GEOTECHNICAL ENGINEERING REPORT
U.S. INTERSTATE ROUTE 84 RECONSTRUCTION
BRIDGE NO. 05668, PLANK ROAD OVER MAD RIVER
STATE PROJECT 151-273
WATERBURY, CONNECTICUT

by

Haley & Aldrich, Inc.
East Hartford, Connecticut

for

Berger, Lehman Associates, P.C.
Wethersfield, Connecticut

File No. 91313-100
Revised January 2003

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HALEY & ALDRICH

Revised 28 January 2003
25 January 2001
File 91313-100

Berger, Lehman Associates, P.C.
20-30 Beaver Road
Wethersfield, Connecticut 06109

Attention: Thomas J. Bulzak, P.E.

Subject: U.S. Interstate Route 84 Reconstruction
Bridge No. 05668, Plank Road over Mad River
State Project 151-273
Waterbury, Connecticut

Ladies and Gentlemen:

This report presents our evaluation of subsurface conditions and geotechnical engineering recommendations for Bridge No. 05668, Plank Road over Mad River for the I-84 Reconstruction Project. This work was conducted in accordance with our agreement dated 26 December 2000.

In summary, subsurface conditions consist of fill and glaciofluvial deposits overlying bedrock. Bridge No. 05668 will be located about 2 m west of an existing bridge over the Mad River (which will be demolished), and will consist of three reinforced concrete box culverts, with wingwalls extending beyond the upstream and downstream ends of Bridge No. 05668 on each side. We recommend that box culverts be designed to bear on a layer of granular fill, or on crushed stone or placed over undisturbed natural soils or existing fill. The wingwalls should be supported on spread footings. Our detailed recommendations follow.

PROPOSED CONSTRUCTION

Bridge No. 05668 (formerly referred to as Structure No. 8), Plank Road over Mad River, will be located between the existing Plank Road Bridge over Mad River and the intersection of Brookdale Road and Plank Road, in Waterbury, Connecticut. See Figure 1, Project Locus. Relocation of the Mad River requires that the existing bridge be removed, and a new bridge constructed over the relocated river. The east abutment of structure 8 will be about 2 m west of the west abutment for the existing bridge, as shown on Figure 2.

Bridge No. 05668 consists of three side-by-side reinforced concrete box culverts, two 4000-

mm wide by 2100-mm deep, and one 4000-mm wide by 2900-mm deep with an 800-mm thick layer of riprap at the bottom. Wingwalls 6 to 13.07 m long will extend beyond the ends of the structure.

Two of the box culverts will bear at EL. 111.9 and the third at EL. 111.0. Wingwalls will bear at EL. 110.5 on the west side and EL. 109.7 on the east side. Plank Road pavement grade will be approximately El. 115.1. Elevations in this report are in meters and refer to NGVD 29.

Plank Road will be closed during construction of Bridge No. 05668. Therefore no construction staging will be required.

SITE CONDITIONS

The existing Plank Road Bridge was reconstructed in 1987, and consists of a single span bridge, 13.56-m long, supported on two abutments, with precast concrete deck units. The bridge carries three lanes of traffic and a pedestrian walkway over the Mad River. Wingwalls extend upstream and downstream of the bridge on each side of the river. Abutments and wingwalls are supported on spread footing foundations that bear at EL. 110.64. Riprap slope protection is present at ground surface between the river and the wingwalls.

Utilities that cross the site include a 21-in. dia. RCP storm drain that discharges into the Mad River, a gas pipe line that follows Plank Road, and two sanitary sewers. Utilities will be relocated as part of construction.

The site is relatively flat with a gentle slope down to the Mad River to the east and a low lying area to the south. Normal water level within the Mad River is about EL. 113.2; the 100-yr. flood level is El. 115.2.

SUBSURFACE INVESTIGATIONS

Recent Explorations

Four borings (S8-1 through S8-4) were drilled by General Borings, Inc. of Prospect, Connecticut, between 21 and 28 November 2000. The test borings were drilled with 76 mm I.D. casing to depths ranging from 19.8 m to 22.9 m and included 3.1 m of rock coring. Bedrock was cored at each boring with a 55-mm I.D. NX core barrel. Standard Penetration Tests were conducted at maximum 1.5-m intervals in the overburden soil.

The boring locations are shown on Figure 2, and test boring logs are presented in Appendix A. As drilled locations and elevations were surveyed by A-I Engineering of Middletown, Connecticut.

Previous Explorations

There are no previous subsurface explorations.

SUBSURFACE CONDITIONS

Subsurface conditions present in the borings consist of fill and glaciofluvial deposits overlying bedrock. Soil strata are described below, in order of increasing depth. A subsurface profile is shown on Figure 3. Subsurface conditions are summarized on Table I.

Thickness (m)	Generalized Description
2.5 to 3.1	**Fill** – Medium dense to dense, dark brown and brown, coarse to fine SAND, little to some gravel, trace silt with cobbles and occasional pieces of asphalt, brick and roots.
13.8 to 16.0	**Glaciofluvial Deposits** – Descriptions vary to a dense to very dense, brown, SAND and GRAVEL, trace silt, with cobbles and boulders; to a SAND, trace gravel and silt, with cobbles and boulders.

Bedrock – Bedrock is described as hard, fresh, GNEISS, and is part of the Waterbury Gneiss formation. Bedrock in recent borings is between EL. 95.3 and EL. 98.6. Elevations of the top of rock are listed in Table I, and the bedrock surface is shown on the subsurface profiles.

Groundwater Conditions

Water was measured in borings between EL. 111.3 and EL. 112.7. However, these levels were measured immediately after drilling, and may not represent stabilized groundwater. Groundwater levels will be controlled by water levels in the nearby Mad River. Groundwater will also fluctuate with season, precipitation and nearby construction activity.

Laboratory Testing

Three grain size analyses (ASTM D422) were performed on representative soil samples to confirm visual classification and to aid in determining engineering properties. Laboratory test results are included in Appendix C.

GEOTECHNICAL ENGINEERING RECOMMENDATIONS

Foundation Type

The existing fill consists of medium dense to very dense sand and gravel. The fill and underlying glaciofluvial sand and gravel are suitable for support of the box culverts. We recommend that the culverts be supported on a 300 mm thick layer of granular fill, or on crushed stone (Form 815 M.01.01, No.6) placed on geotextile above undisturbed glaciofluvial deposits or existing fill. The wingwalls, which have a lower bearing elevation than the box culverts, should be supported on spread footings bearing on a 300-mm thick layer of granular fill, or on crushed stone placed on geotextile over undisturbed glaciofluvial deposits.

Foundation Design Criteria

Design foundations using the following criteria:

- Design box culverts to bear on fill or glaciofluvial deposits at an ultimate bearing pressure of 600 kPa. Design wingwall footings bearing on glaciofluvial deposits for an ultimate bearing pressure of 900 kPa, and a resistance factor of 0.45.

- Design foundations to bear a minimum of 1.2 m below proposed exterior grade, for frost protection. Bearing elevations should consider protection against scour.

- We estimate total settlement will be less than 25 mm, with differential settlements less than 12 mm. Settlement will occur as load is applied.

