REPORT ON
CULVERT 1227 – I-84 OVER BEAVER POND BROOK
I-84 RECONSTRUCTION, STATE PROJECT 151-273
WATERBURY, CONNECTICUT

by

Haley & Aldrich, Inc.
East Harford, Connecticut

for

Berger, Lehman Associates
Wethersfield, Connecticut

File No. 91313-100
Revised February 2003

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HALEY & ALDRICH

Revised 1 February 2003
15 February 2002
File No. 91313-100

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

Attention: Thomas J. Bulzak, P.E., L.S.
Chief Engineer

Subject: Geotechnical Engineering Recommendations
Culvert 1227, I-84 Over Beaver Pond Brook
I-84 Reconstruction, State Project 151-273
Waterbury, Connecticut

Ladies and Gentlemen:

This report presents our evaluation of subsurface conditions and geotechnical engineering recommendations for Culvert 1227, I-84 Over Beaver Pond Brook, part of the I-84 Reconstruction project in Waterbury, Connecticut. The work was conducted in accordance with our agreement dated 26 December 2000.

In summary, subsurface conditions consist of embankment fill over dense glaciofluvial deposits and bedrock. We recommend box culvert and wingwall foundations bear on a 0.15-m thick layer of crushed stone placed over glaciofluvial deposits or bedrock. Design wingwall foundations as spread footings. Detailed recommendations follow.

PROPOSED CONSTRUCTION

Culvert 1227 is part of the I-84 Reconstruction project in Waterbury, Connecticut (refer to Figure 1, Project Locus). Culvert 1227 will be located at approximately WB Sta. 2+714, as shown on Figure 2, and will carry Beaver Pond Brook beneath the widened I-84 highway embankment.

Culvert 1227 will be approximately 112.7-m long, and will consist of two side-by side box culverts, each 3500 mm wide. One culvert will be 3100 mm high, and the other 4000 mm high with a 900 mm layer of riprap over the invert. The invert (or top of riprap) will slope from El. 114.95 at the inlet to El. 113.0 at the outlet. The inlet headwall will bear at El. 112.5. The outlet headwall will bear at El. 110.1, and wingwalls will step up to El. 115. The culvert is shown in profile on Figure 3.

Normal water depth in Culvert 1227 will be about 0.3 m. The design 100-yr. flood level is El. 118.

Elevations are in meters and refer to NGVD-29.

SITE CONDITIONS

The inlet will be located at the northern edge of Reidville Drive, as shown on Figure 2. The alignment follows Reidville Drive west for about 30 m, crosses Beaver Pond Brook to the existing inlet, and follows the existing culvert alignment beneath I-84 to the outlet. Ground surface on the I-84 and Reidville Drive embankments is level or gently sloping. The Beaver Pond Brook channel has side slopes inclined at 1 vertical to 2 horizontal (1:2), and covered with riprap. Ground surface elevations along the alignment vary from about El. 120 on Reidville Drive to about El. 115 adjacent to Beaver Pond Brook at the outlet.

A 450-mm dia. reinforced concrete pipe (RCP) storm drain crosses the western wingwall alignment at the outlet. A 600-mm RCP sewer line crosses beneath the proposed inlet wingwall, and sewer manholes are located adjacent to the wingwall and inlet headwall. We understand utilities will be rerouted prior to construction. Utilities are shown in plan on Figure 2 and on the layout drawing included in Appendix E.

SUBSURFACE CONDITIONS

Test Borings

General Borings, Inc., Prospect, Connecticut, drilled five test borings along or near the culvert (S1227-1 through S1227-3, R70-OW, and S204-1) in March and April 2001. The borings were drilled to depths ranging from 3.7 to 7.7 m below ground surface. Borings were drilled using hollow-stem augers, and were terminated in dense naturally deposited soils or bedrock. Soil samples were taken at maximum 1.5-m intervals. Additional samples were taken at closer intervals within the fill. Test boring locations are shown on Figure 2, and logs are presented in Appendix A.

A groundwater observation well was installed in boring R70-OW to measure water levels. Groundwater observation well installation details are presented in Appendix B.

Haley & Aldrich monitored the drilling and prepared test boring logs. AI Engineers, Middletown, Connecticut, surveyed boring locations and ground surface elevations.

Previous Test Borings

Two previous test borings, designated 1 and 2, were drilled in 1958 for design of the existing culvert. Borings were drilled to 6.1 m below ground surface, respectively, and terminated in dense naturally deposited soils. Approximate locations are shown on Figure 2, and logs are presented in Appendix C.

Laboratory Testing

Two laboratory gradation analyses were performed on representative samples of the fill and glaciofluvial deposits to aid in classification. Tests were conducted in the Haley & Aldrich laboratory in general accordance with ASTM procedures. Laboratory test results are presented in Appendix D.

Subsurface Conditions

The borings encountered fill, glaciofluvial deposits, and bedrock. Generalized soil descriptions are given below in order of increasing depth below ground surface. A subsurface profile is shown on Figure 3.

Thickness, m	Generalized Description
1.8 to 3.7	**Fill** – Medium dense to dense, coarse to fine SAND, trace to little gravel and silt, trace asphalt, wood, brick, ash, coal, concrete. A 75-mm thick layer of wood was encountered in S1227-2. Bituminous concrete pavement was at ground surface in borings S1227-1 and S1227-3. Odors similar to asphalt and fuel oil were noted in borings S1227-1 and S1227-2. Boulders were not encountered in the fill in borings drilled for Culvert 1227. However, boulders were common in other borings for this project, and are likely to be present within the fill.
1.9 to more than 7.6	**Glaciofluvial Deposits** – Dense to very dense, brown, coarse to fine SAND and GRAVEL, with cobbles and boulders. Boulders were detected in borings S1227-2 and S1227-3.
---	**Bedrock** – Bedrock cored in boring S1227-3 was described as very hard, fresh, pink and white, coarse to fine grained granitic GNEISS, and is part of the Waterbury Gneiss formation.

Groundwater levels measured in the borings ranged from El. 113.1 in boring S1227-1, located at the outlet, to El. 116.8 in S204-1, located near the proposed inlet. Groundwater was measured in observation well R70-OW at El. 116.4 on 14 June 2001, 2 months after the well was installed. Groundwater will vary with season, precipitation, nearby construction activity, and other factors.

GEOTECHNICAL ENGINEERING RECOMMENDATIONS

Foundation Type

Glaciofluvial deposits and bedrock are expected at design subgrade level for the culvert. Glaciofluvial deposits are expected at subgrade for headwalls, and wingwalls. We recommend that structures be supported on spread footing foundations bearing on a 0.15-m thick layer of crushed stone. Crushed stone is recommended instead of granular fill due to high groundwater.

Design Culvert 1227 according to the following criteria:

Foundation Design Criteria

- Place the culvert, headwalls, and wingwalls on a 150-mm thick layer of crushed stone (M.01.01 No. 6). Place geotextile fabric (Form 815 Section 7.55 Geotextile, Separation, Medium Survivability) beneath the crushed stone in soil subgrade areas.

- Assume a Load and Resistance Factor Design (LRFD) ultimate bearing capacity of 925 kPa, and a resistance factor of 0.45. Foundations should bear at least 1.2 m below the lowest adjacent ground surface for frost protection. We estimate total settlement will be less than 25 mm, with differential settlement 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. Multiply the vertical surcharge pressure at the top of the box culvert by 0.45 and apply as a uniform lateral pressure distribution.

