3.0 SITE GEOLOGY AND HYDROGEOLOGY

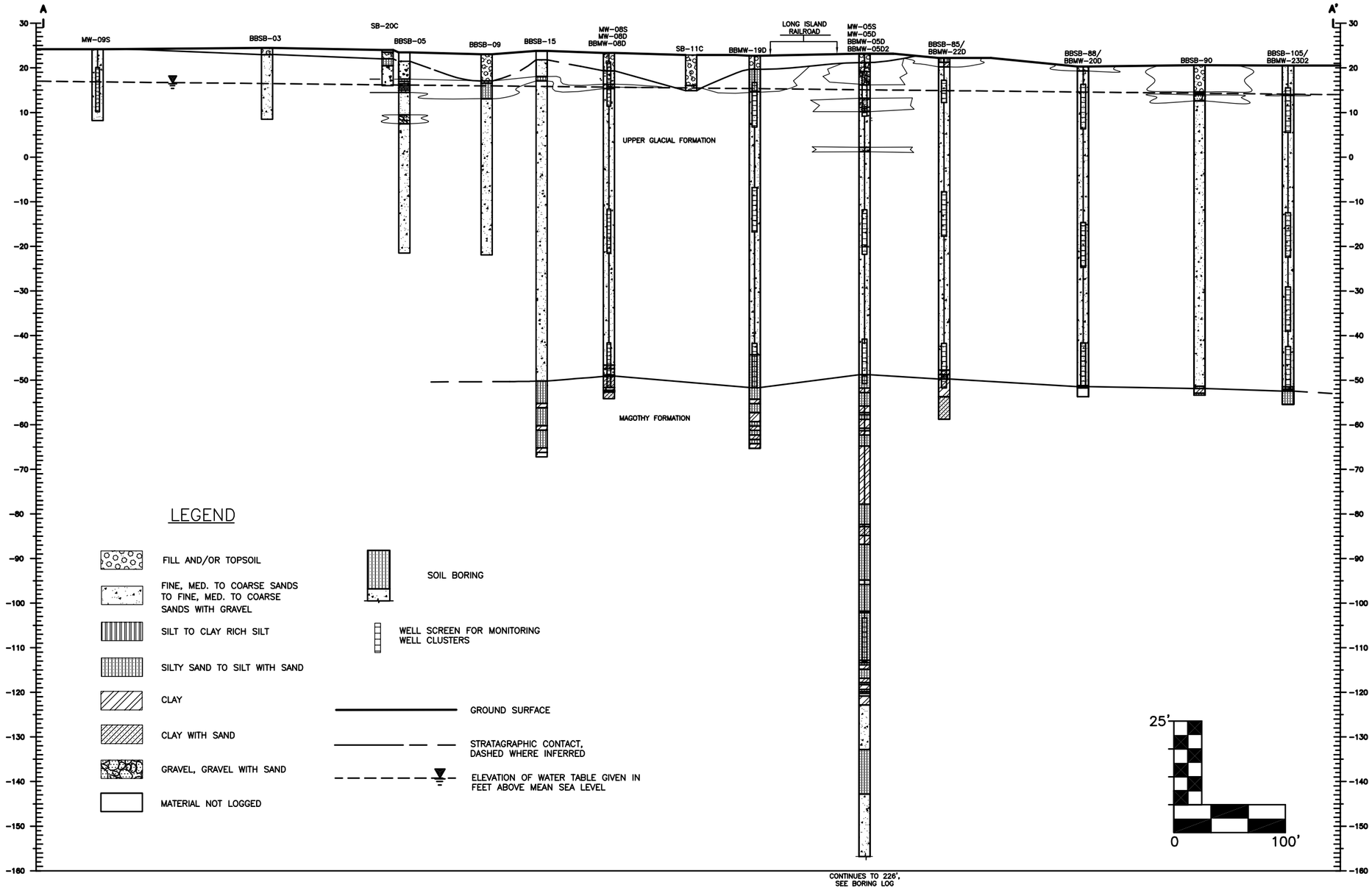
3.1 Introduction

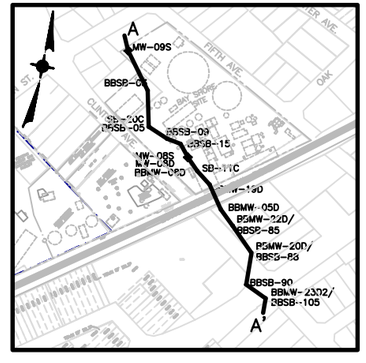
The following section presents the findings as well as a discussion and interpretation of the hydrogeologic data collected as part of the initial field program completed in the Fall of 2000 and the supplemental field program completed in the Summer of 2002. However, the discussion presented in this section focuses particularly on those aspects of site hydrogeology that have been clarified based on the supplemental field program. Data generated as part of the initial and supplemental field programs and utilized in this evaluation include the following:

- Logs from completed borings and monitoring wells;
- Geotechnical analysis of selected soil samples;
- Available boring logs from private and public wells located within or near the study area;
- Hydraulic head measurements from existing and newly installed monitoring wells; and
- Surface water level measurements from stream gauging stations installed at surface water bodies within the study area.

This data was evaluated and interpreted in conjunction with the characterization of the hydrogeology of the study area, as presented in the April 2002 RI Report.

Based on the information described above, five geologic cross sections of the Bay Shore site, including immediately adjacent and downgradient areas, were generated. The cross sections are provided as **Figures 3-1** through **3-5**. In addition three geologic cross sections of the Watchogue Creek/Crum's Brook area were generated and are provided as **Figures 3-6** and **3-7**. **Figures 3-1** through **3-3** are north-south trending geologic cross sections through the Bay Shore site and the adjacent off-site area to the south extending no further than soil boring BBSB-105/BBMW-23 located on the south-west corner of the intersection of Union Boulevard and Clinton Avenue. **Figure 3-4** is a west-east trending geologic cross section that runs along





KEY MAP
SHOWING
CROSS-SECTION LINE

SCALE:1"=500'

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS
GEOLOGIC CROSS-SECTION A-A'

FIGURE 3-1

Dvirka and Bartilucci CONSULTING ENGINEERS
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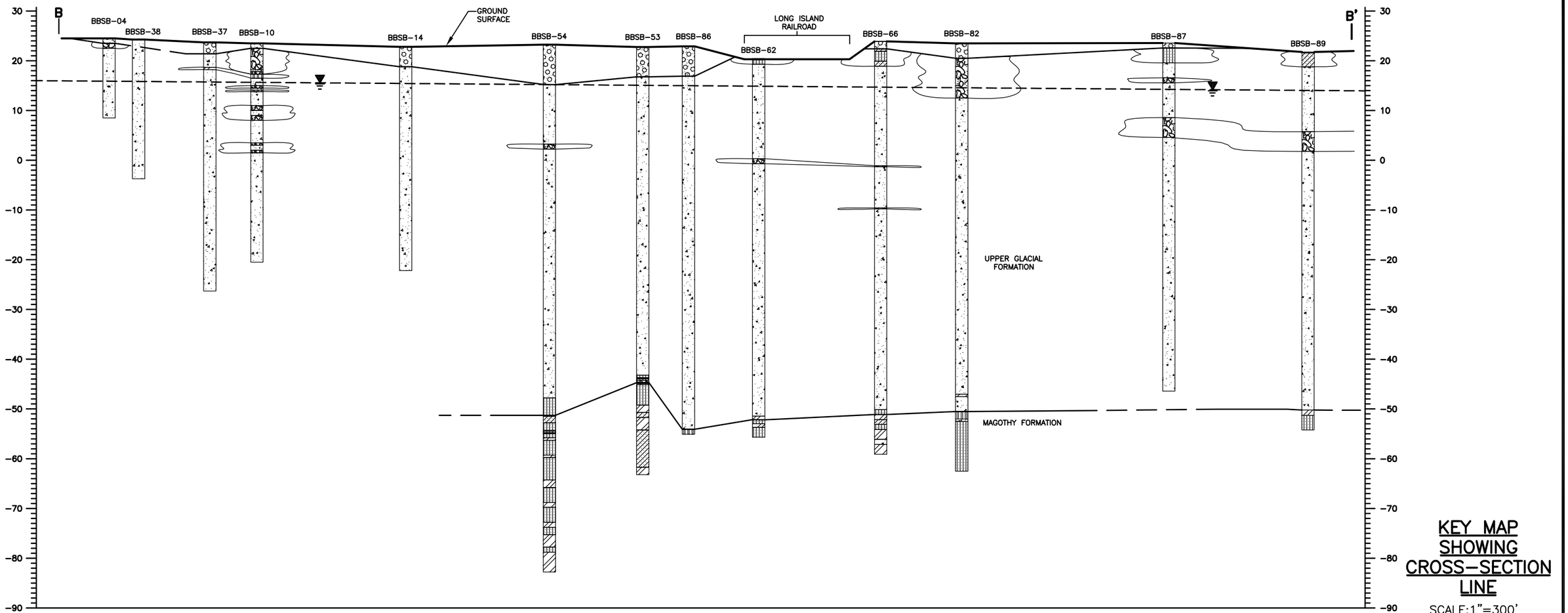
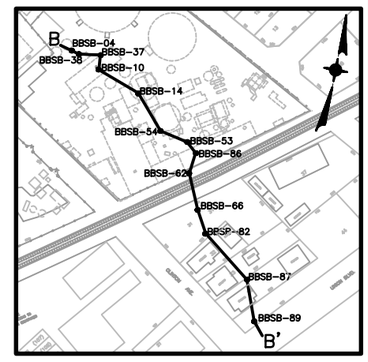
\\Nt4\CADwork\1620B12C\11X17\FIG-3A.dwg, 10/29/02 08:55:22 AM, APostyn



