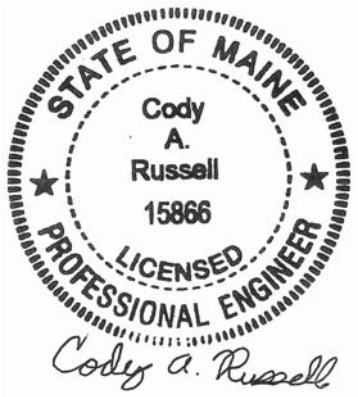
MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE

GEOTECHNICAL DESIGN REPORT

For the Replacement of:

CROSS CULVERT #XC-269581
ROUTE 1
COLUMBIA, MAINE

Prepared by:
Cody Russell, P.E.
Geotechnical Engineer



Reviewed by:
Kathleen Maguire, P.E.
Senior Geotechnical Engineer

Washington County

Soils Report 2020-07

WIN 21772.00
March 27, 2020

PROJECT DETAILS

The purpose of this Geotechnical Design Report is to present subsurface information and make geotechnical design and construction recommendations for the replacement of an existing 92-foot long, 36-inch diameter corrugated metal pipe (CMP) cross culvert (#XC-269581) on Route 1 in Columbia. The existing culvert is in poor condition and a section of the inlet end has severed and lifted approximately 2 feet. The culvert is located approximately 0.35 of a mile southwest of the Columbia Falls town line as shown on the attached Location Map. Route 1 is a Highway Corridor Priority 2 road.

The proposed replacement structure will be a 120-foot long, 96-inch diameter Reinforced Concrete Pipe (RCP) Class III culvert. The invert of the proposed culvert is approximately 23 feet below the existing road grade at the roadway centerline. To facilitate fish passage, Habitat Connectivity Design elements will be used inside the RCP culvert as shown on the Special Details sheets in the Plans. The roadway embankment slopes at the proposed culvert inlet and outlet shall be no steeper than 2H:1V to protect against erosion.

SUBSURFACE INVESTIGATION

One (1) boring (HB-COL-101) and one (1) probe (HB-COL-102) were drilled for this project on March 29, 2017 by New England Boring Contractors (NEBC) of Hermon, Maine using a track mounted drill rig. Exploration locations are shown on the attached Boring Location Plan. Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are shown on the attached boring logs.

Boring HB-COL-101 was drilled using hollow stem auger and rod probe drilling techniques. Soil samples were obtained in the upper approximately 52.0 feet of boring HB-COL-101 at 5-foot intervals using Standard Penetration Test (SPT) methods. The NEBC drill rig is equipped with an automatic hammer to drive the split spoon. The NEBC calibrated automatic hammer delivers approximately 25 percent more energy during driving than the standard rope and cathead system. All N-values discussed in this report are corrected values (N_{60}) computed by applying an average energy transfer factor of 0.75 to the raw field N-values. Probe HB-COL-102 was drilled using solid stem auger techniques. No soils samples were obtained in the probe.

The MaineDOT Geotechnical Team member selected the boring and probe locations, drilling methods, designated type and depth of sampling, reviewed field logs for accuracy and identified field and laboratory testing requirements. A NorthEast Transportation Training and Certification (NETTCP) certified Subsurface Investigator logged the subsurface conditions encountered. The borings were located in the field by taping to surveyed site features after completion of the drilling program.

LABORATORY TESTING

A laboratory testing program was conducted to assist in soil classification, evaluation of engineering properties of the soils and geologic assessment of the project site. Laboratory testing consisted of five (5) standard grain size analyses with natural water content, seven (7) grain size

analyses with hydrometer and natural water content and six (6) Atterberg Limits tests. The results of the laboratory testing program are discussed in the following section and are shown on the attached boring logs, Laboratory Testing Summary Sheet, Grain Size Distribution Curves and Atterberg Limits Plots.

SUBSURFACE CONDITIONS

Subsurface conditions encountered at the test boring generally consisted of fill underlain by layers of native silt and silty clay. An interpretive subsurface profile depicting the generalized soil stratigraphy at the boring location is shown on the attached Interpretive Subsurface Profile.

Boring HB-COL-101 was drilled to a depth of approximately 86.0 feet below ground surface (bgs) and did not encounter a refusal surface. SPT sampling was done to a depth of approximately 52.0 feet bgs. Rods were advanced by hydraulic push from approximately 52.0 feet to 86.0 feet without sampling. Probe HB-COL-102 was drilled to a depth of approximately 40.0 feet bgs and did not encounter a refusal surface.

The table below summarizes the field and laboratory information obtained in boring HB-COL-101:

Approx. Depth BGS[1] (feet)	Soil Description	AASHTO[2] Classification	USCS[3]	WC%[4]
0.0 – 0.5	Pavement			
0.5– 15.5	Fill: Light brown and brown, damp, fine to coarse sand, trace to some gravel, trace to little silt.	A-1-b	SW-SM	2.1 to 6.3
15.5 – 15.9	Layer of Pavement			
15.9 – 18.5	Grey, moist, fine to coarse sand, some gravel, some silt.	A-1-b	SM	9.6
18.5 – 24.0	Grey, wet, silt, little clay, trace fine to coarse sand.	A-4	CL	19.1
24.0 – 51.0	Olive brown and grey with black staining, wet, silty clay, trace fine to coarse sand, trace gravel.	A-4 or A-6	CL	24.7 to 32.1
51.0 – 86.0	Grey, wet, silt, some clay, trace fine to coarse sand, trace gravel.	A-4	CL-ML	23.9

[1]BGS = below ground surface
[2]AASHTO = American Association of State Highway and Transportation Officials
[3]USCS = Unified Soil Classification System
[4]WC% = Water content in percent

Three (3) corrected N-values obtained in the fill ranged from 5 to 18 blows per foot (bpf), indicating that the fill is loose to medium dense in consistency. One N-value in the fill was 35 bpf but this was influenced by the presence of a pavement layer at the bottom of the fill. Seven (7)

corrected N-values obtained in the silt and silty clay layers ranged from WOH (weight of hammer) to 15 bpf, indicating that the silt and clay are very soft to stiff in consistency, with stiffness generally decreasing with depth.

The following table summarizes the results of Atterberg Limits tests done on six (6) samples of the native silty clay and silt:

Boring No. and Sample No.	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
HB-COL-101 6D	24.7	32	22	10	0.27
HB-COL-101 7D	26.1	31	21	10	0.51
HB-COL-101 8D	28.0	30	21	9	0.78
HB-COL-101 9D	32.1	32	20	12	1.01
HB-COL-101 10D	29.9	29	20	9	1.10
HB-COL-101 11D	23.9	22	16	6	1.32

Interpretation of these results indicate that the clayey silt and silt range from having low plasticity to medium plasticity with plasticity generally decreasing with depth. The silty clay in samples 6D and 7D is overconsolidated, meaning it has experienced higher stresses in the past. The silty clay in sample 8D is normally consolidated, meaning it is currently experiencing its highest stress. The silty clay and silt in samples 9D through 11D are on the verge of being a viscous liquid if disturbed. Overburden pressure and interparticle cementation is providing stability to keep the soil in its current state, but the slightest disturbance causing remolding could convert the soil into a viscous fluid.

Groundwater was not recorded in the boring or probe. Groundwater levels can be expected to fluctuate subject to seasonal variations, local soil conditions, topography, precipitation, and construction activity.

GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS

RCP Class III Culvert Construction – The proposed replacement structure will be a 120-foot long, 96-inch diameter Reinforced Concrete Pipe (RCP) Class III. The proposed pipe culvert shall be furnished and installed in accordance with MaineDOT Standard Specification 603.

The invert of the proposed culvert pipe ranges from approximately 9.46 feet at the inlet end to approximately 9.16 feet at the outlet end with a 0.25% slope. To facilitate fish passage, Habitat Connectivity Design elements will be used inside the RCP culvert as shown on the Special Details sheets in the Plans

The proposed structure shall be bedded on a 2-foot thick, geotextile wrapped, geogrid reinforced, crushed stone mat (Underdrain Backfill Material, Type C; Pay Item 203.55, see Special Provision 203, attached). The geogrid reinforcement shall meet the requirements of Special Provision 620, attached. The Reinforcement Geotextile shall meet the requirements of MaineDOT Standard

Specification 722.01. The soils at the bedding elevation shall be excavated using a smooth-edged backhoe bucket to limit disturbance. Any disturbed soils at the bedding elevation resulting from excavation activities shall be removed by hand prior to placement of the geotextile wrapped, geogrid reinforced, crushed stone mat. All subgrade surfaces should be protected from construction traffic in order to limit disturbance. Groundwater and surface water levels shall be depressed sufficiently to allow work in the dry.

The soil backfill shall consist of Granular Borrow (703.19) with a maximum particle size of 4 inches. The Granular Borrow backfill shall be placed in lifts of 6 to 8 inches loose measure and compacted to the manufacturer's specifications or, in the absence of manufacturer's specifications, to at least 92 percent of the AASHTO T-180 maximum dry density. In no case shall the backfill soil be compacted less than 92 percent of the AASHTO T-180 maximum dry density.

Settlement – No settlement issues are anticipated at the site. No changes to the existing vertical or horizontal alignment are currently planned for this project. The proposed RCP Class III culvert is larger in diameter than the existing culvert and will result in a net unloading of the site soils at the structure location. Any settlement due to elastic compression of the bedding material will be immediate and negligible.

Scour and Riprap – Both the inlet and outlet of the RCP Class III culvert pipe shall be protected against scour with riprap conforming to MaineDOT Standard Specification Section 703.26 Plain and Hand Laid Riprap. Slopes shall be no steeper than 2H:1V. No specific scour protection recommendations are needed other than armoring with riprap. The riprap on the slopes shall be underlain by a non-woven, Class 1 Erosion Control Geotextile meeting the requirements of MaineDOT Standard Specification 722.03 that is underlain by a 1-foot layer of protective aggregate cushion consisting of Granular Borrow Material for Underwater Backfill (703.19). The toe of the riprap sections shall be keyed into the existing soils 1 foot below the streambed elevation.

