

GEOTECHNICAL DESIGN REPORT

18-0583

June 21, 2019

Explorations and Geotechnical Engineering Services

Slope Stabilization and Wall Replacement
Project

Route 15 / I-395 Underpass

Brewer, Maine

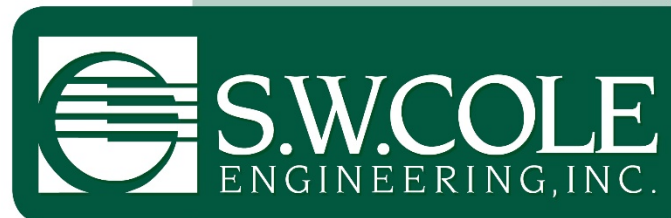
WIN 022833.00

PREPARED FOR:

Maine Department of Transportation
Attention: Kate Maguire, P.E.
State House Station 16
Augusta, ME 04333-0016

PREPARED BY:

S. W. Cole Engineering, Inc.
26 Coles Crossing Drive
Sidney, ME 04330
T: (207) 626-0600



- *Geotechnical Engineering*
- *Construction Materials Testing and Special Inspections*
- *GeoEnvironmental Services*
- *Test Boring Explorations*

This report is being provided for informational purposes regarding subsurface information adjacent to Abutment 2 of the Veterans Remembrance Bridge. Design recommendations have been redacted from this version of the geotechnical report since those recommendations were associated with a different project.

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18-0583

June 21, 2019

Maine Department of Transportation
Attention: Kate Maguire, P.E.
State House Station 16
Augusta, ME 04333-0016

Subject: Geotechnical Design Report
Explorations and Geotechnical Engineering Services
Slope Stabilization and Wall Replacement Project
Route 15 (South Main Street) / I-395 Underpass
Brewer, Maine
WIN 022833.00

Dear Kate:

In accordance with our Proposal dated June 22, 2018 and project Assignment Letter #7 dated June 26, 2018, we have made subsurface explorations for the subject project. The purpose of our services was to obtain subsurface information in order to provide geotechnical recommendations for slope stabilization and earthwork associated with the proposed wall replacement. The services provided by S. W. Cole Engineering, Inc. (S.W.COLE) were conducted in accordance with our Multi-PIN Agreement with the Maine Department of Transportation (MaineDOT), No. 20150720000000000085, dated July 20, 2015. The contents of this report are subject to the limitations in Appendix A.

1.0 INTRODUCTION

1.1 Site Conditions

The project is located on the east side of Route 15 (South Main Street) at the underpass of the Interstate 395 (I-395) Veteran's Remembrance Bridge (Bridge No. 1558) in Brewer, Maine. The project location is shown on the "Site Location Map" attached in Appendix B. The project consists of a ± 145 -foot long, 2 to 15-foot tall steel bin wall with a $\pm 1.5H:1V$ or flatter back-slope that transitions to a soil slope from north to south. The east I-395 bridge abutment is located behind the bin wall and slope. Route 15 (South Main Street) is located at the toe of the bin wall and slope.

Based on the provided information and observations made during a site visit on May 7, 2018, the existing soil slope appears stable and has localized erosion channels corresponding to bridge down spout locations. We understand the slope surface was covered with shotcrete as part of previous mitigation repairs. We understand the existing bin wall is showing signs of minor corrosion. Based on our review of the Historic Bin Wall Details Plan Sheet (Sheet 12) dated September 1983 and 15 foot exposed height, we anticipate the bin wall is about 10 to 15 feet deep and embedded about 3.5 to 5.5 feet. Water seepage was not observed during our visit.

Based on our review of the Historic Soils Reports dated January 1982 and August 1983 prepared by MaineDOT and provided abutment as-built plans, we understand the existing bridge east abutment (Abutment No. 2) is pile-supported. Based on our review of the provided Geotechnical Design Memorandum dated June 29, 2010 prepared by MaineDOT, we understand the existing bridge abutment wing walls consist of Prefabricated Concrete Modular Gravity (PCMG) walls supported on compacted fills.

1.2 Proposed Construction

We understand the wall replacement and slope repair alternatives under consideration include:

- Replace the existing steel bin wall with a Precast Concrete Block Gravity (PCBG) Wall with 1.5H:1V or flatter backslope;
- Replace the existing steel bin wall with a Precast Concrete Modular Gravity (PCMG) Wall with 1.5H:1V or flatter backslope;
- Reconstruct the existing steel bin wall with a new concrete fascia and deadman anchors;
- Reconstruct the existing slope with a 1H:1V or flatter GeoCell Reinforced Slope; and
- Reconstruct the existing soil slope with riprap armoring.

We anticipate the selected option may include a combination of the presented alternatives.

2.0 EXPLORATIONS AND TESTING

2.1 Explorations

2.1.1 Current Explorations

Six test borings (HB-BRE-101, -101A, -102, -102A, -102B and -103) were made at the site between July 23 and 25, 2018 by S. W. Cole Explorations, LLC using a track-mounted Diedrich D50 drill rig. The exploration locations were selected and established in the field by S.W.COLE using taped measurements from existing site features. The exploration locations are shown on the “Boring Location Plan” attached in Appendix B. Logs of the test borings and a Key to Soil and Rock Descriptions and Terms used on the logs are attached in Appendix C.

2.1.2 Historic Explorations

Ten test borings (GP-33-78, GP-1-80, GP-30-80, GP-40-81, GP-1-82, GP-55-82, GP-30-83, MT-5, MT-6 and MT-12) were made in the project vicinity in 1978 and 1983 for the I-395 Veteran’s Remembrance Bridge east abutment development concept. The approximate locations of these test borings are shown on the “Plan and Profile” for the I-395 Bridge attached in Appendix B. Logs of these explorations are attached in Appendix B.

2.2 Testing

The 2018 test borings were drilled using a combination of auger and cased-wash boring drilling techniques. The soils were sampled at 2 to 5-foot intervals using a split-spoon sampler and Standard Penetration Testing (SPT) methods. Upon encountering refusal boring HB-BRE-102B was advanced about 5 feet into bedrock using a NQ2 rock coring. The hammer efficiency factor (0.918), uncorrected SPT blow counts, raw field N-values, corrected N-values (N_{60}) and rock core intervals are shown on the logs in Appendix C. The drill rig was equipped with a calibrated automatic hammer to drive the split-spoon. Corrected N-values in this report were computed by applying an average energy transfer of 0.918 for the calibrated automatic hammer to the raw field N-values.

Soils samples recovered from the test borings were visually classified in our laboratory and transported to the MaineDOT Laboratory in Bangor, Maine for testing to assist soil classification and identification. Laboratory testing was performed on disturbed SPT samples obtained during the explorations. Laboratory testing was performed by the MaineDOT Materials Testing and Exploration Central Laboratory in Bangor, Maine in

accordance with applicable American Association of State Highway and Transportation Officials (AASHTO) testing procedures. Laboratory testing included three grain size analyses with natural water content tests and two grain size analyses with hydrometer and natural water content tests. Laboratory test results are shown on the boring logs in Appendix C and are provided in Appendix D.

3.0 SUBSURFACE CONDITIONS

3.1 Surficial and Bedrock Geology

According to the Maine Geological Survey (MGS) mapping of the Bangor Quadrangle (Open-File 11-6, 2011)¹, mapped surficial geology units within the site vicinity consists of the following:

- Presumpscot Formation consisting of glaciomarine silt, clay, and sand; and
- Eskers consisting of sand and gravel.

The subsurface conditions encountered generally consisted of fill soils from previous site development overlying glacial till. The subsurface conditions encountered are generally consistent with the historic borings made at the site.

According to MGS mapping of the Bangor Quadrangle (Open-File 11-57, 2011)², mapped bedrock geology units within the site vicinity consists of medium to dark grey, medium- to very fine-grained feldspathic metawacke (metamorphosed sandstone) of the Bangor Formation/Penobscot River Member and dark grey to black siltstone and claystone of the Brewer Formation. The bedrock encountered at HB-BRE-102B is generally consistent with the mapped bedrock geology.

3.2 Soil and Bedrock

The 2018 test borings encountered a soils profile generally consisting of fill overlying glacial till underlain by bedrock. The principal strata encountered in the explorations are summarized below. Refer to the attached logs for more detailed descriptions of the subsurface findings at the exploration locations.

¹ Syverson, K. M., and Thompson, A. H., 2011, Surficial geology of the Bangor quadrangle, Maine: Maine Geological Survey, Open-File Map 11-6, map, scale 1:24,000.

² Pollock, S. G., 2011, Bedrock geology of the Bangor quadrangle, Maine: Maine Geological Survey, Open-File Map 11-57, color map, scale 1:24,000

Pavement: Bituminous concrete pavement was encountered at the ground surface in borings HB-BRE-101, -101A, -102, -102A and -102B made through Route 15 (South Main Street). The bituminous concrete pavement thickness was 10.5 to 11 inches (0.9 feet).

Fill: Below the pavement, the borings encountered fills extending to depths of about 5 to 30 feet below ground surface (bgs), corresponding to Elevation (El.) 17.4 to -9.0 feet. The thickness of the fill soils appear to decrease in thickness from north to south. The fill soils generally consisted of sand with varying amounts of gravel and silt with cobbles.