- Design headwalls and wingwalls assuming the lateral earth pressures shown on Figure 4.

- Design headwalls and wingwalls as drained retaining walls, with provisions for water to drain through the face. Provide 100-mm dia. weep holes in accordance with CONNDOT specifications for drainage. Maximum spacing between weep holes should be 3 m.

- Backfill the walls with pervious structure backfill (ConnDOT M.02.05). Place pervious structure backfill behind abutments and wingwalls above a line defined by a 1V:1.5H slope extending up from the heel of the footing.

Seismic Design

The seismic soil coefficient, S, is equal to 1.0, and soils are not susceptible to liquefaction. Wingwalls for Culvert 1227 are greater than 7.5 m high in some areas, and seismic design of wingwalls will be required.

Reuse of Excavated Materials

Based on the results of gradation analyses, excavated soils will not be suitable for reuse as pervious structure backfill or granular fill. Excavated soils will generally be suitable for reuse as 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

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

Bedrock excavation will be required in the vicinity of S1227-3, where bedrock was encountered above invert grade. Bedrock cored in S1227-3 was hard, and controlled blasting will likely be required for bedrock excavation.

Temporary Lateral Support

Culvert 1227 will be constructed in stages. The southern portion from the new inlet to the existing inlet will be constructed early to allow placement of the highway embankment above. The northern portion, which extends beneath the existing I-84 highway embankment, will be constructed after traffic has been shifted to the new embankment.

Excavations will extend up to about 6.5-m below Reidville Drive, and up to about 5 m below I-84. Sloped open cut excavations may be feasible above groundwater. However, temporary lateral support will be required below groundwater, and adjacent to roadways and utilities that will remain in service during construction staging.

Steel sheet piling may not be feasible without pre-excavation due to the likely presence of boulders, which will obstruct installation. In addition, sheeting will need to be pinned to the bedrock surface for toe restraint in areas where bedrock is high. We anticipate soldier piles and lagging will be feasible. However pre-excavation or pre-drilling will likely be required to install soldier piles due to the presence of boulders. Soldier piles will need to be installed in predrilled rock sockets for toe restraint in high bedrock areas.

Cofferdam and Dewatering

Excavation will extend up to about 3 m below water levels measured in the borings, and excavation dewatering will be required. We anticipate that a series of deep wells around the perimeter of the excavation will be required to permit construction in the dry. Cofferdam and dewatering should be specified in the contract documents.

Subgrade Preparation

Due to the wet conditions anticipated, geotextile fabric and crushed stone should be placed immediately after excavation to avoid subgrade disturbance due to seepage.

CLOSURE

This report has been prepared for specific application to Culvert 1227 of 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.

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

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

Enclosures:

- Figure 1 – Project Locus
- Figure 2 – Subsurface Exploration Plan, Culvert 1227 I-84 Over Beaver Pond Brook
- Figure 3 – Subsurface Profile Along Culvert 1227, I-84 Over Beaver Pond Brook
- Figure 4 – Recommended Lateral Earth Pressures
- Appendix A – Test Boring Logs
- Appendix B - Groundwater Observation Well Installation Report
- Appendix C – Logs of Previous Explorations
- Appendix D – Results of Laboratory Testing
- Appendix E – Preliminary Culvert Layout Drawings

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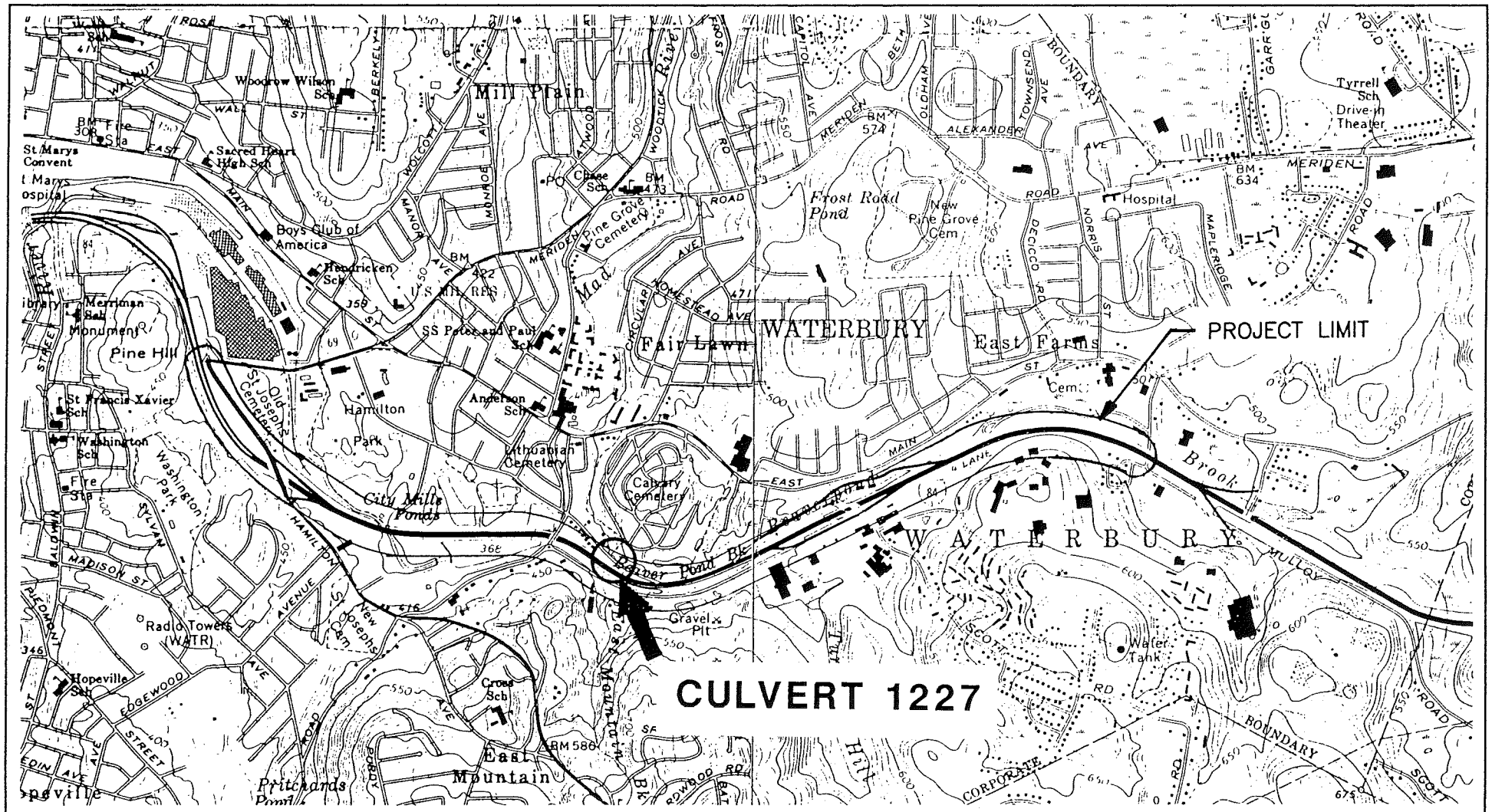
91313-972 CULVERTS/A02