Construction Considerations – Construction activities will include construction of cofferdams and earth support systems to control stream flow during construction. Construction activities will also include common earth excavation. Construction of the proposed RCP Class III culvert will require deep soil excavation. Earth support systems shall be implemented if laying back slopes is not feasible. It is likely that the use of complex (four-sided) braced excavations with dewatering will be necessary due to the depth of the excavation. If this is the case, adequate embedment into firm soils underlying the native silty clay and silt will be necessary to allow for the excavation and maintenance of a stable excavation bottom. All earth support systems shall be designed by a Professional Engineer licensed in the State of Maine. Regardless of the method of excavation, all excavations and earth support systems shall meet all applicable OSHA regulations.

The soils at the bedding elevation shall be excavated using a smooth-edged backhoe bucket to limit disturbance. Any disturbed soils at the bedding elevation resulting from excavation activities shall be removed by hand prior to placement of the geotextile wrapped, geogrid reinforced, crushed stone mat. All subgrade surfaces should be protected from construction traffic in order to limit disturbance. Groundwater and surface water levels shall be depressed sufficiently to allow work in the dry.

The Contractor shall control groundwater and surface water infiltration using temporary ditches, sumps, granular drainage blankets, stone ditch protection or hand-laid riprap with geotextile underlayment to divert groundwater and surface water as needed to maintain a stable excavation and allow work in the dry.

Using the excavated native soils as backfill around the culvert shall not be permitted. The native soils may only be used as Common Borrow in accordance with MaineDOT Standard Specifications 203 and 703.

The Contractor will have to excavate the existing subbase and subgrade fill soils in the vicinity of the culvert. These materials should not be used to re-base the roadway. Excavated subbase sand and gravel may be used as fill below roadway subgrade level in fill areas provided all other requirements of MaineDOT Standard Specifications 203 and 703 are met.

CLOSURE

This report has been prepared for the use of the MaineDOT Highway Program for specific application to the proposed replacement of cross culvert #XC-269581 under Route 1 in Columbia, Maine in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use or warranty is expressed or implied.

In the event that any changes in the nature, design, or location of the proposed project are planned, this report should be reviewed by a geotechnical engineer to assess the appropriateness of the conclusions and recommendations and to modify the recommendations as appropriate to reflect the changes in design. These analyses and recommendations are based in part upon a limited subsurface investigation at discrete exploratory location completed at the site. If variations from the conditions encountered during the investigation appear evident during construction, it may also become necessary to re-evaluate the recommendations made in this report.

It is recommended that a Geotechnical engineer be provided the opportunity for a review of the design and specifications in order that the earthwork and foundation recommendations and construction considerations presented in this report are properly interpreted and implemented in the design and specifications.

Attachments:

Location Map
Boring Location Plan
Interpretive Subsurface Profile
Key to Soil and Rock Descriptions and Terms
Boring Logs
Laboratory Testing Summary Sheet
Grain Size Distribution Curve Sheets
Atterberg Limits Plots
Special Provision 203 – Excavation and Embankment (Culvert Bedding Stone)
Special Provision 620 – Geotextile (Reinforcement Geogrid)

Username: Cody.A.Russell Division: GEOTECH Date:3/27/2020

COLUMBIA, MAINE

The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information. This map is not intended to support emergency dispatch.

0.25 Miles
1 inch = 0.29 miles

Date: 2/10/2020
Time: 11:25:12 AM

SHEET NUMBER 1 OF 3	COLUMBIA U.S. ROUTE 1 LOCATION MAP	STATE OF MAINE DEPARTMENT OF TRANSPORTATION 021772.00 WIN 021772.00 HIGHWAY PLANS

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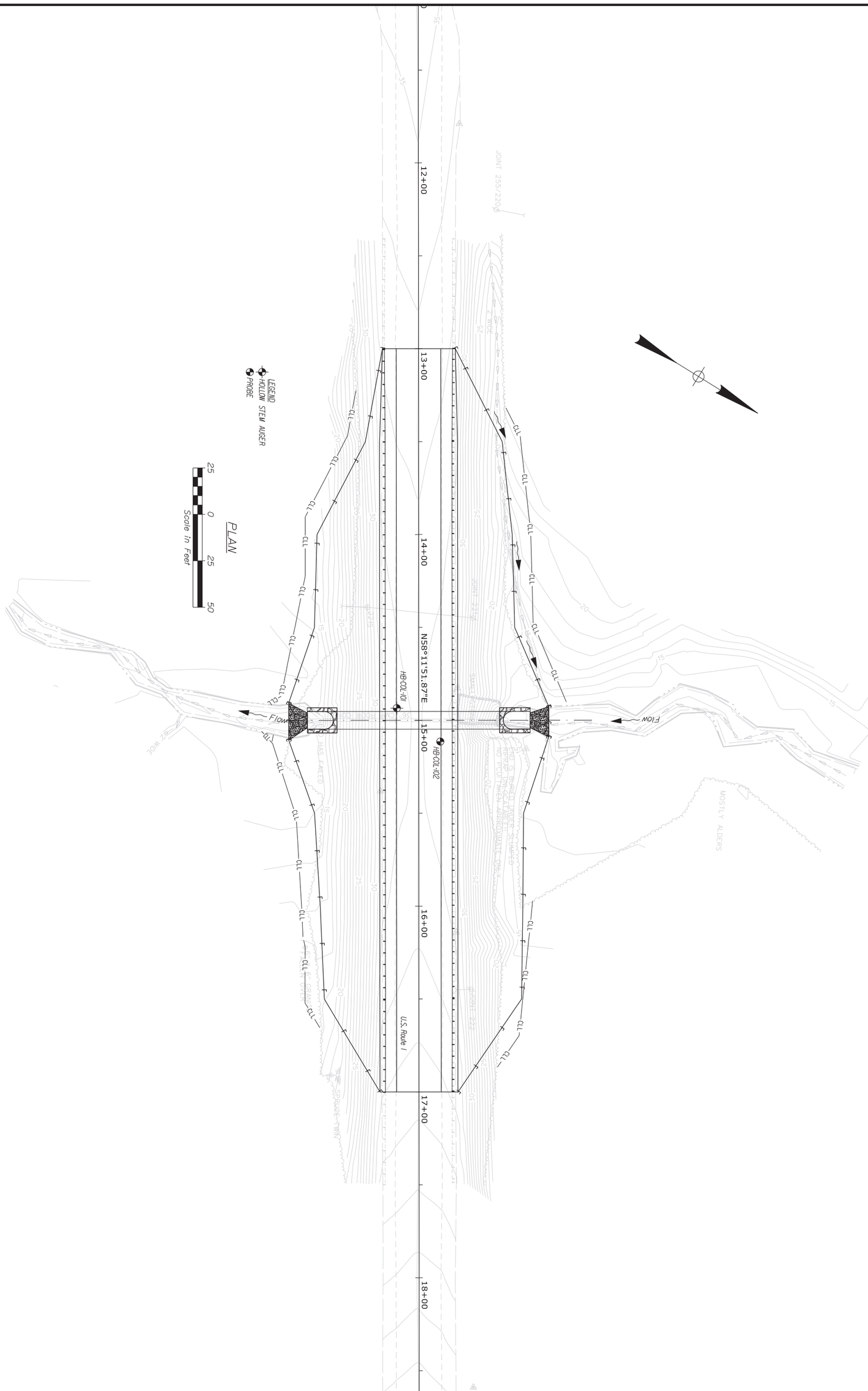


SHEET NUMBER 2 OF 3

COLUMBIA
U.S. ROUTE 1 LARGE CULVERT

BORING LOCATION PLAN

		BY	DATE
PROJ. MANAGER			
DESIGN-DETAILED			
CHECKED-REVIEWED			
DESIGN2-DETAILED2	C.RUSSELL	T.WHITE	FEB 2020
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

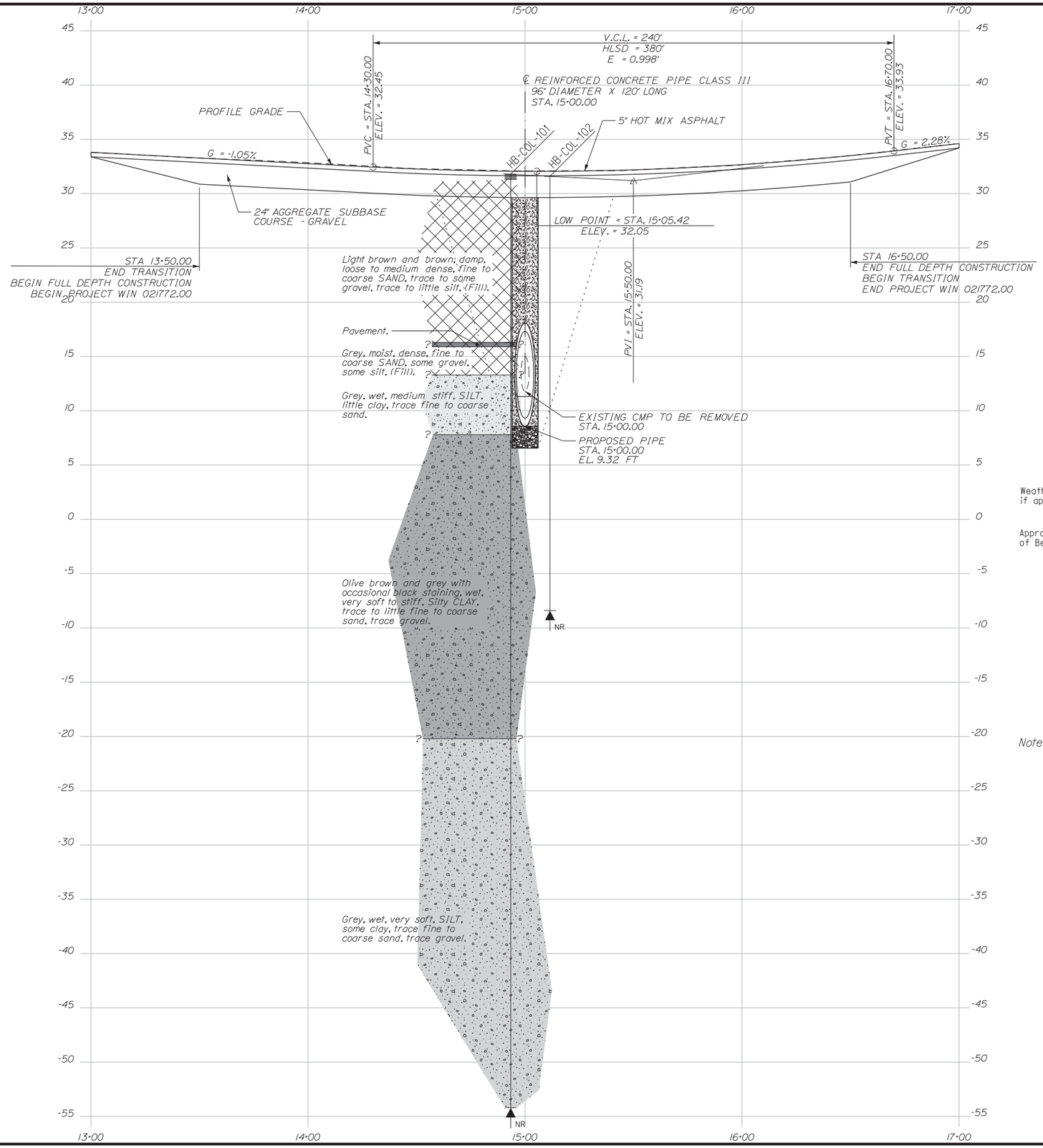
DATE

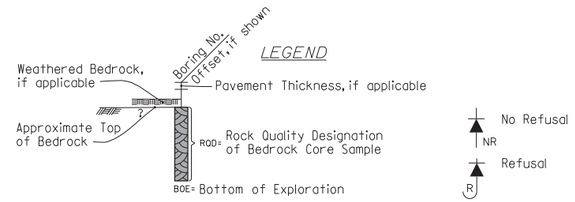
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

