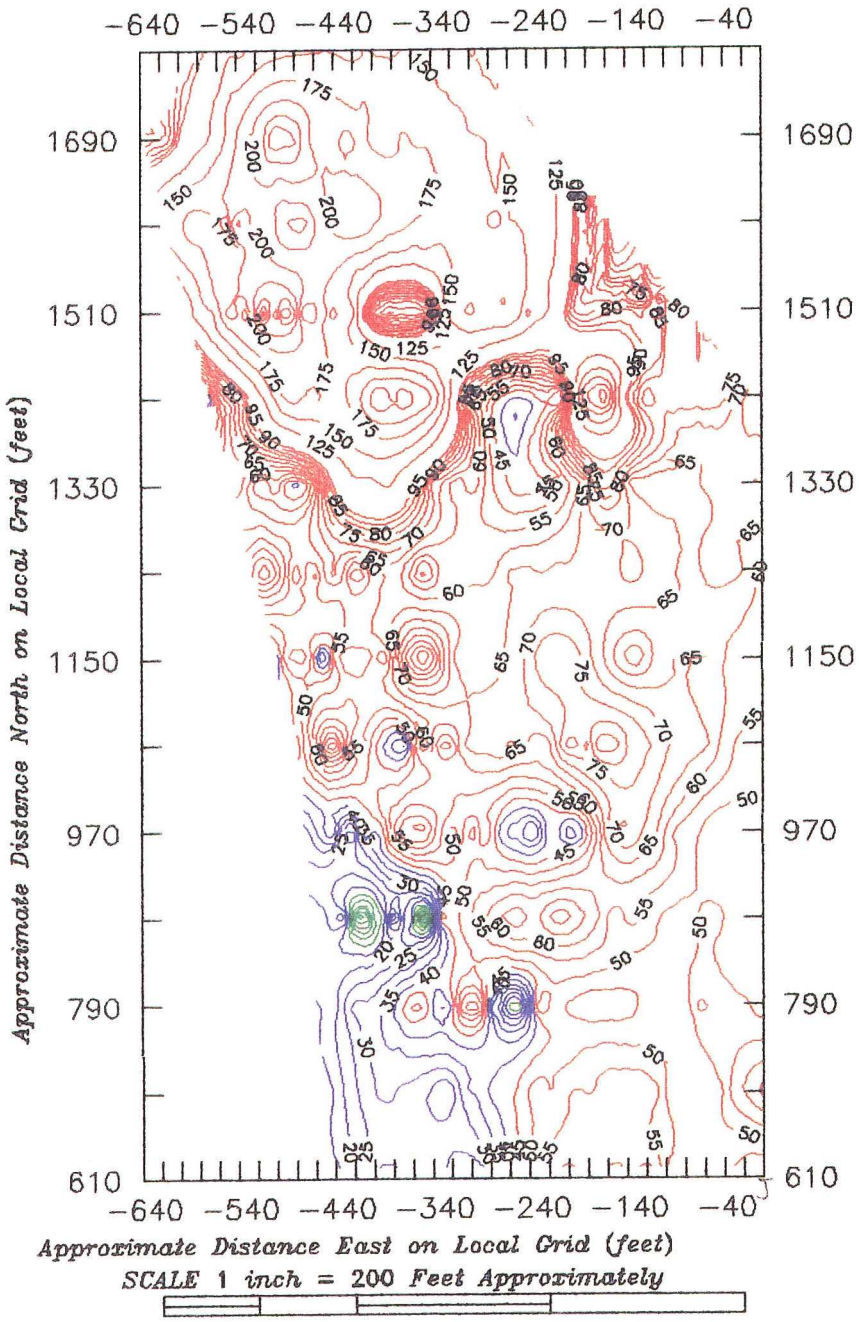


Figure 17: Pig's Eye Landfill--Contour Plot of Conductivities From 1780N to 2950N(West Side)

Contour Interval = 5 and 25 millimhos per meter

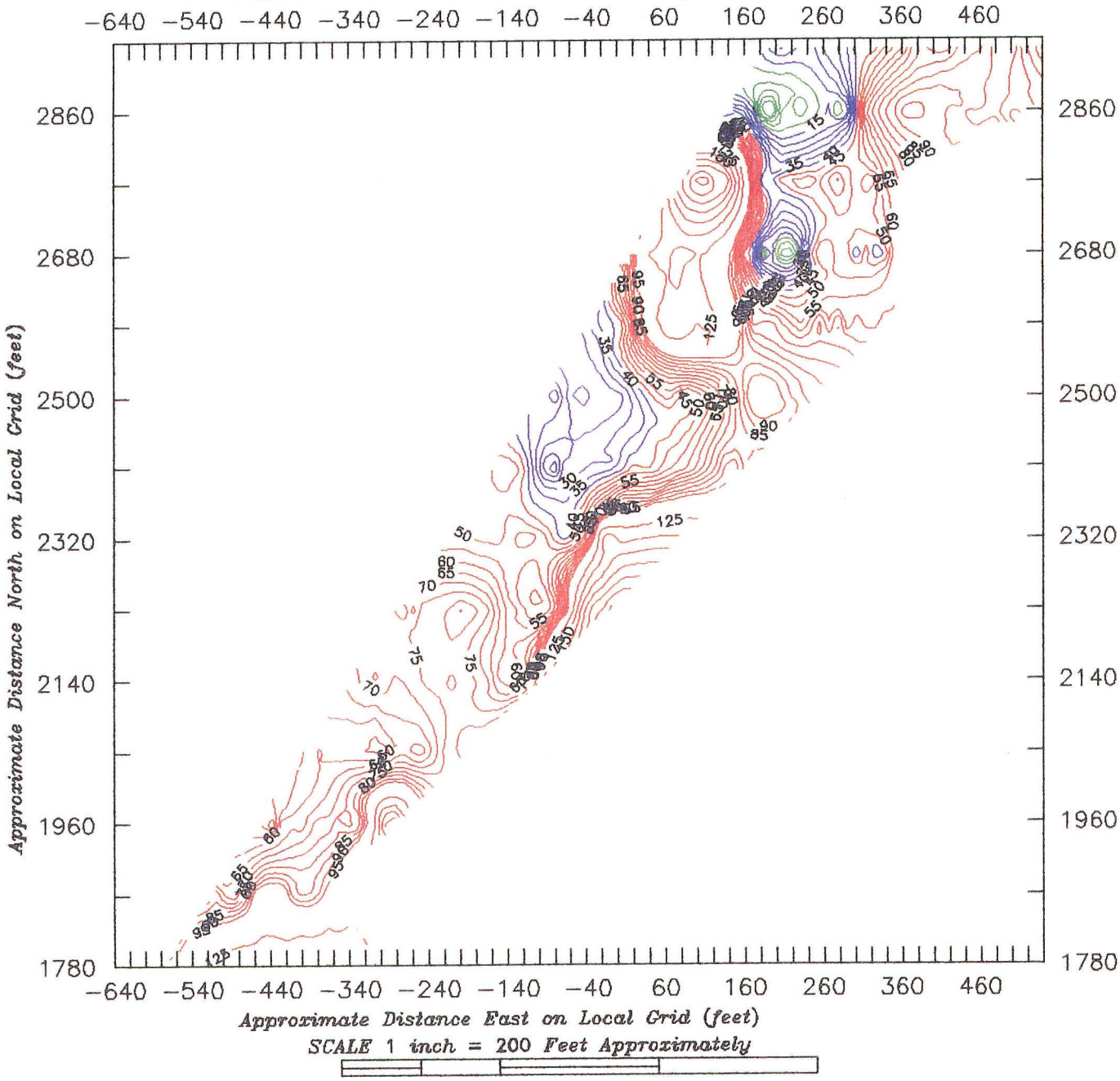


Figure 18: Pig's Eye Landfill--Contour Plot of Conductivities From 2950N to 4120N

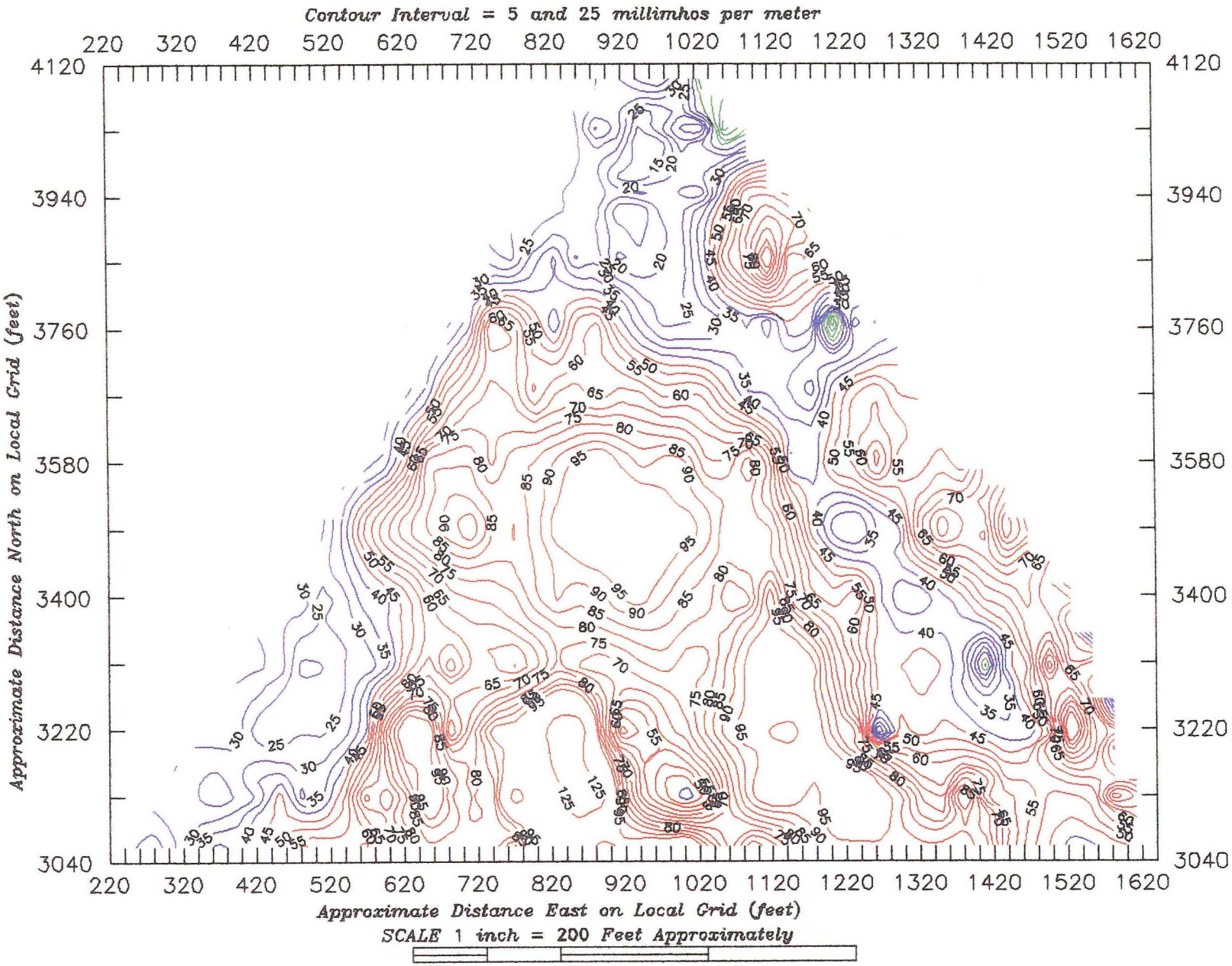


Figure 19: Pig's Eye Landfill--Contour Plot of Inphase Response From 610N to 1780N(West Side)

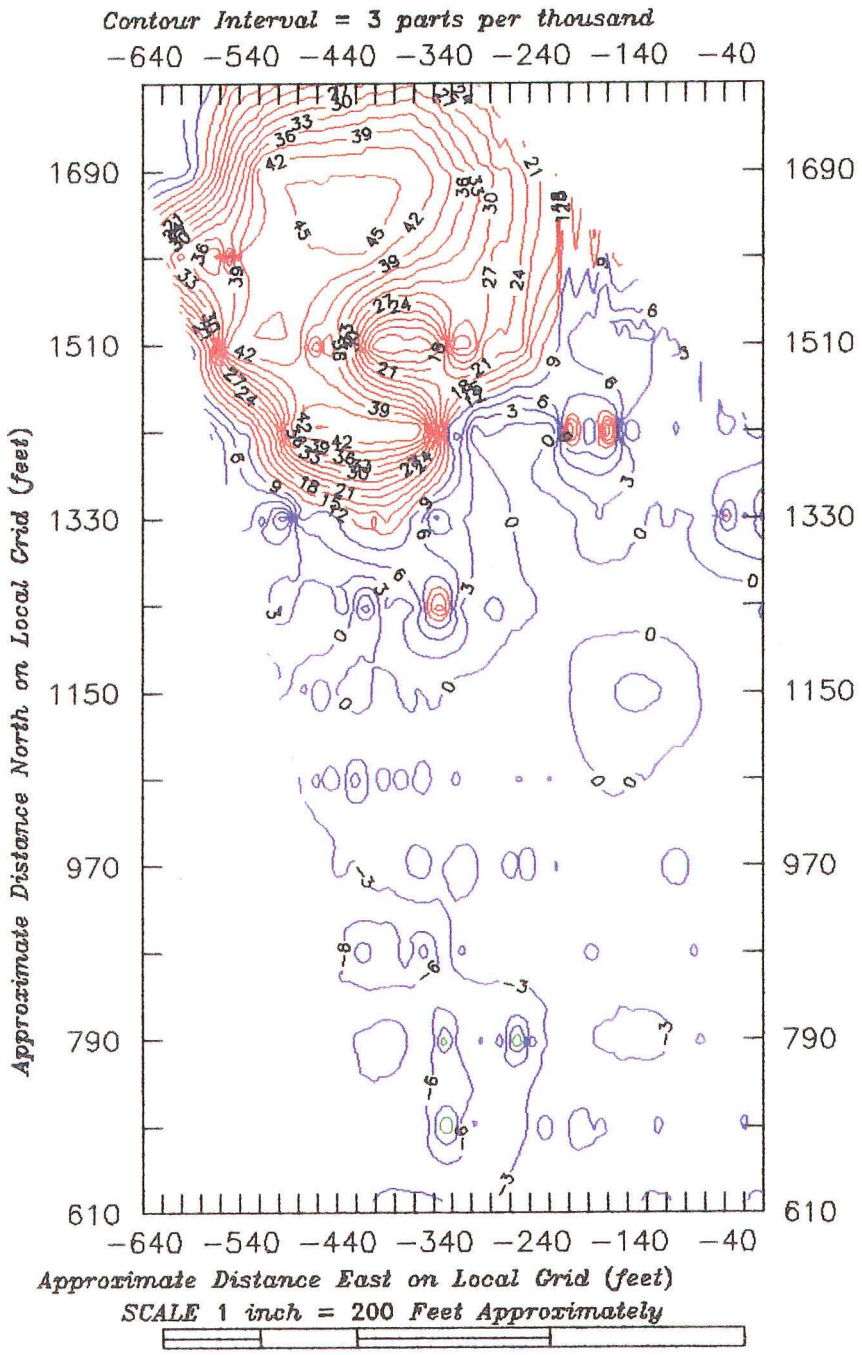


Figure 20: Pig's Eye Landfill--Contour Plot of Inphase Response From 1780N to 2950N(West Side)

