

**GEOTECHNICAL STUDY**

**CONSTRUCTION OF THE  
NEW BRITAIN - HARTFORD BUSWAY  
ConnDOT Project 171-305**

**Proposed Retaining Wall #101  
Sta 121+37 to Sta 129+0 (Left)**

**Prepared for:  
Close, Jensen & Miller, P.C.**

**Prepared by:  
Dr. Clarence Welti, P. E., P. C.**

**April, 2011**



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## **1.0 Introduction and Background:**

**1.1** This study addresses the geotechnical requirements for the design of Retaining Wall #101. The subject wall will be located along the left (west) shoulder of the Busway and contiguous to the Multi-Use Trail from Station 121+37 and terminating at Station 129+0 near the Route 9 overpass. A portion of the wall will cross over the existing box culvert conveying Bass Brook under the present rail bed.

**1.2** Retaining Wall 101 will consist of a proprietary system to be approved by the Connecticut DOT. The wall will serve as a grade separation between the Busway and the Multi Use Trail by supporting shallow to moderate fills beneath the Busway. The height of the grade difference will be up to 5 feet and the overall height of the wall from bottom of the foundation to top of the backfill is estimated to be up to 8± feet. The face of the wall will be located along the west shoulder of the Busway. The foundations will bear on soil. Regarding the wall construction, there do not appear to be any unusual construction consideration based on the topographic and test boring information. One issue requiring careful attention pertains to the sequence and installations of stormwater piping and structures where in close proximity to the proposed wall.

**1.3** Regarding temporary sheeting of excavations for this wall, it is anticipated that any requirements for such sheeting will fall within the scope of the Standard Specifications Form 816. The requirements for temporary shoring should be minimal, except possibly to avoid encroaching into wetland areas. Temporary Sheet Piling and Cofferdam & Pumping are contractor provided items.

**1.4** The design of the wall will be completed in U.S. Customary Units and in accordance with the LRFD method. It is presumed that the designs for temporary shoring can be completed with other methods such as Allowable Stress Design (ASD) or Load Factor Design (LFD).

**1.5 Field exploration** for the proposed wall included five test borings drilled by Associated Borings Company, Inc. in August, 2007. The applicable boring numbers are RW-101-1 through RW-101-5. Five supplemental boring , RW-101-X-1 through RW-101-X-5, were drilled in March, 2011 by Associated Borings Company. The borings were drilled with a 2.5" dia. hollow stem auger to a maximum depth of 35 feet below grade at auger refusal on probable bedrock. The standard penetration tests and soil sampling were performed with a standard 2" dia. split spoon sampler using a 140 pound hammer and a hammer fall of 30 inches.

**1.6 Laboratory Testing** included grain size gradation tests with water content tests on two samples taken from the borings. The results of those tests are included in the appendices.

## **2.0 Geology and Soils Cross Section + Soil Properties:**

**2.1 The Geologic Origin** of the natural soils (beneath the fills) at the site and environs consists of glacial lake deposits atop the bedrock or overlying glacial moraine deposits to the rock. The lake deposits consist generally of medium compact fine sand and silt with trace gravel. The glacial moraine consists generally of very dense fine to medium sand and gravel, some silt. The bedrock from geologic mapping is Portland Arkose (Sandstone or Siltstone).

**2.2 The Soils/Rock Cross Sections** from the borings are generally as follows:

### **Boring RW-101-1 (Busway Sta 122+0; Elev. 99.4):**

Fine SAND, some to and Silt to 25+ feet at the end of the boring, medium compact to dense

### **Boring RW-101-2 ( Sta125+0; Elev. 93.6) and RW-101-3 ( Sta 127+0; Elev. 91.3):**

FILL; fine to coarse SAND, GRAVEL and COBBLES to 4 to 5± feet medium compact to dense

FILL; fine to medium SAND, some to and Gravel, some Silt to 18 feet at RW-101-3 and to 20 feet at RW-101-2

At RW101-2; Fine SAND and Silt, trace Gravel to auger refusal on probable bedrock at 35 feet below grade

At RW-101-3; possible loose Organic layer from 18 feet to 19 feet (beneath the fill)

At RW-101-3; Glacial Till; fine to medium SAND and GRAVEL, some Silt to auger refusal on probable bedrock at 26.5 feet below grade, very dense

### **Boring RW-101-4 ( Sta 127+80; Elev. 91.9) and RW-101-5 ( Sta 128+50; Elev. 92.0):**

FILL; fine to coarse SAND, GRAVEL and COBBLES to 2 to 4± feet, medium compact

FILL; fine to medium SAND and GRAVEL, some Silt to 16 to 17 feet, medium compact

At boring RW-101-5; stratum of fine SAND, some Silt, trace Organics to 20 feet, loose to medium compact

Strata of fine to coarse SAND and GRAVEL, trace Silt or fine SAND, some Silt to auger refusal on probable bedrock at 23 to 24 feet below grade, medium compact to dense

### **Boring RW-101-X-1 ( Sta 121+36; Elev. 96.6), RW-101-X-2 (Sta 122+0; Elev. 96.9), RW-101-X-3 (Sta 123+0; Elev. 95.0), RW-101-X-4 (Sta 123+50; Elev. 93.9), RW-101-X-5 (Sta**

**126+50; Elev. 92.6):**

FILL; fine to coarse SAND and GRAVEL, trace Silt to 3 feet, medium compact

FILL; fine SAND, some Silt to 10 to 18 feet, medium compact to locally loose

At boring RW-101-X-1, X-2 and X-3; SILT, trace fine Sand and Clay to 25+ feet, medium compact

At boring RW-101-X-4 and X-5; Fine SAND, some Silt, little Gravel to 25+ feet, medium compact to dense

**2.3 The Groundwater levels** were observed on boring completion as follows: boring RW-101-X-1, X-2 and X-3 at 2.5 to 4.5 feet (about Elev. 91 to Elev. 93); boring RW-101-1 at 10 feet below grade (about Elev. 89); boring RW-101-X-4, RW-101-X-5, RW-101-2 and RW-101-3 near the base of fills at 15 to 18 feet below grade (about Elev. 73.5 to Elev. 79).

**2.4 Regarding the Soil Properties** the following will apply:

**New Backfill (Material of Section 3.3 below):**

Unit Weight (moist)	125 pcf
Water Content	6 to 8%
Angle of Internal Friction	34°

**Existing Fills:**

Unit Weight	125 pcf
Submerged Unit Weight:	65 pcf
Angle of Internal Friction	32° to 34°
Stiffness Modulus	400+ Tons/sf

**Glacial Lake Soils (Sand and Gravel):**

Unit Weight	120 to 125 pcf
Submerged Unit Weight	66 pcf
Angle of Internal Friction	33+°
Stiffness Modulus	500 to 700+ Tons/sf

**Glacial Moraine, Till:**

Unit Weight	130 pcf
Submerged Unit Weight	70 pcf

Angle of Internal Friction  
Typical Stiffness Modulus

36° to 38°  
>1,000 tons/sf

*Notes:*

*The above soil parameters can be used for the design of temporary shoring.*

*The values of internal friction angle cited are estimated from SPT data*

**2.4** The natural soils and potentially the existing fills will be susceptible to remolding under equipment when wet from ground water or stormwater onto the exposed subgrades.

### 3.0 Foundations and Design Considerations:

**3.1** Regarding **Design of the Wall**, the soil bearing, overturning and sliding must be addressed in the foundations. The **Preliminary Criteria for Foundation Type and Loading** have been assumed by the writer as follows:

1. The maximum total settlement shall not exceed 1" and the maximum differential settlement shall not exceed ½" in 20 feet of length.
2. The seismic section of the ConnDOT and AASHTO bridge design specifications will not apply to the subject walls with height less than 25 feet.

**3.2** The recommended **Foundation Type** is with spread footings. The footings shall be on inorganic soils at least 3 feet below the existing grades to be below any frost disturbed soils and the ConnDOT frost protection depth. In general, the footings will largely fall in the medium compact natural soils or in the existing granular fills. The existing fills are up to 20± feet deep and are present along much of the wall alignment. Regarding establishment of an ultimate bearing capacity, the ultimate loading is based on the internal friction angle, which is related to the soil density and overburden weight. Based on the sample blow counts in the natural soils and fills the angle of internal friction is at least 32°, which indicates an ultimate capacity of at least 20 ksf. The AASHTO LRFD resistance factor based on friction angle estimated from SPT data would be  $\phi_R = 0.35$ . This indicates a design bearing resistance of about 6 to 7 ksf. Based on review of LRFD programs, particularly as relates to reduction for inclined loading, a significant reduction from ultimate bearing capacity is indicated, based on the ratio of lateral loading to vertical loading. This reduction is almost double the reduction for the ASD procedure. **To address this reduction it is suggested that the more appropriate LRFD value for  $\phi$  be 0.50.** Based on the estimated minimum stiffness modulus of 400 Tons/sf the recommended design bearing resistance is 4 ksf to maintain settlements within the design criteria.