The fill was generally medium dense to very dense with SPT N_{60} values ranging from 12 blows per foot (bpf) to 112 bpf.

Glacial Till: Below the fill, the borings encountered glacial till generally consisting of silt and sand with varying amounts of gravel and occasional cobbles and boulders.

The glacial till was generally medium dense to very dense with SPT N_{60} values ranging from 24 bpf to refusal (greater than 50 blows per 6 inch increment of drive).

Bedrock: Upon encountering refusal at a depth of approximately 39.6 feet bgs (El. -19.2 feet), boring HB-BRE-102B was advanced 5 feet into a bedrock by rock coring. The bedrock was classified as grey, moderately hard, meta-sandstone of the Bangor Formation, Penobscot River Member.

3.3 Groundwater

The soils encountered at the test borings were damp to moist from the ground surface. The water level in HB-BRE-102, -102A, -102B and -103 immediately after drilling ranged from 12.5 to 16.3 feet bgs. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate seasonally, particularly in response to periods of snowmelt and precipitation, changes in site use and the water level of adjacent waterways or wet areas.

5.0 CLOSURE

We trust this information meets your present needs. Please contact us if you have any questions or need further assistance.

Sincerely,

S. W. Cole Engineering, Inc.

Michael A. St. Pierre, P.E.
Geotechnical Engineer

Robert E. Chaput, Jr., P.E.
Senior Geotechnical Engineer

MAS/tjb-rec

APPENDIX A

Limitations

This report has been prepared for the exclusive use of the Maine Department of Transportation for specific application to the Slope Stabilization and Wall Replacement Project at the Route 15 / Interstate 395 Underpass (MaineDOT WIN 022833.00) in Brewer, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

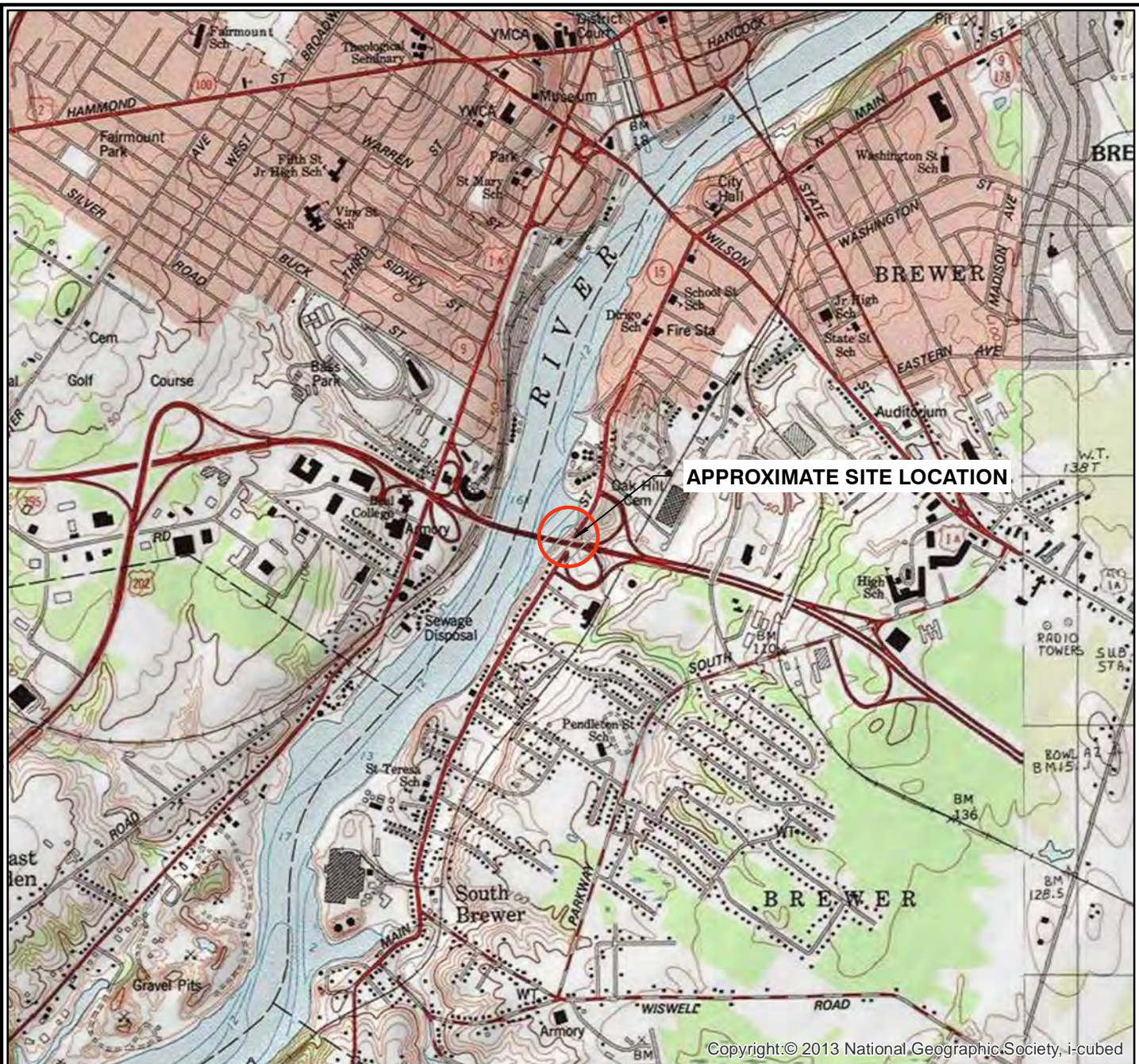
The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.

APPENDIX B

Figures



APPROXIMATE SITE LOCATION

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2,000 0 2,000 4,000



Scale in Feet



S.W.COLE
ENGINEERING, INC.

MAINE DEPARTMENT OF TRANSPORTATION

SITE LOCATION MAP

SLOPE STABILIZATION AND WALL REPLACEMENT PROJECT

SOUTH MAIN STREET / I-395 UNDERPASS

BREWER, MAINE

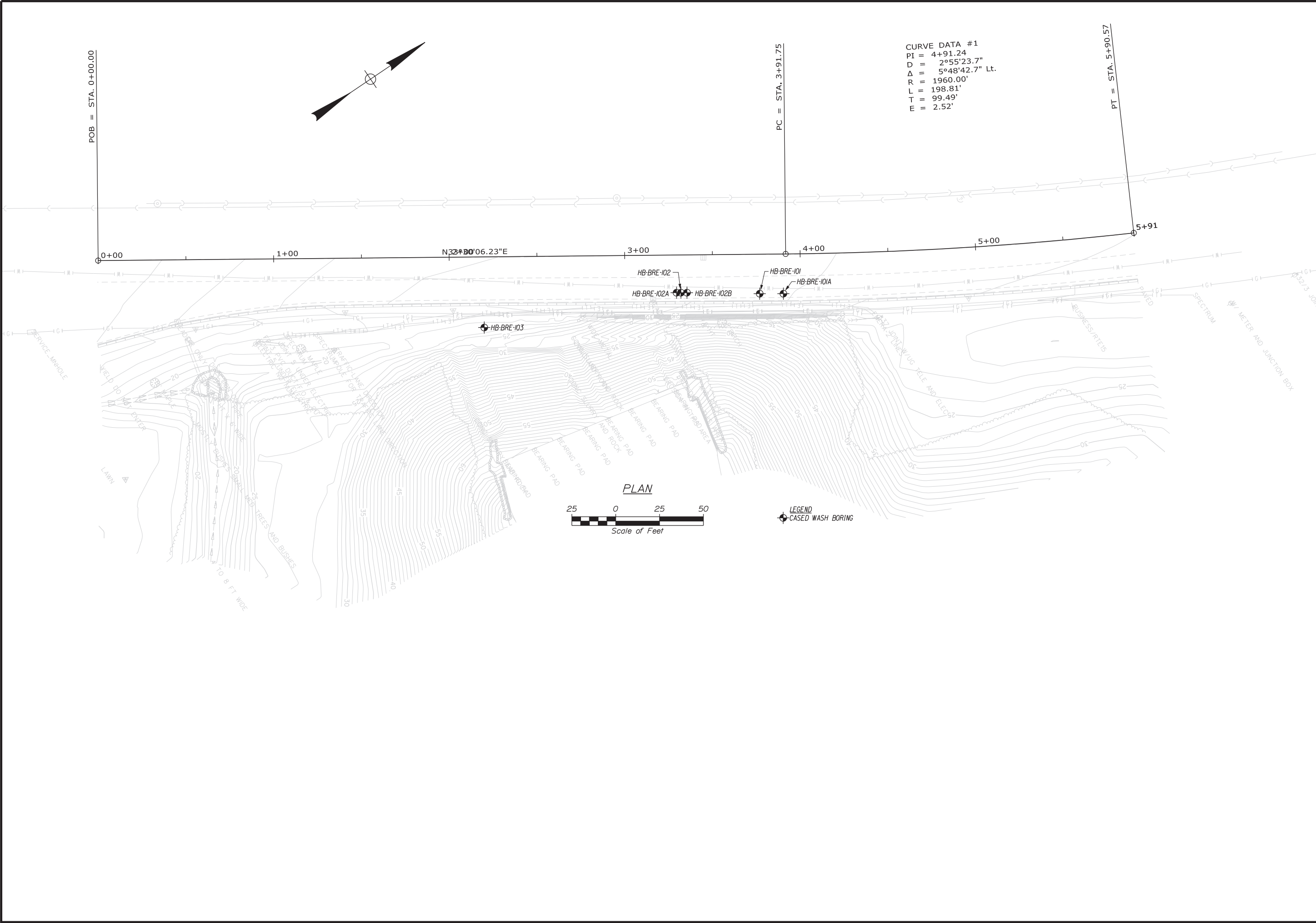
WIN 022833.00

NOTE:

SITE LOCATION MAP PREPARED FROM
ESRI ArcGIS ONLINE AND DATA PARTNERS
INCLUDING USGS AND © 2007 NATIONAL
GEOGRAPHIC SOCIETY.

