PB2001-101561

REPORT NO. 1
FINAL REPORT
CONTRACT NO. 3Z6251
(REPORT NO. 253, MRCE SERIES)
SECTION G4aL, ADDISON ROUTE
SUPPLEMENTARY SUBSURFACE INVESTIGATION

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May 19, 2000

BIBLIOGRAPHIC DATA SHEET	1. Report No. MRCE-00-253	2.	3. Recipient's Accession No.
4. Title and Subtitle Final Report Preliminary Subsurface Investigation Section G4aL, Addison Route			5. Report Date May 19, 2000 6.
7. Author(s) Mueser Rutledge Consulting Engineers			8. Performing Organization Rept. No.
9. Performing Organization Name and Address Mueser Rutledge Consulting Engineers 708 Third Avenue New York, NY 10017			10. Project/Task/Work Unit No. 11. Contract/Grant No. 3Z6251
12. Sponsoring Organization Name and Address Washington Metropolitan Area Transit Authority Washington, DC 20001			13. Type of Report & Period Covered 14.

15. Supplementary Notes

Preliminary Report on March 31, 2000

16. Abstracts

Results are summarized herein of 14 supplementary borings to investigate subsurface conditions along the subway alignment at Station 516+70 and between Stations 593+00 and 655+23. The report contains geological sections, logs of borings, results of laboratory tests on samples recovered, and text describing design and construction problems.

17. Key Words and Document Analysis. 17a. Descriptors

Urban Transportation
Mass Transportation
Urban Planning
Rock Mechanics
Soil Mechanics
Foundation Engineering

17b. Identifiers/Open-Ended Terms

Foundation Engineering

17c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Release Unlimited	UNCLASSIFIED	
	20. Security Class (This Page) UNCLASSIFIED	22. Price

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May 19, 2000

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Re: Section G4aL Addison Route
Final Report
Preliminary Subsurface Investigation
MRCE File No: 9170

Dear Mr. Feng:

In accordance with our schedule, we submit herewith 3 copies of this final report for the preliminary subsurface investigation of the Preferred Modified Tangent Alignment of Section G4aL of Addison Route. Ten copies of the report are being sent at the same time to WMATA G-Route Project Management. A draft of this report was submitted on March 31, 2000. Comments received from WMATA have been incorporated into this final report. We believe that this completes all of the planned preliminary geotechnical investigations for this portion of the Addison Route. A final investigation for the Beltway Crossing of the Addison Route is presently underway, and will be summarized in a separate report.

Very truly yours,

MUESER RUTLEDGE CONSULTING ENGINEERS

By: Hugh S. Lacy
Hugh S. Lacy

DWC:HSL:chs:ltr-5
Enclosures

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EXHIBITS

REPORT NO. 1
FINAL REPORT
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SECTION G4aL, ADDISON ROUTE
PRELIMINARY SUBSURFACE INVESTIGATION

1.0 INTRODUCTION

1.1 Authorization

Contract No. 3Z6251 between DeLeuw Cather & Company (DCCo) and Mueser Rutledge Consulting Engineers (MRCE) provides for subsurface investigations, laboratory testing, and summary reports relating to certain portions of the Rapid Transit System (RTS). One portion of that report covers the making of 14 borings as part of Phase III of preliminary subsurface investigation to provide geotechnical information in connection with the preparation of general plan drawings and preliminary design at the 30% level. One of these borings was drilled along the alignment explored previously and the remaining 13 borings were drilled along an alignment identified as the Preferred Modified Tangent Alignment.

The following MRCE reports contain exploratory data obtained previously for the Addison Route or information relevant to this section:

1. Final Report, Subsurface Investigation, Addison Route, Station 290 (G002) to 488 (G003), dated November, 1973. (MRWJ Series Report No. 95).

2. Supplementary Subsurface Investigation, Addison Route Section G003, dated November 22, 1974 (MRWJ Series Report No. 118).

3. Report on Pumping Test, Addison Route Section G003, dated July 7, 1975 (MRWJ Series Report No. 135).

4. Preliminary Subsurface Investigation, G-Route Addison Road to Largo Town Center, dated November 14, 1996 (MRCE Series Report No. 249).

5. Preliminary Subsurface Investigation, Sections G4 and G5, Addison Route, dated May 16, 2000 (MRCE Series Report No. 252).

1.2 Scope of Work

The scope of work comprises the subsurface investigation for the planned subway alignment from east of the Summerfield Station to east of the Largo Town Center Station. The completed fieldwork consists of a group of 14 borings, 13 of which are along the Preferred Modified Tangent Alignment and the Largo Town Center Station. A previous investigation was performed in 1996 along the Tangent Alignment and the results published in MRCE Series Report No. 249. Borings Nos. MR-53, MR-54U, MR-55, MR-56, MR-61, MR-62, MR-63, MR-64, and MR-65 were drilled along the subway alignment. Borings MR-57U, MR-58, MR-59U and MR-60 were drilled at the planned location of the Largo Town Center Station. The remaining boring, MR-52, was made near the planned location of MR-7 which had been deleted from earlier programs because we were unable to obtain permission to enter the site.

Boring operations commenced January 2000 following WMATA authorization to proceed, and the borings were completed in May 2000. All borings were made by GeoServices Corporation under subcontract to Geotech Engineers, Inc. and were inspected and logged by GeoServices. An MRCE representative was present at the site on a part-time basis during the boring operations to verify that the work was performed in accordance with Metro standards. The boreholes were made by conventional soil boring methods utilizing a tricone roller bit with the aid of casing and water or drilling mud to advance the hole. Observation wells were installed in nine of the borings for continuing measurement of groundwater levels. All borings with the exception of those containing observation wells were grouted at completion. Borings containing observation wells were grouted above a bentonite seal. Corrosion tests on soil samples recovered from selected borings were performed by Artech Testing LLC of Chantilly, VA, under subcontract to Geotech Engineers, Inc. The results of these tests are included in an appendix to this report.

All soil samples recovered from the borings were transported to our laboratory in New York City for examination, check of field classification, and performance of identification testing and engineering properties tests. Soil samples remaining after completion of laboratory testing were returned to Washington, DC, and placed in the designated storage facility.

2.0 TEST BORING AND LABORATORY PROGRAM

2.1 Presentation of Boring Data

Locations of all 14 borings are shown on Drawings Nos. G4aL-SO-5 and G4aL-SO-12 through 17. Locations of the geological sections as well as the general configuration of the Largo Town Center Station are also shown on these sheets. Information from the borings drilled under this contract as well as earlier borings is plotted on the geological sections. Drawing No. G4aL-SO-5 was originally presented as Drawing No. GPG-SO-50 in MRCE Series Report No. 249, dated November 9, 1996, and has been redrawn to incorporate data from current Boring No. MR-52. All geological sections are drawn at an exaggerated scale of one to four. Soil data plotted on the geological sections include sample number designation and position, Standard Penetration Test resistance of the soil sampler, Unified Soil Classification, water contents of the fine-grained soils, Atterberg Limits, and shear strength in ksf. Also shown on the sections are the results of grain size tests on selected soil samples from the borings, giving the percentage by weight of particles passing the Nos. 200 and 40 sieves and of the gravel retained upon the No. 4 sieve. The legend explaining these test symbols in shown on Drawing No. G4aL-SO-17. Final logs of the completed 14 borings are presented on four Drawings Nos. G4aL-SO-18 through G4aL-SO-21. These logs are based on laboratory examination of soil samples and identification testing, and they may differ in detailed interpretations from the driller's logs.

Coordinate locations and ground surface elevations of the borings are listed in Table No. 1. General Information Drawing No. F-1 presents notes and legend applicable to both the geological sections and boring log drawings. This drawing also summarizes the sequence of the principal subsurface strata with their general descriptions. The general strata descriptions of soils encountered in this design section are presented on Drawing No. G4aL-SO-17.

2.2 Laboratory Testing Program

Three inch undisturbed samples were recovered by pushing thin-walled Shelby tubes. Accepted samples were transported to our New York City laboratory for testing of engineering properties. Those tests comprised determination of shear strength by seven tests. In addition, Atterberg Limit tests and grain size determinations were performed. The results of these tests are listed in Table No. 2, Summary of Laboratory Test Data. All split-spoon samples were examined in the laboratory, classifications were checked and water content determined for clayey and fine grained soils. Seven unconsolidated undrained triaxial shear tests were performed on Tertiary soils of Stratum Es and upper Cretaceous soils of Stratum Ms.

2.3 Field Permeability Tests

Nine falling-head tests were performed in the borings with observation wells. Results are plotted on Table No. 3, which gives basic information on the circumstances of the test, strata tested, and computed coefficients of permeability. The coefficients shown on this table represent an average permeability of the strata exposed in the observation well. They are not comparable in reliability to field pumping test results.

Table No.5 lists generalized coefficients of permeability of Tertiary and upper Cretaceous strata extrapolated from full-scale pumping tests on Pleistocene and Terrace soils based on a comparison of identification properties. The values on these two tables chiefly reflect the horizontal coefficients because of the flow conditions to the test wells. They are regarded as more realistic values than those given by the small scale tests in the individual boreholes.

2.4 Potential Corrosion Characteristics

Tests relating to potential corrosion characteristics included pH, resistivity, chlorides, sulfates, and total sulfur. Results of that testing are presented in the Appendix to this report. Tests of soil samples from Borings Nos. MR-63, MR-64, and MR-65 exhibited pH values below 4, indicating highly acidic soils.

2.5 Groundwater Conditions

Water levels measured in observation wells installed in earlier borings and borings made for this investigation are indicated on the geologic sections by a solid triangle symbol for the current borings and an open triangle symbol for the earlier borings. An average water table position estimated from this group of readings is indicated by a dashed line on the geological sections. In general, the groundwater level is a subdued reflection of the ground surface. The lowest groundwater level was recorded in Boring No. MR-37 at Elev. 114.5 and the highest groundwater level was recorded at Boring No. MR-63 at Elev. 166.2. A water level was observed 2.2 feet above ground surface in Boring No. MR-53 corresponding to Elev. 129.8, suggesting artesian conditions presumably due to higher groundwater levels to the east, confined in deeper pervious strata by overlying less pervious strata.

3.0 SUBSURFACE CONDITIONS

3.1 Subsoil Stratification

The subsoil stratification for the Largo Extension comprising the entire subway alignment between Stations 485+00 and 651+70.55 was summarized in MRCE Series Report No. 249, dated November 14, 1996. The principal materials encountered along the Modified Aerial Alignment comprise man-made fills, Tertiary marine deposits of Calvert sands and clays of Strata Cs and Cc, Aquia sands and clays of Strata Es and Ec, upper Cretaceous Monmouth sands and clays of Strata Ms and Mc, and Cretaceous clays and sands of Strata P1 and P2.

3.1.1 Stratum F - Fill Drawings Nos. SK-1, SK-2 and SK-3 show the existing site topography in 1957, 1971, and 1993, respectively. These drawings indicate that very little fill has been added at the site, except in the northern portion of the parking lot at the US Airways Arena, where up to about 23 feet of fill has been added. The fill is generally loose to medium compact sands and silts and medium to very stiff clays that are difficult to distinguish from the underlying soils from which they are derived, except where artificial materials are added. The thickness of fill generally varies between two and eight feet except in the area centered on Borings MR-54U and MR-55, where fill ranges up to 12 feet in thickness.

3.1.2 Stratum Cs (Calvert) Fine Sand, trace to some Silt, Clay and Silty or Clayey Fine Sand Stratum Cs consists of loose to medium compact dark gray, olive gray, green brown, and yellow orange fine sand, trace to some silt, clay and silty or clayey fine sand, trace gravel. This stratum was encountered in Borings Nos. MR-8U and MR-9 overlying the Es sands. Standard Penetration Test (SPT) resistance is in the range of 2 to 17. The low blow count is apparently due to sampling techniques and does not represent a variation in the density of the stratum. Although the stratum is rated as loose to medium compact based on the SPT resistance recorded in the borings, the actual consistency can be classified as medium compact, based on an average shear strength of 2 ksf in previous WMATA work.

3.1.3 Stratum Ec (Aquia) Plastic to Silty and Sandy Clay or Clayey Silt This stratum consists of medium to stiff gray, green, olive gray plastic clay to silty and sandy clay or clayey silt, trace lignite with occasional slightly organic fine sandy and silty clay layers, trace shells. This is the oldest of the Tertiary marine sediments and it was encountered in Borings Nos. MR-25, MR-38, MR-53, MR-58 and MR-60. The clay is preconsolidated in the range of 7 to 8 tsf, and shear strengths increase with depth from about 2 to 3.5 ksf.

3.1.4 Stratum Es (Aquia) Silty and Clayey Fine Sand This stratum consists of loose to medium compact green, olive gray silty and clayey fine sand, trace shells, mica with occasional slightly organic silty and clayey fine sand layers. This stratum was encountered in Boring No. MR-52 beneath the fill, and throughout the Preferred Modified Tangent Alignment beneath Strata F or Cs, or beneath Stratum Ec in Borings Nos. MR-25, MR-38, MR-53, MR-58 and MR-60. SPT values were generally in the range of 3 to 17 blows per foot. Laboratory testing in this and previous WMATA contracts indicated an average shear strength of 2.2 ksf.

3.1.5 Stratum Mc (Monmouth) Slightly Organic Fine Sandy Silt and Clayey Silt This material comprises loose to very compact dark green slightly organic micaceous fine sandy silt, and very stiff to hard clayey silt to silty clay, trace shells, occasionally cemented. This stratum belongs to the upper Cretaceous deposits and was found in Borings Nos. MR-37 and MR-56 beneath Stratum Es, beneath Stratum Ms in Borings Nos. MR-53 and MR-54U and interlayered with Stratum Ms in Borings Nos. MR-38 and MR-55 beneath Strata Ec or Es. The formation is heavily preconsolidated in excess of 10 tsf. Laboratory testing on one tube sample recovered from Boring MR-54U indicated an average shear strength of 4.2 ksf. Shear strengths generally range between 3 and 3.5 ksf based on tests performed earlier for other WMATA design sections.

3.1.6 Stratum Ms (Monmouth) Slightly Organic Micaceous Silty Fine Sand and Clayey Fine Sand This stratum consists of loose to very compact dark green slightly organic micaceous silty fine sand, trace clay and clayey fine sand, trace to some shells, occasionally cemented, and with cemented sand layers. This sandy material is nearly continuous throughout this section. SPT resistance is generally between 10 and 30 blows per foot, but can be as low as 4 blows per foot and in a few instances exceeds 50 blows per foot, reflecting the presence of cemented shell and cemented sand pockets and lenses.

Although the Monmouth formation is classified as loose to very compact based on SPT, the actual consistency can be classified as medium to very compact, based on results of strength tests and its high degree of preconsolidation and significant cementation. Laboratory testing in this and previous WMATA contracts indicates an average shear strength of 3.3 ksf. Further, pile driving in Stratum Ms in previous WMATA contracts required predrilling and/or blasting to penetrate layers of cemented sand and shells.

3.1.7 Stratum P1 (Cretaceous) Plastic Clay Primarily stiff to hard red-brown and gray or light gray plastic clay, silty clay, CH or CL by the Unified Soil Classification System, this stratum is present generally below about Elev. 110 underlying the Monmouth formation. It was found in deep Borings Nos. MR-8U, MR-33U, MR-37, MR-38, MR-39, MR-53 and MR-56 through MR-61. The distinctive characteristics of these mottled red-brown and gray clays is that they are frequently fissured or slickensided. Shear strengths of intact samples tested generally ranged between 3 and 7 ksf. This stratum is not continuous throughout the alignment and is frequently interlayered with materials of Strata P1(CL) and P2.

3.1.8 Stratum P1(CL) (Cretaceous) Sandy Clay Stiff to hard gray silty or sandy clay, with some fine sand layers, trace to some cemented sand and lignite fragments. Shear strengths have a narrower range than the plastic clays of Stratum P1 since slickensides are not particularly numerous. This stratum was found in Borings Nos. MR-8U, MR-33U, MR-37, MR-38, MR-39, MR-56, MR-61 and MR-65, and is frequently interlayered with plastic clays of Stratum P1 and sand of Stratum P2.

3.1.9 Stratum P2 (Cretaceous) Silty or Clayey Sand Stratum P2 consists of compact to very compact, light gray, brown or tan fine to medium sand, some clay, silt or clayey fine to medium sand, trace cemented sand layers, gravel, lignite. This Stratum was encountered in Borings Nos. MR-33U, MR-37, MR-38, MR-56, MR-61, and MR-65, and is interlayered with materials of Strata P1, P1(CL), and P2 (SP-SM).

3.1.10 Stratum P2(SP-SM) (Cretaceous) Sand, Trace Silt or Clay This stratum consists of very compact gray fine to medium sand, trace silt or clay, with cemented sand layers and gravel. It generally is associated with other sands of Stratum P2 and is classified SP-SM, occasionally SP, by the Unified System. These sands were encountered in Borings Nos. MR-37, MR-38 and MR-56.

3.1.11 Stratum P2(G) (Cretaceous) Sand, Some Gravel The P2(G) stratum consists of very compact light gray and brown fine to coarse sand, some gravel, trace to some silt, clay, cemented sand fragments. This material was encountered in Borings Nos. MR-37 and MR-56.

4.0 SUMMARY OF DESIGN AND CONSTRUCTION PROBLEMS

4.1 General Comments

As noted in the geological sections, occasional crossing drainage swales or streams will be interrupted where the subway alignment is not aerial or buried. Designers should decide how to handle the crossing drainage to prevent damming of storm flow by the subway construction.

Retaining walls are planned at several locations along the alignment either to retain a cut or to retain a new fill. Alternatives to conventional cast-in-place concrete retaining walls might be given consideration for retained cut walls. These would consist of secant or tangent piles, or driven steel soldier piles with precast concrete lagging, faced with architectural concrete panels. For heights greater than 15 to 20 feet, permanent tiebacks or battered piles with vertical soldier piles could be employed to limit cantilever moments. Such walls serve as both temporary support of excavation and permanent retaining structures. Alternatively, driven steel soldier piles with timber lagging could be used as temporary support, and a permanent reinforced concrete wall constructed flush to the timber lagging. This method was used in Sections E-6, F-7, and F-9. For walls to retain new fill, we suggest Reinforced Earth walls as in Section E-7 or crib walls as another alternative. The design of all structures must be in accordance with WMATA criteria.

Corrosion testing performed on selected soil samples indicates pH levels as low as 3.7, sulfates as high as 1.9%, and total sulfur as high as 1.4%. The average of the test results indicates pH of 5.4, sulfates of 0.77%, and total sulfur of 0.58%. Sulfates in excess of total sulfur are attributed to variations in levels within the tested samples. Complete results are presented in the appendix. pH values below 4 are considered to indicate acid sulfate soils, also known locally as "cat clays," which are known to exhibit a significant drop in pH upon oxidization. These soils occur in the Cretaceous, upper Cretaceous, and Tertiary deposits of the Maryland Coastal Plain. According the USDA, "If a soil containing sulfidic materials is drained, or if sulfidic materials are otherwise exposed to aerobic conditions, the sulfides oxidize and form sulfuric acid."[1] Both of these conditions are likely to occur during construction of the Largo Extension, the first due to dewatering and the second due to excavation.

The acidic soil and the resulting acidic water can cause severe deterioration of concrete. The 1999 BOCA National Building Code specifies requirements for concrete exposed to sulfate-containing solutions or soils. Those requirements, found in BOCA Section 1907.1.3 and Table 1907.1.3, include the use of Type II or V cement, plus the use of pozzolan, depending on the concentration of sulfate in the water or soil. Testing of additional samples of soil and groundwater samples should be performed in the final boring program to determine appropriate levels of action to be taken. Testing should include Tertiary soils of the Calvert and Aquia formations, which were not tested in this phase.

4.2 Stations 516+00 to 527+00, Underground

The longitudinal geological section on Drawing No. G4aL-SO-05 has been updated to include Boring No. MR-52, which was drilled as a replacement for Boring No. MR-7. The soil stratigraphy has been modified slightly to reflect the new information from this boring. The planned method of construction in this area has been revised from retained cut to underground, as noted at the top of the section. However, a discussion of the impact of this change is outside the scope of this report.

4.3 Stations 593+00 to 596+50, Covered

Subsoil conditions are illustrated in longitudinal geological section on Drawing No. G4aL-SO-12. Subsoils in the area of the covered section consist of a thin layer of Stratum F overlying clay and sand of Strata Ec and Es, ranging in thickness between approximately 8 and 10 feet, followed by Monmouth sands and clays of Strata Ms and Mc overlying Cretaceous sands and clays of Strata P1, P1 (CL), and P2. The top of the Cretaceous strata varies from about Elev. 95 to about 105. Strata Ms and Mc vary in thickness from about 22 to 30 feet. The groundwater level varies from near surface in the wetlands area to about 10 feet below ground surface.

Groundwater was measured in Boring MR-53 at Elev. +129.8, about 2.2 ft above the ground surface. A seep was observed upslope of Boring MR-53 at about the same elevation. These data suggest an artesian water condition in this area, driven by higher groundwater to the east, which may affect the underground portion of the alignment east of Station 596+50. Further, the construction of the underground structure may provide a channel for the movement of groundwater from the east into the wetlands area.

A covered precast structure is planned to span the wetland area, beginning downstation of Drawing No. G4aL-SO-12 with its upstation end at Station 596+50. This structure could be supported on spread foundations bearing on the upper Cretaceous sands of the Monmouth formation of Strata Ms, encountered at about 10 feet below the ground surface. However, the rigorous limitations on differential settlements given by WMATA criteria probably would be exceeded by spread footings and therefore, pile support for the piers and abutments appears necessary.

Piles of up to 70 ton working capacity for the precast structure located roughly between Borings MR-32 and MR-33U could consist of steel H-piles, closed-end pipe or precast concrete piles. We estimate 70-ton pile penetration into Monmouth formation and Cretaceous deposits of about 30 to 40 feet below the ground surface for the pipe piles and precast concrete, and about 45 to 55 feet for the H-piles. Boring No. MR-32 is located at about Station 589+90.

4.4 Stations 596+50 to 603+50, Underground

Subsoils in this area consist of a layer of Stratum F which ranges from about two feet in thickness at Station 596+50 to about 13 feet east of Brightseat Road, overlying sand of Stratum Es ranging in thickness from about 10 to 20 feet, overlying sand of Stratum Ms ranging in thickness from about 5 to 40 feet, overlying silt of Stratum Mc of at least 20 feet in thickness in Boring No. MR-54U, overlying Cretaceous sand and clay of Strata P1 and P2. Groundwater varies from about 10 to 15 feet below ground surface and is a subdued reflection of the ground surface.

Planned top of rail is as much as 32 feet below existing grade, and 15 feet below present groundwater levels. The planned construction at this writing is a cast-in-place invert slab with a precast roof and wall section. The slab will generally bear in the Monmouth formation of Stratum Ms, with allowable bearing pressures of 3 tsf. East of Boring No. MR-54U, base of structure will rise out of the Monmouth sands and will bear in the Aquia sands of Stratum Es. Allowable bearing pressures in Stratum Es should be limited to 2 tsf. Groundwater control will be required during construction, and permanent drainage or waterproofing of the underground structure will be required. Dewatering with wells in advance of excavation is essential to avoid softening of subgrade soils. The silty sands of Strata Es and Ms will require closely spaced wells or vacuum wellpoints to lower the water table. Design of the underground structure must consider the potential movement of groundwater to the west, as discussed in Section 4.3, and provide means for carrying or obstructing water so that the subgrade soils are protected from erosion which could undermine the underground structure. Design of concrete and steel structures must consider the presence of acid-sulfate soils of Stratum Ms. The subway will pass beneath Brightseat Road and a number of utilities below this road. If constructed as a sheeted and braced open cut, the utility support system will require careful planning, especially for the 54 inch water main.

4.5 Stations 603+50 to 606+15, Covered

Conditions are depicted in geological sections on Drawings Nos. G4aL-SO-12 and G4aL-SO-13. Subsoils in the area consist of a layer of fill which ranges from about 13 feet in thickness at Boring No. MR-54U to three feet at Boring No. MR-55, overlying sand of Stratum Es ranging in thickness from about 10 to 15 feet, overlying interlayered clay and sand of Strata Mc and Ms ranging in estimated thickness from about 30 to 45 feet. The top of Cretaceous soils is estimated to be at about Elev. 90. Groundwater varies from about five to 20 feet below ground surface and is a subdued reflection of the ground surface.

