Appendix E-1

Investigation of Groundwater
Flow Conditions
(Geraghty & Miller, Inc. 1989)

INVESTIGATION OF GROUND-WATER FLOW CONDITIONS AT THE ARMCO PLANT MIDDLETOWN, OHIO

Submitted to:

Armco Eastern Steel Division
Middletown, Ohio

May 1989

Submitted by:

GERAGHTY & MILLER, INC.
Ground-Water Consultants

Dublin, Ohio

GERAGHTY & MILLER, INC.
Ground-Water Consultants

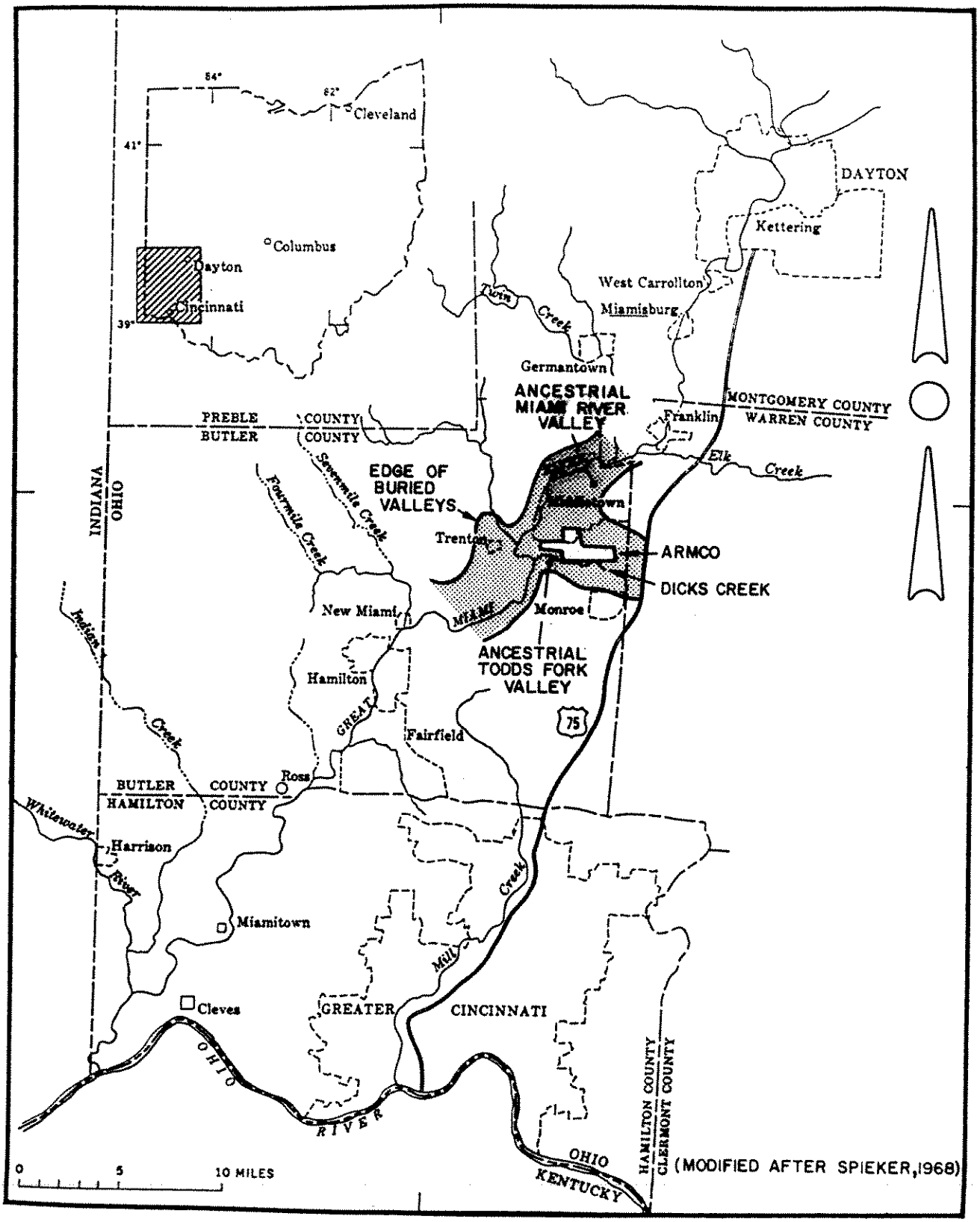
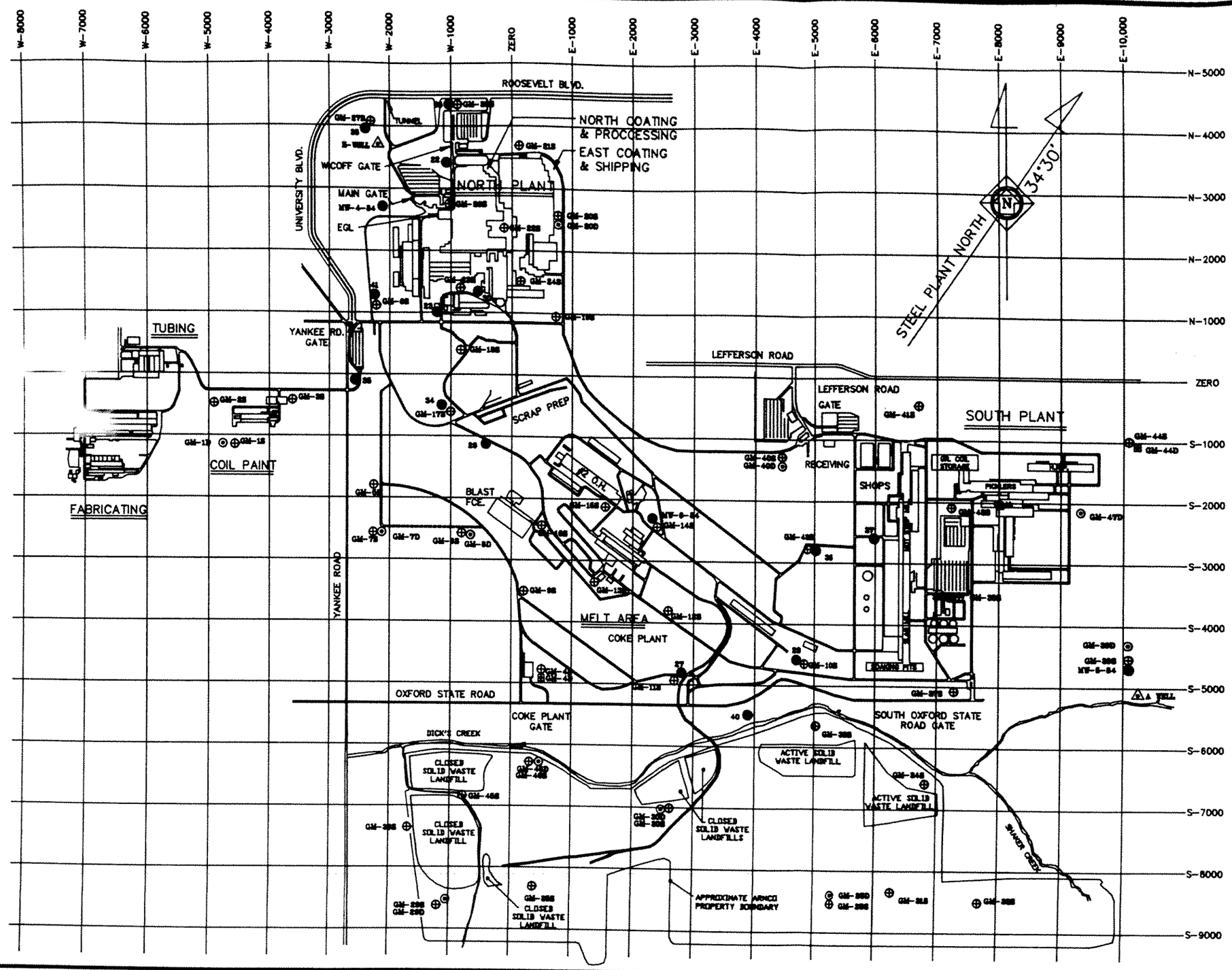