Job No. 18-0583
Date: 08/23/2018

Scale 1:24000
Sheet 1



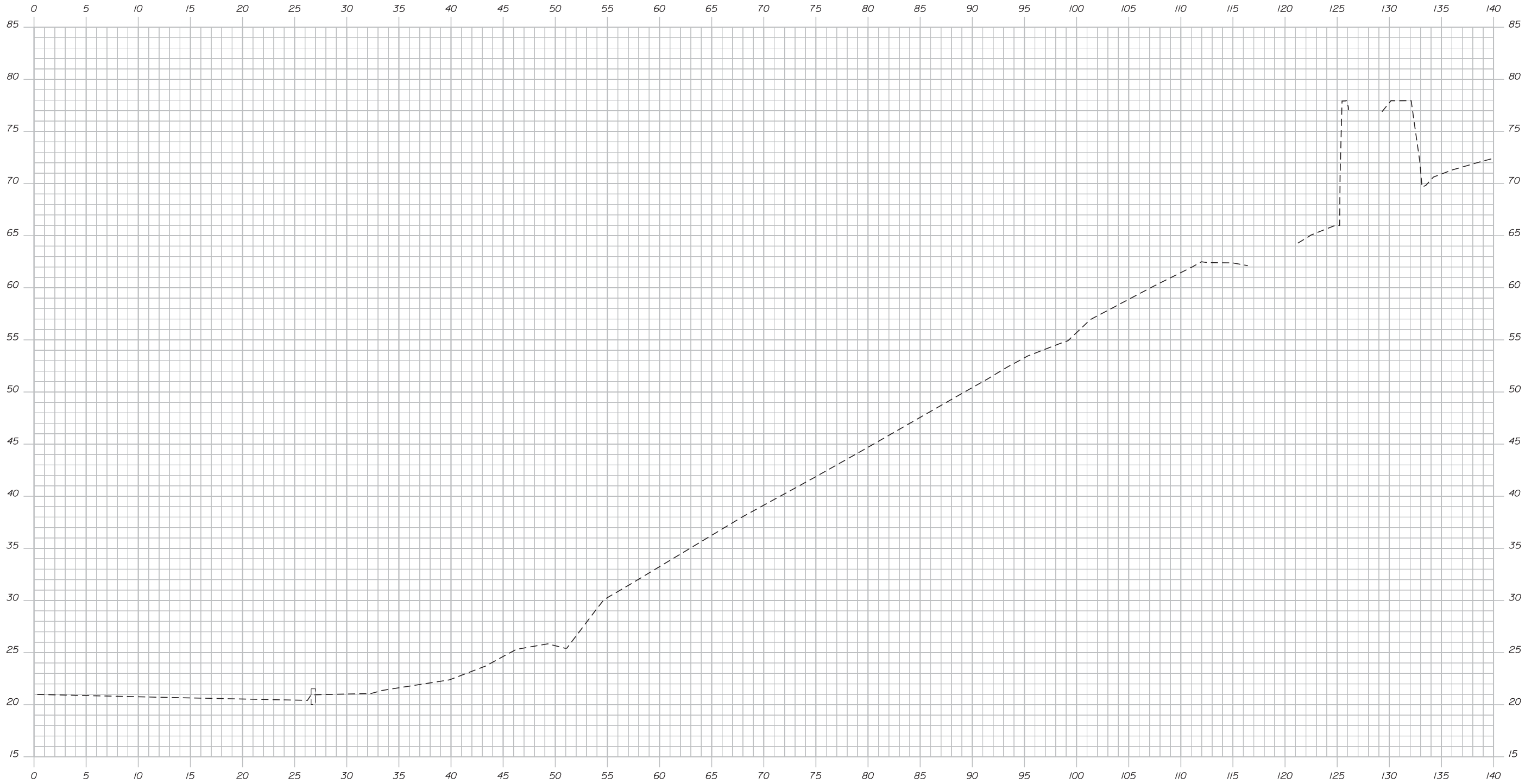
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		-BORING LOCATION PLAN- SLOPE STABILIZATION & WALL REPLACEMENT		DESIGN-DETAILED CHECKED-REVIEWED DESIGN2-DETAILED2 DESIGN3-DETAILED3	----- -----<				

Date:6/20/2019

Username: Terry.White

Division: GEOTECH

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STATE OF MAINE

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WIN
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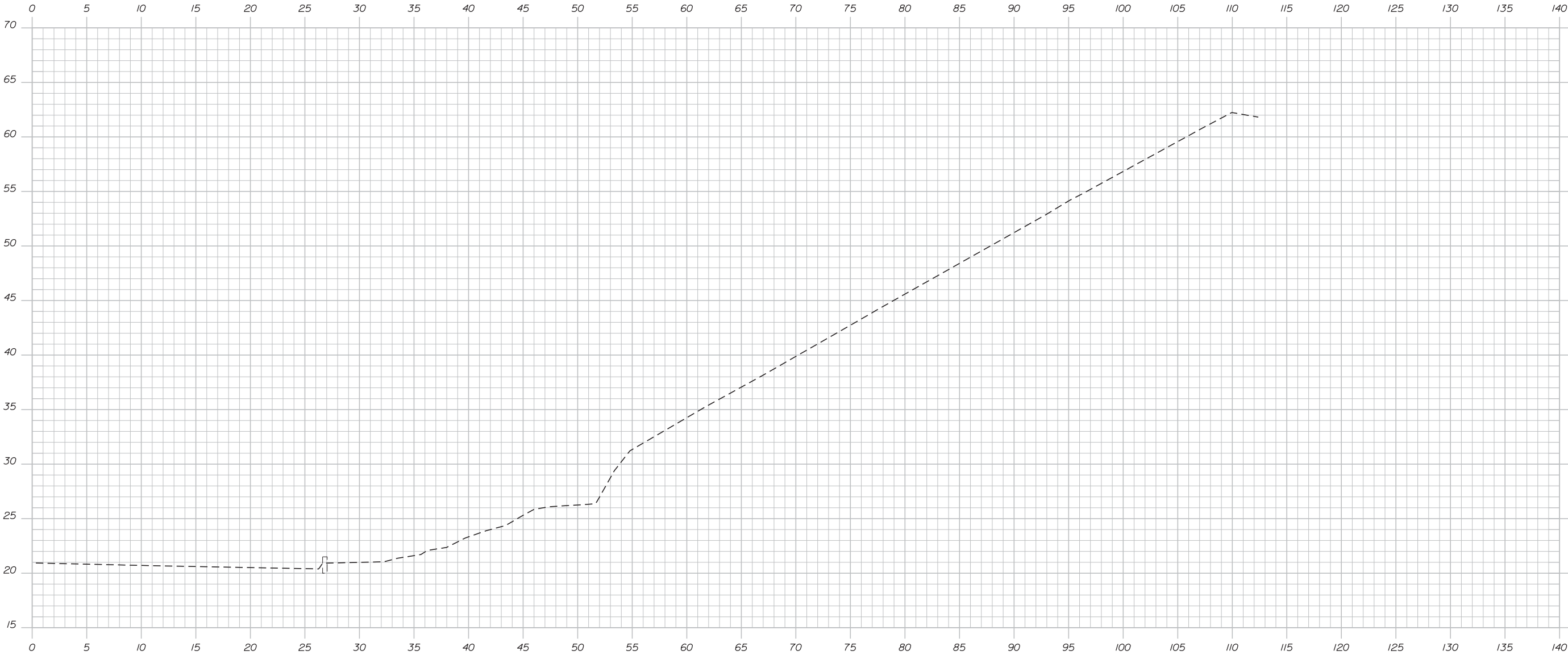
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ROUTE 15 (SOUTH MAIN ST.)