Proposed construction consists of a covered structure consisting of a cast-in-place slab with precast wall and roof sections. Available support is in a transition, with top of rail in Aquia sands of Stratum Es at the west end, and on planned new fill or a structure at the east end. Planned fill or structure heights are up to 10 feet. The slab at the west end of the covered structure could bear in Stratum Es at an allowable pressure of 2 tsf. This method may be used westward until the point where the existing fill is about four feet thick by removing the fill and replacing it with structural fill. Beyond this point, alternatives for structural support could include piles or structural fill, provided that sufficient time is available in the construction schedule for a surcharge to be placed atop the structural fill.

If the pile alternative is selected, the covered structure could be directly supported by piles driven into the lower Monmouth formation of Strata Mc and Ms below about Elev. 105, and/or the Cretaceous formation of Strata P1 and P2. Piles of up to 70 ton capacity could consist of steel H-piles, closed-end pipe, or precast concrete piles. We estimate 70-ton pile penetration into the lower Monmouth and/or Cretaceous formations of about 15 to 20 feet for pipe and precast piles, and 20 to 30 feet for steel H-piles. The choice of pipe piles will be influenced by market prices, but it is expected that the shorter precast pile could be more economical. If regrading requiring fill placement in the vicinity of the piles is performed, downdrag loads attributable to the new fill must be considered in pile design.

If the fill alternative is selected, the surcharge should be equal to 110% of the permanent structural load and live load, to preload the underlying soils, to minimize differential settlements between the covered box and the adjacent pile-supported aerial structures. If structural fill is used, existing fills should be removed and the subgrade proofrolled. Structural fill should consist of select, controlled fill meeting WMATA gradation requirements given in Section 2.1B of Standard Specifications Section 204, installed in accordance with these specifications.

4.6 Stations 606+15 to 619+00, Covered Aerial Through Girder and Aerial

Conditions are depicted in geological sections on Drawings Nos. G4aL-SO-13 and G4aL-SO-14. Subsoils in the area consist of a layer of fill which is generally about five feet in thickness, overlying sand of Stratum Es ranging in thickness from about 5 to 10 feet, overlying interlayered clay and sand of Strata Mc and Ms ranging in thickness from about 5 to 20 feet, overlying interlayered Cretaceous sand and clay of Strata P1, P1(CL), P2, P2(SP-SM) and P2(G). The top of Cretaceous soils ranges between about Elev. 100 and 110. At the location of Boring MR-38, a four-foot layer of Stratum Ec was encountered beneath Stratum F. Groundwater varies from about two to 12 feet below ground surface and is a subdued reflection of the ground surface.

Proposed construction consists of aerial structures throughout, typically supported at intervals ranging from about 50 to 150 feet, dictated by the features to be crossed. These structures pass above the Capital Beltway and Harry S Truman Drive. Because of the presence of loose to medium density soils of the Aquia and Monmouth formations at depths ranging from 25 to 35 feet below the ground surface, coupled with a groundwater table averaging between five and ten feet below ground surface, shallow spread bearing for support of the aerial structures are not indicated. The aerial structures are on a curve and subject to lateral and centrifugal forces. The lateral forces could induce unequal base pressures on spread foundations, causing a tendency for tilting of the aerial structures. In addition, the rigorous limitations on differential settlements between aerial structure piers given by WMATA criteria probably would be exceeded if the piers are founded on spread footings; therefore, pile support of the piers and abutments of the aerial structures appears necessary.

Piles of up to 70 ton capacity could consist of steel H-piles, closed-end pipe, or precast concrete piles. We estimate 70 ton pile penetration into the Cretaceous formation of Strata P1, P1 (CL), P2, P2(SP-SM) and P2(G) of about 15 to 20 feet for pipe and precast piles and about 20 to 30 feet for the steel H-piles. The choice of pile type will be influenced by market prices, but it is expected that the shorter precast pile could be more economical.

The positioning of piers adjacent to the Capital Beltway are critical to minimize the cost of work restrictions related to maintenance of highway traffic. The impact of pile driving and pile cap construction on the 84-inch water line should be considered in the design. Piles driven within about 15 ft of an underground utility should be predrilled to the level of the utility invert to minimize the risk of damage. The pile caps should be constructed as shallow as possible to minimize dewatering requirements.

4.7 Stations 619+00 to 633+00, Retained Fill, Largo Town Center Station Platform

Locations of the retained fill, which includes the Largo Town Center Station Platform, are shown in geological sections on Drawings Nos. G4aL-SO-14 and G4aL-SO-15. Subsoils consist of a thin layer of fill overlying, in order of increasing depth, Aquia clays and sands of Strata Ec and Es, Monmouth sands of Stratum Ms, and Cretaceous clays and sands of Strata P1 and P2. The groundwater level is five to 10 feet below ground surface, ranging between Elev. 132 and 138.

Existing fill should be removed at the locations of the retaining wall foundations for the retained fills and the subgrades proofrolled prior to construction of the walls. Surface vegetation, topsoil and organic soils should be removed from areas to receive embankment fill and subgrade similarly proofrolled. Allowable soil bearing capacity for the design of wall foundations is 2 tsf. Retained fill may consist of materials meeting WMATA requirements for embankment, fill, and backfill given in Section 2.1A of Standard Specifications Section 204.

Foundations for the Largo Town Center Station could be supported by spread bearing on select, controlled fill meeting WMATA gradation requirements given in Section 2.1B of Standard Specifications Section 204. The existing fill should be removed and the surface proofrolled prior to placing the controlled fill. Allowable soil bearing capacity for design of the station foundations is 1.5 tsf.

Groundwater is deeper than planned excavations in this section, and should have minimal impact on design or construction.

4.8 Stations 633+00 to 636+80, Transition

Conditions are depicted on the right side of Drawing No. G4aL-50-15. Subsoils in the area consist of a thin layer of fill overlying, in order of increasing depth, Aquia clays and sands of Strata Ec and Es, Monmouth sands of Stratum Ms, and Cretaceous clays of Stratum P1. The groundwater level is two to 10 feet below ground surface, ranging between Elev. 138 and Elev. 152. The groundwater surface daylights in a stream at Station 634+30.

Construction methods have not been defined in this area, but the alignment will descend sharply from the station platform which is on retained fill to the cut and cover section to the east. Recommendations for the retained fill presented in Section 4.7 will apply here as will recommendations for the cut and cover presented in Section 4.9. The stream at about Station 634+30 will be carried beneath the alignment in a multiple box culvert, which should be founded on the Monmouth sands of Stratum Ms. Similarly, the selected transition structure between the retained fill and the cut and cover should be founded on Stratum Ms.

Groundwater recommendations in Section 4.9 will apply to the cut and cover and deeper portions of the transition structure.

4.9 Stations 636+80 to 655+23, Cut and Cover

Conditions are depicted in geological sections on Drawings Nos. G4aL-SO-16 and G4aL-SO-17. Subsoils in the area consist of a layer of Stratum F which ranges from about two to five feet in thickness, overlying sand of Stratum Es ranging in thickness from about five to 20 feet, overlying sand of Stratum Ms ranging in thickness from about 30 to 45 feet, overlying Cretaceous sand and clay of Strata P1, (P1(CL) and P2. The top of Cretaceous soils is at about Elev. 115. Groundwater varies from about four to 14 feet below ground surface and is a subdued reflection of the ground surface. A second water level was observed in MR-65 at a depth of 36 feet below grade.

The design in this area is under revision, with current plans for cut and cover construction with top of rail between Elev. +139 and +135. Foundations for the cut-and-cover structure between Stations 636+80 and 655+23 will be bearing primarily on the Monmouth sands of Stratum Ms at depths generally 35 to 45 ft below existing grade. Allowable soil bearing capacity for design of foundations is up to 3 tsf. Groundwater is as much as 30 feet above top of rail, requiring groundwater control during construction and permanent track drainage. Temporary dewatering in advance of excavation should be required. The discussion of dewatering methods for Station 596+50 to Station 603+50 will also apply for this area. It will be important to provide appropriate filters for drainage systems to avoid loss of the silty sand subgrade soil which could cause settlement of track and retaining structures. If ballasted track is used, ballast needs to be underlain by filters to protect the underlying silty sands from filling the open voids in the ballast. Sulfate levels of 0.7% and 1.0% were recorded in this section in Stratum Ms, requiring special consideration be given to design of concrete and steel structures which will contact these soils and potential treatment of groundwater discharged from temporary dewatering and permanent drainage systems.

Consideration should be given to mining this 1800 foot rail track with an EPBM, to eliminate the need for construction dewatering and a deep excavation support system. A pumping test in this area would provide permeability and transmissivity data for Tertiary soils which could help determine the time necessary for predrainage. This information would be useful in determining the degree of difficulty in dewatering for a cut and cover tunnel, the feasibility of a mined tunnel using an open faced shield and the potential benefits of using an EPBM tunneling method. Pumping tests have not been performed in Tertiary deposits previously for Metro. We recommend that a pumping test be performed during the preliminary design phase to provide information for final design and construction.

REFERENCES

1. Davis, Susan L., *Identifying Sulfidic Materials and Acid Sulfate Soils*, December 1999, USDA Natural Resources Conservation Service.

TABLE NO. 1, SURVEY DATA FOR BORINGS (SECTION G4aL - ADDISON ROUTE)

BORING NUMBER	HORIZONTAL CONTROL COORDINATES:		VERTICAL CONTROL: GROUND SURFACE	STATUS OF OBSERVATION WELLS		
	NORTH	EAST	ELEVATION (FT)	INSTALLED	TYPE	PRESENT CONDITION
MR-52	445,345	1,346,715	210.7	03-03-00	1-1/2"	F
MR-53	447,870	1,353,883	127.6	03-02-00	1-1/2"	F
MR-54U	447,942	1,354,627	165.4	02-29-00	1-1/2"	F
MR-55	447,986	1,355,012	141.2			
MR-56	448,173	1,355,292	125.0	05-02-00	1-1/2"	F
MR-57U	448,993	1,356,140	145.3			
MR-58	449,324	1,356,486	146.0			
MR-59U	449,533	1,356,696	146.4			
MR-60	449,777	1,356,942	145.8	01-27-00	1-1/2"	F
MR-61	450,484	1,357,245	167.4	02-01-00	1-1/2"	F
MR-62	450,881	1,357,272	176.6	02-02-00	1-1/2"	F
MR-63	451,283	1,357,294	178.1	02-02-00	1-1/2"	F
MR-64	451,544	1,357,312	176.6	02-03-00	1-1/2"	F
MR-65	452,046	1,357,343	163.9	02-04-00	1-1/2"	F

LEGEND

F - Indicates observation well functioning in 2000.

TABLE NO. 2

SUMMARY OF LABORATORY TEST DATA

SAMPLE IDENTIFICATION				CLASSIFICATION PROPERTIES									PHYSICAL PROPERTIES													
										UNIFIED SOIL CLASSIFICATION SYSTEM			STRENGTH: UNCONFINED COMPRESSION			STRENGTH: TRIAXIAL COMPRESSION					CONSOLIDATION					
BORING NUMBER	SAMPLE NUMBER	DEPTH FT.	STRATUM DESIGNATION	NATURAL WATER CONTENT % (W) AVERAGE OF ENTIRE SAMPLE	LIQUID LIMIT (W_L)	PLASTICITY INDEX (I_P)	NATURAL WATER CONTENT OF LIMIT SAMPLE, Wn,%	SPECIFIC GRAVITY OF SOLIDS (G_s)	DRY DENSITY, PCF	SOIL TYPE	% SAND (<# 4 >#200 SIEVE)	% FINES (<#200 SIEVE)	COMPRESSIVE STRENGTH TSF	WATER CONTENT AT END OF TEST, %	STRAIN AT FAILURE, %	TYPE OF TEST	DEVIATOR STRESS (σ_1-σ_3), TSF	CONFINING PRESSURE (σ_3), TSF	NATURAL WATER CONTENT, Wn, %	WATER CONTENT AT END OF TEST, W_f, %	NATURAL WATER CONTENT, Wn, %	EXISTING OVERBURDEN STRESS P_o, TSF	ESTIMATED PRECONSOLIDATION STRESS, P_c, TSF	COMPRESSION INDEX, C_c	SWELLING INDEX, C_s	VOID RATIO AT START OF SWELL, e_f
MR-54U	11U	26.0	Ms	27						SM																
				24						SP-SM	91	9														
	13U	30.8	Mc	30						ML						Q	4.39	0.5	29.1	29.2						
										ML						Q	4.93	1.0	28.8	29.0						
										ML	36	64				Q	3.49	2.0	31.4	32.0						
MR-57U	4U	6.5	Es	16				2.65		SC&SM	68	32				Q	2.06	0.5	16.5	16.6						
										SC&SM						Q	2.55	1.0	16.0	15.9						
	11U	20.0	Ms	28						SM-SC		42				Q	2.74	0.5	27.0	27.2						
										SM-SC						Q	3.72	1.0	27.4	27.6						
MR-59U	10U	21.0	Ms	27				2.74		SM-SC						Q	1.24	0.5	28.4	28.3						
										SM-SC	63	37				Q	1.79	1.0	25.8	26.3						
										SM-SC						Q	5.64	2.0	25.0	24.9						

1. ALL TESTS SUMMARIZED ABOVE WERE PERFORMED IN THE SOILS LABORATORY OF MUESER RUTLEDGE CONSULTING ENGINEERS.
2. THE SAMPLE DEPTH LISTED ABOVE IS THE AVERAGE DEPTH OF THE SAMPLE RECOVERED.
3. FOR GROUND SURFACE ELEVATIONS AT THE BORINGS SEE TABLE NO. 1. FOR GENERALIZED STRATA DESCRIPTIONS SEE DRAWING NO. F-1.
4. "NATURAL WATER CONTENT OF THE ENTIRE SAMPLE" IS A WEIGHTED AVERAGE OF ALL MATERIAL TYPES RECOVERED.
5. THE TRIAXIAL COMPRESSION TESTS PERFORMED WERE:
   - Q - QUICK TESTS (UU - UNCONSOLIDATED UNDRAINED TESTS)
   - Qc - CONSOLIDATED QUICK TESTS (CU - CONSOLIDATED UNDRAINED TESTS)
6. STRENGTH TESTS WERE PERFORMED ON PISTON TYPE SAMPLES (U) APPROXIMATELY 2.9 INCHES IN DIAMETER AND ON SHELBY TYPE SAMPLES (S) APPROXIMATELY 1.8 INCHES IN DIAMETER. THE RATIO OF HEIGHT TO DIAMETER OF ALL STRENGTH TEST SPECIMENS WAS APPROXIMATELY 2.0.
7. THE TRIAXIAL COMPRESSION TESTS WERE PERFORMED AT A RATE OF STRAIN OF APPROXIMATELY 1 PER CENT PER MINUTE.
8. THE DIRECT SHEAR TESTS WERE PERFORMED AT A CONSTANT RATE OF STRAIN EQUAL TO A HORIZONTAL DISPLACEMENT OF 0.02 INCHES PER HOUR. THE SPECIMENS WERE OF APPROXIMATELY 1/2 INCH THICKNESS.
9. COMPRESSION INDEX Cc - STRAIGHT LINE PORTION OF THE VIRGIN CURVE OF CONSOLIDATLION TEST: $e = eo - Cc \log P/Po$
10. SWELLING INDEX Cs - STRAIGHT LINE PORTION OF THE REBOUND CURVE OF CONSOLIDATION TEST: $e = eo - Cs \log P/Po$

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DATE May-00 FILE NO. 9170 SHEET 1 OF 1 TABLE NO. 2

TABLE NO. 3, SUMMARY OF RISING AND FALLING HEAD PERMEABILITY TESTS IN OBSERVATION WELLS (SECTION G4aL ADDISON ROUTE SITE PREPARATION AND MITIGATION)

BORING NO.	MR-52	MR-53	MR-54U	MR-56	MR-60	MR-61
TYPE OF TEST	FALLING HEAD	FALLING HEAD	FALLING HEAD	FALLING HEAD	FALLING HEAD	FALLING HEAD
ELEVATION OF TOP AND BOTTOM OF OPENING TESTED	+ 187.7 + 170.7	+ 109.6 + 77.6	+ 137.4 + 115.4	+ 119.0 + 51.0	+ 109.3 + 87.3	+ 139.4 + 108.9
LENGTH OF OPENING IN FEET	17.0	32.0	22.0	68.0	22.0	30.5
COMPUTED PERMEABILITY, FEET/MINUTE	1.7×10^{-5}	5.3×10^{-5}	8.6×10^{-6}	1.7×10^{-4}	2.5×10^{-6}	1.1×10^{-5}
STRATUM TESTED	Ms	Mc & P1	Ms	Es, Mc, P2(G), P2(SP-SM), P1 & P2	P1	Ms, P1 & P2

BORING NO.	MR-62	MR-63	MR-64	MR-65		
TYPE OF TEST	FALLING HEAD	FALLING HEAD	FALLING HEAD	FALLING HEAD		
ELEVATION OF TOP AND BOTTOM OF OPENING TESTED	+ 148.6 + 118.1	+ 150.1 + 119.6	+ 148.6 + 116.6	+ 135.9 + 103.9		
LENGTH OF OPENING IN FEET	30.5	30.5	32.0	32.0		
COMPUTED PERMEABILITY, FEET/MINUTE	1.2×10^{-5}	1.6×10^{-5}	5.7×10^{-6}	3.1×10^{-6}		
STRATUM TESTED	Ms	Ms	Ms	Ms, P1 & P2		

TABLE NO. 4

REPRESENTATIVE PERMEABILITY VALUES

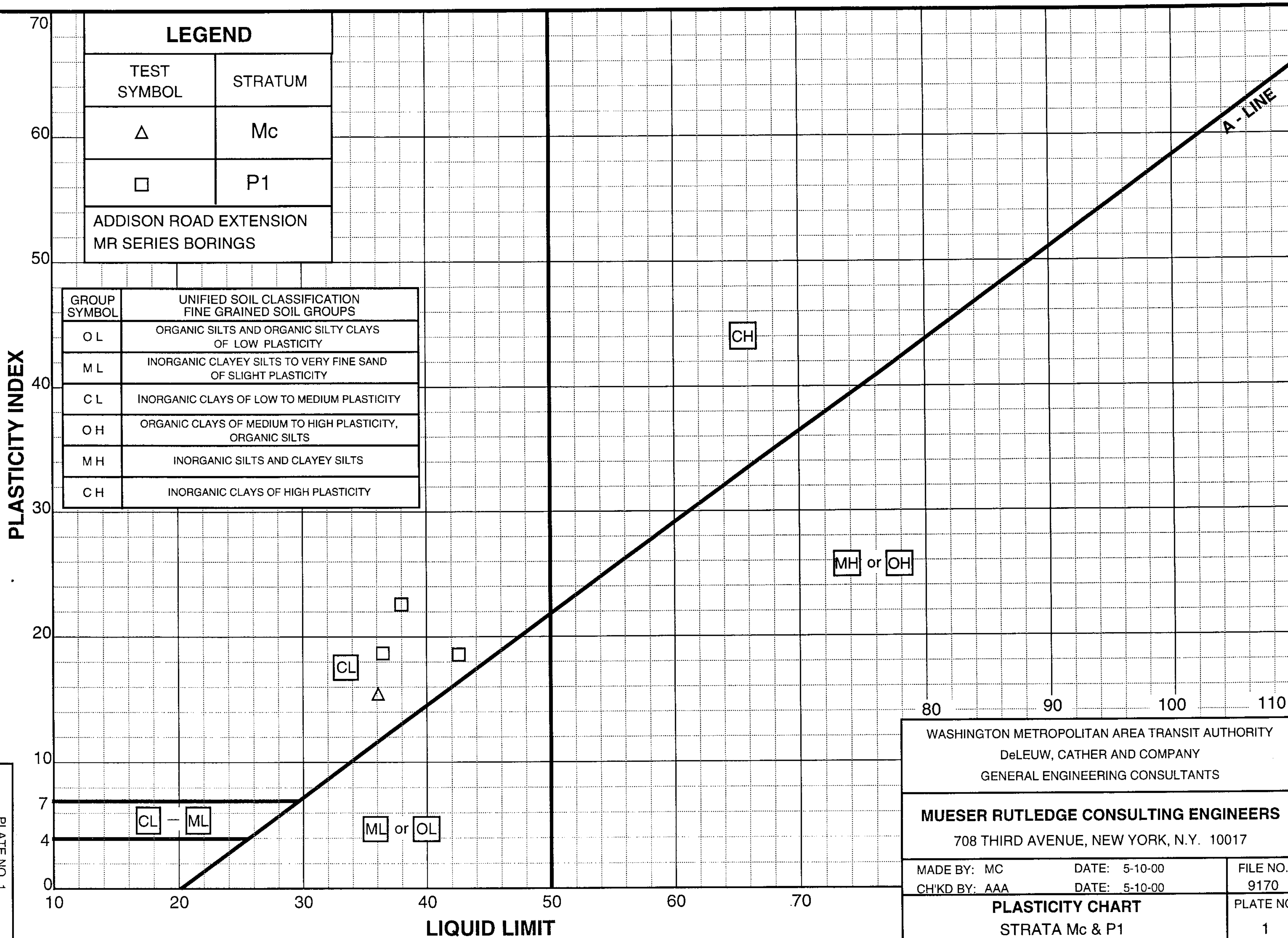
STRATUM	SOIL TYPE	COEFFICIENT OF PERMEABILITY K, (FT/MIN)
A1	Organic Clay	10^{-5} to 10^{-6}
A2	Silty Sand	10^{-3} to 10^{-4}
T0	Organic Clay	10^{-5} to 10^{-6}
T1	Silty Clay	10^{-5} to 10^{-6}
T2	Silty Sand	10^{-3} to 10^{-5}
T3	Gravelly Sand	$5x10^{-2}$ to 10^{-3}
T4	Silty Sand	10^{-3} to 10^{-4}
T5	Gravelly Sand	$5x10^{-2}$ to 10^{-3}
P1	Clay	10^{-7} Typical
P2	Clayey Sand	10^{-3} to 10^{-5}
P3	Sandy Clay	10^{-4} to 10^{-6}

NOTE:

Range of permeabilities shown in this table is a general summary based on full scale pumping tests in earlier WMATA studies. The permeability values determine from small samples of the various strata or from borehole permeability tests frequently fall outside of the range noted.