- Design the culvert for loading in accordance with AASHTO LRFD Specifications for Highway Bridges, Sections 3 and 12. Design box culverts for lateral earth pressures based on an equivalent fluid unit weight of soil equal to 8.7 kN/m^3 (55 pcf), which assumes an at-rest coefficient of earth pressure of 0.45. Include the lateral component of the vertical surcharge pressure due to traffic or vehicle loading. Multiplying the vertical surcharge pressure at the top of the box culvert by 0.45 and apply as a uniform lateral pressure distribution.

<u>Box Culvert</u>

Bearing elevations for the box culverts are El 111.0 and El. 111.9. Borings indicate that the bottom of fill (top of glaciofluvial deposits) is between EL. 111.3 and EL. 112.4, 1.4 m above to 0.6 m below culvert subgrade level. Therefore, box culverts will bear on both fill and glaciofluvial deposits. An ultimate bearing pressure of 600 kPa is recommended.

Wingwalls

Bearing elevations for wingwalls are El 109.7 and El. 110.5, 0.8 m to 2.7 m below the top of glaciofluvial deposits. Therefore, wingwalls will bear on glaciofluvial deposits. An ultimate bearing pressure of 900 kPa is recommended.

Lateral Earth Pressures

Wingwalls should be designed for active earth pressure and traffic surcharge pressures as shown on Figure 4. Sliding and overturning criteria are also provided on that figure.

Seismic Design

Soils conditions at the site are defined as AASHTO Soil Profile Type I. The soils at the site are not considered to be liquefaction susceptible under the design earthquake event, and seismically induced settlement should not be significant. Based on the Bridge Design Manual, single span bridges and buried structures do not need to be designed for seismic loads.

Structure Backfill and Drainage

Pervious structure backfill should be placed behind the wingwalls above a line defined by a 1V:1.5H slope extending up from the heel of the footing and extending to the top of the culvert. Pervious structure backfill should meet the requirements of CONNDOT Form 815 M.02.05.

We recommend the wingwalls and the outer walls of culverts be drained by 100 mm dia. weep holes installed according to CONNDOT specifications. Maximum spacing between weep holes should be
3 m.

Reuse of Excavated Soils

The existing soils to be excavated consist of fill and glaciofluvial deposits. Based on the results of the sieve analyses, soils do not meet gradation requirements for pervious structure backfill or granular fill. Excavated soils will generally be suitable for embankment fill.

CONSTRUCTION CONSIDERATIONS

This section provides comments related to foundation construction and other geotechnical aspects of the project. It will aid those responsible for preparation of contract plans and specifications and those involved with construction monitoring. Contractors should evaluate potential construction problems on the basis of their own knowledge and experience in the

area and on the basis of similar localities, taking into account their own proposed equipment, construction methods and procedures.

Excavation and Temporary Lateral Support

Temporary excavations up to about 5.6 m high will be required to construct culverts and wingwalls. Sloped open-cut excavations may be feasible above groundwater since Plank Road will be closed and construction staging is not required. However, temporary lateral support will be required for the portion of excavations below groundwater, where there is insufficient space for an open cut, and to protect existing utilities that must remain in service during construction. Steel sheet piling is expected to be the preferred temporary lateral support system because it will block water flow into the excavation more efficiently than solder piles and lagging. However, cobbles and boulders in the overburden could hinder installation of sheets, resulting in gaps in the wall. Depending on the quantity of flow into the excavation, an additional line of sheet piling in localized areas might be effective in reducing flow.

Soldier piles and lagging may be feasible for portions of the excavation above groundwater, although pre-excavation or rotary drilling may be required at some locations to penetrate boulders.

Excavations will be in fill and glaciofluvial deposits. Conventional heavy construction equipment appears practical for excavation of overburden soils. However, chiseling or mechanical splitting maybe necessary for removal of boulders.

Excavation geometry should conform to OSHA excavation regulations contained in 29 CFR Part 1926, latest edition. Temporary soil slopes above groundwater of 1V:1H (Soil Profile Type B), or flatter, appear appropriate but should be confirmed during construction based on conditions at the time of excavation.

Cofferdam and Dewatering

Water levels measured in recent borings were between EL. 111.3 and 112.7, 1.7 m above to 0.6 m below culvert subgrade, and 0.8 m to 3.0 m above wingwall footing subgrade. Therefore, cofferdam and dewatering will be required. The fill and glaciofluvial deposits are very pervious, and excavation dewatering quantities could be significant. We anticipate that a sheetpile cofferdam, combined with pumping from wells inside the excavation, will be necessary for dewatering. Crushed stone and geotextile fabric placed over the exposed subgrade should facilitate excavation dewatering and help maintain a stable subgrade.

CLOSURE

This report has been prepared for specific application to the I-84 Reconstruction project, as understood at this time, in accordance with generally accepted geotechnical engineering practice. In the event that changes in the nature, design or location of the project elements are planned, the conclusions and recommendations contained in this report should not be considered valid, unless the changes are reviewed by Haley & Aldrich, Inc. and the conclusions of this report modified or verified in writing.

The analyses and recommendations are based, in part, upon the data obtained from the referenced subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations then appear, it may be necessary to reevaluate the recommendations of this report.

We appreciate the opportunity to provide engineering services on this project. Please do not hesitate to call if you have any questions or comments.

Sincerely yours,
HALEY & ALDRICH, INC.

Kurtis E. Amidon
Engineer

Nathan L. Whetten, P.E., C.G.
Senior Engineer

John P. Dugan, Jr., P.E.
Senior Vice President

Enclosures:

Attachments:
Table I - Summary of Subsurface Data
Figure 1 - Project Locus
Figure 2 – Subsurface Exploration Plan
Figure 3 – Subsurface Profile
Figure 4 – Recommended Lateral Loads on Unrestrained Wingwalls
Appendix A – Recent Test Borings Logs
Appendix B – Results of Laboratory Testing

TABLE I
SUMMARY OF SUBSURFACE DATA
BRIDGE NO. 05668, PLANK ROAD OVER MAD RIVER
U.S. INTERSTATE ROUTE 84 RECONSTRUCTION
STATE PROJECT NO. 151-273
WATERBURY, CONNECTICUT