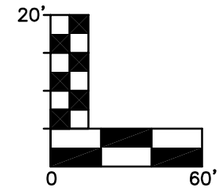
KEY MAP SHOWING CROSS-SECTION LINE

SCALE: 1"=300'



LEGEND

- FILL AND/OR TOPSOIL
- FINE, MED. TO COARSE SANDS TO FINE, MED. TO COARSE SANDS WITH GRAVEL
- SILT TO CLAY RICH SILT
- SILTY SAND TO SILT WITH SAND
- CLAY
- CLAY WITH SAND
- GRAVEL, GRAVEL WITH SAND
- MATERIAL NOT LOGGED
- SOIL BORING
- WELL SCREEN FOR MONITORING WELL CLUSTERS
- GROUND SURFACE
- STRATAGRAPHIC CONTACT, DASHED WHERE INFERRED
- ELEVATION OF WATER TABLE GIVEN IN FEET ABOVE MEAN SEA LEVEL



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS
GEOLOGIC CROSS-SECTION B-B'

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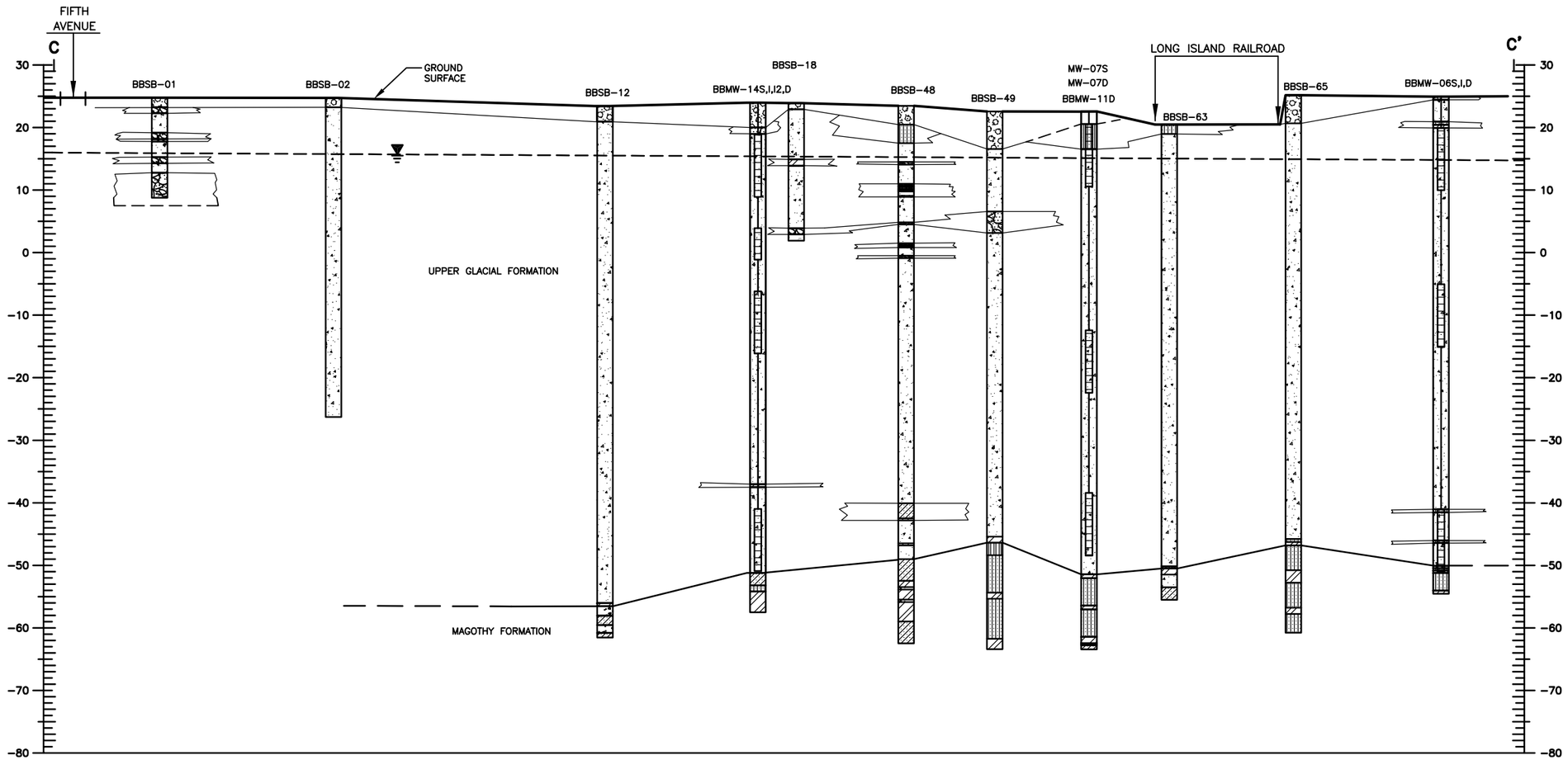
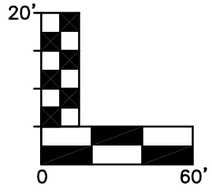
FIGURE 3-2

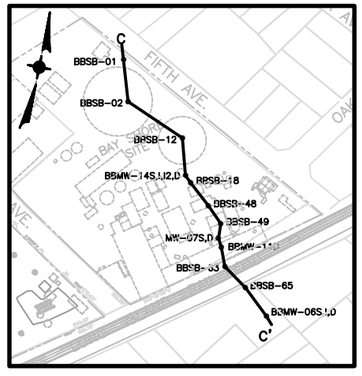
\\Nt4\CADwork\1620B12C\11X17\FIG-3B.dwg, 10/29/02 08:52:57 AM, APostyn



LEGEND

- FILL AND/OR TOPSOIL
- FINE, MED. TO COARSE SANDS TO FINE, MED. TO COARSE SANDS WITH GRAVEL
- SILT TO CLAY RICH SILT
- SILTY SAND TO SILT WITH SAND
- CLAY
- CLAY WITH SAND
- GRAVEL, GRAVEL WITH SAND
- MATERIAL NOT LOGGED
- SOIL BORING
- WELL SCREEN FOR MONITORING WELL CLUSTERS
- GROUND SURFACE
- STRATAGRAPHIC CONTACT, DASHED WHERE INFERRED
- ELEVATION OF WATER TABLE GIVEN IN FEET ABOVE MEAN SEA LEVEL





KEY MAP SHOWING CROSS-SECTION LINE

SCALE: 1"=300'

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS GEOLOGIC CROSS-SECTION C-C'

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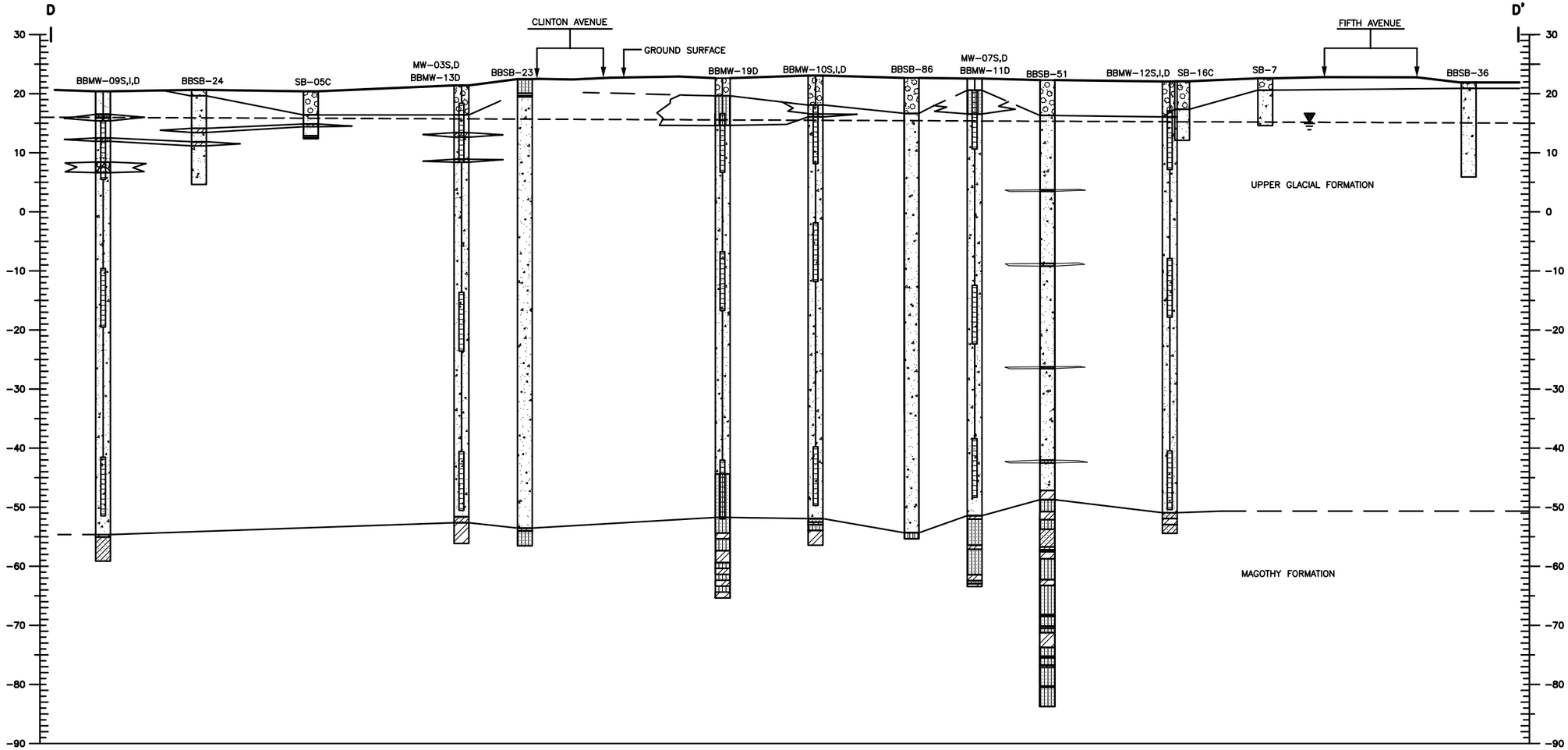
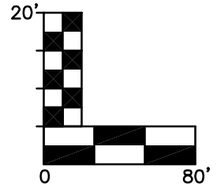
FIGURE 3-3