021772.00

WIN
21772.00

HIGHWAY PLANS





Note: This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and bedrock transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

021772.00

WIN
21772.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	-----	---
DESIGN-DETAILED	-----	-----
CHECKED-REVIEWED	-----	-----
DESIGN2-DETAILED2	C.RUSSELL	FEB 2020
DESIGN3-DETAILED3	-----	-----
REVISIONS 1	-----	-----
REVISIONS 2	-----	-----
REVISIONS 3	-----	-----
REVISIONS 4	-----	-----
FIELD CHANGES	-----	-----

SIGNATURE

P.E. NUMBER

DATE

COLUMBIA
U.S. ROUTE 1 LARGE CULVERT
INTERPRETIVE SUBSURFACE PROFILE

SHEET NUMBER
3
OF 3

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UNIFIED SOIL CLASSIFICATION 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 (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS (little or no fines)	SW	Well-graded sands, Gravelly sands, 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
			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.
			CL	Inorganic clays of low to medium plasticity, Gravelly clays, Sandy clays, Silty clays, lean clays.
			OL	Organic silts and organic Silty clays of low plasticity.
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine Sandy or Silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

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

MODIFIED BURMISTER SYSTEM

Descriptive Term	Portion of Total (%)
trace	0 - 10
little	11 - 20
some	21 - 35
adjective (e.g. Sandy, Clayey)	36 - 50

TERMS DESCRIBING DENSITY/CONSISTENCY

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).

Density of Cohesionless Soils	Standard Penetration Resistance N-Value (blows per foot)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

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.

Consistency of Cohesive soils	SPT N-Value (blows per foot)	Approximate Undrained Shear Strength (psf)	Field Guidelines
Very Soft	WOH, WOR, WOP, <2	0 - 250	Fist easily penetrates
Soft	2 - 4	250 - 500	Thumb easily penetrates
Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort
Stiff	9 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	16 - 30	2000 - 4000	Indented by thumbnail
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

$$\text{RQD (\%)} = \frac{\text{sum of the lengths of intact pieces of core* > 4 inches}}{\text{length of core advance}}$$

*Minimum NQ rock core (1.88 in. OD of core)

Rock Quality Based on RQD

Rock 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 quality (very poor, poor, etc.)
ref: ASTM D6032 and FHWA NHI-16-072 GEC 5 - Geotechnical Site Characterization, Table 4-12
Recovery (inch/inch and percentage)
Rock Core Rate (X.X ft - Y.Y ft (min:sec))

Maine Department of Transportation
Geotechnical Section
Key to Soil and Rock Descriptions and Terms
Field Identification Information

Sample Container Labeling Requirements:

WIN
Bridge Name / Town
Boring Number
Sample Number
Sample Depth
Blow Counts
Sample Recovery
Date
Personnel Initials

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 1 Large Culvert
Location: Columbia, Maine

Boring No.: HB-COL-101
WIN: 21772.00

Driller:	New England Boring	**Elevation (ft.)**	31.8	**Auger ID/OD:**	2.75-6.25"
Operator:	Mike/Shane	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	3/29/2017; 09:00-13:00	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	14+93.4, 11.6 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.75	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							H$A	31.3		6" HMA.	
										0.5	
	1D	24/18	1.00 - 3.00	10/7/7/7	14	18				Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	G#269995 A-1-b, SW-SM WC=6.3%
5	2D	24/10	5.00 - 7.00	2/2/2/2	4	5				Light brown, damp, loose, fine to coarse SAND, little gravel, trace silt, (Fill).	G#269996 A-1-b, SW-SM WC=4.4%
10	3D	24/19	10.00 - 12.00	2/2/4/5	6	8				Light brown, damp, loose, fine to coarse SAND, trace gravel, trace silt, (Fill).	G#269997 A-1-b, SW-SM WC=4.5%
15	4D/A	24/20	15.00 - 17.00	3/19/9/14	28	35		16.3		4D (15.0-15.5 ft bgs) Light brown, damp, loose, fine to coarse SAND, some gravel, trace silt, (Fill).	G#269998 A-1-b, SW-SM WC=2.1%
								15.9		15.5	
										Layer of HMA.	G#269999 A-1-b, SM WC=9.6%
										15.9	
										4D/A (15.9-17.0 ft bgs) Grey, moist, dense, fine to coarse SAND, some gravel, some silt, (Fill).	
								13.3		18.5	
20	5D	24/20	20.00 - 22.00	1/2/3/4	5	6				Grey, wet, medium stiff, SILT, little clay, trace fine to coarse sand.	G#270000 A-4, CL WC=19.1%
								7.8		24.0	
25											

Remarks:

-NEBC-1 Auto Hammer

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 1 Large Culvert
Location: Columbia, Maine

Boring No.: HB-COL-101
WIN: 21772.00

Driller:	New England Boring	**Elevation (ft.)**	31.8	**Auger ID/OD:**	2.75-6.25"
Operator:	Mike/Shane	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	3/29/2017; 09:00-13:00	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	14+93.4, 11.6 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.75	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
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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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	6D	24/22	25.00 - 27.00	3/5/7/8	12	15				Olive-brown, wet, stiff, Silty CLAY, trace fine to medium sand.	G#270351 A-6, CL WC=24.7% LL=32 PL=22 PI=10
30	7D	24/24	30.00 - 32.00	WOH/1/2/3	3	4				Grey, wet, soft, Silty CLAY, trace fine to medium sand, black staining.	G#270352 A-6, CL WC=26.1% LL=31 PL=21 PI=10
35	8D	24/24	35.00 - 37.00	WOH/WOH/1/1	1	1				Grey, wet, very soft, Silty CLAY, trace fine to medium sand, black staining.	G#270353 A-4, CL WC=28.0% LL=30 PL=21 PI=9
40	9D	24/24	40.00 - 42.00	WOH/WOH/WOH/ WOH	---					Grey, wet, very soft, Silty CLAY, little fine to coarse sand, trace gravel.	G#270354 A-6, CL WC=32.1% LL=32 PL=20 PI=12
45	10D	24/24	45.00 - 47.00	WOH/WOH/WOH/ WOH	---					Grey, wet, very soft, Silty CLAY, little fine to coarse sand, trace gravel.	G#270355 A-4, CL WC=29.9% LL=29 PL=20 PI=9
50											

Remarks:

-NEBC-1 Auto Hammer

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 1 Large Culvert
Location: Columbia, Maine

Boring No.: HB-COL-101
WIN: 21772.00

Driller:	New England Boring	**Elevation (ft.)**	31.8	**Auger ID/OD:**	2.75-6.25"
Operator:	Mike/Shane	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	3/29/2017; 09:00-13:00	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	14+93.4, 11.6 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.75	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50	11D	24/24	50.00 - 52.00	WOH/WOH/WOH/ WOH	---			-19.2		51.0	G#270356 A-4, CL-ML WC=22 PL=16 PI=6
								-20.2		Grey, wet, very soft, SILT, some clay, trace fine to coarse sand, trace gravel.	
							ROD PROBE			52.0 Hydraulic Pushed rods to 86.0 ft bgs.	
55											
60											
65											
70											
75											

Remarks:

-NEBC-1 Auto Hammer

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 1 Large Culvert
Location: Columbia, Maine

Boring No.: HB-COL-101
WIN: 21772.00

Driller:	New England Boring	**Elevation (ft.)**	31.8	**Auger ID/OD:**	2.75-6.25"
Operator:	Mike/Shane	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	3/29/2017; 09:00-13:00	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	14+93.4, 11.6 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.75	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
75											
80											
85											
								-54.2		86.0 **Bottom of Exploration at 86.0 feet below ground surface.** NO REFUSAL	
90											
95											
100											

Remarks:

-NEBC-1 Auto Hammer

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 1 Large Culvert
Location: Columbia, Maine

Boring No.: HB-COL-102
WIN: 21772.00

Drilling Contractor:	New England Boring	**Elevation (ft.)**	31.6	**Auger ID/OD:**	2.75-6.25"
Operator:	Mike/Shane	**Datum:**	NAVD88	**Sampler:**	N/A
Logged By:	B. Wilder	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	3/29/2017; 13:00-14:25	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	15+11.5, 11.7 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

Definitions:
D = Spilt Spoon Sample
S = Sample off Auger Flights
B = Bucket Sample off Auger Flights
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MV = Unsuccessful Field Vane Shear Test Attempt
V = Field Vane Shear Test, PP= Pocket Penetrometer
MU = Unsuccessful Thin Wall Tube Sample 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 1 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-value = Raw Field SPT N-value
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent ≅ = Similar or Equal too
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						HSA			No material descriptions given in probe.	
5										
10										
15										
20										
25										

Remarks:

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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: U.S. Route 1 Large Culvert
Location: Columbia, Maine

Boring No.: HB-COL-102
WIN: 21772.00

Drilling Contractor:	New England Boring	**Elevation (ft.)**	31.6	**Auger ID/OD:**	2.75-6.25"
Operator:	Mike/Shane	**Datum:**	NAVD88	**Sampler:**	N/A
Logged By:	B. Wilder	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	3/29/2017; 13:00-14:25	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	15+11.5, 11.7 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

Definitions:
D = Spilt Spoon Sample
S = Sample off Auger Flights
B = Bucket Sample off Auger Flights
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MV = Unsuccessful Field Vane Shear Test Attempt
V = Field Vane Shear Test, PP= Pocket Penetrometer
MU = Unsuccessful Thin Wall Tube Sample Attempt
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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 1 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-value = Raw Field SPT N-value
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent ≅ = Similar or Equal too
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25						HYD PUSH			Hydraulic Pushed rods to 40.0 ft bgs.	
30										
35										
40							-8.4		40.0 **Bottom of Exploration at 40.0 feet below ground surface.** NO REFUSAL	
45										
50										

Remarks:

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.