SITE COORDINATES: 041°32'26.86"N 073°01'10.77"W

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

HALEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

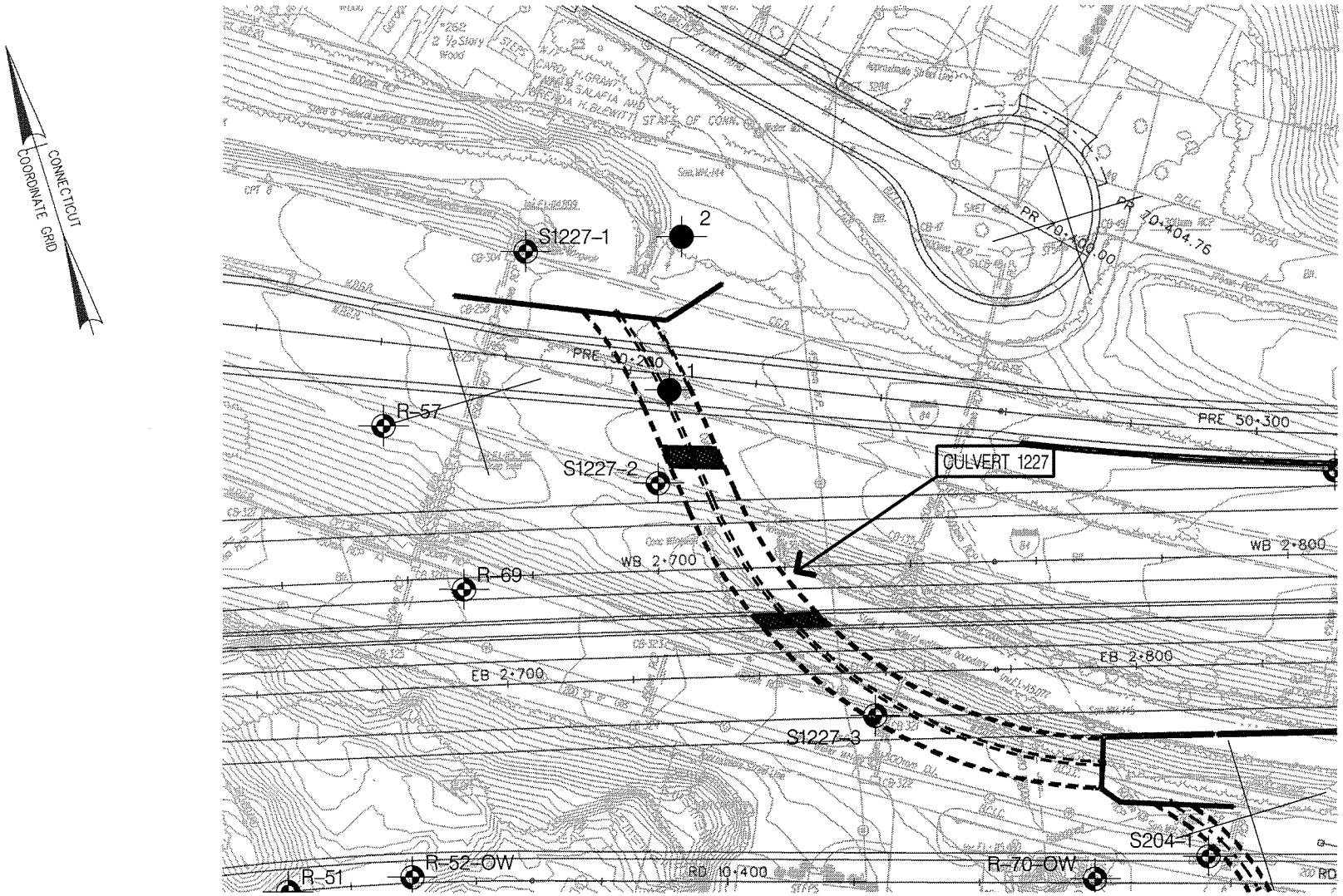
U.S. INTERSTATE 84 RECONSTRUCTION
STATE PROJECT NO. 151-0273
WATERBURY, CONNECTICUT

PROJECT LOCUS

SCALE: 1:24,000

FEBRUARY 2002

FIGURE 1



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, MIDDLETOWN CONNECTICUT.
2. ELEVATIONS ARE IN METERS, REFER TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929.

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

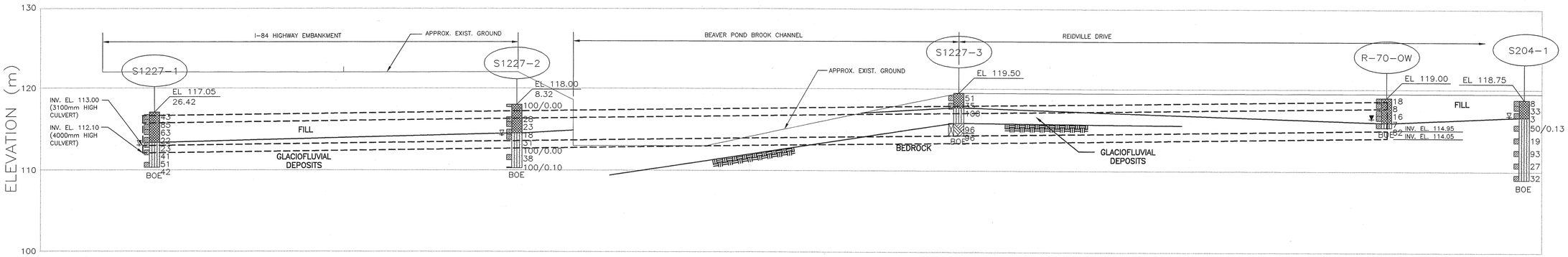
SUBSURFACE EXPLORATION PLAN
STRUCTURE 1227 I-84 OVER
BEAVER POND BROOK

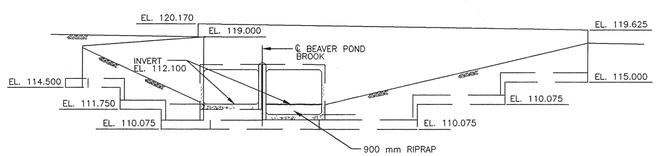
SCALE: 1:1000

FEBRUARY 2002

91313-100

FIGURE 2





ELEVATION (OUTLET)

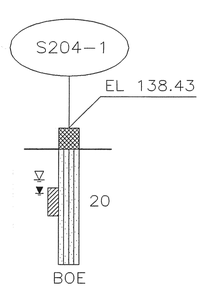
LITHOLOGY GRAPHICS

Fill | Glaciofluvial Deposits | Glacial Till | Bedrock

SAMPLER GRAPHICS

SAMPLE OBTAINED BY A 51 mm O.D. SPLIT SPOON SAMPLER WITH A 63.5 kg WEIGHT FALLING 0.76 m – NUMBER INDICATES STANDARD PENETRATION RESISTANCE N-VALUE OF SAMPLE INTERVAL, IN BLOWS PER 0.3 m

CORE SAMPLE 55 mm DIA.



EXPLORATION DESIGNATION.

APPROXIMATE GROUND SURFACE ELEVATION (METERS) AT EXPLORATION

MAJOR STRATUM BOUNDARY BETWEEN DIFFERENT SOIL TYPES

WATER LEVEL NOTED DURING OR SHORTLY AFTER DRILLING

WATER LEVEL NOTED IN OBSERVATION WELL ON 14 JUNE 2001, 2 MONTHS AFTER WELL INSTALLATION

SAMPLE LOCATION AND INTERVAL. SEE SAMPLER GRAPHIC LEGEND FOR SAMPLE TYPE

BOTTOM OF EXPLORATION

NOTES

1. REFER TO FIGURE 2 FOR LOCATIONS OF TEST BORINGS.
2. INFORMATION ON PROPOSED CULVERT, WINGWALLS, AND FINAL GROUND SURFACE CONFIGURATION WAS PROVIDED BY BERGER LEHMAN ASSOCIATES.
3. STRATA BOUNDARIES ARE INTERPOLATED FROM TEST BORINGS AND MAY VARY BETWEEN BORING LOCATIONS.
4. ELEVATIONS ARE IN METERS AND REFER TO NGVD-29.