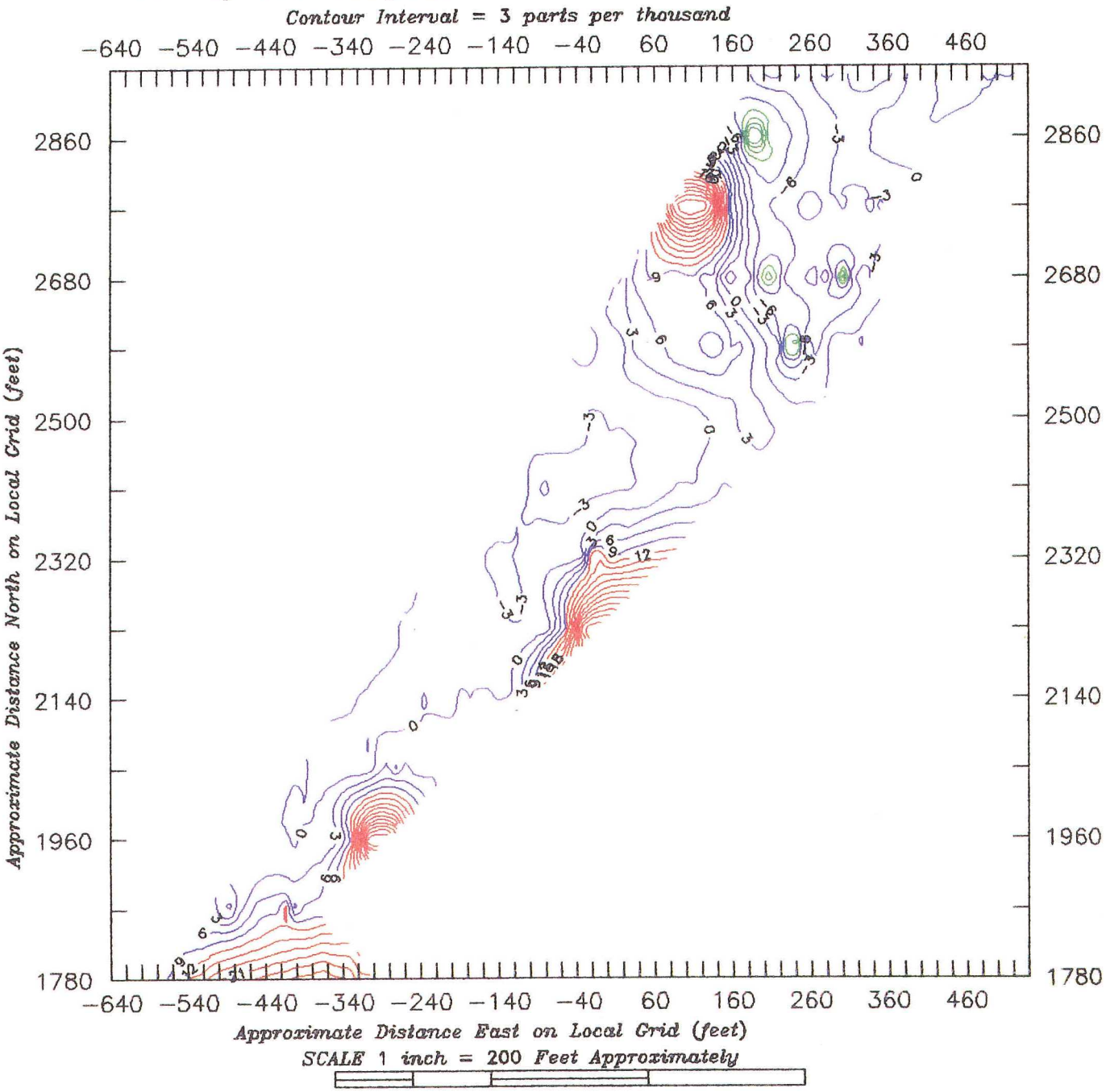


Figure 21: Pig's Eye Landfill--Contour Plot of Inphase Response From 2950N to 4120N

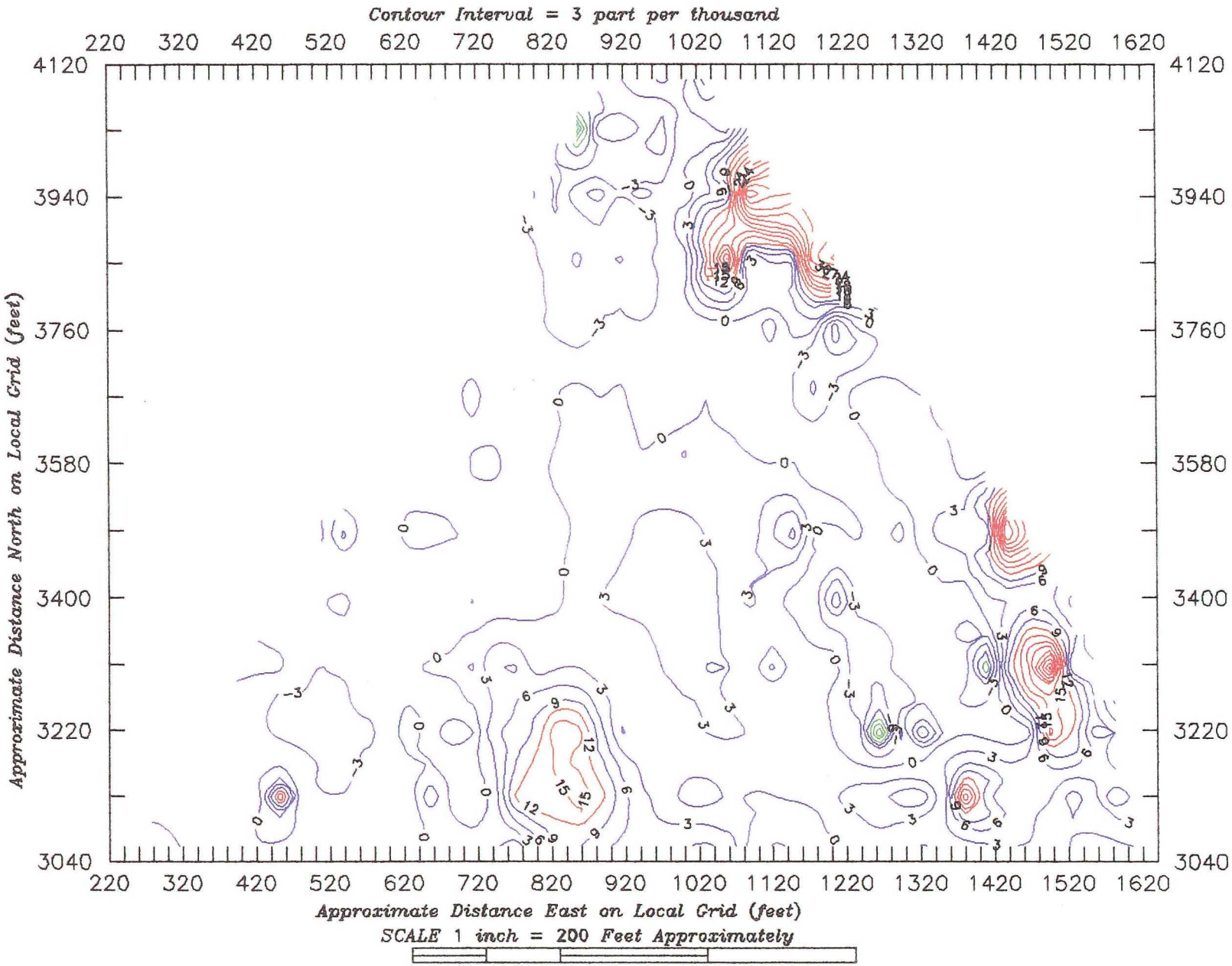


Figure 22:Pig's Eye Landfill--Transect DPERM1
App. Cond. (Follows Edge of Berm Stations 680 to 840)

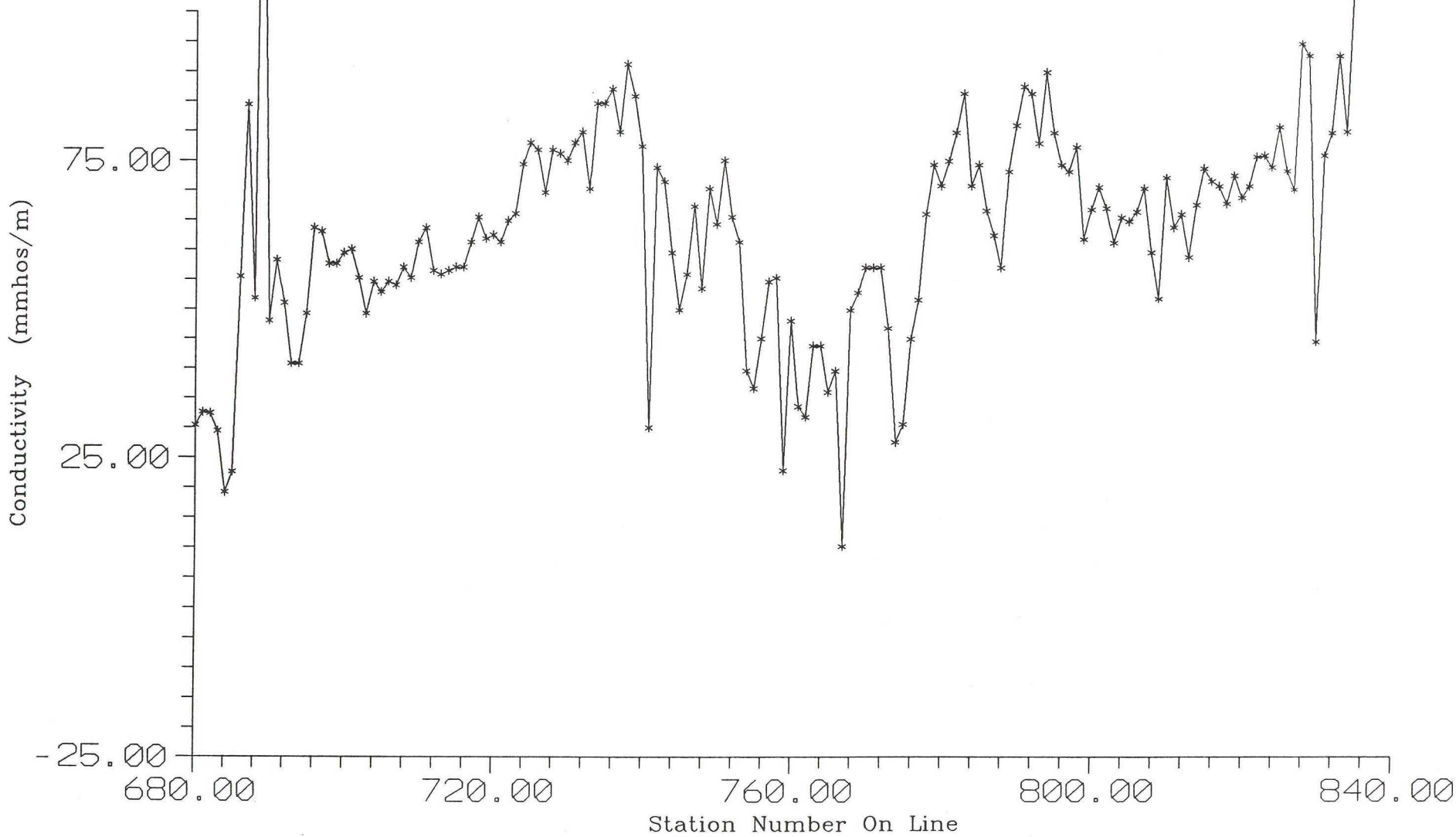


Figure 23:Pig's Eye Landfill--Transect DPERM1
Inphase Response (Follows Edge of Berm Stations 680 to 840)