Boring No.: HB-COL-102

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Columbia Work Number: 21772.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C. %	L.L.	P.I.	Classification		
									Unified	AASHTO	Frost
HB-COL-101, 1D	14+93.4	11.6 Rt.	1.0-3.0	269995	1	6.3			SW-SM	A-1-b	0
HB-COL-101, 2D	14+93.4	11.6 Rt.	5.0-7.0	269996	1	4.4			SW-SM	A-1-b	0
HB-COL-101, 3D	14+93.4	11.6 Rt.	10.0-12.0	269997	1	4.5			SW-SM	A-1-b	0
HB-COL-101, 4D	14+93.4	11.6 Rt.	15.0-15.5	269998	1	2.1			SW-SM	A-1-b	0
HB-COL-101, 4D/A	14+93.4	11.6 Rt.	15.9-17.0	269999	1	9.6			SM	A-1-b	II
HB-COL-101, 5D	14+93.4	11.6 Rt.	20.0-22.0	270000	1	19.1			CL	A-4	IV
HB-COL-101, 6D	14+93.4	11.6 Rt.	25.0-27.0	270351	2	24.7	32	10	CL	A-6	IV
HB-COL-101, 7D	14+93.4	11.6 Rt.	30.0-32.0	270352	2	26.1	31	10	CL	A-6	IV
HB-COL-101, 8D	14+93.4	11.6 Rt.	35.0-37.0	270353	2	28.0	30	9	CL	A-4	IV
HB-COL-101, 9D	14+93.4	11.6 Rt.	40.0-42.0	270354	2	32.1	32	12	CL	A-6	III
HB-COL-101, 10D	14+93.4	11.6 Rt.	45.0-47.0	270355	2	29.9	29	9	CL	A-4	IV
HB-COL-101, 11D	14+93.4	11.6 Rt.	51.0-52.0	270356	2	23.9	22	6	CL-ML	A-4	IV

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the MaineDOT and Corps of Engineers Classification Systems.

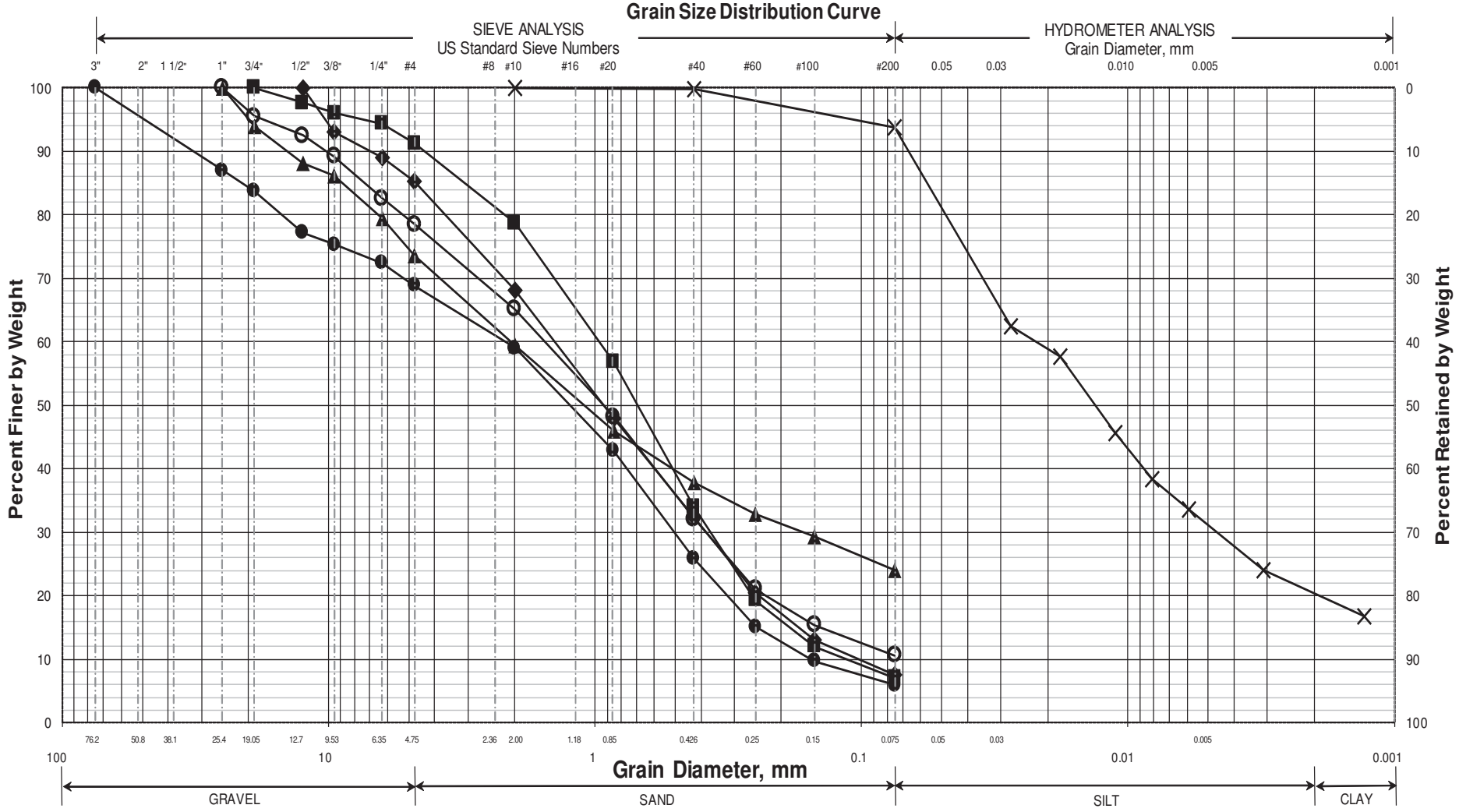
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

LL = Liquid limit as determined by AASHTO T 89-96 and/or ASTM D 4318-98 NP = Non Plastic

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

Maine Department of Transportation
Grain Size Distribution Curve

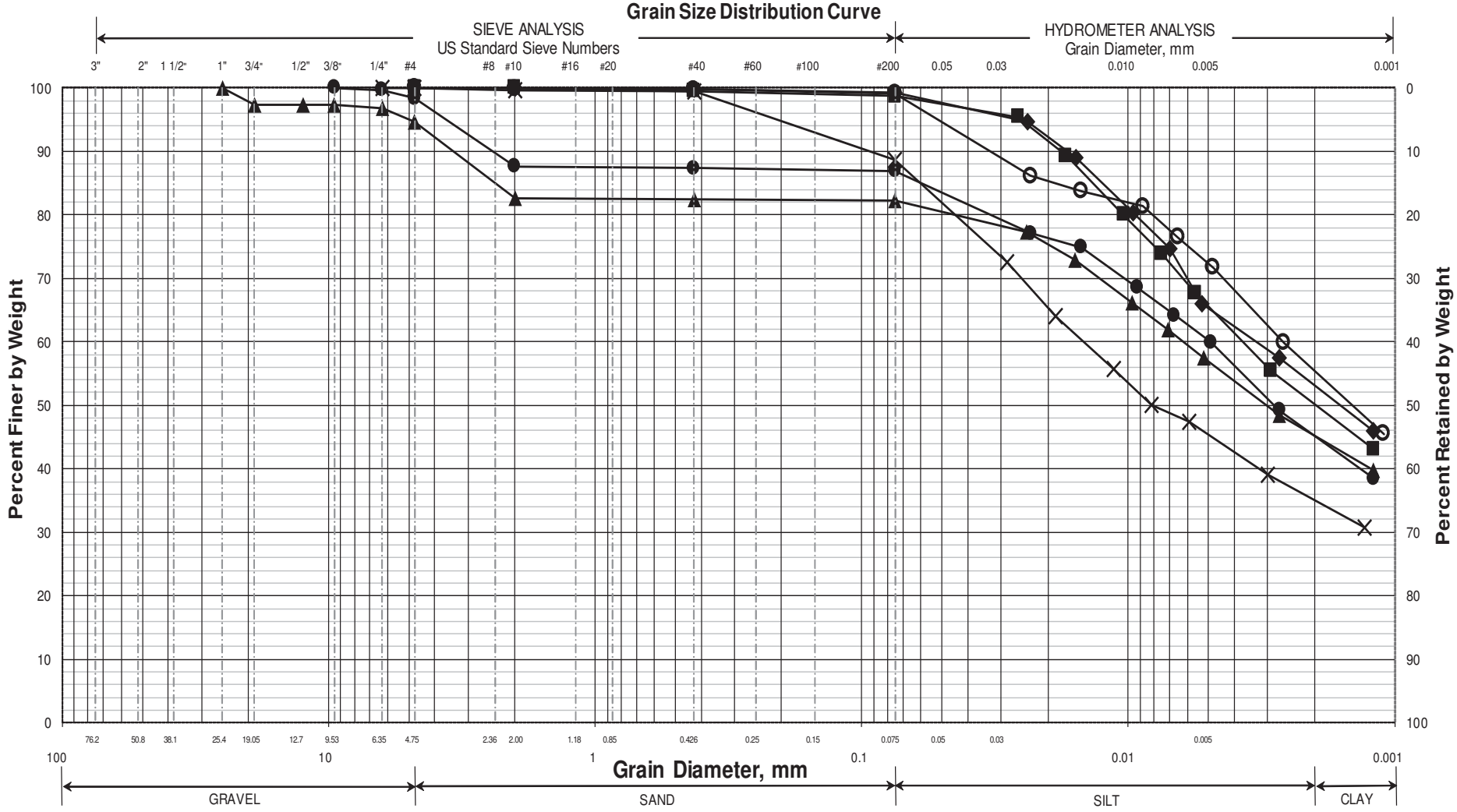


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-COL-101/1D	14+93.4	11.6 RT	1.0-3.0	SAND, some gravel, little silt.	6.3			
◆	HB-COL-101/2D	14+93.4	11.6 RT	5.0-7.0	SAND, little gravel, trace silt.	4.4			
■	HB-COL-101/3D	14+93.4	11.6 RT	10.0-12.0	SAND, trace gravel, trace silt.	4.5			
●	HB-COL-101/4D	14+93.4	11.6 RT	15.0-15.5	SAND, some gravel, trace silt.	2.1			
▲	HB-COL-101/4DA	14+93.4	11.6 RT	15.9-17.0	SAND, some gravel, some silt.	9.6			
×	HB-COL-101/5D	14+93.4	11.6 RT	20.0-22.0	SILT, little clay, trace sand.	19.1			