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U.S INTERSTATE ROUTE 84 RECONSTRUCTION
STATE PROJECT NO. 151-0273
WATERBURY, CONNECTICUT

SUBSURFACE PROFILE CULVERT 1227 ALONG I-84 OVER BEAVER POND BROOK

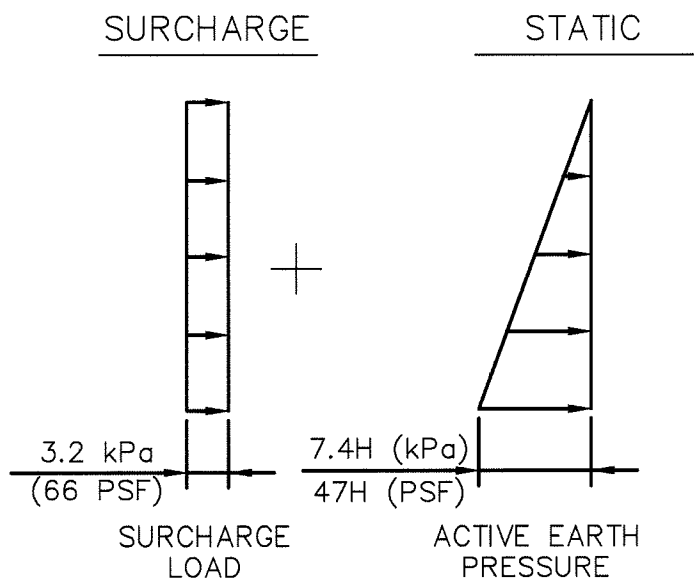
SCALE: AS SHOWN

FEBRUARY 2002

FIGURE 3

91313-972 CULVERTS/B01

91313-100 A04



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 1V:2H SLOPING BACKFILL BEHIND THE WALL.
4. SLIDING:
   COEFF. OF FRICTION BETWEEN FOOTING AND BASE = 0.60
   RESISTANCE FACTOR = 0.8
5. STABILITY:
   RESISTANCE FACTOR = 0.65
6. IGNORE PASSIVE RESISTANCE IN FRONT OF FOOTING.

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U.S. ROUTE INTERSTATE 84 RECONTRUCTION
STATE PROJECT NO. 151-0273
WATERBURY, CONNECTICUT

RECOMMENDED LATERAL LOADS

NOT TO SCALE

FEBRUARY 2002

FIGURE 4

APPENDIX A

Test Boring Logs

M. Jennette DRILLER	SM - 001 - M REV. 1/94 BORING REPORT STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION	Hole No. **S1227-1**
S. Poff INSPECTOR	TOWN: **Waterbury, CT**	Line & Station Offset N. Coordinate **230820.20**
Haley & Aldrich, Inc. SOILS ENGINEER	PROJECT NAME: **Reconstruction of I-84** PROJECT NUMBER: **State: 151-273/H&A: 91313-102**	E. Coordinate **283316.10** **Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

Surface Elevation: **117.05**		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: **16 April 2001**	Utilized						X		X					
Date Finished: **16 April 2001**	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		108		35	X	35	35	55	55
@ **3.96** m after **0** hours	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ m after hours	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.)
											0.18	-BITUMINOUS CONCRETE-
		0.30-0.91	1	0.61	0.17	D	12	21	22	23		Dense brown coarse to fine SAND, some coarse to fine gravel, little silt, asphalt, odor, moist
		0.91-1.52	2	0.61	0.20	D	20	32	53	33		Very dense brown coarse to fine SAND,little coarse to fine gravel, silt, asphalt, odor, moist
		1.52-2.13	3	0.61	0.20	D	88	42	21	24		Same as D2
		2.13-2.74	4	0.61	0.25	D	12	12	10	11		Medium dense light brown coarse to fine SAND, little silt, moist
		3.05-3.66	5	0.61	0.02	D	6	7	16	21	113.39	Medium dense brown coarse to fine SAND, little silt, wet
		3.66-4.27	6	0.61	0.00	D	15	16	25	40	3.66	-FILL-
5		4.57-5.18	7	0.61	0.45	D	12	24	27	27		No Recovery Very dense orange brown coarse to fine SAND, trace silt, fine gravel, wet
		6.10-6.71	8	0.61	0.61	D	6	14	28	57	110.34 6.71	Dense orange brown coarse to fine SAND, trace silt, wet -GLACIOFLUVIAL DEPOSITS- Bottom of Exploration at 6.71 m.
10												
15												

Casing Size	From	To	Meters of Earth	Rock
HSA	**0.0**	**6.10**	**6.71** m	**-** m
			No. of Samples	
			8D	

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

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. **S1227-1**
Sheet **1** of **1**

R. Posa DRILLER	SM - 001 - M REV. 1/94 BORING REPORT STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION	Hole No. **S1227-2**
S. Poff INSPECTOR	TOWN: **Waterbury, CT**	Line & Station Offset N. Coordinate **230778.40**
Haley & Aldrich, Inc. SOILS ENGINEER	PROJECT NAME: **Reconstruction of I-84** PROJECT NUMBER: **State: 151-273/H&A: 91313-102**	E. Coordinate **283325.40** **Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: **118.00**	Utilized						X		X					
Date Started: **5 April 2001**	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Date Finished: **5 April 2001**	Size I.D. (mm)	60	76	100	64		83		35	X	35	35	55	55
Groundwater Observations	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ **3.70** m after **0.25** hours	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	
@ m after hours														

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.)
		0.00-0.30	1	0.30	0.10	D	2	17	100/0.00		0.08	-TOPSOIL- Verydense light brown coarse to fine SAND, little fine gravel, silt, trace roots, moist
		1.52-2.13	2	0.61	0.48	D	14	15	13	12	116.32 1.68	Auger refusal at 1.0 m. Medium dense light brown coarse to fine SAND, some fine gravel, little silt, trace wood, moist
		2.13-2.74	3	0.61	0.15	D	10	11	12	14	1.76 1.93	3 in. ORGANICS layer (wood), organic odor
		3.05-3.66	4	0.61	0.20	D	10	11	7	12	114.49	Medium dense gray coarse to fine GRAVEL and coarse to fine SAND, little silt, trace fuel oil odor (weathered)
		3.66-4.27	5	0.61	0.08	D	8	11	20	17	3.51 113.79	
5		4.57-4.57	6	0.00	0.00	D	9	100/0.00			4.21 4.27	Medium dense dark brown to black coarse to fine SAND and coarse to fine GRAVEL, little silt, brick, trace coal, ash, glass, concrete, wood, organic odor, moist -FILL- Dense gray brown coarse to fine SAND and SILT, little fine gravel, with cobbles, wet
		6.10-6.71	7	0.61	0.38	D	14	17	21	18		Dense light brown to orange brown coarse to fine GRAVEL and coarse to fine SAND, little silt, wet
		7.62-7.72	8	0.10	0.08	D	100/0.10				110.28 7.72	Note: Auger through boulder 4.41 to 4.88 m. No recovery, on boulder Dense brown coarse to fine SAND and SILT, some coarse to fine gravel, wet Very dense brown coarse to fine GRAVEL and coarse to fine SAND, some silt, wet Note: Split spoon refusal @ 7.72 m. on probable boulder -GLACIOFLUVIAL DEPOSITS- Bottom of Exploration at 7.72 m.
10												
15												