\\Nt4\CADwork\1620B12C\11X17\FIG-3C.dwg, 10/29/02 08:56:10 AM, APostyn



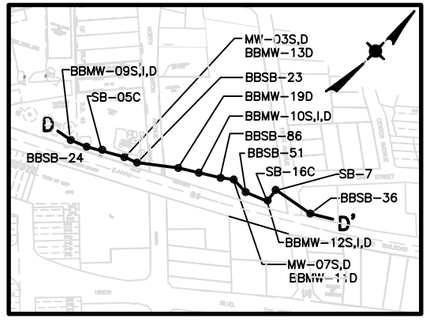
LEGEND

- FILL AND/OR TOPSOIL
- FINE, MED. TO COARSE SANDS TO FINE, MED. TO COARSE SANDS WITH GRAVEL
- SILT TO CLAY RICH SILT
- SILTY SAND TO SILT WITH SAND
- CLAY
- CLAY WITH SAND
- GRAVEL, GRAVEL WITH SAND
- MATERIAL NOT LOGGED
- SOIL BORING
- WELL SCREEN FOR MONITORING WELL CLUSTERS
- GROUND SURFACE
- STRATAGRAPHIC CONTACT, DASHED WHERE INFERRED
- ELEVATION OF WATER TABLE GIVEN IN FEET ABOVE MEAN SEA LEVEL



KEY MAP SHOWING CROSS-SECTION LINE

SCALE: 1"=500'



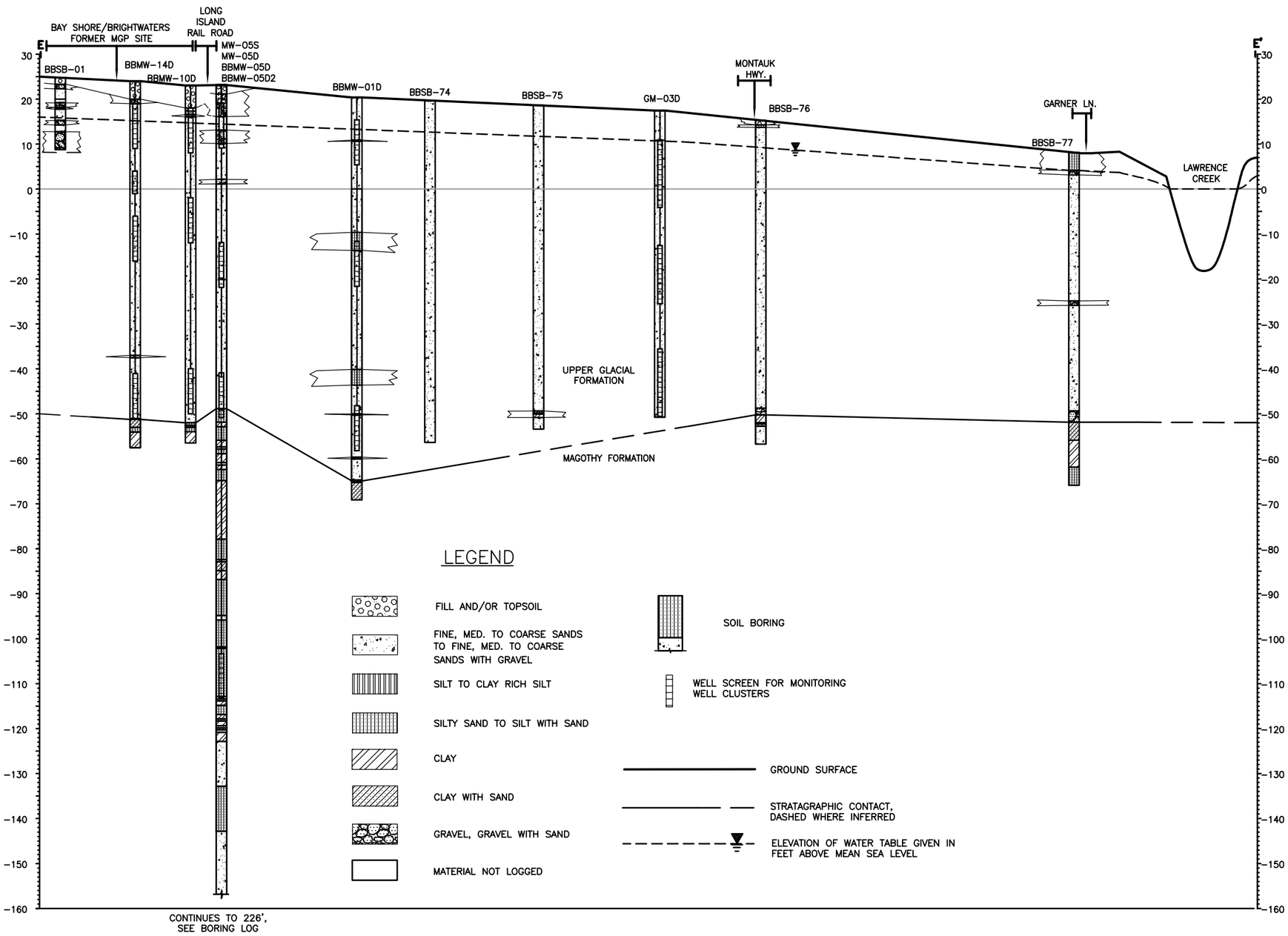
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

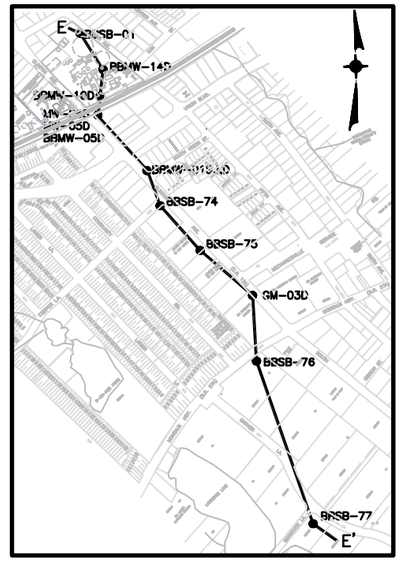
BAY SHORE SITE AND BAY SHORE WEST PARCEL GEOLOGIC CROSS-SECTION D-D'

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

FIGURE 3-4

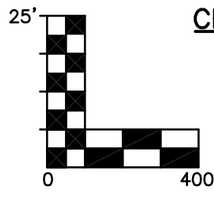
F:\1620B12C\11X17\FIG-3D.dwg, 01/03/03 11:22:59 AM, PMartorano





KEY MAP SHOWING CROSS-SECTION LINE

SCALE:1"=1000'