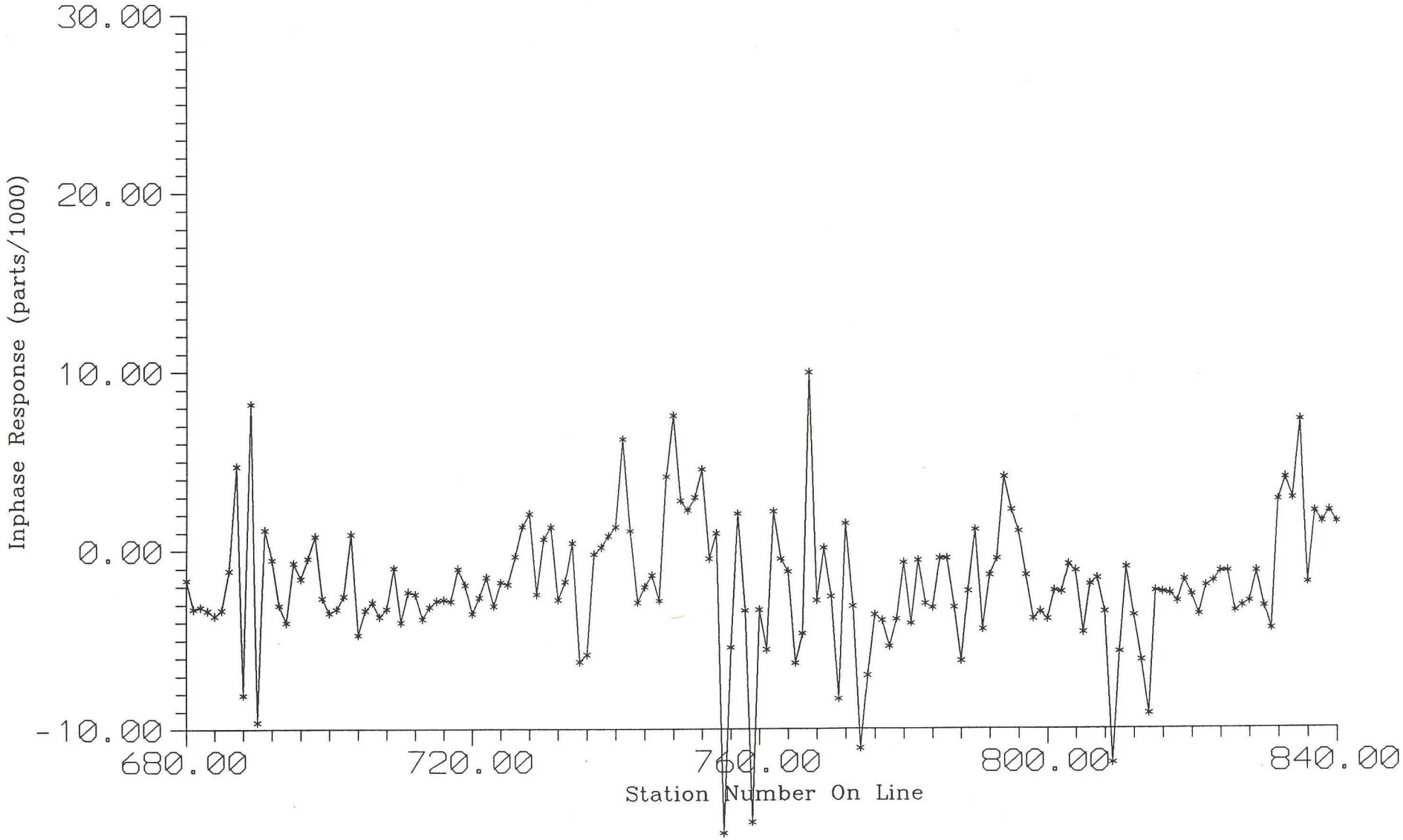
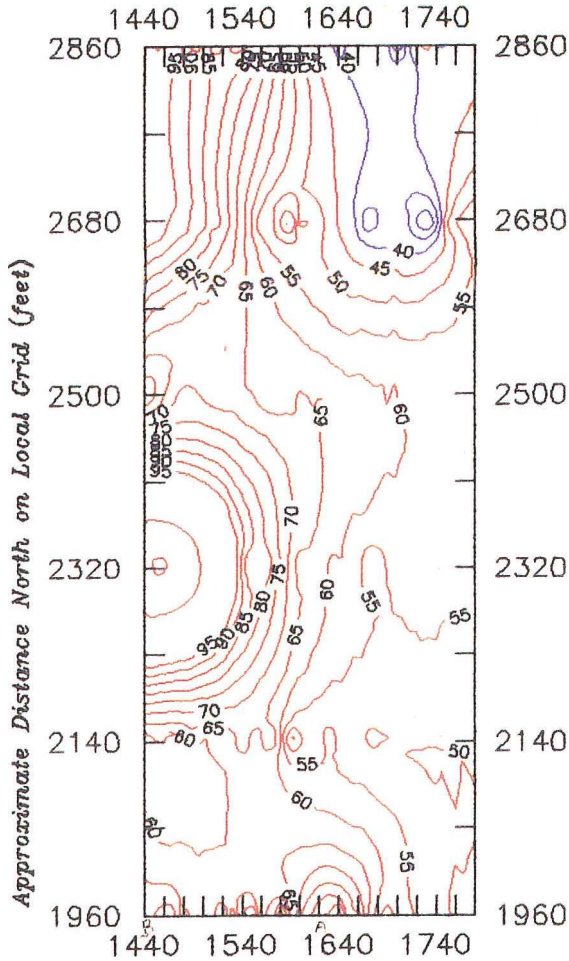


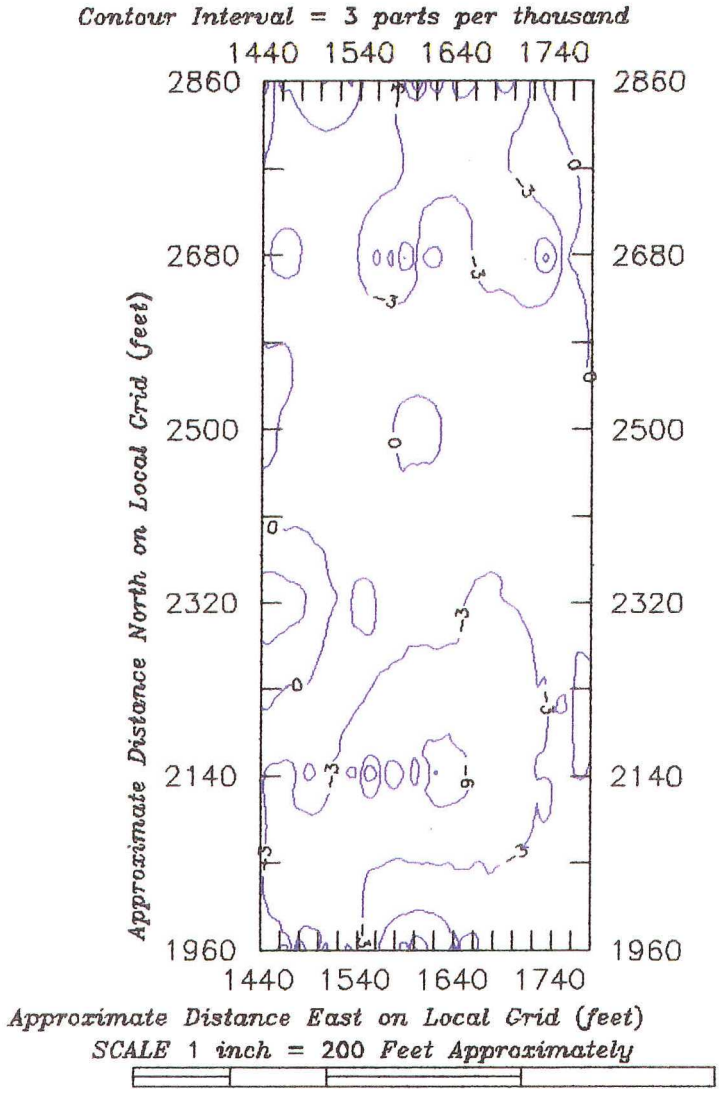
Figure 24: Pig's Eye Landfill--Contour Plot of Conductivities From 1960N to 2860N(East Side)

Contour Interval = 5 and 25 millimhos per meter



SCALE 1 inch = 200 Feet Approximately

Figure 25: Pig's Eye Landfill--Contour Plot of Inphase Response From 1960N to 2860N(East Side)



Appendix A: Overview of Electromagnetic Surveys

Overview of Electromagnetic Surveys

Electromagnetic surveys attempt to measure near surface electrical conductivity, the inverse of electrical resistivity, through electromagnetic induction methods. The basic instrumentation required to accomplish this is pictorially defined in Figure 1-A. A surface transmitter coil, Tx, is driven with an audio frequency alternating current. The magnetic field resulting from current flow in the transmitter coil causes induced currents to flow in the ground. The induced ground current creates a secondary magnetic field which can be sensed by a surface receiving coil, Rx. The surface receiving coil will also sense the primary magnetic field resulting from current flow in the coil Tx but this primary field lags the secondary field by 90 degrees. The phase shift between the primary and secondary fields provides a basis for their separation.

In general, the magnitude of the secondary field sensed by receiver coil Rx is a nonlinear function of the coil spacing, operating frequency, and surface conductivity. However, for selected values of operating frequency and coil spacing the magnitude of the secondary field is a linear function of the surface conductivity. Hence, if an appropriate frequency and coil spacing are utilized, the magnitude of the secondary field phase shifted by 90 degrees from the primary field can be used to imply the near surface conductivity. The magnitude of the magnetic field sensed by Rx and inphase with the primary field can also be measured. This is known as an inphase measurement and can be expressed in terms of parts per thousand (ppt) of the primary field.

The penetration depth of electromagnetic measurements is highly dependent upon surface conductivity. Under ideal conditions, the EM-31 equipment used in this study can achieve penetration depths of approximately 15 to 20 feet for normal conductivity measurements. However, the presence of surface metal can limit penetration to the surface. Thus, it is only possible to state that penetration depth can be as deep as approximately 20 feet and note that measured conductivities do not define a burial depth. A more conservative estimate for detecting buried metal is less than 10 feet. In comparison and also under ideal conditions, the EM-34 equipment implementing a 20 meter coil spacing can achieve penetration depths of

approximately 45 to 100 feet depending on the orientation of the coils, horizontal or vertical. The presence of sporadic surface metal can limit penetration, but not usually as severely as the EM31. Thus as it is with the EM31, it is only possible to state that penetration depth can be as deep as approximately 45 to 100 feet with a 20 meter coil spacing. Again, measured conductivities do not define a burial depth. With respect to metal detection, the instrument, EM34, is not usually used to locate buried metal, unless the burials are extremely large.

While electromagnetic measurements provide an excellent method for the detection of near surface metal objects, the measurements cannot define the type or form of metal involved. For example, conductivity measurements cannot distinguish between aluminum barrels, iron engine blocks, concrete with steel reinforcing rod, or steel kitchen appliances.

Metal within an electromagnetically surveyed area can be detected with either the conductivity measurements or the inphase measurements. Electrically conducting material, generally steel, within a few feet of the surface will cause electromagnetic field distortions which will result in zero or even negative values of measured conductance. Deeper metallic objects will cause less field distortion and lead to measured conductivities which are abnormally high in comparison to site background values. Inphase measurements are believed to be more sensitive to metal than conductivity measurements. Thus, inphase anomalies may indicate the presence of metal at too great a depth to effect the conductivity measurements. Hence, metallic objects within the confines of a survey area are characterized by one or more of the following:

1. Zero or negative conductivities.

2. Conductivities abnormally high or low for site soils.

3. Anomalous inphase values.

Appendix B: Department of Energy document No. DOE/HWP-100.

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
STANDARD OPERATING PROCEDURE 16
ELECTROMAGNETIC INDUCTION SURVEY

1. OBJECTIVE

The objective of this procedure is to describe the procedures and theory necessary for personnel to conduct an electromagnetic (EM) survey.

2. BACKGROUND

The EM survey method, which is an inductive field measurement, is used as a nondestructive, noninvasive, and cost-efficient method for the initial survey and assessment of potentially contaminated sites. Electrical conductivity measured by the EM method is a function of the soil and rock, its permeability and porosity, and the fluid composition and saturation. From this electrical conductivity data, both the natural geohydrologic conditions and many types of contaminant plumes can be mapped, as well as trench boundaries, buried wastes, drums, and utility lines.

The EM survey may be performed in one of three ways: horizontal, vertical, or a combination of both horizontal and vertical.

In the horizontal approach, one depth (i.e., a single receiver-transmitter coil spacing on the EM) is selected and the whole site is characterized at that depth. In the vertical method, selected points on the site are chosen to perform EM readings at various depths, thus giving a vertical point profile.

When using both techniques, a three-dimensional picture of the site can be developed.

3. RESPONSIBILITIES

Site Manager: The Site Manager is responsible for ensuring that the field personnel are capable of performing this procedure and the EM survey is conducted in accordance with this procedure.

Project Field Geologist/Geophysicist: The Project Field Geologist/Geophysicist is responsible for complying with this procedure, and for verifying that adequate high quality data have been collected.

4. REQUIRED EQUIPMENT

- One electromagnetic instrument consisting of a transmitter coil, a receiver coil, phase sensing circuits and amplifiers, and, as an option, chart and/or magnetic tape recorders.
- Flags, ropes, etc., for establishing a grid.
- Personnel protective clothing and equipment specified by the site-specific health and safety plan.

5. PROCEDURES

5.1 SETUP

The following steps must be followed when preparing for the EM survey:

1. Review past disposal practices of the site to be surveyed so that buried targeted and nontargeted ferrous objects can be identified.
2. Review the site geology to determine if there are any variable geologic conditions or geologic features that may produce anomalies and affect detection of the target.
3. If anomalies are expected, estimate their intensities.
4. Determine whether the EM survey will be done horizontally, vertically, or a combination of both.
5. Set up a grid system based on the type of survey that has been selected.
6. Tie the grid system to existing "permanent" features (i.e., roads and buildings) so the grid may be copied easily in the field for the placement of drill holes and monitoring wells and for tracing plume movement.
7. Mark the grid system origin and key axes or nodes to ensure accurate placement of instrumentation.

5.2 CALIBRATION

EM instruments are calibrated by the manufacturer; however, on large projects requiring more than a day to complete, a local standard site in the field must be chosen to provide a

reference base station. This will allow the user to check for "drift" in the instrument's performance and permit correlation between instruments.

The following steps must be followed when calibrating the EM instruments:

1. Select a site and obtain a reading with the EM instrument.
2. In the field logbook, record the site, orientation of each coil to the ground (i.e., 45° with respect to ground), coil spacing, and the EM reading.
3. At the start of each subsequent day, obtain a reading at the test site with the same coil spacing and orientation as before.
4. Record this reading in the field logbook and setting and compare with the initial reading as a check for drift in the instrument.

5.3 HORIZONTAL OPERATION

The following steps must be followed when preparing for and performing a horizontal survey:

1. Tie the grid system to existing "permanent" features (i.e., roads and buildings) so the grid may be copied easily in the field for the placement of drill holes and monitoring wells and for tracing plume movement.
2. Space the grid stations between 10 and 30 m apart, depending on the area to be surveyed.
3. Determine the depth at which the survey will be performed and select the proper EM unit. The sampling depth of the EM equipment is a function of the instrument's coil spacing. The nominal sampling depth of an EM system is taken to be ~1.5 times the coil spacing.
4. Take a measurement at a particular site by placing the EM equipment at a station and taking the reading in accordance with the operating instructions for the particular instrument being used.
5. Record the reading and survey marks in the field logbook. Record survey marks and make comments even when a magnetic tape or a strip-chart recorder is being used.

5.4 VERTICAL OPERATION

The following steps must be followed when preparing for and performing a vertical survey:

1. Determine the stations at which the depth readings are desired.
2. Determine the depths at which data are desired.

3. Select EM equipment with the proper coil spacing to provide data at the required depth.
4. Take a measurement at a particular site by placing the EM equipment at a station and taking the reading in accordance with the operating instructions for the particular instrument being used.
5. Record the reading and survey marks in the field logbook. Record survey marks and make comments even when magnetic tape or a strip-chart recorder is being used.

6. RESTRICTIONS/LIMITATIONS

EM instrumentation has limitations with regard to sensitivity and penetration. Operator's manuals, published references, and field experience should be used to evaluate whether the instrumentation can achieve the desired goals. More specific EM instrumentation limitations are listed below.

- EM has less sounding (vertical) resolution than resistivity methods because of the limited number of depth intervals that it can be adjusted to read.
- The acquisition of data from depths of 0.75 to 60 m requires the use of three different EM systems having the necessary coil springs.
- An EM measurement is influenced more by shallower materials than deeper ones, and this must be considered when evaluating data.
- EM measurements become nonlinear in zones of very high conductivity.
- The EM method is susceptible to noise from a number of sources including natural atmospheric noise, power lines, radio transmitters, buried metallic trash, pipes, cables, nearby fences, vehicles, and buildings.
- Data from EM surveys are considered to be screening data and, therefore, meet Data Quality Objective Level B requirements only.

7. REFERENCES

Air Force Engineering and Services Center, Engineering and Service Laboratory, *Groundwater Contamination Response Guide*, 1983.

U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, *Geophysical Techniques for Sensing Buried Wastes and Waste Migration.*

U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.1, 1987.