Casing Size	From	To	Meters of Earth	Rock
HSA	0.0	7.62	7.72 m	- m
			No. of Samples	
			8D	

NOTES: **Case mounted Mobile Drill 580 with cat head to drive safety hammer. Borehole backfilled with 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. **S1227-2**
Sheet **1** of **1**

M. Jennette	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **S1227-3**
DRILLER	STATE OF CONNECTICUT	Line & Station
C. White	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Waterbury, CT**	N. Coordinate **230732.70**
Haley & Aldrich, Inc.	PROJECT NAME: **Reconstruction of I-84**	E. Coordinate **283347.50**
SOILS ENGINEER	PROJECT NUMBER: **State: 151-273/H&A: 91313-102**	**Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: **119.50**														
Date Started: **22 March 2001**	Utilized						X		X					X
Date Finished: **22 March 2001**	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		108		35	X	35	35	55	55
@ **NO** m after ____ hours	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ ____ m after ____ hours	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.)
												-ASPHALT AND ROADSTONE-
		0.30-0.91	1	0.61	0.18	D	18	25	26	100	0.23	Very dense coarse to fine SAND, some medium to fine gravel, cobbles
		1.22-1.83	2	0.61	0.15	D	23	16	19	25	117.90	
		~~1.83-1.98~~	~~3~~	~~0.15~~	~~0.00~~	~~D~~	~~100~~				1.60 / 1.83	Dense coarse to fine SAND, some medium to fine gravel
												-FILL-
		3.70-5.22	1	1.52	1.46	C		[RQD = 96%]			115.80 / 3.70	No recovery, boulder Auger refusal at 3.05 m. Roller bit to 3.7 m.
												-GLACIOFLUVIAL DEPOSITS-
5											114.30 / 5.20	Very hard, fresh, gray, pink and white, coarse to fine grained granitic GNEISS. Foliation is moderately dipping to high angle, extremely close. Joints are moderately dipping to high angle, close to moderate, rough, stepped to undulating, discolored, open
												-BEDROCK-
												Bottom of Exploration at 5.22 m.
10												
15												

Casing			Meters of	
Size	From	To	Earth	Rock
HSA	**0.0**	**3.05**	**3.70** m	**1.52** m
NX	**3.7**	**5.20**	No. of Samples	
			3D,1C	

NOTES: **Truck mounted Mobile Drill B-52 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. **S1227-3**
Sheet **1** of **1**

J. Ouellette DRILLER	SM - 001 - M REV. 1/94 BORING REPORT STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION	Hole No. **R-70-OW**
J. Miller INSPECTOR	TOWN: **Waterbury, CT**	Line & Station Offset N. Coordinate **230697.50**
Haley & Aldrich, Inc. SOILS ENGINEER	PROJECT NAME: **Reconstruction of I-84** PROJECT NUMBER: **State: 151-273/H&A: 91313-102**	E. Coordinate **283373.40** **Berger, Lehman Associates, P.C.**
	BORING CONTRACTOR: **General Borings, Inc.**	PRIME DESIGNER

Surface Elevation: **119.00**
Date Started: **10 April 2001**
Date Finished: **10 April 2001**
Groundwater Observations
@ **2.74** m after **0** hours
@ m after hours

	Casing				Auger		Mud	Sampler		Core Barrel			
Utilized						X		X					
Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Size I.D. (mm)	60	76	100	64		83		35	X	35	35	55	55
Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
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	7	12	6	5	0.10	-TOPSOIL-
		0.61-1.22	2	0.61	0.25	D	7	5	3	2		Medium dense light brown coarse to fine SAND, little medium to fine gravel, trace silt, moist
		1.52-2.13	3	0.61	0.15	D	3	9	7	3		Loose brown coarse to fine SAND, little medium to fine gravel, trace silt, moist
		2.13-2.74	4	0.61	0.10	D	4	4	3	2		Same as D2, except medium dense
											115.95	Loose brown coarse to fine SAND, little medium to fine gravel, trace silt, wet
		3.05-3.66	5	0.61	0.41	D	50	48	34	28	3.05 115.34	-FILL-
											3.66	Very dense brown coarse to fine SAND, some medium to fine gravel, trace silt, wet -GLACIOFLUVIAL DEPOSITS-
5												Bottom of Exploration at 3.66 m.
10												
15												

Casing Size	From	To	Meters of Earth	Rock
HSA	0.0	3.00	3.66 m	- m
			No. of Samples	
			5D	

NOTES: **Truck mounted Mobile Drill B-53 with wire winch to drive safety hammer. Observation well installed in completed borehole**

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. **R-70-OW**
Sheet **1** of **1**

J. Ouellette DRILLER	SM - 001 - M REV. 1/94 BORING REPORT STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION	Hole No. **S204-1**
J. Miller INSPECTOR	TOWN: **Waterbury, CT**	Line & Station Offset N. Coordinate **230695.70**
Haley & Aldrich, Inc. SOILS ENGINEER	PROJECT NAME: **Reconstruction of I-84** PROJECT NUMBER: **State: 151-273/H&A: 91313-102** BORING CONTRACTOR: **General Borings, Inc.**	E. Coordinate **283391.70** **Berger, Lehman Associates, P.C.** PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: **118.75**	Utilized						X		X					
Date Started: **9 April 2001**	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Date Finished: **9 April 2001**	Size I.D. (mm)	60	76	100	64		83		35	X	35	35	55	55
Groundwater Observations	Hammer (kg)	136	136	136	136			Bit	63.5		Type		Diamond	
@ **2.00** m after - hours	Fall (m)	0.6	0.6	0.6	0.6				0.76		of bit		Carbide	
@ m after hours														

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	0.38	D	3	3	5	9		Loose brown coarse to fine SAND, little coarse to fine gravel
		0.61-1.22	2	0.61	0.48	D	20	26	7	7		Same as D1, except dense
											117.45 1.30	
		1.52-2.13	3	0.61	0.51	D	1	1	2	4		Very loose light brown coarse to fine SAND, little fine gravel, trace silt, wet
											116.60 2.15	-FILL-
		3.05-3.66	4	0.61	0.28	D	56	50/0.13				Very dense gray brown coarse to fine SAND, little coarse to fine gravel, trace silt, wet
5		4.57-5.18	5	0.61	0.51	D	8	10	9	11		Medium dense gray brown coarse to fine SAND, trace silt, wet
		6.10-6.71	6	0.61	0.61	D	29	39	54	37		Very dense light brown coarse to fine SAND, little medium gravel, trace silt, wet
		7.62-8.23	7	0.61	0.41	D	10	10	17	19		Same as D6, except medium dense
		9.14-9.75	8	0.61	0.41	D	15	13	19	20		Same as D7
10											109.00 9.75	-GLACIOFLUVIAL DEPOSITS- Bottom of Exploration at 9.75 m.
15												

Casing Size	From	To	Meters of Earth	Rock
HSA	**0.0**	**9.10**	**9.75** m	- m
			No. of Samples	
			8D	

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

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. **S204-1**
Sheet **1** of **1**