TABLE NO. 5
REPRESENTATIVE PERMEABILITY VALUES

STRATUM	SOIL TYPE	COEFFICIENT OF PERMEABILITY K, (FT/MIN)
Q2	Fine to coarse sand, some medium to coarse gravel	5×10^{-2} to 10^{-3}
Cc	Plastic clay, silty and sandy clay or clayey silt	10^{-6} to 10^{-7}
Cs	Fine sand, trace to some silt, clay and clayey fine sand	10^{-3} to 10^{-5}
Ec	Plastic clay to silty and sandy clay or clayey silt	10^{-6} to 10^{-7}
Es	Silty and clayey fine sand	10^{-3} to 10^{-5}
Mc	Slightly organic fine sandy silt and clayey silt	10^{-5} to 10^{-6}
Ms	Slightly organic micaceous silty or clayey fine sand	10^{-3} to 10^{-5}



LEGEND

TEST SYMBOL	STRATUM
△	Mc
□	P1

ADDISON ROAD EXTENSION
MR SERIES BORINGS

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
O L	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
M L	INORGANIC CLAYEY SILTS TO VERY FINE SAND OF SLIGHT PLASTICITY
C L	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY
O H	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
M H	INORGANIC SILTS AND CLAYEY SILTS
C H	INORGANIC CLAYS OF HIGH PLASTICITY

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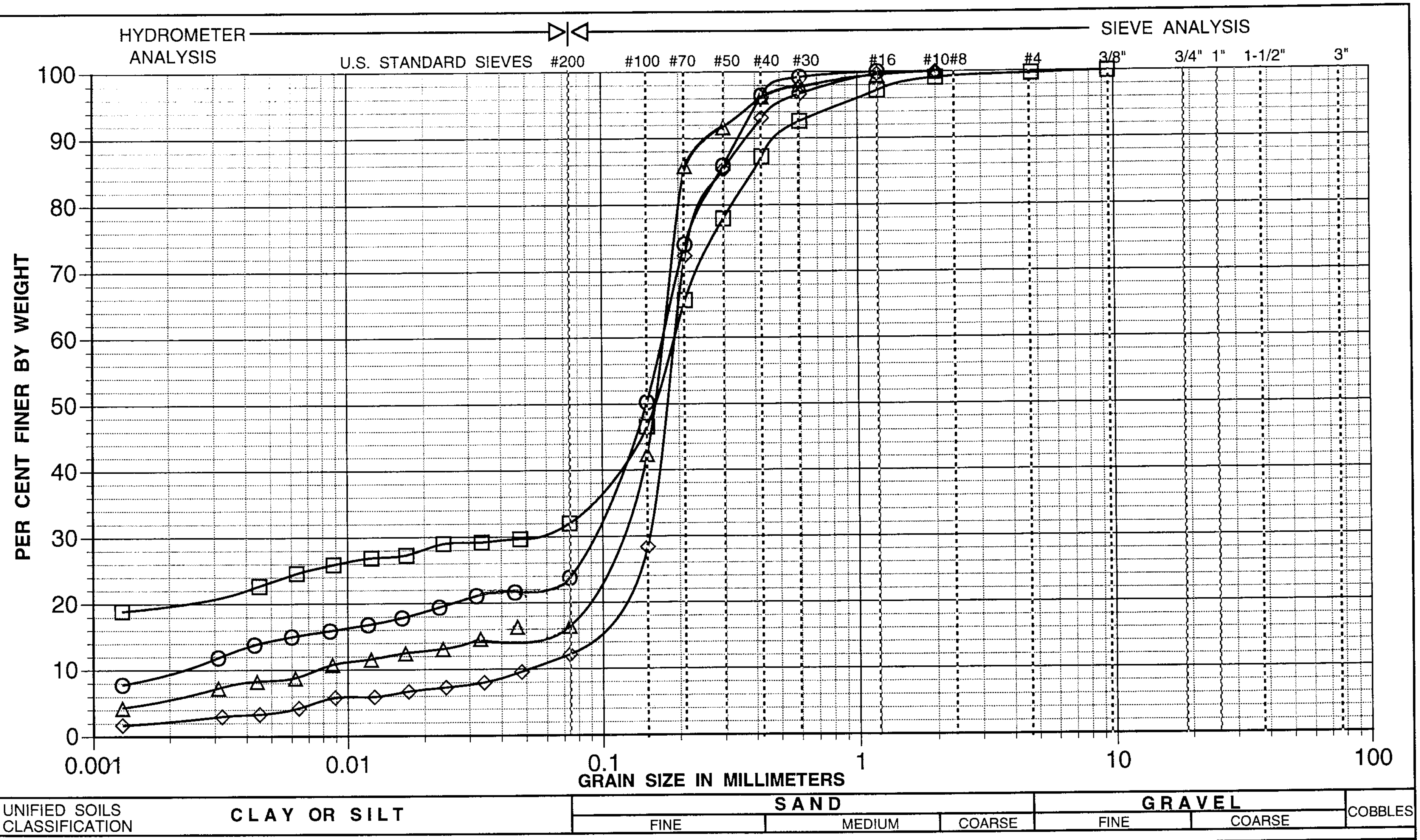
PLASTICITY CHART STRATA Mc & P1		PLATE NO. 1



SYMBOL	BORING	SAMPLE	DESCRIPTION OF SAMPLE
○	MR-54U	7D	
□	MR-57U	4U	STRATUM Es
△	MR-61	3D	
◇	MR-62	6D	

PLATE NO. 2

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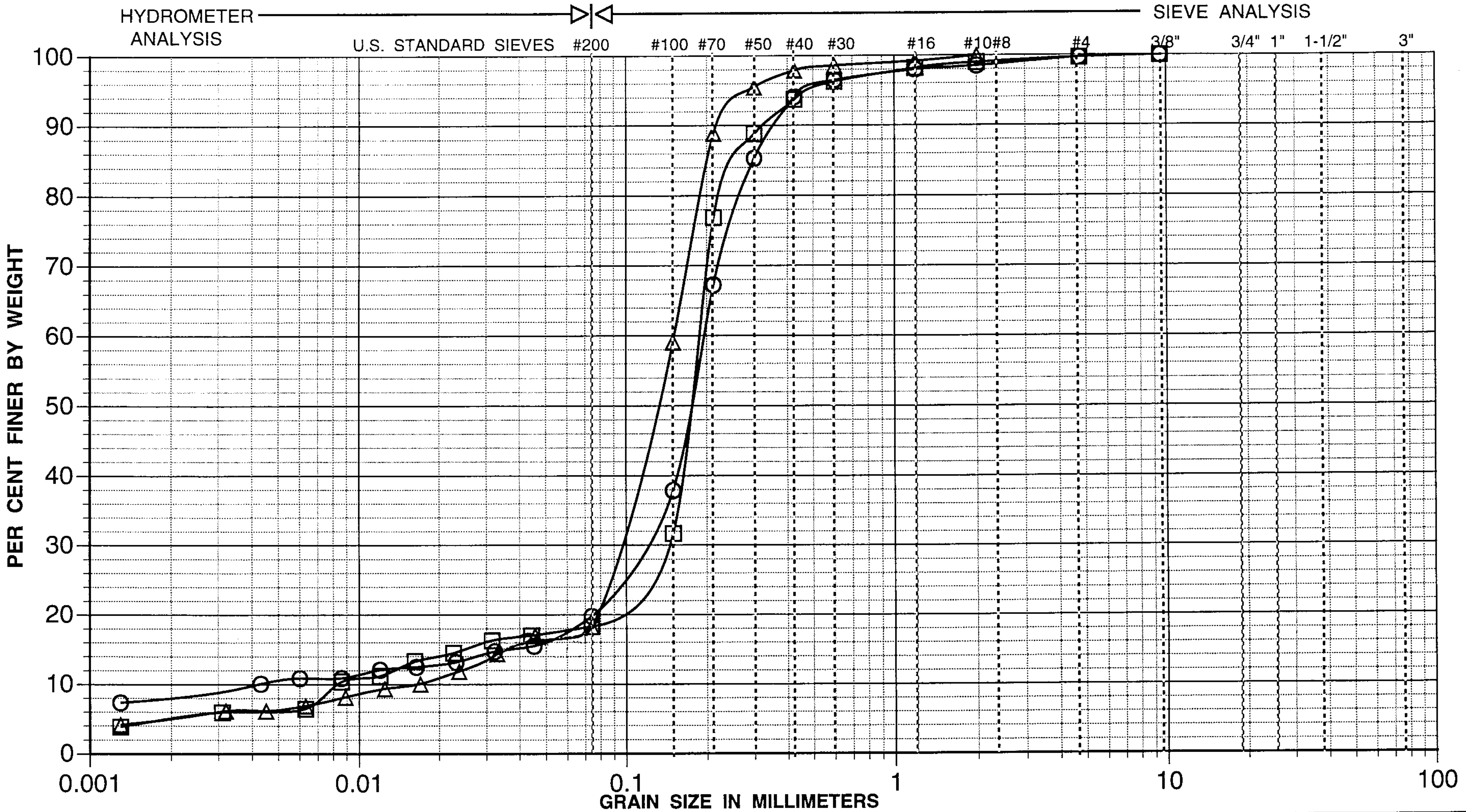
GRADATION CURVES
STRATUM Es

PLATE NO. 2



UNIFIED SOILS CLASSIFICATION	CLAY OR SILT	SAND			GRAVEL		COBBLES
		FINE	MEDIUM	COARSE	FINE	COARSE	

SYMBOL	BORING	SAMPLE	DESCRIPTION OF SAMPLE
○	MR-63	5D	STRATUM (Es)
□	MR-64	6D	
△	MR-65	4D	

PLATE NO. 3

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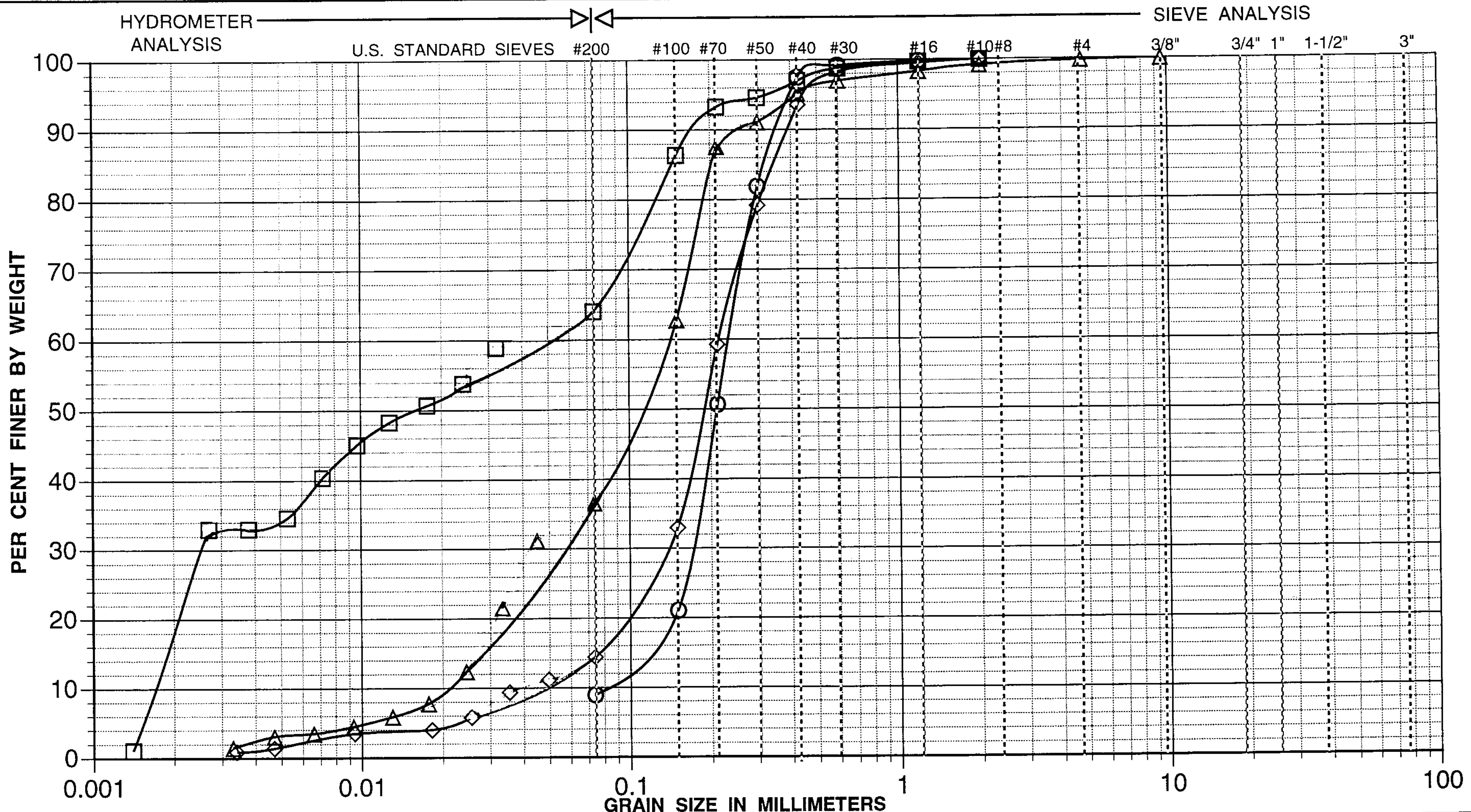
GRADATION CURVES
STRATUM (Es)

PLATE NO. 3



UNIFIED SOILS CLASSIFICATION	CLAY OR SILT	SAND			GRAVEL		COBBLES
		FINE	MEDIUM	COARSE	FINE	COARSE	

SYMBOL	BORING	SAMPLE	STRATA	DESCRIPTION OF SAMPLE
○	MR-54U	11U BOT	Ms	
□	MR-54U	13U	Ms	
△	MR-59U	10U	Ms	
◇	MR-61	7D	Ms	

STRATA Ms & Mc

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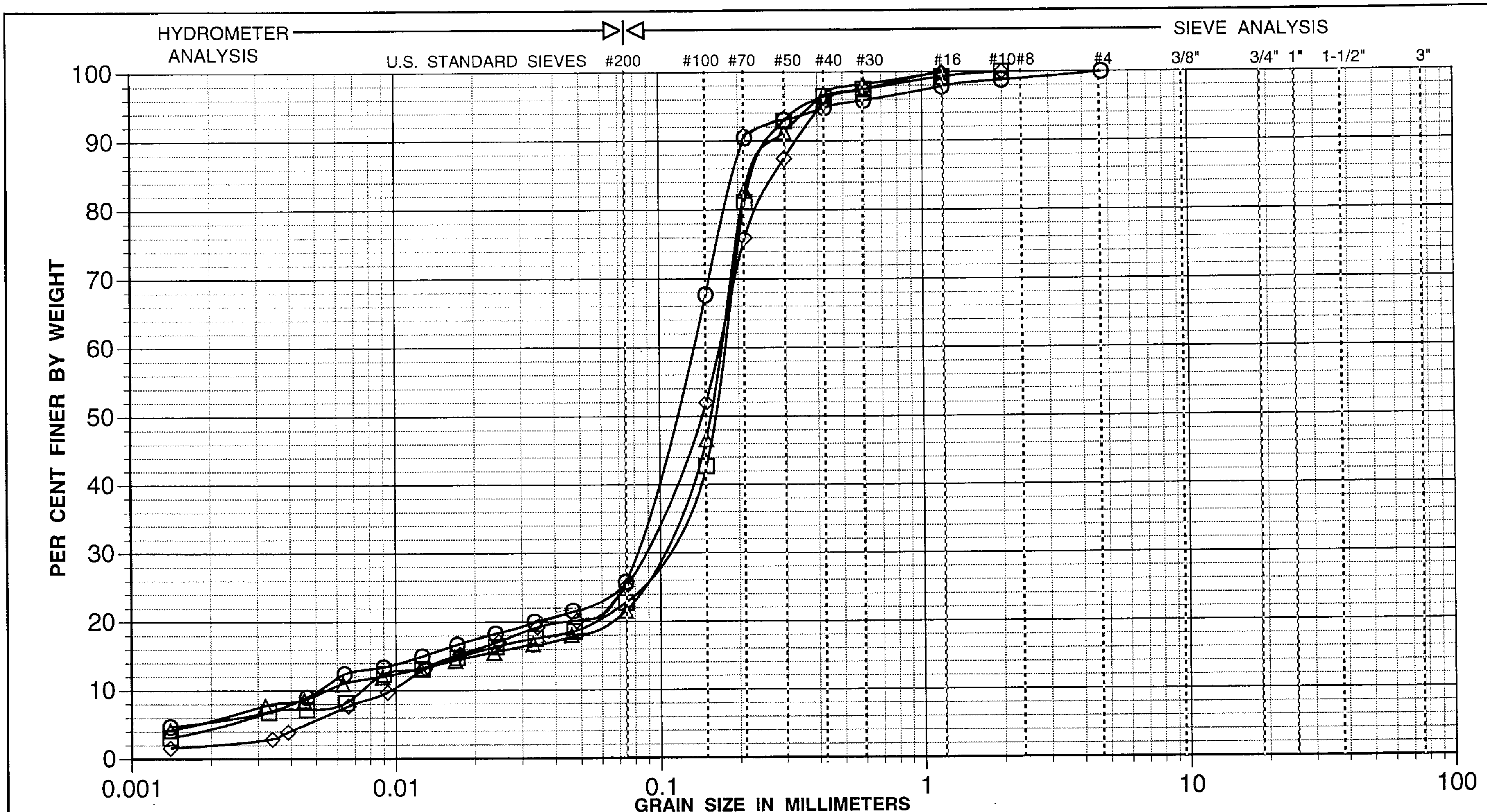
GRADATION CURVES
STRATA Ms & Mc

PLATE NO. 4

PLATE NO. 4



UNIFIED SOILS CLASSIFICATION	CLAY OR SILT	SAND			GRAVEL		COBBLES
		FINE	MEDIUM	COARSE	FINE	COARSE	

SYMBOL	BORING	SAMPLE	DESCRIPTION OF SAMPLE
○	MR-62	10D	
□	MR-63	11D	STRATUM (Ms)
△	MR-64	11D	
◇	MR-65	7D	

PLATE NO. 5

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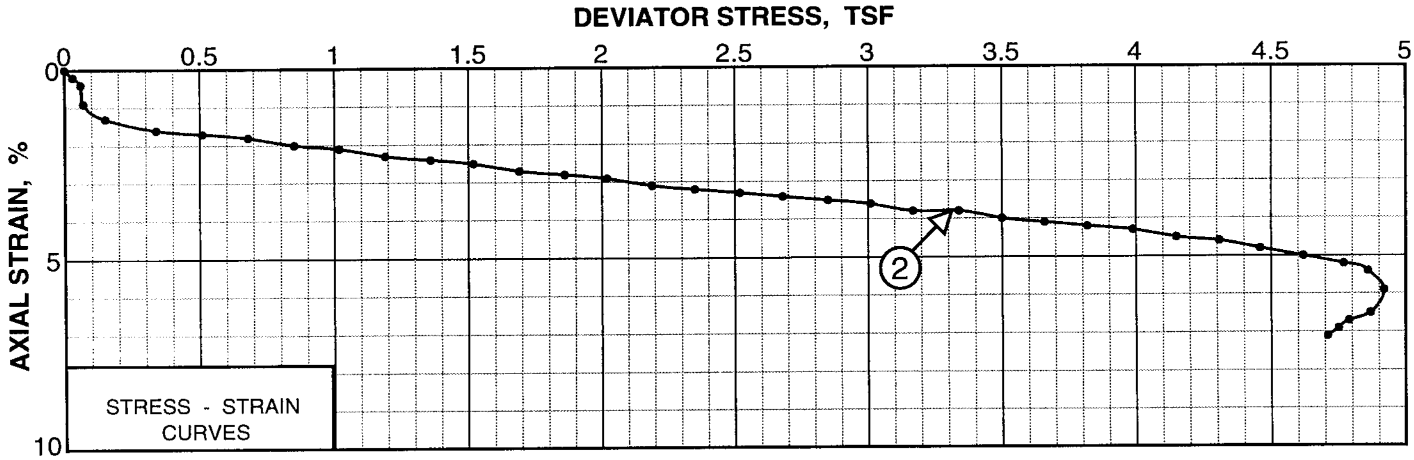
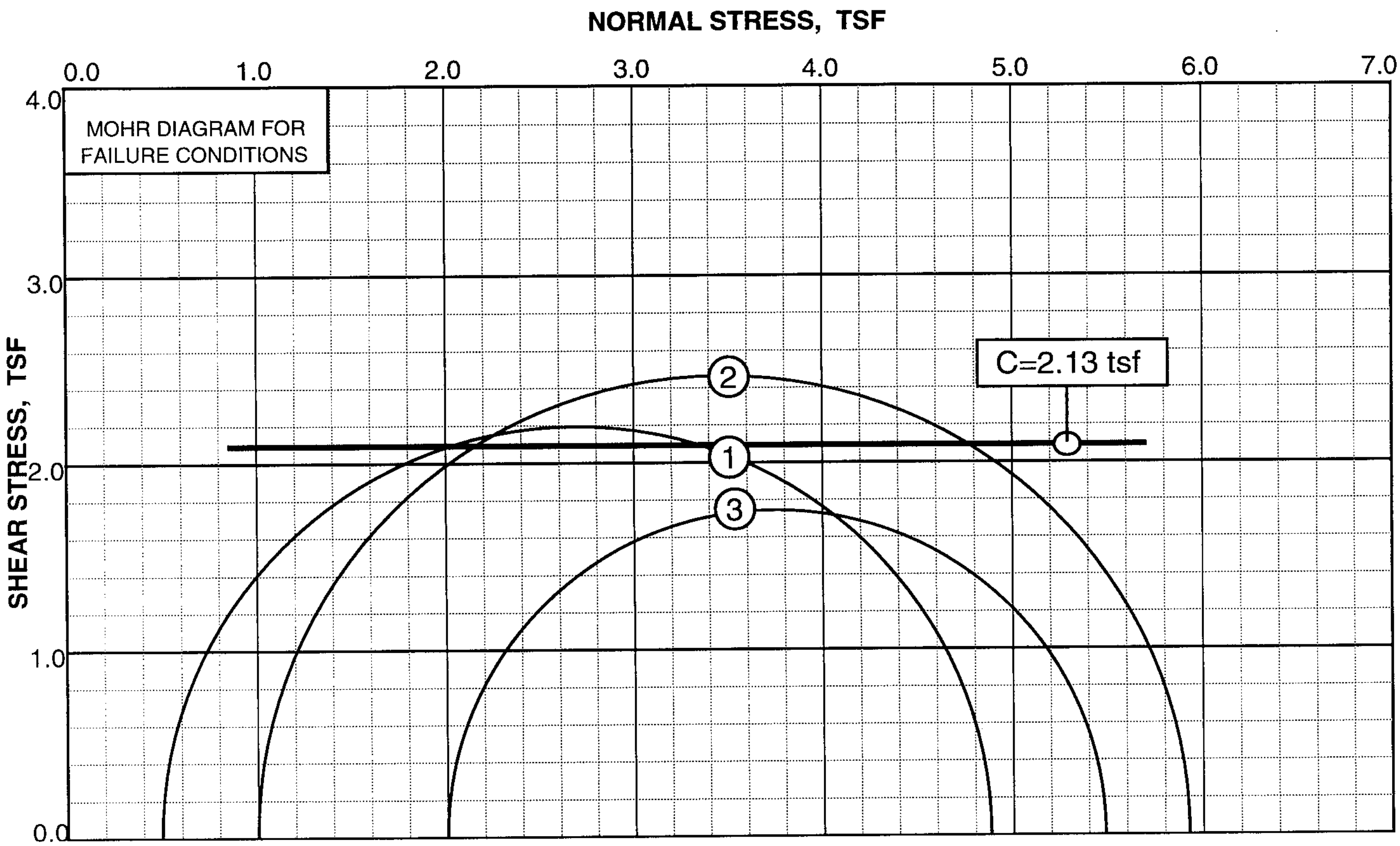
CH'KD BY: AAA	DATE: 4-10-00	
GRADATION CURVES STRATUM (Ms)		PLATE NO. 5





DESCRIPTION OF MATERIAL TESTED

BLACK SLIGHTLY ORGANIC MICACEOUS FINE SANDY SILT, TRACE CLAY, CLAY POCKETS, MICA, SHELLS
STRATUM Mc

KEY	BORING NO.	SAMPLE NO.	SOIL TYPE	TEST TYPE	LATERAL PRESSURE TSF	WATER CONTENT-%		DEGREE OF SATURATION-%		DEVIATOR STRESS TSF	AXIAL STRAIN %
						INITIAL	FINAL	INITIAL	FINAL		
1	MR-54U	13U	ML	Q	0.5	29	29			4.39	4
2	MR-54U	13U	ML	Q	1.0	29	29			4.93	6
3	MR-54U	13U	ML	Q	2.0	31	32			3.49	10