Appendix C: Pig's Eye Landfill–EM31 Data

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-450	610	10.8	-5.0
-440	610	11.6	-4.9
-430	610	15.8	-4.5
-420	610	22.2	-5.0
-410	610	25.6	-3.6
-400	610	30.4	-2.3
-390	610	32.4	-2.0
-380	610	30.0	-2.1
-370	610	29.4	-2.2
-360	610	28.6	-2.7
-350	610	30.2	-1.3
-340	610	27.0	-2.8
-330	610	28.2	-1.4
-320	610	22.6	-4.0
-310	610	20.8	-4.4
-300	610	20.6	-4.2
-290	610	23.0	-4.3
-280	610	24.4	-3.1
-270	610	35.8	-2.3
-260	610	41.4	-1.5
-250	610	48.0	-1.0
-220	610	59.8	-2.6
-210	610	59.6	-0.6
-200	610	64.0	-0.6
-190	610	58.4	-0.4
-180	610	55.0	-0.9
-170	610	55.4	-2.2
-160	610	54.6	-3.4
-150	610	50.8	-2.9
-140	610	54.6	-0.5
-130	610	63.0	-2.1
-120	610	63.0	-5.8
-110	610	64.4	-1.9
-100	610	49.2	-7.7
-90	610	36.8	1.1
-80	610	45.0	-2.5
-70	610	51.0	0.0
-60	610	46.6	-0.8
-50	610	48.6	-2.6
-40	610	42.6	-3.3
-30	610	46.8	0.3
-20	610	41.8	0.4
-10	610	35.0	-9.3
0	610	38.4	-2.8
-450	700	11.0	-5.1
-440	700	16.0	-4.5
-430	700	20.6	-4.7
-420	700	24.2	-4.6
-410	700	26.4	-4.1

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-400	700	29.8	-3.7
-390	700	31.4	-3.1
-380	700	30.6	-3.4
-370	700	28.2	-4.1
-360	700	29.0	-4.1
-350	700	25.6	-3.4
-340	700	25.0	-7.2
-330	700	17.6	-15.1
-320	700	21.6	-13.8
-310	700	34.0	-4.0
-300	700	35.6	-2.2
-290	700	36.6	-2.9
-280	700	41.6	-5.1
-270	700	42.8	-6.4
-260	700	39.8	-3.8
-250	700	48.0	-5.3
-240	700	50.6	-2.3
-230	700	56.4	1.6
-220	700	48.4	0.6
-210	700	51.6	-1.6
-200	700	56.0	0.1
-190	700	55.6	2.0
-180	700	53.8	-0.5
-170	700	56.2	0.3
-160	700	58.4	-0.2
-150	700	58.0	0.1
-140	700	58.4	-0.5
-130	700	61.0	-2.3
-120	700	57.6	-1.9
-110	700	57.4	1.6
-100	700	48.6	-0.8
-90	700	45.4	-1.8
-80	700	45.6	-1.8
-70	700	44.6	-0.9
-60	700	45.6	0.1
-50	700	47.6	-3.0
-40	700	49.2	-3.1
-30	700	59.8	-1.0
-20	700	60.2	2.0
-10	700	60.8	-3.4
0	700	68.4	0.0
-450	790	15.8	-4.8
-440	790	16.4	-4.9
-430	790	26.2	-4.8
-420	790	32.8	-2.2
-410	790	30.6	-2.6
-400	790	30.6	-2.6
-390	790	35.8	-0.6
-380	790	38.2	-0.9

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-370	790	45.4	-1.6
-360	790	51.6	-5.6
-350	790	51.6	-2.9
-340	790	38.4	-3.5
-330	790	33.2	-16.3
-320	790	40.0	-7.8
-310	790	64.4	-1.8
-300	790	70.2	-4.7
-290	790	65.6	-1.8
-280	790	25.8	-6.7
-270	790	25.0	1.1
-260	790	5.4	-11.4
-250	790	4.2	-17.4
-240	790	33.0	0.6
-230	790	59.2	-4.8
-220	790	49.4	-2.1
-210	790	47.0	-0.6
-200	790	43.8	-0.8
-190	790	43.8	-2.0
-180	790	39.8	-2.4
-170	790	42.6	-3.9
-160	790	40.4	-3.4
-150	790	43.2	-4.8
-140	790	41.8	-2.9
-130	790	45.6	-3.7
-120	790	45.8	-3.5
-110	790	47.2	-4.0
-100	790	47.8	-3.3
-90	790	49.0	-2.8
-80	790	49.4	-0.8
-70	790	50.8	-3.5
-60	790	48.4	-3.2
-50	790	54.2	-1.7
-40	790	53.0	-1.0
-30	790	49.6	-1.8
-20	790	51.4	-1.7
-10	790	49.0	-2.2
0	790	45.8	-1.8
-450	880	18.2	-5.7
-440	880	23.6	-6.3
-430	880	30.8	-3.3
-420	880	-10.6	-9.9
-410	880	-22.8	-11.5
-400	880	7.8	-7.1
-390	880	6.0	-6.7
-380	880	48.6	-9.1
-370	880	16.4	-2.6
-360	880	21.6	-6.0
-350	880	-30.8	-12.4

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-340	880	7.4	-5.5
-330	880	57.8	-6.6
-320	880	43.0	-2.2
-310	880	52.0	1.5
-300	880	55.0	-2.2
-290	880	57.6	-1.1
-280	880	61.2	-2.0
-270	880	64.8	-1.3
-260	880	66.4	-1.8
-250	880	68.8	-2.3
-240	880	62.6	-2.5
-230	880	64.0	-3.3
-220	880	70.0	-0.4
-210	880	73.8	-0.6
-200	880	71.2	-2.2
-190	880	66.6	-2.4
-180	880	64.2	-3.5
-170	880	60.8	-3.3
-160	880	54.2	-1.0
-150	880	51.4	-1.2
-140	880	56.6	-0.3
-130	880	58.0	-2.4
-120	880	51.6	-0.4
-110	880	50.4	-0.8
-100	880	49.2	-2.1
-90	880	48.6	-2.7
-80	880	48.2	-2.8
-70	880	49.4	-3.3
-60	880	50.8	-2.3
-50	880	52.0	-1.8
-40	880	49.8	-1.6
-30	880	47.8	-1.6
-20	880	46.6	-3.1
-10	880	49.2	-1.6
0	880	48.8	-1.8
-470	970	27.0	-4.5
-460	970	33.2	-5.0
-450	970	40.2	-6.1
-440	970	49.4	-0.4
-430	970	17.8	-3.1
-420	970	9.4	-3.7
-410	970	53.4	-1.4
-400	970	35.8	-1.6
-390	970	40.6	-1.2
-380	970	59.6	-0.9
-370	970	69.4	-0.9
-360	970	69.8	1.2
-350	970	74.8	2.8
-340	970	62.2	-0.9

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-330	970	55.2	-3.6
-320	970	43.6	-3.2
-310	970	58.4	-5.5
-300	970	34.2	-4.1
-290	970	56.6	-2.0
-280	970	53.6	-2.9
-270	970	36.4	0.0
-260	970	31.6	1.6
-250	970	37.0	-1.6
-240	970	19.6	3.6
-230	970	29.0	-3.7
-220	970	47.6	-0.4
-210	970	44.0	1.2
-200	970	29.2	-3.1
-190	970	34.2	-2.7
-180	970	46.2	-2.8
-170	970	53.4	0.5
-160	970	72.4	-1.5
-150	970	75.4	-1.3
-140	970	74.8	-1.1
-130	970	72.4	-1.6
-120	970	68.2	-1.7
-110	970	66.4	-2.3
-100	970	60.0	-3.6
-90	970	53.0	-4.2
-80	970	53.6	-3.3
-70	970	51.6	-2.2
-60	970	48.6	-1.8
-50	970	47.2	-1.3
-40	970	46.0	-1.4
-30	970	45.2	-1.3
-20	970	46.2	-1.6
-10	970	48.0	-1.3
0	970	50.2	-1.8
-480	1060	40.2	-3.6
-470	1060	52.4	-0.6
-460	1060	56.0	-5.6
-450	1060	83.4	3.1
-440	1060	90.2	1.9
-430	1060	71.2	-2.9
-420	1060	46.0	-9.4
-410	1060	59.6	-3.0
-400	1060	46.6	-1.9
-390	1060	40.0	4.9
-380	1060	34.2	-3.9
-370	1060	27.6	-6.3
-360	1060	42.4	1.2
-350	1060	74.0	2.8
-340	1060	62.0	-0.9

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-330	1060	48.2	-3.1
-320	1060	48.4	1.0
-310	1060	64.2	-0.3
-300	1060	67.2	-1.4
-290	1060	67.0	-1.1
-280	1060	66.4	-1.0
-270	1060	68.6	-2.3
-260	1060	71.2	-0.4
-250	1060	69.2	0.3
-240	1060	64.6	-0.7
-230	1060	61.2	-1.9
-220	1060	63.0	-3.4
-210	1060	73.0	-0.5
-200	1060	82.8	-0.5
-190	1060	81.2	0.0
-180	1060	72.4	-0.5
-170	1060	88.6	-0.1
-160	1060	88.2	0.6
-150	1060	86.8	0.9
-140	1060	79.0	-0.2
-130	1060	78.0	-0.2
-120	1060	76.6	0.2
-110	1060	73.2	-0.4
-100	1060	71.0	-1.1
-90	1060	68.8	-1.2
-80	1060	67.6	-1.2
-70	1060	67.6	-1.6
-60	1060	66.6	-1.5
-50	1060	63.4	-1.9
-40	1060	57.2	-2.7
-30	1060	55.4	-2.4
-20	1060	53.2	-2.0
-10	1060	52.6	-1.7
0	1060	52.0	-0.9
-520	1150	24.6	-4.3
-510	1150	33.2	-1.8
-500	1150	32.2	1.6
-490	1150	56.0	-0.3
-480	1150	56.2	-0.9
-470	1150	58.0	2.0
-460	1150	46.4	-7.6
-450	1150	19.2	-5.2
-440	1150	59.0	1.0
-430	1150	63.4	0.9
-420	1150	62.2	1.3
-410	1150	59.8	2.3
-400	1150	62.2	-1.2
-390	1150	46.2	-2.6
-380	1150	62.6	-1.2

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-370	1150	83.0	1.8
-360	1150	88.8	-0.9
-350	1150	103.4	0.6
-340	1150	95.0	1.0
-330	1150	77.8	0.3
-320	1150	66.6	-2.0
-310	1150	59.8	-1.6
-300	1150	60.2	-0.9
-290	1150	62.8	-1.0
-280	1150	64.0	-0.7
-270	1150	64.6	-1.3
-260	1150	66.8	-0.8
-250	1150	67.0	-0.3
-240	1150	71.6	-1.1
-230	1150	77.0	-0.4
-220	1150	79.6	-0.8
-210	1150	80.2	0.2
-200	1150	78.0	-0.4
-190	1150	76.8	0.9
-180	1150	71.4	0.7
-170	1150	67.8	1.0
-160	1150	64.0	1.9
-150	1150	58.4	3.6
-140	1150	53.8	4.3
-130	1150	50.0	4.4
-120	1150	56.2	3.3
-110	1150	62.2	3.4
-100	1150	64.4	2.5
-90	1150	65.4	2.0
-80	1150	65.2	1.3
-70	1150	65.0	0.1
-60	1150	63.6	-0.3
-50	1150	60.0	-0.2
-40	1150	61.0	-0.9
-30	1150	57.4	-1.3
-20	1150	55.4	-1.7
-10	1150	58.4	-2.0
0	1150	59.2	-2.0
-600	1240	31.8	-4.7
-590	1240	36.2	-3.1
-580	1240	41.0	1.2
-570	1240	41.2	-0.6
-560	1240	55.6	1.0
-550	1240	53.2	-0.8
-540	1240	58.2	-2.5
-530	1240	68.0	1.2
-520	1240	79.8	0.9
-510	1240	86.2	0.8
-500	1240	75.2	8.6

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-490	1240	66.2	2.9
-480	1240	47.2	3.0
-470	1240	61.0	2.4
-460	1240	43.8	0.9
-450	1240	61.4	-0.3
-440	1240	68.8	3.6
-430	1240	62.2	6.0
-420	1240	45.2	-1.3
-410	1240	47.0	-9.8
-400	1240	61.2	-2.5
-390	1240	59.2	4.4
-380	1240	64.0	2.5
-370	1240	61.0	2.1
-360	1240	54.8	2.4
-350	1240	40.8	6.5
-340	1240	46.6	19.2
-330	1240	60.2	21.3
-320	1240	55.4	6.2
-310	1240	59.2	2.3
-300	1240	59.8	0.5
-290	1240	56.8	0.0
-280	1240	58.6	-0.1
-270	1240	60.6	-0.3
-260	1240	66.0	0.7
-250	1240	65.2	1.7
-240	1240	66.8	0.6
-230	1240	64.0	-0.4
-220	1240	65.0	0.0
-210	1240	66.2	-0.4
-200	1240	66.0	-0.5
-190	1240	65.6	-0.4
-180	1240	65.6	-0.8
-170	1240	66.8	-0.9
-160	1240	66.4	-1.6
-150	1240	66.6	-1.8
-140	1240	74.2	-1.1
-130	1240	71.6	-1.2
-120	1240	69.0	-1.3
-110	1240	69.0	-1.5
-100	1240	69.4	-1.7
-90	1240	64.8	-1.3
-80	1240	63.4	-2.7
-70	1240	65.4	-2.1
-60	1240	64.6	-1.7
-50	1240	66.8	-1.8
-40	1240	66.8	-1.6
-30	1240	66.6	-1.8
-20	1240	65.6	-1.9
-10	1240	61.6	-2.3

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
0	1240	56.8	-3.3
-630	1330	37.6	-0.7
-620	1330	44.8	0.0
-610	1330	50.4	-1.3
-600	1330	61.0	0.2
-590	1330	62.2	-0.6
-580	1330	62.2	-1.3
-570	1330	63.6	2.4
-560	1330	64.2	3.1
-550	1330	61.8	3.4
-540	1330	63.4	3.3
-530	1330	57.4	5.7
-520	1330	46.2	-1.2
-510	1330	44.8	0.7
-500	1330	55.0	-7.0
-490	1330	43.8	-6.7
-480	1330	37.2	8.9
-470	1330	41.6	9.3
-460	1330	52.6	6.5
-450	1330	74.6	5.6
-440	1330	95.8	8.5
-430	1330	102.0	10.6
-420	1330	123.4	12.7
-410	1330	115.4	13.6
-400	1330	115.4	10.6
-390	1330	126.6	17.1
-380	1330	126.6	12.8
-370	1330	107.6	12.1
-360	1330	92.2	7.8
-350	1330	97.8	6.6
-340	1330	64.8	-1.8
-330	1330	65.2	1.3
-320	1330	59.2	3.9
-310	1330	54.4	3.0
-300	1330	66.6	2.8
-290	1330	58.4	2.3
-280	1330	51.6	2.9
-270	1330	47.8	2.3
-260	1330	45.2	-0.3
-250	1330	41.8	-1.0
-240	1330	43.0	-0.9
-230	1330	45.4	-2.3
-220	1330	42.4	-1.6
-210	1330	45.0	-0.9
-200	1330	54.4	-0.6
-190	1330	57.6	0.3
-180	1330	63.2	1.3
-170	1330	89.2	3.9
-160	1330	87.2	1.4

