APPENDIX A

Report
Soils and Foundation Investigation
Proposed Appalachian Trail Pedestrian Bridges
Townships of Wantage and Vernon, New Jersey
State of New Jersey

MELICK-TULLY
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December 6, 1984

State of New Jersey
c/o Gar Chew Lai, Architect and Engineer
10 Evergreen Avenue
North Haledon, New Jersey 07508

Attention: Mr. Lawrence Edler, P.E.

Gentlemen:

Report
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Townships of Wantage and Vernon, New Jersey
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INTRODUCTION

This report presents the results of a soils and foundation investigation performed at the sites of two pedestrian bridges which may be constructed for the State of New Jersey in Wantage and Vernon Townships, New Jersey. One bridge is to be constructed across the Pochuck Creek, east of Sussex County Route 517 in Vernon Township, while the second bridge is to be constructed across the Wallkill River east of Route 284 and south of the New York-New Jersey border in Wantage Township.

PROPOSED CONSTRUCTION

We understand that the proposed timber bridges over the Pochuck Creek and Wallkill River will be approximately 80 feet and 150 feet in length, respectively. The bridges are anticipated to impose maximum foundation loads of less than 25 kips at the Pochuck site, and less than 50 kips at the Wallkill site.

PURPOSE AND SCOPE OF WORK

The purpose of our services was to:

1) explore the site subsurface soil, groundwater, and rock conditions to the significant foundation depths;

2) estimate the relevant engineering properties of the encountered subsurface materials;

3) evaluate the site foundation requirements considering the anticipated structural loading and encountered subsurface conditions;

4) recommend appropriate foundation types for support of the proposed structures, and present detailed foundation design and installation criteria for the recommended types;

5) estimate the post-construction settlements of the recommended foundation systems; and

6) discuss appropriate earthwork procedures inherent in the foundation construction, including anticipation and management of groundwater, depth of excavations required to remove unsuitable materials, etc.

To accomplish these purposes, a subsurface exploration program consisting of two supervised test borings was conducted at each proposed bridge. The borings were

performed using track-mounted rotary wash or hollow stem auger drilling equipment, and extended to depths ranging from approximately 20 to 40 feet below the existing surface grades. The locations of the borings are shown relative to the existing and proposed site features on the Plot Plans, Plates 1A and 1B.

Representative samples of the encountered subsurface materials were obtained from the borings at closely spaced intervals in accordance with the procedures of the Standard Penetration Test. For this test, a standard split barrel sampler (two inches outside diameter, one and three-eighths inches inside diameter) is advanced into the soil using a 140 pound weight falling 30 inches. After discounting the initial six inches of penetration, the number of blows required to advance the sampler a distance of one foot is recorded and designated as the standard penetration resistance. These values, as well as detailed descriptions of the encountered materials, are shown on the Logs of Borings, Plates 2A through 2D. The soils were visually classified in accordance with the Unified Soil Classification System described on Plate 3.

In addition, rock coring was performed in one of the borings to investigate the nature of the underlying bedrock. The coring was performed using a BX-size core barrel which extracts a core approximately one and

five-eighths inches in diameter. The rock core data is shown on the appropriate Log of Boring.

All field work was performed under the direct technical supervision of a geotechnical engineer from Melick-Tully and Associates, Inc. Our representative maintained continuous logs of the explorations as the work proceeded, and supervised the soil sampling operations so as to develop the desired subsurface information. The borings were located in the field by representatives of Gar Chew Lai, Architect and Engineer, and ground surface elevations at the boring locations were estimated by our firm using topographic plans prepared by Gerald C. Henry, Inc.

All soil and rock samples obtained from the borings were returned to our office where they were further examined. Due to the relatively distinct nature of the encountered subsurface materials, laboratory testing was not deemed necessary.

The results of the field exploration program and visual examination of the soil and rock samples have provided the basis for our engineering analyses and design recommendations.

SITE CONDITIONS

Surface Features: The proposed bridge sites are

primarily level, open fields with scattered trees and wooded areas on the banks of the existing Pochuck Creek and Wallkill River.