SYMBOLS FOR TEST TYPES

Q - UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TESTS

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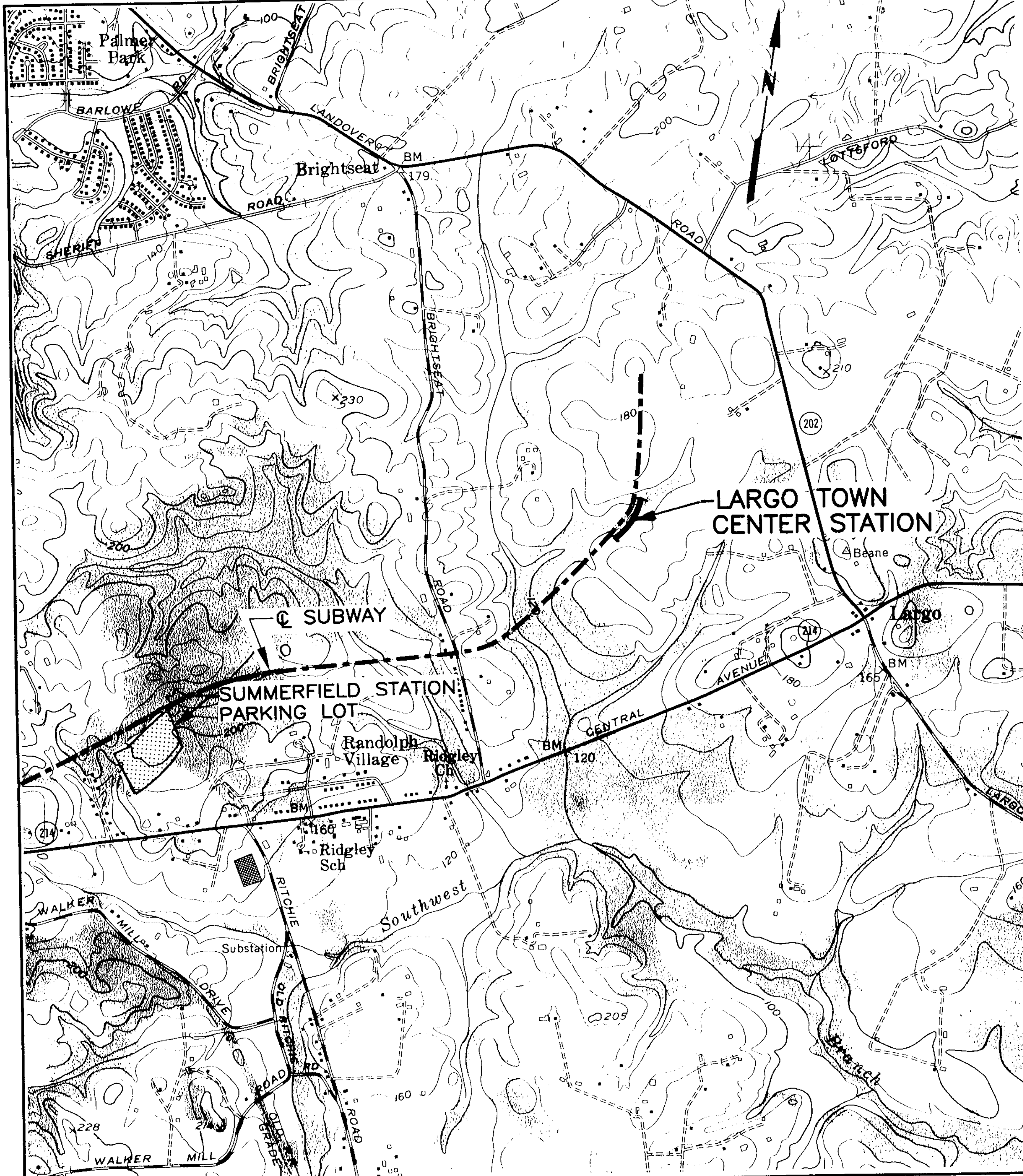
CH'KD BY: AAA	DATE: 5-1-00	
SUMMARY OF STRENGTH TESTS		PLATE NO.
BORING NO. MR-54U		6



PORTION OF MAP TITLED:
USGS LANHAM QUADRANGLE
CONTOUR INTERVAL 20FT–
MEAN SEA LEVEL DATUM

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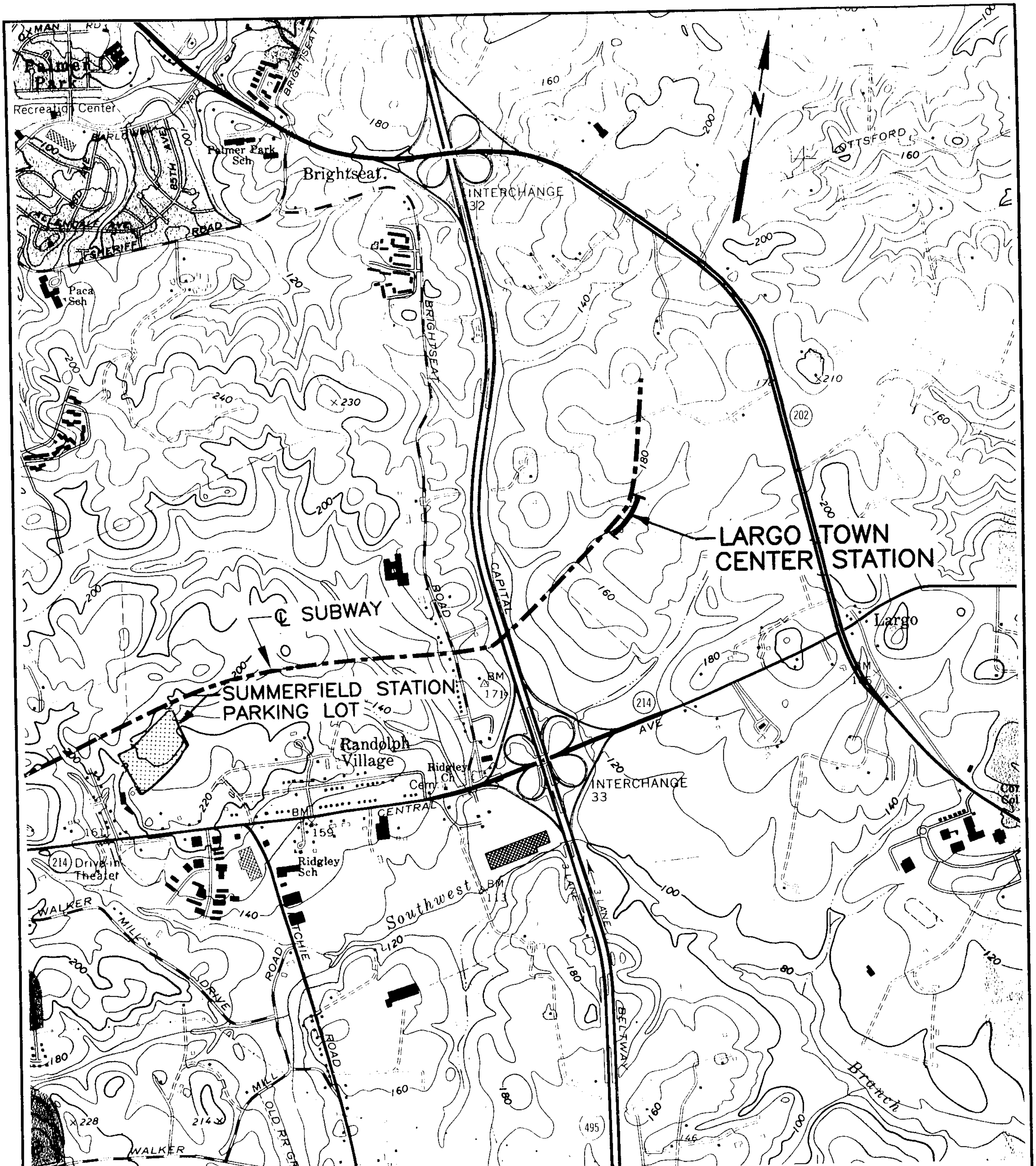
1"=2000'	CH'KD BY D.W.C.	DATE 5–00	9170

TOPOGRAPHIC SURVEY
OF SITE – 1957

DRAWING NO.
SK–1



PORTION OF MAP TITLED:
USGS LANHAM QUADRANGLE
CONTOUR INTERVAL 20FT—
MEAN SEA LEVEL DATUM

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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SCALE	MADE BY	DATE	FILE NO.
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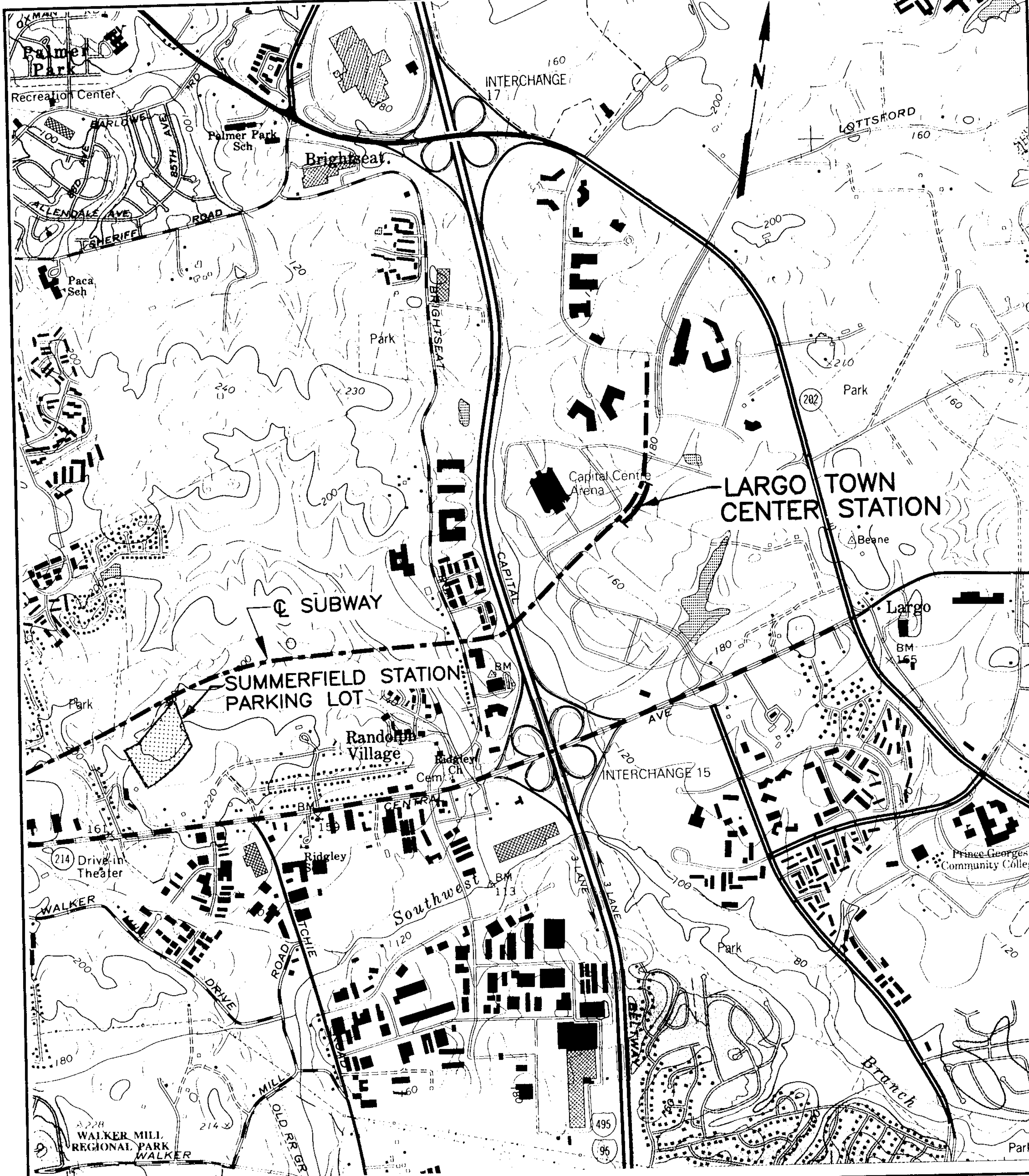
	CH'KD BY D.W.C.	DATE 5-00	DRAWING NO.

TOPOGRAPHIC SURVEY
OF SITE – 1971

SK-2



PORTION OF MAP TITLED:
USGS LANHAM QUADRANGLE
CONTOUR INTERVAL 20FT—
MEAN SEA LEVEL DATUM

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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SCALE	MADE BY A.P.	DATE 5-00	FILE NO. 9170
1"=2000'	CH'KD BY D.W.C.	DATE 5-00	DRAWING NO.

TOPOGRAPHIC SURVEY
OF SITE - 1993

SK-3

GENERAL NOTES

1. THIS DRAWING CONTAINS REFERENCE INFORMATION FOR ANY SUBSURFACE INVESTIGATION PERFORMED FOR THE WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY (WMATA). SPECIFIC DETAILS WHICH PERTAIN TO INDIVIDUAL INVESTIGATIONS ARE CONTAINED ON BORING LOG DRAWINGS OR GEOLOGICAL SECTIONS IN A SERIES OF TECHNICAL REPORTS.

2. THE BORINGS WHOSE DETAILED LOGS ARE CONTAINED IN THESE REPORTS WERE MADE BY A BORING CONTRACTOR UNDER THE CONTINUOUS INSPECTION OF RESIDENT ENGINEERS OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON (MRWJ). THESE DETAILED LOGS WERE DERIVED FROM MRWJ FIELD BORING LOGS AFTER EXAMINATION AND CHECK OF SOIL CLASSIFICATION IN THE LABORATORY. SOIL DESCRIPTIONS MAY NOT AGREE WITH THE ORIGINAL MRWJ FIELD LOGS OR WITH THE BORING CONTRACTOR'S LOGS, COPIES OF WHICH ARE ON FILE AT WMATA. THESE SOURCES SHOULD BE CONSULTED FOR ADDITIONAL DETAILS REGARDING BORING OPERATIONS AND THE NATURE OF MATERIALS ENCOUNTERED.

3. SOIL SAMPLES AND ROCK CORES RECOVERED IN BORINGS MADE FOR WMATA WHICH REMAINED AFTER LABORATORY TESTING HAVE BEEN STORED IN WASHINGTON D.C. AT THE WMATA WAREHOUSE AND ARE AVAILABLE FOR INSPECTION.

4. ELEVATIONS SHOWN ON THE DRAWINGS OR NOTED ON THE BORING LOGS REFER TO USC&GS MEAN SEA LEVEL DATUM OF 1929, WHICH IS DESIGNATED AS PROJECT DATUM. COORDINATES LISTED FOR BORING LOCATIONS REFER TO THE COORDINATE SYSTEMS EMPLOYED ON THIS PROJECT WHICH GENERALLY COMPRISE THE MARYLAND STATE PLANE COORDINATE SYSTEM OR THE VIRGINIA STATE PLANE COORDINATE SYSTEM, ADJUSTED FOR SCALE AND ELEVATION TO THE PROJECT GRID.

5. THE PLAN AND PROFILE ON GEOLOGICAL SECTION DRAWINGS GENERALLY SHOW THE CENTERLINE OF THE SUBWAY OUTBOUND TRACK, STATIONING ON THAT CENTERLINE, THE POSITION OF TOP OF RAIL IN PROFILE, AND, IN SOME INSTANCES, THE TOP AND BOTTOM OF THE EXTERIOR OF THE SUBWAY STRUCTURE IN PROFILE. THESE DATA WERE OBTAINED FROM THE DE LEUW, CATHER AND COMPANY GENERAL PLANS WHICH WERE AVAILABLE AT THE DATE OF THE REPORT. THE SUBWAY PLAN AND PROFILE WHICH ARE SHOWN IN REPORTS MADE PRIOR TO CONSTRUCTION ARE SUBJECT TO CHANGE IN FINAL PLANS.

6. GEOLOGICAL SECTION DRAWINGS DEPICT THE OVERALL SUBSURFACE STRATIFICATION, DIVIDING MATERIALS INTO THE BROAD CATEGORIES LISTED UNDER "GENERALIZED STRATA DESCRIPTIONS". THE LINES SEPARATING STRATA ARE NECESSARILY INTERPOLATED BETWEEN BORINGS AND MAY OR MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.

7. IN CERTAIN INSTANCES THE SUBSURFACE INVESTIGATIONS FOR WMATA HAVE UTILIZED BORING DATA AND REPORTS PREPARED BY OTHER ORGANIZATIONS FOR OTHER PROJECTS. COPIES OF THESE ORIGINAL DATA AND REPORTS ARE ON FILE AT WMATA AND SHOULD BE CONSULTED FOR FURTHER DETAILS.

8. THE GROUND WATER LEVELS NOTED ON THE DETAILED BORING LOGS AND PLOTTED ON THE GEOLOGICAL SECTIONS REPRESENT AVERAGE OR TYPICAL VALUES OBSERVED DURING THE PERIOD OF THE BORING OPERATION OR SHORTLY AFTER COMPLETION OF A BORE HOLE. THESE OBSERVATIONS MAY NOT REFLECT SEASONAL CHANGES IN THE WATER TABLE OR THE EFFECTS OF INTENSE RAINFALL OR RUNOFF. IN ANY EXCAVATION TRICKLING FLOW OR SEEPAGE MAY BE ENCOUNTERED FROM PERCHED WATER WHICH IS AT LEVELS ABOVE THE WATER TABLE OBSERVED IN THE BORINGS.

9. OBSERVATION WELLS OR PIEZOMETERS CONSISTING OF A STEEL OR PVC STANDPIPE WITH A PERFORATED INTAKE POINT HAVE BEEN INSTALLED IN CERTAIN OF THE TEST BORINGS, AS NOTED ON THE BORING LOGS. MEASUREMENTS OF WATER LEVELS HAVE BEEN MADE IN CERTAIN OF THESE STANDPIPES AT VARIOUS TIMES. THESE DATA ARE ON FILE AT WMATA AND SHOULD BE CONSULTED FOR AN INDICATION OF SEASONAL FLUCTUATIONS OF GROUND WATER LEVELS.

UNIFIED CLASSIFICATION SYSTEM

COARSE GRAINED SOILS (MORE THAN HALF LARGER THAN NO.200 SIEVE)	GRAVELS AND GRAVELLY SOILS (MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO.4)	CLEAN (LESS THAN 5% SMALLER THAN NO.200)	GW GP GP-GM	WELL GRADED GRAVEL, LITTLE OR NO FINES. SINGLE-SIZE, NARROWLY GRADED GRAVEL, FEW FINES GRAVEL WITH MODERATE FINES, 5% TO 12% PASSING NO.200.
		DIRTY (MORE THAN 12% SMALLER THAN NO.200)	GM GC GM-GC	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURES. CLAYEY GRAVEL, GRAVEL-SAND-CLAY MIXTURES. GRAVEL-SAND MIX WITH SILTY CLAY OR CLAYEY SILT FINES.
	SANDS AND SANDY SOILS (MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO.4)	CLEAN (LESS THAN 5% SMALLER THAN NO.200)	SW SP SP-SM	WELL GRADED SAND, LITTLE OR NO FINES. SINGLE-SIZE NARROWLY GRADED LEVEL, FEW FINES. SAND WITH MODERATE FINES, 5% TO 12% PASSING NO.200.
		DIRTY (MORE THAN 12% SMALLER THAN NO.200)	SM SC SM-SC	SILTY SAND, SAND-SILT MIXTURES. CLAYEY SAND, SAND-CLAY MIXTURES SAND WITH SILTY CLAY OR CLAYEY SILT FINES.
FINE GRAINED SOILS (MORE THAN HALF SMALLER THAN NO.200 SIEVE)	SILTS AND CLAYS LL<50		ML CL OL	INORGANIC SILT, ROCK FLOUR, CLAYEY SILT (LIMITS PLOT BELOW A-LINE) INORGANIC CLAY OF LOW TO MEDIUM PLASTICITY (LIMITS PLOT ABOVE A-LINE) ORGANIC SILT AND SILTY CLAY OF LOW PLASTICITY LIMITS PLOT BELOW A-LINE)
	SILTS AND CLAYS LL>50		MH CH OH	INORGANIC SILT, SPONGY, TALCY, MICACEOUS SILT (LIMITS PLOT BELOW A-LINE) INORGANIC PLASTIC CLAY, TOUGH AND FAT CLAY (LIMITS PLOT ABOVE A-LINE) ORGANIC CLAY OF MEDIUM TO HIGH PLASTICITY (LIMITS PLOT BELOW A-LINE
	PEAT AND HIGHLY ORGANIC		PT	PEAT, HIGHLY ORGANIC SOIL, SPONGY, COMPRESSIBLE, DARK COLOR, FIBROUS, DISTINCT ORGANIC ODOR (LIMITS PLOT BELOW A-LINE)

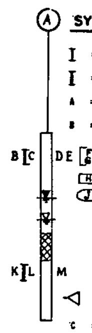
NOTES AND LEGEND FOR PLANS AND GEOLOGICAL SECTIONS

SYMBOLS UTILIZED ON LOCATION PLANS AND STRIP MAPS

1. BORINGS MADE IN THIS INVESTIGATION FOR WMATA UNDER THE CONTINUOUS INSPECTION OF MRWJ RESIDENT ENGINEERS ARE SHOWN THUS:
   - ON LOCATION PLANS AND STRIP MAPS:
     - BORINGS WITHOUT UNDISTURBED SAMPLES:
     - BORINGS WITH UNDISTURBED SAMPLES:
   - ON GEOLOGICAL SECTIONS:
     - BORINGS WITHOUT UNDISTURBED SAMPLES:
     - BORINGS WITH UNDISTURBED SAMPLES:
2. BORINGS WHICH HAVE BEEN MADE BY OTHER ORGANIZATIONS FOR OTHER PROJECTS AND ARE UTILIZED IN THIS INVESTIGATION ARE SHOWN THUS:
   - ON LOCATION PLANS AND STRIP MAPS:
   - ON GEOLOGICAL SECTIONS:

   THE GENERAL LOCATION OF THESE PROJECTS IN PLAN ARE SHOWN WITH A NUMBER DESIGNATION WITHIN A DIAMOND SYMBOL: 5
3. LOCATION AND ORIENTATION OF GEOLOGICAL SECTIONS GENERALLY ARE SHOWN ON THE PLAN ON WHICH BORING LOCATIONS ARE PLOTTED.

SYMBOLS UTILIZED ON GEOLOGICAL SECTIONS



- I = LOCATION AND LENGTH OF SOIL SAMPLE
- I = LOCATION AND LENGTH OF ROCK CORE RUN
- A = NUMBER AND LOCATION OF BORING.
- B = NUMBER AND TYPE OF SOIL SAMPLE:
  - SUFFIX "D" = DRY SAMPLE TAKEN WITH 2" OD SPLIT SPOON;
  - SUFFIX "S" = SHELBY SAMPLE TAKEN WITH 2" OD THIN TUBE;
  - SUFFIX "U" = UNDISTURBED SAMPLE TAKEN WITH 3" OD THIN TUBE USING PISTON SAMPLER;
  - SUFFIX "R" = SAMPLE TAKEN WITH OPEN-END DRILL ROD;
  - SUFFIX "UD" OR "SD" = THIN TUBE SAMPLE DISTURBED IN SAMPLING;
  - "NR" = SAMPLE ATTEMPTED BUT NOT RECOVERED;
  - SUFFIX "C" = ROCK CORE RUN USING NX SIZE DOUBLE TUBE DIAMOND CORE BARREL, PRODUCING CORE APPROXIMATELY 2-1/8" ø;
  - "CORE" = CORING IN OVERBURDEN OR CORING IN BEDROCK WITH SAWTOOTH BIT OR ROTARY DRILLING BIT.
- C = SAMPLER PENETRATION RESISTANCE IN BLOWS PER FOOT EXCEPT WHERE SPECIFIC DISTANCE IS NOTED.
  SAMPLER DRIVEN WITH 140 LB. HAMMER FALLING 30".
  P = THIN TUBE SAMPLE ADVANCED BY PUSHING
  T = THIN TUBE SAMPLE ADVANCED BY TAPPING.
  WR = SAMPLER ADVANCED UNDER WEIGHT OF RODS
  WH = SAMPLER ADVANCED UNDER WEIGHT OF RODS AND HAMMER
  (R SAMPLES DRIVEN WITH 300 LB. HAMMER FALLING 18")
- D = SAMPLE CLASSIFICATION ACCORDING TO UNIFIED SOIL CLASSIFICATION SYSTEM
- E = SAMPLE NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT
- [F] = ATTERBERG LIQUID LIMIT VALUE.
- [G] = ATTERBERG PLASTIC LIMIT VALUE.
- [H] = SHEAR STRENGTH IN KSF DETERMINED FROM UNCONFINED COMPRESSION TEST FOR SOIL SAMPLES OR COMPRESSIVE STRENGTH IN KSI FOR ROCK CORES.
- (J) = SHEAR STRENGTH IN KSF DETERMINED FROM UNCONSOLIDATED-UNDRAINED TRIAXIAL SHEAR TEST.
- K = NUMBER DESIGNATION OF NX SIZE ROCK CORE RUN.
- L = LENGTH OF ROCK CORE RECOVERY EXPRESSED AS A PERCENT OF LENGTH OF CORE RUN
- M = ROCK QUALITY DESIGNATION (RQD) IN PERCENT.
- = GROUND WATER LEVELS OBSERVED DURING THE PERIOD OF THIS FIELD INVESTIGATION PROGRAM.
- = GROUND WATER LEVELS OBSERVED AT AN EARLIER TIME IN BORINGS NOT MADE FOR THIS INVESTIGATION.
- = POSITION OF POROUS BACKFILL SURROUNDING OBSERVATION WELL IN BORINGS MADE FOR WMATA.
- M.L. = POSITION OF MATCH LINE BETWEEN GEOLOGICAL SECTIONS.
- S = CORROSION TEST OF SOIL SAMPLE.
- W = CORROSION TEST OF WATER SAMPLE.