FIGURE 1. LOCATION OF BURIED VALLEYS



WELL ID	Y COORD	X COORD
GM-1S	S 999.09	W 4901.57
GM-2S	S 573.76	W 4934.63
GM-3S	S 607.98	W 3734.37
GM-4S	S 4858.34	W 467.61
GM-5S	S 2027.81	W 2111.12
GM-6S	N 1363.28	W 2214.97
GM-7S	S 2609.79	W 2071.45
GM-8S	S 2619.93	W 661.23
GM-9S	S 3599.61	E 190.77
GM-10S	S 4594.19	E 4694.39
GM-11S	S 4914.76	E 2612.53
GM-12S	S 3720.83	E 2405.41
GM-13S	S 3275.13	E 1392.89
GM-14S	S 2434.34	E 2382.10
GM-15S	S 2181.92	E 1614.87
GM-16S	S 2323.91	E 546.15
GM-17S	S 547.78	W 1139.20
GM-18S	N 394.38	W 515.55
GM-19S	N 882.21	E 765.00
GM-20S	N 2510.80	E 792.51
GM-21S	N 3612.88	W 248.91
GM-22S	N 2329.02	W 49.57
GM-23S	N 1335.84	W 669.55
GM-24S	N 1762.11	E 168.22
GM-25S	N 4368.31	W 1095.44
GM-26S	N 2709.86	W 1020.54
GM-27S	N 3954.47	W 2415.77
GM-28S	S 8533.27	E 5283.39
GM-29S	S 8619.09	W 1203.12
GM-30S	S 7007.36	E 2557.70
GM-31S	S 8340.38	E 6269.49
GM-32S	S 8506.42	E 7685.29
GM-33S	S 5648.58	E 5015.97
GM-34S	S 6682.88	E 6791.72
GM-35S	S 8303.19	E 372.19
GM-36S	S 7350.18	W 1699.69
GM-37S	S 5072.00	E 7272.97
GM-38S	S 3554.41	E 7158.09
GM-39S	S 4703.58	E 10073.85
GM-40S	S 1287.29	E 4430.84
GM-41S	S 436.52	E 6694.41
GM-42S	S 2086.60	E 7221.48
GM-43S	S 2777.23	E 4974.55
GM-44S	S 985.51	E 10075.12
GM-45S	S 6834.36	W 794.91
GM-46S	S 6283.97	E 350.69
GM-1D	S 996.75	W 4910.22
GM-7D	S 2610.65	W 2060.37
GM-8D	S 2620.09	W 649.79
GM-20D	N 2502.27	E 792.73
GM-28D	S 8537.87	E 5280.46
GM-29D	S 8615.20	W 1198.05
GM-30D	S 6999.28	E 2556.62
GM-39D	S 4307.66	E 10065.83
GM-40D	S 1295.55	E 4432.46
GM-46D	S 6282.76	E 342.54
GM-47D	S 2143.16	E 9309.33
22	N 3414.91	W 1092.12
23	N 1004.17	W 1246.25
26	S 1125.41	W 443.41
27	S 4809.83	E 2791.05
29	S 4582.74	E 4670.84
30	N 1341.22	W 573.17
33	N 4388.00	W 1125.00
34	S 500.35	W 1167.87
35	S 95.24	W 2568.84
36	S 2800.00	E 5000.00
37	S 2600.00	E 5970.00
38	N 3951.14	W 2414.70
39	S 3537.35	E 7192.64
40	S 5481.48	E 3872.60
41	N 1287.03	W 2259.85
MW-4-84	N 2712.94	W 2128.87
MW-5-84	S 4700.58	E 10081.00
MW-6-84	S 2429.75	E 2376.44
K-WELL	N 3560.69	W 2043.61
A-WELL	S 5131.50	E 10268.90

Figure 3

NOTES:

1. ARMCO REF# 581549

LEGEND

- ARMCO EXISTING PRODUCTION OR OBSERVATION WELLS
- SHALLOW PIEZOMETERS
- LAYNE OBSERVATION WELLS
- DEEP PIEZOMETERS
- ABANDONED BOREHOLES

GERAGHTY & MILLER, INC.
Ground-Water Consultants

SCALE

0 1000' 2000'

CLIENT: ARMCO INC.
MIDDLETOWN, OHIO

TITLE: LOCATION OF ARMCO PIEZOMETERS, PRODUCTION WELLS, & OBSERVATION WELLS

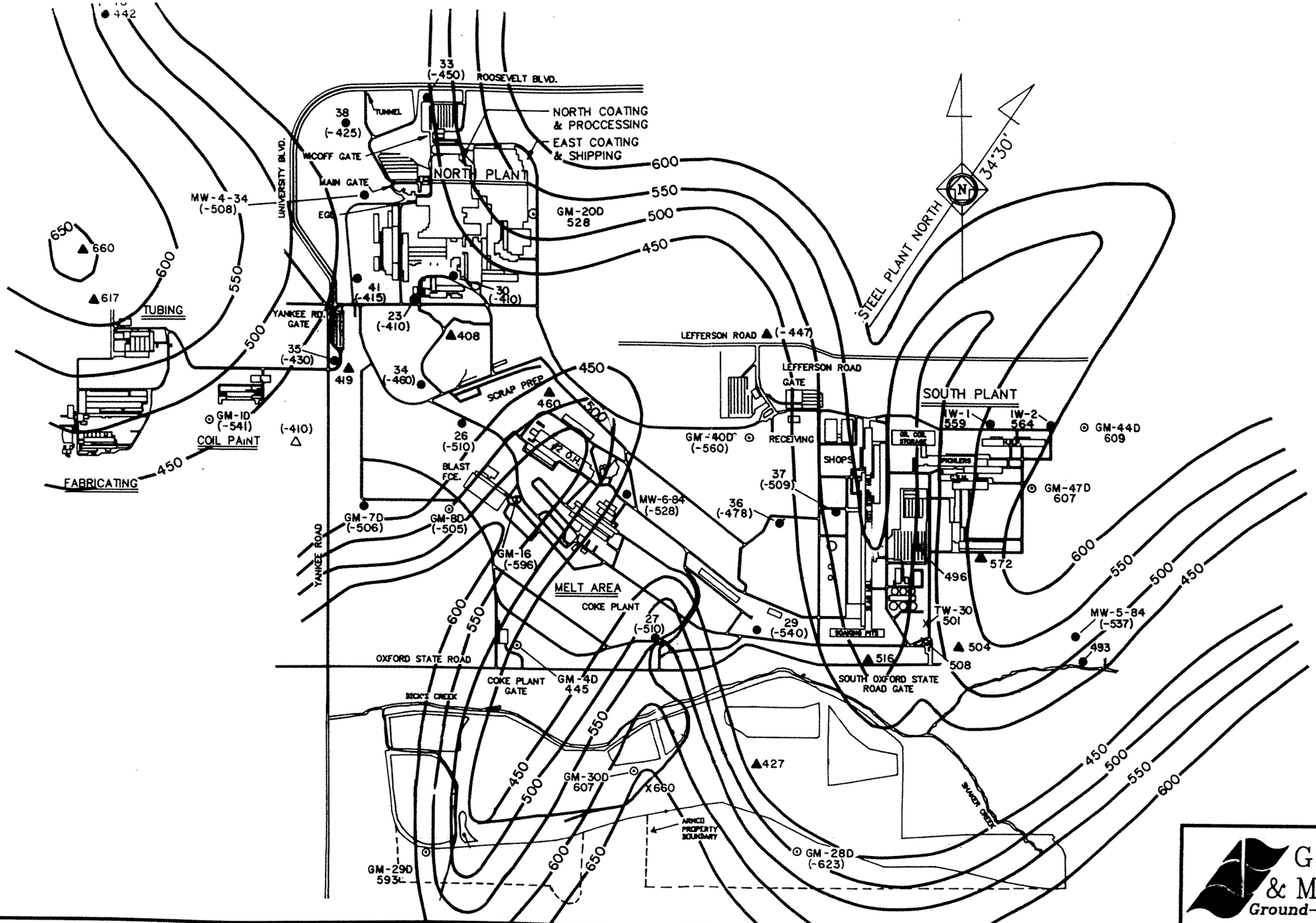


Figure 20

GERAGHTY & MILLER, INC.
Ground-Water Consultants

NOTES:

(-) INDICATES WELL DID NOT HIT BEDROCK. NUMBER INDICATES ELEVATION OF DEEPEST POINT DRILLED.