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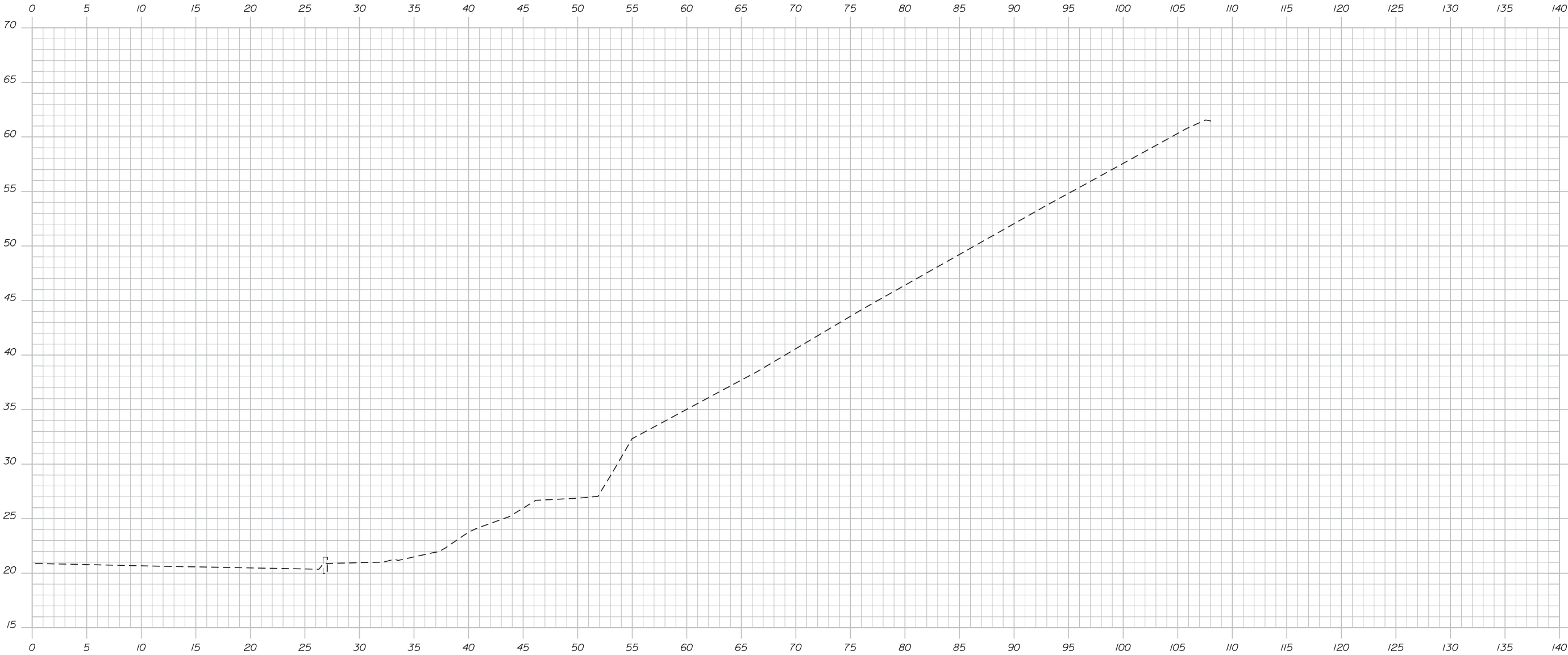
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22833.00		REVISIONS 4	REVISIONS 5	REVISIONS 6	DATE
HIGHWAY PLANS		FIELD CHANGES	FIELD CHANGES	FIELD CHANGES	FIELD CHANGES

BREWER
ROUTE 15 (SOUTH MAIN ST.)

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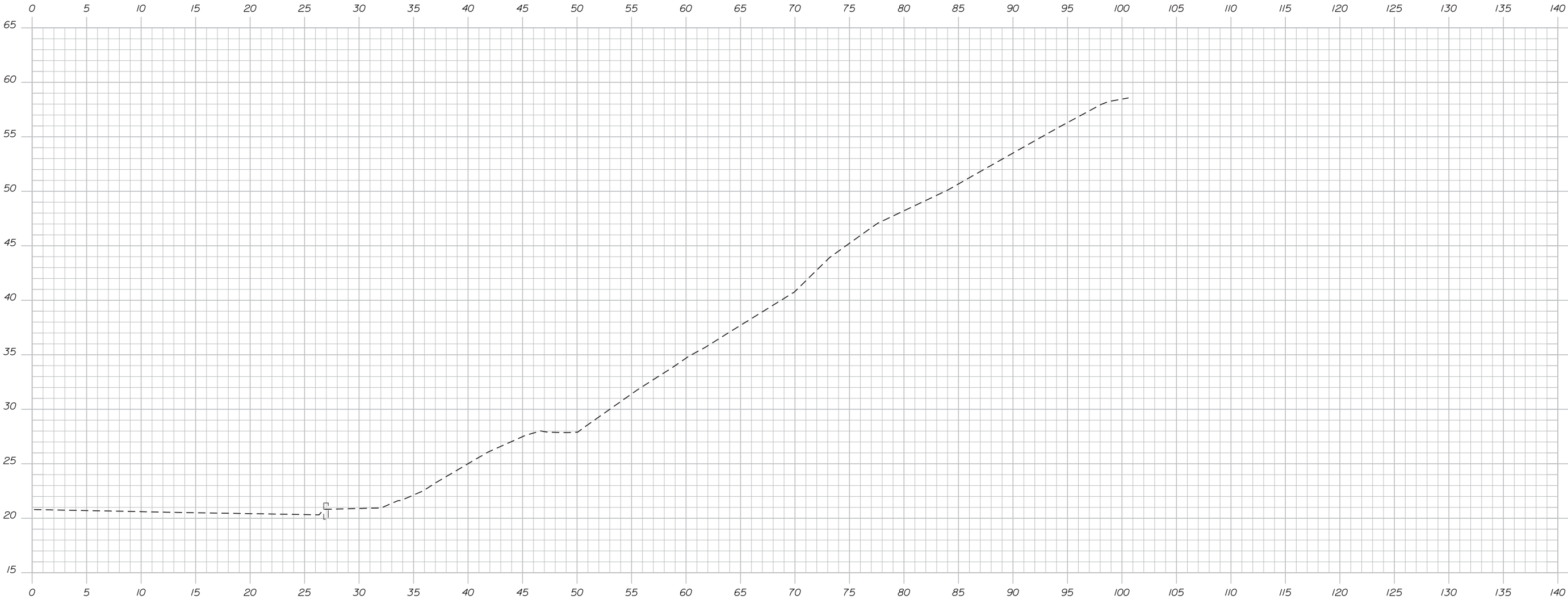
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M.S.T. PIERRE

T. WHITE

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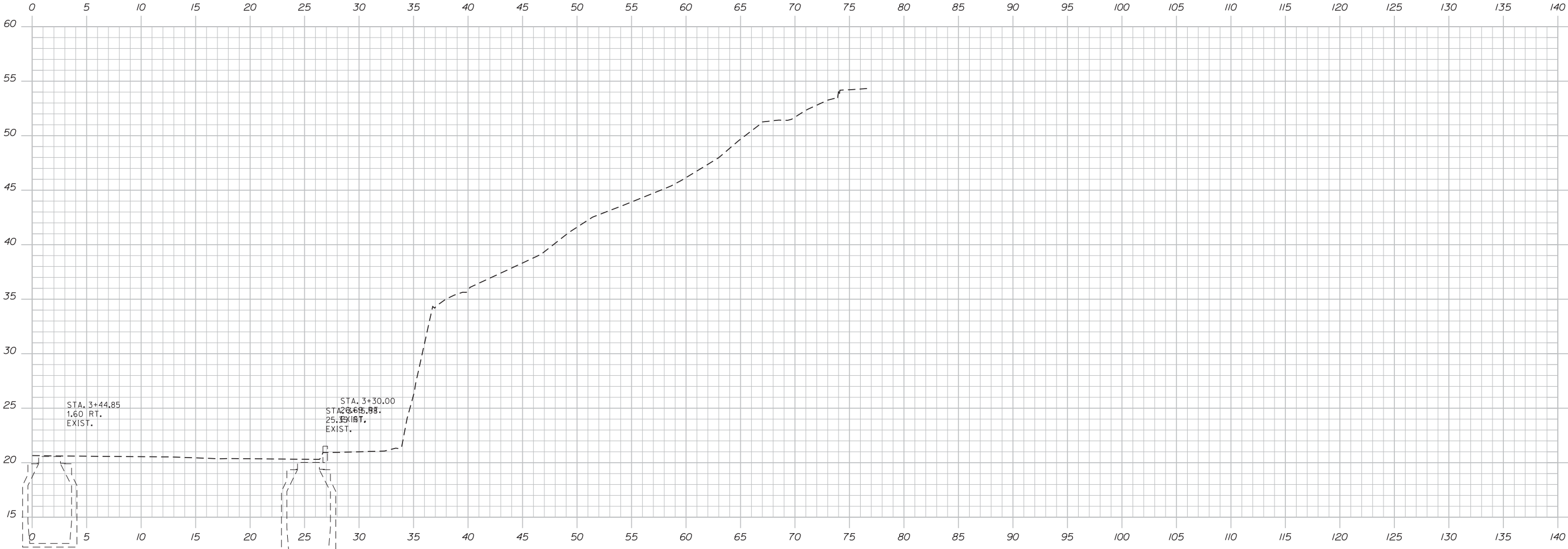
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HIGHWAY PLANS