NOTES AND LEGEND FOR BORING LOG DRAWINGS

(A) (B) (C) (D) (E) (F)

- A = DEPTH BELOW GROUND SURFACE IN FEET
- B = NUMBER OF BLOWS OF 300 LB. HAMMER FALLING 18" REQUIRED TO DRIVE CASING OF THE SIZE NOTED ONE FOOT.
- C = NUMBER AND TYPE OF SAMPLE
  - SUFFIX "D" = DRY SAMPLE TAKEN WITH 2" OD SPLIT SPOON;
  - SUFFIX "S" = SHELBY SAMPLE TAKEN WITH 2" OD THIN TUBE;
  - SUFFIX "U" = UNDISTURBED SAMPLE TAKEN WITH 3" OD THIN TUBE USING PISTON SAMPLER;
  - SUFFIX "R" = SAMPLE TAKEN WITH OPEN-END DRILL ROD;
  - SUFFIX "UD" OR "SD" = THIN TUBE SAMPLE DISTURBED IN SAMPLING;
  - "NR" = SAMPLE ATTEMPTED BUT NOT RECOVERED;
  - SUFFIX "C" = ROCK CORE RUN USING NX SIZE DOUBLE TUBE DIAMOND CORE BARREL, PRODUCING CORE APPROXIMATELY 2-1/8" ø;
  - "CORE" = CORING IN OVERBURDEN OR CORING IN BEDROCK WITH SAWTOOTH BIT OR ROTARY DRILLING BIT.
- D = SAMPLER PENETRATION RESISTANCE IN BLOWS PER 6" OF DRIVING EXCEPT WHERE SPECIFIC DISTANCE IS NOTED.
  SAMPLER DRIVEN WITH 140 LB. HAMMER FALLING 30"
  P = THIN TUBE SAMPLE ADVANCED BY PUSHING
  T = THIN TUBE SAMPLE ADVANCED BY TAPPING
  WR = SAMPLER ADVANCED UNDER WEIGHT OF RODS
  WH = SAMPLER ADVANCED UNDER WEIGHT OF RODS AND HAMMER
  (R SAMPLES DRIVEN WITH 300 LB. HAMMER FALLING 18")
  78/25 — LENGTH OF ROCK CORE RECOVERY EXPRESSED AS A PERCENT OF LENGTH OF CORE RUN; ROCK QUALITY DESIGNATION (RQD) IN PERCENT
- E = DESCRIPTION OF INDIVIDUAL SOIL SAMPLE, INCLUDING UNIFIED SOIL CLASSIFICATION SYMBOL, OR DESCRIPTION OF INDIVIDUAL ROCK CORE RUN.
- F = DESCRIPTION OF PRINCIPAL SOIL STRATA OR PRINCIPAL DIVISIONS OF BEDROCK. STRATA DIVISION LINES ARE NOTED WITH DEPTH BELOW GROUND SURFACE.

CONSISTENCY OR COMPACTNESS FROM SAMPLER PENETRATION RESISTANCE

THE DEGREE OF CONSISTENCY OR COMPACTNESS OF SAMPLES IS NOT GIVEN IN THE BORING LOG DESCRIPTIONS BUT IS INDICATED BY THE FOLLOWING VALUES OF STANDARD SAMPLER PENETRATION RESISTANCE IN BLOWS PER FOOT:

FINE GRAINED SOILS, SILTS AND CLAYS:		COARSE GRAINED SOILS, SANDS AND GRAVELS:	
LESS THAN 2 BPF	= VERY SOFT	LESS THAN 4 BPF	= VERY LOOSE
2 TO 4 BPF	= SOFT	4 TO 10 BPF	= LOOSE
4 TO 8 BPF	= MEDIUM STIFF	10 TO 30 BPF	= MEDIUM COMPACT
8 TO 15 BPF	= STIFF	30 TO 50 BPF	= COMPACT
15 TO 30 BPF	= VERY STIFF	GREATER THAN 50	= VERY COMPACT
GREATER THAN 30	= HARD		

ABBREVIATIONS

MISCELLANEOUS

BOTTOM	= BOT.
CARBONACEOUS	= CARB.
CAVITIES	= CVTS.
CEMENTED	= CEM.
CONCRETIONS	= CONC.
DITTO	= Do.
FRAGMENTS	= FGNTS.
INTERBEDDED	= INTRBD.
INTERLAYERED	= INLRD.
LAYERS	= LYRS.
LENSES	= LNS.
MATERIAL	= MTL.
MATTER	= MTR.
MEADOW MAT	= MDW.MT.
MICACEOUS	= MIC.
MISCELLANEOUS	= MISC.
NUMEROUS	= NUM.
OCCASIONAL	= OCC.
ORGANIC	= ORG.
PARTICLES	= PCLS.
PEAT	= PT.
PIECES	= PCS.
POCKET	= PKT.
PROBABLY	= PROB.
ROOTS	= RTS.
SEAMS	= SMS.
SLICKENSIDED	= SLKS.
SLIGHTLY	= SL.
SOME	= SM.
TRACE	= TR.
VEGETATION	= VEG.
VERY	= V
WITH	= W/

GRAIN SIZE AND SHAPE

ANGULAR	= ANG.
COARSE	= C
COARSE TO FINE	= C-F
COARSE TO MEDIUM	= C-M
FINE	= F
FINE TO COARSE	= F-C
FINE TO MEDIUM	= F-M
MEDIUM	= M
MEDIUM TO COARSE	= M-C
MEDIUM TO FINE	= M-F
SMALL	= SML.

CONSISTENCY

COMPACT	= CPT.
MEDIUM COMPACT	= MED.CPT.
DECAYED	= DCYD.
DECOMPOSED	= DEC.
DISINTEGRATED	= DSNTG.
FRACTURED	= FRCT.
HARD	= HD.
MEDIUM	= MED.
RELATIVELY SOUND	= REL.SND.
SOFT	= SFT.
SOUND	= SND.
STIFF	= STF.
WEATHERED	= WTHRD.

COLOR

BLACK	= BLK.
BLUE	= BL.
BROWN	= BRN.
DARK	= DK.
GRAY	= GRY.
GREEN	= GRN.
LIGHT	= LT.
MOTTLED	= MTLD.
PURPLE	= PRP.
ORANGE	= OR.
WHITE	= WHT.
YELLOW	= YEL.

SOIL OR ROCK TYPE

BOULDER	= BLDR.
BRICK	= BRK.
CINDERS	= CNDR.
CLAY	= CL.
CLAYEY SAND	= CL.SA.
CLAYEY SILT	= CL.SI.
COBBLE	= CBL.
GNEISS	= GNS.
GRANITE	= GRT.
GRAVEL	= GVL.
LIGNITE	= LIGN.
SAND	= SA.
SANDY CLAY	= SA.CL.
SANDY SILT	= SA.SI.
SCHIST	= SCH.
SHALE	= SH.
SHELLS	= SLS.
SILT	= SI.
SILTY CLAY	= SI.CL.
SILTY SAND	= SI.SA.

GENERALIZED STRATA DESCRIPTIONS

SYMBOL	DESCRIPTION	UNIFIED SOIL CLASSIFICATION PRIMARY	UNIFIED SOIL CLASSIFICATION SECONDARY	SOURCE AND AGE
(F)	FILL, GENERALLY COMPOSED OF INORGANIC SOIL OBTAINED FROM NEARBY NATURAL MATERIALS. MAY BE DERIVED FROM TERRACE, CRETACEOUS SOILS OR DECOMPOSED ROCK.	ML SM	SC CL	MAN-MADE IN HISTORIC TIMES
(A1)	VERY SOFT TO MEDIUM STIFF DARK GRAY AND BROWN ORGANIC CLAY WITH LENSES OF HIGHLY ORGANIC MATERIAL (WHERE LOCATED UNDER WATER). SOFT TO STIFF MOTTLED GRAY-BROWN SLIGHTLY ORGANIC SILTY OR SANDY CLAY (WHERE LOCATED ON LAND).	CL CH OH	OL PT	RIVER ALLUVIUM OF POST-GLACIAL TIMES
(A2)	LOOSE TO MEDIUM COMPACT GRAY OR DARK BROWN SILTY FINE TO MEDIUM SAND WITH OCCASIONAL POCKETS OR LENSES OF SMALL GRAVEL. MAY BE SLIGHTLY TO MODERATELY ORGANIC.	SM	SP	
(T1)	STIFF TO MEDIUM STIFF LIGHT BROWN OR GRAY OR MOTTLED BROWN-GRAY SILTY CLAY OR CLAYEY SILT WITH LENSES OF BROWN SILTY FINE SAND. IN SOME AREAS, SEVERAL SEPARATE LAYERS OF PLEISTOCENE CLAYS HAVE BEEN ENCOUNTERED, WHICH ARE DISTINGUISHED BY A LETTER SUFFIX: T1A, T1C, ETC.	CL ML CH	LENSES OF SM OR SC	PORTIONS OF THE "25-FOOT" "50-FOOT" AND "90-FOOT" TERRACES, DEPOSITED BY RIVERS IN PLEISTOCENE TIMES
(T0)	MEDIUM STIFF TO STIFF DARK GRAY ORGANIC CLAY WITH NUMEROUS WOOD FRAGMENTS. USUALLY FOUND INTERLENSED WITH STRATUM T4.	CL OL	CH OH	
(T2)	MEDIUM COMPACT TO COMPACT BROWN AND RED-BROWN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH TRACE OF GRAVEL AND OCCASIONAL BOULDERS.	SM SC	SP SW	
(T3)	COMPACT TO VERY COMPACT BROWN AND RED-BROWN FINE TO COARSE SAND WITH SOME SILT AND GRAVEL AND VARIABLE AMOUNTS OF COBBLES AND BOULDERS.	SW SM	SP GM	
(T4)	MEDIUM COMPACT TO COMPACT GRAY AND GRAY-BROWN FINE TO MEDIUM SAND WITH SOME SILT AND SMALL GRAVEL, CONTAINING LENSES OF DARK GRAY CLAY, OCCASIONALLY SLIGHTLY ORGANIC.	SM SP	SW	
(T5)	COMPACT TO VERY COMPACT GRAY AND GRAY-BROWN FINE TO COARSE SAND WITH SOME GRAVEL, SOME TO TRACE OF SILT AND VARIABLE AMOUNTS OF COBBLES AND BOULDERS, OFTEN CONCENTRATED AT BASE OF LAYER.	SW SM	SP GM	
(Q1)	LOOSE TO MEDIUM COMPACT LIGHT BROWN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH TRACE OF SMALL GRAVEL.	SM SC		BRANDYWINE FORMATION OF EARLY PLEISTOCENE OR PLIOCENE TIMES
(Q2)	LOOSE TO MEDIUM COMPACT LIGHT BROWN OR TAN SILTY OR CLAYEY MEDIUM TO FINE SAND WITH SOME SMALL GRAVEL.	SM SC	SP	
(C)	MEDIUM COMPACT GRAY AND TAN SILTY FINE SAND OR MEDIUM STIFF TO STIFF DARK GRAY TO OLIVE-GREEN CLAY. CALVERT FORMATION OF MIOCENE AGE.	SM CH	SP CL	MARINE DEPOSITS OF TERTIARY OR UPPER CRETACEOUS PERIODS
(E)	MEDIUM STIFF DARK GREEN OR BROWN CLAY AND SILTY CLAY. AQUIA FORMATION OF EOCENE AGE.	MH CH	ML CL	
(M)	MEDIUM STIFF TO STIFF GREEN OR BROWN SILT AND CLAY. MONMOUTH FORMATION OF UPPER CRETACEOUS AGE.	MH CL	ML CH	
(P1)	HARD MOTTLED RED-BROWN AND GRAY OR LIGHT GRAY AND TAN PLASTIC CLAY WITH OCCASIONAL POCKETS OF FINE SAND. GENERALLY CONSISTS OF PATAPSCO FORMATION BUT MAY INCLUDE RARITAN FORMATION AT UPPER LEVELS.	CH	CL	POTOMAC GROUP OF CRETACEOUS PERIOD
(P2)	COMPACT TO VERY COMPACT LIGHT GRAY OR TAN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH POCKETS OF SILTY CLAY AND TRACE OF SMALL GRAVEL, OCCASIONAL LIGNITE FRAGMENTS. ALSO INCLUDES MAGOTHY FORMATION OF UPPER CRETACEOUS AGE.	SM SC SP	SP	
(P3)	HARD GRAY-GREEN OR GRAY-BLUE-GREEN SILTY OR SANDY CLAY AND VERY COMPACT SILTY OR CLAYEY FINE TO MEDIUM SAND WITH OCCASIONAL SMALL GRAVEL AND SCATTERED BOULDERS.	CL SC	ML SM	
(P4)	VERY COMPACT MOTTLED LIGHT GRAY, TAN, BUFF OR WHITE SILTY OR CLAYEY FINE TO MEDIUM SAND WITH SOME GRAVEL AND SCATTERED LIGNITE FRAGMENTS, FREQUENTLY WITH DENSE NESTS AND POCKETS OF ANGULAR ROCK FRAGMENTS, COBBLES AND BOULDERS.	SM SW SC	SP GM	

NOTE

THE GENERALIZED STRATA DESCRIPTIONS NOTED IN THIS COLUMN AND GIVEN IN THE TEXT OF THE MRJD REPORTS ON SUBSURFACE INVESTIGATIONS ARE INTENDED TO COVER THE TYPICAL RANGE OF MATERIALS GROUPED WITHIN A PARTICULAR STRATUM.

FOR A DETAILED BREAKDOWN OF THE ACTUAL CONSTITUENT MATERIALS WITHIN THAT STRATUM, REFERENCE SHOULD BE MADE TO BORING AND LABORATORY TEST INFORMATION RELEVANT TO ANY SPECIFIC LOCATION.

DEFINITION OF MODIFYING ADJECTIVES USED TO DESCRIBE SOIL CONSTITUENTS IN SAMPLE AND STRATA DESCRIPTIONS

CONSTITUENT	PROPORTIONS OF SOIL CONSTITUENTS	PERCENTAGE BY DRY WEIGHT
MAJOR	NOUN FORM: GRAVEL, SAND, SILT, ETC.	50 OR MORE
MINOR	ADJECTIVE FORM: GRAVELLY, SANDY, ETC	31 TO 49
	SOME: SOME SAND, SOME SILT, ETC.	13 TO 30
	TRACE: TRACE GRAVEL, TRACE CLAY	1 TO 12
	AND: SAND AND GRAVEL	USE FOR EQUAL AMOUNTS
	WITH: WITH ROCK FRAGMENTS, WITH ORGANIC MATTER	INDICATES PRESENCE ONLY

DESIGNED	DATE
DRAWN	DATE
CHECKED	DATE
APPROVED	DATE

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION
3-86	JPG.	Revised Abbreviations	3-76	JPG	Revised Generalized Strata Descriptions
5-93	JPG	Revised Percentage limits of Soil adjectives "trace" and "Some".	5-80	JPG	Revised General Notes and Sampler Penetration Resistance.
			3-81	JPG.	Added Note on Generalized Strata Descriptions and Definition of Soil Adjectives.

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER · RUTLEDGE · WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK 17, N. Y.

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE & ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

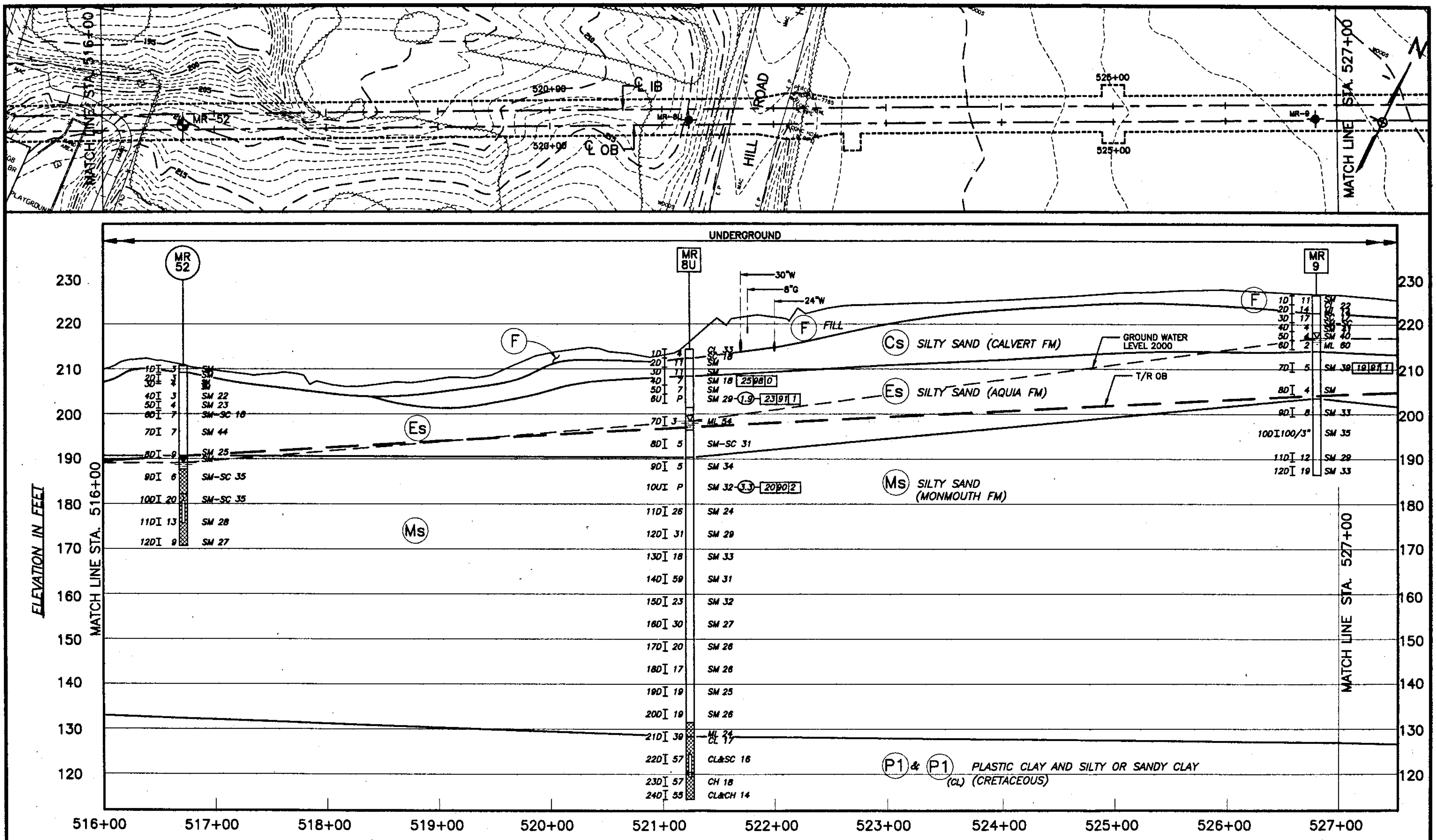
SUBMITTED

APPROVED

SUBSURFACE INVESTIGATION
GENERAL INFORMATION DRAWING

SCALE

DRAWING NO. F-1



DESIGNED		DATE
DRAWN	AH	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1 & G4aL-SO-17	GENERAL NOTES, LEGEND AND GENERAL STRATA DESCRIPTIONS

REVISIONS

DATE	BY	DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

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708 THIRD AVENUE, NEW YORK, N.Y. 10017

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HARRY WEESE ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

ADDISON ROAD
SITE PREPARATION AND MITIGATION
PLAN AND GEOLOGICAL SECTION
STA. 516+00 to STA. 527+00

SCALE H: 1" = 40' V: 1" = 10'

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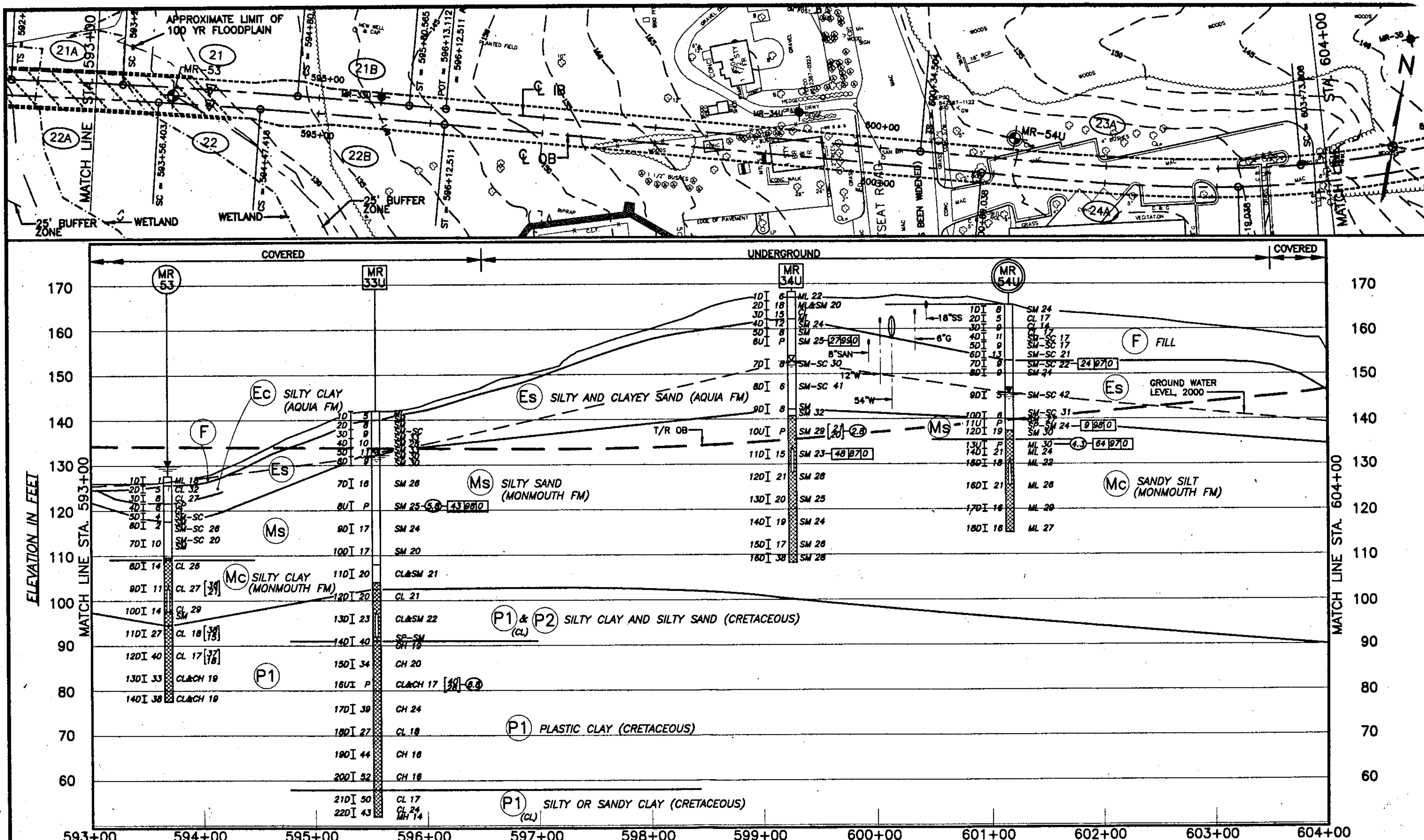

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DRAWN	AH	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		DATE

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PLAN AND GEOLOGICAL SECTION
STA. 593+00 to STA. 604+00

SCALE H: 1" = 40' V: 1" = 10'