LEGEND TOP OF BEDROCK ELEVATIONS

- ● ARMCO PRODUCTION OR OBSERVATION WELLS
- ⊗ SHALLOW PIEZOMETERS
- ⊙ DEEP PIEZOMETERS
- ▲ DATA FROM USGS REPORT 605 B OF WELLS

CI = 50 FT.

SCALE

0 1000' 2000'

CLIENT: ARMCO INC. MIDDLETOWN, OHIO

TITLE: Bedrock Topography Map

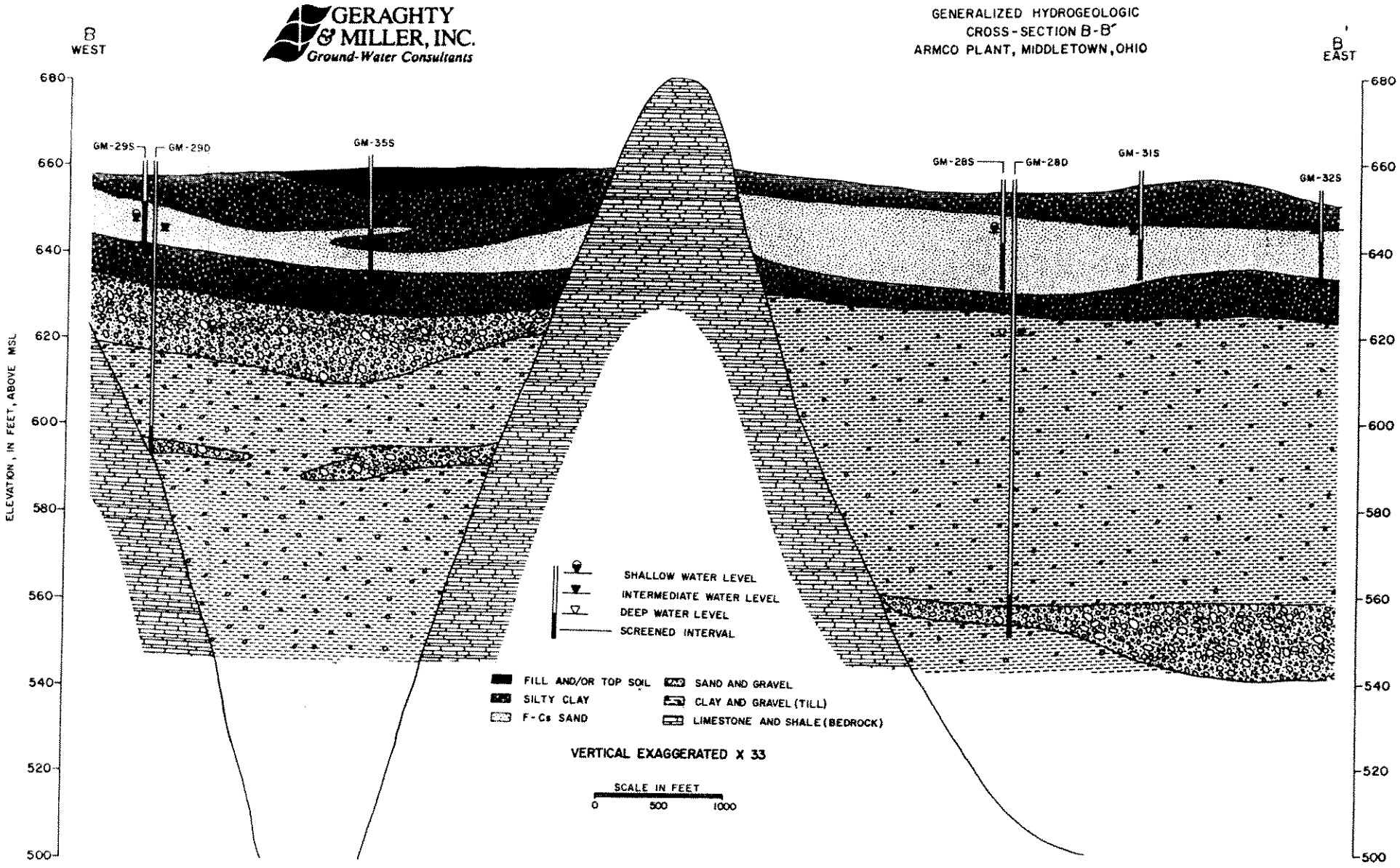

GERAGHTY & MILLER, INC.
Ground-Water Consultants
GENERALIZED HYDROGEOLOGIC
CROSS-SECTION B-B'
ARMCO PLANT, MIDDLETOWN, OHIO
B
WEST
B'
EAST
ELEVATION, IN FEET, ABOVE MSL
680
660
640
620
600
580
560
540
520
500
GM-29S
GM-29D
GM-35S
GM-28S
GM-28D
GM-31S
GM-32S
SHALLOW WATER LEVEL
INTERMEDIATE WATER LEVEL
DEEP WATER LEVEL
SCREENED INTERVAL
FILL AND/OR TOP SOIL
SILTY CLAY
F-Cs SAND
SAND AND GRAVEL
CLAY AND GRAVEL (TILL)
LIMESTONE AND SHALE (BEDROCK)
VERTICAL EXAGGERATED X 33
SCALE IN FEET
0
500
1000

