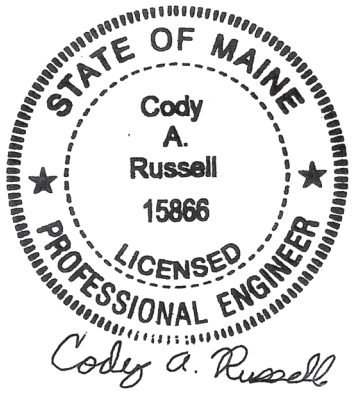
MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE

GEOTECHNICAL DESIGN REPORT

For the Construction of

MAPLE HILL BRIDGE
ROUTE 115
NORTH YARMOUTH, MAINE

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



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

Cumberland County
WIN 23693.00

Soils Report 2023-06
Bridge No. 6639

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Table of Contents

Sheets

Appendices

1.0 INTRODUCTION

The purpose of this Geotechnical Design Report is to present subsurface information and make geotechnical recommendations for the replacement an existing large culvert on Route 115 in North Yarmouth, Maine. A subsurface investigation has been completed at the site to evaluate subsurface conditions and to develop geotechnical design and construction recommendations for the replacement structure. This report presents the subsurface information obtained during the subsurface investigation and soil laboratory testing programs and provides design and construction recommendations and geotechnical design parameters for the culvert replacement.

The existing structure (#911957) consists of twin 36-inch diameter, 54-foot long, corrugated metal pipe (CMP) culverts on Route 115 in North Yarmouth. The existing culvert is in critical condition, with severe deterioration causing signs of uneven settlement in the roadway, a failed granite headwall on the outlet and, erosion on the inlet and outlet ends. Route 115 is a Highway Corridor Priority 4 road.

The proposed replacement structure will be a 11-foot, 5-inch span by 7-foot, 3-inch rise by 96-foot long polymer coated structural steel pipe arch on a skew of approximately 2.8 degrees to the roadway centerline. The invert of the proposed culvert is approximately 14 feet below the existing road grade at the roadway centerline. To facilitate fish passage, Habitat Connectivity Design elements will be used inside the proposed polymer coated structural steel pipe arch as shown on the Special Details Sheet 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.

2.0 GEOLOGIC SETTING

The existing culvert carries an unnamed stream under Route 115 in North Yarmouth and is located 0.05 miles south of the intersection with Mill Road as shown on Sheet 1 – Location Map.

According to the Maine Geological Survey (MGS) map titled Surficial Geology Cumberland Center Quadrangle, Maine Open File No. 99-81 (1999) the surficial soils at the site consist of Presumpscot Formation. These soils typically consist of marine silt and clay with sandy beds and lenses.

According to the map titled Bedrock Geologic Map of Maine (1985) published by the MGS, the bedrock in the vicinity of the site consists of intrusive, Carboniferous Granite with Muscovite intrusions commonly known as the Sebago Pluton.

3.0 SUBSURFACE INVESTIGATION

One (1) boring (HB-NYA-101) and one (1) probe (HB-NYA-102) were drilled on opposite, diagonal corners of the existing structure on December 6, 2019 by a S.W. Cole drill crew using a track mounted Diedrich D-50 drill rig. Exploration locations are shown on Sheet 2 – Boring Location Plan & Interpretive Subsurface Profile with Boring Logs. Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are presented on the Boring Logs in Appendix A.

Boring HB-NYA-101 was drilled using hollow stem auger drilling techniques. Soil samples were obtained in boring HB-NYA-101 at 5-foot intervals using Standard Penetration Test (SPT) methods. The S.W. Cole drill rig is equipped with an automatic hammer to drive the split spoon. The S.W. Cole calibrated automatic hammer delivers approximately 68.5 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 of 1.011 to the raw field N-values. Probe HB-NYA-102 was drilled using solid stem auger techniques. No soil 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 Program (NETTCP) certified subsurface inspector logged subsurface conditions encountered in the explorations. The boring and probe were located in the field by taping to surveyed site features after completion of the drilling program.