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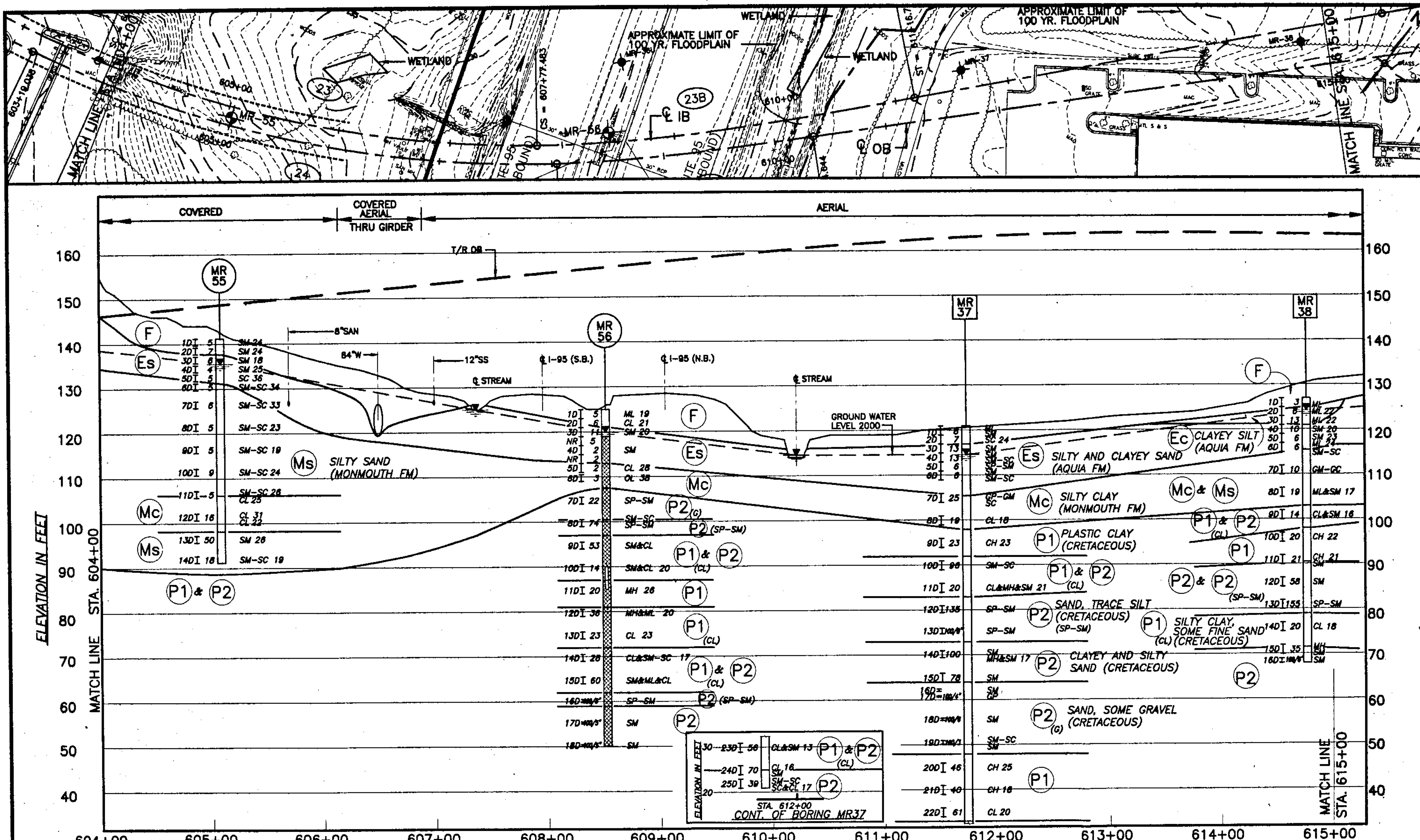


DESIGNED		DATE
DRAWN	AH	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1 & G4aL-S0-17	GENERAL NOTES, LEGEND AND GENERAL STRATA DESCRIPTIONS

REVISIONS

DATE	BY	DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, N.Y. 10017

SUBMITTED

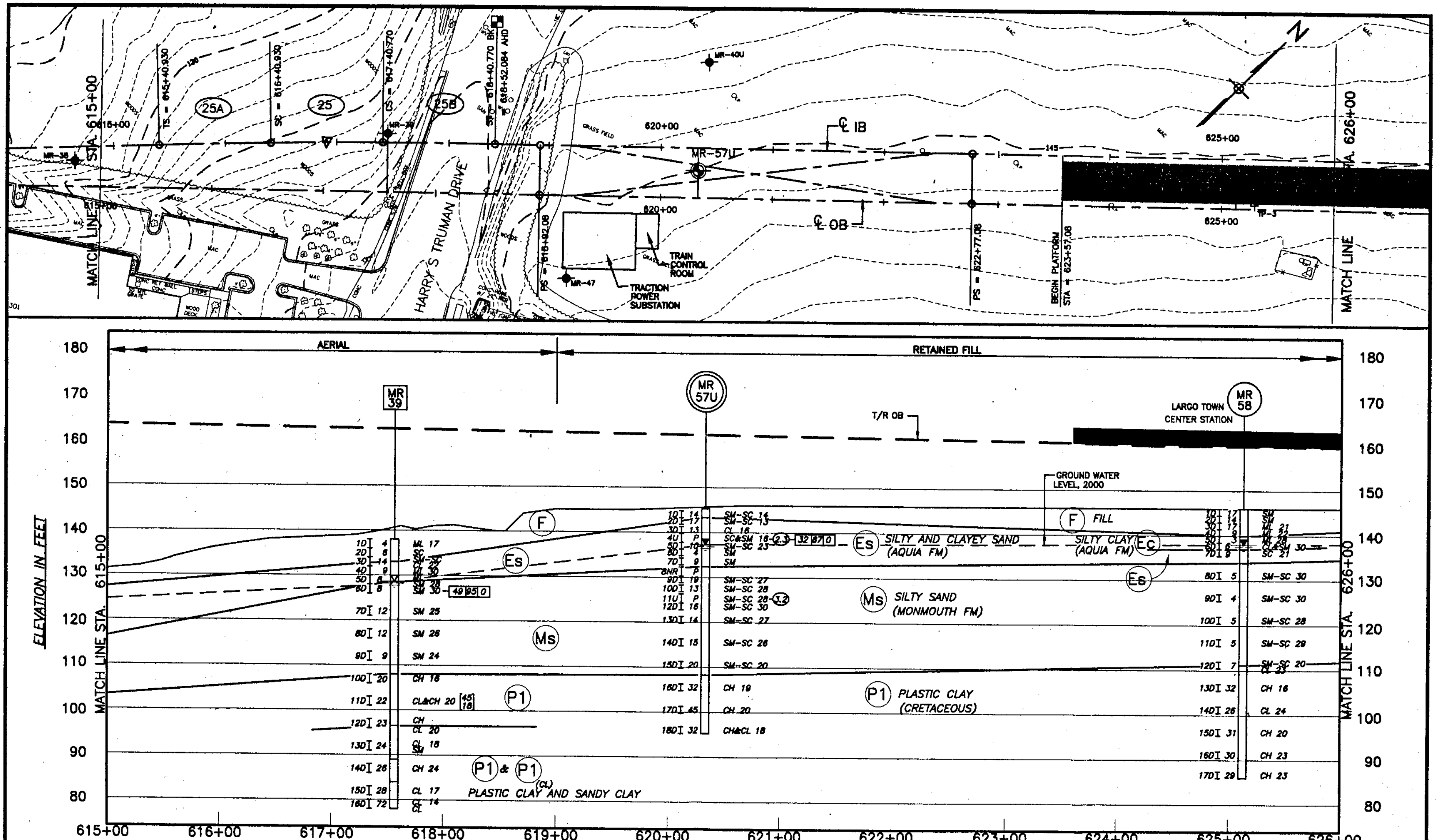
DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

ADDISON ROUTE
SITE PREPARATION AND MITIGATION
PLAN AND GEOLOGICAL SECTION
STA. 604+00 to STA. 615+00

SCALE H: 1" = 40' V: 1" = 10'

DRAWING NO. G4aL-S0-13



DESIGNED ____ DATE ____	REFERENCE DRAWINGS	REVISIONS
DRAWN AH DATE 5-00	NUMBER: F-1 & G4aL-SO-17 — DESCRIPTION: GENERAL NOTES, LEGEND AND GENERAL STRATA DESCRIPTIONS	DATE / BY / DESCRIPTION
CHECKED AAA, DWC, HSL DATE 5-00		
APPROVED ____ DATE ____		

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

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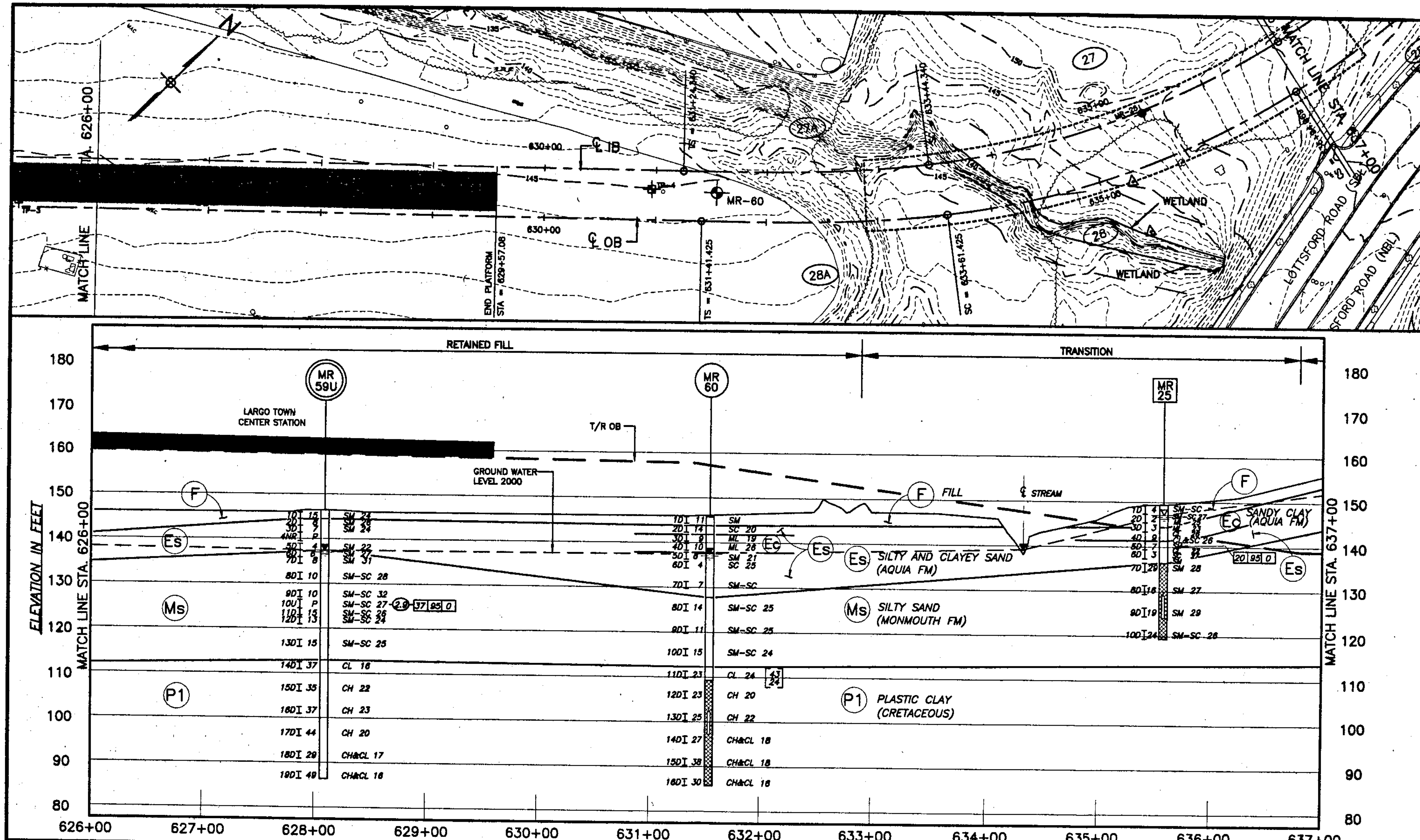
ADDISON ROUTE
SITE PREPARATION AND MITIGATION
PLAN AND GEOLOGICAL SECTION
STA. 615+00 to STA. 626+00

SCALE H: 1" = 40' V: 1" = 10'

DRAWING NO. G4aL-SO-14



DESIGNED		DATE
DRAWN	AH	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1 & G4aL-SO-17	GENERAL NOTES, LEGEND AND GENERAL STRATA DESCRIPTIONS

REVISIONS

DATE	BY	DESCRIPTION
10-18-96		DELETED HOME CONTOURS

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

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708 THIRD AVENUE, NEW YORK, N.Y. 10017

SUBMITTED

DE LEUW, CATHER & COMPANY
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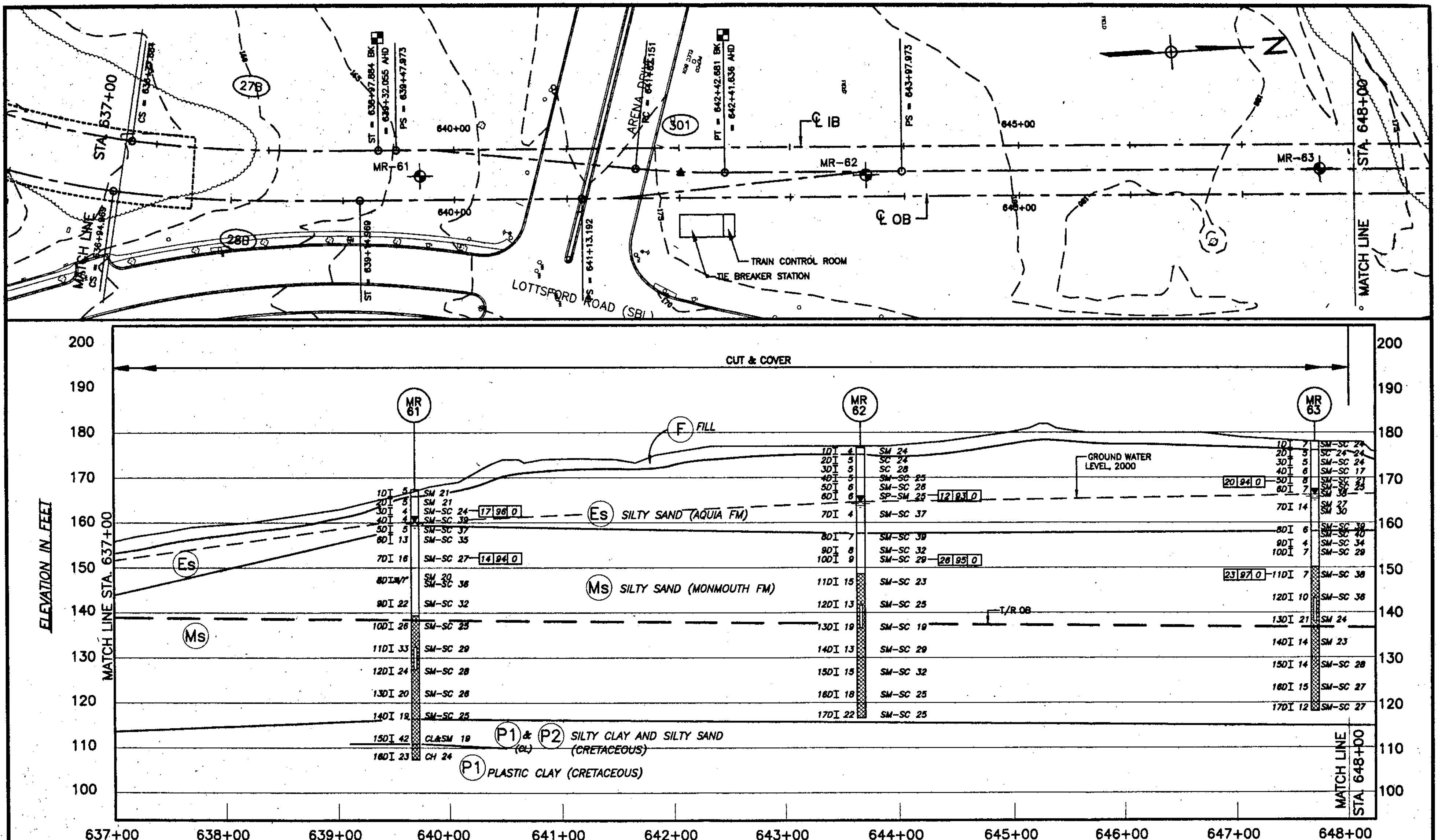
GENERAL ARCHITECTURAL CONSULTANT

ADDISON ROUTE
SITE PREPARATION AND MITIGATION
PLAN AND GEOLOGICAL SECTION
STA. 626+00 to STA. 637+00

SCALE H: 1" = 40' V: 1" = 10'

DRAWING NO. G4aL-SO-15



DESIGNED		DATE
DRAWN	AH	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
T-1 & G4aL-SO-17	GENERAL NOTES, LEGEND AND GENERAL STRATA DESCRIPTIONS

REVISIONS

DATE	BY	DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, N.Y. 10017
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DE LEUW, CATHER & COMPANY
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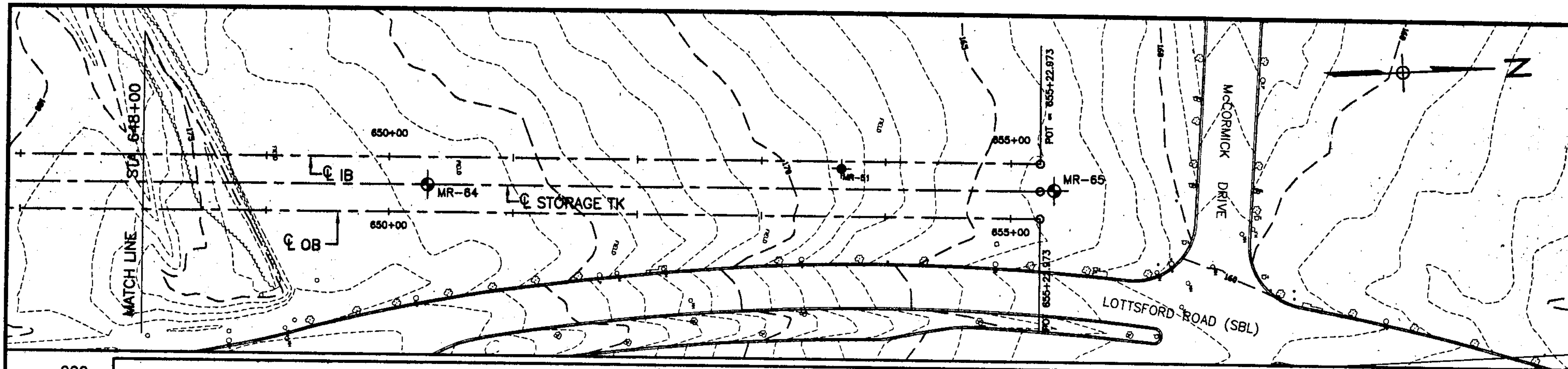
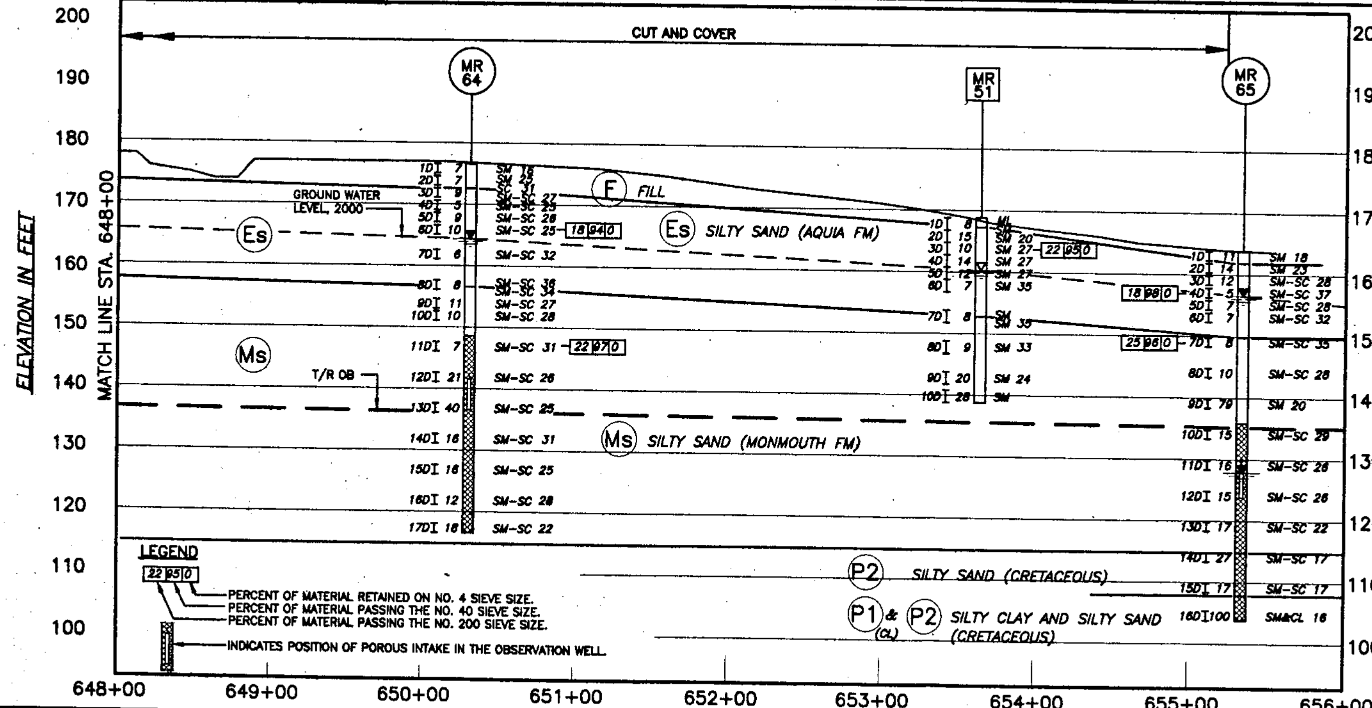
HARRY WEESE ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

ADDISON ROUTE
SITE PREPARATION AND MITIGATION
PLAN AND GEOLOGICAL SECTION
STA. 637+00 to STA. 648+00

SCALE H: 1" = 40' V: 1" = 10'

DRAWING NO. G4aL-SO-16





GENERAL STRATA DESCRIPTIONS:

STRATUM Cc (CALVERT), PLASTIC CLAY, SILTY AND SANDY CLAY OR CLAYEY SILT: MEDIUM TO STIFF DARK GRAY, GREEN, BROWN AND YELLOW ORANGE PLASTIC CLAY, SILTY AND SANDY CLAY OR CLAYEY SILT, TRACE FINE SAND, GRAVEL.

STRATUM Cs (CALVERT), FINE SAND, TRACE TO SOME SILT, CLAY AND SILTY OR CLAYEY FINE SAND: LOOSE TO MEDIUM COMPACT DARK GRAY, OLIVE GRAY, GREEN BROWN AND YELLOW ORANGE FINE SAND, TRACE TO SOME SILT, CLAY AND SILTY OR CLAYEY FINE SAND, TRACE GRAVEL.

STRATUM Ec (AQUIA), PLASTIC TO SILTY AND SANDY CLAY OR CLAYEY SILT: MEDIUM TO STIFF GRAY, GREEN OLIVE GRAY PLASTIC CLAY TO SILTY AND SANDY CLAY OR CLAYEY SILT, TRACE LIGNITE WITH OCCASIONAL SLIGHTLY ORGANIC FINE SANDY AND SILTY CLAY LAYERS, TRACE SHELLS.

STRATUM Es (AQUIA), SILTY AND CLAYEY FINE SAND: LOOSE TO MEDIUM COMPACT GRAY GREEN, OLIVE GRAY SILTY SAND, CLAYEY FINE SAND, TRACE SHELLS WITH OCCASIONAL SLIGHTLY ORGANIC SILTY AND CLAYEY FINE SAND LAYERS.

STRATUM Mc (MONMOUTH), SLIGHTLY ORGANIC MICACEOUS FINE SANDY SILT AND CLAYEY SILT: LOOSE TO VERY COMPACT DARK GREEN SLIGHTLY ORGANIC MICACEOUS FINE SANDY SILT, AND VERY STIFF TO HARD CLAYEY SILT TO SILTY CLAY TRACE SHELLS, OCCASIONALLY CEMENTED.