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

NORTH-SOUTH GEOLOGIC CROSS-SECTION E-E' FROM BAY SHORE SITE THROUGH BAY SHORE PLUME

Dvirka and Bartilucci CONSULTING ENGINEERS
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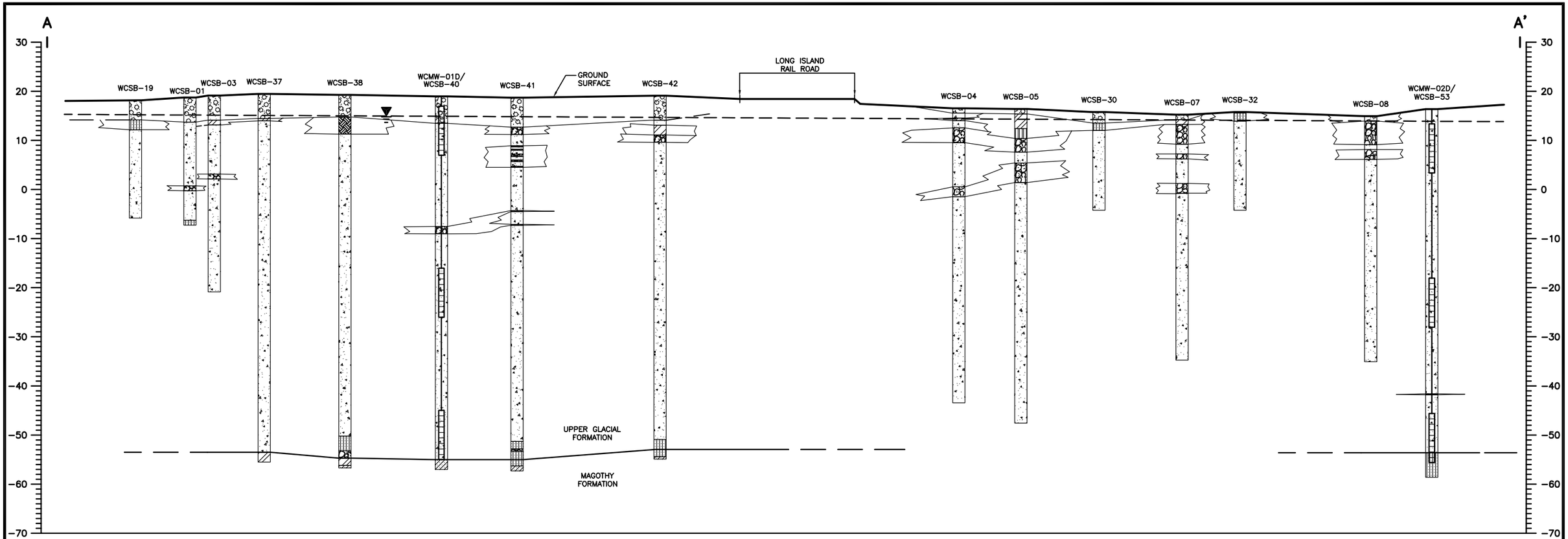
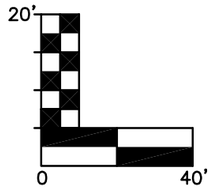
FIGURE 3-5

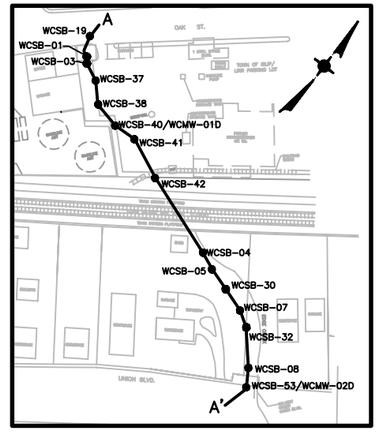
F:\1620B12C\11X17\FIG-3E.dwg, 01/03/03 11:21:32 AM, PMartorano



LEGEND

- FILL AND/OR TOPSOIL
- FINE, MED. TO COARSE SANDS TO FINE, MED. TO COARSE SANDS WITH GRAVEL
- SILT TO CLAY RICH SILT
- SILTY SAND TO SILT WITH SAND
- CLAY
- CLAY WITH SAND
- GRAVEL, GRAVEL WITH SAND
- PEAT
- MATERIAL NOT LOGGED
- SOIL BORING
- WELL SCREEN FOR MONITORING WELL CLUSTERS
- GROUND SURFACE
- STRATAGRAPHIC CONTACT, DASHED WHERE INFERRED
- ELEVATION OF WATER TABLE GIVEN IN FEET ABOVE MEAN SEA LEVEL





KEY MAP
SHOWING CROSS-SECTION LINE
SCALE:1"=200'

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

Dvirka and Bartilucci CONSULTING ENGINEERS
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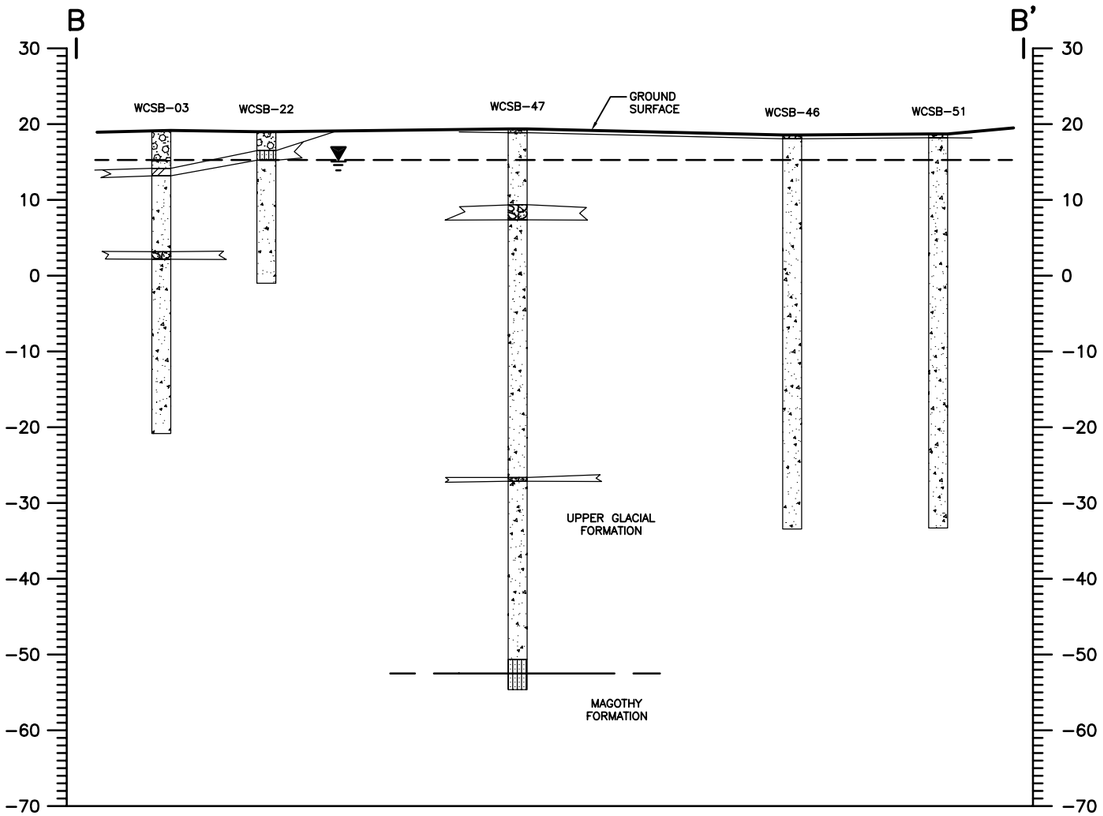
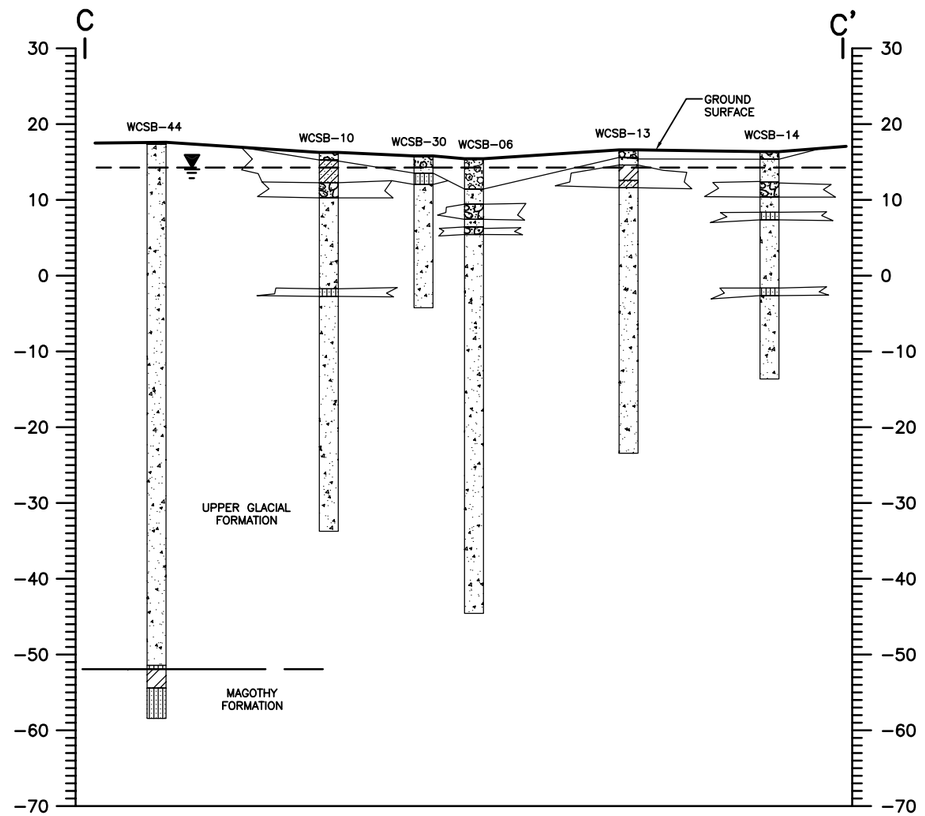
WATCHOGUE CREEK
GEOLOGIC CROSS-SECTION A-A'