WIN
021772.00
Town
Columbia
Reported by/Date
WHITE, TERRY A 2/10/2020

Maine Department of Transportation
Grain Size Distribution Curve

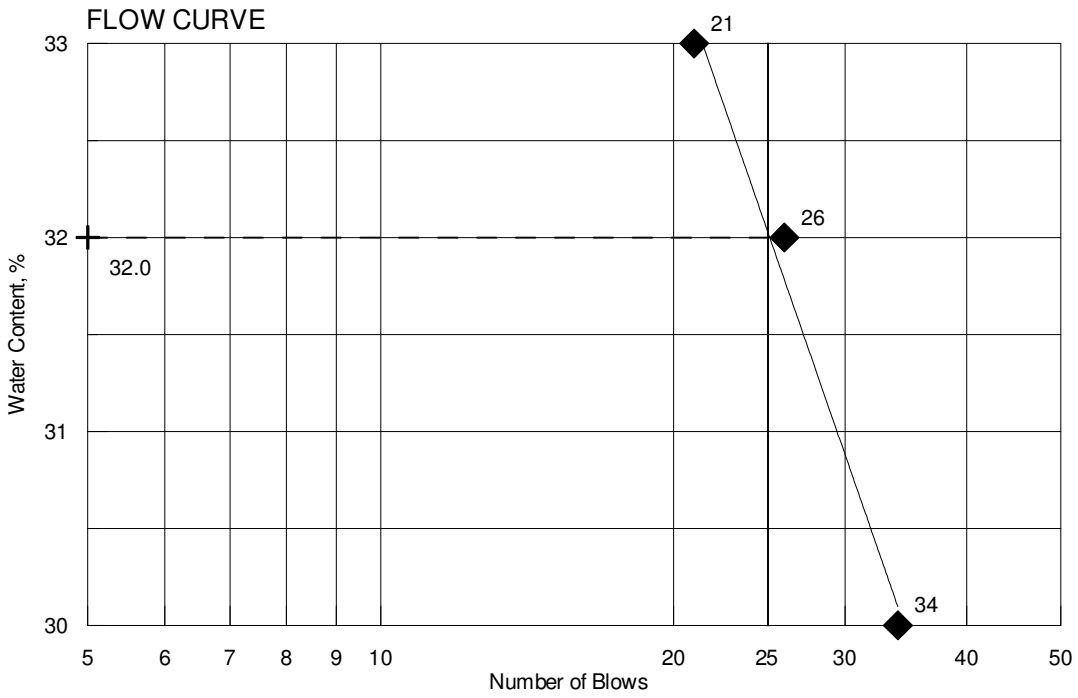


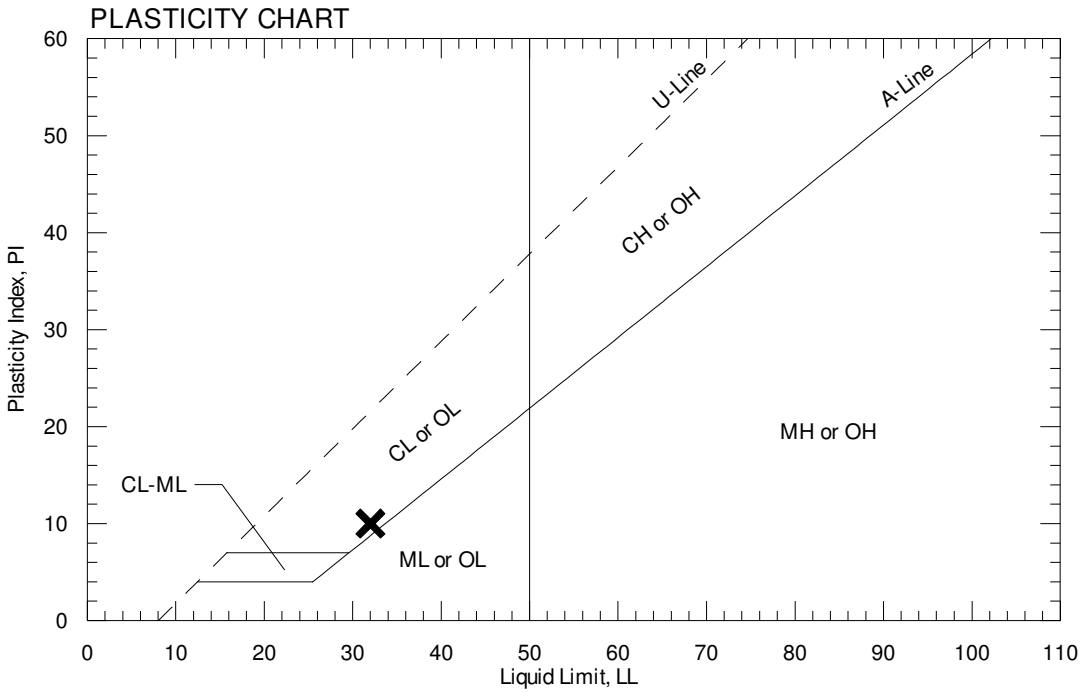
UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-COL-101/6D	14+93.4	11.6 RT	25.0-27.0	Silty CLAY, trace sand.	24.7	32	22	10
◆	HB-COL-101/7D	14+93.4	11.6 RT	30.0-32.0	Silty CLAY, trace sand.	26.1	31	21	10
■	HB-COL-101/8D	14+93.4	11.6 RT	35.0-37.0	Silty CLAY, trace sand.	28.0	30	21	9
●	HB-COL-101/9D	14+93.4	11.6 RT	40.0-42.0	Silty CLAY, little sand, trace gravel.	32.1	32	20	12
▲	HB-COL-101/10D	14+93.4	11.6 RT	45.0-47.0	Silty CLAY, little sand, trace gravel.	29.9	29	20	9
×	HB-COL-101/11D	14+93.4	11.6 RT	50.0-52.0	SILT, some clay, trace sand, trace gravel.	23.9	22	16	6

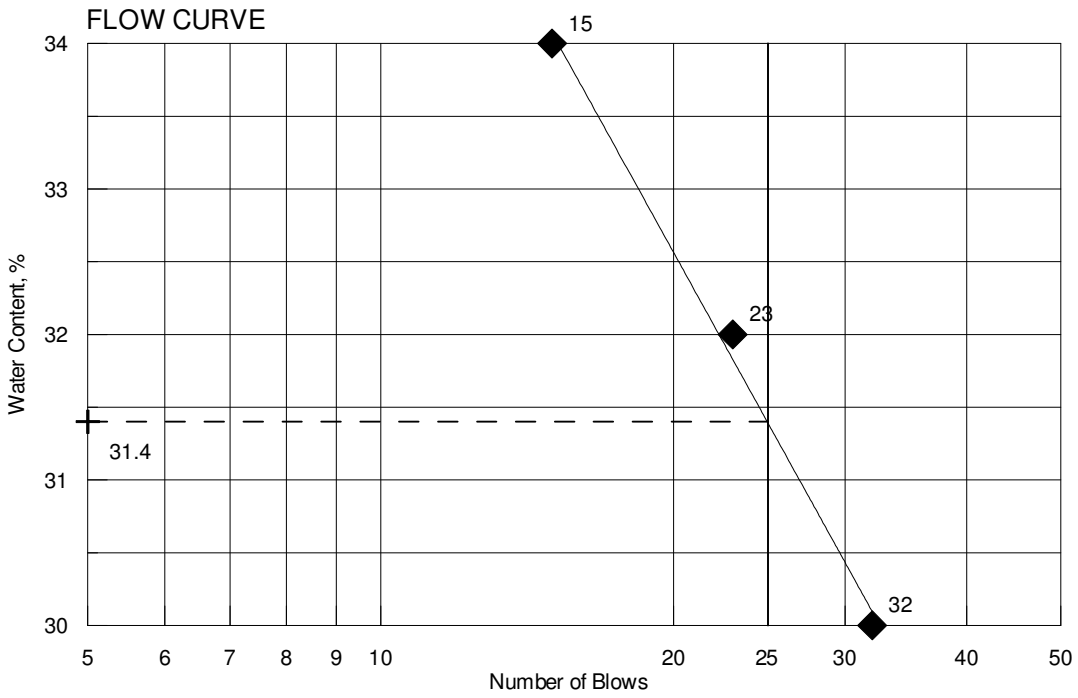
WIN
021772.00
Town
Columbia
Reported by/Date
WHITE, TERRY A 2/10/2020