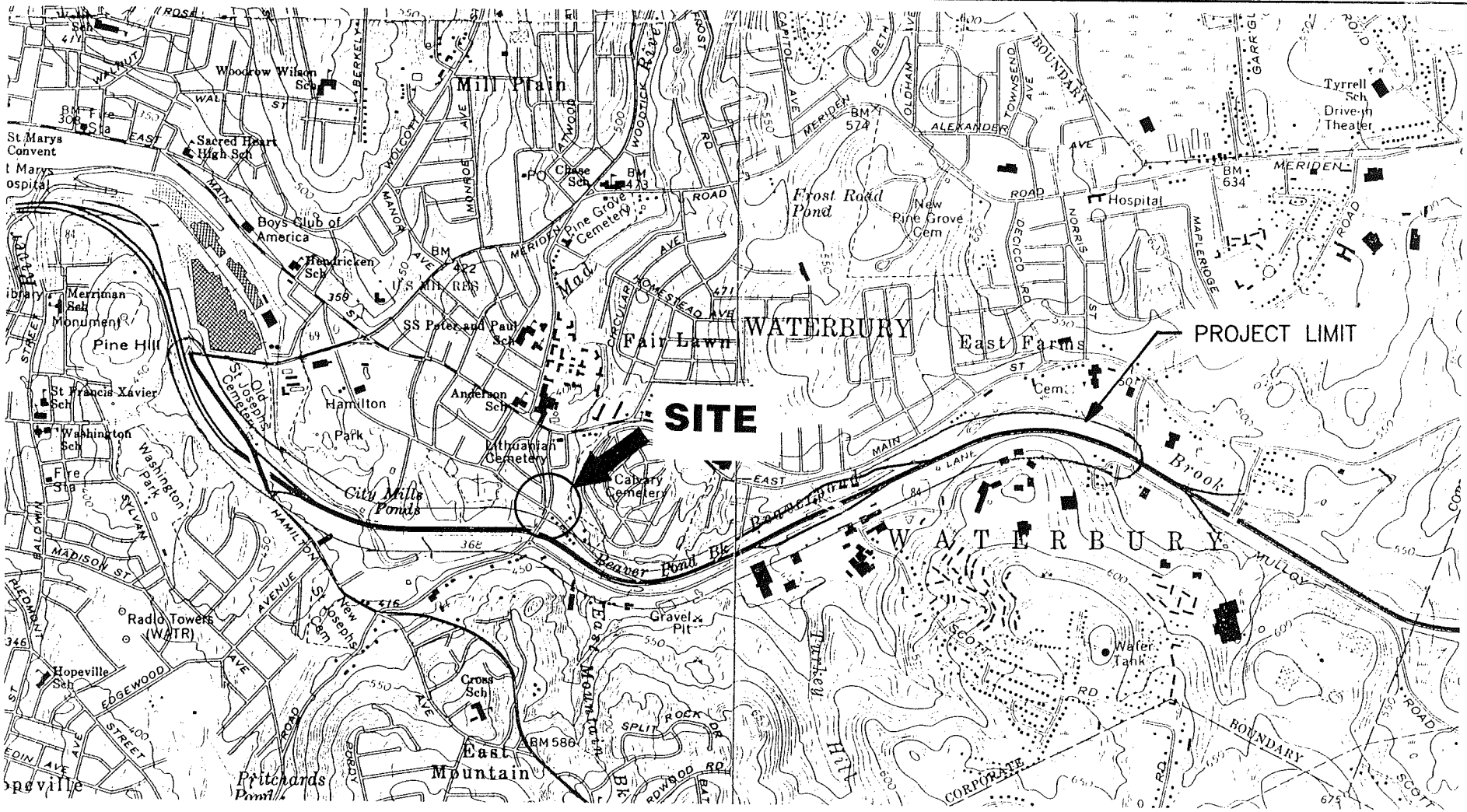
EXPLOR. NUMBER	ELEV. (m)	DEPTH (m)	THICKNESS OF SOIL STRATA (m)		BEDROCK LEVEL (m)		WATER LEVEL (m)	
			FILL	GLACIO FLUVIAL	DEPTH	ELEV.	DEPTH	ELEV.
Recent								
S8-1	115.03	21.34	3.05	14.78	17.83	97.20	2.29	112.74
S8-2	114.88	19.81	2.50	13.81	16.31	98.57	3.05	111.83
S8-3	114.79	21.95	3.05	15.24	18.29	96.50	2.60	112.19
S8-4	114.31	22.86	3.05	16.00	19.05	95.26	3.05	111.26

NOTES:

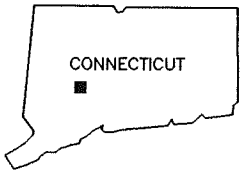
Haley & Aldrich, Inc.

1. Elevations are in meters and refer to the NGVD 29.
2. Refer to boring logs for detailed soil and rock descriptions.
3. Water levels were measured shortly after drilling and may not represent stabilized groundwater.

91313-100 A01



SITE COORDINATES: 041°32'26.09"N 073°00'33.57"W



U.S.G.S. QUADRANGLES: WATERBURY & SOUTHINGTON, CONNECTICUT

HALLEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

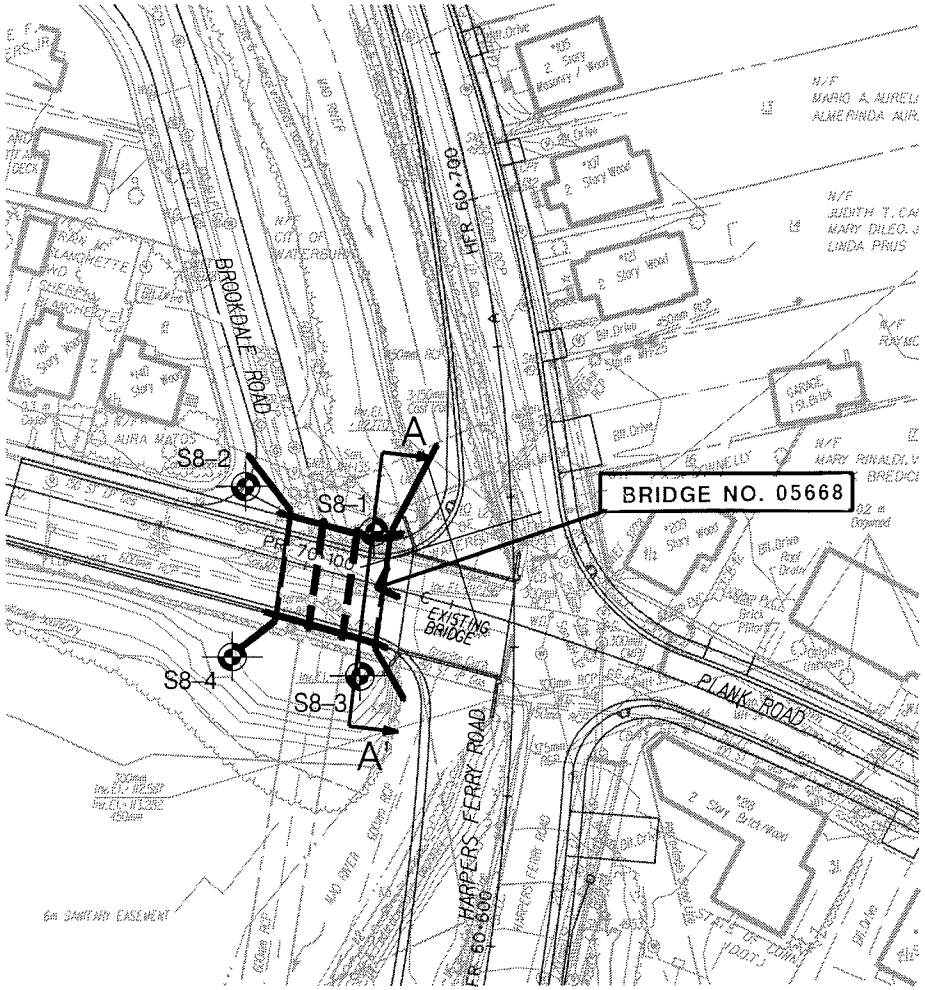
U.S. INTERSTATE 84 RECONSTRUCTION
STATE PROJECT NO. 151-273
WATERBURY, CONNECTICUT

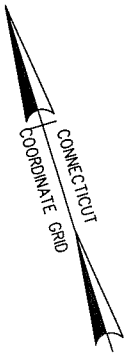
PROJECT LOCUS
BRIDGE NO. 05668
PLANK ROAD OVER MAD RIVER

SCALE: 1:24,000

JANUARY 2001

FIGURE 1





A'
A

LOCATION OF CROSS-SECTION
(SEE FIGURE 3)

PLAN LEGEND

LOCATION OF RECENT TEST BORING DRILLED BY GENERAL BORINGS, INC. OF PROSPECT, CONNECTICUT.