FIGURE 3-6

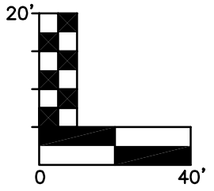
\\N4\CADwork\16620B12C\11X17\FIG-3F.dwg, 10/29/02 09:01:28 AM, APostyn

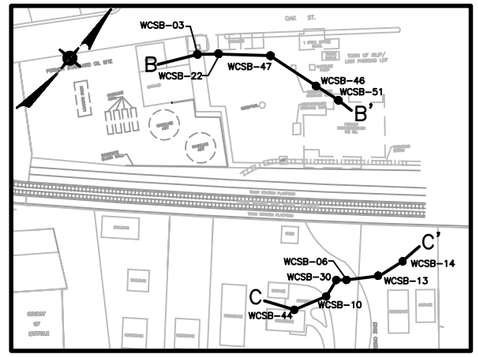




LEGEND

- FILL AND/OR TOPSOIL
- FINE, MED. TO COARSE SANDS TO FINE, MED. TO COARSE SANDS WITH GRAVEL
- SILT TO CLAY RICH SILT
- SILTY SAND TO SILT WITH SAND
- CLAY
- CLAY WITH SAND
- GRAVEL, GRAVEL WITH SAND
- MATERIAL NOT LOGGED
- SOIL BORING
- WELL SCREEN FOR MONITORING WELL CLUSTERS
- GROUND SURFACE
- STRATAGRAPHIC CONTACT, DASHED WHERE INFERRED
- ELEVATION OF WATER TABLE GIVEN IN FEET ABOVE MEAN SEA LEVEL





KEY MAP
SHOWING CROSS-SECTION LINE

SCALE: 1"=200'

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

WATCHOGUE CREEK
GEOLOGIC CROSS-SECTIONS B-B' AND C-C'

FIGURE 3-7

\\Nt4\CADwork\1620B12C\11X17\FIG-3G.dwg, 10/29/02 09:02:43 AM, APostyn

the north side of the Long Island Rail Road from monitoring well cluster BBMW-09 in the Brightwaters Yard to soil boring BBSB-36 located across Fifth Avenue from the south-east corner of the Bay Shore site. **Figure 3-5** is a north-south trending geologic cross section extending from soil boring BBSB-01 at the north end of the Bay Shore site through the length of the dissolved BTEX/PAH plume to soil boring BBSB-77, a distance of approximately 3600 feet.

Figure 3-6 is a north-south trending geologic cross section in the Watchogue Creek/Crum's Brook area, which extends south from soil boring WCSB-19 on Oak Street to soil boring WCSB-53/WCMW-02, located along Union Boulevard. **Figure 3-7** includes west-east trending geologic cross sections B-B' and C-C', which are located on the north and south sides of the Long Island Rail Road, respectively.

The locations of probes, borings and monitoring wells referenced in this section are shown on **Drawings 2A** and **2B** and on **Figure 2-1**. Boring and test pit logs from the supplemental field program are included in **Appendix A** of this report. Boring and test pit logs from the initial field program are provided in **Appendix C** of the April 2002 RI Report.

3.2 Site Stratigraphy

Consistent with the findings of the initial field program, there are four general stratigraphic units within the study area that are of importance with respect to this investigation: a fill unit, a recent silt/clay unit, glacial outwash deposits and the Magothy formation. The following is a brief description of each unit along with a presentation and discussion of any new findings from the supplemental field program. Please refer to the April 2002 RI Report for a full description of each unit and a discussion of the original findings.

Fill Material

The fill material encountered throughout the site is highly variable in character and thickness. However, it generally consists of brown to black sands and gravels with varying amounts of glass, brick, coal, ash, clinker and wood. The fill material extends throughout the

southern two-thirds of the Bay Shore Site with the thickest component located along the southern most portion of the parcel as indicated by cross sections A-A', B-B' and D-D' provided on **Figures 3-1**, **3-2** and **3-4**, respectively. Fill material was encountered immediately south of the site at soil borings BBSB-65, BBSB-67 and BBSB-82, consisting of a mixture of brown sand, silt, clay and gravel with glass and coal fragments.

The fill material within the southern portion of the site contained extensive amounts of construction/demolition (C&D) material, such as brick, metal piping, concrete block and wood. Based on the nature of the C&D material, it is likely that it originated as a result of the demolition of the MGP facility which occurred in 1973. On-site test pit excavations completed during the supplemental field program determined that the locations of foundations and other subsurface structures remaining on-site are consistent with historic drawings for the MGP site.

Recent Clay/Silt Unit

The initial field program found that underlying the fill unit exists a recent-aged (post-glacial) clay-silt unit that was gray to brown to black in color and ranged from stiff to slightly plastic with varying amounts of fine sand. The unit was found primarily beneath the Brightwaters Yard where the headwaters of Lawrence Creek likely flowed prior to the site being developed. Within the Bay Shore site and Bay Shore West Parcel, the recent clay-silt unit was sporadically detected and hence, discontinuous within these portions of the study area. Therefore, the recent clay-silt unit was not considered an effective confining unit within these areas. Soil borings and test pits completed during the supplemental field program confirm the discontinuous nature of the recent clay-silt unit within the Bay Shore site and Bay Shore West Parcel. However, the unit was most commonly encountered in the southwestern portion of the Bay Shore site, such as in soil boring BBMW-18D (5' thick). In addition, evidence of the clay-silt unit was noted in test pit BBTP-12, which is also located in the southwestern portion of the site.

Glacial Outwash Deposits

Consistent with regional geology, a continuous sequence of glacial outwash sand and gravel exists throughout the site and surrounding areas. The glacial outwash deposits comprise the entire Upper Glacial aquifer. Within the site, the upper surface of the outwash deposits is located immediately below the surficial topsoil layer in areas where the fill and recent clay-silt units are absent. Where these units are present, outwash deposits are generally within 8 feet of ground surface. Within and adjacent to the site, the outwash deposits vary slightly in thickness, averaging approximately 65-70 feet. The thickness ranges from approximately 76 feet at BBSB-12 located within the east-central portion of the Bay Shore site to a minimum of 61.5 feet observed at BBSB-53 located within the south-central portion of the Bay Shore site. The glacial outwash deposits are thickest in the off-site portion of the study area with a maximum thickness of approximately 85-90 feet observed at soil boring BBMW-16D. The glacial outwash deposits rest on top of the low permeable Magothy formation, which is discussed below.

The glacial outwash deposits consist of a yellow-brown to orange colored medium to coarse quartzose sand with minor amounts of silt and gravel. The upper portions of the outwash deposits are generally well sorted and appear to have good to excellent primary porosity. The medium to coarse sands encountered throughout the site, as well as areas to the south, are typical of glacial outwash deposits which comprise the Upper Glacial aquifer within southern Suffolk County. Glacial outwash deposits within this area of Long Island exhibit excellent water transmitting properties with horizontal hydraulic conductivities ranging from 147 feet per day to 270 feet per day (USGS Water Supply Report No. 1768 and USGS Professional Paper No. 800-C).

Geotechnical data for shallow glacial outwash deposits collected during the supplemental field program presented on **Table 3-1** indicates that the grain size distribution is consistent with that found during the initial field program.

The initial field program found that the outwash deposits appear to remain fairly consistent in nature through its vertical extent, although at a number of supplemental borings,

TABLE 3-1
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR SHALLOW GLACIAL OUTWASH DEPOSITS

Sample Identification		BBSB-42	BBSB-49	BBSB-50	BBSB-56	BBSB-65	BBSB-74	BBSB-74	BBSB-75
Depth (feet)		16-18	24-26	21-23	21-23	16-18	8-10	16-18	8-10
Date		2/12/02	2/11/02	2/11/02	2/13/02	2/14/02	2/13/02	2/13/02	2/14/02
CHARACTERISTIC	UNIT								
Sieve	%	<1	<1	1	<1	1	2	3	4
Hyd (2 μ)	%	<1	N/A	<1	<1	<1	N/A	N/A	N/A
G_s	none	2.66	2.66	2.64	2.67	2.68	2.67	2.66	2.67
d_{10}	mm	0.28	0.24	0.21	0.24	0.28	0.19	0.18	0.24

NOTES:

Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd - % sample particles finer than 2 μ as determined through hydrometer analysis
G_s - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ - Micron
N/A - Not analyzed
* - d_{10} finer than endpoint of grain size analysis

TABLE 3-1 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR SHALLOW GLACIAL OUTWASH DEPOSITS

Sample Identification		BBSB-76	BBSB-77	BBMW-21	AVERAGE CHARACTERISTICS OF SHALLOW GLACIAL OUTWASH DEPOSITS
Depth (feet)		8-10	8-10	33-35	
Date		2/20/02	2/21/02	2/23/02	
CHARACTERISTIC	UNIT				
Sieve	%	5	2	2	2
Hyd (2 μ)	%	2	1	1	1
G_s	none	2.66	2.68	2.63	2.66
d_{10}	mm	0.17	0.27	0.25	0.23

NOTES:

Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd - % sample particles finer than 2 μ as determined through hydrometer analysis
G_s - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ - Micron
N/A - Not analyzed
* - d_{10} finer than endpoint of grain size analysis

such as BBSB-54, BBSB-57 and BBSB-65, results indicated that deeper deposits (i.e., below 60 feet bgs) contained greater amounts of fine mica particles, principally muscovite/biotite. This increased concentration of fine mica particles likely reduces the hydraulic conductivity of the deeper outwash deposits at or near the base of the glacial outwash/Magothy Formation interface.