APPENDIX B

Groundwater Observation Well Installation Report

HALEY & ALDRICH

OBSERVATION WELL INSTALLATION REPORT

Well No. R-70-OW

Boring No. R-70-OW

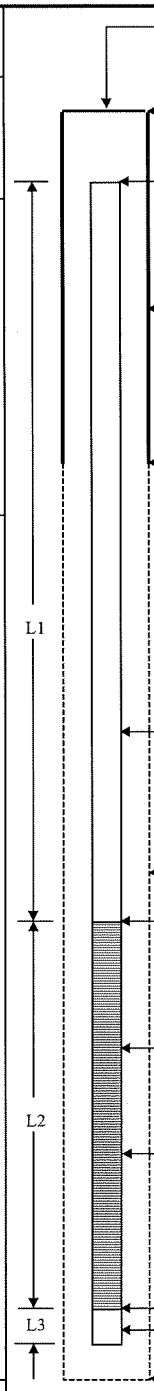
PROJECT	Reconstruction of I-84	H&A FILE NO.	91313-100
LOCATION	Waterbury, Connecticut	PROJECT MGR.	N. Whetten
CLIENT	Berger, Lehman Associates	FIELD REP.	J. Miller
CONTRACTOR	General Borings, Inc.	DATE INSTALLED	4/10/2001
DRILLER	J. Douellette	WATER LEVEL	2.74 m.

Ground El.	119.0 m	Location	See Plan	☐ Guard Pipe
El. Datum	NGVD-29			☑ Roadway Box

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL
TOP SOIL	
0.10	CONCRETE
	0.61
	DRILL CUTTINGS
	1.80
FILL	
	#2 WELL SAND
3.05	
GLACIALFLUVIAL DEPOSIT	
3.66 m	3.66 m

(Bottom of Exlporation)

(Numbers refer to depth from ground surface in meter)



(Not to Scale)

Type of protective cover/lock	Roadway Box	
Height of top of roadway box above ground surface	0.00	m
Height of top of riser pipe above ground surface	0.05	m
Type of protective casing:	Roadway Box	
Length	0.25	m
Inside Diameter	-	m
Depth of bottom of roadway box	0.25	m

Type of Seals	Top of Seal (m)	Thickness (m)
Concrete	0.0	0.61
Drill Cuttings	0.61	1.19
Sand	1.8	1.86

Type of riser pipe:	Schedule 40 PVC	
Inside diameter of riser pipe	0.05	m
Type of backfill around riser	Drill Cuttings	
Diameter of borehole	0.10	m
Depth to top of well screen	0.60	m
Type of screen	Schedule 40 PVC	
Screen gauge or size of openings	0.025	cm
Diameter of screen	5.0	cm
Type of backfill around screen	#2 Well Sand	
Depth of bottom of well screen	3.66	m
Bottom of Silt trap	--	m
Depth of bottom of borehole	3.66	m

Riser Pay Length (L1)	+	Length of screen (L2)	+	Length of silt trap (L3)	=	Pay length
0.66 m	+	3.00 m	+	-- m	=	3.66 m

COMMENTS:

Form # 3010

HALEY & ALDRICH

GROUNDWATER MONITORING REPORT

OW/PZ NO.

R-70

PROJECT	Reconstruction of I-84	**H&A FILE NO.**	91313-100
LOCATION	Waterbury, Connecticut	**PROJECT MGR.**	N. Whetten
CLIENT	Berger, Lehman Associates	**DATE INSTALLED**	10-Apr-01
CONTRACTOR	General Borings, Inc.		
REFERENCE ELEVATION	118.95		

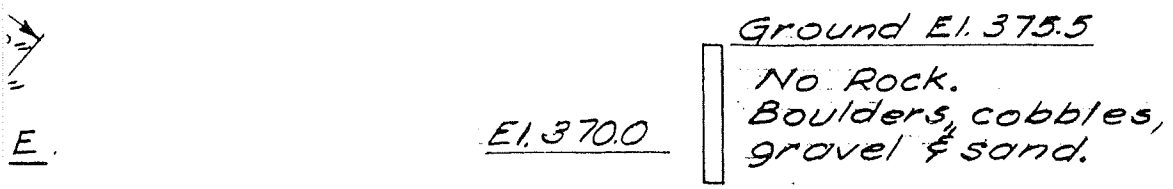
DESCRIPTION OF REFERENCE POINT ☑ **PVC** ☐ **Roadway / Casing** ☐ **Ground Surface** ☐ **Other:**

Date	Time (military)	Elapsed Time (days)	Depth of Water Below Reference Point (m)	Elevation of Water	Remarks	Read By
14-Jun-01	940	65	2.52	116.43		PAC

APPENDIX C

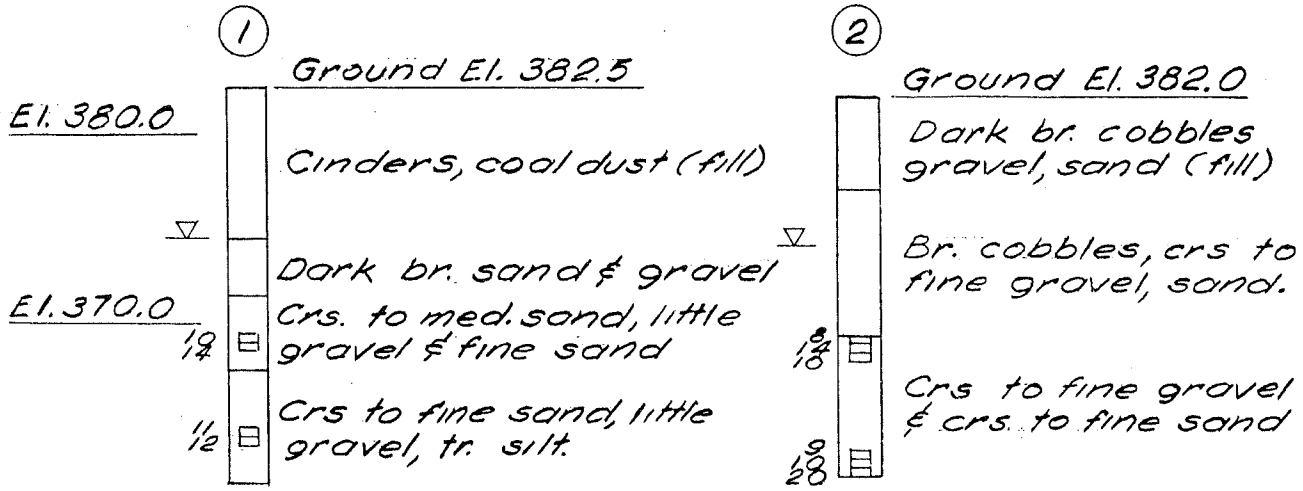
Logs of Previous Explorations

PUB. ROAD DIV. NO	STATE	TOWN	FED. AID PROJ. NO.	PROJ. NO.	YEAR	ROUTE NO.	SHEET NO	TOT. SHE
1	CONN	Waterbury	I-138(9)	182-20	1958		51	94



REVISIONS SUBMITTED FOR THIS SHEET

BAR SOUNDING



10 □ indicates the number of blows required to drive a 2½" sampler pipe 6" with a 300# hammer falling 20"

BORINGS

QUANTITIES		
Structure Excavation (Comp.)	c.y.	2100
Class "A" Concrete	c.y.	620
½" Prem. Bit. Jt. Filler for Bridges	s.f.	400
Deformed Steel Bars	lb.	91,000
Dampproofing	s.y.	860
Pervious Structure Backfill	c.y.	1120
Riprap	Ton	80