Based on the available topographic information, it appears that the existing ground surface elevations at the top of the banks of the Creek site are approximately Elevation +393 feet. The existing ground surface elevations at the top of the banks of the Wallkill River site range from approximately Elevation +382 feet to +384 feet.

Subsurface Conditions: The subsurface conditions encountered in the test borings performed for this study consisted of the following generalized strata in order of increasing depth:

1) Both sites were observed to be blanketed by a layer of topsoil. At the Pochuck Creek site, the topsoil was found to be approximately twelve inches in thickness, while at the Wallkill River site the topsoil was observed to be approximately 24 inches in thickness.

2) The topsoil was underlain by medium to very stiff clayey silts at the Pochuck Creek site to depths of approximately eight feet, where a layer of soft to medium organic sandy silt was encountered. The organic soils extended to depths of approximately 12 to 13 feet below the existing surface grades.

   The topsoil was underlain by very soft organic silts at the Wallkill River site to depths ranging from approximately 11 to 17 feet below the existing surface grades. The organic soils were underlain by stiff to very stiff silts and clays to depths ranging from approximately 21 to 32 1/2 feet below the existing surface grades.

3) The organic soils were underlain by medium dense sands at the Pochuck Creek site extending to the maximum depths explored.

   The silts and clays were underlain by medium dense to dense sandy soils or shale bedrock at the Wallkill River site extending to the maximum depths explored.

Groundwater was encountered at depths of approximately five feet below the existing ground surface in the borings performed at the Pochuck Creek site. Because the borings at the Wallkill River site were advanced with the use of drilling fluid, accurate water levels could not be obtained. It should be anticipated that the groundwater levels would fluctuate do to seasonal variations in rainfall, temperature, and flooding.

CONCLUSIONS AND RECOMMENDATIONS

Pochuck Creek Site:

1) The organic soils encountered in the borings to depths of approximately 12 to 13 feet below the existing surface grades would not provide suitable support of the proposed foundations.

2) Two alternate foundation systems appear feasible. The first alternate consists of excavation of the upper silts and organic soils to the surface of the underlying medium dense sands. The bridge could then be supported by conventional spread foundations which derive their support form the underlying sandy soils. The excavation could be backfilled to conventional shallow foundation levels with clean 3/4 inch crushed stone, if desired. Shallow foundations which derive their support directly from either natural medium dense sandy soils or crushed stone backfill could be designed to impose maximum allowable net bearing pressures of up to 4,000 pounds per square foot.

Groundwater was encountered at depths of approximately five feet below the existing ground surface in the borings performed for this study. In order to avoid disturbance of the subgrade soils exposed at the bottom of the mass excavations, and to allow the foundation construction to be performed in a relatively dry condition it will be necessary to dewater the mass excavation on a continuous basis during construction.

We estimate that post-construction settlements of shallow foundations designed and constructed in accordance with our recommendations would be on the order of three-quarters of one inch or less.

3) The second alternate consists of supporting the bridge abutments with a pile foundation system. We estimate that treated timber piles having a minimum seven inch tip diameter could be installed to provide allowable design capacities of 25 tons.

The piles should be driven to their required resistance as determined by the modified Engineering News Record formula. We recommend that all piles be driven a minimum of five feet into the bearing stratum beneath the soft organic soils (approximate Elevations +376 feet) in order to develop sufficient resistance to lateral loads. Piles which penetrate a minimum of five feet into the sand bearing stratum may be designed to resist lateral loads of up to one ton.

The borings performed at the Pochuck Creek site extended to depths on the order of 20 feet below the existing surface grades. The soils encountered in the borings at the completion depths consisted of medium dense sands. If the pile foundation system alternate is chosen, additional test borings would be required to accurately estimate the required pile lengths.

We estimate that post-construction settlements of bridge abutments supported by pile foundations installed in accordance with our recommendations would be on the order of three-quarters of one inch, or less.