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WIN 22833.00 HIGHWAY PLANS

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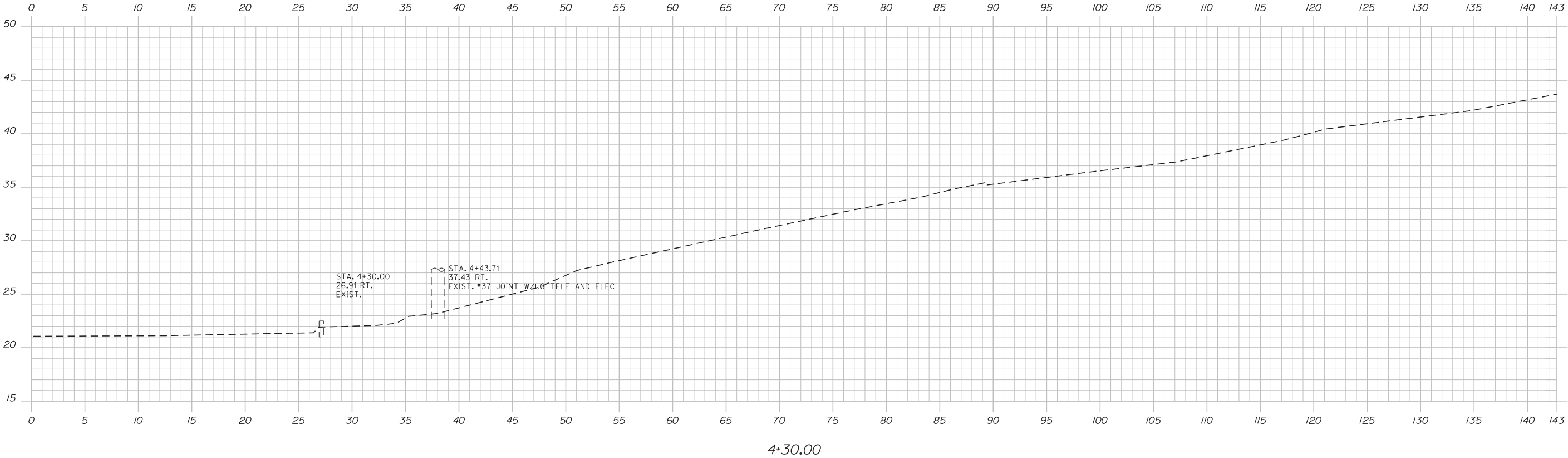
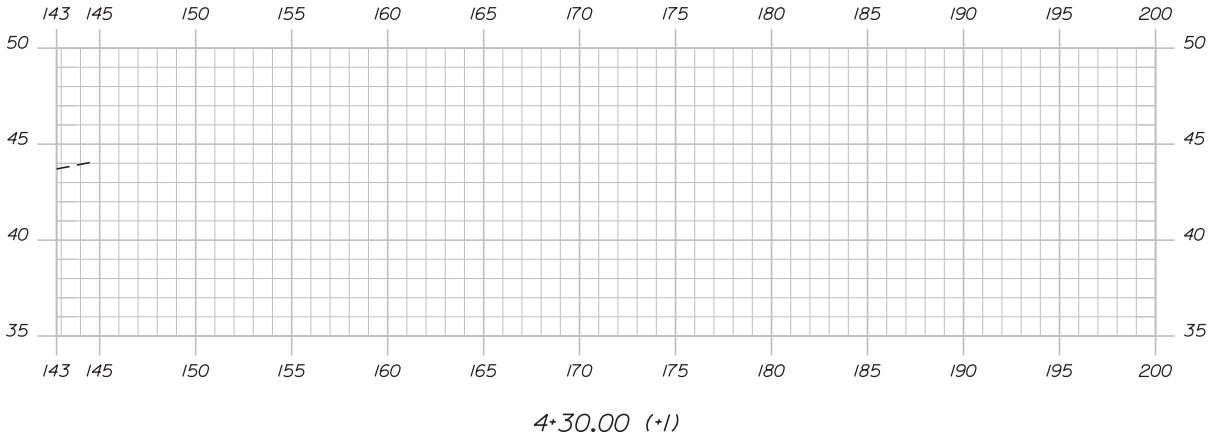
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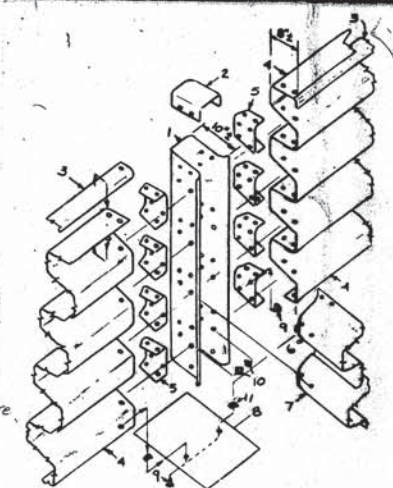
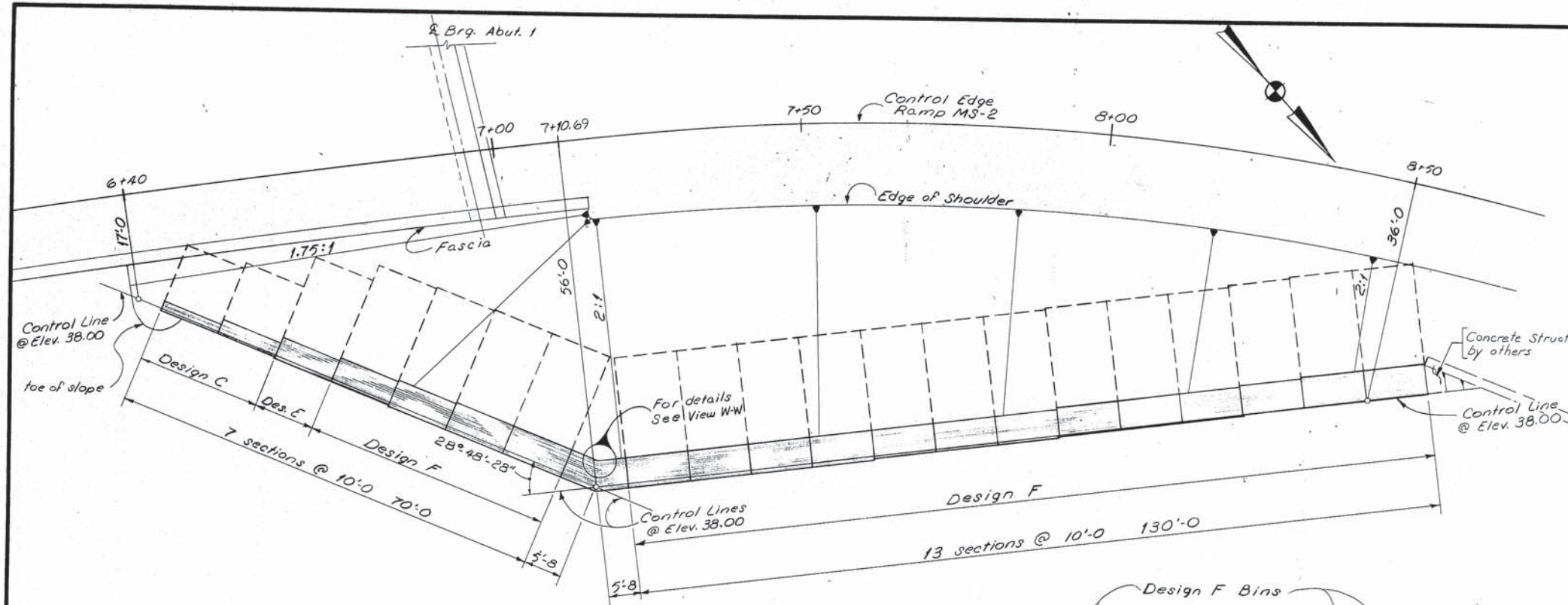


STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
022833.00
WIN 22833.00
HIGHWAY PLANS

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BREWER ROUTE 15 (SOUTH MAIN ST.)
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NOTE:
The exploded view is the front panel joint of the steel bin-type retaining wall as seen from the rear. Other wall member configurations may be used if it is of equal strength and approved by the Engineer. See the Parts List.

For co-ordination requirements see note 6 sheet 2.

For retaining wall options see note 7 sheet 2.