LOCATION OF PREVIOUS TEST BORING

NOTES:

1. BASE PLAN PROVIDED BY BERGER, LEHMAN ASSOCIATES. BORING LOCATIONS WERE SURVEYED BY A-I ENGINEERS.
2. ELEVATIONS ARE IN METERS, REFER TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929.
3. REFER TO THE TEXT AND APPENDICES.

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U.S. INTERSTATE ROUTE 84 RECONSTRUCTION
STATE PROJECT NO. 151-273
WATERBURY, CONNECTICUT

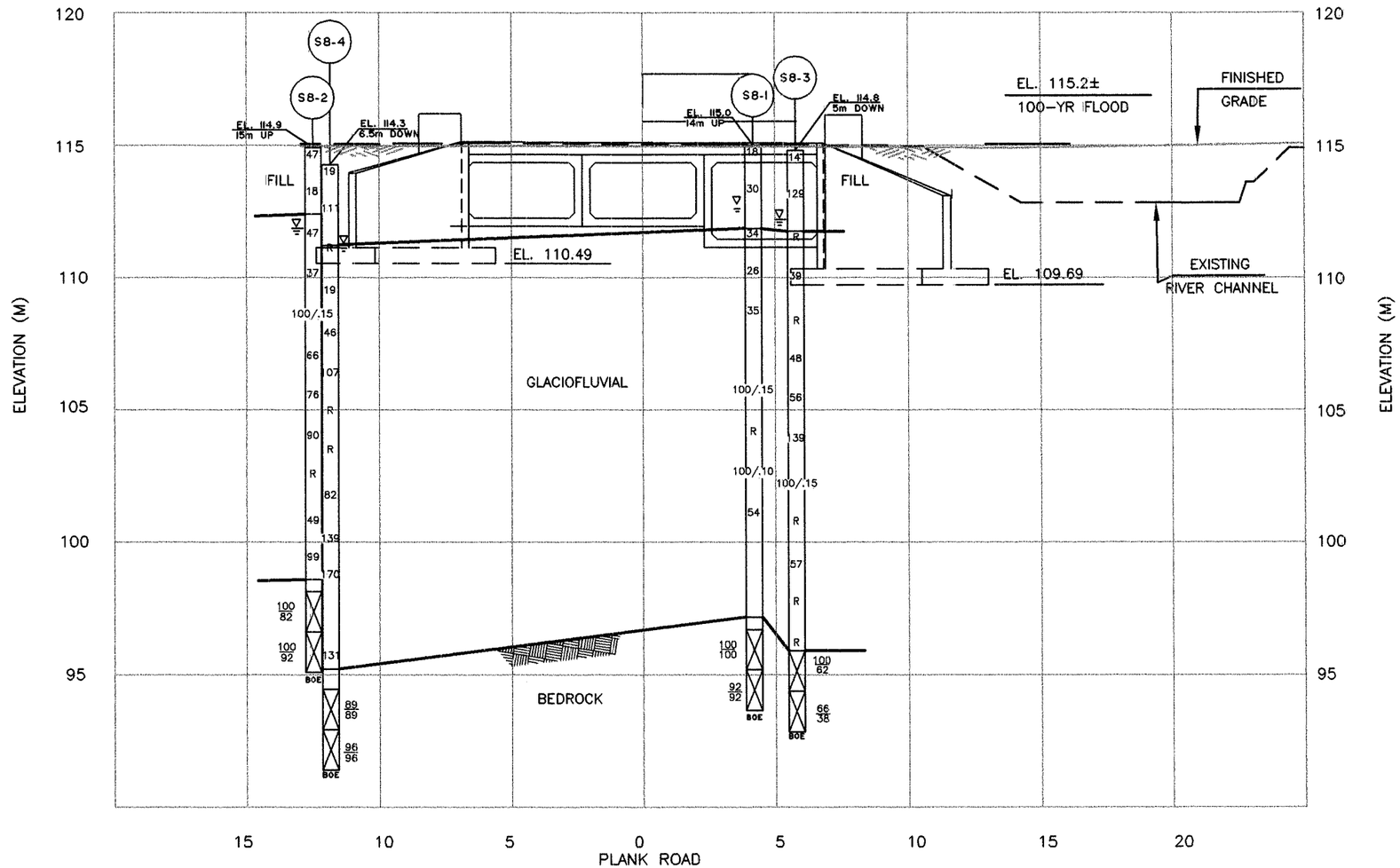
PLANK ROAD OVER MAD RIVER
BRIDGE NO. 05668

SCALE: 1:1000

JANUARY 2001

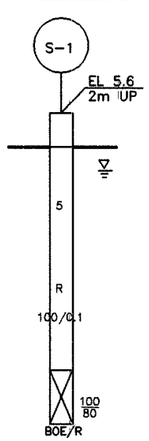
91313-100

FIGURE 2



BOX CULVERT
(LOOKING SOUTH)

LEGEND:



- EL 5.6 / 2m UP — APPROXIMATE GROUND SURFACE ELEVATION / OFFSET DISTANCE AND DIRECTION ALONG BASELINE
- MAJOR STRATUM BOUNDARY
- WATER LEVEL NOTED DURING OR SHORTLY AFTER DRILLING.
- 5 — LOCATION OF SAMPLE OBTAINED BY DRIVING A 50 mm O.D. SPLIT-SPOON SAMPLER WITH A 63.5 kg WEIGHT FALLING 762 mm. NUMBER INDICATES STANDARD PENETRATION RESISTANCE "N" VALUE, IN BLOWS PER 0.30 m.
- R — INDICATES SPLIT SPOON REFUSAL
- 100/0.1 — SAMPLER DRIVEN <0.30 m, FRACTION INDICATES: NUMBER BLOWS TO DRIVE SAMPLER / DEPTH SAMPLER WAS DRIVEN (m)
- 100/80 — CORE SAMPLE, 50 mm DIA., FRACTION INDICATES: % CORE RECOVERY / ROCK QUALITY DESIGNATION (%RQD)
- BOE/R — BOTTOM OF EXPLORATION/REFUSAL

NOTES:

1. SEE FIGURE 2, SUBSURFACE EXPLORATION PLAN, FOR TEST BORING AND FOUNDATION LOCATIONS.
2. FOR DETAILED DESCRIPTION OF SUBSURFACE MATERIAL REFER TO TEST BORING LOGS CONTAINED IN APPENDIX A AND B OF THIS REPORT.
3. LINES REPRESENTING CHANGES IN STRATA ARE BASED UPON INTERPOLATION BETWEEN SUBSURFACE EXPLORATIONS AND MAY NOT REPRESENT ACTUAL FIELD CONDITIONS AT OTHER THAN SPECIFIED EXPLORATION LOCATIONS.
4. THE STRATIFICATION LINES SHOWN ON THE GRAPHIC REPRESENTATION OF THE TEST BORINGS REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES. THE TRANSITION BETWEEN MATERIALS IS APPROXIMATE.