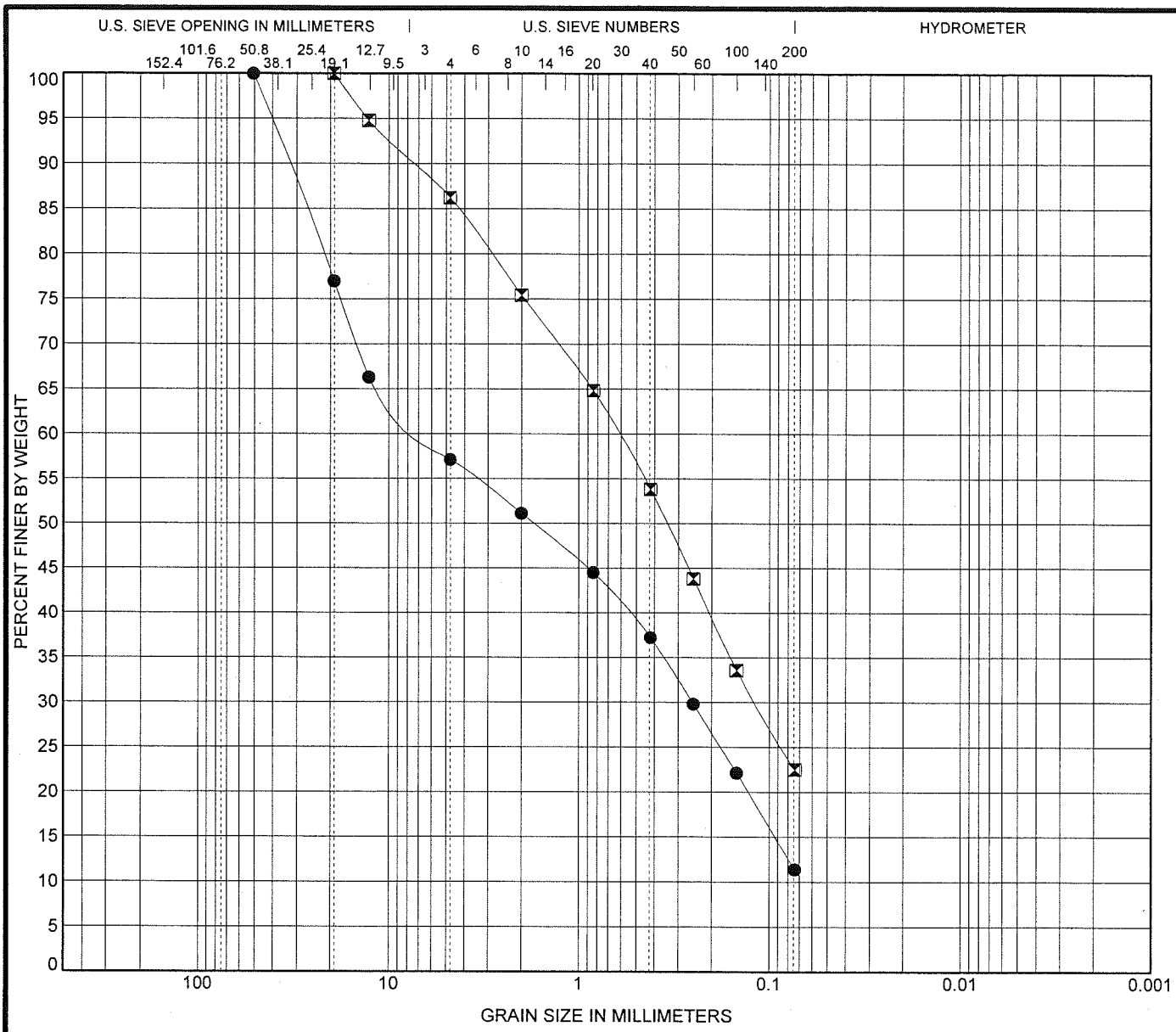
Wing

El. 385.0

2"

APPENDIX D

Results of Laboratory Testing



	COBBLES	% GRAVEL			% SAND		% FINES	
		COARSE	MEDIUM	FINE	COARSE	FINE	% SILT	% CLAY
●	0.0	16.3	20.1	12.5	13.9	25.8	11.4	
⊠	0.0	0.0	7.7	16.8	21.6	31.3	22.5	

	Expl. No.	Sample No.	Depth (m)	LL	PL	PI	Water Content (%)	Cc	Cu
●	S1227-1	S3	1.52-2.13				5.59		
⊠	S1227-2	S7	6.10-6.71				17.65		

	Sample Description
●	Gray-brown coarse to fine SAND and coarse to fine GRAVEL, little silt. (FILL)
⊠	Brown coarse to fine SAND and coarse to fine GRAVEL, little silt. (GLACIOFLUVIAL DEPOSIT)

Remarks:

HALEY & ALDRICH
Glastonbury, Connecticut

I-84 Reconstruction
Waterbury, Connecticut
State Project No.: 151-273

GRAIN SIZE DISTRIBUTION

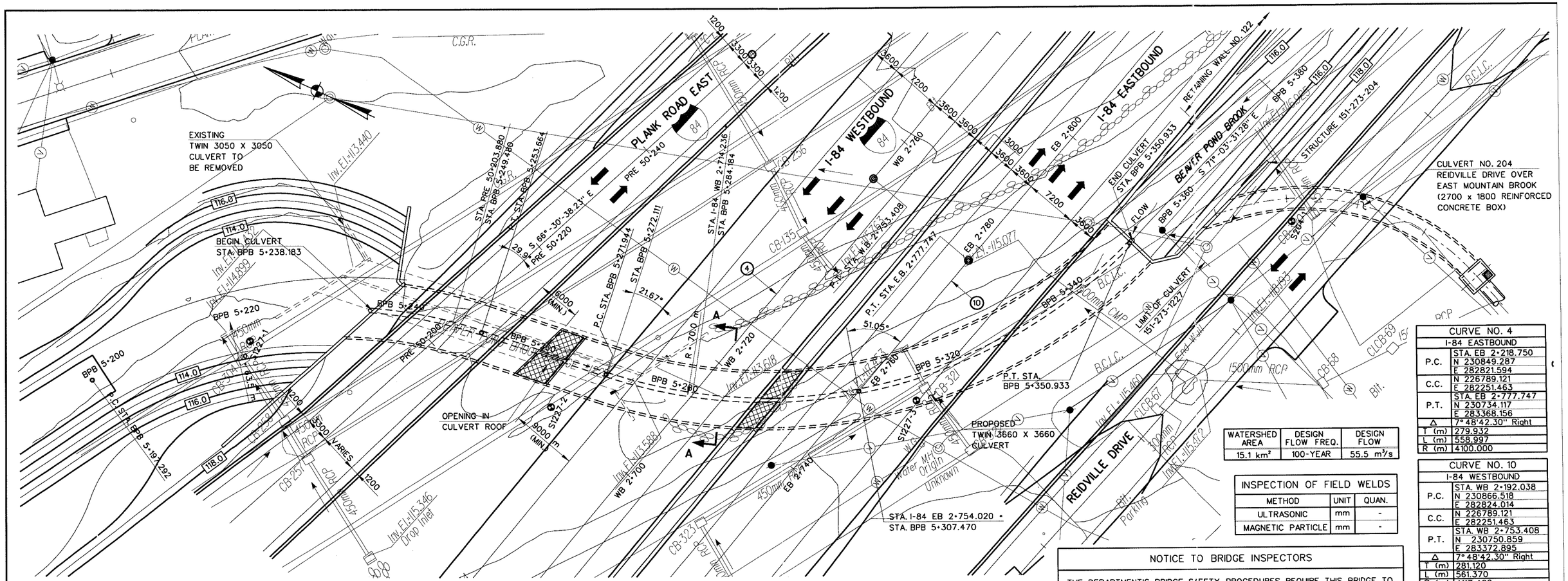
Date: 2/11/2002

File No.: 91313-100

CONN DOT SIEVE 91313S.GPJ US LAB.GDT 2/11/02

APPENDIX E

Preliminary Culvert Layout Drawings



BORING LEGEND

- NEW BORING (2001)