STRATUM Ms (MONMOUTH), SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND AND CLAYEY FINE SAND: LOOSE TO VERY COMPACT DARK GREEN SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND, TRACE CLAY AND CLAYEY FINE SAND AND FINE SAND, SOME SILT, TRACE TO SOME SHELLS, OCCASIONALLY CEMENTED, CEMENTED SAND LAYERS.

STRATUM P1 (CRETACEOUS), PLASTIC CLAY: STIFF TO HARD MOTTLED RED-BROWN AND GRAY OR LIGHT GRAY PLASTIC CLAY TO SILTY CLAY, TRACE FINE SAND, SILT POCKETS, SAND POCKETS, CEMENTED SAND, LIGNITE, GENERALLY SLICKENSIDED.

STRATUM P1(CL) (CRETACEOUS), SANDY CLAY: STIFF TO HARD GRAY SILTY CLAY, SOME FINE SAND LAYERS TO SANDY CLAY, TRACE CEMENTED SAND, LIGNITE.

STRATUM P2(CRETACEOUS), SAND, SOME SILT, CLAY: COMPACT TO VERY COMPACT, LIGHT GRAY, BROWN OR TAN FINE TO MEDIUM SAND, SOME SILT, CLAY TO SILTY OR CLAYEY FINE TO MEDIUM SAND, TRACE CEMENTED SAND LAYERS, GRAVEL, LIGNITE.

STRATUM P2(SP-SM) (CRETACEOUS), SAND, TRACE SILT, CLAY: VERY COMPACT GRAY FINE TO MEDIUM SAND, TRACE SILT, CLAY, TRACE CEMENTED SAND LAYERS, GRAVEL, OCCASIONAL CLAY POCKETS.

STRATUM P2(G) (CRETACEOUS), SAND, SOME GRAVEL: VERY COMPACT LIGHT GRAY AND BROWN FINE TO COARSE SAND, SOME GRAVEL, TRACE TO SOME SILT, CLAY, CEMENTED SAND FRAGMENTS.

DESIGNED		DATE
DRAWN	AH	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1	GENERAL NOTES AND LEGEND

REVISIONS

DATE	BY	DESCRIPTION

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, N.Y. 10017
SUBMITTED

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

ADDISON ROUTE
SITE PREPARATION AND MITIGATION
PLAN AND GEOLOGICAL SECTION
STA. 648+00 to STA. 655+23

SCALE H: 1" = 40' V: 1" = 10'

DRAWING NO. G4aL-SO-17

BORING NUMBER MR-52
Ground surface elevation +210.7

Casing blows: 3, 6, 12, 15

Sample	Blows	Description
1D	1,1,2	Brown silty fine sand, trace clay, silt pockets, roots (Fill) (SM)
2D	1,1,2	Brown silty fine sand, tr clay (SM)
3D	3,2,2	Top: Do 2D (SM) Bot: Gray f sand, sm si, tr cl, mica (SM)
4D	1,1,2	Gray brown fine sand, some silt, trace clay, roots (SM)
5D	2,2,2	Gray red brown silty fine sand, trace clay, mica (SM)
6D	3,3,4	Gray silty fine sand, trace clay, mica (SM-SC)
7D	3,3,4	Red brown silty fine sand, trace silt seams, clay, mica (SM)
8D	4,4,5	Top: Red brn fine sand, some silt, tr clay, mica, cemented sand (SM) Bot: Gray fine sand, some silt, tr clay, mica (SM)
9D	1,4,2	Gray fine sand, some silt, trace clay, mica (SM-SC)
10D	32,14,6	Dark gray slightly organic fine sand, some silt, shells, trace cemented shells, cemented sand, clay layers, mica (SM-SC)
11D	4,5,8	Black slightly organic micaceous fine sand, some silt, trace, shells, clay (SM)
12D	4,4,5	Do 11D (SM)

Strata: FILL 1.5' — LOOSE GRAY RED BROWN SILTY FINE SAND TO FINE SAND, SOME SILT, TRACE CLAY, MICA, CEMENTED SAND — 20.0' — LOOSE TO MEDIUM COMPACT GRAY TO BLACK SLIGHTLY ORGANIC MICACEOUS FINE SAND, SOME SILT, TRACE TO SOME SHELLS, TRACE CLAY, CEMENTED SHELLS, CEMENTED SAND, CLAY LAYERS — 40.0'

DEPTH BELOW GROUND SURFACE, FEET

Boring started 3-2-00 completed 3-3-00
Final depths:
Boring = 40.0' Casing = 4.0'
Casing diameter = 4"
Average depth of ground water
observed in the boring = 21.6' =El. +189.1

REMARKS:

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Used water below 4' depth to maintain hole open.

Encountered cemented sand at 20' depth and 30' depth.

Encountered cemented shells at 30' depth.

Observation well consisting of 1-1/2" PVC pipe installed with tip at 35' depth.

Borehole was grouted between 0' and 22' depth.

BORING NUMBER MR-53
Ground surface elevation +127.6

Casing blows: 2, 6, 10, 15, 18, 16, 12, 11, 9, 11, 13, 12, 17, 21

Sample	Blows	Description
1D	1/12",1	Soft brown clayey silt, some fine sand, trace gravel, vegetation (Fill) (ML)
2D	2,2,3	Medium gray brown silty clay, trace fine sand (CL)
3D	3,4,4	Medium gray green silty clay, trace fine sand, gravel, roots (CL)
4D	2,3,3	Top 1": Gray gravel (GP) Bot: Gray green silty clay (CL)
5D	3,2,2	Top: Brn f-c sand, sm gvl, silt, tr cl (SM-SC) Bot: Gray green f-m sand, sm silt (SM)
6D	2,1,1	Black slightly organic fine sand, some silt, trace clay (SM-SC)
7D	6,6,4	Top: Do 6D, trace gravel (SM-SC) Bot: Brown fine to coarse sand, some gravel, silt (SM)
8D	3,6,8	Medium brown silty clay, trace fine sand pockets, fine sand layers (CL)
9D	4,5,6	Stiff gray silty clay, trace brown fine sand layers & pockets (CL)
10D	3,6,8	Top: Do 9D (CL) Bot: Brown fine to medium sand, some silt, trace clay pockets, lignite (SM)
11D	7,12,15	Very stiff red brown & light brown silty clay, trace fine sand, fine sand layers (CL)
12D	10,16,24	Hard red brown silty clay, trace silt pockets (CL)
13D	7,14,19	Hard mottled red brown & gray silty clay to clay, trace silt pockets & layers, fine sand (CL&CH)
14D	10,16,22	Do 13D (CL&CH)

Strata: FILL 2.0' — MEDIUM GRAY GRN SILTY CLAY, TR F SAND, GVL 6.0' — LOOSE GRY GRN F-C SAND, SM GVL, SI, TR CL, CLY LYRS 10.0' — LOOSE BLACK SLIGHTLY ORGANIC FINE SAND, SM SILT, TR CLAY WITH TR TO SM F-C SAND & GVL LYRS 18.5' — STIFF TO MEDIUM BROWN TO GRAY SILTY CLAY, TRACE FINE SAND LAYERS & POCKETS — 30.0' — MED CPT F-M SAND 33.0' — HARD TO VERY STIFF RED BROWN GRAY SILTY CLAY TO CLAY, TRACE FINE SAND, FINE SAND LAYERS, SILT LAYERS & POCKETS — 50.0'

Boring started 3-1-00 completed 3-2-00
Final depths:
Boring = 50.0' Casing = 14.0'
Casing diameter = 4"
Average level of ground water
observed in the boring = 2.2' (Above Ground) =El. +129.8

REMARKS:

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Borehole was caving-in due to heavy gravel between 6' and 18.5' depth.

Used mud below 6' depth to maintain hole open.

Observation well consisting of 1-1/2" PVC pipe installed with tip at 30' depth.

Borehole was grouted between 0' and 17' depth.

BORING NUMBER MR-54U
Ground surface elevation +165.4

Casing blows: 6, 8, 9, 20

Sample	Blows	Description
1D	2,4,4	Brown silty fine sand, trace clay layers, clay pockets, gravel, grass (Fill) (SM)
2D	2,2,3	Gray brown fine sandy clay, trace gravel layers (Fill) (CL)
3D	3,4,5	Brown fine to medium sandy clay, trace gravel (Fill) (CL)
4D	5,6,6	Top:Brn f-m sa cl, tr gvl, org si pkts(Fill)(CL) Bot:Brn si f-m sand, tr gvl, cl (Fill)(SM-SC)
5D	3,4,5	Brown silty fine to coarse sand, some gravel, tr clay, organic silt (Fill) (SM-SC)
6D	3,5,7	Brown gray silty fine sand, trace clay, wood (Fill) (SM-SC)
7D	3,4,6	Brown green fine sand, some silt, trace clay, medium sand (SM-SC)
8D	4,4,5	Brown green fine to medium sand, some silt, trace mica, clay (SM)
9D	1,2,3	Brown gray silty fine sand, trace clay, mica (SM-SC)
10D	2,2,4	Brn gray mic silty fine sand, tr cl (SM-SC)
11U	P	Top: Black f sand, sm organic silt, tr cl (SM) Bot: Gray f sand, tr silt, clay (SP-SM)
12D	3,6,11	Black micaceous fine sand, some organic silt, trace shells, clay pockets (SM)
13U	P	Black sl org micaceous fine sandy silt, trace clay, clay pockets, shells (ML)
14D	7,9,12	Dark gray slightly org mic fine sandy silt, tr clay, cl pkts, shells, cem sand, lign (ML)
15D	5,7,11	Do 14D (ML)
16D	6,10,11	Dark gray slightly organic micaceous fine sandy silt, trace clay, shells (ML)
17D	3,7,9	Do 16D (ML)
18D	5,7,9	Do 16D (ML)

Strata: FILL — 12.0' — LOOSE BROWN GRAY GREEN SILTY FINE SAND TO FINE TO MEDIUM SAND, SOME SILT, TRACE CLAY, MICA — 25.0' — MED CPT BLK MIC F SAND, TR TO SM ORG SI, TR CLAY, SHELLS 30.0' — MEDIUM COMPACT DARK GRAY TO BLACK SLIGHTLY ORGANIC MICACEOUS FINE SANDY SILT, TRACE CLAY, CLAY POCKETS, SHELLS, CEMENTED SAND, LIGNITE — 50.0'

Boring started 2-29-00 completed 2-29-00
Final depths:
Boring = 50.0' Casing = 4.0'
Casing diameter = 4"
Average depth of ground water
observed in the boring = 19.7' =El. +145.7

REMARKS:

Used water below 4' depth to maintain hole open.

Encountered cemented sand between 32' and 35' depth.

Observation well consisting of 1-1/2" PVC pipe installed with tip at 40' depth.

Borehole was grouted between 0' and 27' depth.

BORING NUMBER MR-55
Ground surface elevation +141.2

Casing blows: 3, 10, 29, 28, 11/6"

Sample	Blows	Description
1D	1,2,3	Brown silty fine sand, trace gravel, clay, vegetation (Fill) (SM)
2D	2,3,4	Brown micaceous silty fine sand, trace roots (Fill) (SM)
3D	7,3,3	Brown fine sand, some silt, trace clay (SM)
4D	2,2,2	Do 3D, trace clay pockets (SM)
5D	2,2,3	Brown gray fine sand, some clay, trace clay pockets (SC)
6D	2,2,3	Dark gray slightly organic micaceous silty fine sand, trace clay, clay pockets (SM-SC)
7D	WH/4",3/2",4,2	Black slightly organic micaceous silty fine sand, trace clay (SM-SC)
8D	1,2,3	Do 7D (SM-SC)
9D	2,2,3	Do 7D (SM-SC)
10D	3,4,5	Do 7D (SM-SC)
11D	2,2,3	Top: Black slightly organic micaceous silty fine sand, trace gravel, clay, m-f sand pockets, lignite (SM-SC) Bot: Medium black silty clay, trace gravel, fine sand pockets, lignite (CL)
12D	3,5,11	Top: Very stiff brown silty clay (CL) Bot: Very stiff black silty clay, trace lignite (CL)
13D	18,22,28	Dark gray slightly organic fine sand, some silt, trace clay (SM)
14D	5,6,12	Dark gray slightly organic silty fine sand, trace clay, clay lyrs (SM-SC)

Strata: FILL 3.5' — LOOSE BROWN GRAY FINE SAND, SM SILT, CLAY, TRACE CLAY POCKETS 10.0' — LOOSE DARK GRAY TO BLACK SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND, TRACE CLAY, CLAY POCKETS, LIGNITE, GRAVEL — 35.0' — MEDIUM TO VERY STIFF BLACK & BROWN SILTY CLAY, TRACE GRAVEL, LIGNITE 43.0' — MED CPT TO CPT DK GRY SLIGHTLY ORGANIC SILTY FINE SAND TO FINE SAND, SM SILT, TR CLAY 50.0'

Boring started 2-29-00 completed 2-29-00
Final depths:
Boring = 50.0' Casing = 4.5'
Casing diameter = 4"
Average depth of ground water
observed in the boring = 5.7' =El. +135.5

REMARKS:

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Used water below 4.5' depth to maintain hole open.

Borehole was grouted upon completion.

NOTES

1. BORINGS NOS. MR-52 THROUGH MR-65 WERE MADE AND INSPECTED BY GEO SERVICES CORPORATION UNDER SUBCONTRACT TO GEOTECH ENGINEERS, INC., BETWEEN JANUARY AND MAY, 2000.
2. COORDINATE LOCATIONS OF THE BORINGS ARE LISTED IN TABLE NO. 1 OF MRCE REPORT NO. 253.

DESIGNED		DATE
DRAWN	MC	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1	GENERAL NOTES AND LEGEND
G4aL-SO-05	BORING LOCATION PLAN AND
G4aL-SO-12	GEOLOGIC SECTION
G4aL-SO-13	

REVISIONS

DATE	BY	DESCRIPTION

STATE OF MARYLAND — HUGH S. LACY — PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, N.Y. 10017
SUBMITTED

DE LEUW, CATHER & COMPANY
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HARRY WEESE ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

ADDISON ROUTE
LOGS OF MR-SERIES BORINGS
MR-52 TO MR-55

SCALE 0 6' 12'

DRAWING NO. G4aL-SO-18

CADFILE

BORING NUMBER MR-56
Ground surface elevation +125.0

Casing blows: 8, 12, 11, 16, 10, 10, 11, 10, 8, 8, 11, 10, 7, 7, 8, 5, 8, 12, 7, 18, 44, 31, 68, 133, 138, 110

Depth (ft)	Sample	Blows	Description
0	1D	1,2,3,4	Brown fine sandy silt, trace clay, gravel, roots, fine sand layers (Fill) (ML)
2	2D	3,3,3,4	Red brown silty clay, some silty fine sand layers, gravel (Fill) (CL)
4	3D	4,5,6,8	Gray fine sand, some silt, trace clay, wood, clay seams, gravel layers (SM)
6	NR	3,3,2,1	No recovery
8	4D	1,1,1,1	Gray fine to medium sand, some silt, trace gravel, clay, clay layers (SM)
10	NR	1,1,1,1	No recovery
12	5D	1,1,1,1	Soft dark gray slightly organic silty clay, tr fine sand, fine sand seams (CL)
15	6D	1,2,1	Soft dark gray slightly organic clayey silt, trace mica (OL)
20	7D	6,10,12	Light gray white fine to medium sand, some gravel, trace silt, clay (SP-SM)
25	8D	11,27,47	Top: Light grey fine to medium sand, some clay (SM-SC) Bot: Brown fine sand, trace silt, clay pockets (SP-SM)
30	9D	19,16,37	Brown fine to medium sand, some silt, silty clay layers, trace cemented sand (SM&CL)
35	10D	6,8,8	Interlayered red fine sand, some silt, trace clay and stiff red gray silty clay (Slickensided Clay) (SM&CL)
40	11D	6,8,11	Stiff red brown clayey silt (MH)
45	12D	10,16,20	Interlayered stiff red brown clayey silt & fine sandy silt, trace clay, silty fine sand seams (MH&ML)
50	13D	6,10,13	Stiff gray brown silty clay to fine sandy clay, trace silty fine sand layers (CL)
55	14D	12,11,17	Interlayered very stiff green brown fine sandy clay & silty fine sand, trace clay (CL&SM-SC)
60	15D	15,29,31	Red brown fine to medium sand, some silt interlayered with fine sandy clay & fine sandy silt (SM&ML&CL)
65	16D	66, 34/2"	Brown fine to medium sand, trace silt, layers of silty fine sand & clay (SP-SM)
70	17D	100/6"	Brown fine to medium sand, some silt, trace cemented sand, cemented sand layers (SM)
75	18D	100/5"	Brn fine to coarse sand, sm silt, cemented sand, tr cemented sand layers (SM)

Strata
FILL 4.0'
LOOSE TO MEDIUM CPT F-M SAND, SM SILT, TR GRAVEL, CLAY CLAY POCKETS 12.0'
SOFT DK GRAY SLIGHTLY ORG SILTY CLAY TO CLAYEY SILT, TR FINE SAND, MICA 17.5'
MED CPT LT GRAY WHITE F-M SAND, SM GRAVEL, TR SILT, CLAY 24.5'
V CPT FINE SAND, SM CLAY TO F SA, TR SI 28.0'
MEDIUM COMPACT TO V COMPACT RED BRN FINE SAND, SM SILT & LYRS OF STIFF RED GRY SILTY CLAY, TR CEMENTED SAND (SLICKENSIDED CLAY) 38.0'
STIFF RED BROWN CLAYEY SILT 44.0'
INTERLAYERED STIFF RED BRN TO GRAY BRN CLAYEY SILT, SILTY CLAY, FINE SANDY CLAY AND SANDY SILT, TR SILTY F SA LYRS 53.0'
INTERLAYERED VERY STIFF GRN BRN F SANDY CLAY TO FINE SANDY SILT AND CPT TO V CPT RED BRN F-M SAND, SM SILT, TR CLAY 63.0'
V CPT BRN F-M SAND, TR SILT 66.0'
VERY COMPACT BRN F-C SAND, SM SILT, TR TO SM CEMENTED SAND, TR CEMENTED SAND LAYERS 74.9'

DEPTH BELOW GROUND SURFACE, FEET

Boring started 5-1-00 completed 5-2-00
Final depths:
Boring = 74.9' Casing = 26.0'
Casing diameter = 4"
Average depth of ground water observed in the boring = 5.1' =El. +119.9

REMARKS:

0.3' topsoil at the surface.

Washed ahead of casing between 6' and 20' depth and then drove casing. Casing blows are not representative of the consistency of the soil.

Used water below 26' depth to maintain hole open.

Encountered cemented sand and cemented sand layers between 29.5' to 31' and 69.5' to 74.9' depths.

Observation well consisting of 1-1/2" PVC pipe installed with tip at 40' depth.

Borehole was grouted between 0' and 3' depth.

BORING NUMBER MR-57U
Ground surface elevation +145.3

Casing blows: 11, 11, 9, 8, 10, 14, 24, 31

Depth (ft)	Sample	Blows	Description
0	1D	5,6,8	Brn silty f sand, tr clay pkts (Fill) (SM-SC)
2	2D	8,8,9	Gray brown silty fine sand, trace clay, clay pockets (SM-SC)
4	3D	6,6,7	Stiff brn si clay, sm f sand, tr f sa pkts (CL)
6	4U	P	Gray grn brn clayey f sand, sm silty f-m sand pkts, tr f sa clay pkts, gvl (SC&SM)
8	5D	4,5,5	Brn grn f sand,sm si,tr cl,gvl,cl pkts(SM-SC)
10	6D	4,2,2	Brown fine sand, some silt, trace clay (SM)
11	7D	4,4,5	Brown fine sand, some silt (SM)
13	8NR	P	No recovery
15	9D	5,8,11	Black slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
17	10D	4,6,7	Do 9D (SM-SC)
19	11U	P	Black slightly organic micaceous silty f sand, tr to sm shells, tr clay (SM-SC)
21	12D	5,7,9	Black slightly organic micaceous silty fine sand, some shells, trace clay (SM-SC)
25	13D	5,6,8	Black slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
30	14D	6,7,8	Do 13D (SM-SC)
35	15D	6,8,12	Do 13D (SM-SC)
40	16D	8,14,18	Very stiff red gray brown clay, trace fine sand, silt pockets (CH)
45	17D	11,19,28	Very stiff red brown clay (CH)
50	18D	8,13,19	V stiff red brn clay to silty clay, tr si pkts, fine sandy silt seams(Slickensided)(CH&CL)

Strata
FILL 2.0'
LOOSE TO MEDIUM COMPACT BRN FINE SAND, SM SILT TO SILTY FINE SAND, TR CLAY, CLAY POCKETS & LAYERS, GRAVEL 12.8'
MEDIUM COMPACT BLACK SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND, TRACE TO SOME SHELLS, TRACE CLAY 37.0'
VERY STIFF RED GRAY BROWN CLAY TO SILTY CLAY, TRACE FINE SAND, SILT POCKETS, FINE SANDY SILT SEAMS (OCCASION-ALLY SLICKEN-SIDED) 50.0'

Boring started 1-31-00 completed 1-31-00
Final depths:
Boring = 50.0' Casing = 9.0'
Casing diameter = 4"
Average depth of ground water observed in the boring = 8.0' =El. +137.3

REMARKS:

2" blacktop at the surface.

Used water below 9' depth to maintain hole open.

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Pushed tube from 17' to 18.8' depth. Sample not recovered. Took split spoon Sample No. 10D between 17' and 18.5' depth.

Bottom of tube of Sample No. 11U bent due to the presence of some shells.

Borehole was grouted upon completion.

BORING NUMBER MR-58
Ground surface elevation +146.0

Casing blows: 12, 11, 13, 12, 25, 18, 13, 16

Depth (ft)	Sample	Blows	Description
0	1D	6,8,9	Brn si mic silty f sand, tr gvl, clay(Fill) (SM)
2	2D	5,6,9	Brn silty f sand, sm gvl, tr clay (Fill) (SM)
4	3D	5,8,9	Brn f sa silt, tr cl, cl pkts, gvl, rts (Fill) (ML)
6	4D	2,4,5	Brn gray clayey silt, sm fine sand, dec wood, trace gravel (Fill) (ML)
7	5D	1,1,2	Soft gry cl silt, tr f sand, f sa lyrs, rts (ML)
8	6D	2,3,3	Soft gray grn si clay, sm silty f sand layers, trace gravel, roots (CL&SM)
10	7D	2,4,5	Green brown clayey fine sand, some gravel (SC)
15	8D	1,2,3	Dark gray slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
20	9D	1,2,2	Do 8D, trace shell layers (SM-SC)
25	10D	1,2,3	Do 8D (SM-SC)
30	11D	2,2,3	Do 8D (SM-SC)
35	12D	2,3,4	Top: Dk gray slightly organic micaceous silty fine sand, some gravel, trace clay (SM-SC) Bot: Very stiff light gray silty clay, trace fine sand, silt seams (CL)
40	13D	8,13,19	Hard red clay, trace fine sand, fine sand pockets (CH)
45	14D	8,11,15	Very stiff mottled red gray clay (CL)
50	15D	10,13,19	Do 14D, trace silt pockets, cemented silt (CH)
55	16D	7,13,17	Very stiff mottled red gray clay (CH)
60	17D	8,14,15	Do 16D (CH)

Strata
FILL 6.0'
SOFT CL SI TO SI CL TR TO SM SI SA LYRS, TR GVL ROOTS 9.0'
LOOSE CLAYEY F SAND, SM GVL 12.0'
LOOSE DARK GRAY SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND, TRACE CLAY, SHELLS, SHELL LAYERS, (SOME GRAVEL AT 34.5' DEPTH) 34.8'
VERY STIFF TO HARD MOTTLED RED GRAY CLAY TO SILTY CLAY, TRACE FINE SAND, SILT POCKETS, FINE SAND POCKETS, SILT SEAMS, CEMENTED SILT 60.0'

Boring started 1-24-00 completed 1-24-00
Final depths:
Boring = 60.0' Casing = 9.0'
Casing diameter = 4"
Average depth of ground water observed in the boring = 8.0' =El. +138.0

REMARKS:

2" gravel base at the surface.

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Used water below 9' depth to maintain hole open.

Borehole was grouted upon completion.