**3.2.1** There shall be a compacted granular fill conforming to Form 816, section M.02.01, as underlay beneath the wall footings. For footings falling on the natural soils the underlay shall be at least 6" thick, and at least 24" thick for footings on the existing fills. The granular fill shall be compacted to at least 95% of modified optimum density. The compacted granular fill will provide a uniformly stiff surface to receive the footings. If the subgrades are wet from rainwater or possible ground water, the initial 6" layer of the underlay shall be with No. 8 crushed stone.

**3.3** The required backfill for the walls shall be Pervious Structure Backfill conforming to ConnDOT Form 816, M.02.05. This material will have a unit weight of 125 pcf and internal friction angle of 34°.

**3.4** The ultimate friction angle between the concrete and soil at the footing base is about 31°. This would result in ultimate sliding factor of **0.60**, based on AASHTO criteria. The applicable resistance factor for sliding of pre-cast concrete on the soil can be  $\phi_R = 0.90$  and for cast in place concrete the factor is  $\phi_R = 0.80$ .

**3.5** Regarding **Lateral Earth Pressure**, design of the free standing walls can be based on active earth pressure using the active pressure coefficient  $K_A = 0.28$  (level backfill). The design lateral loads should include a live load surcharge of up to 2 feet of soil dependent on the distance of the walls from traffic lanes.

**3.6** Regarding **groundwater mitigation**, there shall be 6" structure under drains placed in the backfill at the base of the wall.

**3.7 Summary of Preliminary Foundation Design Parameters for Wall #101:**

PARAMETER	LRFD DESIGN VALUE	ULTIMATE RESISTANCE	COMMENTS
Design Bearing Resistance	4 ksf (based on settlement)	20+ ksf	Resistance factor $\phi_R = 0.35$
Backfill Unit Weight *	125 pcf	—	ConnDOT Form 816 M.02.05
Angle of Internal Friction $\phi_1$ (Backfill) *	34°	—	Compacted Pervious Backfill 95% of MOD
Sliding Factor, pre-cast concrete on soil	0.54	0.60	Resistance factor $\phi_R = 0.90$
Sliding Factor, cast in place concrete on soil	0.48	0.60	Resistance factor $\phi_R = 0.80$
Interface Friction Angle Concrete to Backfill, $\delta$	21°	30°	Value from AASHTO LRFD Manual
Active Pressure Coefficient, $K_A$ (Backfill)	0.28	—	
Frost Protection Depth	4 feet	—	ConnDOT Bridge Design Guide

\* For Backfill conforming to Pervious Structure backfill (section M.02.05)

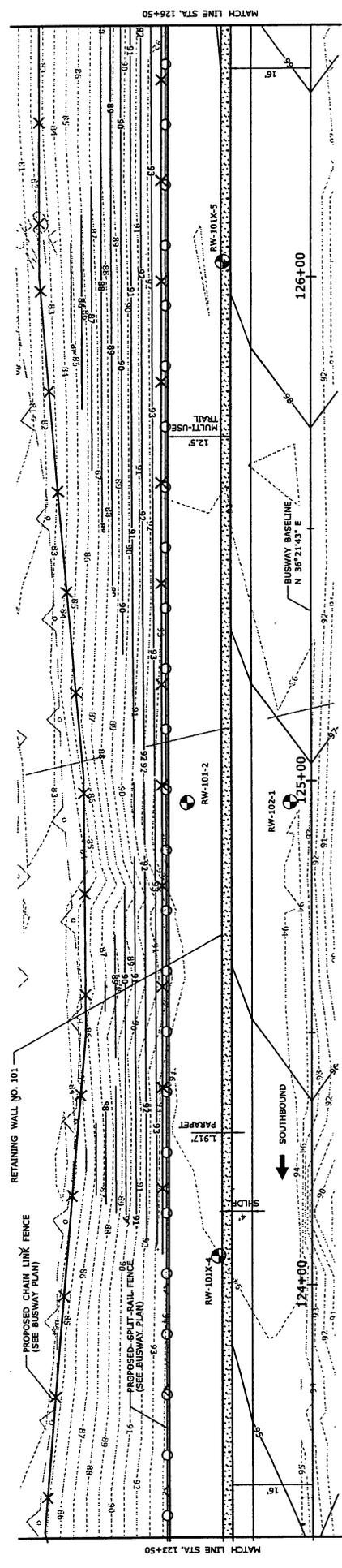
**4.0 Report Conditions:** This report has been prepared for specific a application to the subject project in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made. In the event that any changes in the nature, design and location of structures are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

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

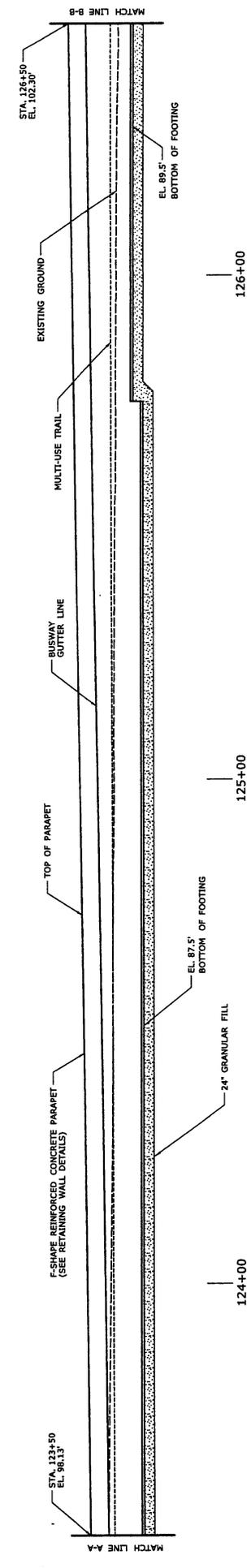
Dr. Clarence Welti, P.E., P.C., should perform a general review of the final design and specifications in order that geotechnical design recommendations may be properly interpreted and implemented as they were intended.