Figure 21

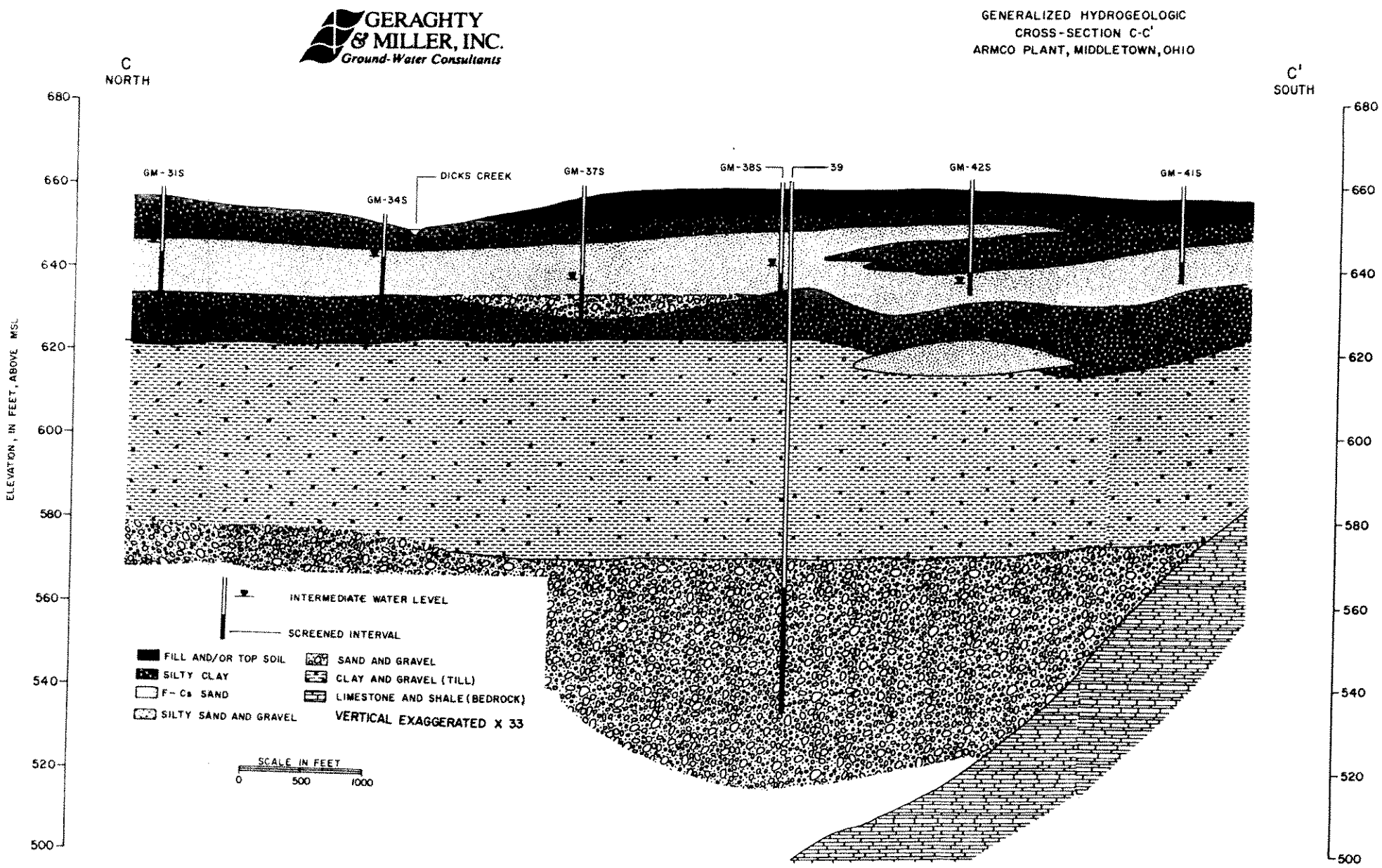

GERAGHTY & MILLER, INC.
Ground-Water Consultants
GENERALIZED HYDROGEOLOGIC
CROSS-SECTION C-C'
ARMCO PLANT, MIDDLETOWN, OHIO
C
NORTH
C'
SOUTH
ELEVATION, IN FEET, ABOVE MSL
680
660
640
620
600
580
560
540
520
500
GM-31S
GM-34S
DICKS CREEK
GM-37S
GM-38S
39
GM-42S
GM-41S
INTERMEDIATE WATER LEVEL
SCREENED INTERVAL
FILL AND/OR TOP SOIL
SILTY CLAY
F-Cs SAND
SILTY SAND AND GRAVEL
SAND AND GRAVEL
CLAY AND GRAVEL (TILL)
LIMESTONE AND SHALE (BEDROCK)
VERTICAL EXAGGERATED X 33
SCALE IN FEET
0
500
1000

Figure 22

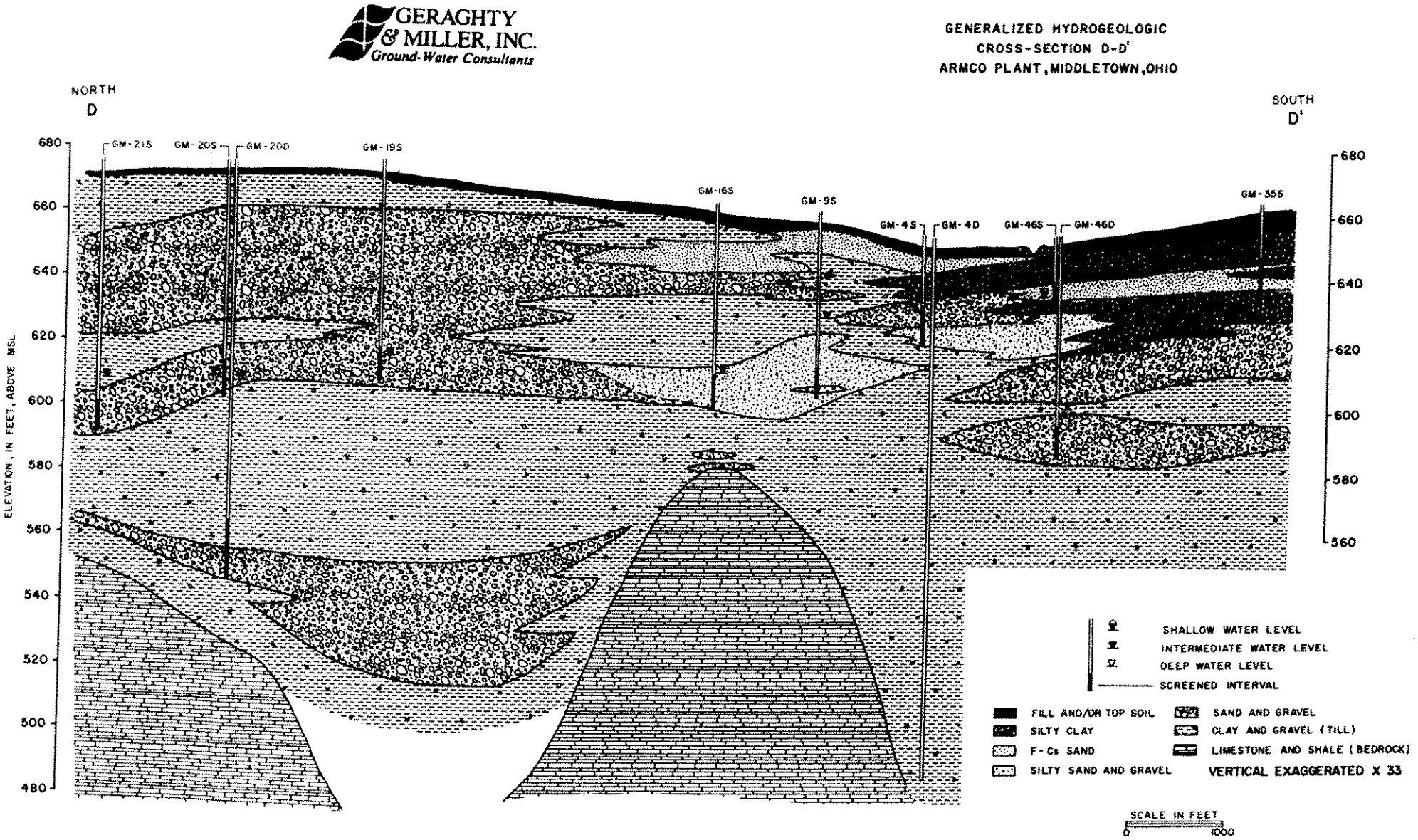

GERAGHTY & MILLER, INC.
Ground-Water Consultants
GENERALIZED HYDROGEOLOGIC
CROSS-SECTION D-D'
ARMCO PLANT, MIDDLETOWN, OHIO
NORTH
D
SOUTH
D'
ELEVATION, IN FEET, ABOVE MSL
680
660
640
620
600
580
560
540
520
500
480
GM-21S
GM-20S
GM-20D
GM-19S
GM-16S
GM-9S
GM-4S
GM-4D
GM-46S
GM-46D
GM-35S
SHALLOW WATER LEVEL
INTERMEDIATE WATER LEVEL
DEEP WATER LEVEL
SCREENED INTERVAL
FILL AND/OR TOP SOIL
SILTY CLAY
F-Cs SAND
SILTY SAND AND GRAVEL
SAND AND GRAVEL
CLAY AND GRAVEL (TILL)
LIMESTONE AND SHALE (BEDROCK)
VERTICAL EXAGGERATED X 33
SCALE IN FEET
0
1000