Wallkill River Site:

1) The organic soils encountered in the borings to depths ranging from approximately 12 to 17 feet below the existing surface grades would not provide suitable support for the bridge foundations.

2) The two alternate foundation systems previously outlined for the Pochuck Creek bridge site are also appropriate for support of the Wallkill River bridge. However, as the organic soils extended to a depth of approximately 17 feet below the existing ground surface at the location of Boring 3, it may be more desirable to use a pile foundation system at this location.

   If the excavation alternate is chosen, the work should be performed in accordance with the recommendations previously described for the Pochuck Creek bridge site.

   If the pile foundation alternate is chosen, the piles should be designed and installed in accordance with the recommendations previously described for the Pochuck Creek bridge site. The piles should derive their support from the underlying medium dense to dense sands, or shale bedrock. For preliminary planning purposes, we estimate that the piles would extend to tip elevations of approximately +360 feet on the east side of the Wallkill River, and to approximately +348 feet on the west side of the river.

   The individual piles may be designed to resist lateral loads of up to one ton.

   We estimate that maximum post-construction settlements of pile foundations designed and constructed in accordance with our recommendations would be on the order of three-quarters of one inch, or less.

LIMITATIONS

This report has been prepared for the exclusive use of Gar Chew Lai, Architect and Engineer, for specific

application to design of two proposed Appalachian Trail pedestrian bridges in Wantage and Vernon Townships, New Jersey. This report has been prepared in accordance with generally accepted geotechnical engineering practices, and no other warranty, expressed or implied, is made.

In the event that any changes in the nature, design or locations of the structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing.

The analysis and recommendations submitted in this report are based in part of the data obtained from four widely-spaced test borings. The nature and extent of variations between the explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

We recommend that Melick-Tully and Associates, Inc. be provided the opportunity for a general review of the final design and specifications in order that our earthwork and foundation recommendations may be properly interpreted and implemented in the construction documents. If Melick-Tully and Associates, Inc. is not accorded the privilege of

making this recommended review, we can assume no responsibility for misinterpretation of our recommendations

This report was prepared for design purposes only, and may not be sufficient to prepare an accurate bid. Contractors wishing copies of the report may secure then from Gar Chew Lai, Architect and Engineer, with the understanding that its scope is limited to design considerations.

We recommend that a qualified geotechnical engineer be retained to provide continuous on-site soils engineering services during construction of the earthwork and foundation phases of the work. This is to observe compliance with the design concepts, specifications or recommendations, and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Please contact us if you have any questions concerning this report.

The following Plates are attached and complete this report:

Plates 1A and 1B - Plot Plan

Plates 2A through 2D - Logs of Borings

Plate 3 - Unified Soil Classification System

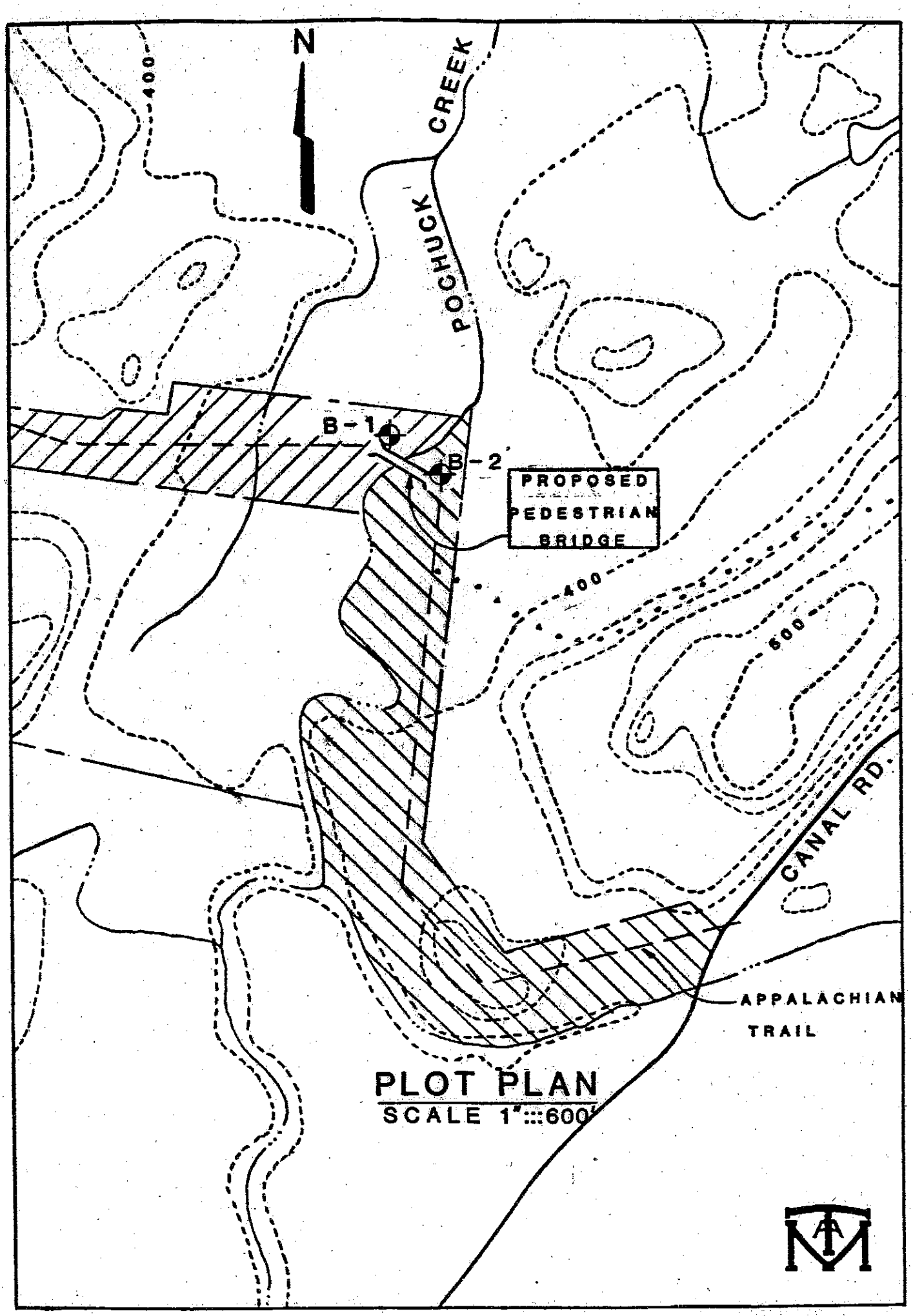
Respectfully submitted,

MELICK-TULLY AND ASSOCIATES, INC.

Todd E. Horowitz, P.E.

Robert J. Van Orden, P.E.
Vice President

TEH:RJVO:tlw
2034-022
(3 copies submitted)