**APPENDIX 1**  
**BORING LOCATION PLAN**  
**TEST BORING LOGS**

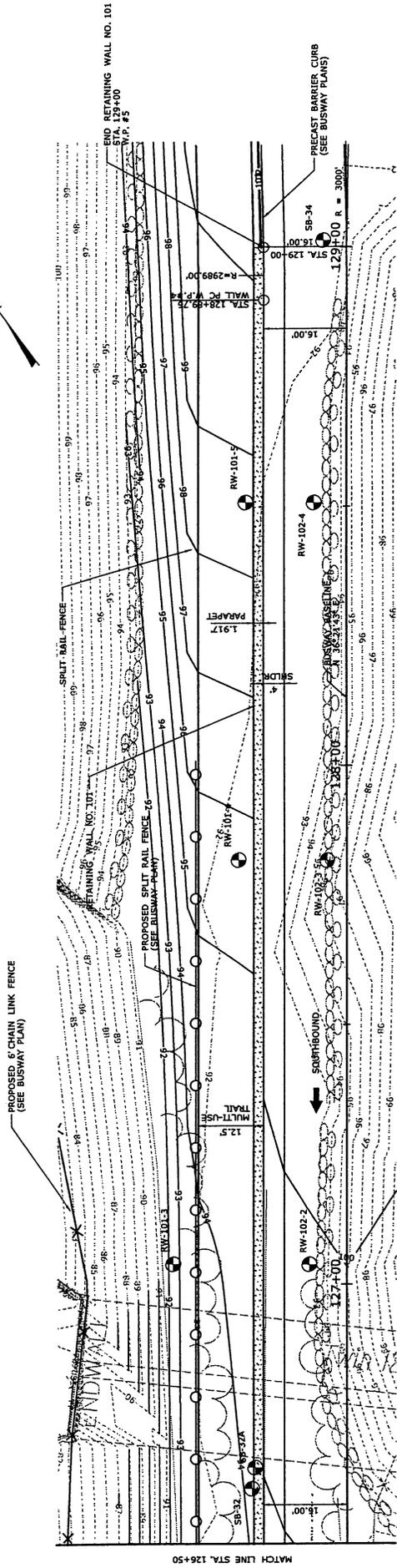




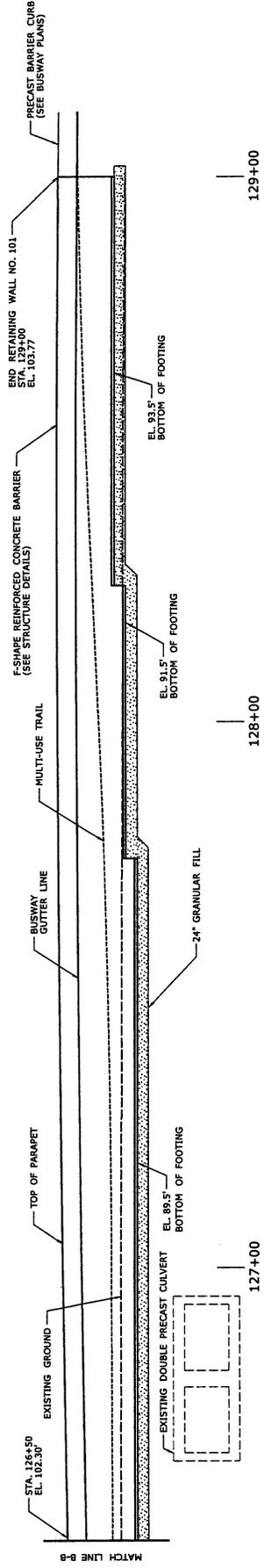
**PLAN**



**ELEVATION**



**PLAN**



**ELEVATION**

Thomas Lloret		<b>SM-001 REV. 10/92</b>				<b>BORING REPORT</b>				SHEET 1 OF 1		
DRILLER Don Moodie		STATE OF CONNECTICUT				DEPARTMENT OF TRANSPORTATION				Associated Borings Co., Inc.		
INSPECTOR Wolti & Associates, P.C.		TOWN: New Britain/Newington, CT				BORING CONTRACTOR Close Jensen & Miller, P.C.						
SOILS ENGINEER		PROJECT NAME: Hartford-New Britain Busway				DESIGN ENGINEER						
PROJECT NUMBER: 171-305		LOCATION:										
Surface Elevation: 99.44		Auger				Casing				Hole No. <b>RW-101-1</b>		
Date Started: 8/25/2007		Type				SS				Line & Station 122+0		
Date Finished: 8/25/2007		Size I. D. 2 1/4 in				2 in				Offset 25' LT		
Groundwater Observations		Hammer				140 lb				N Coordinate 811446.76		
AT 10 'AFTER 0 HRS		Fall				30 in				E. Coordinate 997751.89		
AT 'AFTER HRS												
DEPTH	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0-6	6-12	12-18	18-24		
5		0.0 - 2.0	1	12	14	D	3	3	7	7	25	Red Br. F. Silty Sand
		2.0 - 4.0	2	24	14	D	10	18	17	15		
		4.0 - 6.0	3	24	13	D	15	18	22	20		
10												
		10.0 - 12.0	4	24	13	D	10	16	17	18		
15												
		15.0 - 17.0	5	24	20	D	10	10	26	14		
20												
		20.0 - 22.0	6	24	20	D	11	11	10	14		
25												
		23.0 - 25.0	7	24	20	D	10	10	10	12		
30												
35												
40												
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth 25.0		Footage in Rock 0.0		No. of Samples 7		Hole No. <b>RW-101-1</b>						
SAMPLE TYPE CODING: D = DRIVEN		C = CORE		A = AUGER		UP = UNDISTURBED PISTON						
PROPORTIONS USED: TRACE = 1-10%		LITTLE = 10-20%		SOME = 20-35%		AND = 35-50%						

Jaime Lloret DRILLER		SM-001 REV. 10/92		BORING REPORT		SHEET 1 OF 1						
INSPECTOR Welti & Associates, P.C.		TOWN: New Britain/Newington, CT		STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION		Associated Borings Co., Inc.						
SOILS ENGINEER		PROJECT NAME: Hartford-New Britain Busway		PROJECT NUMBER: 171-305		BORING CONTRACTOR Close Jensen & Miller, P.C.						
Surface Elevation: 96.58		LOCATION:				DESIGN ENGINEER						
Date Started:	3/14/2011	Auger		Casing		Sampler						
Date Finished:	3/14/2011	Type	HSA			Core Bar						
Groundwater Observations		Size I. D.	2 1/4 in		2 in							
AT 2.5 ' AFTER 0 HRS		Hammer			140 lb	Bit						
AT ' AFTER HRS		Fall			30 in							
D E P T H	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0-6	6-12	12-18	18-24		
5		1.0 - 3.0	1	24	6	D	4	3	4	3	3	Blk C-F Sand and Gravel (Fill)
		3.0 - 5.0	2	24	6	D	7	9	7	9		Red Br. F. Sand, Some Silt
		5.0 - 7.0	3	24	14	D	4	7	6	7		
10		10.0 - 12.0	4	24	12	D	4	7	7	8	10	Red Br. Silt, Tr. F. Sand, Tr. Clay
15		15.0 - 17.0	5	24	6	D	25	9	11	12	25	
20		20.0 - 22.0	6	24	15	D	4	7	7	8	25	
		23.0 - 25.0	7	24	14	D	10	10	10	11		
25											25	End of Boring - 25.0
30											25	
35											25	
40											25	
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth		25.0	Footage in Rock		0.0	No. of Samples		7	Hole No.		RW-101X-1	
SAMPLE TYPE CODING:		D = DRIVEN		C = CORE		A = AUGER		UP = UNDISTURBED PISTON				
PROPORTIONS USED:		TRACE = 1-10%		LITTLE = 10-20%		SOME = 20-35%		AND = 35-50%				

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SOILS ENGINEER		PROJECT NAME: Hartford-New Britain Busway		PROJECT NUMBER: 171-305		BORING CONTRACTOR Close Jensen & Miller, P.C.						
Surface Elevation: 96.4		Type		Auger		Core Bar						
Date Started: 3/22/2011		Size I. D. 2 1/4 in		Hammer		Hole No. RW-101X-2						
Date Finished: 3/22/2011		Groundwater Observations		Fall		Line & Station 121+99						
AT 4.5 ' AFTER 0 HRS		Type		2 in		Offset 22' LT						
AT ' AFTER HRS		Hammer		140 lb Bit		N Coordinate 811439.62						
		Fall		30 in		E. Coordinate 997774.70						
D E P T H	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0 - 6	6 - 12	12-18	18-24		
5		1.0 - 3.0	1	24	8	D	10	14	16	12	3	Blk C-F Sand and Gravel (Fill)
		3.0 - 5.0	2	24	12	D	12	10	10	11		Red Br. F. Sand, Some Silt
		5.0 - 7.0	3	24	12	D	4	7	7	7		
10		10.0 - 12.0	4	24	13	D	3	4	4	5	13	Red Br. Silt, Tr. F. Sand, Tr. Clay
		15.0 - 17.0	5	24	20	D	2	4	4	5		
20		20.0 - 22.0	6	24	11	D	8	8	10	10	25	End of Boring - 25.0
		23.0 - 25.0	7	24	12	D	10	10	11	11		
30												
35												
40												
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth 25.0		Footage in Rock 0.0		No. of Samples 7		Hole No. RW-101X-2						
SAMPLE TYPE CODING: D = DRIVEN C = CORE A = AUGER UP = UNDISTURBED PISTON		PROPORTIONS USED: TRACE = 1-10% LITTLE = 10-20% SOME = 20-35% AND = 35-50%										