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-150	1330	85.0	2.0
-140	1330	65.4	-0.1
-130	1330	61.4	2.0
-120	1330	62.8	-0.2
-110	1330	60.8	-2.0
-100	1330	60.2	2.0
-90	1330	63.8	-0.5
-80	1330	63.0	-0.1
-70	1330	63.2	0.0
-60	1330	66.0	2.2
-50	1330	66.2	-0.8
-40	1330	65.2	13.7
-30	1330	68.2	6.2
-20	1330	66.2	2.1
-10	1330	70.8	4.9
0	1330	69.2	11.0
-640	1420	35.4	-1.6
-630	1420	38.2	-1.4
-620	1420	44.4	2.4
-610	1420	43.2	-1.1
-600	1420	43.2	1.1
-590	1420	31.2	5.6
-580	1420	27.0	3.0
-570	1420	26.4	-3.4
-560	1420	58.2	5.5
-550	1420	67.2	3.8
-540	1420	72.0	11.1
-530	1420	84.0	6.9
-520	1420	109.8	16.3
-510	1420	125.4	17.7
-500	1420	148.2	22.1
-490	1420	182.4	36.5
-480	1420	183.0	44.5
-470	1420	174.0	44.5
-460	1420	166.2	44.5
-450	1420	177.0	44.5
-440	1420	169.2	44.5
-430	1420	172.2	44.5
-420	1420	175.2	44.5
-410	1420	202.2	44.5
-400	1420	229.8	44.5
-390	1420	266.4	44.5
-380	1420	207.0	44.5
-370	1420	247.2	44.5
-360	1420	231.6	44.5
-350	1420	211.8	44.5
-340	1420	210.4	26.6
-330	1420	170.0	18.9
-320	1420	121.4	-0.3

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-310	1420	88.8	13.0
-300	1420	55.4	-5.2
-290	1420	62.0	0.6
-280	1420	50.6	0.8
-270	1420	45.8	0.0
-260	1420	42.2	-1.5
-250	1420	39.2	-1.2
-240	1420	40.6	-0.6
-230	1420	43.4	-1.6
-220	1420	51.4	-1.7
-210	1420	35.0	-3.2
-200	1420	36.0	31.3
-190	1420	132.8	9.3
-180	1420	215.2	5.3
-170	1420	204.0	7.1
-160	1420	278.8	35.2
-150	1420	134.0	5.5
-140	1420	82.0	-4.8
-130	1420	87.6	-1.1
-120	1420	66.8	3.8
-110	1420	76.0	0.5
-100	1420	77.8	0.4
-90	1420	79.4	5.1
-80	1420	80.6	0.8
-70	1420	79.6	0.4
-60	1420	79.2	1.4
-50	1420	80.0	0.5
-40	1420	77.2	-0.6
-30	1420	73.0	0.3
-20	1420	66.2	0.4
-10	1420	62.0	-0.8
0	1420	59.4	-0.7
-640	1510	45.0	-0.5
-630	1510	56.4	0.1
-620	1510	54.0	4.1
-610	1510	69.0	3.7
-600	1510	81.0	3.9
-590	1510	100.8	7.9
-580	1510	146.4	12.7
-570	1510	143.4	17.3
-560	1510	152.4	33.1
-550	1510	205.2	44.5
-540	1510	224.4	44.5
-530	1510	143.4	44.5
-520	1510	232.0	44.5
-510	1510	336.0	44.5
-500	1510	174.0	44.5
-490	1510	312.0	44.5
-480	1510	270.0	44.5

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-470	1510	141.6	37.5
-460	1510	160.2	27.4
-450	1510	210.0	44.5
-440	1510	126.0	38.1
-430	1510	171.0	31.3
-420	1510	168.6	27.3
-410	1510	91.8	17.4
-400	1510	53.4	9.7
-390	1510	47.4	9.5
-380	1510	42.0	9.0
-370	1510	46.8	11.1
-360	1510	43.8	10.4
-350	1510	45.0	10.2
-340	1510	50.4	11.6
-330	1510	82.8	14.8
-320	1510	176.4	36.3
-310	1510	165.0	33.9
-300	1510	184.2	34.4
-290	1510	163.2	23.9
-280	1510	162.0	22.7
-270	1510	177.0	22.3
-260	1510	172.8	23.2
-250	1510	174.6	23.5
-240	1510	115.8	15.1
-230	1510	139.2	12.7
-220	1510	125.4	10.7
-210	1510	121.2	9.3
-200	1510	89.8	6.1
-190	1510	76.2	3.4
-180	1510	76.0	3.8
-640	1600	105.6	10.4
-630	1600	134.4	20.4
-620	1600	174.0	29.3
-610	1600	166.8	33.1
-600	1600	146.4	38.3
-590	1600	197.4	33.5
-580	1600	184.2	39.0
-570	1600	177.6	41.5
-560	1600	190.2	44.6
-550	1600	90.6	21.4
-540	1600	258.6	44.6
-530	1600	200.4	44.5
-520	1600	198.0	44.6
-510	1600	189.0	44.6
-500	1600	183.0	44.6
-490	1600	152.4	44.6
-480	1600	143.4	43.4
-470	1600	136.8	44.6
-460	1600	165.0	44.6

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-450	1600	211.2	44.6
-440	1600	197.4	44.6
-430	1600	212.4	44.5
-420	1600	217.2	44.6
-410	1600	216.6	44.5
-610	1690	74.4	4.9
-600	1690	92.4	5.1
-590	1690	113.4	5.1
-580	1690	117.6	11.9
-570	1690	123.0	13.4
-560	1690	130.8	20.8
-550	1690	157.8	27.3
-540	1690	163.8	30.4
-530	1690	212.4	35.1
-520	1690	196.2	44.6
-510	1690	207.6	44.6
-500	1690	303.6	44.6
-490	1690	242.4	44.6
-480	1690	272.4	44.6
-470	1690	206.4	44.6
-460	1690	194.4	44.6
-450	1690	178.8	44.6
-440	1690	171.6	44.6
-430	1690	216.0	44.6
-420	1690	208.2	44.6
-410	1690	183.0	44.6
-400	1690	171.0	44.6
-390	1690	151.2	44.6
-380	1690	154.2	44.6
-370	1690	181.8	44.6
-360	1690	172.8	44.6
-520	1870	69.0	3.3
-510	1870	81.6	4.2
-500	1870	75.6	0.7
-490	1870	56.4	-8.7
-480	1870	75.6	1.2
-470	1870	78.0	3.0
-460	1870	103.2	4.6
-450	1870	105.6	7.7
-440	1870	106.2	9.9
-430	1870	114.0	4.7
-420	1870	102.0	11.0
-410	1870	81.6	16.2
-400	1870	85.2	-3.4
-390	1870	85.8	8.4
-380	1870	87.6	7.6
-370	1870	100.2	6.4
-360	1870	105.6	7.3
-460	1960	51.6	3.1

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-450	1960	52.2	-0.1
-440	1960	30.6	1.9
-430	1960	63.6	-0.9
-420	1960	66.0	1.3
-410	1960	62.4	0.5
-400	1960	61.2	-0.8
-390	1960	67.8	1.5
-380	1960	75.0	-0.8
-370	1960	68.4	3.5
-360	1960	75.6	-0.5
-350	1960	82.2	2.6
-340	1960	70.8	4.2
-330	1960	73.2	7.9
-320	1960	86.4	16.3
-310	1960	116.4	44.6
-300	1960	141.0	44.6
-290	1960	250.8	44.5
-280	1960	219.0	44.5
-270	1960	147.6	44.6
-260	1960	100.0	19.7
-250	1960	85.4	6.4
-240	1960	84.2	6.0
-230	1960	79.4	6.7
-220	1960	72.4	5.9
-210	1960	78.8	3.6
-200	1960	75.0	-0.7
-190	1960	52.4	5.7
-180	1960	51.4	-15.5
1440	1960	65.4	-3.0
1450	1960	70.2	-1.9
1460	1960	73.6	0.6
1470	1960	75.0	1.4
1480	1960	57.8	-13.3
1490	1960	60.6	-8.0
1500	1960	61.8	-5.6
1510	1960	62.4	-6.5
1520	1960	71.8	-2.0
1530	1960	56.6	-7.0
1540	1960	69.0	-4.9
1550	1960	77.2	-2.3
1560	1960	58.8	-1.4
1570	1960	60.8	2.9
1580	1960	44.4	2.9
1590	1960	62.4	-3.5
1600	1960	75.2	7.4
1610	1960	79.6	3.7
1620	1960	84.6	1.5
1630	1960	85.2	0.5
1640	1960	94.6	6.5

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1650	1960	72.6	-8.7
1660	1960	78.4	-3.4
1670	1960	63.8	-2.4
1680	1960	56.8	-2.4
1690	1960	52.0	-2.0
1700	1960	58.0	-1.8
1710	1960	59.8	-1.0
1720	1960	52.6	-1.9
1730	1960	49.8	-2.1
1740	1960	51.8	-1.7
1750	1960	51.0	-1.9
1760	1960	48.8	-0.6
-390	2050	55.2	1.3
-380	2050	61.4	-1.1
-370	2050	58.8	-2.6
-360	2050	57.2	-1.4
-350	2050	56.4	-3.4
-340	2050	56.2	-1.8
-330	2050	55.2	-1.4
-320	2050	54.8	-1.9
-310	2050	56.2	-2.4
-300	2050	52.0	0.4
-290	2050	53.8	1.5
-280	2050	63.2	5.7
-270	2050	64.4	-1.3
-260	2050	58.4	4.8
-250	2050	57.6	2.6
-240	2050	59.8	-0.2
-230	2050	71.4	3.0
-220	2050	75.8	2.6
-210	2050	79.0	1.7
-200	2050	80.2	3.4
-190	2050	83.8	0.7
-180	2050	87.6	0.8
-330	2140	67.2	0.9
-320	2140	74.2	-0.3
-310	2140	76.4	-0.2
-300	2140	75.0	-0.6
-290	2140	70.6	-0.8
-280	2140	67.2	-2.7
-270	2140	71.2	-2.1
-260	2140	69.8	-0.7
-250	2140	75.2	-2.0
-240	2140	76.6	0.4
-230	2140	75.8	0.3
-220	2140	77.2	-1.1
-210	2140	72.2	-0.5
-200	2140	77.0	-2.8
-190	2140	75.0	1.6

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-180	2140	77.2	0.2
-170	2140	73.0	-0.2
-160	2140	69.0	1.9
-150	2140	57.8	0.6
-140	2140	57.4	-0.4
-130	2140	55.4	-0.2
-120	2140	57.6	1.1
-110	2140	74.4	1.4
-100	2140	97.8	3.8
-90	2140	144.0	12.2
-80	2140	178.2	24.0
-70	2140	192.6	30.6
-60	2140	214.0	25.6
-50	2140	254.0	35.5
-40	2140	242.0	41.9
-30	2140	206.0	44.3
-20	2140	428.0	44.3
-10	2140	570.0	44.3
0	2140	412.0	44.3
1440	2140	54.4	-2.1
1450	2140	60.2	-4.2
1460	2140	60.2	-3.1
1470	2140	56.6	-5.6
1480	2140	56.4	-1.9
1490	2140	65.0	2.4
1500	2140	56.4	-1.0
1510	2140	64.0	-3.5
1520	2140	63.2	-4.3
1530	2140	60.8	-2.8
1540	2140	69.4	-1.4
1550	2140	61.8	-13.4
1560	2140	63.4	-10.1
1570	2140	71.6	0.0
1580	2140	60.0	-1.0
1590	2140	39.8	-3.3
1600	2140	49.0	-9.8
1610	2140	54.4	-1.6
1620	2140	50.2	-11.1
1630	2140	61.4	-7.3
1640	2140	51.0	-6.9
1650	2140	51.4	-8.8
1660	2140	56.2	-3.2
1670	2140	47.4	-6.9
1680	2140	49.6	-3.8
-280	2230	75.0	2.9
-270	2230	79.2	1.0
-260	2230	66.2	-2.6
-250	2230	79.2	-0.4
-240	2230	76.6	0.9

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
-230	2230	78.6	-1.8
-220	2230	78.6	-2.2
-210	2230	81.2	0.2
-200	2230	85.6	-1.6
-190	2230	83.2	-1.0
-180	2230	79.0	-0.4
-170	2230	79.6	-2.6
-160	2230	73.0	-2.9
-150	2230	64.4	-1.0
-140	2230	58.8	-1.6
-130	2230	55.8	-2.6
-120	2230	50.6	-2.4
-110	2230	47.2	-2.7
-100	2230	46.4	-1.8
-90	2230	45.0	-0.2
-80	2230	55.8	-3.1
-70	2230	72.0	2.3
-60	2230	108.0	5.1
-50	2230	153.6	11.9
-40	2230	214.0	26.6
-30	2230	240.0	44.3
-20	2230	248.0	44.3
-10	2230	282.0	44.3
0	2230	290.0	44.3
-220	2320	49.0	-0.5
-210	2320	52.8	-0.1
-200	2320	53.0	-0.5
-190	2320	50.6	-1.9
-180	2320	49.6	-2.1
-170	2320	48.4	-2.0
-160	2320	49.0	-2.6
-150	2320	47.8	-3.5
-140	2320	51.4	-3.7
-130	2320	55.2	-3.4
-120	2320	58.8	-3.0
-110	2320	55.8	-2.7
-100	2320	55.8	-1.2
-90	2320	49.4	-1.5
-80	2320	43.6	0.4
-70	2320	35.4	-1.4
-60	2320	43.2	-2.3
-50	2320	46.8	-0.5
-40	2320	58.8	-2.1
-30	2320	81.6	-0.8
-20	2320	166.2	17.1
-10	2320	168.0	17.1
0	2320	134.4	7.8
1440	2320	146.8	4.2
1450	2320	152.4	5.7