Geotechnical data for deep glacial deposits collected during the supplemental field program is summarized on **Table 3-2**. The grain size distribution is consistent with what was found during the intial field program. The supplemental data indicates an average percentage of particles passing through the 200 sieve of 11 compared to 4.45 for the initial data. However, BBSB-75 (68-70 feet), a sample of gray clay and silt most likely representative of the top of the Magothy formation, is skewing the results. Removing this sample reduces the sieve percentage to 5, which is consistent with the results from the initial field program. Furthermore, the average d_{10} (effective grain size – the diameter at which 10% of the sample is finer and 90% coarser) is 0.12 for the supplemental samples (0.13 if BBSB-75 [68-70 feet] is removed) compared to 0.13 from the initial samples. Overall, it is clear from the supplemental geotechnical results that the deep glacial deposits are finer (average d_{10} = 0.12) than the shallow glacial deposits (average d_{10} = 0.23), possibly due to the presence of fine mica particles described above.

Magothy Formation

Based on completed deep borings within the site as well as at downgradient locations, the glacial outwash deposits are directly underlain by a fine sand, silt and clay formation varying from light gray to black in color and ranging from hard to slightly plastic in texture. This low permeability unit is described as being highly micaceous with several samples containing lignite. Analysis of several undisturbed sediment samples (Shelby tube samples) conducted as part of the initial field program confirmed the low permeable nature of the Magothy formation with an average vertical permeability of only 1.74×10^{-5} cm/second or 0.05 feet/day. Therefore, the upper portion of the Magothy formation acts as an effective confining unit limiting the vertical migration of any chemical constituents beyond the glacial outwash deposits.

TABLE 3-2
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR DEEP GLACIAL DEPOSITS

Sample Identification		BBSB-42	BBSB-49	BBSB-50	BBSB-56	BBSB-65	BBSB-74	BBSB-75	BBSB-75	BBSB-76
Depth (feet)		63-65	64-66	64-66	68-70	62-64	52-54	52-54	68-70	40-44
Date		2/13/02	2/11/02	2/11/02	2/14/02	2/14/02	2/13/02	2/14/02	2/14/02	2/20/02
CHARACTERISTIC	UNITS									
Sieve	%	5	7	3	4	7	4	5	90	1
Hyd (2 μ)	%	2	<1	1	1	2	N/A	N/A	N/A	N/A
G_s	none	2.65	2.68	2.67	2.67	2.71	2.69	2.67	2.76	2.66
d_{10}	mm	0.1	0.085	0.16	0.15	0.085	0.17	0.095	<0.0014*	0.19

NOTES:

Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd - % sample particles finer than 2 μ as determined through hydrometer analysis
G_s - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ - Micron
N/A - Not analyzed
* - d_{10} finer than endpoint of grain size analysis

TABLE 3-2 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR DEEP GLACIAL DEPOSITS

Sample Identification		BBSB-76	BBSB-77	BBSB-77	BBSB-81	BBMW-21	AVERAGE CHARACTERISTICS OF DEEP GLACIAL DEPOSITS
Depth (feet)		60-64	32-36	56-58	63-65	73-75	
Date		2/20/02	2/21/02	2/21/02	2/15/02	2/23/02	
CHARACTERISTIC	UNITS						
Sieve	%	11	1	4	3	9	11
Hyd (2 μ)	%	2	1	2	1	2	2
G_s	none	2.68	2.68	2.69	2.68	2.32	2.66
d_{10}	mm	0.07	0.17	0.15	0.16	0.1	0.12

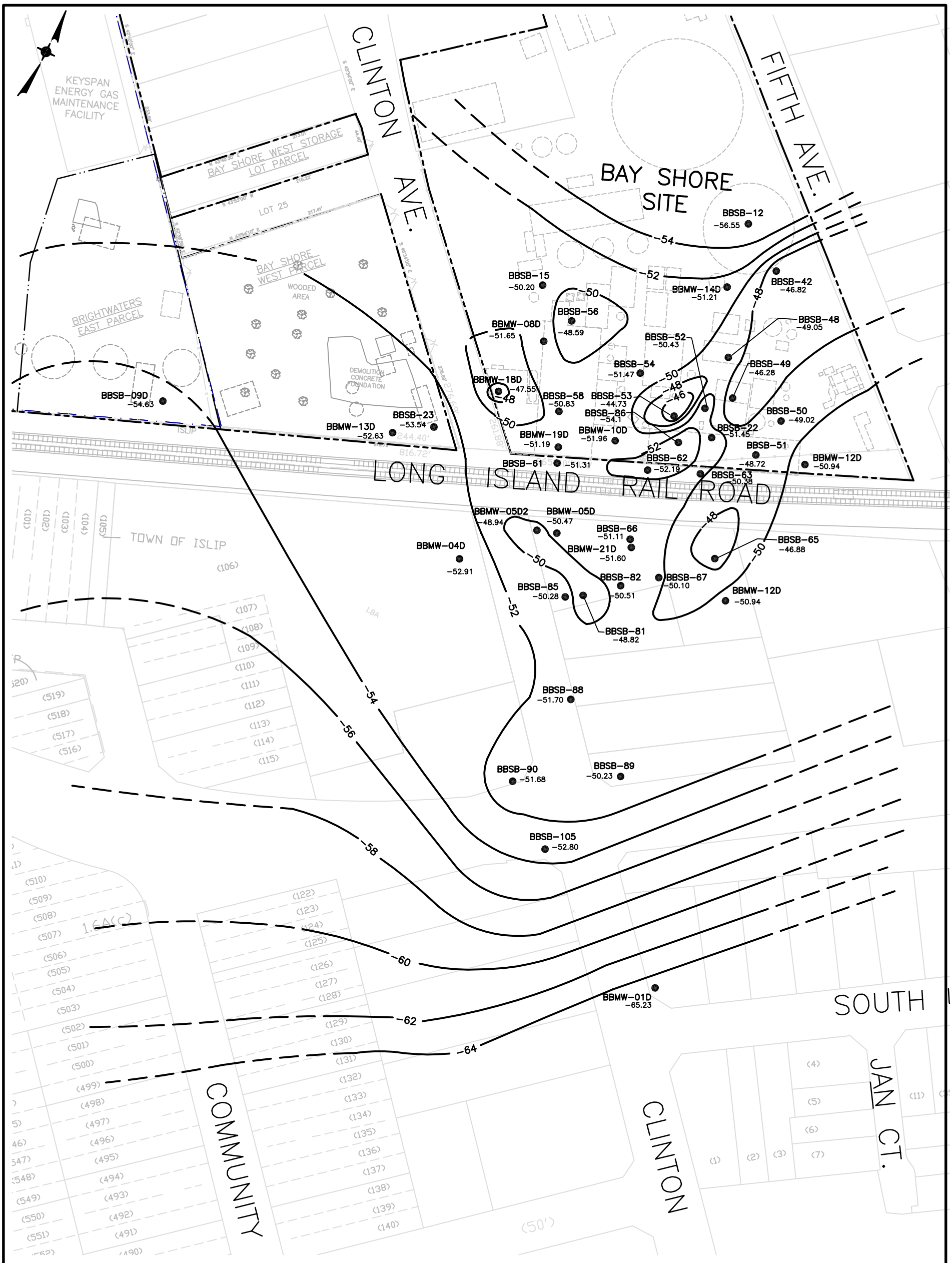
NOTES:

Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd - % sample particles finer than 2 μ as determined through hydrometer analysis
G_s - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ - Micron
N/A - Not analyzed
* - d_{10} finer than endpoint of grain size analysis

As discussed in the April 2002 RI Report, the Magothy formation is approximately 800 to 900 feet thick within this area of Long Island. Furthermore, the Magothy formation comprises the Magothy aquifer which is the primary source of public water in Suffolk County. However, the upper portion of the Magothy formation contains extensive amounts of silt and clay and generally has poor water transmitting properties. As a result, public supply wells are screened within the mid to lower portions of the Magothy aquifer and are generally no less than 500 feet in depth.

A contour map depicting the top of the Magothy formation beneath the Bay Shore site, Bay Shore West Parcel and downgradient areas is presented as **Figure 3-8**. Due to the number of deep soil borings completed within the southern half of the Bay Shore site and adjacent off-site areas as part of the supplemental field program, data on the "topography" of the Magothy formation is much more complete for this area. On the other hand, data is more sparse in the remaining portions of the study area, including south of Union Boulevard, the northern half of the site and the Brightwaters Yard. As a result, the level of detail relative to the topography of the Magothy formation in these areas is not as complete. This distribution of data is clearly illustrated on **Figure 3-8**.