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SOILS ENGINEER		PROJECT NAME: Hartford-New Britain Busway				PROJECT NUMBER: 171-305				BORING CONTRACTOR Close Jensen & Miller, P.C.		
Surface Elevation: 95.03		LOCATION:				DESIGN ENGINEER						
Date Started: 3/22/2011		Auger		Casing		Sampler		Core Bar		Hole No. <b>RW-101X-3</b>		
Date Finished: 3/22/2011		Type		HSA						Line & Station 123+01		
Groundwater Observations		Size I. D.		2 1/4 in		2 in				Offset 18' LT		
AT 4.5 ' AFTER 0 HRS		Hammer				140 lb		Bit		N Coordinate 811518.85		
AT ' AFTER HRS		Fall				30 in				E. Coordinate 997838.50		
DEPTH	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0 - 6	6 - 12	12-18	18-24		
5		1.0 - 3.0	1	24	6	D	10	12	12	14	3	Blk C-F Sand and Gravel (Fill)
		3.0 - 5.0	2	24	5	D	12	10	6	6		Red Br. F. Sand, Some Silt
		5.0 - 7.0	3	24	6	D	4	7	7	8		
10		10.0 - 12.0	4	24	15	D	6	4	7	7	13	Red Br. Silt, Tr. F. Sand, Tr. Clay
15		15.0 - 17.0	5	24	16	D	4	7	8	8	25	End of Boring - 25.0
20		20.0 - 22.0	6	24	16	D	4	4	6	6		
25		23.0 - 25.0	7	24	12	D	6	6	4	6		
30												
35												
40												
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth 25.0		Footage in Rock 0.0		No. of Samples 7		Hole No. RW-101X-3						
SAMPLE TYPE CODING: D = DRIVEN C = CORE		A = AUGER		UP = UNDISTURBED PISTON								
PROPORTIONS USED: TRACE = 1-10%		LITTLE = 10-20%		SOME = 20-35%		AND = 35-50%						

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SOILS ENGINEER		PROJECT NAME: Hartford-New Britain Busway		PROJECT NUMBER: 171-305		BORING CONTRACTOR Close Jensen & Miller, P.C.						
Surface Elevation: 93.9		LOCATION:		DESIGN ENGINEER								
Date Started: 3/22/2011		Auger		Casing		Sampler		Core Bar		Hole No. <b>RW-101X-4</b>		
Date Finished: 3/22/2011		Type		HSA						Line & Station 124+06		
Groundwater Observations		Size I. D.		2 1/4 in		2 in				Offset 19' LT		
AT 15 'AFTER 0 HRS		Hammer				140 lb		Bit		N Coordinate 811604.09		
AT 'AFTER HRS		Fall				30 in				E. Coordinate 997899.98		
D E P T H	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0-6	6-12	12-18	18-24		
5		1.0-3.0	1	24	6	D	7	10	12	12	3	Blk C-F Sand and Gravel (Fill)
		3.0-5.0	2	24	8	D	13	10	10	10		
		5.0-7.0	3	24	12	D	5	7	5	7		
		7.0-9.0	4	24	6	D	7	7	6	6		
10		10.0-12.0	5	24	2	D	1	1	1	1	15	Red Br. F. Sand, Some Silt (Fill)
		12.0-14.0	6	24	4	D	2	2	1	1		
15		15.0-17.0	7	24	15	D	8	8	9	8	25	Red Br. F. Sand, Some Silt Little F. Gravel
		20.0-22.0	8	24	6	D	8	12	12	11		
20		23.0-25.0	9	24	0	D	15	21	24	20	25	End of Boring - 25.0
25											30	
30											35	
35											40	
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth 25.0		Footage in Rock 0.0		No. of Samples 9		Hole No. <b>RW-101X-4</b>						
SAMPLE TYPE CODING: D = DRIVEN		C = CORE		A = AUGER		UP = UNDISTURBED PISTON						
PROPORTIONS USED: TRACE = 1-10%		LITTLE = 10-20%		SOME = 20-35%		AND = 35-50%						

Jaime Lloret		SM-001 REV. 10/92		BORING REPORT		SHEET 1 OF 1						
DRILLER		STATE OF CONNECTICUT										
INSPECTOR		DEPARTMENT OF TRANSPORTATION				Associated Borings Co., Inc.						
Welti & Associates, P.C.		TOWN: New Britain/Newington, CT				BORING CONTRACTOR						
SOILS ENGINEER		PROJECT NAME: Hartford-New Britain Busway				Close Jensen & Miller, P.C.						
Surface Elevation: 92.6		PROJECT NUMBER: 171-305				DESIGN ENGINEER						
Date Started: 3/22/2011		Auger		Casing		Sampler						
Date Finished: 3/22/2011		Type		HSA		Core Bar						
Groundwater Observations		Size I. D.		2 1/4 in		2 in						
AT 18 ' AFTER 0 HRS		Hammer				140 lb Bit						
AT ' AFTER HRS		Fall				30 in						
Hole No.		RW-101X-5										
Line & Station		126+03										
Offset		18' LT										
N Coordinate		811762.35										
E. Coordinate		998017.78										
D E P T H	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0 - 6	6 - 12	12-18	18-24		
5		1.0 - 3.0	1	24	6	D	6	10	11	10	3	Blk C-F Sand and Gravel (Fill)
		3.0 - 5.0	2	24	7	D	7	10	12	7		
		5.0 - 7.0	3	24	6	D	5	6	5	6		
		7.0 - 9.0	4	24	15	D	7	6	7	7		
10		10.0 - 12.0	5	24	8	D	3	4	5	5	18	Red Br. F. Sand, Some Silt (Fill)
		12.0 - 14.0	6	24	10	D	4	5	5	5		
15		15.0 - 17.0	7	24	10	D	3	4	5	4		
		17.0 - 19.0	8	24	8	D	4	5	8	10		
20		20.0 - 22.0	9	24	0	D	12	14	18	14	25	Red Br. F. Sand, Some Silt Little F. Gravel
		23.0 - 25.0	10	24	4	D	10	21	25	23		
25											25	End of Boring - 25.0
30											30	
35											35	
40											40	
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth		Footage in Rock		No. of Samples		Hole No.		RW-101X-5				
SAMPLE TYPE CODING:		D = DRIVEN		C = CORE		A = AUGER		UP = UNDISTURBED PISTON				
PROPORTIONS USED:		TRACE = 1-10%		LITTLE = 10-20%		SOME = 20-35%		AND = 35-50%				

Thomas Lloret		<b>SM-001 REV. 10/92 BORING REPORT</b>								SHEET 1 OF 1		
DRILLER Don Moodie		STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION								Associated Borings Co., Inc.		
INSPECTOR Walti & Associates, P.C.		TOWN: New Britain/Newington, CT								BORING CONTRACTOR Close Jensen & Miller, P.C.		
SOILS ENGINEER		PROJECT NAME: Hartford-New Britain Busway								DESIGN ENGINEER		
Surface Elevation: 99.44		PROJECT NUMBER: 171-305										
Date Started: 8/25/2007		Auger		Casing		Sampler		Core Bar		Hole No. <b>RW-101-1</b>		
Date Finished: 8/25/2007		Type		HSA		SS				Line & Station 122+0		
Groundwater Observations		Size I. D.		2 1/4 in		2 in				Offset 25' LT		
AT 10 ' AFTER 0 HRS		Hammer				140 lb		Bit		N Coordinate 811446.76		
AT ' AFTER HRS		Fall				30 in				E. Coordinate 997751.89		
D E P T H	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0-6	6-12	12-18	18-24		
5		0.0 - 2.0	1	12	14	D	3	3	7	7	25	Red Br. F. Silty Sand
		2.0 - 4.0	2	24	14	D	10	18	17	15		
		4.0 - 6.0	3	24	13	D	15	18	22	20		
10		10.0 - 12.0	4	24	13	D	10	16	17	18	25	End of Boring - 25.0
15		15.0 - 17.0	5	24	20	D	10	10	26	14	25	End of Boring - 25.0
20		20.0 - 22.0	6	24	20	D	11	11	10	14	25	End of Boring - 25.0
25		23.0 - 25.0	7	24	20	D	10	10	10	12	25	End of Boring - 25.0
30											25	End of Boring - 25.0
35											25	End of Boring - 25.0
40											25	End of Boring - 25.0
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For				Feet		
Footage in Earth 25.0		Footage in Rock 0.0		No. of Samples 7		Hole No. <b>RW-101-1</b>						
SAMPLE TYPE CODING: D = DRIVEN C = CORE A = AUGER UP = UNDISTURBED PISTON		PROPORTIONS USED: TRACE = 1-10% LITTLE = 10-20% SOME = 20-35% AND = 35-50%										