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1460	2320	158.4	4.8
1470	2320	144.6	2.5
1480	2320	140.4	5.6
1490	2320	136.8	1.8
1500	2320	115.8	0.0
1510	2320	124.2	0.0
1520	2320	118.2	0.7
1530	2320	109.8	-0.4
1540	2320	82.2	-7.1
1550	2320	78.0	-7.7
1560	2320	88.8	-0.3
1570	2320	80.4	-0.6
1580	2320	75.6	-1.0
1590	2320	69.0	-2.8
1600	2320	59.4	-1.6
1610	2320	64.2	-1.3
1620	2320	66.6	-0.3
1630	2320	55.8	1.0
1640	2320	60.6	-4.2
1650	2320	60.0	-2.7
1660	2320	61.2	-2.8
1670	2320	43.8	-7.3
1680	2320	52.8	-2.2
1690	2320	57.0	-3.0
-170	2410	46.6	-0.6
-160	2410	47.2	-1.2
-150	2410	57.2	-1.8
-140	2410	51.6	-1.5
-130	2410	52.0	-2.2
-120	2410	48.8	-2.2
-110	2410	35.8	-0.3
-100	2410	28.4	-3.9
-90	2410	14.2	-3.6
-80	2410	6.4	-9.5
-70	2410	30.2	-3.1
-60	2410	26.8	-3.5
-50	2410	27.6	-3.7
-40	2410	29.6	-3.7
-30	2410	30.6	-3.7
-20	2410	31.2	-3.7
-10	2410	32.4	-3.9
0	2410	34.2	-3.8
10	2410	39.6	-3.7
20	2410	48.0	-3.1
30	2410	42.0	-3.5
40	2410	42.6	-2.8
50	2410	47.4	-2.5
60	2410	52.2	-2.1
70	2410	55.2	-1.6

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
80	2410	55.8	-0.3
90	2410	59.4	0.2
100	2410	64.2	0.1
110	2410	71.4	-0.1
120	2410	77.4	-0.2
130	2410	84.6	1.0
140	2410	96.6	2.9
150	2410	90.6	3.4
160	2410	80.4	2.8
170	2410	72.6	1.8
180	2410	69.6	1.1
-90	2500	32.0	-2.6
-80	2500	40.4	-1.2
-70	2500	28.8	-0.6
-60	2500	21.6	-1.2
-50	2500	17.2	-0.3
-40	2500	18.6	-0.4
-30	2500	22.0	-3.7
-20	2500	21.6	-3.7
-10	2500	22.8	-3.7
0	2500	22.8	-2.0
10	2500	26.4	-3.1
70	2500	54.0	-1.7
80	2500	38.4	-2.6
90	2500	43.8	-2.4
100	2500	47.4	-1.5
110	2500	52.2	-1.5
120	2500	58.8	-0.4
130	2500	64.8	0.5
140	2500	78.0	0.9
150	2500	81.6	0.4
160	2500	91.8	1.4
170	2500	105.6	4.6
180	2500	106.8	4.9
1440	2500	52.2	-6.9
1450	2500	60.0	-3.7
1460	2500	64.2	-2.0
1470	2500	69.0	-1.3
1480	2500	73.2	0.5
1490	2500	72.6	-3.3
1500	2500	68.4	-1.0
1510	2500	68.4	-2.6
1520	2500	65.4	-2.6
1530	2500	70.2	-2.6
1540	2500	62.4	-0.4
1550	2500	67.2	-3.5
1560	2500	61.8	-2.5
1570	2500	60.0	0.2
1580	2500	62.4	-0.4

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1590	2500	61.8	3.9
1600	2500	68.4	-0.1
1610	2500	62.4	2.1
1620	2500	66.0	1.1
1630	2500	64.2	-1.2
-50	2590	18.0	-1.7
-40	2590	33.0	2.2
-30	2590	30.6	2.8
-20	2590	38.4	1.3
-10	2590	38.4	-0.6
0	2590	40.8	-2.0
10	2590	45.0	-3.6
20	2590	63.0	-1.4
30	2590	97.8	2.3
40	2590	123.0	5.7
50	2590	117.0	5.3
60	2590	143.4	7.9
70	2590	146.4	0.6
80	2590	158.4	11.6
90	2590	118.2	7.5
100	2590	124.8	8.9
110	2590	131.4	7.8
120	2590	124.8	8.3
130	2590	136.2	12.1
140	2590	121.8	10.0
150	2590	103.8	9.8
160	2590	84.0	3.7
170	2590	63.0	8.1
180	2590	71.4	3.9
190	2590	72.0	2.6
200	2590	73.2	0.3
210	2590	62.4	-0.9
220	2590	59.4	0.4
230	2590	53.4	-17.0
240	2590	52.8	-24.1
250	2590	85.2	1.7
260	2590	57.6	-0.2
270	2590	58.8	-6.8
280	2590	79.8	-1.3
290	2590	47.0	5.0
300	2590	66.0	0.0
310	2590	60.8	2.9
320	2590	54.0	-1.6
330	2590	62.0	0.3
340	2590	62.6	3.6
350	2590	60.8	1.8
360	2590	59.2	4.1
-10	2680	33.0	-2.7
0	2680	58.2	-0.2

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
10	2680	60.6	-0.5
20	2680	86.4	-1.2
30	2680	115.2	6.1
40	2680	126.6	8.3
50	2680	123.6	8.4
60	2680	132.6	10.5
70	2680	120.0	8.0
80	2680	120.0	7.4
90	2680	115.2	5.8
100	2680	129.0	8.7
110	2680	127.8	9.4
120	2680	105.0	4.5
130	2680	101.4	4.6
140	2680	109.8	7.7
150	2680	79.2	-5.9
160	2680	44.4	-5.4
170	2680	46.8	-0.3
180	2680	-9.6	-0.6
190	2680	24.0	-7.5
200	2680	9.0	-14.8
210	2680	-8.4	-18.8
220	2680	-3.0	-8.9
230	2680	10.8	-3.6
240	2680	39.6	-3.6
250	2680	50.4	-2.8
260	2680	59.4	-11.1
270	2680	50.4	-5.0
280	2680	45.0	1.5
290	2680	48.6	-6.6
300	2680	29.4	-24.0
310	2680	57.0	-5.3
320	2680	34.2	-2.0
330	2680	37.8	0.4
340	2680	40.8	-5.2
350	2680	58.2	-3.0
360	2680	81.6	1.4
1440	2680	102.6	-2.3
1450	2680	103.8	0.3
1460	2680	97.2	3.2
1470	2680	91.8	2.2
1480	2680	96.0	-0.5
1490	2680	86.4	-0.7
1500	2680	89.4	-3.6
1510	2680	78.6	-1.1
1520	2680	82.8	-0.7
1530	2680	71.4	-0.7
1540	2680	68.4	-3.8
1550	2680	60.0	-4.0
1560	2680	49.2	-9.5

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1570	2680	52.8	0.4
1580	2680	44.4	-5.7
1590	2680	33.6	-13.2
1600	2680	61.2	-0.6
1610	2680	52.8	1.3
1620	2680	52.2	1.5
1630	2680	48.0	-1.1
1640	2680	43.8	-2.8
1650	2680	42.0	-2.6
1660	2680	39.6	-3.1
1670	2680	28.2	-5.0
1680	2680	35.4	-3.6
1690	2680	39.0	-3.1
1700	2680	40.2	-4.2
1710	2680	36.0	-2.2
1720	2680	29.4	-5.0
1730	2680	22.2	-11.7
1740	2680	31.8	-7.7
1750	2680	50.4	-0.6
1760	2680	55.8	1.5
1770	2680	56.4	1.5
1780	2680	58.8	2.6
40	2770	39.0	-2.2
50	2770	79.8	1.6
60	2770	133.8	11.0
70	2770	219.0	29.5
80	2770	210.0	35.7
90	2770	250.2	44.4
100	2770	283.8	44.4
110	2770	301.8	44.4
120	2770	224.6	44.4
130	2770	279.2	44.4
140	2770	226.4	32.3
150	2770	162.2	10.8
160	2770	111.8	3.7
170	2770	81.2	0.9
180	2770	35.8	-2.0
190	2770	35.0	-10.0
200	2770	42.0	-7.8
210	2770	51.4	-5.3
220	2770	50.2	-2.7
230	2770	51.4	-4.0
240	2770	55.6	-4.8
250	2770	50.4	0.8
260	2770	48.4	-2.6
270	2770	60.6	-1.8
280	2770	62.2	-3.8
290	2770	49.4	-4.3
300	2770	50.2	-1.4

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
310	2770	43.0	-4.8
320	2770	41.2	-4.2
330	2770	45.6	-4.8
340	2770	70.0	1.1
350	2770	65.4	-9.7
360	2770	73.8	-3.2
130	2860	18.7	-4.6
140	2860	36.4	-1.1
150	2860	34.6	-1.4
160	2860	27.8	-2.5
170	2860	21.4	-3.4
180	2860	-6.1	-24.3
190	2860	-31.4	-31.8
200	2860	-3.1	-13.2
210	2860	10.8	-8.1
220	2860	9.0	-8.9
230	2860	-3.0	-11.9
240	2860	9.0	-6.4
250	2860	4.8	-7.1
260	2860	16.2	-5.7
270	2860	19.2	-3.5
280	2860	-2.4	-6.1
290	2860	11.4	-7.6
300	2860	34.8	2.7
310	2860	67.8	-2.6
320	2860	73.8	-1.6
330	2860	79.8	0.7
340	2860	85.8	-0.8
350	2860	88.2	2.9
360	2860	97.8	2.5
1440	2860	106.0	-8.5
1450	2860	92.4	-3.3
1460	2860	97.2	1.7
1470	2860	102.0	-0.1
1480	2860	86.4	1.2
1490	2860	90.6	1.7
1500	2860	91.2	3.3
1510	2860	77.4	2.6
1520	2860	78.6	1.0
1530	2860	86.4	-0.2
1540	2860	86.4	0.8
1550	2860	84.0	-1.5
1560	2860	69.6	-0.6
1570	2860	70.2	0.6
1580	2860	61.2	-2.6
1590	2860	57.6	-7.7
1600	2860	49.2	-13.4
1610	2860	45.6	-3.2
1620	2860	43.2	-1.1

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1630	2860	40.2	-4.4
1640	2860	39.4	-1.6
1650	2860	40.4	-2.1
1660	2860	36.6	-3.1
1670	2860	40.0	-3.8
1680	2860	39.0	-6.1
1690	2860	37.8	-7.8
1700	2860	23.6	-5.6
1710	2860	38.6	-3.9
1720	2860	43.8	-2.0
1730	2860	47.0	0.4
1740	2860	39.4	2.0
190	2950	16.2	-5.8
200	2950	36.6	0.3
210	2950	29.4	-0.3
220	2950	25.6	0.0
230	2950	24.2	-2.6
240	2950	4.0	-11.3
250	2950	21.2	-4.1
260	2950	37.6	-5.0
270	2950	28.4	2.7
280	2950	30.6	3.3
290	2950	31.6	-0.5
300	2950	46.0	0.3
310	2950	48.4	-4.1
320	2950	26.8	-6.7
330	2950	47.4	-6.5
340	2950	46.0	-9.3
350	2950	56.0	0.2
360	2950	47.0	-7.8
370	2950	68.0	-0.7
380	2950	79.0	0.1
390	2950	78.8	0.0
400	2950	63.4	1.6
410	2950	67.4	1.2
420	2950	66.2	3.0
430	2950	77.4	4.0
440	2950	91.8	2.5
450	2950	72.4	6.2
460	2950	85.0	3.2
470	2950	89.4	3.4
480	2950	79.6	2.5
490	2950	79.2	2.8
500	2950	96.8	3.5
510	2950	73.6	2.0
520	2950	58.6	5.8
530	2950	76.8	2.8
540	2950	49.4	1.1
550	2950	50.6	-2.7

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
560	2950	53.2	-2.9
570	2950	58.6	2.5
580	2950	70.8	-8.8
590	2950	46.6	6.1
600	2950	47.0	-7.6
610	2950	69.6	-2.7
620	2950	78.8	5.0
630	2950	78.0	4.8
640	2950	82.8	0.6
650	2950	84.2	4.5
660	2950	101.6	4.2
670	2950	57.8	-2.3
680	2950	59.4	-0.4
690	2950	75.4	0.7
700	2950	89.8	4.4
710	2950	95.6	4.5
720	2950	90.2	7.2
220	3040	22.8	-3.5
230	3040	30.0	-2.1
240	3040	30.6	-1.9
250	3040	28.8	-3.2
260	3040	7.2	-17.4
270	3040	-14.4	-9.0
280	3040	29.4	1.2
290	3040	19.2	-5.6
300	3040	13.8	-2.6
310	3040	26.4	-2.3
320	3040	30.4	-6.6
330	3040	39.2	-2.5
340	3040	45.2	-0.9
350	3040	47.6	-0.3
360	3040	45.2	-3.3
370	3040	46.0	-3.5
380	3040	44.2	-2.0
390	3040	38.8	-1.4
400	3040	39.4	1.7
410	3040	39.8	-0.4
420	3040	44.2	-1.2
430	3040	47.4	-0.2
440	3040	52.2	0.3
450	3040	55.2	-2.6
460	3040	61.8	-2.3
470	3040	68.2	0.2
480	3040	70.4	0.9
490	3040	70.6	1.9
500	3040	60.4	-1.9
510	3040	64.6	-1.6
520	3040	59.0	-2.2
530	3040	69.2	-2.6

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
540	3040	68.2	-3.6
550	3040	55.2	-2.4
560	3040	32.6	6.9
570	3040	47.6	2.2
580	3040	54.8	-2.2
590	3040	79.2	-6.9
600	3040	68.0	10.5
610	3040	53.4	-15.9
620	3040	71.4	-8.9
630	3040	75.6	0.8
640	3040	83.2	3.2
650	3040	80.0	2.4
660	3040	86.4	3.6
670	3040	77.6	-0.4
680	3040	67.8	-1.2
690	3040	76.4	0.8
700	3040	83.0	0.5
710	3040	84.4	2.5
720	3040	89.6	2.6
730	3040	88.8	2.9
740	3040	92.8	2.6
750	3040	86.4	2.6
760	3040	50.0	-10.2
770	3040	32.4	-10.3
780	3040	52.0	-2.7
790	3040	90.4	-2.1
800	3040	74.4	0.9
810	3040	119.6	8.0
820	3040	100.6	-3.1
830	3040	97.8	15.8
840	3040	95.4	10.5
850	3040	96.8	7.7
860	3040	95.0	6.3
870	3040	94.4	5.1
880	3040	80.2	3.7
890	3040	74.6	4.0
900	3040	81.8	5.9
910	3040	95.4	3.2
920	3040	104.8	5.9
930	3040	112.2	4.3
940	3040	120.6	4.2
950	3040	108.0	3.8
960	3040	114.0	5.7
970	3040	125.4	6.0
980	3040	102.0	6.7
990	3040	133.8	5.0
1000	3040	148.2	8.2
1010	3040	123.0	8.0
1020	3040	106.2	7.4