As shown on **Figure 3-8**, the Magothy formation is generally level within the southern portion of the Bay Shore south to Union Boulevard ranging from approximately –48 to –52 feet below mean sea level (msl). However, the surface of the Magothy formation appears to be shallowest in the south-central/south-eastern portion of the site as seen on **Figure 3-8** and on west-east cross section D-D' (**Figure 3-4**). Also, there appears to be a subtle trough running from the south-central/south-western portion of the Bay Shore site south/south-southeast to soil boring BBSB-105/BBMW-23 at the southwest corner of Clinton Avenue and Union Boulevard. This trough in the surface of the Magothy formation is apparent on north-south cross section A-A' south of monitoring well BBMW-08D (**Figure 3-1**), and on west-east cross section D-D' (**Figure 3-4**). This subtle trough is coincident with a zone of DNAPL identified above the Magothy formation immediately south of the Bay Shore site (refer to **Section 4.2.1.4**). It is possible that the trough is serving to facilitate the accumulation of DNAPL detected in this area.



SOURCE: BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION.
NOTE: STIE SURVEY DATA SHOWN ON THIS MAP IS FOR KEYSPAN USE ONLY AND IS NOT TO BE RELIED UPON BY OTHERS

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A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

TOP OF MAGOTHY FORMATION

FIGURE 3–8

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Another prominent feature in the Magothy formation is an apparent mound in the south-central portion of the site identified at soil borings BBSB-53 (-44.73 feet msl) and BBSB-49 (-46.28 feet msl). Furthermore, there appears to be a second trough in the surface of the Magothy formation towards the northeast portion of the site (BBSB-12 at –56.55 feet msl). However, information on the Magothy formation is limited to the data gathered at this one boring in this area of the site.

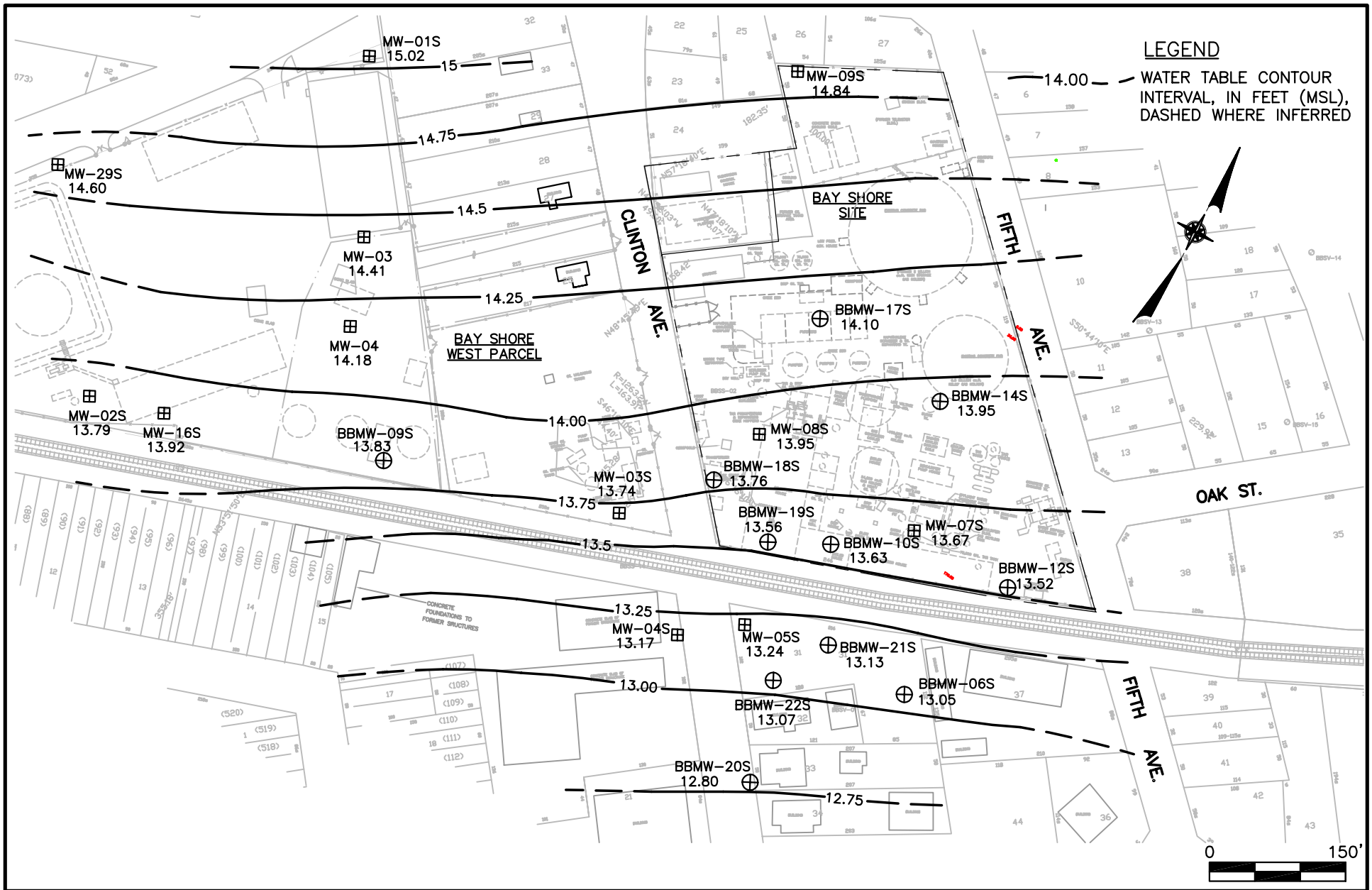
Off-site to the south, the general trend from the southern portion of the site towards the south/south-southeast is a gradual slope to the south followed by a steeper slope towards BBMW-01D (-65.23 feet msl) into an apparent erosional valley, first identified in the April 2002 RI Report. This trend is identifiable on cross section E-E' (**Figure 3-5)**.

Due to the importance of the low permeability zone at the top of the Magothy formation, a deep boring, BBMW-05D2, was completed in order to determine the thickness of the zone. Soil characterization from this deep boring is graphically depicted in cross sections on **Figures 3-1** and **3-5**, and **Drawings 4A** and **4D**. The low permeable clays and silts at the top of the Magothy formation were estimated to be approximately 74 feet thick (from 72 to 146 feet bgs) followed by an 80-foot thick zone of medium-coarse sand (from 146 to 226 feet bgs, the base of the boring). This sand zone was found to contain some silt from 156 to 166 feet and some clay and silt near the base of the recovered material at approximately 214 feet bgs.

3.3 Groundwater Flow and Hydraulic Gradients

Based on depth to water measurements collected during June 2002 (see **Table 2-11**), groundwater at the Bay Shore Site is approximately 6 to 8 feet below grade. Downgradient of the Bay Shore Site, depth to groundwater is variable due to changes in ground surface elevation but gradually decreases with the shallowest measurements collected from monitoring wells located along Garner Lane, approximately 2,000 feet south of the site.

Based on water level measurements recorded at monitoring wells on August 28, 2002, an on-site water table contour map was developed and is presented as **Figure 3-9**. Based on water