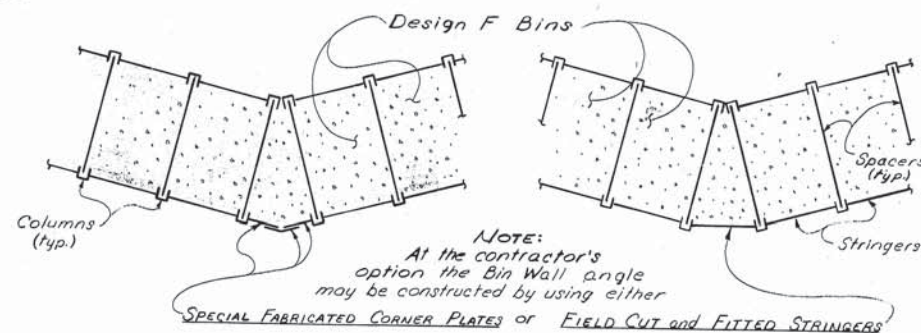
BIN WALL DETAIL
(EXPLODED VIEW)

PARTS LIST

Unit	Name	Gage	Description
1	Column	8	Vertical member connecting all other units.
2	Column Cap	12	Cover for front column.
3	Stringer Stiffener	8	Top flange protector.
4	Stringer	see typ. section	Horizontal longitudinal member in front and rear walls.
5	Connecting Panel	8	Connector for attaching stringers to columns.
6	Spacer	see des. table	Transverse members that separate the front and rear columns.
7	Bottom Spacer		Special bottom transverse member.
8	Base Plate	1	Installation plate on which the column rests.
*	Column Splice	10	Connects columns for higher walls.
*	Split Column	8	Connects rear stringer of thinner wall to spacers of thicker wall.
9	1 1/4" x 8" bolts		
10	5/8" nuts		
11	5/8" spring nuts		

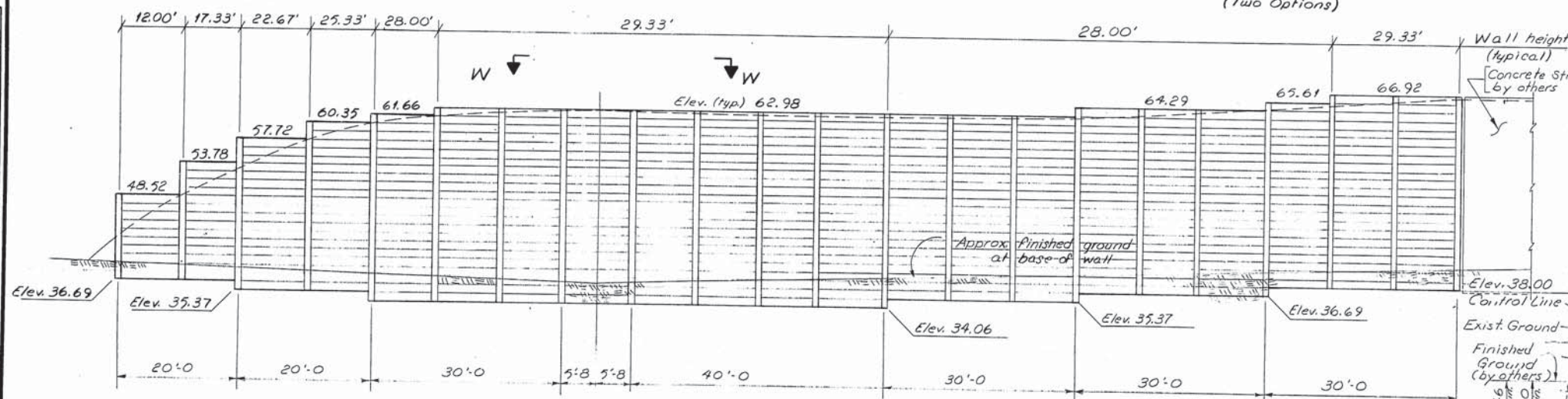
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PLAN

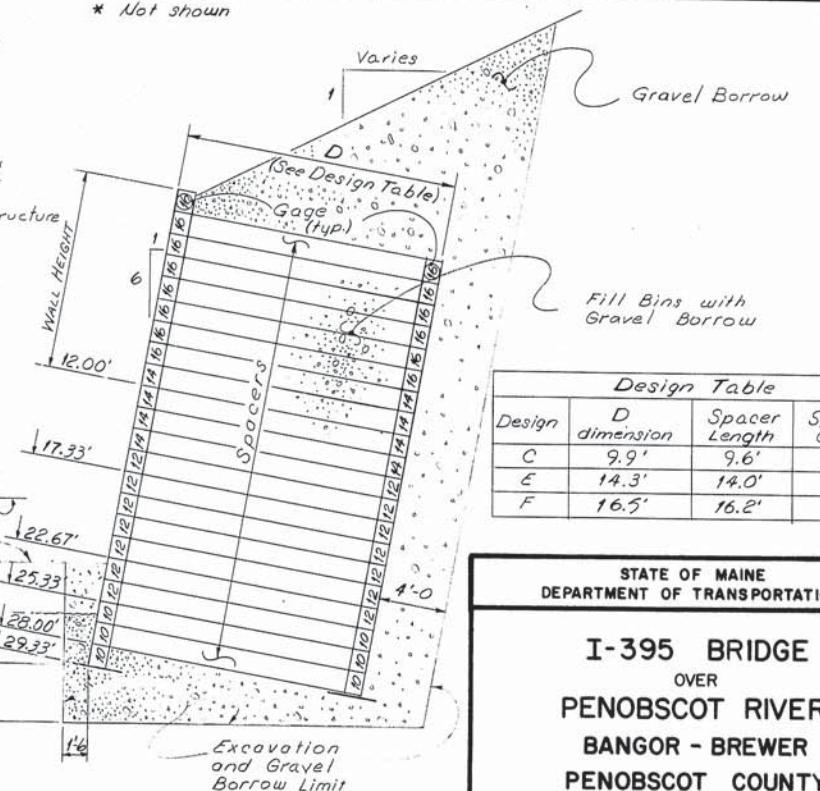


NOTE:
At the contractor's option the Bin Wall angle may be constructed by using either SPECIAL FABRICATED CORNER PLATES or FIELD CUT and FITTED STRINGERS

VIEW W-W
(Two Options)



ELEVATION



Design Table			
Design	D dimension	Spacer Length	Spacer Gage
C	9.9'	9.6'	14
E	14.3'	14.0'	12
F	16.5'	16.2'	12

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

I-395 BRIDGE
OVER
PENOBSCOT RIVER
BANGOR - BREWER
PENOBSCOT COUNTY

BIN WALL DETAILS

SHEET 12 OF AUGUSTA, MAINE Sept. 1983

R88-273

TYPICAL SECTION
(For all Designs)

Concrete

PROJECT DESIGN ENGINEER	DATE
DESIGN - DETAILED	3-83
CHECKED	
REVISIONS	
FIELD CHANGES	
PLANS	

BURNING 44132 45710-1

APPENDIX C
Boring Logs & Key to Soil and Rock Descriptions and Terms

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: South Main Street Slope Stabilization and Wall Replacement Project Location: Brewer, Maine				Boring No.: HB-BRE-101 WIN: 022833.00																																																																																																																																																																																																																																																																																																																							
Driller: S. W. Cole Explorations, LLC				Elevation (ft.) 20.8				Auger ID/OD: 5 inch Solid-Stem																																																																																																																																																																																																																																																																																																																							
Operator: M. Leonard				Datum: NAVD88				Sampler: Standard Split Spoon																																																																																																																																																																																																																																																																																																																							
Logged By: N. Strout				Rig Type: Diedrich D50				Hammer Wt./Fall: 140 lb / 30 inch																																																																																																																																																																																																																																																																																																																							
Date Start/Finish: 07-25-2018				Drilling Method: SSA				Core Barrel: N/A																																																																																																																																																																																																																																																																																																																							
Boring Location: Sta 3+76.8, 22.5 ft Rt				Casing ID/OD: N/A				Water Level*: No water observed.																																																																																																																																																																																																																																																																																																																							
Hammer Efficiency Factor: 0.918				Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>																																																																																																																																																																																																																																																																																																																											
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt				R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person				S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected																																																																																																																																																																																																																																																																																																																							
T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																																																																																																																																																																																																																																																																																																																															
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: South Main Street Slope Stabilization and Wall Replacement Project Location: Brewer, Maine				Boring No.: HB-BRE-101A WIN: 022833.00				
Driller: S. W. Cole Explorations, LLC				Elevation (ft.) 21.0				Auger ID/OD: 5" Solid-Stem				
Operator: M. Leonard				Datum: NAVD88				Sampler: Standard Split Spoon				
Logged By: N. Strout				Rig Type: Diedrich D50				Hammer Wt./Fall: 140#/30"				
Date Start/Finish: 07-25-2018				Drilling Method: Cased Wash				Core Barrel: N/A				
Boring Location: Sta 3+90.3; 22.6 ft Rt				Casing ID/OD: HW 4"/4.5"				Water Level*: No water observed				
Hammer Efficiency Factor: 0.918				Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>								
<div style="display: flex; justify-content: space-between; font-size: 0.8em;"> <div> Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt </div> <div> R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person </div> <div> S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected </div> <div> T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test </div> </div>												
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	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0							SSA	20.1		10.5" of Pavement		
										See HB-BWR-101 for description of strata from 0 to 10 ft bgs.		
5												
10	1D	24/10	10.00 - 12.00	13/7/6/7	13	20	35			Brown, damp, medium dense, SAND, some gravel, some silt, (Fill).		
							48					
							63					
							50					
							54					
15	2D	24/7	15.00 - 17.00	9/6/6/6	12	18	51			Brown, wet, medium dense, SAND, some silt, little gravel, (Fill).		
							46					
							49					
							52					
							98					
20	3D	24/6	20.00 - 22.00	6/3/13/23	16	24	39			Similar to above.		
							278					
							OPEN					
25												

Remarks:
 Autohammer SN 367
 bgs = below ground surface
 Casing driven using autohammer.
 Borehole caved at 15.6 ft bgs.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.




 * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Page 1 of 2

Boring No.: HB-BRE-101A

<div>Maine Department of Transportation</div> <div>Soil/Rock Exploration Log</div> <div>US CUSTOMARY UNITS</div>				<div>Project: South Main Street Slope Stabilization and Wall Replacement Project</div> <div>Location: Brewer, Maine</div>				<div>Boring No.: HB-BRE-101A</div> <div>WIN: 022833.00</div>																																																																																																																																																																																																									
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: South Main Street Slope Stabilization and Wall Replacement Project Location: Brewer, Maine				Boring No.: HB-BRE-102 WIN: 022833.00				
Driller: S. W. Cole Explorations, LLC				Elevation (ft.) 20.4				Auger ID/OD: 5" Solid-Stem				
Operator: M. Leonard				Datum: NAVD88				Sampler: Standard Split Spoon				
Logged By: N. Strout				Rig Type: Diedrich D50				Hammer Wt./Fall:				
Date Start/Finish: 07-23-2018				Drilling Method: Cased Wash				Core Barrel: NQ2				
Boring Location: Sta 3+31.9; 21.5 ft Rt				Casing ID/OD: HW 4"/4.5" NW 3"/3.5"				Water Level*: 14.9 ft				
Hammer Efficiency Factor: 0.918				Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>								
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test												
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	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0	1D	24/17	0.90 - 2.90	32/35/38/38	73	112	SSA	19.5		11" of Pavement Brown, damp, very dense, Gravelly SAND, trace silt, (Fill). Brown, moist, dense, SAND, some silt, little gravel, fine to medium sand, (Fill). Brown, moist, medium dense, SAND, some silt, trace gravel, trace clay, fine to medium sand, (Fill). Brown, wet, very dense, Silty SAND, little gravel, (Glacial Till). Advanced by rollercone through boulder from 19 to 20.4 ft bgs. Similar to above.	#342683 A-4, SC-SM WC=10.4%	
5	2D	24/19	5.00 - 7.00	6/11/14/9	25	38						
10	3D	24/7	10.00 - 12.00	6/5/5/5	10	15	32					
							33					
							45					
							71					
							56					
15	4D	24/15	15.00 - 17.00	11/24/34/44	58	89	110	5.4				
							107					
							158					
							377					
							OPEN					
20	5D	24/17	20.50 - 22.50	13/23/27/29	50	77	195					
							252					
							231					
							146					
25							187					
Remarks: Autohammer SN 367 bgs = below ground surface Casing driven using autohammer. Water level measurement taken after pulling casing.												
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Page 1 of 2 Boring No.: HB-BRE-102		




<div>Maine Department of Transportation</div> <div>Soil/Rock Exploration Log US CUSTOMARY UNITS</div>						<div>Project: South Main Street Slope Stabilization and Wall Replacement Project</div> <div>Location: Brewer, Maine</div>			<div>Boring No.: HB-BRE-102</div> <div>WIN: 022833.00</div>																																																																																														
Driller: S. W. Cole Explorations, LLC				Elevation (ft.): 20.4				Auger ID/OD: 5" Solid-Stem																																																																																															
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[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: South Main Street Slope Stabilization and Wall Replacement Project Location: Brewer, Maine				Boring No.: HB-BRE-102A WIN: 022833.00			
Driller: S. W. Cole Explorations, LLC				Elevation (ft.) 20.3				Auger ID/OD: 5" Solid-Stem			
Operator: M. Leonard				Datum: NAVD88				Sampler: Standard Split Spoon			
Logged By: N. Strout				Rig Type: Diedrich D50				Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 07-23-2018 / 07-24-2018				Drilling Method: Cased Wash				Core Barrel: N/A			
Boring Location: Sta 3+29.4; 21.5 ft Rt				Casing ID/OD: HW 4"/4.5"				Water Level*: 12.5 ft			
Hammer Efficiency Factor: 0.918				Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>							
<div>Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt</div> <div>R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person</div> <div>S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected</div> <div>T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test</div>											
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	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)			
25								-5.2	<div>HW casing broke while driving from 25 to 25.5 feet bgs. 5 ft of HW casing abandoned in borehole. Offset to HB-BRE-102B.</div> <div>Bottom of Exploration at 25.5 feet below ground surface. No Refusal.</div>		
50											
Remarks: Autohammer SN 367 bgs = below ground surface Casing driven using autohammer. Water level measurment taken after pulling casing.											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.									Page 2 of 2		
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: South Main Street Slope Stabilization and Wall Replacement Project Location: Brewer, Maine				Boring No.: HB-BRE-102B WIN: 022833.00			
Driller: S. W. Cole Explorations, LLC				Elevation (ft.) 20.4				Auger ID/OD: 2.25"/4.5" Hollow-Stem			
Operator: M. Leonard				Datum: NAVD88				Sampler: Standard Split Spoon			
Logged By: N. Strout				Rig Type: Diedrich D50				Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 07-24-2018				Drilling Method: Cased Wash				Core Barrel: N/A			
Boring Location: Sta 3+35.3; 21.5 ft Rt				Casing ID/OD: HW 4"/4.5"				Water Level*: 13.0 ft			
Hammer Efficiency Factor: 0.918				Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>							
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
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	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
25										Grey, wet, dense, Sandy SILT, little gravel, (Glacial Till). Similar to above except, very dense.	
30	1D	24/17	30.00 - 32.00	20/16/11/10	27	41	51				
							59				
							54				
							60				
							83				
35	2D	24/12	35.00 - 37.00	7/11/27/33	38	58	107				
							77				
							134				
							182				
40	R1	60/41	40.00 - 45.00	RQD = 0%			168 OPEN NQ2				
45											
50											
Remarks: Autohammer SN 367 bgs = below ground surface Casing driven using autohammer. Water level measurement taken after pulling casing.											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 2 of 2	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: HB-BRE-102B	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: South Main Street Slope Stabilization and Wall Replacement Project Location: Brewer, Maine				Boring No.: HB-BRE-103 WIN: 022833.00																																																																																																																																																																																																																																									
Driller: S. W. Cole Explorations, LLC		Elevation (ft.) 22.4		Auger ID/OD: 5" Solid-Stem																																																																																																																																																																																																																																													
Operator: M. Leonard		Datum: NAVD88		Sampler: Standard Split Spoon																																																																																																																																																																																																																																													
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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows																																																																																																																																																																																																																																										
0	1D	24/13	0.00 - 2.00	7/8/8/8	16	24	SSA		17.4	Brown, damp, medium dense, Gravelly SAND, little silt, trace asphalt, (Fill) .																																																																																																																																																																																																																																							
	2D	24/5	2.00 - 4.00	7/4/4/5	8	12																																																																																																																																																																																																																																											
5	3D	24/18	5.00 - 7.00	9/6/10/13	16	24																																																																																																																																																																																																																																											
	4D	24/17	7.00 - 9.00	16/35/41/22	76	116																																																																																																																																																																																																																																											
10	5D	24/9	10.00 - 12.00	12/19/14/19	33	50	85																																																																																																																																																																																																																																										
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15	6D	24/17	15.00 - 17.00	28/33/26/22	59	90	57																																																																																																																																																																																																																																										
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20	7D	24/16	20.00 - 22.00	10/16/17/25	33	50	89																																																																																																																																																																																																																																										
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Remarks: Autohammer SN 367 bgs = below ground surface Casing driven using autohammer. Water level measurment taken at beginning of day on 07-25-2018.																																																																																																																																																																																																																																																	
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 2																																																																																																																																																																																																																																							
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: HB-BRE-103																																																																																																																																																																																																																																							

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: South Main Street Slope Stabilization and Wall Replacement Project Location: Brewer, Maine		Boring No.: HB-BRE-103 WIN: 022833.00				
Driller: S. W. Cole Explorations, LLC		Elevation (ft.) 22.4		Auger ID/OD: 5" Solid-Stem						
Operator: M. Leonard		Datum: NAVD88		Sampler: Standard Split Spoon						
Logged By: N. Strout		Rig Type: Diedrich D50		Hammer Wt./Fall:						
Date Start/Finish: 07-24-2018 / 07-25-2018		Drilling Method: Cased Wash		Core Barrel: NQ2						
Boring Location:		Casing ID/OD: HW 4"/4.5"		Water Level*: 16.3 ft						
Hammer Efficiency Factor: 0.918		Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>								
<div style="font-size: small;"> Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S_u(lab) = Lab Vane Undrained Shear Strength (psf) q_p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test </div>										
Depth (ft.)	Sample Information							Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows			
25	8D	24/19	25.00 - 27.00	19/44/46/72	90	138			Grey, wet, very dense, Sandy SILT, little gravel, (Glacial Till). Bottom of Exploration at 27.0 feet below ground surface. No Refusal.	
50										
Remarks: Autohammer SN 367 bgs = below ground surface Casing driven using autohammer. Water level measurement taken at beginning of day on 07-25-2018.										
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.									Page 2 of 2 Boring No.: HB-BRE-103	