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1030	3040	103.8	10.1
1040	3040	81.0	4.9
1050	3040	87.0	11.7
1060	3040	80.4	6.0
1070	3040	67.2	8.2
1080	3040	44.4	-2.9
1090	3040	43.2	-4.2
1100	3040	43.8	-3.0
1110	3040	50.4	-4.4
1120	3040	54.0	-4.4
1130	3040	58.2	-3.2
1140	3040	67.8	-3.5
1150	3040	73.2	-3.7
1160	3040	76.8	-4.1
1170	3040	79.2	-1.1
1180	3040	86.4	-1.5
1190	3040	86.4	0.4
1200	3040	87.0	-0.9
1210	3040	92.4	-1.2
1220	3040	85.8	-1.1
1230	3040	85.8	-1.4
1240	3040	88.2	-1.3
1250	3040	87.0	1.8
1260	3040	91.8	2.9
1270	3040	90.6	-1.4
1280	3040	91.2	3.2
1290	3040	99.6	1.0
1300	3040	95.4	0.9
1310	3040	93.6	-3.3
1320	3040	93.6	-3.2
1330	3040	94.8	-2.3
1340	3040	98.4	3.5
1350	3040	85.8	-1.9
1360	3040	103.2	-3.8
1370	3040	90.6	0.3
1380	3040	95.4	-1.6
1390	3040	91.8	0.1
1400	3040	99.0	-1.8
1410	3040	97.8	-1.4
1420	3040	84.0	3.4
1430	3040	58.2	0.3
1440	3040	58.8	-0.1
1450	3040	60.6	5.0
1460	3040	45.6	1.3
1470	3040	54.6	2.2
1480	3040	49.8	2.6
1490	3040	46.2	2.8
1500	3040	45.0	-0.4
1510	3040	37.8	0.9

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1520	3040	30.0	-0.5
1530	3040	34.2	-1.7
1540	3040	32.4	-1.1
1550	3040	35.4	-1.6
1560	3040	37.2	-1.4
1570	3040	39.0	-1.6
1580	3040	36.0	-0.6
1590	3040	32.4	-1.0
1600	3040	30.6	-6.6
1610	3040	34.8	-3.0
1620	3040	42.0	-0.2
1630	3040	51.6	3.3
1640	3040	45.0	5.9
300	3130	28.8	-0.9
310	3130	27.6	-1.6
320	3130	25.8	-1.9
330	3130	27.0	-1.2
340	3130	24.6	-1.9
350	3130	22.2	-3.1
360	3130	22.2	-1.7
370	3130	21.6	-2.9
380	3130	21.0	-3.7
390	3130	19.8	-2.9
400	3130	34.2	-1.9
410	3130	38.4	-1.7
420	3130	24.6	-2.3
430	3130	44.4	-1.1
440	3130	55.2	5.6
450	3130	49.8	24.1
460	3130	41.4	-5.3
470	3130	34.8	-3.0
480	3130	27.6	-2.9
490	3130	32.4	-3.1
500	3130	31.2	-3.6
510	3130	35.4	-2.8
520	3130	37.2	-3.3
530	3130	39.6	-3.1
540	3130	51.6	-2.9
550	3130	55.8	-2.8
560	3130	67.2	-2.1
570	3130	79.8	-2.3
580	3130	87.6	-2.4
590	3130	66.0	0.8
600	3130	66.0	-4.1
610	3130	69.0	-7.9
620	3130	69.6	-4.3
630	3130	90.0	-0.7
640	3130	115.2	2.5
650	3130	112.8	2.2

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
660	3130	106.8	8.9
670	3130	117.0	1.1
680	3130	84.0	-1.7
690	3130	86.4	0.1
700	3130	79.8	-2.0
710	3130	84.6	-1.6
720	3130	67.8	-3.6
730	3130	51.6	-5.4
740	3130	78.0	0.1
750	3130	116.4	6.3
760	3130	84.6	5.9
770	3130	142.2	11.7
780	3130	134.4	20.0
790	3130	112.2	13.1
800	3130	101.4	15.0
810	3130	100.2	16.1
820	3130	116.4	13.8
830	3130	118.8	11.8
840	3130	130.2	15.1
850	3130	143.4	17.8
860	3130	135.6	18.5
870	3130	151.8	12.6
880	3130	158.4	15.4
890	3130	121.8	11.8
900	3130	97.2	10.4
910	3130	89.4	8.9
920	3130	75.0	5.5
930	3130	65.4	4.4
940	3130	59.4	3.1
950	3130	55.8	3.8
960	3130	48.6	0.6
970	3130	48.6	2.2
980	3130	40.2	1.3
990	3130	36.6	1.2
1000	3130	35.4	-1.7
1010	3130	36.0	-1.0
1020	3130	39.0	-0.7
1030	3130	46.2	-1.5
1040	3130	56.4	-0.8
1050	3130	67.8	0.1
1060	3130	75.0	0.7
1070	3130	83.4	-0.5
1080	3130	89.4	0.9
1090	3130	94.2	-0.5
1100	3130	98.4	1.2
1110	3130	99.0	0.5
1120	3130	103.8	-0.2
1130	3130	99.0	0.7
1140	3130	99.6	-0.3

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1150	3130	100.8	0.7
1160	3130	94.2	-0.3
1170	3130	89.4	-0.3
1180	3130	91.2	1.8
1190	3130	102.0	-1.4
1200	3130	106.2	2.7
1210	3130	112.2	3.1
1220	3130	128.4	3.6
1230	3130	118.8	5.9
1240	3130	118.2	4.3
1250	3130	105.6	3.0
1260	3130	96.0	2.3
1270	3130	102.6	8.8
1280	3130	111.0	4.5
1290	3130	95.4	10.0
1300	3130	77.2	2.9
1310	3130	77.2	8.2
1320	3130	73.6	8.4
1330	3130	77.0	6.2
1340	3130	47.2	-9.4
1350	3130	73.4	0.4
1360	3130	52.2	8.0
1370	3130	67.4	-3.7
1380	3130	112.2	26.5
1390	3130	127.8	41.8
1400	3130	124.2	13.2
1410	3130	49.6	4.5
1420	3130	52.6	8.9
1430	3130	56.6	5.7
1440	3130	62.4	4.2
1450	3130	57.6	4.0
1460	3130	56.2	4.5
1470	3130	58.6	4.4
1480	3130	54.4	3.8
1490	3130	50.4	2.1
1500	3130	47.4	4.4
1510	3130	50.2	1.8
1520	3130	52.8	-0.6
1530	3130	46.8	-2.1
1540	3130	53.2	-1.2
1550	3130	51.0	1.7
1560	3130	51.2	2.3
1570	3130	59.0	3.3
1580	3130	95.8	10.8
1590	3130	43.4	3.6
1600	3130	52.0	0.9
1610	3130	70.8	4.0
1620	3130	101.6	8.0
370	3220	33.6	-1.1

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
380	3220	30.8	-1.0
390	3220	32.6	-0.7
400	3220	32.8	-1.3
410	3220	25.8	-1.7
420	3220	22.2	-2.4
430	3220	19.6	-2.9
440	3220	19.2	-3.7
450	3220	21.8	-3.3
460	3220	21.8	-3.8
470	3220	23.4	-4.0
480	3220	25.0	-3.9
490	3220	23.2	-3.9
500	3220	24.6	-3.7
510	3220	23.8	-3.8
520	3220	25.0	-3.6
530	3220	25.6	-3.6
540	3220	27.8	-3.1
550	3220	30.4	-3.2
560	3220	31.2	-3.1
570	3220	39.8	-5.2
580	3220	45.4	-1.0
590	3220	69.6	-2.2
600	3220	87.0	-0.7
610	3220	97.4	-1.1
620	3220	98.0	2.2
630	3220	111.0	0.4
640	3220	136.8	2.9
650	3220	104.6	-0.5
660	3220	97.2	-1.3
670	3220	64.8	-0.6
680	3220	55.0	-9.5
690	3220	50.6	-1.0
700	3220	65.0	2.8
710	3220	74.0	-2.9
720	3220	83.4	-5.0
730	3220	89.0	0.6
740	3220	101.4	5.9
750	3220	93.8	6.9
760	3220	99.2	6.2
770	3220	99.6	6.9
780	3220	101.8	4.5
790	3220	98.6	11.5
800	3220	104.0	8.9
810	3220	118.4	10.9
820	3220	125.4	14.8
830	3220	153.6	18.3
840	3220	139.0	18.5
850	3220	113.8	16.4
860	3220	150.8	15.6

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
870	3220	140.6	12.6
880	3220	104.0	9.3
890	3220	75.0	6.0
900	3220	46.2	-3.6
910	3220	40.2	0.9
920	3220	42.6	-1.3
930	3220	47.4	1.7
940	3220	49.8	0.1
950	3220	55.2	1.6
960	3220	58.8	1.3
970	3220	61.8	0.5
980	3220	67.2	0.3
990	3220	70.2	1.4
1000	3220	67.8	1.9
1010	3220	67.8	3.7
1020	3220	73.2	3.0
1030	3220	81.6	3.4
1040	3220	86.4	2.6
1050	3220	96.6	3.2
1060	3220	94.8	3.6
1070	3220	91.2	3.3
1080	3220	94.8	3.5
1090	3220	99.6	3.0
1100	3220	98.4	1.3
1110	3220	97.8	0.7
1120	3220	94.8	-0.4
1130	3220	85.8	2.8
1140	3220	84.6	0.3
1150	3220	95.4	2.1
1160	3220	109.2	0.5
1170	3220	99.6	3.0
1180	3220	102.6	0.9
1190	3220	95.4	0.2
1200	3220	88.8	0.5
1210	3220	80.4	-1.6
1220	3220	80.4	-1.1
1230	3220	79.8	-1.3
1240	3220	78.6	1.9
1250	3220	43.2	-7.6
1260	3220	-6.0	-32.0
1270	3220	52.8	-6.4
1280	3220	51.0	0.3
1290	3220	45.6	1.1
1300	3220	47.4	1.0
1310	3220	50.4	-1.9
1320	3220	42.0	-15.7
1330	3220	36.0	-7.6
1340	3220	44.4	10.6
1350	3220	46.8	-4.9

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1360	3220	42.0	-4.2
1370	3220	46.8	0.7
1380	3220	43.2	-0.7
1390	3220	42.6	-1.4
1400	3220	40.8	-1.6
1410	3220	37.8	-1.5
1420	3220	37.2	0.1
1430	3220	36.0	-1.2
1440	3220	36.6	-2.0
1450	3220	33.6	-4.8
1460	3220	26.4	-2.7
1470	3220	40.4	0.0
1480	3220	59.8	2.8
1490	3220	29.8	13.4
1500	3220	63.4	27.3
1510	3220	148.4	18.0
1520	3220	101.4	11.1
1530	3220	113.4	11.9
1540	3220	85.2	14.4
1550	3220	72.0	2.1
1560	3220	68.4	0.3
1570	3220	56.4	1.8
1580	3220	54.0	3.1
1590	3220	89.4	4.1
1600	3220	-58.2	-8.2
440	3310	36.0	0.5
450	3310	39.0	1.1
460	3310	24.6	0.4
470	3310	21.0	-4.0
480	3310	18.6	-2.7
490	3310	18.6	-2.8
500	3310	18.0	-2.9
510	3310	20.4	-2.9
520	3310	20.4	-3.2
530	3310	23.4	-3.0
540	3310	25.2	-2.0
550	3310	27.6	-4.6
560	3310	21.0	-2.0
570	3310	26.4	-0.5
580	3310	34.8	-3.5
590	3310	43.2	0.1
600	3310	25.2	0.3
610	3310	28.8	-3.5
620	3310	39.0	-0.6
630	3310	62.4	-0.2
640	3310	54.6	-3.1
650	3310	64.8	0.9
660	3310	60.0	0.8
670	3310	51.0	-2.0

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
680	3310	43.2	1.3
690	3310	46.8	1.0
700	3310	54.6	-0.7
710	3310	58.8	-2.0
720	3310	65.4	2.2
730	3310	65.4	5.3
740	3310	66.6	6.2
750	3310	42.6	4.9
760	3310	48.6	4.3
770	3310	54.0	8.1
780	3310	54.6	1.5
790	3310	57.6	2.2
800	3310	63.0	1.3
810	3310	63.6	-0.5
820	3310	67.8	1.3
830	3310	77.4	2.5
840	3310	82.2	3.2
850	3310	74.4	3.7
860	3310	64.2	2.1
870	3310	63.6	1.4
880	3310	64.8	0.6
890	3310	66.6	0.9
900	3310	70.2	0.8
910	3310	70.8	1.4
920	3310	69.6	0.6
930	3310	73.2	1.0
940	3310	70.8	1.0
950	3310	79.2	2.2
960	3310	82.8	1.9
970	3310	78.6	2.3
980	3310	75.6	5.2
990	3310	75.6	4.8
1000	3310	74.4	5.1
1010	3310	72.0	4.1
1020	3310	68.4	1.1
1030	3310	75.0	2.6
1040	3310	73.8	4.4
1050	3310	84.6	4.5
1060	3310	87.0	3.1
1070	3310	89.4	1.4
1080	3310	82.8	1.0
1090	3310	97.8	2.4
1100	3310	111.0	3.1
1110	3310	117.0	2.3
1120	3310	111.6	-8.5
1130	3310	111.6	3.3
1140	3310	107.4	3.1
1150	3310	100.2	0.4
1160	3310	101.4	3.6

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1170	3310	104.4	0.6
1180	3310	91.2	-0.8
1190	3310	84.0	2.9
1200	3310	77.4	2.6
1210	3310	72.0	-1.5
1220	3310	66.0	2.8
1230	3310	70.2	4.0
1240	3310	57.6	-15.8
1250	3310	23.4	-21.7
1260	3310	45.0	-1.7
1270	3310	43.2	-2.1
1280	3310	44.4	-2.0
1290	3310	45.0	-2.0
1300	3310	45.0	-2.1
1310	3310	45.0	-1.9
1320	3310	47.4	-1.9
1330	3310	50.4	-0.7
1340	3310	48.6	0.1
1350	3310	45.0	-2.3
1360	3310	40.2	-3.3
1370	3310	37.8	-1.2
1380	3310	34.8	-0.8
1390	3310	34.8	-1.2
1400	3310	24.0	-2.3
1410	3310	-4.2	-18.5
1420	3310	-16.2	-28.3
1430	3310	41.4	2.3
1440	3310	48.0	13.1
1450	3310	53.4	29.3
1460	3310	40.2	12.0
1500	3310	99.0	44.5
1510	3310	60.6	1.3
1520	3310	51.6	0.0
1530	3310	54.0	-0.1
1540	3310	51.6	0.1
1550	3310	58.8	1.3
1560	3310	79.2	2.7
1570	3310	29.4	-3.7
1580	3310	-15.6	-10.8
470	3400	30.4	-1.9
480	3400	38.4	0.6
490	3400	35.0	-0.7
500	3400	23.0	-1.6
510	3400	20.0	-3.4
520	3400	24.2	-3.5
530	3400	26.4	-2.9
540	3400	26.6	-3.7
550	3400	36.6	-2.6
560	3400	35.8	-2.5