0 5 10
SCALE IN METERS

HALEY & ALDRICH
UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

U.S. INTERSTATE ROUTE 84 RECONSTRUCTION
STATE PROJECT NO. 151-273
WATERBURY, CONNECTICUT

SUBSURFACE PROFILE

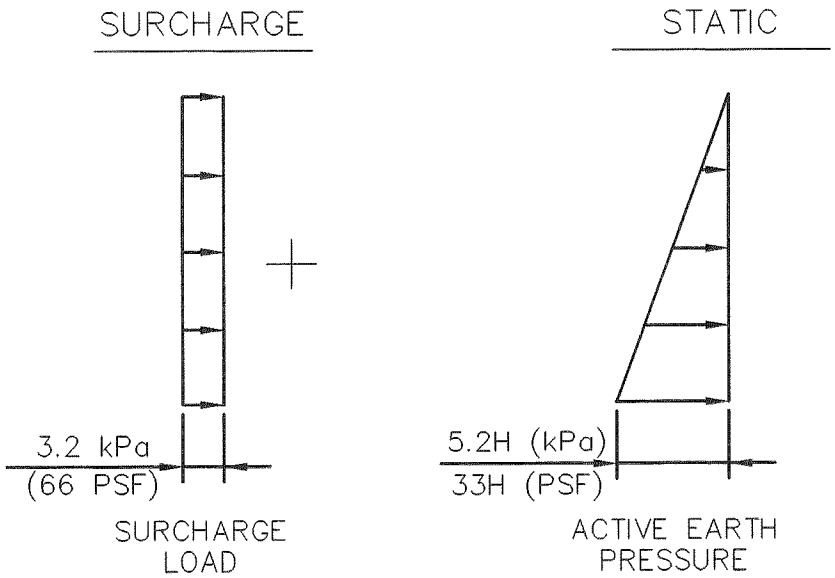
BRIDGE NO. 05668
PLANK ROAD OVER MAD RIVER

SCALE: AS SHOWN JANUARY 2001

91313-100 B1

FIGURE 3

91313-100 A05



NOTES:

1. H IS IN METERS FOR S.I. CALCULATIONS AND FT. FOR ENGLISH CALCULATIONS.
2. THE WALL SHOULD BE DRAINED BY PERVIOUS STRUCTURE BACKFILL AND A STRUCTURE UNDERDRAIN OR WEEPHOLES, THEREFORE A HYDROSTATIC PRESSURE DIAGRAM IS OMITTED FROM THIS FIGURE.
3. THESE PRESSURE DISTRIBUTIONS ASSUME HORIZONTAL BACKFILL BEHIND THE WALL.
4. SLIDING:
   COEFF. OF FRICTION BETWEEN FOOTING AND BASE = 0.60
   RESISTANCE FACTOR = 0.80
5. STABILITY:
   RESISTANCE FACTOR = 0.65
6. IGNORE PASSIVE RESISTANCE IN FRONT OF FOOTING.

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UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

U.S. ROUTE INTERSTATE 84 RECONSTRUCTION
STATE PROJECT NO. 151-273
WATERBURY, CONNECTICUT

RECOMMENDED LATERAL LOADS ON UNRESTRAINED WINGWALLS

NOT TO SCALE

JANUARY 2001

FIGURE 4

APPENDIX A

Recent Test Borings Logs

J. Muccino	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **S8-1**
DRILLER	STATE OF CONNECTICUT	Line & Station
P. Carrera	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Waterbury, Connecticut**	N. Coordinate **231003.98**
Haley & Aldrich, Inc.	PROJECT NAME: **Reconstruction of I-84**	E. Coordinate **283190.67**
SOILS ENGINEER	PROJECT NUMBER: **State: 151-273/H&A: 91313-100**	**Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: **115.03**	Utilized		X						X					X
Date Started: **28 November 2000**	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Date Finished:	Size I.D. (mm)	60	76	100	64				35	X	35	35	55	55
Groundwater Observations	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ **2.29** m after **0** days	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	
@ m after days														

DEPTH	Casing blows per half meter	SAMPLE DEPTH IN METERS FROM - TO	NO.	PEN. m	REC m	Type	BLOWS PER 0.15 METERS ON SAMPLER 0-0.15	0.15-0.30	0.30-0.45	0.45-0.60	STRATA CHANGE ELEV./DEPTH (m)	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.00-0.61	1	0.61	0.25	D	10	11	7	15		Medium dense red brown coarse to fine SAND, little medium to fine gravel, trace silt
		1.52-2.13	2	0.61	0.25	D	16	19	11	11		Dense brown coarse to fine SAND and GRAVEL, trace silt, brick and asphalt fragments -FILL-
											111.98	
		3.05-3.66	3	0.61	0.41	D	11	19	15	12	3.05	Dense brown coarse to fine GRAVEL, some coarse to fine sand, little silt
5		4.57-5.18	4	0.61	0.36	D	10	10	16	24		Medium dense brown coarse to fine SAND, some medium to fine gravel
		6.10-6.71	5	0.61	0.30	D	15	19	16	21		Dense brown coarse to fine SAND, little medium to fine gravel, trace silt
												Boulder 7.32 m. to 7.92 m.
10		9.14-9.44	6	0.30	0.20	D	31	100				Very dense brown, medium to fine GRAVEL, little coarse to fine sand, trace silt
		10.67-10.82	7	0.15	0.15	D	100					Very dense gray brown coarse to fine GRAVEL, little coarse to fine sand, trace silt
		12.19-12.44	8	0.25	0.25	D	30	100/.10				Very dense brown coarse to fine SAND and medium to fine gravel, trace silt
15		13.72-14.33	9	0.61	0.15	D	27	23	31	32		Very dense brown fine SAND, trace coarse sand, trace silt

Casing Size	From	To	Meters of Earth	Rock
NW	**0.0**	**18.3**	**17.83** m	**3.51** m
			No. of Samples	
			11D,2C	

NOTES: **Truck mounted Mobile Drill B-53 with wire winch to drive safety hammer. Borehole backfilled with drill cuttings upon completion**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. **S8-1**
Sheet **1** of **2**

J. Muccino	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **S8-1**
DRILLER	STATE OF CONNECTICUT	Line & Station
P. Carrera	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Waterbury, Connecticut**	N. Coordinate **231003.98**
Haley & Aldrich, Inc.	PROJECT NAME: **Reconstruction of I-84**	E. Coordinate **283190.67**
SOILS ENGINEER	PROJECT NUMBER: **State: 151-273/H&A: 91313-100**	**Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: **115.03**														
Date Started: **28 November 2000**	Utilized		X						X					X
Date Finished:	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Groundwater Observations	Size I.D. (mm)	60	76	100	64				35	X	35	35	55	55
@ **2.29** m after **0** days	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ m after days	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	