Jaime Lloret		SM-001 REV. 10/92		BORING REPORT		SHEET 1 OF 1						
DRILLER		STATE OF CONNECTICUT										
Don Moodie		DEPARTMENT OF TRANSPORTATION				Associated Borings Co., Inc.						
INSPECTOR		TOWN:		New Britain/Newington, CT		BORING CONTRACTOR						
Welti & Associates, P.C.		PROJECT NAME:		Hartford-New Britain Busway		Close Jensen & Miller, P.C.						
SOILS ENGINEER		PROJECT NUMBER:		171-305		DESIGN ENGINEER						
Surface Elevation: 93.57		LOCATION:										
Date Started: 8/31/2007		Auger		Casing		Sampler		Core Bar		Hole No. <b>RW-101-2</b>		
Date Finished: 8/31/2007		Type		HSA		SS				Line & Station 125+0		
Groundwater Observations		Size I. D.		2 1/4 in		2 in				Offset 5' LT		
AT 18 ' AFTER 0 HRS		Hammer				140 lb		Bit		N Coordinate 811680.23		
AT ' AFTER HRS		Fall				30 in				E. Coordinate 997948.37		
D E P T H	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0-6	6-12	12-18	18-24		
5											4	Blk & Br. C-F Sand and C-F Gravel, Cobbles (Fill)
		5.0 - 7.0	1	24	12	D	9	11	14	11		
10											17.5	Red Br. M-F Sand, Some Silt, Some C-F Gravel, (Fill)
		10.0 - 12.0	2	24	8	D	7	6	7	9		
15											20	Red Br. C-F Sand, Some C-F Gravel (Fill)
		14.0 - 16.0	3	24	6	D	4	5	7	8		
20											35	Red Br. F. Silty Sand, Tr. C-F Gravel
		16.0 - 18.0	4	24	8	D	5	7	11	40		
25											35	Refusal - 35.0
		18.0 - 20.0	5	24	14	D	22	19	18	17		
30											35	NOTE: BORING ELEVATION 15' HIGHER DUE TO OFFSET
		20.0 - 22.0	6	24	7	D	9	11	7	7		
35											35	NOTE: BORING ELEVATION 15' HIGHER DUE TO OFFSET
		22.0 - 24.0	7	24	10	D	9	9	14	14		
40											35	NOTE: BORING ELEVATION 15' HIGHER DUE TO OFFSET
		25.0 - 27.0	8	24	19	D	7	10	11	12		
											35	NOTE: BORING ELEVATION 15' HIGHER DUE TO OFFSET
	30.0 - 32.0	9	24	14	D	7	10	11	12			
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth 35.0		Footage in Rock 0.0		No. of Samples 9		Hole No. <b>RW-101-2</b>						
SAMPLE TYPE CODING: D = DRIVEN C = CORE		A = AUGER		UP = UNDISTURBED PISTON								
PROPORTIONS USED: TRACE = 1-10% LITTLE = 10-20%		SOME = 20-35%		AND = 35-50%								

Thomas Lloret		SM-001 REV. 10/92 BORING REPORT								SHEET 1 OF 1		
DRILLER Don Moodie		STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION								Associated Borings Co., Inc.		
INSPECTOR Walti & Associates, P.C.		TOWN: New Britain/Newington, CT				PROJECT NAME: Hartford-New Britain Busway				BORING CONTRACTOR Close Jensen & Miller, P.C.		
SOILS ENGINEER		PROJECT NUMBER: 171-305				DESIGN ENGINEER						
Surface Elevation: 91.3		LOCATION:										
Date Started: 8/25/2007		Auger		Casing		Sampler		Core Bar		Hole No. <b>RW-101-3</b>		
Date Finished: 8/25/2007		Type		HSA		SS				Line & Station 127+0		
Groundwater Observations		Size I. D.		2 1/4 in		2 in				Offset 22' LT		
AT 18 'AFTER 0 HRS		Hammer				140 lb		Bit		N Coordinate 811852.86		
AT 'AFTER HRS		Fall				30 in				E. Coordinate 998065.00		
DEPTH	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0-6	6-12	12-18	18-24		
5		0.0 - 2.0	1	12	5	D	13	15	X	X	5	Red Br. M-F Sand and C-F Gravel (Fill)
		2.0 - 4.0	2	24	14	D	11	13	13	17		
		4.0 - 6.0	3	12	8	D	17	50	X	X		
10		6.0 - 8.0	BLDR				X	X	X	X	18	Red Br. M-F Sand and C-F Gravel (Fill)
		8.0 - 10.0	4	24	11	D	12	13	13	20		
		10.0 - 12.0	5	24	10	D	12	14	36	15		
15		12.0 - 14.0	6	12	5	D	27	50	X	X	19	Possible Organic Layer (No Rec in Spoon) Red Br. M-F Sand and C-F Gravel, Some Silt
		14.0 - 16.0	7	24	11	D	16	17	11	15		
		16.0 - 18.0	8	24	14	D	15	15	21	11		
20		18.0 - 20.0	9	24	0	D	2	2	11	14	26.5	Refusal - 26.5
		20.0 - 22.0	10	24	4	D	14	15	36	10		
		22.0 - 24.0	11	24	12	D	14	20	40	36		
25		25.0 - 26.2	12	14	6	D	17	30	50/2"	X	30	
35											40	
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth 26.5		Footage in Rock 0.0		No. of Samples 12		Hole No. <b>RW-101-3</b>						
SAMPLE TYPE CODING: D = DRIVEN C = CORE		A = AUGER		UP = UNDISTURBED PISTON								
PROPORTIONS USED: TRACE = 1-10% LITTLE = 10-20%		SOME = 20-35%		AND = 35-50%								

Thomas Lloret		SM-001 REV. 10/92		BORING REPORT		SHEET 1 OF 1						
DRILLER Don Moodie		STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION				Associated Borings Co., Inc.						
INSPECTOR Welti & Associates, P.C.		TOWN: New Britain/Newington, CT				BORING CONTRACTOR Close Jensen & Miller, P.C.						
SOILS ENGINEER		PROJECT NAME: Hartford-New Britain Busway				DESIGN ENGINEER						
PROJECT NUMBER: 171-305		LOCATION:										
Surface Elevation: 91.92						Hole No. <b>RW-101-4</b>						
Date Started: 8/25/2007		Auger		Casing		Sampler						
Date Finished: 8/25/2007		Type		HSA		SS						
Groundwater Observations		Size I. D.		2 1/4 in		2 in						
AT 18 ' AFTER 0 HRS		Hammer				140 lb Bit						
AT ' AFTER HRS		Fall				30 in						
D E P T H	Casing blows per foot	SAMPLE				BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)	
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0 - 6	6 - 12	12-18			18-24
5		2.0 - 4.0	1	24	10	D	10	17	15	20	2	Red Br. M-F Sand and C-F Gravel (Fill)
		4.0 - 6.0	2	24	15	D	7	10	11	11		Red Br. M-F Silty Sand, Some C-F Gravel (Fill)
		6.0 - 8.0	3	24	10	D	9	11	13	11	17	
		8.0 - 10.0	4	24	11	D	10	10	14	12		
		10.0 - 12.0	5	24	13	D	5	6	6	6		
	12.0 - 14.0	6	24	10	D	5	5	5	5			
	14.0 - 16.0	7	24	10	D	5	4	5	5			
15		16.0 - 18.0	8	24	10	D	5	4	4	4	24	
20		20.0 - 22.0	9	24	11	D	10	10	12	14		
25											24	Refusal - 24.0
30												
35												
40												
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth 24.0		Footage in Rock 0.0		No. of Samples 9		Hole No. <b>RW-101-4</b>						
SAMPLE TYPE CODING: D = DRIVEN C = CORE		A = AUGER		UP = UNDISTURBED PISTON								
PROPORTIONS USED: TRACE = 1-10%		LITTLE = 10-20%		SOME = 20-35%		AND = 35-50%						