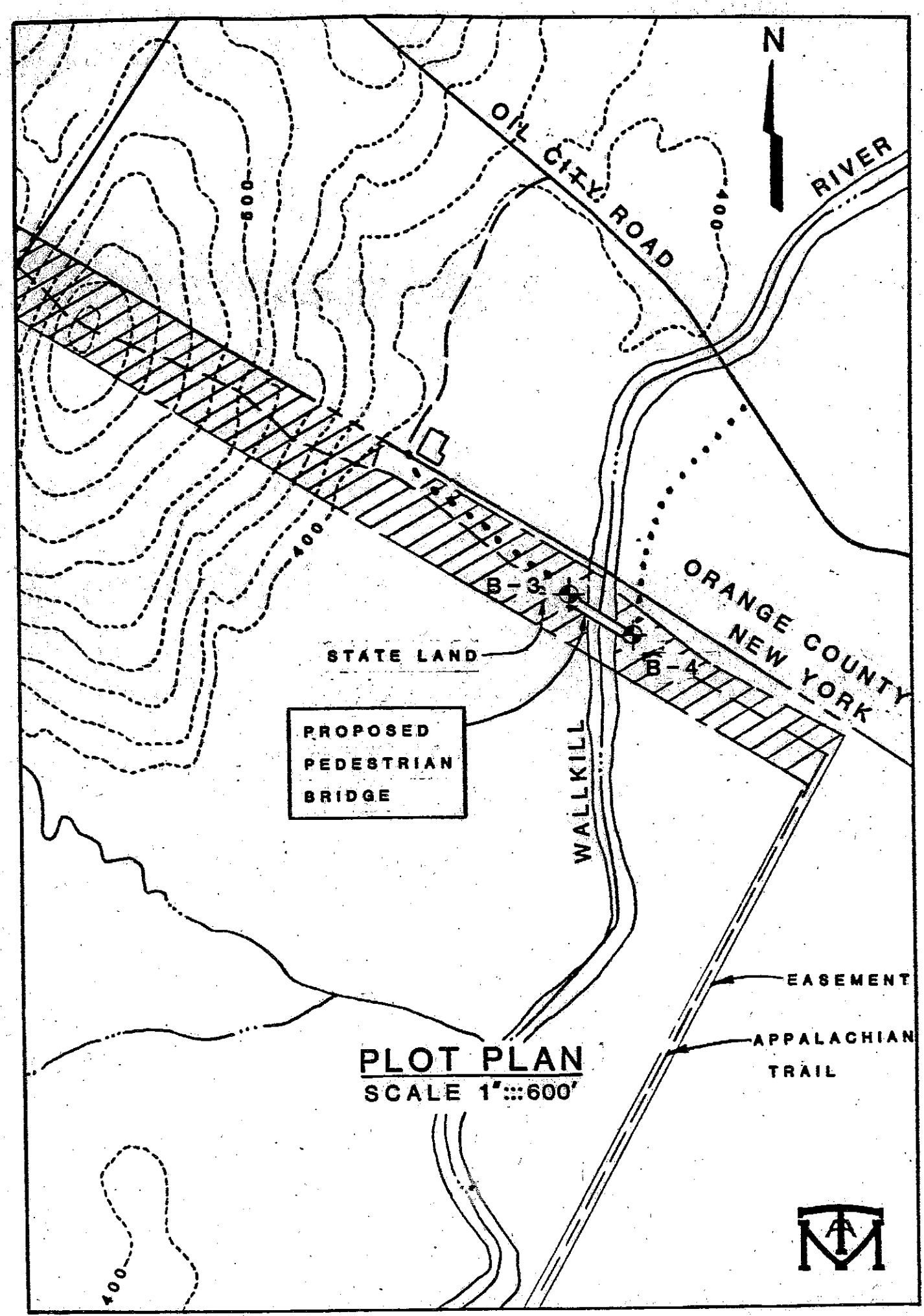
PLOT PLAN

SCALE 1"=600'

REVISIONS
BY _____ DATE _____

BY DEM DATE 11/27/84
CHECKED BY TEH FILE _____

PLATE 1A



REVISIONS
BY _____ DATE _____

FILE _____

BY D.E.M. DATE 11/27/84
CHECKED BY T.E.H.

PLATE 1B

LOG OF BORING

BORING NO. B-1

SURFACE ELEV. +393 ft.(±)(Site Datumn)

WATER DEPTH	4'-11"	
TIME		
DATE	8/9/84	

DEPTH (FEET)	SAMPLES	STANDARD PENETRATION RESISTANCE	SYMBOL	DESCRIPTION
0		3		Topsoil - Brown organic silt, with roots
		5	ML	Mottled gray and brown clayey silt, (medium)
5		14		-grading gray (very stiff) @ 4'-0"
		12		
		7	OL	Dark gray organic silt, and fine to medium sand (medium)
10				
		14	SM	Gray fine to medium sand, little silt (medium dense)
15				
		21		
20				
25				BORING COMPLETED @ 20'-0" ON 8/9/84
30				
35				GENERAL BORING NOTES:
40				1) WOH - indicates that sampler was advanced under the weight of the 140 pound hammer
				2) "REC" - indicates the length of rock core recovered as a percentage of the total length of core run "RQD" - indicates the rock quality designation, which is a modified recovery that only considers pieces of core greater than four inches in length