DEPTH	Casing blows per half meter	SAMPLE DEPTH IN METERS FROM - TO	NO.	PEN. m	REC m	Type	BLOWS PER 0.15 METERS ON SAMPLER 0-0.15	0.15-0.30	0.30-0.45	0.45-0.60	STRATA CHANGE ELEV./ DEPTH (m)	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		15.24-15.39	10	0.15	0.00	D	100					No recovery - pushing gravel
												Boulder from 16.76 m. to 17.53 m.
		16.76-16.76	11	0.00	0.00	D	100/0					
											97.20	-GLACIOFLUVIAL DEPOSITS-
											17.83	Top of rock at 17.83 m.
		18.29-19.81	1	1.52	1.52	C		[RQD = 100%]				Hard, fresh, gray and white, medium to fine grained BIOTITE GNEISS. Foliation is horizontal to low angle, extremely close. Joints are low angle to moderately dipping, close to wide, rough, planar to undulating, discolored, open to tight.
20		19.81-21.33	2	1.52	1.40	C		[RQD = 92%]				Same as C1, except joints are low angle, undulating
											93.69	-BEDROCK-
											21.34	Bottom of Exploration at 21.34m.
25												
30												

Casing Size	From	To	Meters of Earth	Rock
NW	**0.0**	**18.3**	**17.83** m	**3.51** m
			No. of Samples	
			11D,2C	

NOTES: **Truck mounted Mobile Drill B-53 with wire winch to drive safety hammer. Borehole backfilled with drill cuttings upon completion**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. **S8-1**
Sheet **2** of **2**

J. Muccino	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **S8-2**
DRILLER	STATE OF CONNECTICUT	Line & Station
P. Carrera	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Waterbury, Connecticut**	N. Coordinate **231014.73**
Haley & Aldrich, Inc.	PROJECT NAME: **Reconstruction of I-84**	E. Coordinate **283176.18**
SOILS ENGINEER	PROJECT NUMBER: **State: 151-273/H&A: 91313-100**	**Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: **114.88**														
Date Started: **21 November 2000**	Utilized		X						X					X
Date Finished: **28 November 2000**	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Groundwater Observations	Size I.D. (mm)	60	76	100	64				35	X	35	35	55	55
@ **3.05** m after **0** days	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ m after days	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	

DEPTH	Casing blows per half meter	SAMPLE DEPTH IN METERS FROM - TO	NO.	PEN. m	REC m	Type	BLOWS PER 0.15 METERS ON SAMPLER 0-0.15	0.15-0.30	0.30-0.45	0.45-0.60	STRATA CHANGE ELEV./DEPTH (m)	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.00-0.61	1	0.61	0.23	D	6	18	29	43	114.27 / 0.61	Dense brown coarse to fine SAND, some medium to fine gravel
		1.52-2.13	2	0.61	0.48	D	7	9	9	13	112.38 / 2.50	Medium dense brown coarse to fine SAND and fine GRAVEL with cobbles -FILL-
		3.05-3.66	3	0.61	0.38	D	19	21	26	29	110.88 / 4.00	Dense brown coarse to fine SAND, trace silt, fine gravel with cobbles
5		4.57-5.18	4	0.61	0.43	D	8	16	21	15	108.88 / 6.00	Dense brown fine SAND, little coarse sand, trace fine gravel
		6.10-6.40	5	0.30	0.30	D	48	100				Very dense brown coarse to fine SAND and coarse to fine gravel with cobbles
		7.62-8.23	6	0.61	0.20	D	14	27	39	44		Very dense brown coarse to fine SAND, little medium to fine gravel, trace silt with boulder
10		9.14-9.75	7	0.61	0.28	D	36	39	37	49		Very dense brown coarse to fine SAND, little fine gravel -GLACIOFLUVIAL DEPOSIT-
		10.67-11.28	8	0.61	0.28	D	26	51	39	50		Very dense brown medium to fine GRAVEL and sand, trace silt Boulder from 10.06 - 10.36 m
		12.19-12.34	9	0.15	0.00	D	100					No recovery
15		13.72-14.33	10	0.61	0.41	D	26	21	28	23		Dense brown coarse to fine SAND, trace fine gravel

Casing Size	From	To	Meters of Earth	Rock
NW	**0.0**	**16.8**	**16.31** m	**3.50** m
			No. of Samples	
			11D, 2C	

NOTES: **Truck mounted Mobile Drill B-53 with wire winch to drive safety hammer. Borehole backfilled with drill cuttings upon completion.**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. **S8-2**
Sheet **1** of **2**

J. Muccino	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **S8-2**
DRILLER	STATE OF CONNECTICUT	Line & Station
P. Carrera	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Waterbury, Connecticut**	N. Coordinate **231014.73**
Haley & Aldrich, Inc.	PROJECT NAME: **Reconstruction of I-84**	E. Coordinate **283176.18**
SOILS ENGINEER	PROJECT NUMBER: **State: 151-273/H&A: 91313-100**	**Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: **114.88**	Utilized		X						X					X
Date Started: **21 November 2000**	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Date Finished: **28 November 2000**	Size I.D. (mm)	60	76	100	64				35	X	35	35	55	55
Groundwater Observations	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ **3.05** m after **0** days	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	
@ m after days														

DEPTH	Casing blows per half meter	SAMPLE DEPTH IN METERS FROM - TO	NO.	PEN. m	REC m	Type	BLOWS PER 0.15 METERS ON SAMPLER 0-0.15	0.15-0.30	0.30-0.45	0.45-0.60	STRATA CHANGE ELEV./DEPTH (m)	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		15.24-15.74	11	0.50	0.30	D	23	43	56	50/.05	98.57	Very dense brown coarse to fine SAND -GLACIOFLUVIAL DEPOSIT-
		16.76-18.28	1	1.52	1.52	C		[RQD = 82%]			16.31	C1: Hard, fresh, gray and white, medium to fine grained Biotite GNEISS. Foliation is moderately dipping, extremely close. Joints are low angle, very close to moderate, rough, undulating, fresh, open. C2: Same as C1 except joints were close to wide.
		18.28-19.80	2	1.52	1.52	C		[RQD = 92%]			95.07	-BEDROCK-
20											19.81	BOTTOM OF EXPLORATION 19.81 m
25												
30												

Casing Size	From	To	Meters of Earth	Rock
NW	**0.0**	**16.8**	**16.31** m	**3.50** m
			No. of Samples	
			11D, 2C	

NOTES: **Truck mounted Mobile Drill B-53 with wire winch to drive safety hammer. Borehole backfilled with drill cuttings upon completion.**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. **S8-2**
Sheet **2** of **2**

E. Del Priore	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **S8-3**
DRILLER	STATE OF CONNECTICUT	Line & Station
P. Carrera	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Waterbury, Connecticut**	N. Coordinate **230986.11**
Haley & Aldrich, Inc.	PROJECT NAME: **Reconstruction of I-84**	E. Coordinate **283183.26**
SOILS ENGINEER	PROJECT NUMBER: **State: 151-273/H&A: 91313-100**	**Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: **114.79**														
Date Started: **28 November 2000**	Utilized		X						X					X
Date Finished:	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Groundwater Observations	Size I.D. (mm)	60	76	100	64				35	X	35	35	55	55
@ **3.05** m after **0** days	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ **2.60** m after **0** days	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	