Jaime Lloret		SM-001 REV. 10/92		BORING REPORT		SHEET 1 OF 1						
DRILLER		STATE OF CONNECTICUT										
Don Moodie		DEPARTMENT OF TRANSPORTATION				Associated Borings Co., Inc.						
INSPECTOR		TOWN:		New Britain/Newington, CT		BORING CONTRACTOR						
Welti & Associates, P.C.		PROJECT NAME:		Hartford-New Britain Busway		Close Jensen & Miller, P.C.						
SOILS ENGINEER		PROJECT NUMBER:		171-305		DESIGN ENGINEER						
Surface Elevation: 92.04		LOCATION:										
Date Started: 8/30/2007		Auger		Casing		Sampler		Core Bar		Hole No. <b>RW-101-5</b>		
Date Finished: 8/30/2007		Type		HSA		SS				Line & Station 128+50		
Groundwater Observations		Size I. D.		2 1/4 in		2 in				Offset 3' LT		
AT 17 ' AFTER 0 HRS		Hammer				140 lb		Bit		N Coordinate 811955.11		
AT ' AFTER HRS		Fall				30 in				E. Coordinate 998173.70		
DEPTH	Casing blows per foot	SAMPLE					BLOWS PER 6 INCHES ON SAMPLER				STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	0-6	6-12	12-18	18-24		
5		0.0 - 1.5	1	18	6	D	9	31	50	X	4	Blk & Br. C-F Sand and C-F Gravel, Cobbles (Fill)
		2.0 - 4.0	2	24	10	D	9	12	11	11		
		4.0 - 6.0	3	24	12	D	10	10	9	10		
		6.0 - 8.0	4	24	12	D	10	6	7	9		
		8.0 - 10.0	5	24	16	D	8	10	7	10		
10		10.0 - 12.0	6	24	10	D	7	9	8	9	16	Br. C-F Sand and C-F Gravel, Cobbles (Fill)
		12.0 - 14.0	7	24	12	D	6	7	9	9		
		14.0 - 16.0	8	24	8	D	4	5	3	3		
15		16.0 - 18.0	9	24	20	D	3	2	3	4	20	Red Br. F. Sand, Some Silt, Tr. Organics
		18.0 - 20.0	10	24	14	D	4	6	7	10		
20		20.0 - 22.0	11	24	13	D	7	9	11	50	23	Red Br. F. Sand, Some Silt
25											23	Refusal - 23.0
30											23	Refusal - 23.0
35											23	Refusal - 23.0
40											23	Refusal - 23.0
From Ground Surface to		Feet Used		Inch Casing Then		Inch Casing For		Feet				
Footage in Earth 23.0		Footage in Rock 0.0		No. of Samples 11		Hole No. <b>RW-101-5</b>						
SAMPLE TYPE CODING: D = DRIVEN		C = CORE		A = AUGER		UP = UNDISTURBED PISTON						
PROPORTIONS USED: TRACE = 1-10%		LITTLE = 10-20%		SOME = 20-35%		AND = 35-50%						

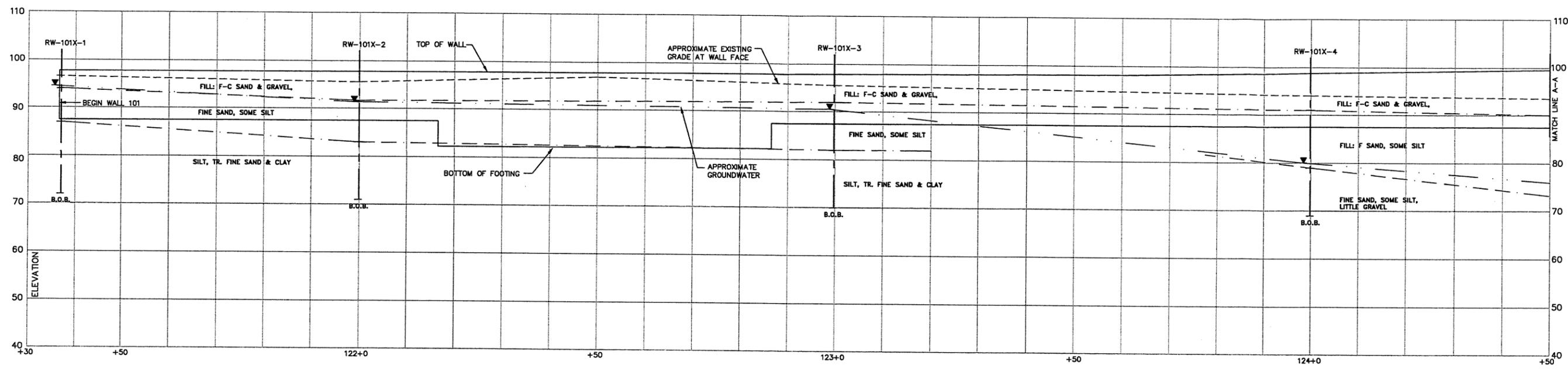
**APPENDIX 2**

**GRAIN SIZE GRADATION TESTS**

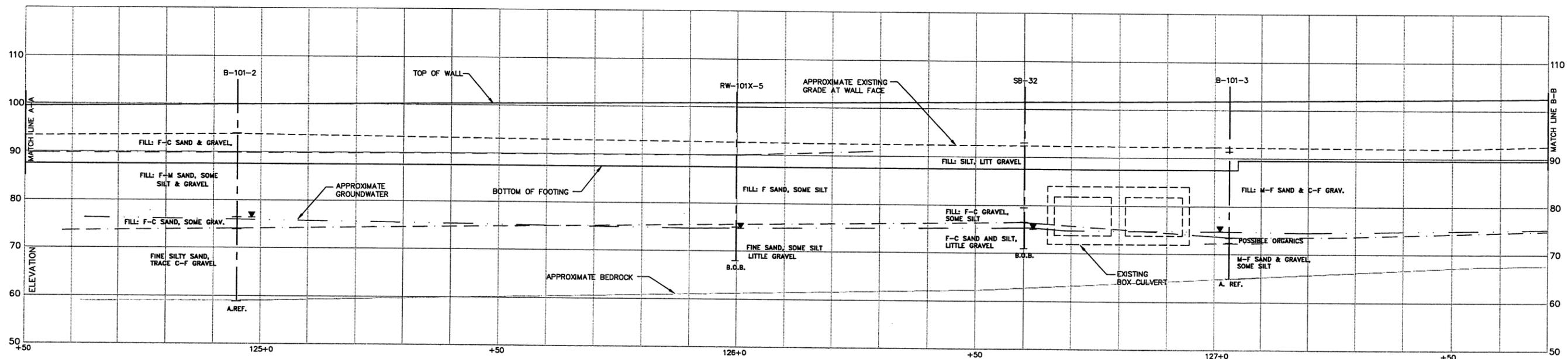
**WATER CONTENT TESTS**

## **APPENDIX 2**

### **Geologic Sections + Grain Size Gradations (if any)**



SOIL PROFILE - WALL 101



SOIL PROFILE - WALL 101

- A. REF. = AUGER REFUSAL
- B.O.B. = BOTTOM OF BORING
- ▼ = OBSERVED GROUNDWATER LEVEL
- = ESTIMATED WATER TABLE
- = STRATUM CHANGE
- = GRADE LINE