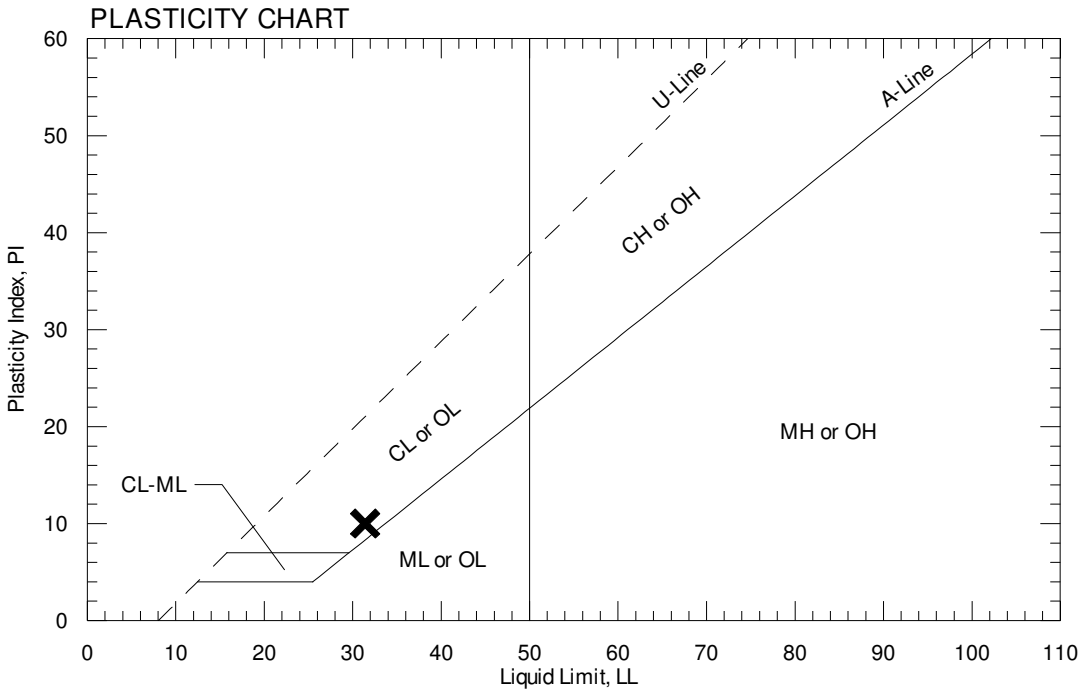
TOWN	Columbia	Reference No.	270351
WIN	021772.00	Water Content, %	24.7
Sampled	3/29/2017	Liquid Limit @ 25 blows (T 89), %	32
Boring No./Sample No.	HB-COL-101/6D	Plastic Limit (T 90), %	22
Station	14+93.4	Plasticity Index (T 90), %	10
Depth	25.0-27.0	Tested By	



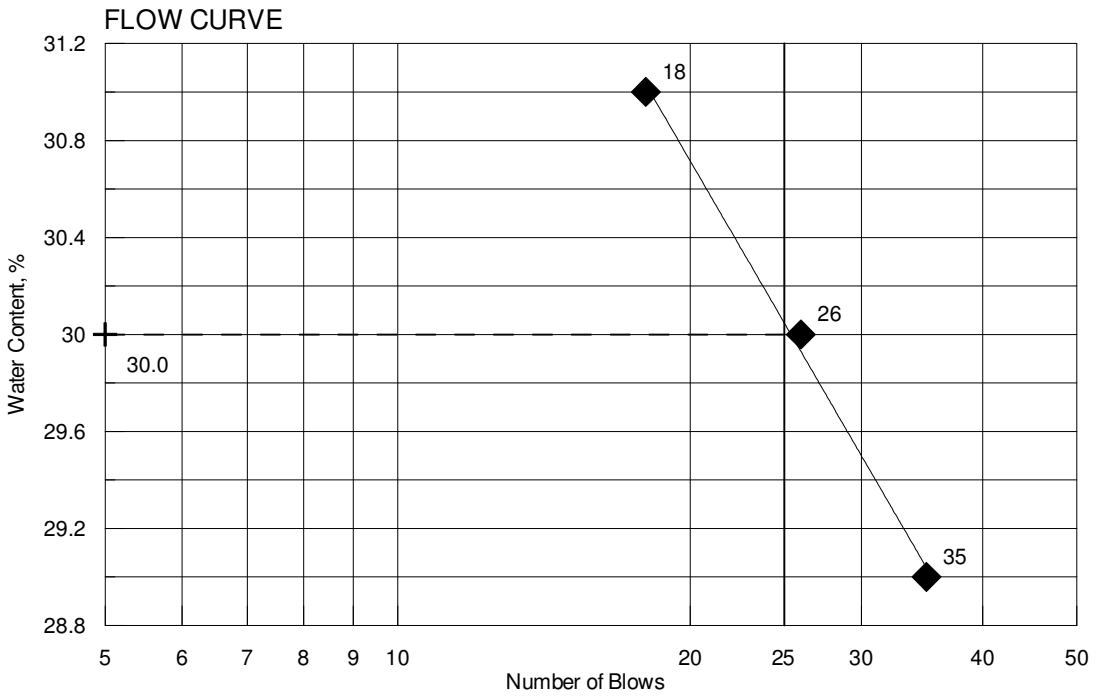


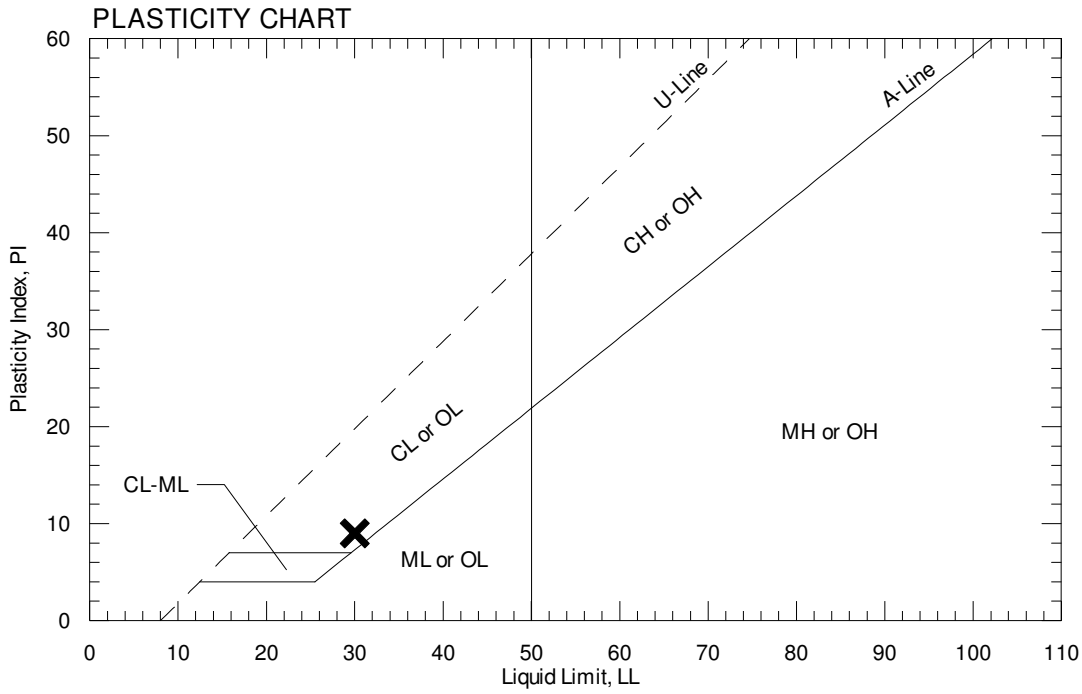
TOWN	Columbia	Reference No.	270352
WIN	021772.00	Water Content, %	26.1
Sampled	3/29/2017	Liquid Limit @ 25 blows (T 89), %	31
Boring No./Sample No.	HB-COL-101/7D	Plastic Limit (T 90), %	21
Station	14+93.4	Plasticity Index (T 90), %	10
Depth	30.0-32.0	Tested By	BBURR