DEPTH	Casing blows per half meter	SAMPLE DEPTH IN METERS FROM - TO	NO.	PEN. m	REC m	Type	BLOWS PER 0.15 METERS ON SAMPLER 0-0.15	0.15-0.30	0.30-0.45	0.45-0.60	STRATA CHANGE ELEV./DEPTH (m)	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.00-0.61	1	0.61	0.45	D	15	8	6	6		Medium dense dark brown coarse to fine SAND, some coarse to fine gravel
		1.52-1.97	2	0.45	0.08	D	14	29	100			Very dense dark brown coarse to fine GRAVEL, and coarse to fine SAND
											111.74	-FILL-
		3.05-3.20	3	0.15	0.00	D	100				3.05	No recovery
5		4.57-5.18	4	0.61	0.30	D	11	17	22	25		Dense brown coarse to fine SAND, and fine gravel
		6.10-6.18	5	0.08	0.00	D	100/.08					No recovery boulder to 6.71 m.
		7.62-8.23	6	0.61	0.45	D	15	21	27	35		Dense brown coarse to fine SAND, and gravel, little silt
												Boulder 8.23 m. to 8.99 m.
10		9.14-9.75	7	0.61	0.45	D	19	27	29	33		Dense brown coarse to fine SAND, trace fine gravel, silt
		10.67-11.12	8	0.45	0.30	D	31	39	100			Very dense brown fine SAND, little coarse sand
		12.19-12.49	9	0.30	0.30	D	38	100				Very dense brown fine SAND, coarse sand, fine gravel
		13.72-13.87	10	0.15	0.05	D	125					Very dense brown fine SAND, little gravel, silt
15												

Casing Size	From	To	Meters of Earth	Rock
NW	**0.0**	**18.9**	**18.29** m	**3.68** m
			No. of Samples	
			13D, 2C	

NOTES: **Bomb mounted Diedrich D50 with wire winch to drive safety hammer. Borehole backfilled with drill cuttings upon completion.**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. **S8-3**
Sheet **1** of **2**

E. Del Priore	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **S8-3**
DRILLER	STATE OF CONNECTICUT	Line & Station
P. Carrera	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Waterbury, Connecticut**	N. Coordinate **230986.11**
Haley & Aldrich, Inc.	PROJECT NAME: **Reconstruction of I-84**	E. Coordinate **283183.26**
SOILS ENGINEER	PROJECT NUMBER: **State: 151-273/H&A: 91313-100**	**Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

Surface Elevation: **114.79**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **28 November 2000**	Utilized		X						X					X
Date Finished:	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Groundwater Observations	Size I.D. (mm)	60	76	100	64				35	X	35	35	55	55
@ **3.05** m after **0** days	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ **2.60** m after **0** days	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	

DEPTH	Casing blows per half meter	SAMPLE DEPTH IN METERS FROM - TO	NO.	PEN. m	REC m	Type	BLOWS PER 0.15 METERS ON SAMPLER 0-0.15	0.15-0.30	0.30-0.45	0.45-0.60	STRATA CHANGE ELEV./DEPTH (m)	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		15.24-15.85	11	0.61	0.45	D	15	23	34	57		Very dense light brown fine SAND, trace silt, coarse sand
		16.76-16.91	12	0.15	0.15	D	100					Very dense light brown coarse to fine SAND, trace silt
											96.50	-GLACIOFLUVIAL DEPOSITS-
		18.29-18.29	13	0.00	0.00	D	50/0				18.29	No recovery
		18.90-20.42	1	1.52	1.52	C		[RQD = 62%]				C1: Hard, fresh, gray and white, coarse to fine grained GNEISS. Foliation is high angle, extremely close. Joints are low to high angle, very close to close, rough, undulating, discolored to fresh, open.
20												
		20.42-21.94	2	1.52	1.00	C		[RQD = 38%]				C2: Very hard, fresh, gray and white, coarse to fine grained GNEISS. Foliation is moderately dipping, very to extremely close. Joints are low angle, to moderately dipping, very close to close, rough, undulating, discolored, open.
											92.84	
											21.95	Bottom of Exploration at 21.95 m.
25												
30												

Casing			Meters of	
Size	From	To	Earth	Rock
NW	**0.0**	**18.9**	**18.29** m	**3.68** m
			No. of Samples	
			13D, 2C	

NOTES: **Bomb mounted Diedrich D50 with wire winch to drive safety hammer. Borehole backfilled with drill cuttings upon completion.**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. **S8-3**
Sheet **2** of **2**

E. Del Priore	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **S8-4**
DRILLER	STATE OF CONNECTICUT	Line & Station
P. Carrera	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Waterbury, Connecticut**	N. Coordinate **230993.56**
Haley & Aldrich, Inc.	PROJECT NAME: **Reconstruction of I-84**	E. Coordinate **283167.83**
SOILS ENGINEER	PROJECT NUMBER: **State: 151-273/H&A: 91313-100**	**Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

Surface Elevation: **114.31**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **27 November 2000**	Utilized		X						X					X
Date Finished: **28 November 2000**	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Groundwater Observations	Size I.D. (mm)	60	76	100	64				35	X	35	35	55	55
@ **3.05** m after **0** days	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ m after days	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	

DEPTH	Casing blows per half meter	SAMPLE DEPTH IN METERS FROM - TO	NO.	PEN. m	REC m	Type	BLOWS PER 0.15 METERS ON SAMPLER 0-0.15	0.15-0.30	0.30-0.45	0.45-0.60	STRATA CHANGE ELEV./DEPTH (m)	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.00-0.61	1	0.61	0.15	D	4	8	11	14		Medium dense dark brown coarse to fine SAND, some gravel, asphalt
		1.57-2.02	2	0.45	0.15	D	12	11	100			Very dense brown coarse to fine SAND, trace gravel, trace silt, roots
											111.26	-FILL-
		3.05-3.13	3	0.08	0.00	D	100/.08				3.05	No recovery. Boulder from 3.05 - 3.59 m
5		4.57-5.18	4	0.61	0.30	D	8	10	9	12		Medium dense brown fine SAND, trace silt, coarse sand
		6.10-6.71	5	0.61	0.45	D	17	21	25	32		Dense brown coarse to fine SAND, little medium to fine gravel, trace silt
		7.62-8.23	6	0.61	0.45	D	23	53	54	65		Very dense brown coarse to fine SAND, some medium to fine gravel, trace silt
10		9.14-9.29	7	0.15	0.05	D	100					Very dense brown medium to fine GRAVEL, trace fine sand, silt
		10.67-10.75	8	0.08	0.00	D	100/.08					No recovery. On boulder.
		12.19-12.80	9	0.61	0.10	D	9	21	61	74		Blowing sand at 12.19 washed out Very dense brown coarse to fine SAND
15		13.72-14.17	10	0.45	0.45	D	23	39	100			Very dense light brown coarse to fine SAND, little silt, trace coarse to fine gravel -GLACIOFLUVIAL DEPOSITS-

Casing Size	From	To	Meters of Earth	Rock
NW	**0.0**	**19.1**	**19.05** m	**3.81** m
			No. of Samples	
			13D, 2C	

NOTES: **Bomb mounted Diedrich D10 with wire winch to drive safety hammer. Borehole backfilled with drill cuttings upon completion.**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. **S8-4**
Sheet **1** of **2**

E. Del Priore	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **S8-4**
DRILLER	STATE OF CONNECTICUT	Line & Station
P. Carrera	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Waterbury, Connecticut**	N. Coordinate **230993.56**
Haley & Aldrich, Inc.	PROJECT NAME: **Reconstruction of I-84**	E. Coordinate **283167.83**
SOILS ENGINEER	PROJECT NUMBER: **State: 151-273/H&A: 91313-100**	**Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: **114.31**	Utilized		X						X					X
Date Started: **27 November 2000**	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Date Finished: **28 November 2000**	Size I.D. (mm)	60	76	100	64				35	X	35	35	55	55
Groundwater Observations	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ **3.05** m after **0** days	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	
@ m after days														