PLAN

SCALE: 1:250

	CULVERT INLET
DESIGN FLOW ELEVATION	118.0
FREEBOARD (m)	N/A

WATERSHED AREA	DESIGN FLOW FREQ.	DESIGN FLOW
15.1 km²	100-YEAR	55.5 m³/s

INSPECTION OF FIELD WELDS		
METHOD	UNIT	QUAN.
ULTRASONIC	mm	-
MAGNETIC PARTICLE	mm	-

NOTICE TO BRIDGE INSPECTORS

THE DEPARTMENT'S BRIDGE SAFETY PROCEDURES REQUIRE THIS BRIDGE TO BE INSPECTED FOR, BUT NOT LIMITED TO, ALL APPROPRIATE COMPONENTS INDICATED IN THE GOVERNING MANUALS FOR BRIDGE INSPECTION. ATTENTION MUST BE GIVEN TO INSPECTING THE FOLLOWING SPECIAL COMPONENTS AND DETAILS. (THE LISTING OF COMPONENTS FOR SPECIFIC ATTENTION SHALL NOT BE CONSTRUED TO REDUCE THE IMPORTANCE OF INSPECTION OF ANY OTHER COMPONENT OF THE STRUCTURE.) THE FREQUENCY OF INSPECTION OF THIS STRUCTURE SHALL BE IN ACCORDANCE WITH THE GOVERNING MANUALS FOR BRIDGE INSPECTION, UNLESS OTHERWISE DIRECTED BY THE ENGINEER OF BRIDGES AND STRUCTURES.

COMPONENT OR DETAIL	BRIDGE SHEET REFERENCE

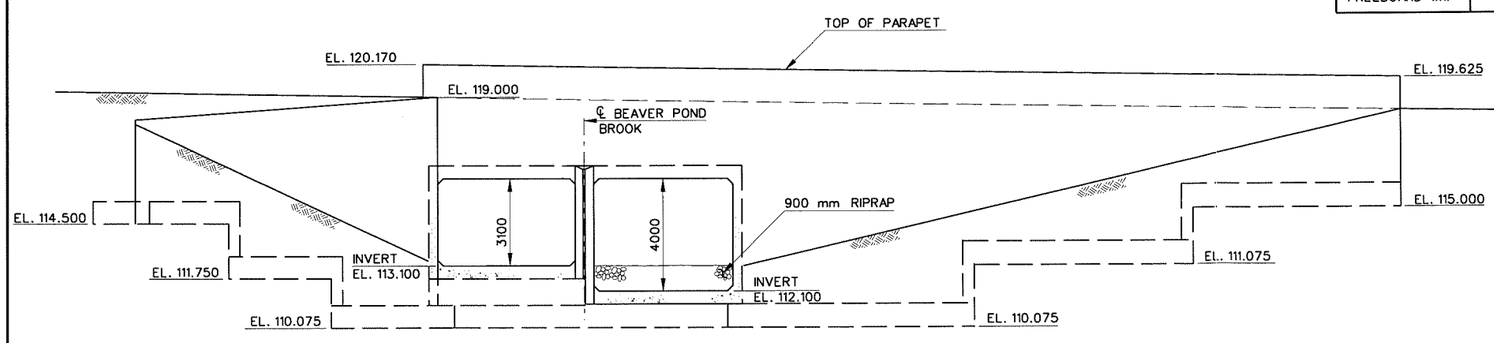
CURVE NO. 4	
I-84 EASTBOUND	
P.C.	STA. EB 2+218.750
	N 230849.287
	E 282821.594
C.C.	N 226789.121
	E 282251.463
P.T.	STA. EB 2+777.747
	N 230734.117
	E 283368.156
Δ	7° 48'42.30" Right
T (m)	279.932
L (m)	558.997
R (m)	4100.000

CURVE NO. 10	
I-84 WESTBOUND	
P.C.	STA. WB 2+192.038
	N 230866.518
	E 282824.014
C.C.	N 226789.121
	E 282251.463
P.T.	STA. WB 2+753.408
	N 230750.859
	E 283372.895
Δ	7° 48'42.30" Right
T (m)	281.120
L (m)	561.370
R (m)	4117.400

CURVE NO. BPB2	
BEAVER POND BROOK	
P.C.	STA. BPB 5+197.292
	N 230837.862
	E 283301.916
C.C.	N 230784.445
	E 283267.583
P.T.	STA. BPB 5+253.664
	N 230791.529
	E 283330.686
Δ	50° 51'50.65" Right
T (m)	33.559
L (m)	61.958
R (m)	63.000

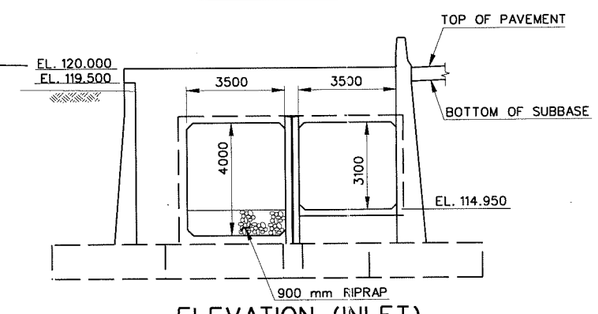
CURVE NO. BPB3	
BEAVER POND BROOK	
P.C.	STA. BPB 5+271.944
	N 230773.363
	E 283781.173
C.C.	N 230780.742
	E 283402.289
P.T.	STA. BPB 5+350.933
	N 230714.963
	E 283379.567
Δ	64° 39'11.91" Left
T (m)	44.298
L (m)	78.989
R (m)	70.000

CURVE DATA



ELEVATION (OUTLET)

SCALE: 1:100



ELEVATION (INLET)

SCALE: 1:100

REV.	DATE	DESCRIPTION	SHEET. NO
		REVISIONS	

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE TRUE CONDITIONS OR THE ACTUAL QUANTITIES OR DISTRIBUTION OF QUANTITIES OF WORK WHICH WILL BE REQUIRED

CADD ...\0273f122701.brg
PLOTTED 22 FEB 2002
SCALE AS NOTED

DESIGNER: H. DIERKS
DRAFTER: A. PRESS
CHECKED BY: N. VYAS
DATE CHECKED:

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
ENGINEER: BERGER LEHMAN ASSOCIATES, P.C.
APPROVED BY:
DATE:

PROJECT TITLE:
RECONSTRUCTION OF I-84 WATERBURY
I-84 OVER BEAVER POND BROOK
STRUCTURE NO. 151-273-1227

TOWN: WATERBURY

DRAWING TITLE:
STRUCTURE LAYOUT FOR DESIGN
GENERAL PLAN AND ELEVATION

PROJECT NO.: 151-273
DRAWING NO.: 1
SHEET NO.:

...\str1227\fd\0273f122701.brg Feb. 22, 2002 15:32:20