Figure 23

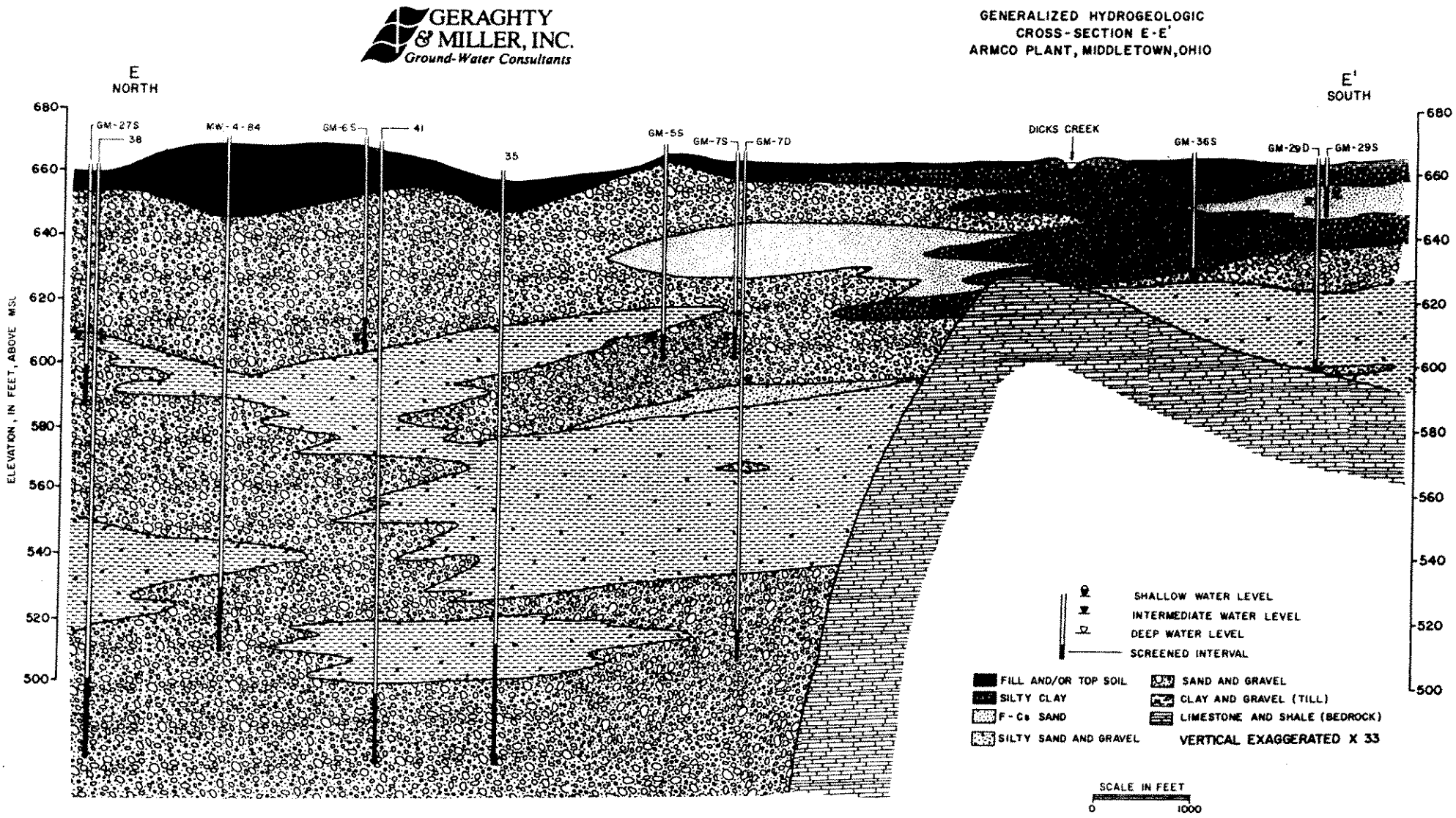
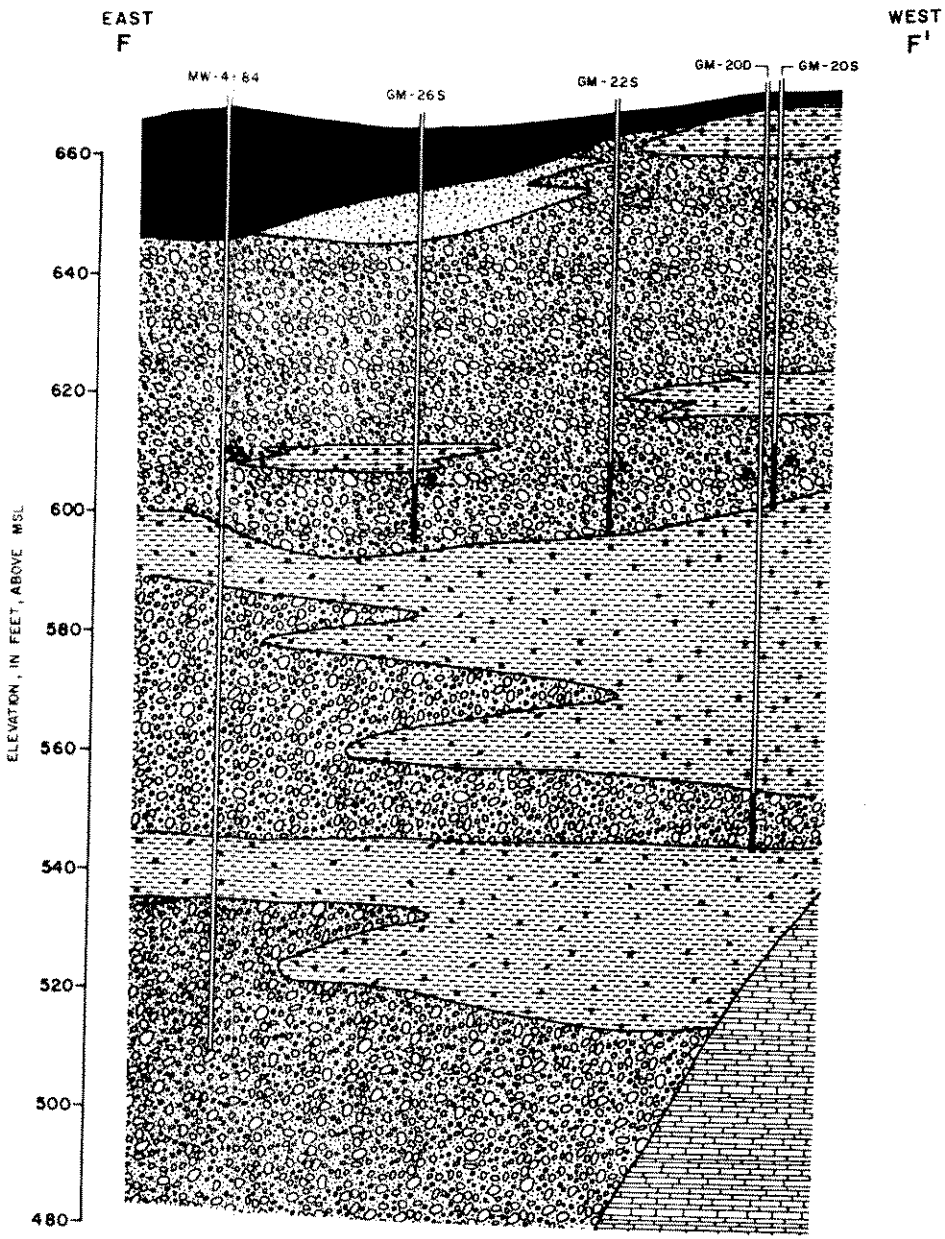

GERAGHTY & MILLER, INC.
Ground-Water Consultants
GENERALIZED HYDROGEOLOGIC
CROSS-SECTION E-E'
ARMCO PLANT, MIDDLETOWN, OHIO
E
NORTH
E'
SOUTH
ELEVATION, IN FEET, ABOVE MSL
680
660
640
620
600
580
560
540
520
500
GM-27S
38
MW-4-84
GM-6S
41
35
GM-5S
GM-7S
GM-7D
DICKS CREEK
GM-36S
GM-29D
GM-29S
SHALLOW WATER LEVEL
INTERMEDIATE WATER LEVEL
DEEP WATER LEVEL
SCREENED INTERVAL
FILL AND/OR TOP SOIL
SILTY CLAY
F-Cs SAND
SILTY SAND AND GRAVEL
SAND AND GRAVEL
CLAY AND GRAVEL (TILL)
LIMESTONE AND SHALE (BEDROCK)
VERTICAL EXAGGERATED X 33
SCALE IN FEET
0
1000