DEPTH	Casing blows per half meter	SAMPLE DEPTH IN METERS FROM - TO	NO.	PEN. m	REC m	Type	BLOWS PER 0.15 METERS ON SAMPLER 0-0.15	0.15-0.30	0.30-0.45	0.45-0.60	STRATA CHANGE ELEV./DEPTH (m)	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		15.24-15.69	11	0.45	0.45	D	61	70	100			Very dense light brown interbedded coarse to fine SAND and fine SAND, little silt
		16.76-17.51	12	0.75	0.10	D	100					Very dense brown fine SAND, trace silt, coarse sand
		18.29-18.74	13	0.45	0.30	D	19	31	100			Same as D12 with little medium to fine gravel
											95.26 19.05	-GLACIOFLUVIAL DEPOSITS-
20		19.81-21.33	1	1.52	1.35	C		[RQD = 89%]				C1: Hard, fresh, gray and white, medium to fine grained Biotite GNEISS. Foliation is vertical, extremely close. Joints are moderately dipping, moderate, rough, planar to undulating, fresh to discolored.
		21.34-22.86	2	1.52	1.46	C		[RQD = 96%]				C2: Same as C1 except coarse to fine grained. Foliation is high angle and joints are moderately dipping to low angle.
											91.45 22.86	-BEDROCK-
												BOTTOM OF EXPLORATION 22.86 m
25												
30												

Casing Size	From	To	Meters of Earth	Rock
NW	**0.0**	**19.1**	**19.05** m	**3.81** m
			No. of Samples	
			13D, 2C	

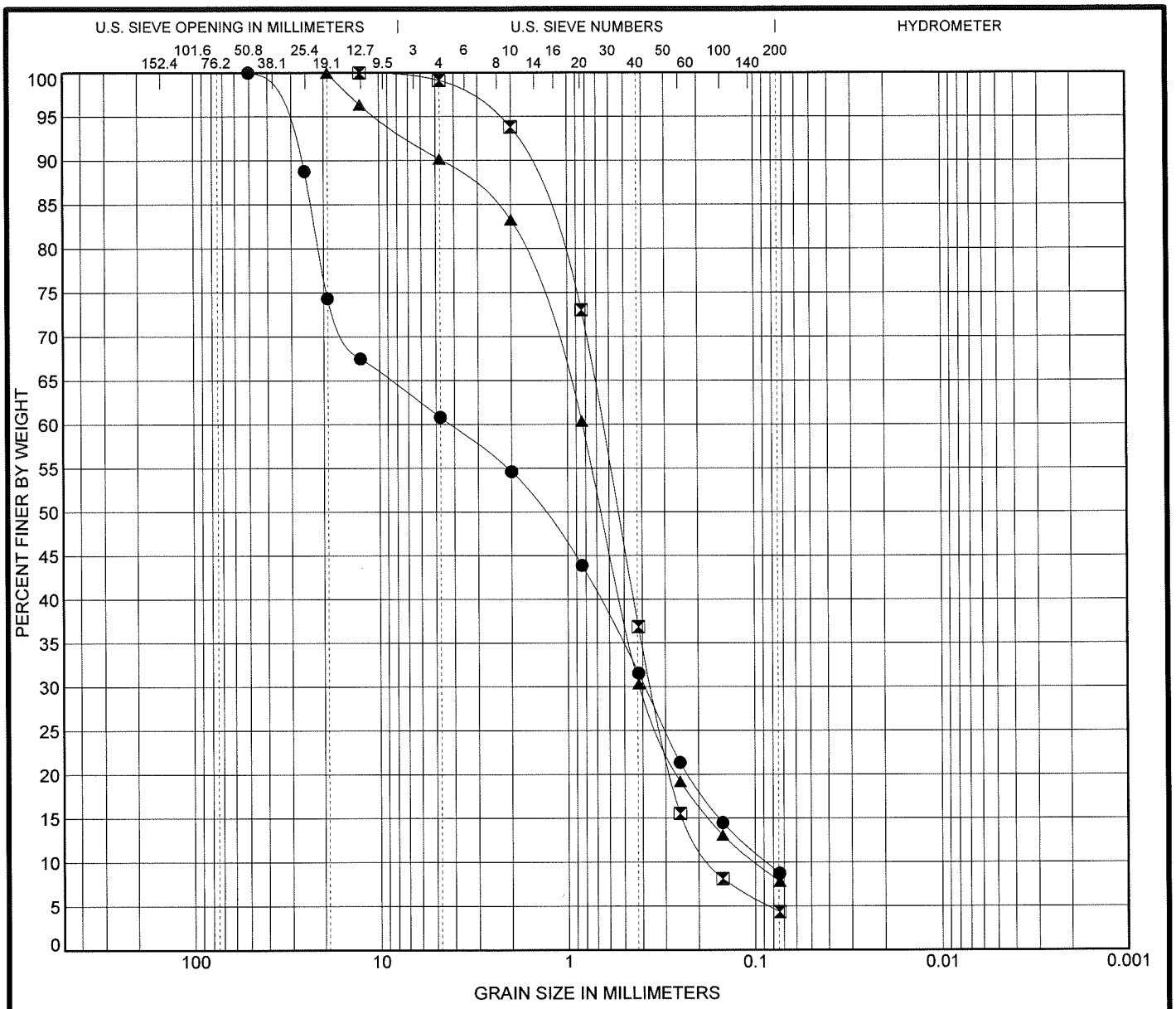
NOTES: **Bomb mounted Diedrich D10 with wire winch to drive safety hammer. Borehole backfilled with drill cuttings upon completion.**

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. **S8-4**
Sheet **2** of **2**

APPENDIX B

Results of Laboratory Testing



	COBBLES	% GRAVEL			% SAND		% FINES	
		COARSE	MEDIUM	FINE	COARSE	FINE	% SILT	% CLAY
●	0.0	11.2	23.3	10.9	23.1	22.8	8.8	
⊠	0.0	0.0	0.3	5.9	57.0	32.5	4.4	
▲	0.0	0.0	5.5	11.3	53.0	22.5	7.8	

	Expl. No.	Sample No.	Depth (m)	LL	PL	PI	Water Content (%)	Cc	Cu
●	S8-1	D2	1.52-2.13				5.8	0.41	49.30
⊠	S8-2	D3	3.05-3.66				21	1.14	3.86
▲	S8-4	D2	1.52-1.97				9.6	2.09	8.43

	Sample Description
●	**Coarse to fine SAND and GRAVEL, trace silt - FILL**
⊠	**Coarse to fine SAND, trace silt, trace gravel - GLACIOFLUVIAL**
▲	**Coarse to fine SAND, trace gravel, trace silt - FILL**

Remarks:

HALEY & ALDRICH
Glastonbury, Connecticut

U.S. Interstate Route 84 Reconstruction
Waterbury, Connecticut
State Project No.: 151-273

GRAIN SIZE DISTRIBUTION

Date: 1/4/2001 File No.: 91313-100

CONN DOT SIEVE 91313SA.GPJ US LAB.GDT 1/26/01