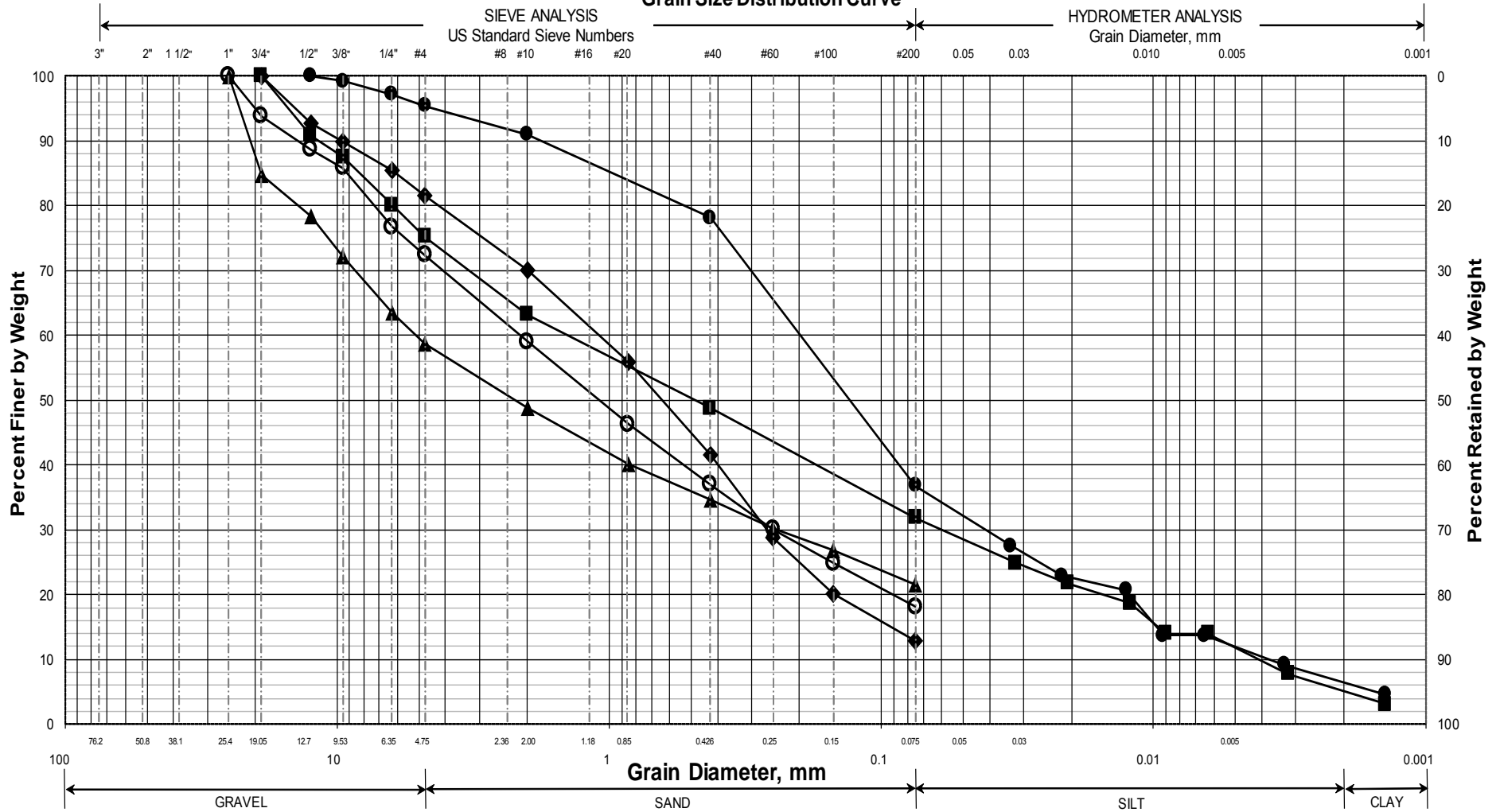
UNIFIED SOIL CLASSIFICATION SYSTEM					MODIFIED BURMISTER SYSTEM			
MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES				
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	Descriptive Term		Portion of Total (%)	
		(little or no fines)	GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.	trace	0 - 10		
					little	11 - 20		
					some	21 - 35		
					adjective (e.g. sandy, clayey)	36 - 50		
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS	SW	Well-graded sands, gravelly sands, little or no fines	TERMS DESCRIBING DENSITY/CONSISTENCY			
		(little or no fines)	SP	Poorly-graded sands, gravelly sand, little or no fines.				
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Coarse-grained soils (more than half of material is larger than No. 200 sieve): Includes (1) clean gravels; (2) silty or clayey gravels; and (3) silty, clayey or gravelly sands. Density is rated according to standard penetration resistance (N-value).			
			SC	Clayey sands, sand-clay mixtures.				
			FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.	Density of Cohesionless Soils	
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Very loose			N-Value (blows per foot)			
OL	Organic silts and organic silty clays of low plasticity.	Loose			0 - 4			
		Medium Dense			5 - 10			
		Dense			11 - 30			
SILTS AND CLAYS (liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.		Dense	31 - 50			
	CH	Inorganic clays of high plasticity, fat clays.		Very Dense	> 50			
	OH	Organic clays of medium to high plasticity, organic silts.		Fine-grained soils (more than half of material is smaller than No. 200 sieve): Includes (1) inorganic and organic silts and clays; (2) gravelly, sandy or silty clays; and (3) clayey silts. Consistency is rated according to undrained shear strength as indicated.				
	HIGHLY ORGANIC SOILS	Pt		Peat and other highly organic soils.	Consistency of Cohesive soils		Approximate Undrained Shear Strength (psf)	
					Field Guidelines			
Desired Soil Observations (in this order, if applicable): Color (Munsell color chart) Moisture (dry, damp, moist, wet) Density/Consistency (from above right hand side) Texture (fine, medium, coarse, etc.) Name (sand, silty sand, clay, etc., including portions - trace, little, etc.) Gradation (well-graded, poorly-graded, uniform, etc.) Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic) Structure (layering, fractures, cracks, etc.) Bonding (well, moderately, loosely, etc.,) Cementation (weak, moderate, or strong) Geologic Origin (till, marine clay, alluvium, etc.) Groundwater level					Rock Quality Designation (RQD): RQD (%) = $\frac{\text{sum of the lengths of intact pieces of core} * > 4 \text{ inches}}{\text{length of core advance}}$ *Minimum NQ rock core (1.88 in. OD of core)			
					Correlation of RQD to Rock Mass Quality			
					Rock Mass Quality		RQD (%)	
					Very Poor		≤25	
					Poor		26 - 50	
					Fair		51 - 75	
					Good		76 - 90	
					Excellent		91 - 100	
					Desired Rock Observations (in this order, if applicable): Color (Munsell color chart) Texture (aphanitic, fine-grained, etc.) Rock Type (granite, schist, sandstone, etc.) Hardness (very hard, hard, mod. hard, etc.) Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.) Geologic discontinuities/jointing: -dip (horiz - 0-5 deg., low angle - 5-35 deg., mod. dipping - 35-55 deg., steep - 55-85 deg., vertical - 85-90 deg.) -spacing (very close - <2 inch, close - 2-12 inch, mod. close - 1-3 feet, wide - 3-10 feet, very wide >10 feet) -tightness (tight, open, or healed) -infilling (grain size, color, etc.) Formation (Waterville, Ellsworth, Cape Elizabeth, etc.) RQD and correlation to rock mass quality (very poor, poor, etc.) ref: ASTM D6032 and AASHTO Standard Specification for Highway Bridges, 17th Ed. Table 4.4.8.1.2A Recovery (inch/inch and percentage) Rock Core Rate (X.X ft - Y.Y ft (min:sec))			
					Sample Container Labeling Requirements: WIN Blow Counts Bridge Name / Town Sample Recovery Boring Number Date Sample Number Personnel Initials Sample Depth			
Maine Department of Transportation Geotechnical Section Key to Soil and Rock Descriptions and Terms Field Identification Information								

APPENDIX D
Laboratory Test Results

Work Number: 22833.00

PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

Maine Department of Transportation Grain Size Distribution Curve



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-BRE-101/2D	3+76.8	22.5 RT	3.0-5.0	SAND, some gravel, little silt.	5.3			
◆	HB-BRE-101/3D	3+76.8	22.5 RT	5.0-7.0	SAND, little gravel, little silt.	4.8			
■	HB-BRE-101A/5D	3+90.3	22.6 RT	30.0-31.4	SAND, some silt, some gravel, trace clay.	9			
●	HB-BRE-102/3D	3+31.9	21.5 RT	10.0-12.0	SAND, some silt, trace clay, trace gravel.	10.4			
▲	HB-BRE-102/6D	3+31.9	21.5 RT	25.0-27.0	Sandy GRAVEL, some silt.	7			
X									

WIN
022833.00
Town
Brewer
Reported by/Date
WHITE, TERRY A 9/25/2018