Figure 24



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Ground-Water Consultants

GENERALIZED HYDROGEOLOGIC CROSS-SECTION F-F'
ARMCO PLANT, MIDDLETOWN, OHIO

INTERMEDIATE WATER
SCREENED INTERVAL

FILL AND/OR TOP SOIL
SILTY CLAY
F-Cs SAND
SILTY SAND AND GRAVEL
SAND AND GRAVEL
CLAY AND GRAVEL (TILL)
LIMESTONE AND SHALE (BEDROCK)

VERTICAL EXAGGERATED X 33

SCALE IN FEET
0 500 1000

Figure 25

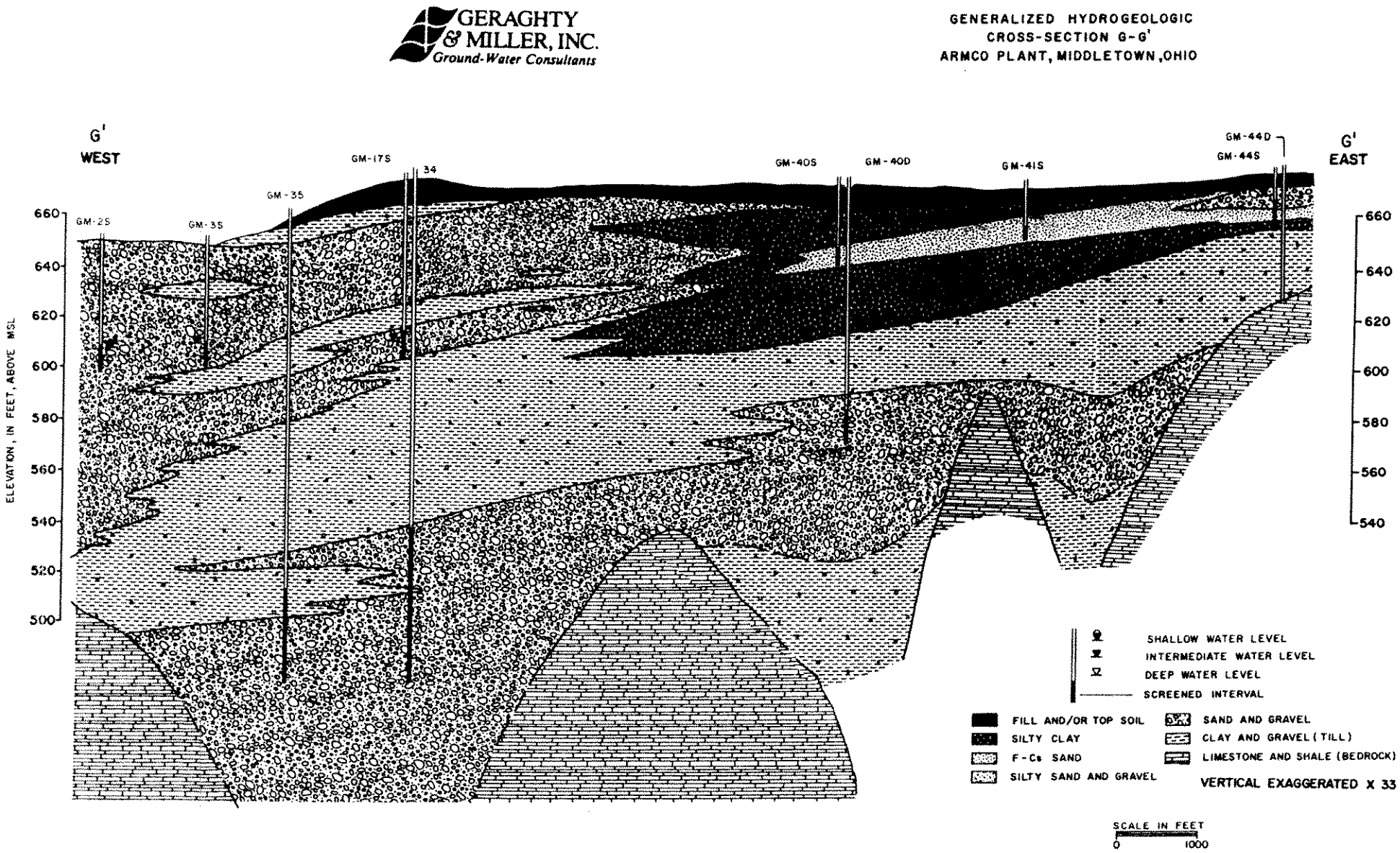

GERAGHTY & MILLER, INC.
Ground-Water Consultants
GENERALIZED HYDROGEOLOGIC
CROSS-SECTION G-G'
ARMCO PLANT, MIDDLETOWN, OHIO
G'
WEST
G'
EAST
GM-2S
GM-3S
GM-3S
GM-17S
34
GM-40S
GM-40D
GM-41S
GM-44D
GM-44S
ELEVATION, IN FEET, ABOVE MSL
660
640
620
600
580
560
540
520
500
SHALLOW WATER LEVEL
INTERMEDIATE WATER LEVEL
DEEP WATER LEVEL
SCREENED INTERVAL
FILL AND/OR TOP SOIL
SILTY CLAY
F-Cs SAND
SILTY SAND AND GRAVEL
SAND AND GRAVEL
CLAY AND GRAVEL (TILL)
LIMESTONE AND SHALE (BEDROCK)
VERTICAL EXAGGERATED X 33
SCALE IN FEET
0
1000