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

ON-SITE WATER TABLE CONTOUR MAP

AUGUST 28, 2002

FIGURE 3-9

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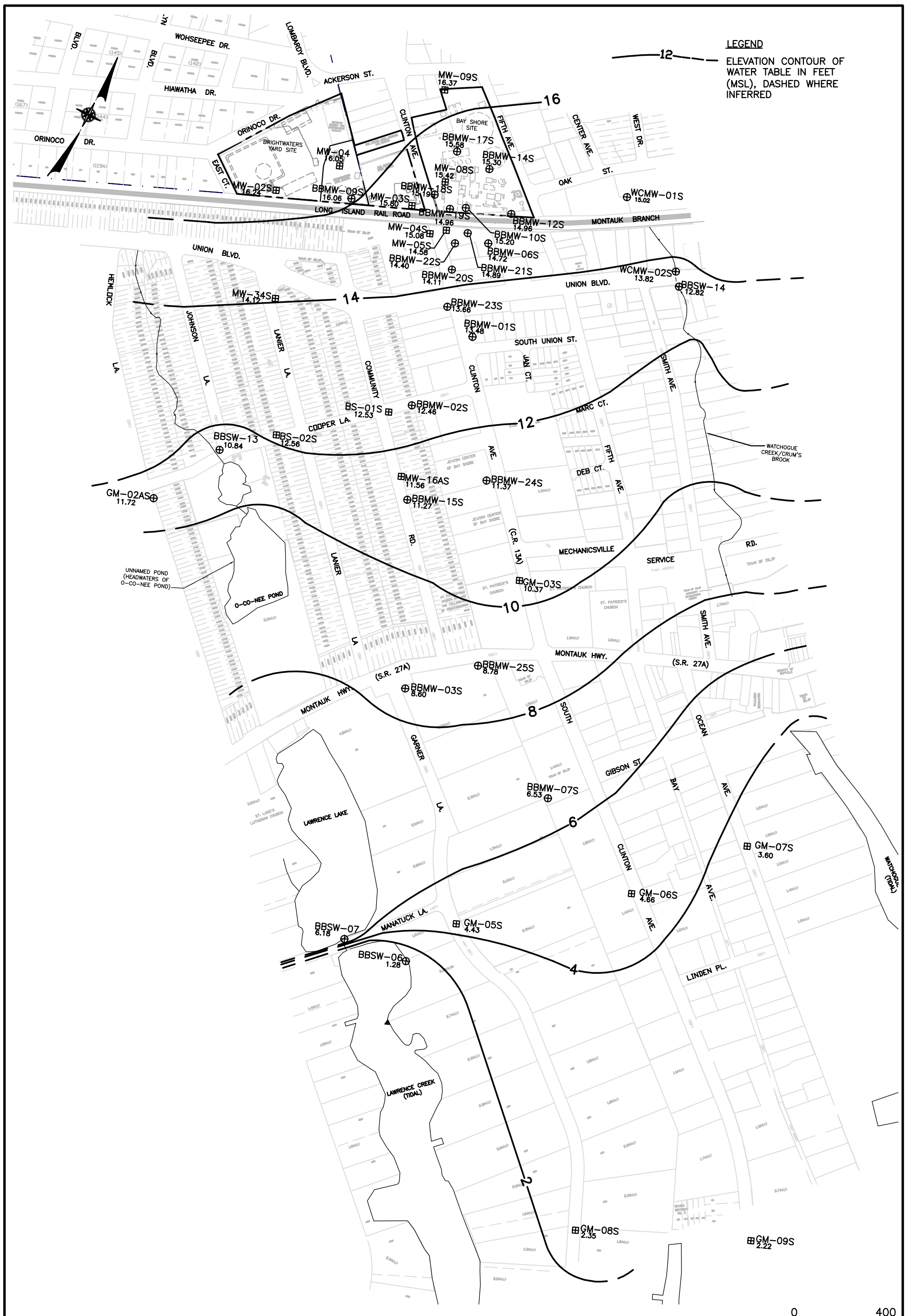
level measurements recorded at monitoring wells from June 6-10, 2002, an off-site water table contour map (**Figure 3-10**) and an off-site potentiometric surface map of the deep Upper Glacial aquifer (**Figure 3-11**) were developed.

As shown on **Figure 3-9**, on-site groundwater generally flows in a south to southeast direction throughout the site. Several of the minor localized anomalies detected in on-site groundwater flow during the initial field program are not apparent in the more recent round of water level measurements. However, groundwater appears to flow in a more southerly direction within the western portion of the Brightwaters Yard. Consistent with the findings of the initial field program, **Figure 3-10** indicates that shallow groundwater south of the site continues to flow in a south to southeasterly direction within a distance of approximately 1,000 feet downgradient. However, further south of the site, groundwater flow is influenced by the southern flowing surface water systems located to the east and west with groundwater west of Fifth Avenue flowing toward the O-Co-Nee Pond and Lawrence Lake/Lawrence Creek drainage system in a more south-southwesterly direction. Groundwater east of Fifth Avenue appears to flow in a more east-southeast direction, eventually discharging to the Watchogue Creek drainage system. Consistent with the findings of the initial field program, there appears to be a localized anomaly in groundwater flow east of the southernmost half of Lawrence Lake. We believe that this anomaly is caused by the fact that Lawrence Lake is artificially impounded at its southernmost end which has resulted in the localized mounding of groundwater at the southern half of lake. As a result of this mounding, groundwater which would normally flow in a more westerly direction and eventually discharge to the lake is deflected in a more southerly direction. East of the southern portion of Lawrence Lake, groundwater continues to flow south until reaching the tidal area of Lawrence Creek, south of Manatuck Lane. At this point, groundwater flow becomes predominantly westerly in response to a relatively strong westerly hydraulic gradient as determined by water elevations observed at the northeastern end of Lawrence Creek (gauging station BBSW-06) and monitoring well GM-05S, located approximately 300 feet to the east of the creek. Due to the tidal influence on the creek, the westerly gradient towards Lawrence Creek is strongest during periods of low tide and weakest during periods of high tide.



SOURCE: BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION.
NOTE: STIE SURVEY DATA SHOWN ON THIS MAP IS FOR KEYSPAN USE ONLY AND IS NOT TO BE RELIED UPON BY OTHERS

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

OFF-SITE WATER TABLE CONTOUR MAP
JUNE 6-10, 2002

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FIGURE 3-10

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SOURCE: BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION.
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BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

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POTENTIOMETRIC SURFACE OF DEEP UPPER GLACIAL AQUIFER JUNE 6–10, 2002

FIGURE 3–11

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Consistent with the initial field program, the potentiometric surface of the deep zone of the Upper Glacial aquifer, shown on **Figure 3-11**, generally indicates a southerly groundwater flow direction for a distance of approximately 1,600 feet. However, at this point groundwater appears to flow predominantly in a southeasterly direction, towards the tidal portion of Watchogue Creek. Only deep groundwater west of Community Road and Garner Lane appears to flow towards Lawrence Creek. However, this apparent change in flow direction may not actually be occurring given that the potentiometric contours appear to be significantly shifted as result of one water level measurement recorded at monitoring well GM-05D which is under artesian conditions. The water level at GM-05D may be a much more localized effect than indicated by the potentiometric map. Furthermore, chemical data from deep monitoring wells and completed groundwater probes do not suggest a change in the direction of the Bay Shore plume migration south of Montauk Highway as this potentiometric surface map may suggest.

As seen on **Table 2-11**, monitoring wells located immediately downgradient of the site to points as far south as Montauk Highway show virtually no vertical head difference, indicating a predominantly horizontal groundwater flow within this area. Monitoring well cluster GM-07 located on Ocean Avenue south of Montauk Highway indicated a subtle upward vertical head distribution of 0.11 feet in June 2002, perhaps an indication of groundwater discharge to Watchogue Creek. However, this upward vertical head distribution was measured at only 0.05 feet in March 2002. The only substantial vertical head gradient was observed at well cluster GM-05 located on Garner Lane, approximately 300 feet east of Lawrence Creek, where the deep well static head was measured at 8.51 feet mean sea level (msl) and the shallow well exhibited a static water level of only 4.43 feet msl, a difference of 4.08 feet. This difference was reported as 5.64 feet in the initial field program and was 5.61 feet during the March 2002 round of water level measurements. These results indicate a strong upward vertical gradient and an area of groundwater discharge. Additionally, GM-05D appears to be under artesian conditions with the static head being above the top of the well casing at this location. As a result, groundwater will freely flow from this well when the well cap is removed.

Finally, the installation of deep well BBMW-05D2, screened from 126.5-136.5 feet bgs, allows one to compare the difference in the vertical head distribution between the Magothy and

Upper Glacial aquifers, at least at this one location. As shown on **Table 2-11**, in three rounds of water level measurements in 2002 - March, June and August – the static head of the deep well was greater than the static head of the shallow well, with differences of 0.55 feet, 0.32 feet and 0.14 feet, respectively. This indicates a slight upward vertical gradient between the two aquifer systems at this location.

3.4 Watchogue Creek/Crum's Brook Hydrogeology

Fill Material

Fill in the Watchogue Creek/Crum's Brook area tends to be dark gray to dark brown in color and contains varying amounts of brick and asphalt pieces, glass fragments, ash and vesicular slag. The fill, when found, is generally 4 to 6 feet in thickness. An exception was at soil boring WCSB-49, in the location of the former Knickerbocker Ice Co., where up to 12 feet of fill was observed.

Glacial Outwash Deposits

The glacial outwash deposits in the Watchogue Creek/Crum's Brook area are generally consistent in lithology and thickness with those found within and adjacent to the Bay Shore site. Additionally, as seen on the cross sections on **Figures 3-6** and **3-7**, there tends to be a number of gravel-rich lenses in this area, primarily south of the Long Island Rail Road. These lenses are usually found within 20 feet of the ground surface. Also, there was a zone of peat identified at soil boring WCSB-38 within 8 feet of the ground surface immediately beneath a zone of fill.

Magothy Formation

The surface of the Magothy formation is generally flat as seen on **Figure 3-6**. The surface elevation of the formation varies from approximately –52 to –55 feet msl. There does not seem to be any apparent trends in the topography of the Magothy formation in this area based on the currently available data.

Groundwater Flow and Hydraulic Gradients

Based on depth to water measurements taken during June 2002 (see **Table 2-11**), groundwater at the Watchogue Creek/Crum's Brook area is approximately 4 feet below grade (15.02 feet msl) north of the Long Island Rail Road, as measured at monitoring well WCMW-01S, and approximately 2 feet below grade (13.82 feet msl) south of the Long Island Rail Road, as measured at monitoring well WCMW-02S located along Union Boulevard. This indicates that groundwater generally flows in a southerly direction in this area. The deep wells, WCMW-01D (15.09 feet msl) and WCMW-02D (13.88 msl), indicate that groundwater in the deep glacial sediments flows in a similar fashion.

The water level data further suggests a slight upward gradient in the vertical head distribution between the deep and shallow wells at monitoring well clusters WCMW-01 and WCMW-02. The deep wells exhibit greater static heads when compared to the corresponding shallow wells with differences of 0.07 and 0.06 feet, respectively, possibly indicating an area of groundwater discharge.