BORING NUMBER MR-59U
Ground surface elevation +146.4

Casing blows: 9, 11, 12, 11, 10, 10, 12, 13

Depth (ft)	Sample	Blows	Description
0	1D	5,7,8	Gray brown silty fine sand (Fill) (SM)
2	2D	3,4,4	Gray brown silty fine sand (SM)
4	3D	2,3,4	Brown fine sand, some silt (SM)
6	4NR	P	No recovery
8	5D	2,2,2	Brn grey f-m sand, sm silt, tr silt pkts (SM)
10	6D	2,3,3	Gray sl org mic f sand, sm silt tr sis (SM)
11	7D	2,4,4	Do 6D (SM)
15	8D	3,4,6	Black slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
18	9D	3,4,6	Blk slightly organic mic si f sand, sm shell lyrs, tr clay, shells (SM-SC)
20	10U	P	Black slightly organic micaceous silty fine sand, trace clay, shells, m sand (SM-SC)
22	11D	3,7,8	Black slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
24	12D	3,6,7	Do 11D (SM-SC)
30	13D	6,6,9	Do 11D (SM-SC)
35	14D	9,14,23	Hard grey red silty clay (CL)
40	15D	9,15,20	Very stiff mottled red gray clay (CH)
45	16D	10,17,20	Very stiff mottled red grey clay (CH)
50	17D	11,18,26	Do 16D (CH)
55	18D	9,13,16	Very stiff mottled red gray clay to silty clay (CH&CL)
60	19D	10,20,29	Hard mottled red green clay to silty clay, trace silt pockets (CH&CL)

Strata
FILL 2.0'
LOOSE BROWN GRAY SILTY FINE SAND TO FINE TO MEDIUM SAND, SM SILT, TR SILT POCKETS 9.0'
LOOSE TO MEDIUM COMPACT BLACK & GRAY SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND, TRACE CLAY, SHELLS, SHELL LAYERS 33.5'
VERY STIFF TO HARD MOTTLED RED GRAY, GREEN CLAY TO SILTY CLAY, TRACE SILT POCKETS 60.0'

Boring started 1-28-00 completed 1-28-00
Final depths:
Boring = 60.0' Casing = 9.0'
Casing diameter = 4"
Average depth of ground water observed in the boring = 8.0' =El. +138.4

REMARKS:

0.2' blacktop at the surface.

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Pushed tube between 10.5' & 12.5 depth. Sample not recovered. Took split spoon Sample No. 7D between 10.5' and 12' depth.

Used water below 9' depth to maintain hole open.

Borehole was grouted upon completion.

DESIGNED		DATE
DRAWN	AC	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1 &	GENERAL NOTES AND LEGEND
G4aL-SO-18	
G4aL-SO-13	BORING LOCATION PLAN AND
G4aL-SO-14	GEOLOGIC SECTION
G4aL-SO-15	

REVISIONS

DATE	DESCRIPTION

STATE OF MARYLAND · PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, N.Y. 10017

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

ADDISON ROUTE
LOGS OF MR-SERIES BORINGS
MR-56 TO MR-59U

SCALE 0 6' 12'

DRAWING NO. G4aL-SO-19

CADFILE

DEPTH BELOW GROUND SURFACE, FEET

BORING NUMBER MR-60
Ground surface elevation +145.8

Casing blows: 28, 40, 13, 12, 15, 14, 17, 14

Sample	Blows	Description
1D	5,5,6	Brown fine to coarse sand, some gravel, silt, tr crushed stone (Fill) (SM)
2D	5,5,9	Brown clayey fine sand (SC)
3D	3,4,6	Gray fine sandy silt, trace lignite, organic matter (ML)
4D	3,4,6	Medium green brown clayey silt, trace fine sand, cemented silt (ML)
5D	5,4,4	Brown gray fine sand, some silt, trace silt pockets, gravel, mica (SM)
6D	1,1,3	Gray brown fine sand, some clay, trace gravel, clay seams, mica (SC)
7D	4,5,2	Gray green fine sand, some silt, gravel, trace clay, gravel layers (SM-SC)
8D	5,7,7	Black slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
9D	4,5,6	Do 8D (SM-SC)
10D	4,6,9	Do 8D (SM-SC)
11D	6,9,14	Stiff red silty clay (CL)
12D	6,10,13	Stiff mottled red gray clay, trace silt pockets (Slickensided) (CH)
13D	7,11,14	Stiff red clay (CH)
14D	6,11,16	Very stiff red grey clay to silty clay, trace cemented silt (CH&CL)
15D	10,15,23	Hard red gray clay to silty clay, trace silt pockets, silt layers (CH&CL)
16D	8,13,17	Hard mottled red gray clay to silty clay, trace silt pockets (CH&CL)

Strata:
- FILL, 2.0'
- MED CPT CLAYEY F SAND 4.0'
- MEDIUM GRAY GRN CLAYEY SILT & F SANDY SILT, TR LIGN 8.0'
- LOOSE GRAY GREEN BROWN FINE SAND, SOME SILT, CLAY, TRACE TO SOME GRAVEL, TRACE CLAY SEAMS, MICA, GRAVEL LAYERS 18.0'
- MEDIUM COMPACT BLACK SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND, TRACE CLAY, SHELLS 33.5'
- STIFF TO HARD RED GRAY CLAY TO SILTY CLAY, TRACE SILT POCKETS, CEMENTED SILT, SILT LAYERS (OCCASIONALLY SLICKENSIDED) 60.0'

BORING NUMBER MR-61
Ground surface elevation +167.4

Casing blows: 7, 8, 13, 3, 6, 7, 8, 11

Sample	Blows	Description
1D	1,2,3	Brown silty fine sand, trace roots (Fill) (SM)
2D	2,2,3	Brown silty fine sand (SM)
3D	2,2,2	Gray brown fine sand, some silt, trace clay, medium sand (SM-SC)
4D	1,2,2	Gray fine sand, some silt, trace clay (SM-SC)
5D	1,2,3	Gray slightly organic micaceous fine sand, some silt, trace clay, shells (SM-SC)
6D	3,5,8,12	Black slightly organic micaceous fine sand, some silt, trace clay, shells (SM-SC)
7D	4,6,10	Black slightly organic micaceous fine sand, some silt, trace clay, medium sand, shells (SM-SC)
8D	62,25,13/1"	Top: Black slightly organic micaceous fine sand, some silt, gravel, tr shells (SM) Bot: Black slightly organic micaceous fine sand, some silt, trace clay, shells (SM-SC)
9D	6,8,13	Black slightly organic micaceous fine sand, some silt, trace clay, shells (SM-SC)
10D	7,12,14	Do 9D (SM-SC)
11D	12,17,16	Black slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
12D	0,11,13	Do 11D (SM-SC)
13D	6,8,11	Do 11D (SM-SC)
14D	5,8,10	Do 11D (SM-SC)
15D	8,16,26	Interlayered stiff light gray silty clay & silty fine sand, trace lignite (CL&SM)
16D	6,10,13	Very stiff mottled red gray clay (CH)

Strata:
- FILL 1.5'
- LOOSE BROWN SILTY FINE SAND TO FINE SAND, SM SILT, TRACE CLAY 8.0'
- LOOSE TO COMPACT BLACK SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND TO FINE SAND, SOME SILT, TRACE CLAY, SHELLS WITH SOME GRAVEL BETWEEN 19.5' & 20.8' OCCASIONAL CEMENTED SAND LAYERS 51.0'
- INTERLAYERED STIFF SILTY CLAY & SILTY FINE SAND 56.5'
- VERY STIFF RED GRAY CLAY 60.0'

BORING NUMBER MR-62
Ground surface elevation +176.6

Casing blows: 6, 8, 5, 9, 2, 4, 6, 6

Sample	Blows	Description
1D	1,2,2	Brown silty fine sand, trace roots (Fill) (SM)
2D	2,2,3	Brown clayey fine sand (SC)
3D	1,3,2	Do 2D (SC)
4D	1,2,3	Brown silty fine sand, trace clay (SM-SC)
5D	2,2,4	Do 4D (SM-SC)
6D	2,3,3	Gray brown fine sand, trace silt, medium sand (SP-SM)
7D	2,2,2	Brown gray fine sand, some silt, trace clay (SM-SC)
8D	3,3,4	Gray slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
9D	2,3,5	Do 8D (SM-SC)
10D	3,3,6	Gray slightly organic micaceous fine sand, some silt, shell layers, trace clay, shells (SM-SC)
11D	9,7,8	Gray slightly organic micaceous fine sand, some silt, trace clay, shells (SM-SC)
12D	3,6,7	Do 11D (SM-SC)
13D	6,9,10	Do 11D (SM-SC)
14D	3,6,7	Gray slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
15D	4,6,9	Do 14D (SM-SC)
16D	5,8,10	Do 14D (SM-SC)
17D	6,10,12	Do 14D (SM-SC)

Strata:
- FILL 1.5'
- LOOSE BROWN GRAY SILTY & CLAYEY FINE SAND TO FINE SAND, TRACE TO SOME SILT, TRACE CLAY 19.0'
- LOOSE TO MEDIUM COMPACT GRAY SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND TO FINE SAND, SOME SILT, TRACE CLAY, SHELLS, OCCASIONAL SHELL LAYERS, CEMENTED SAND LAYERS 60.0'

BORING NUMBER MR-63
Ground surface elevation +178.1

Casing blows: 7, 7, 16

Sample	Blows	Description
1D	3,4,3	Brown silty fine sand, trace clay, roots (Fill) (SM-SC)
2D	1,2,3	Brown clayey fine sand (SC)
3D	2,2,3	Brown silty fine sand, trace clay (SM-SC)
4D	2,3,3	Gray brn fine sand, sm silt, tr clay, medium to coarse sand, shells (SM-SC)
5D	3,3,5	Do 4D (SM-SC)
6D	3,3,4	Top: Do 4D (SM-SC) Bot: Gray fine sand, some silt (SM)
7D	5,7,7	Top: Red gray fine sand, some silt (SM) Bot: Gray brown fine sand, some silt (SM)
8D	2,3,3	Top: Brn gray silty f sand, tr clay (SM-SC) Bot: Gray slightly org micaceous fine sand, some silt, trace clay, shells (SM-SC)
9D	2,2,2	Do 8D, Bot (SM-SC)
10D	3,3,4	Gray slightly organic micaceous fine sand, some silt, trace clay, shells (SM-SC)
11D	2,3,4	Gray slightly organic micaceous fine sand, some silt, trace clay, medium sand (SM-SC)
12D	3,4,6	Do 11D (SM-SC)
13D	6,9,12	Gray slightly organic micaceous fine sand, some silt, trace shells (SM)
14D	7,8,6	Do 13D (SM)
15D	4,6,8	Gray slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)
16D	5,6,9	Do 15D (SM-SC)
17D	5,5,7	Do 15D (SM-SC)

Strata:
- FILL 2.0'
- LOOSE TO MEDIUM COMPACT GRAY BROWN TO RED GRAY SILTY FINE SAND TO FINE SAND, SOME SILT, TRACE CLAY SHELLS 20.0'
- LOOSE TO MEDIUM COMPACT GRAY SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND TO FINE SAND, SOME SILT, TRACE CLAY SHELLS, CEMENTED SAND LAYERS 60.0'

MR-60

Boring started 1-26-00 completed 1-27-00
Final depths:
Boring = 60.0' Casing = 9.0'
Casing diameter = 4"
Average depth of ground water observed in the boring = 8.3' =El. +137.5

REMARKS:

0.1' blacktop at the surface.

Used 140 lb. Automatic hammer to drive 2-inch O.D. Split spoon sampler.

Used water below 9' depth to maintain hole open.

Encountered gravel layer at 14.8' depth.

Observation well consisting of 1-1/2" PVC pipe installed with tip at 48.5' depth.

Borehole was grouted between 0' and 35.5' depth.

MR-61

Boring started 1-31-00 completed 2-1-00
Final depths:
Boring = 60.0' Casing = 9.0'
Casing diameter = 4"
Average depth of ground water observed in the boring = 7.2' =El. +160.2

REMARKS:

0.8' topsoil at the surface.

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Used water below 9' depth to maintain hole open.

Encountered cemented sand layers at 19.5' depth.

Observation well consisting of 1-1/2" PVC pipe installed with tip at 40' depth.

Borehole was grouted between 0' and 27' depth.

MR-62

Boring started 2-1-00 completed 2-2-00
Final depths:
Boring = 60.0' Casing = 9.0'
Casing diameter = 4"
Average depth of ground water observed in the boring = 12.0' =El. +164.6

REMARKS:

0.5' topsoil at the surface.

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Used water below 9' depth to maintain hole open.

Encountered cemented sand layers at 28.5' depth & 50' depth.

Observation well consisting of 1-1/2" PVC pipe installed with tip at 40' depth.

Borehole was grouted between 0' and 27' depth.

MR-63

Boring started 2-2-00 completed 2-2-00
Final depths:
Boring = 60.0' Casing = 4.0'
Casing diameter = 4"
Average depth of ground water observed in the boring = 11.9' =El. +166.2

REMARKS:

0.3' topsoil at the surface.

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Used water below 4' depth to maintain hole open.

Encountered cemented sand layer at 14' depth.

Observation well consisting of 1-1/2" PVC pipe installed with tip at 40' depth.

Borehole was grouted between 0' and 27' depth.

DESIGNED		DATE
DRAWN	MC	5-00 DATE
CHECKED	AAA, DWC, HSL	5-00 DATE
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1 & G4aL-SO-18	GENERAL NOTES AND LEGEND
G4aL-SO-15 G4aL-SO-16	BORING LOCATION PLAN AND GEOLOGIC SECTION

REVISIONS

DATE	BY	DESCRIPTION

STATE OF MARYLAND · HUGH S. LACY · REGISTERED · PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, NY 10017

SUBMITTED

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT

HARRY WEESE ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

ADDISON ROUTE
LOGS OF MR-SERIES BORINGS
MR-60 TO MR-63

SCALE 0 6' 12'

DRAWING NO G4aL-SO-20

CADFILE

BORING NUMBER MR-64
Ground surface elevation +176.6

DEPTH BELOW GROUND SURFACE, FEET

Casing blows: 4, 13, 14, 15, 6/6"

Depth	Sample	Blows	Description	Stratum
	1D	1,3,4	Brown silty fine sand, trace root (Fill) (SM)	FILL
	2D	2,3,4	Do 1D (Fill) (SM)	4.0'
5	3D	3,4,5	Top: Red brn clayey f sand, tr gravel (SC) Bot: Red brn silty f sand, tr clay (SM-SC)	
	4D	2,2,3	Do 3D, Bot (SM-SC)	
	5D	4,4,6	Red gray fine sand, some silt, trace clay, medium to coarse sand, gravel (SM-SC)	LOOSE RED BROWN TO GRAY BROWN SILTY FINE SAND TO FINE SAND, SOME SILT, TRACE CLAY, GRAVEL
10	6D	4,4,6	Do 5D (SM-SC)	
15	7D	2,2,4	Gray brown fine sand, some silt, trace clay (SM-SC)	
20	8D	2,3,5	Top: Do 7D (SM-SC) Bot: Gray slightly organic micaceous fine sand, some silt, trace clay, shells (SM-SC)	20.0'
	9D	4,4,7	Do 8D, Bot (SM-SC)	
25	10D	3,4,6	Do 8D, Bot (SM-SC)	
30	11D	2,2,5	Do 8D, Bot (SM-SC)	
35	12D	6,8,13	Do 8D, Bot (SM-SC)	LOOSE TO MEDIUM COMPACT GRAY SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND TO FINE SAND, SOME SILT, TRACE CLAY, SHELLS WITH OCCASIONAL GRAVEL
40	13D	7,17,23	Do 8D, Bot (SM-SC)	
45	14D	4,8,8	Gray slightly organic micaceous silty fine sand, trace clay, shells (SM-SC)	
50	15D	4,7,9	Do 14D (SM-SC)	
55	16D	5,5,7	Do 14D (SM-SC)	
60	17D	8,8,10	Do 14D, trace gravel (SM-SC)	60.0'

Boring started 2-3-00 completed 2-3-00
Final depths:
Boring = 60.0' Casing = 4.5'
Casing diameter = 4"
Average depth of ground water
observed in the boring = 12.1' =El. +164.5

REMARKS:

0.2' topsoil at the surface.

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler

Used water below 4.5' depth to maintain hole open.

Observation well consisting of 1-1/2" PVC pipe installed with tip at 40' depth.

Borehole was grouted between 0' and 27' depth.

BORING NUMBER MR-65
Ground surface elevation +163.9

Casing blows: 8, 13, 29, 31, 20/6"

Depth	Sample	Blows	Description	Stratum
	1D	2,4,7	Brown silty fine sand, trace roots (Fill) (SM)	FILL 2.0'
	2D	5,6,6	Red gray silty fine sand (SM)	LOOSE TO MEDIUM COMPACT RED GRAY TO GRAY BROWN SILTY FINE SAND TO FINE SAND, SOME SILT, TRACE CLAY
5	3D	4,6,6	Red gray silty fine sand, trace clay (SM-SC)	
	4D	2,2,3	Brown gray fine sand, some silt, trace clay (SM-SC)	
	5D	2,3,4	Do 4D (SM-SC)	
10	6D	2,3,4	Do 4D (SM-SC)	14.0'
15	7D	2,3,5	Black slightly organic micaceous fine sand, some silt, trace clay, medium sand, shells (SM-SC)	
20	8D	2,3,7	Do 7D (SM-SC)	
25	9D	25,29,50	Black slightly organic micaceous fine sand, some silt, cemented sand layers (SM)	LOOSE TO VERY COMPACT BLACK SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND TO FINE SAND, SOME SILT, TRACE CLAY, SHELLS OCCASIONAL CEMENTED SAND LAYERS
30	10D	5,6,9	Black slightly organic micaceous silty fine sand, trace clay (SM-SC)	
35	11D	5,7,9	Do 10D (SM-SC)	
40	12D	4,7,8	Do 10D (SM-SC)	
45	13D	6,7,10	Do 10D (SM-SC)	49.0'
50	14D	8,11,16	Light gray silty fine sand, trace clay, clay layers (SM-SC)	MEDIUM CPT LT GRAY SILTY FINE SAND, TRACE TO SOME CLAY, TR CLAY LAYERS 56.0'
55	15D	6,8,8	Light gray silty fine sand, some clay (SM-SC)	V CPT LT GRAY SILTY FINE SAND, SM CL LYRS
60	16D	17,36,61	Lt gray silty f sand, sm clay lyrs (SM&CL)	60.0'

Boring started 2-3-00 completed 2-4-00
Final depths:
Boring = 60.0' Casing = 4.5'
Casing diameter = 4"
Average depth of ground water
observed in the boring = 7.3' =El. +156.6
36.0' +127.9

REMARKS:

0.1' topsoil at the surface.

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Used water below 4.5' depth to maintain hole open.

Encountered cemented sand layers between 22.8' & 27.8' depth.

Encountered trace of cemented sand between 44' and 49' depth

Observation well consisting of 1-1/2" PVC pipe installed with tip at 40' depth.

Two groundwater levels were observed during drilling. The groundwater level at 7.3' depth was observed in the borehole in the overnight reading of 2-4-2000. The groundwater level at 36' depth was observed in the well.

Borehole was grouted between 0' and 27' depth.

DESIGNED		DATE
DRAWN	MC	5-00 DATE
CHECKED	AAA, DWC, HSL	5-00 DATE
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1 & G4aL-SO-18	GENERAL NOTES AND LEGEND
G4aL-SO-17	BORING LOCATION PLAN AND GEOLOGIC SECTION

REVISIONS

DATE	BY	DESCRIPTION

STATE OF MARYLAND · HUGH S. LACY · REGISTERED · PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, NY 10017
SUBMITTED Hugh S. Lacy

DE LEUW, CATHER & COMPANY
GENERAL ENGINEERING CONSULTANT
HARRY WEESE ASSOCIATES
GENERAL ARCHITECTURAL CONSULTANT

ADDISON ROUTE
LOGS OF MR-SERIES BORINGS
MR-64 TO MR-65

SCALE 0 6' 12'

DRAWING NO G4aL-SO-21

CADFILE

APPENDIX

CORROSION AND CHEMICAL TESTS FOR THIS INVESTIGATION

ARTECH TESTING, L.L.C.

14554 LEE ROAD · CHANTILLY, VA 20151-1632
703 378-7263 · 800 283-7848 · FAX 703 378-7274

PRODUCT TESTING · FAILURE ANALYSIS · LITIGATION SUPPORT · CHEMICAL ANALYSIS · ENGINEERING CONSULTING · MATERIALS RESEARCH · BIOMATERIALS · FOOTWEAR TESTING

March 10, 2000

Mr. Rajesh Geol
Geotech Engineers, Inc.
11890-U Old Baltimore Pike
Beltsville, MD 20705

Subject: Analysis of WMATA Soil Borings

Reference: Geotech Job # 96909B
ARTECH C00025

Dear Mr. Geol:

On 2/22/2000 six samples of soil were submitted to ARTECH Testing for the determination of pH, chloride, sulfate, total sulfur, and resistivity. Chloride ion was determined by California Department of Transportation Test 432. Sulfate ion was determined gravimetrically by combusting a portion of the sample and analyzing by APHA Method 4500-SO_4 C. Total sulfur was determined by combustion followed by idometric titration. All chemical properties are reported in dry weight percent. The pH and resistivity were determined by California Department of Transportation Test 643. The results are presented in the following table:

Geotech ID	ARTECH Lab ID	% Solids	pH	% Chloride	% Total Sulfur	% Sulfate**	Resistivity ohm/cm
MR 62/22.0'	C00025-1	78.7	7.23	0.0014	0.445	0.240	51,940
MR 65/14.0'	C00025-2	74.7	3.84	0.0088	0.478	0.382	26,700
MR 59U/15.0'	C00025-3	78.2	6.91	0.0053	1.37	1.86	29,200
MR 61/12.0'	C00025-4	76.5	7.23	0.0026	0.080	0.515	294,000
MR 64/22.0'	C00025-5	84.9	3.73	0.0040	0.510	0.677	52,200
MR 63/22.0'	C00025-6	73.5	3.67	0.0082	0.605	0.967	13,600

** Note - In several instances the sulfate result is higher than the total sulfur value. Total sulfur was reanalyzed with significant variance between results. This is probably due mainly to the uneven distribution of sulfur bearing materials within the sample.

If ARTECH Testing can be of any further assistance, on this or any other matter, please contact us at any time.

Sincerely,
ARTECH Testing, LLC

Sandra Conley

Sandra Conley
Manager, Chemistry Lab

ARTECH TESTING, L.L.C.

14554 LEE ROAD · CHANTILLY, VA 20151-1632
703 378-7263 · 800 283-7848 · FAX 703 378-7274

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PRODUCT TESTING

FAILURE ANALYSIS

LITIGATION SUPPORT

CHEMICAL ANALYSIS

ENGINEERING CONSULTING

MATERIALS RESEARCH

BIOMATERIALS

FOOTWEAR TESTING

April 4, 2000

Mr. Rajesh Geol
Geotech Engineers, Inc.
11890-U Old Baltimore Pike
Beltsville, MD 20705

Subject: Analysis of WMATA Soil Borings

Reference: Geotech Job # 96909B
ARTECH C00047

Dear Mr. Geol:

On 3/16/2000 two samples of soil were submitted to ARTECH Testing for the determination of pH, chloride, sulfate, total sulfur, and resistivity. Chloride ion was determined by California Department of Transportation Test 432. Sulfate ion was determined gravimetrically by combusting a portion of the sample and analyzing by APHA Method 4500-SO_4 C. Total sulfur was determined by combustion followed by idometric titration. All chemical properties are reported in dry weight percent. The pH and resistivity were determined by California Department of Transportation Test 643. The results are presented in the following table:

Geotech ID	ARTECH Lab ID	% Solids	pH	% Chloride	% Total Sulfur	% Sulfate	Resistivity ohm/cm
MR 54/15.0'	C00047-1	79.5	4.37	0.0078	0.301	0.028	370,000
MR 52/5.0'	C00047-2	84.5	4.09	0.0001	0.041	0.027	390,000

If ARTECH Testing can be of any further assistance, on this or any other matter, please contact us at any time.

Sincerely,
ARTECH Testing, LLC

Sandra Conley

Sandra Conley
Manager, Chemistry Lab