Figure 26

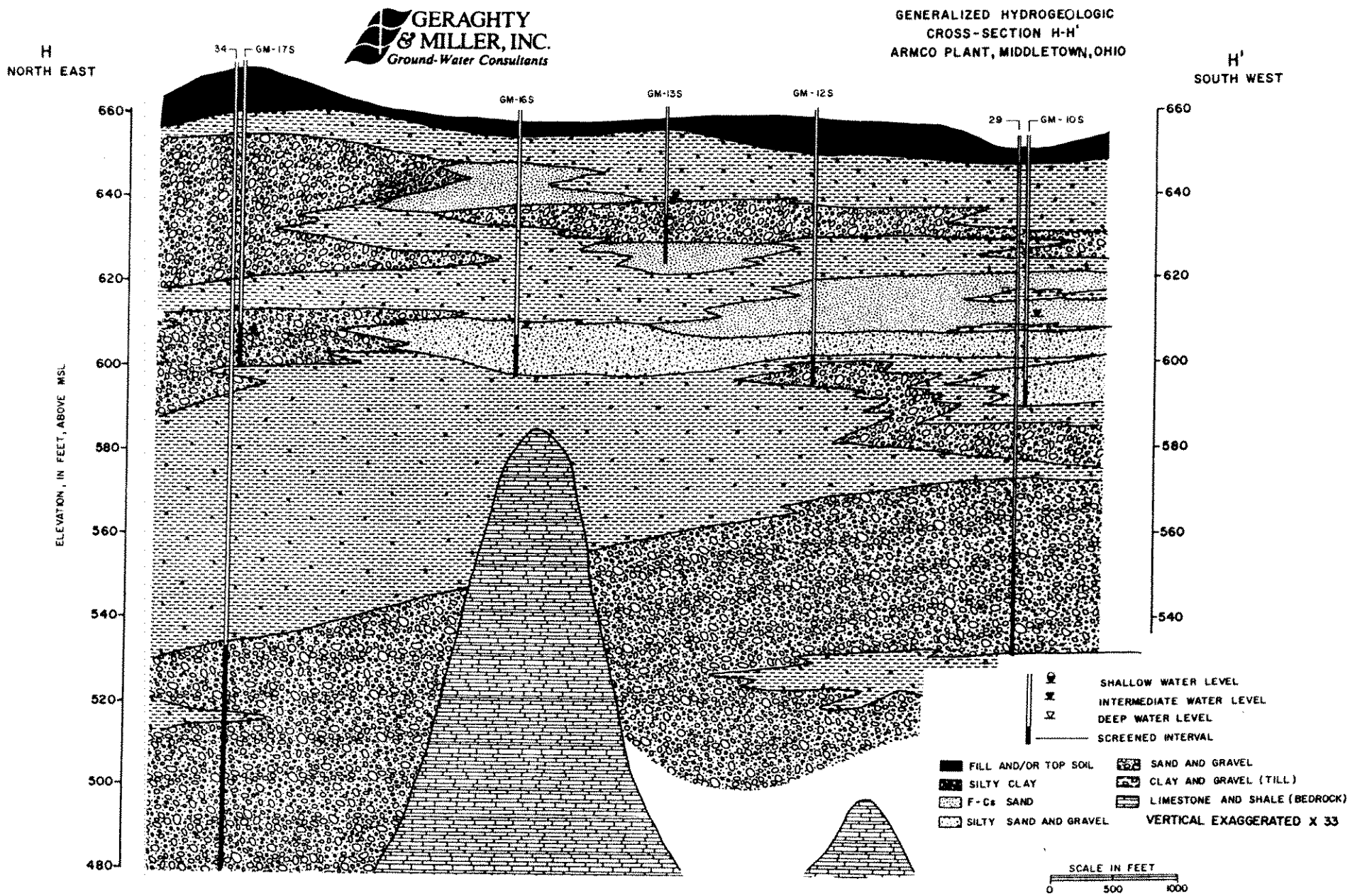

GERAGHTY & MILLER, INC.
Ground-Water Consultants
GENERALIZED HYDROGEOLOGIC
CROSS-SECTION H-H'
ARMCO PLANT, MIDDLETOWN, OHIO
H
NORTH EAST
H'
SOUTH WEST
34
GM-17S
GM-16S
GM-13S
GM-12S
29
GM-10S
ELEVATION, IN FEET, ABOVE MSL
660
640
620
600
580
560
540
520
500
480
SHALLOW WATER LEVEL
INTERMEDIATE WATER LEVEL
DEEP WATER LEVEL
SCREENED INTERVAL
FILL AND/OR TOP SOIL
SILTY CLAY
F-Cs SAND
SILTY SAND AND GRAVEL
SAND AND GRAVEL
CLAY AND GRAVEL (TILL)
LIMESTONE AND SHALE (BEDROCK)
VERTICAL EXAGGERATED X 33
SCALE IN FEET
0
500
1000