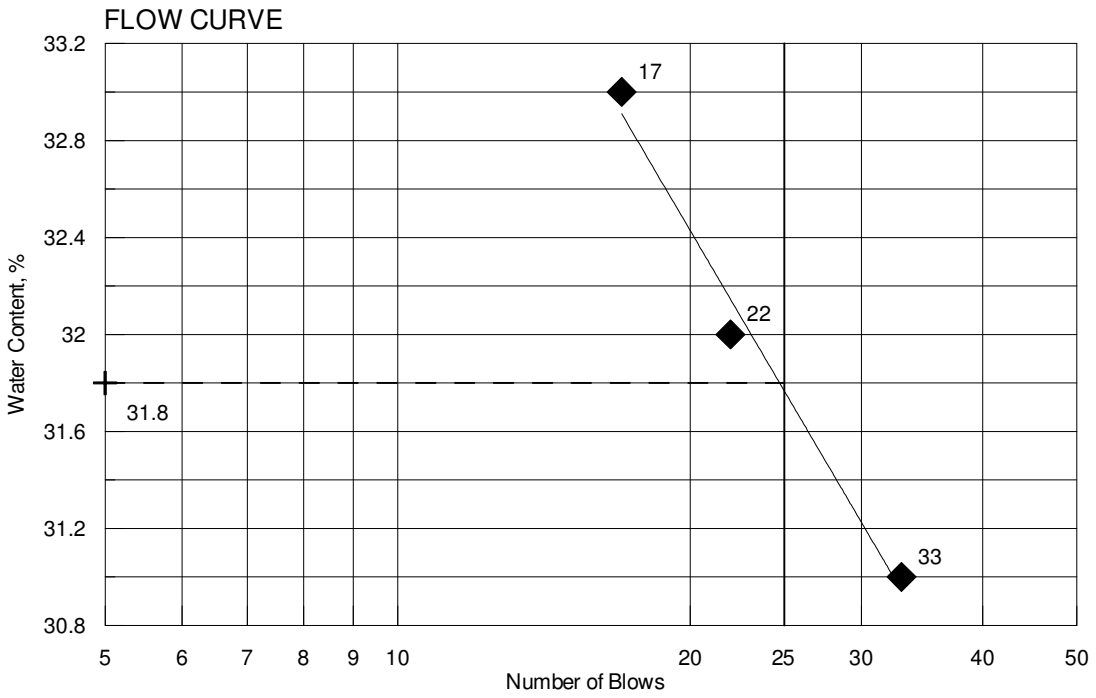


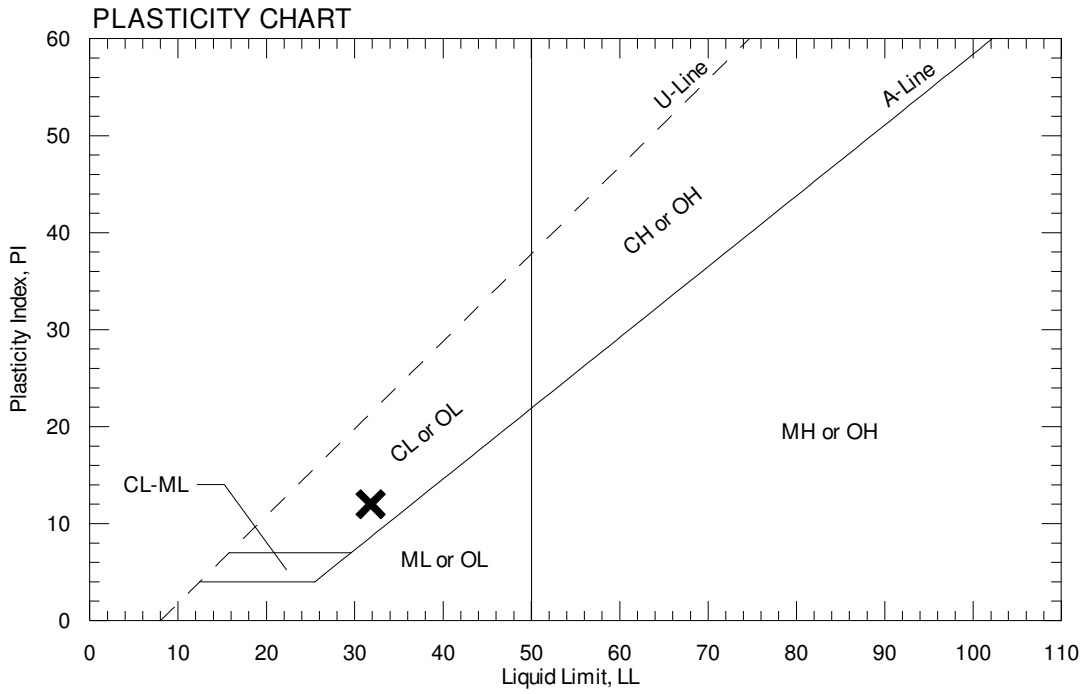
TOWN	Columbia	Reference No.	270353
WIN	021772.00	Water Content, %	28
Sampled	3/29/2017	Liquid Limit @ 25 blows (T 89), %	30
Boring No./Sample No.	HB-COL-101/8D	Plastic Limit (T 90), %	21
Station	14+93.4	Plasticity Index (T 90), %	9
Depth	35.0-37.0	Tested By	BBURR



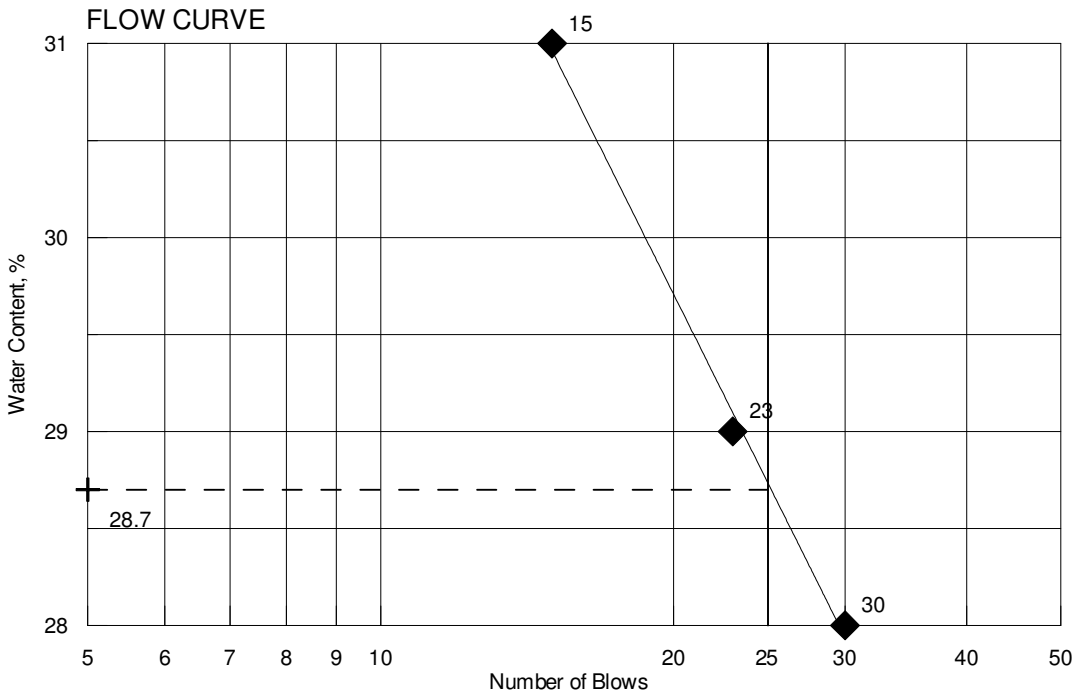


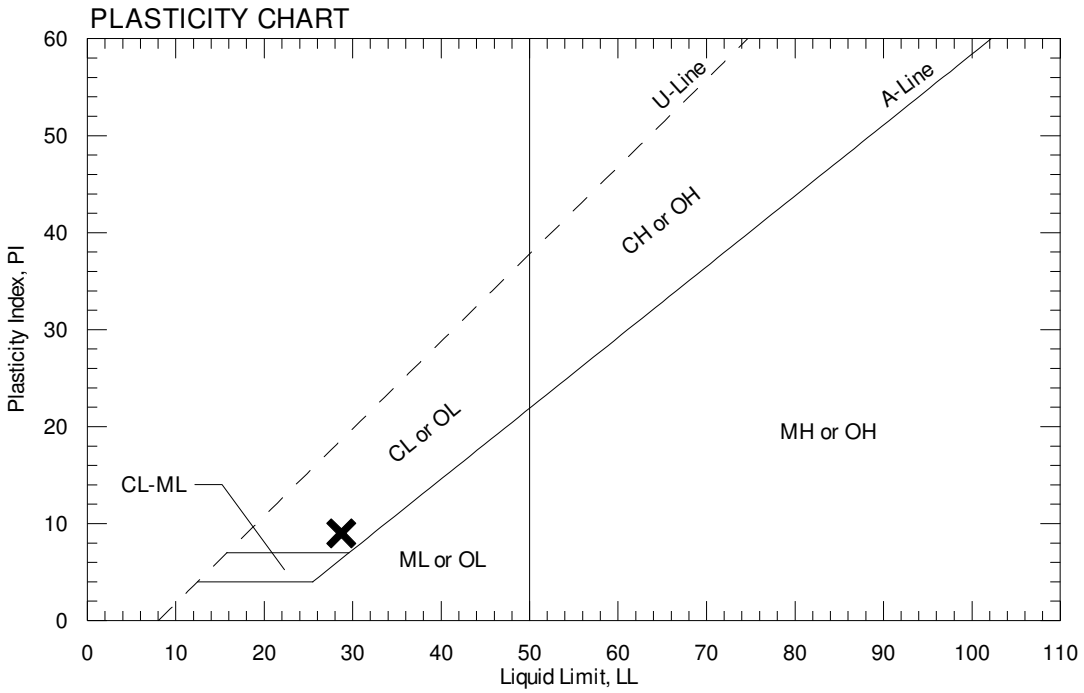
TOWN	Columbia	Reference No.	270354
WIN	021772.00	Water Content, %	32.1
Sampled	3/29/2017	Liquid Limit @ 25 blows (T 89), %	32
Boring No./Sample No.	HB-COL-101/9D	Plastic Limit (T 90), %	20
Station	14+93.4	Plasticity Index (T 90), %	12
Depth	40.0-42.0	Tested By	BBURR