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
570	3400	40.6	-2.1
580	3400	39.0	-1.4
590	3400	38.6	-2.5
600	3400	39.8	0.6
610	3400	39.0	-4.1
620	3400	46.8	0.5
630	3400	49.8	-1.9
640	3400	51.2	-1.6
650	3400	56.2	-1.2
660	3400	64.6	-0.1
670	3400	66.0	-0.5
680	3400	69.6	-2.2
690	3400	63.8	0.4
700	3400	69.8	-1.8
710	3400	71.2	-4.3
720	3400	68.6	-3.2
730	3400	68.8	-2.0
740	3400	74.2	-1.8
750	3400	70.2	0.0
760	3400	70.8	0.1
770	3400	70.4	-2.3
780	3400	84.2	-5.4
790	3400	85.2	0.3
800	3400	84.4	-0.7
810	3400	83.0	-0.9
820	3400	87.6	-1.3
830	3400	95.2	-0.4
840	3400	88.8	-0.1
850	3400	88.0	0.8
860	3400	87.8	1.5
870	3400	84.4	2.9
880	3400	81.4	3.2
890	3400	91.2	3.3
900	3400	94.8	1.9
910	3400	98.0	4.2
920	3400	94.6	3.9
930	3400	95.8	3.5
940	3400	97.2	3.1
950	3400	99.0	3.0
960	3400	93.2	4.3
970	3400	90.8	6.2
980	3400	89.4	4.9
990	3400	90.2	4.2
1000	3400	84.0	3.6
1010	3400	83.6	3.7
1020	3400	88.0	4.2
1030	3400	86.4	4.3
1040	3400	76.6	3.5
1050	3400	72.4	2.8

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
520	3490	23.4	-3.8
530	3490	35.4	-0.1
540	3490	37.2	10.4
550	3490	37.2	-3.3
560	3490	58.8	0.7
570	3490	57.6	-3.4
580	3490	60.0	-4.4
590	3490	68.4	-1.6
600	3490	69.0	-0.7
610	3490	74.4	-3.1
620	3490	80.4	1.0
630	3490	81.0	1.5
640	3490	83.4	0.8
650	3490	91.2	1.6
660	3490	83.4	-1.0
670	3490	86.4	-0.9
680	3490	90.6	0.9
690	3490	98.4	-0.4
700	3490	103.8	0.0
710	3490	99.6	0.8
720	3490	100.2	-0.6
730	3490	93.0	-0.7
740	3490	84.6	-2.1
750	3490	86.4	-3.5
760	3490	77.4	0.6
770	3490	80.4	-1.3
780	3490	77.4	-2.2
790	3490	86.4	-0.8
800	3490	87.6	-1.4
810	3490	93.0	0.3
820	3490	94.2	-1.0
830	3490	98.4	-0.2
840	3490	104.0	-1.3
850	3490	98.4	0.2
860	3490	99.4	0.6
870	3490	98.6	0.8
880	3490	105.2	2.1
890	3490	106.2	2.6
900	3490	106.6	2.8
910	3490	101.4	1.9
920	3490	103.2	1.7
930	3490	106.0	2.1
940	3490	110.8	2.0
950	3490	100.6	6.9
960	3490	101.4	3.2
970	3490	98.6	4.0
980	3490	99.0	4.6
990	3490	99.0	3.9
1000	3490	100.0	3.6

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
680	3580	80.0	-2.8
690	3580	80.8	-3.0
700	3580	92.6	-0.5
710	3580	94.6	-1.4
720	3580	71.2	3.7
730	3580	67.0	-2.0
740	3580	73.2	2.5
750	3580	77.4	-0.7
760	3580	85.6	-0.5
770	3580	84.2	-1.1
780	3580	81.0	-0.6
790	3580	93.0	-0.4
800	3580	81.8	0.5
810	3580	89.2	-0.6
820	3580	89.0	0.5
830	3580	92.2	-0.3
840	3580	95.4	0.5
850	3580	95.4	1.0
860	3580	96.0	1.4
870	3580	102.8	1.0
880	3580	102.6	1.6
890	3580	105.8	0.8
900	3580	94.8	0.1
910	3580	95.6	0.5
920	3580	95.2	0.2
930	3580	91.6	-0.5
940	3580	91.8	1.1
950	3580	83.8	-0.7
960	3580	88.4	-0.2
970	3580	95.2	0.5
980	3580	91.2	1.1
990	3580	95.0	1.6
1000	3580	94.4	-1.6
1010	3580	89.8	0.3
1020	3580	86.6	1.9
1030	3580	75.8	2.6
1040	3580	68.8	1.5
1050	3580	65.8	2.3
1060	3580	77.2	-0.6
1070	3580	83.0	0.2
1080	3580	87.4	0.4
1090	3580	89.6	0.1
1100	3580	93.4	0.6
1110	3580	87.6	-1.4
1120	3580	73.2	-0.5
1130	3580	51.4	2.0
1140	3580	36.4	-0.1
1150	3580	31.8	0.3
1160	3580	34.6	-0.4

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1170	3580	31.4	-1.1
1180	3580	36.0	-2.7
1190	3580	49.0	-2.8
1200	3580	57.2	-2.5
1210	3580	55.6	-2.2
1220	3580	49.4	5.3
1230	3580	49.0	-5.9
1240	3580	62.0	-2.8
1250	3580	78.6	0.6
1260	3580	79.4	-0.3
1270	3580	70.0	-0.1
1280	3580	60.6	1.1
1290	3580	52.4	1.5
1300	3580	49.0	0.9
1310	3580	48.6	1.2
1320	3580	51.2	1.4
1330	3580	57.4	1.5
1340	3580	60.6	2.5
1350	3580	57.4	2.3
1360	3580	56.0	0.8
1370	3580	59.2	1.3
1380	3580	83.6	2.5
1390	3580	-37.2	-16.2
1400	3580	75.6	-3.8
630	3670	29.8	-1.8
640	3670	28.2	-2.6
650	3670	33.2	-1.4
660	3670	41.2	-1.5
670	3670	50.0	0.2
680	3670	55.4	-1.4
690	3670	62.2	-4.1
700	3670	66.8	-0.9
710	3670	71.4	1.0
720	3670	56.2	3.8
730	3670	71.2	1.2
740	3670	72.0	-3.9
750	3670	72.4	-0.7
760	3670	76.4	-3.3
770	3670	69.6	-3.7
780	3670	66.4	-1.9
790	3670	54.8	-2.1
800	3670	57.2	-1.3
810	3670	46.6	-2.7
820	3670	56.4	-1.8
830	3670	70.6	1.5
840	3670	71.6	0.6
850	3670	60.4	0.4
860	3670	71.0	0.7
870	3670	74.2	1.5

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
880	3670	61.8	-0.1
890	3670	53.2	-1.5
900	3670	72.4	3.6
910	3670	61.8	-1.0
920	3670	71.6	1.6
930	3670	66.4	-0.1
940	3670	71.2	-2.0
950	3670	62.2	-2.1
960	3670	57.8	1.8
970	3670	56.6	-1.5
980	3670	60.2	-1.7
990	3670	63.4	0.7
1000	3670	59.8	0.9
1010	3670	61.0	-2.2
1020	3670	64.4	-2.9
1030	3670	62.8	2.0
1040	3670	50.4	-1.0
1050	3670	52.4	0.0
1060	3670	49.6	-1.4
1070	3670	39.8	-0.4
1080	3670	33.2	-1.8
1090	3670	37.0	-2.3
1100	3670	35.6	-2.1
1110	3670	34.8	-1.8
1120	3670	35.0	-2.0
1130	3670	28.8	-5.2
1140	3670	28.8	-2.2
1150	3670	30.0	-3.2
1160	3670	33.0	-1.1
1170	3670	22.4	-7.8
1180	3670	15.4	-8.1
1190	3670	41.0	0.2
1200	3670	44.8	0.1
1210	3670	42.8	-3.5
1220	3670	55.8	-3.8
1230	3670	51.0	2.2
1240	3670	60.4	1.6
1250	3670	61.8	1.9
1260	3670	62.6	2.4
1270	3670	59.0	1.8
1280	3670	50.6	1.0
1290	3670	49.4	0.3
1300	3670	50.2	0.9
690	3760	31.2	-2.1
700	3760	33.0	-3.5
710	3760	34.2	0.6
720	3760	45.6	-0.1
730	3760	59.8	-2.5
740	3760	76.8	-2.9

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
750	3760	79.6	-3.8
760	3760	83.8	-2.0
770	3760	70.2	-1.9
780	3760	56.0	-1.6
790	3760	53.2	-3.7
800	3760	57.2	-2.1
810	3760	32.8	-1.8
820	3760	33.8	-2.8
830	3760	31.8	-4.6
840	3760	52.2	-2.0
850	3760	57.2	-3.0
860	3760	55.4	-5.7
870	3760	69.2	-6.7
880	3760	59.8	-0.7
890	3760	63.2	-3.5
900	3760	66.2	-2.3
910	3760	44.2	-2.1
920	3760	39.0	-3.5
930	3760	38.0	-2.7
940	3760	36.2	-2.5
950	3760	30.8	-2.8
960	3760	24.4	-2.9
970	3760	24.2	-2.6
980	3760	24.4	-3.4
990	3760	25.8	-3.9
1000	3760	25.8	-1.9
1010	3760	26.0	-5.4
1020	3760	22.0	-0.2
1030	3760	26.6	-2.9
1040	3760	26.2	-1.7
1050	3760	25.6	-2.2
1060	3760	28.4	-1.2
1070	3760	29.2	-1.1
1080	3760	32.6	-1.4
1090	3760	34.0	-1.1
1100	3760	35.4	-0.4
1110	3760	29.2	-4.5
1120	3760	16.6	-6.4
1130	3760	30.4	-2.6
1140	3760	48.6	1.3
1150	3760	41.6	0.7
1160	3760	37.8	0.0
1170	3760	40.4	0.0
1180	3760	40.4	0.3
1190	3760	42.0	1.4
1200	3760	51.0	9.6
1210	3760	-85.6	-31.3
1220	3760	0.0	-29.6
1230	3760	49.6	1.7

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1240	3760	38.2	-4.0
1250	3760	25.6	-4.1
740	3850	23.4	-2.9
750	3850	24.4	-3.0
760	3850	24.4	-2.4
770	3850	18.2	-1.5
780	3850	19.0	-0.3
790	3850	21.6	-1.4
800	3850	34.8	-3.0
810	3850	42.4	-4.4
820	3850	32.6	-1.4
830	3850	46.4	-4.3
840	3850	37.2	-4.2
850	3850	25.0	-5.5
860	3850	22.8	-7.9
870	3850	34.6	-5.5
880	3850	26.2	-2.9
890	3850	31.8	-3.4
900	3850	30.0	-3.7
910	3850	13.2	-2.2
920	3850	14.4	-3.0
930	3850	9.0	-5.4
940	3850	16.2	-3.0
950	3850	18.0	-3.5
960	3850	19.2	-2.2
970	3850	19.8	-2.6
980	3350	20.4	-1.9
990	3850	23.4	-2.0
1000	3850	23.4	-1.0
1010	3850	22.2	-2.9
1020	3850	24.6	-5.7
1030	3850	33.6	-1.7
1040	3850	51.6	44.1
1050	3850	61.2	44.1
1060	3850	65.4	36.7
1070	3850	58.8	0.2
1080	3850	66.0	3.0
1090	3850	66.6	-2.8
1100	3850	93.6	1.7
1110	3850	120.0	2.2
1120	3850	99.6	1.9
1130	3850	98.4	3.3
1140	3850	64.8	-0.3
1150	3850	58.6	1.9
1160	3850	56.8	1.7
1170	3850	52.2	20.6
1180	3850	72.4	44.1
790	3940	22.4	-3.0
800	3940	24.6	-2.7

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
810	3940	20.2	-2.8
820	3940	19.8	-4.3
830	3940	25.0	-5.0
840	3940	14.6	-21.9
850	3940	20.2	5.4
860	3940	31.4	-3.0
870	3940	32.8	-2.0
880	3940	25.4	2.6
890	3940	27.8	1.0
900	3940	29.2	-3.0
910	3940	26.8	-2.6
920	3940	24.8	-0.2
930	3940	-79.0	-31.3
940	3940	34.0	5.3
950	3940	24.4	1.8
960	3940	20.8	-2.5
970	3940	24.4	-2.0
980	3940	24.6	-1.6
990	3940	23.2	-2.1
1000	3940	17.2	-3.4
1010	3940	23.2	-0.5
1020	3940	30.2	14.3
1030	3940	10.2	0.3
1040	3940	42.4	8.6
1050	3940	44.6	9.3
1060	3940	42.6	1.5
1070	3940	47.8	8.3
1080	3940	71.8	44.1
840	4030	20.6	-3.3
850	4030	27.4	-2.7
860	4030	21.2	-30.9
870	4030	10.8	-31.3
880	4030	39.2	2.6
890	4030	41.8	-2.9
900	4030	35.2	-2.6
910	4030	33.2	-2.4
920	4030	33.4	-2.5
930	4030	30.4	0.2
940	4030	24.4	-0.9
950	4030	1.6	-5.4
960	4030	-57.0	-24.5
970	4030	20.0	-9.0
980	4030	31.0	-3.2
990	4030	38.6	-2.0
1000	4030	43.6	-0.9
1010	4030	14.2	1.3
1020	4030	20.8	3.9
1030	4030	49.8	0.0
1040	4030	-11.0	-7.3

Appendix C: Pig's Eye Landfill--EM31 Data

X Distance East (ft)	Y Distance North (ft)	Conductivity (millimhos/meter)	Inphase Response (parts per thousand)
1050	4030	-11.2	-7.5
890	4120	30.0	-4.1
900	4120	31.2	-3.0
910	4120	36.2	-1.7
920	4120	36.6	-3.0
930	4120	42.2	-0.7
940	4120	40.4	-1.8
950	4120	48.0	-2.6
960	4120	56.8	0.3
970	4120	56.2	0.0
980	4120	54.6	4.3
990	4120	45.8	10.5
1000	4120	41.4	1.6
1010	4120	42.0	-1.6
1020	4120	48.0	-10.0
1030	4120	-68.6	-24.7
1040	4120	3.4	-8.6

LEGEND

—45— CONDUCTIVTY CONTOUR (INTERVAL= 3 PARTS FER THOUSAND)

100' 0 100' 200'
SCALE: 1" = 200'

NOTE: GRID MEASURES 180' X 200'.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE B-1
CONDUCTIVITY CONTOURS

PRC ENVIRONMENTAL MANAGEMENT, INC.

PIG-GEOB.DWG -- 11/23/94 -- CFR --080--000404

LEGEND

—3— INPHASE CONTOUR (INTERVAL=3 PARTS PER THOUSAND)

100' 0 100' 200'
SCALE: 1" = 200'

NOTE: GRID MEASURES 180' X 200'.

PIG'S EYE DUMP
ST. PAUL, MINNESOTA

FIGURE B-2

INPHASE RESPONSE CONTOURS

PRC ENVIRONMENTAL MANAGEMENT, INC.

SOURCE: MODIFIED FROM RAMSEY COUNTY GIS DATABASE MAP 1994

PIG-GEOB.DWG - 11/23/94 - CFR -060-000404