Figure 27

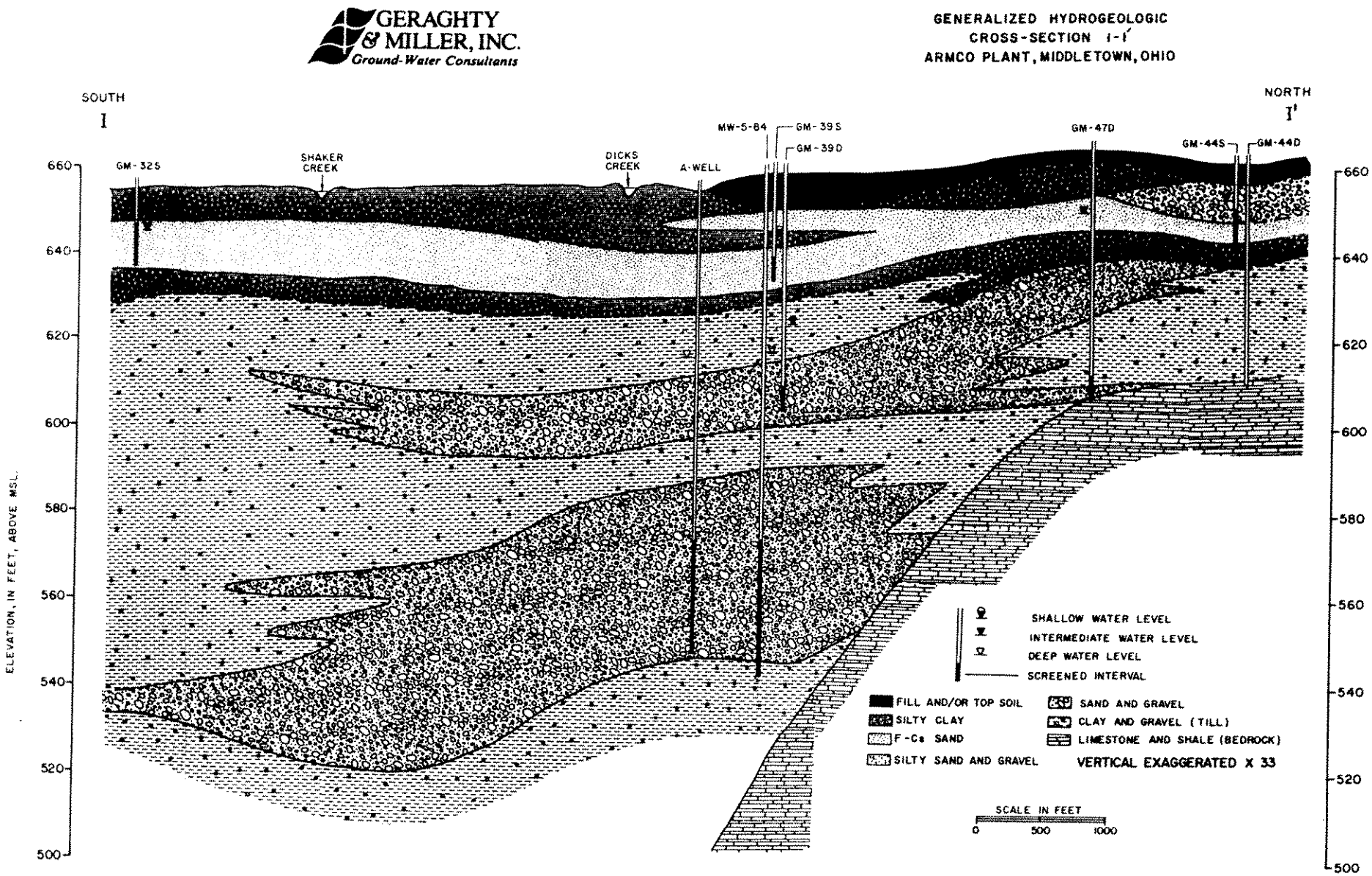
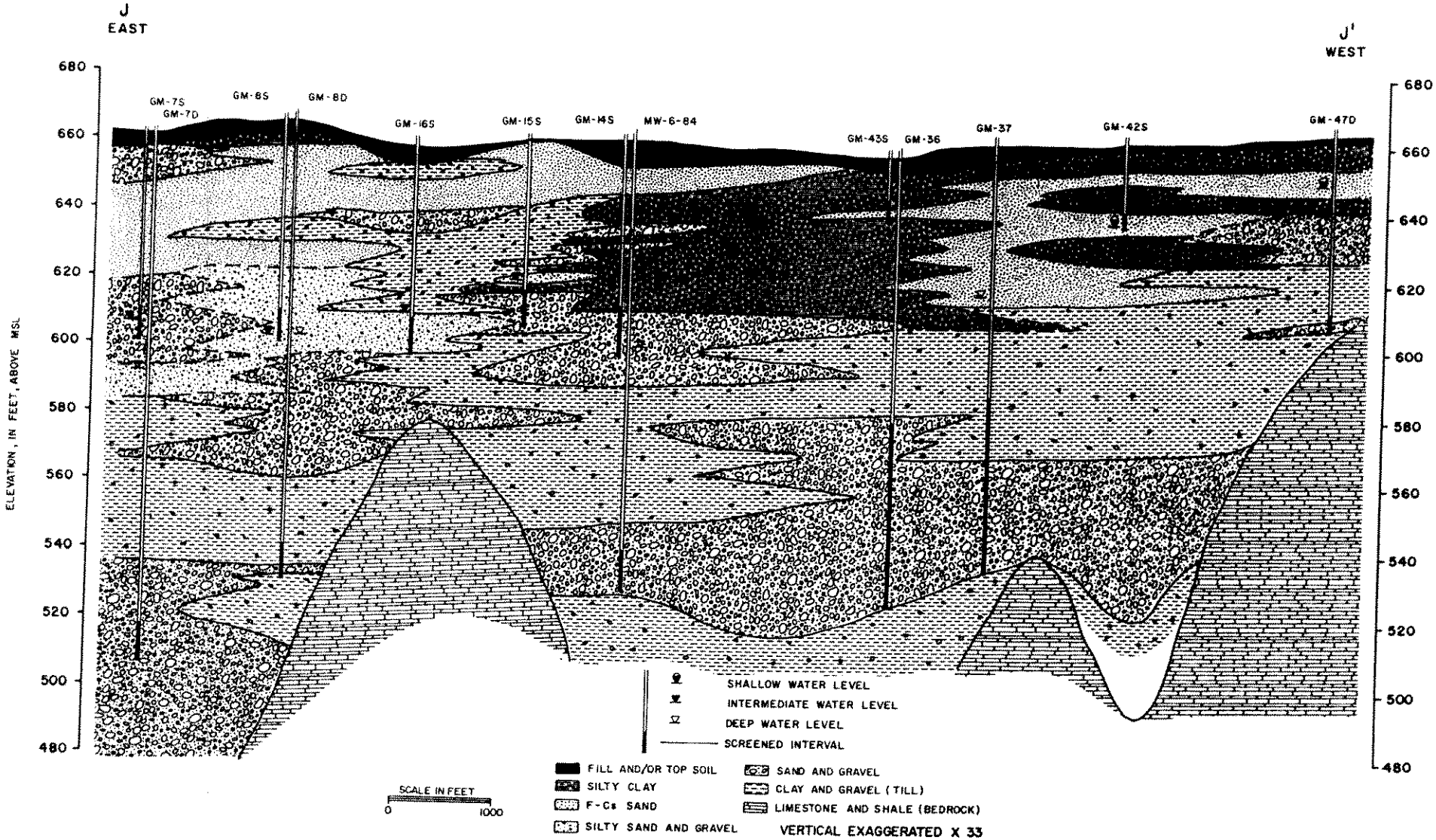
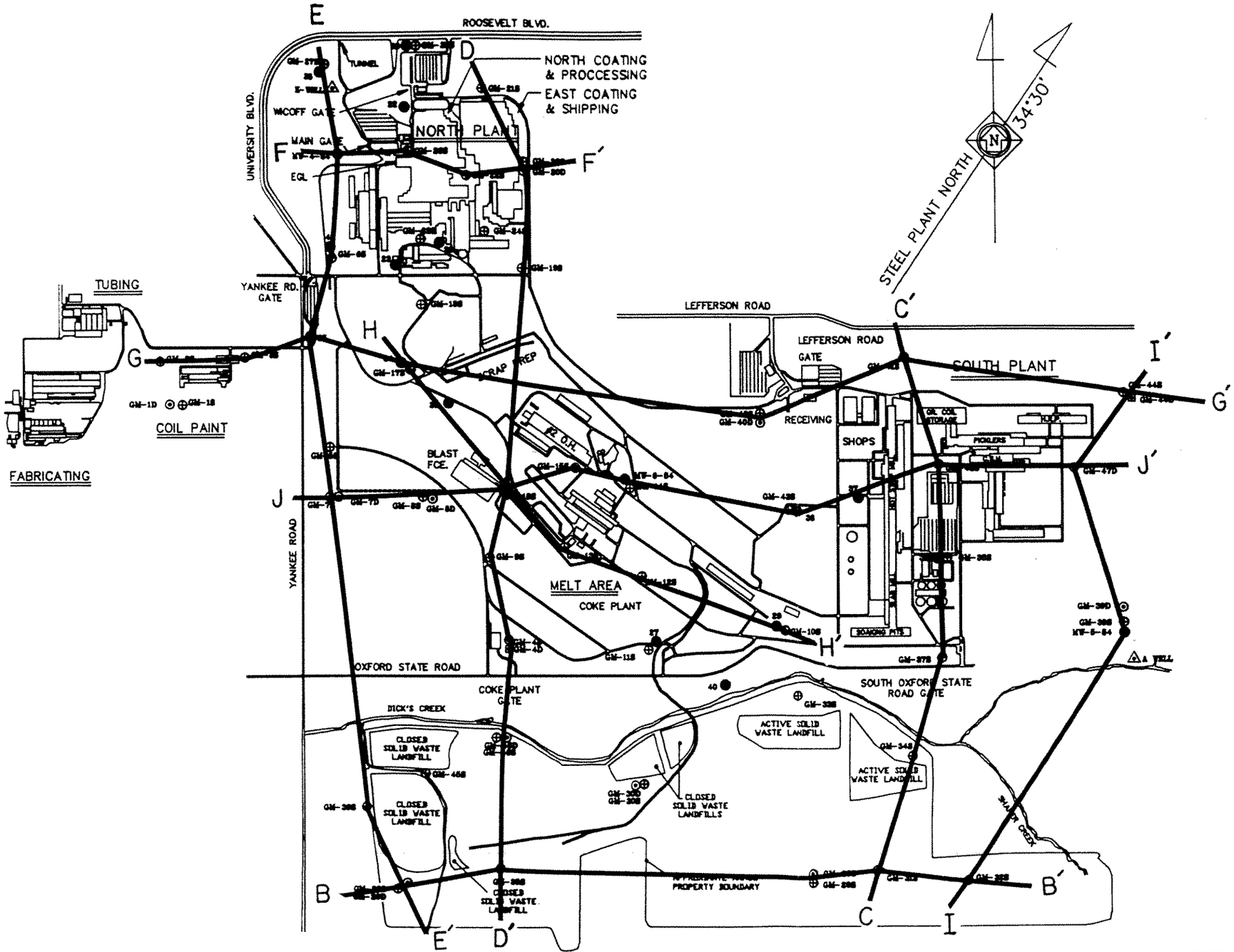

GERAGHTY & MILLER, INC.
Ground-Water Consultants
GENERALIZED HYDROGEOLOGIC
CROSS-SECTION I-I'
ARMCO PLANT, MIDDLETOWN, OHIO
SOUTH
I
NORTH
I'
GM-32S
SHAKER CREEK
DICKS CREEK
A-WELL
MW-5-84
GM-39S
GM-39D
GM-47D
GM-44S
GM-44D
ELEVATION, IN FEET, ABOVE MSL
660
640
620
600
580
560
540
520
500
SHALLOW WATER LEVEL
INTERMEDIATE WATER LEVEL
DEEP WATER LEVEL
SCREENED INTERVAL
FILL AND/OR TOP SOIL
SILTY CLAY
F-Cs SAND
SILTY SAND AND GRAVEL
SAND AND GRAVEL
CLAY AND GRAVEL (TILL)
LIMESTONE AND SHALE (BEDROCK)
VERTICAL EXAGGERATED X 33
SCALE IN FEET
0
500
1000

Figure 28

GERAGHTY & MILLER, INC.
Ground-Water Consultants

GENERALIZED HYDROGEOLOGIC
CROSS-SECTION J-J'
ARMCO PLANT, MIDDLETOWN, OHIO





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GM-8D	S 2620.09	W 649.79
GM-20D	N 2502.27	E 792.73
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GM-46D	S 6282.76	E 342.54
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23	N 1004.17	W 1246.25
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27	S 4809.83	E 2791.05
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30	N 1341.22	W 573.17
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37	S 2600.00	E 5970.00
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MW-6-84	S 2429.75	E 2376.44
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Figure 30

NOTES:

1. ARMCO REF# 581549

LEGEND

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- ⊕ SHALLOW PIEZOMETERS
- △ LAYNE OBSERVATION WELLS
- ⊙ DEEP PIEZOMETERS
- ⊞ ABANDONED BOREHOLES

GERAGHTY & MILLER, INC.
Ground-Water Consultants

SCALE

0 1000' 2000'

CLIENT: ARMCO INC.
MIDDLETOWN, OHIO

TITLE: Location of Lines of Section