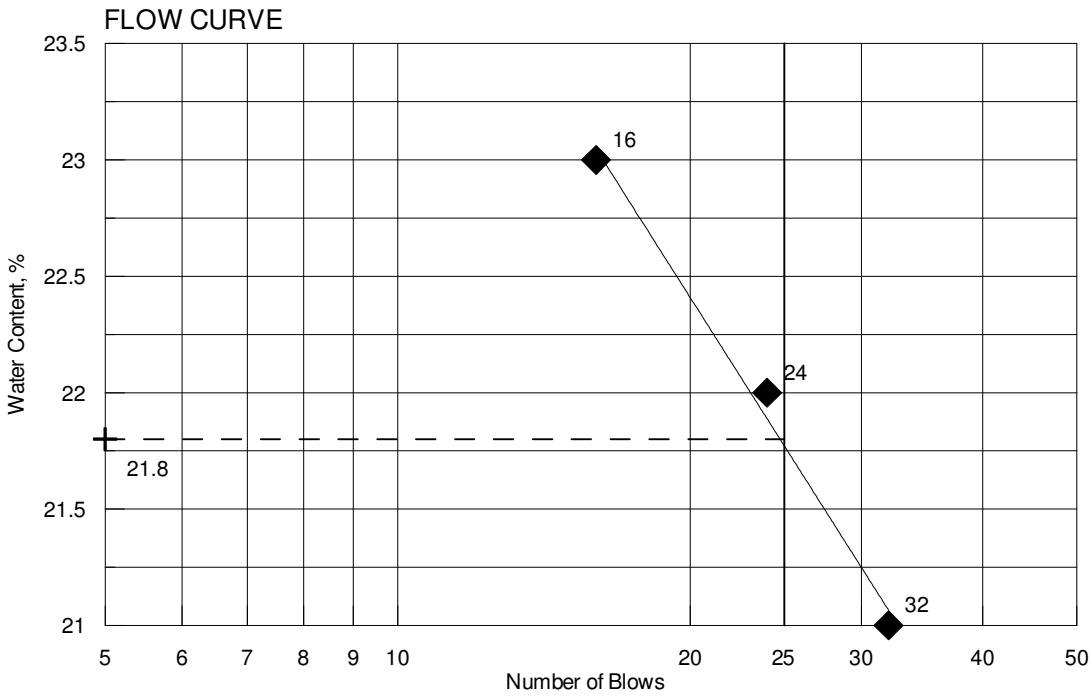


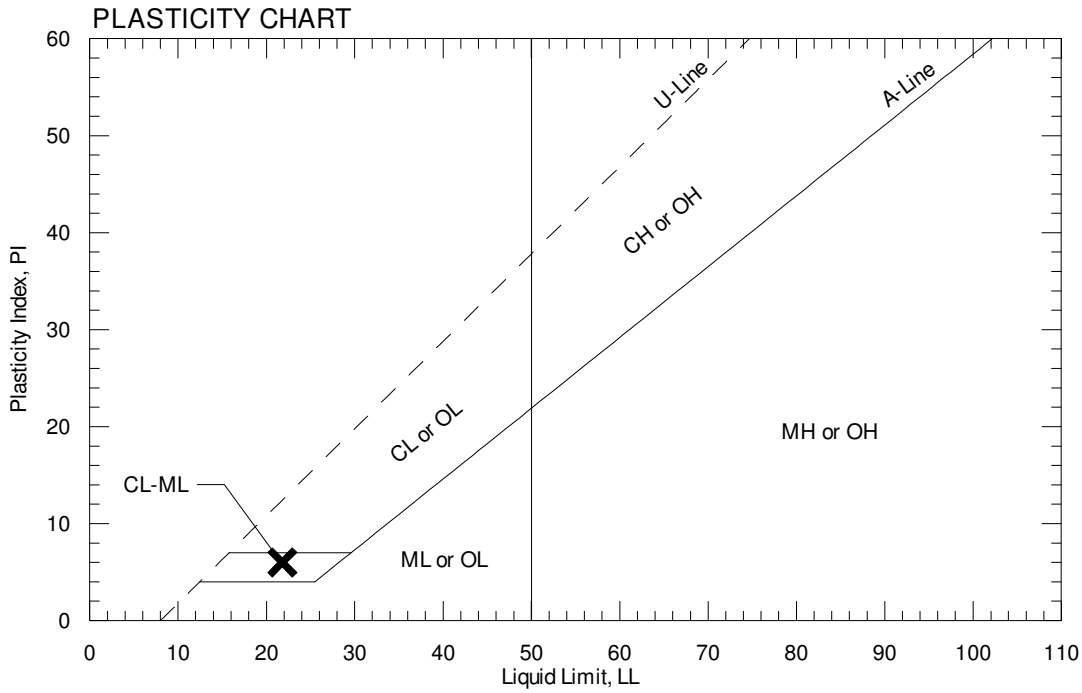
TOWN	Columbia	Reference No.	270355
WIN	021772.00	Water Content, %	29.9
Sampled	3/29/2017	Liquid Limit @ 25 blows (T 89), %	29
Boring No./Sample No.	HB-COL-101/10D	Plastic Limit (T 90), %	20
Station	14+93.4	Plasticity Index (T 90), %	9
Depth	45.0-47.0	Tested By	BBURR





TOWN	Columbia	Reference No.	270356
WIN	021772.00	Water Content, %	23.9
Sampled	3/29/2017	Liquid Limit @ 25 blows (T 89), %	22
Boring No./Sample No.	HB-COL-101/11D	Plastic Limit (T 90), %	16
Station	14+93.4	Plasticity Index (T 90), %	6
Depth	50.0-52.0	Tested By	BBURR





SPECIAL PROVISION
SECTION 203
EXCAVATION AND EMBANKMENT
(Culvert Bedding Stone)

Description This work shall consist of constructing a foundation pad of Culvert Bedding Stone in accordance with these specifications and in reasonably close conformity with the width, length, grade and thickness shown on the Plans or established by the Resident.

Materials Culvert Bedding Stone shall meet the requirements of Standard Specification Section 703.22, Underdrain Backfill Material, Type C.

Construction Requirements The Culvert Bedding Stone shall be placed and graded as shown on the Plans or as directed by the Resident, and shall be compacted as required to ensure that all voids in the stone are filled, as approved by the Resident.

Method of Measurement Culvert Bedding Stone will be measured by the cubic yard, complete, in place.

Basis of Payment The accepted quantity of Culvert Bedding Stone will be paid for at the Contract unit price per cubic yard, complete, in place.

Payment will be made under:

Pay Item	Pay Unit
203.55 Culvert Bedding Stone	Cubic Yard

SPECIAL PROVISION
SECTION 620 - GEOTEXTILES
(Reinforcement Geogrid)

Amend Standard Specification 620 – GEOTEXTILES to include the following:

620.01 Description This work shall consist of furnishing and installing Reinforcement Geogrid within the Culvert Bedding Stone in accordance with these specifications and in reasonably close conformity with the lines, grades, and dimensions shown on the plans or as directed by the Resident.

620.02 Material Reinforcement Geogrid shall consist of a regular network of integrally connected, polymeric tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil, aggregate or other material. The Reinforcement Geogrid structure shall be dimensionally stable to retain its geometry under construction stresses and shall have high resistance to damage during construction, ultraviolet degradation, and all forms of chemical and biological degradation encountered in the soil being reinforced.

The Reinforcement Geogrid shall meet or exceed the Minimum Average Roll Values (MARV) of the properties in Table 1. Acceptable manufacturers for Reinforcement Geogrids must be approved by the Resident.

Table 1 - Physical Property Requirements
(Biaxial Reinforcement Geogrid)

Reinforcement Geogrid Mechanical Property	Test Method	Minimum Average Roll Value (MARV)[1]
Tensile strength at 5% Strain MD or XD	ASTM D 6637	1,200 lb/ft
Rib Junction Strength	GRI-GG2	1,000 lb/ft in both directions
Aperture Openings		Between 0.75 and 3 inches
Percent Open Area		50 to 80%

[1] Values are minimum average roll values determined in accordance with ASTM D 4759

A biaxial Reinforcement Geogrid shall be used in this application.

620.03 Placement Reinforcement Geogrid shall be installed, in accordance with the manufacturer's recommendations, unless otherwise modified by this Special Provision. The Reinforcement Geogrid shall be placed within the layers of Crushed Stone Bedding at the proper elevation and alignment as shown on the Plans or as directed by the Resident.

1. The Reinforcement Geogrid shall be placed in continuous longitudinal strips. Splicing along the length will not be allowed. Reinforcement Geogrid shall be oriented such that the roll length runs either parallel or perpendicular to the construction centerline. The Contractor shall verify correct orientation of the Reinforcement Geogrid.

2. Reinforcement Geogrid may be temporarily secured in-place with staples, pins, sand bags or backfill as required by fill properties, fill placement procedures, or weather conditions, or as directed by the Resident.

3. Coverage of less than 100 percent shall not be allowed.

4. The Reinforcement Geogrid shall be lightly anchored and pulled taut to reduce any slack as directed by the Resident.

5. Fill shall not be dumped directly onto the Reinforcement Geogrid. It shall be dumped at the edge of the Reinforcement Geogrid or on a previous course of fill with a minimum compacted depth of 8 inches.

6. The Reinforcement Geogrid shall be covered with fill materials within 7 days of placement to protect against unnecessary exposure.

7. Fill may then be pushed onto the Reinforcement Geogrid using a track mounted bulldozer. At no time shall construction equipment be allowed directly onto the Reinforcement Geogrid. Track mounted equipment shall be allowed on previous courses of fill with a minimum compacted depth of 8 inches. Smooth drum roller compaction equipment shall be allowed on previous courses of fill with a minimum compacted depth of 8 inches and spread fill with a minimum depth of 12 inches, loose measure. At no time shall rubber tired or sheeps-foot rollers be allowed onto the reinforced fill. Turning of vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the Reinforcement Geogrid. Sudden breaking and sharp turning shall be avoided. Equipment speeds over 10 MPH shall not be allowed.

8. Placement, spreading, and compaction of soil on top of the Reinforcement Geogrid shall advance from one end of the Reinforcement Geogrid and move towards the other. Care shall be taken to minimize the development of wrinkles and to ensure that the Reinforcement Geogrid doesn't move from its position during fill placement. A spotter shall observe all fill placement operations to ensure the Reinforcement Geogrid does not slip, achieves the minimum coverage specified on the Plans, and is not damaged by the work.

9. Fill shall be compacted as specified in (1) the Standard Specifications or (2) to at least 90 percent of the maximum dry density determined in accordance with AASHTO T-180, whichever is greater. Density testing shall be made at a minimum frequency of one (1) test per lift or as otherwise specified in the Standard Specifications. Care shall be taken not to drive test apparatus through the Reinforcement Geogrid tensile elements.

10. All rutting formed during construction shall be filled with new Culvert Bedding Stone. In no case shall rutting be filled by blading down

620.04 Overlap Adjacent rolls of Reinforcement Geogrid shall be overlapped a minimum of 1 foot.

620.05 Seams Seams along adjacent lengths of Reinforcement Geogrid shall be tied together with hog rings or cable ties every 3 to 6 feet.

620.06 Certification Prior to construction the Contractor shall submit to the Resident the Manufacturer’s certification that the Reinforcement Geogrid supplied has been evaluated in full compliance with this Specification and is fit for long-term, critical soil reinforcement applications.

The Contractor's submittal package shall include, but not be limited to, actual tests for tension/creep, durability/aging, construction damage, and quality control tensile testing.

620.08 Shipment, Storage, Protection, and Repair of Fabric The Contractor shall check the Reinforcement Geogrid upon delivery to ensure that the proper material has been received. Each Reinforcement Geogrid roll shall be shipped in a protective bag and clearly marked with roll number, lot number, geogrid style and principle strength direction. During all periods of shipment and storage, the Reinforcement Geogrid shall be protected from temperatures greater than 140°F and all deleterious materials that might otherwise become affixed to the Reinforcement Geogrid and effect its performance. The manufacturer's recommendations shall be followed with regard to protection from direct sunlight. The Reinforcement Geogrid shall be stored off the ground in a clean, dry environment out of the pathway of construction equipment.

Any Reinforcement Geogrid damage shall be repaired or replaced in accordance with the manufacturer's recommendations. The Contractor shall replace any Reinforcement Geogrid damaged during installation at no additional cost to the Department.

620.09 Method of Measurement Reinforcement Geogrid will be measured by the number of Square Yards of surface area installed. Overlaps for connections, splices, patches, and repairs of damaged Reinforcement Geogrid, etc. are incidental to this Pay Item.

620.10 Basis of Payment Reinforcement Geogrid placement will be paid for per Square Yard in-place which shall be full compensation for all off-loading, inspection, storage, labor, materials, equipment, tools and any incidentals to complete the installation.

Payment will be made under:

Pay Item	Pay Unit
620.65 Reinforcement Geogrid	Square Yard