PLATE 2A

LOG OF BORING

BORING NO. B-2
SURFACE ELEV. +394 ft (±) (Site Datumn)

WATER DEPTH	4'-11"	
TIME		
DATE	8/9/84	

DEPTH (FEET)	SAMPLES	STANDARD PENETRATION RESISTANCE	SYMBOL	DESCRIPTION
0		4		Topsoil - Brown organic silt ,with roots
		7	ML	Mottled gray and brown clayey silt, trace fine sand (medium)
5		10		-grading (stiff) @ 4'-0"
		12		-grading gray in color @ 6'-0"
10		6	OH	Dark brown organic silt, trace fine sand (soft)
		20	SM	Gray fine to medium sand, little silt (medium dense)
15				
		11		
20				BORING COMPLETED @ 20'-0" ON 8/9/84
25				
30				
35				
40				

PLATE 2B

LOG OF BORING

BORING NO. B-3
SURFACE ELEV. +383.5 ft (±) (Site Datumn)

WATER DEPTH	*	
TIME		
DATE		

DEPTH (FEET)	SAMPLES	STANDARD PENETRATION RESISTANCE	SYMBOL	DESCRIPTION
0		3		Topsoil - Dark Brown organic silt ,with roots
		1	OH	Dark Gray organic silt (very soft)
5		WOH		
		WOH		-grading green brown in color
		WOH		
10		WOH		
		WOH		
15				
		8	ML/CL	Interlayered gray clay and silt, trace fine sand, (medium stiff to stiff)
20				
		8		
25				
		7		
30				
		39	SM	Gray fine to medium sand, and clayey silt ,with shale fragments (dense)
35				
		50		
40				BORING COMPLETED @ 40'-0" ON 8/16/84
				* WATER LEVEL NOT RECORDED

(See Notes on Plate 2A)

PLATE 2C

LOG OF BORING

BORING NO. B-4
SURFACE ELEV. +382.5 ft (±) (Site Datumn)

WATER DEPTH	*	
TIME		
DATE		

DEPTH (FEET)	SAMPLES	STANDARD PENETRATION RESISTANCE	SYMBOL	DESCRIPTION
0		2		Topsoil - Brown organic silt ,with roots (soft)
		WOH		
5		WOH	OH	Dark brown organic silt (very soft)
		WOH		
10				
		9	ML/CL	Interlayered gray silt and clay (stiff)
15				-grading (very stiff) @ 18'-0"
		21		
20				
		BX		Refusal to further penetration with casing at 21'-0"
		Core 1		Gray shale bedrock, hard, moderate bedding
25				EX CORE RUN #1 22'-0" - 25'-0"
				"REC" = 78%
				"RQD = 39%
30				
				BORING COMPLETED @ 25'-0" ON 8/17/84
				*WATER LEVEL NOT RECORDED
35				
40				

(See Notes of Plate 2A)

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS — LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

GRADATION *

% FINER BY WEIGHT	
TRACE	0% TO 10%
LITTLE	10% TO 20%
SOME	20% TO 35%
AND	35% TO 50%

COMPACTNESS * SAND AND/OR GRAVEL

	RELATIVE DENSITY
LOOSE	0% TO 40%
MEDIUM DENSE	40% TO 70%
DENSE	70% TO 90%
VERY DENSE	90% TO 100%

CONSISTENCY * CLAY AND/OR SILT

	RANGE OF SHEARING STRENGTH IN POUNDS PER SQUARE FOOT
VERY SOFT	LESS THAN 250
SOFT	250 TO 500
MEDIUM	500 TO 1000
STIFF	1000 TO 2000
VERY STIFF	2000 TO 4000
HARD	GREATER THAN 4000

* VALUES ARE FROM LABORATORY OR FIELD TEST DATA, WHERE APPLICABLE. WHEN NO TESTING WAS PERFORMED, VALUES ARE ESTIMATED.

UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL CLASSIFICATION CHART

PLATE 2