REVISIONS		
DATE	NO.	DESCRIPTION

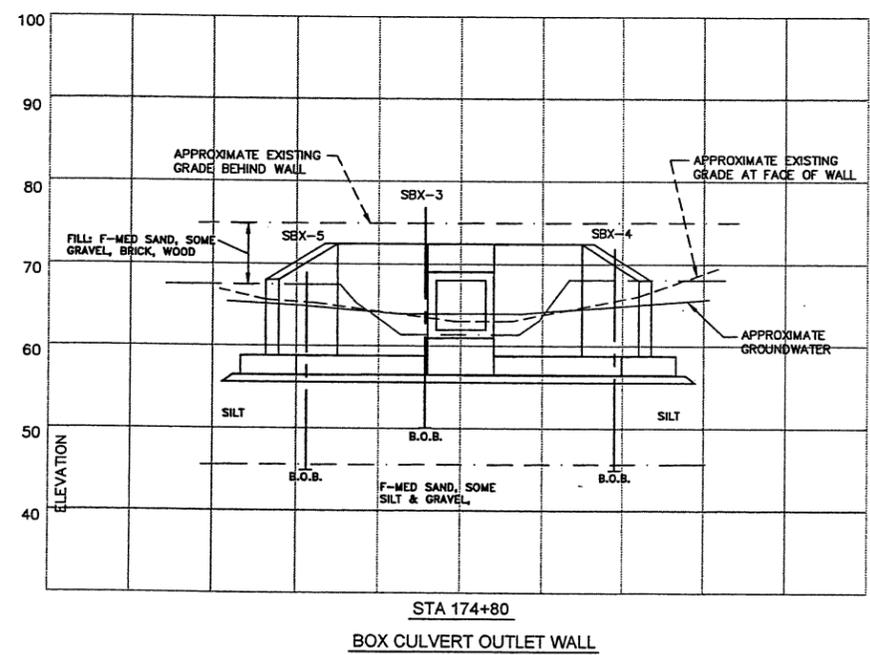
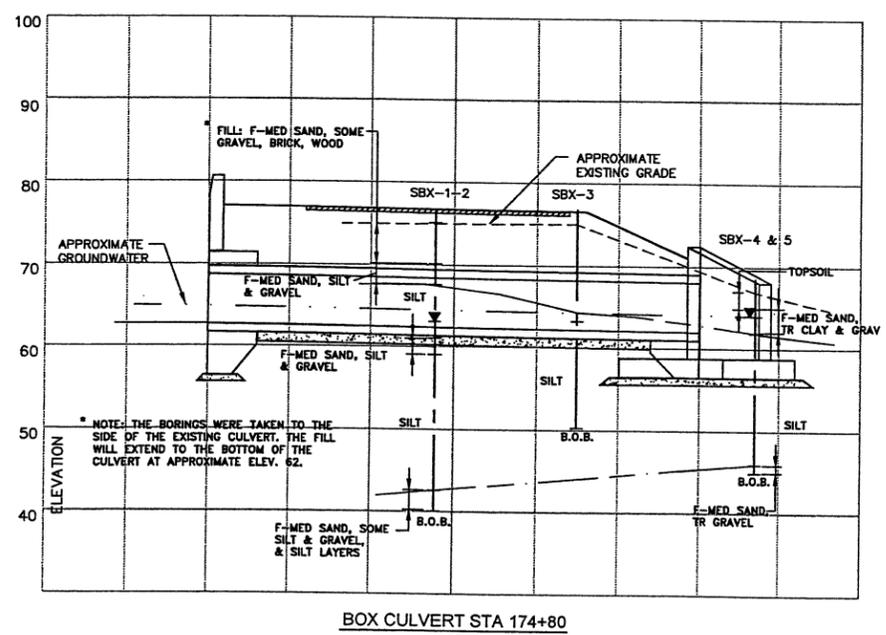
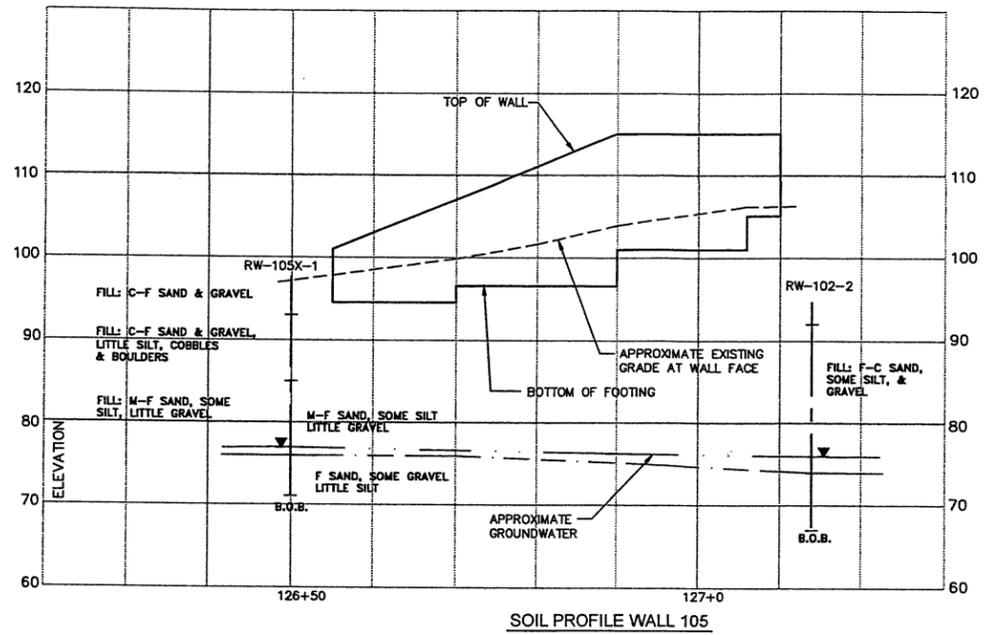
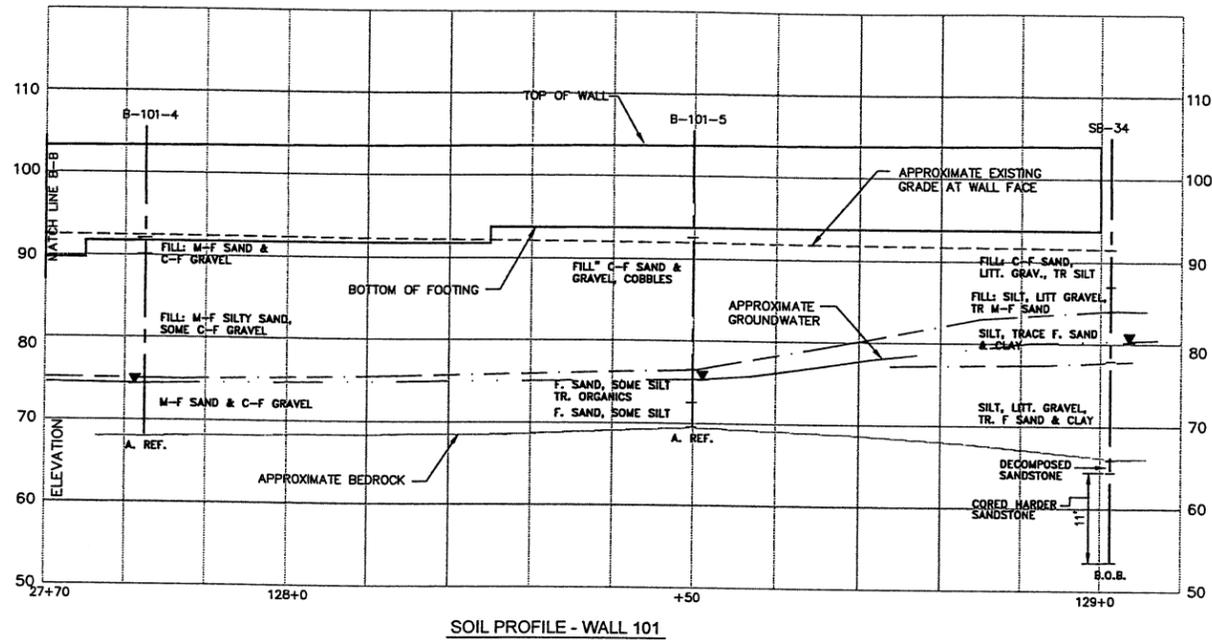
NEW BRITAIN - HARTFORD BUSWAY  
NEWINGTON SECTIONS A & B

STRUCTURE GEOTECHNICAL SECTIONS

SCALE: 1" = 10' DATE: MARCH 30, 2011

DR. CLARENCE WELT, P.E., P.C.  
227 WILLIAMS STREET, P.O. BOX 807  
GLASTONBURY, CONNECTICUT 06033

SHEET 1



- A. REF. = AUGER REFUSAL
- B.O.B. = BOTTOM OF BORING
- ▼ = OBSERVED GROUNDWATER LEVEL
- = ESTIMATED WATER TABLE
- = STRATUM CHANGE
- = GRADE LINE

REVISIONS		
DATE	NO.	DESCRIPTION

NEW BRITAIN - HARTFORD BUSWAY  
NEWINGTON SECTIONS A & B

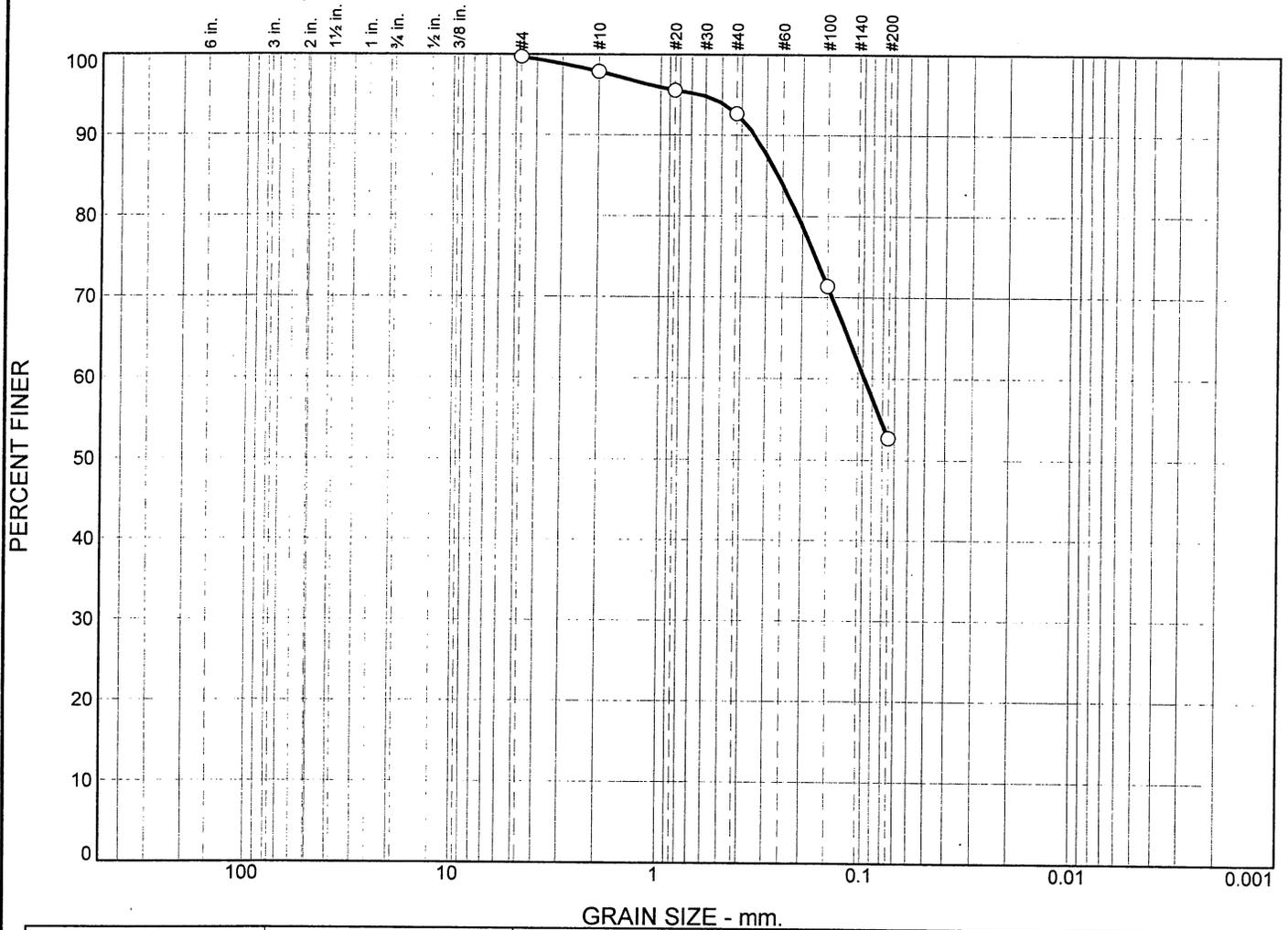
STRUCTURE GEOTECHNICAL SECTIONS

SCALE: 1" = 10'      DATE: MARCH 30, 2011

DR. CLARENCE WELTI, P.E., P.C.  
227 WILLIAMS STREET, P.O. BOX 587  
GLASTONBURY, CONNECTICUT 06033

SHEET 2

# Particle Size Distribution Report



GRAIN SIZE - mm.											
% +3"		% Gravel		% Sand			% Fines				
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay			
○				2	5	40	53				
⊗		LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○				0.2632	0.0981						

Material Description	USCS	AASHTO
○		

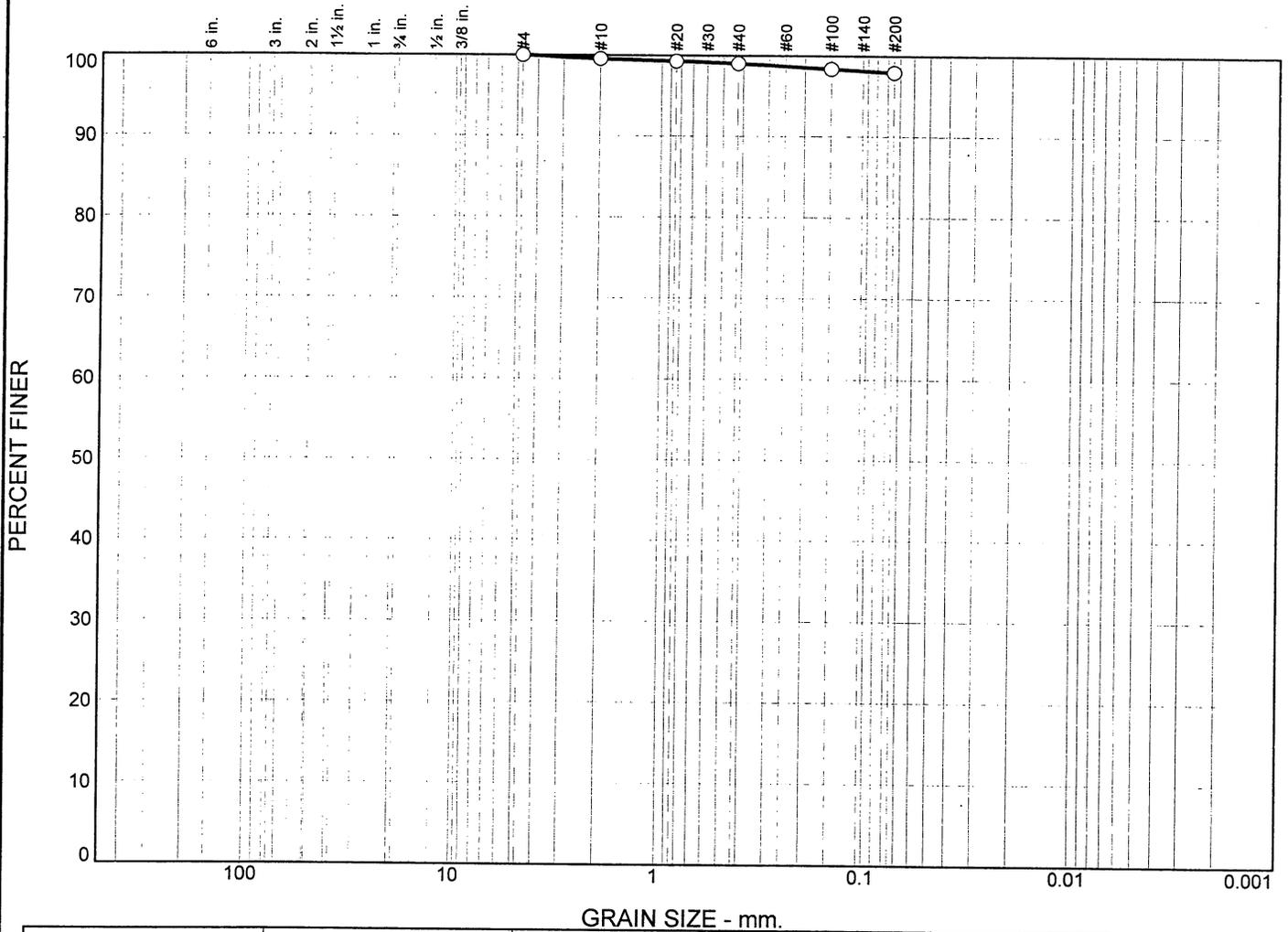
**Project No.** \_\_\_\_\_ **Client:** CJM  
**Project:** NEW BRITAIN BUSWAY  
 ○ **Source of Sample:** RW101-1      **Depth:** 4-6'      **Sample Number:** 3

**Remarks:**  
 ○ Water Content - 1.4%

CLARENCE WELTI ASSOCIATES, INC.

Figure

# Particle Size Distribution Report



GRAIN SIZE - mm.										
	% +3"	% Gravel		% Sand			% Fines		Clay	
		Coarse	Fine	Coarse	Medium	Fine	Silt			
○	0	0	0	0	1	1	98			
⊗	LL	PL	D85	D60	D50	D30	D15	D10	Cc	Cu
○										
Material Description								USCS	AASHTO	
○										

**Project No.** \_\_\_\_\_ **Client:** CJM  
**Project:** NEW BRITAIN BUSWAY  
**Source of Sample:** RW101-2      **Depth:** 10-12'      **Sample Number:** 2

CLARENCE WELTI ASSOCIATES, INC.

**Remarks:**  
 ○ Water content - 20.7%