4.0 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 six (6) standard grain size analyses with natural water content. The results of the laboratory testing program are discussed in the following section and are included in Appendix B – Laboratory Test Results. Laboratory test information is also shown on the Boring Logs in Appendix A.

5.0 SUBSURFACE CONDITIONS

Subsurface conditions encountered at the test boring generally consisted of fill consisting of interbedded layers of sand and sandy silt underlain by native sand. An interpretive subsurface profile depicting the generalized soil stratigraphy at the boring location is shown on Sheet 2 – Boring Location Plan & Interpretive Subsurface Profile with Boring Logs.

Boring HB-NYA-101 was drilled to a depth of approximately 22.0 feet below ground surface (bgs) without encountering a refusal surface. Probe HB-NYA-102 was drilled to a depth of approximately 22.0 feet bgs without encountering a refusal surface.

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

Approx. Depth BGS[1] (feet)	Soil Description	AASHTO[2] Classification	USCS[3]	WC%[4]
0.0 – 10.0	Fill – Interbedded layers of brown, damp to wet, fine to coarse sand, little to some gravel, trace to some silt and light brown, moist, fine to coarse sandy silt, trace gravel. Wood layer – 9.5 to 10.0 feet bgs.	A-1-a or A-2-4 A-4	SW-SM or SM CL	2.1 to 3.6 20.4
10.0 – 22.0	Brown, moist to wet, fine to coarse sand, little to some gravel, little to some silt.	A-2-4 or A-1-b	SM	7.5 to 27.7

[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

Corrected SPT N_{60}-values obtained in the fill sand ranged from 22 to 29 blows per foot (bpf) indicating that the fill sand is medium dense in consistency. No SPT N_{60}-values were obtained in the fill sandy silt. Corrected SPT N_{60}-values obtained in the native sand ranged from 29 to 83 blows per foot (bpf) indicating that the native sand is medium dense to very dense in consistency.

Groundwater was recorded in boring HB-NYA-101 at a depth of approximately 12.0 feet bgs. Groundwater level was not observed in probe HB-NYA-102. Groundwater levels can be expected to fluctuate subject to seasonal variations, local soil conditions, topography, precipitation, and construction activity.

6.0 GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS

The following sections discuss geotechnical recommendations for the design and construction of the proposed polymer coated structural steel pipe arch.

6.1 Polymer Coated Structural Steel Pipe Arch Design and Construction

The proposed replacement structure will be a 11-foot, 5-inch span by 7-foot, 3-inch rise by 96-foot long polymer coated structural steel pipe arch culvert on a skew of approximately 2.8 degrees to the roadway centerline. The proposed structure inlet and outlet slopes shall be riprapped with slopes no steeper than 2H:1V to protect against erosion. The proposed pipe arch culvert shall be designed and constructed in accordance with MaineDOT Standard Specification 603.

The invert of the proposed polymer coated structural steel pipe arch culvert ranges from approximate elevation 193.84 feet at the inlet end to approximate elevation 192.40 feet at the outlet end with a slope of approximately 1.5%. To facilitate fish passage, Habitat Connectivity

Design elements will be used inside the polymer coated structural steel pipe arch culvert as shown on the Special Details Sheet in the Plans.

The full nature of the culvert bearing surface will not become evident until the culvert excavation is made. Any cobbles or boulders in excess of 6 inches encountered at the bedding elevation shall be removed and replaced with compacted Granular Borrow Material for Underwater Backfill or Crushed Stone ¾-Inch. A layer of wood fill may be encountered in the excavation and shall be removed within the excavation limits. Any disturbed soils at the bedding elevation resulting from excavation activities should be removed by hand prior to placement of the bedding material. The prepared subgrade shall be proofrolled using a static roller to visually confirm the prepared subgrade is firm and stable. The exposed subgrade shall be free of ponded water so that bedding material placement and compaction can be completed in the dry.

The proposed structure shall be bedded on a 1-foot thick layer of Granular Borrow, Material for Underwater Backfill meeting the requirements of MaineDOT Standard Specification 703.19. The soil envelope and backfill shall consist of Standard Specification 703.19 - Granular Borrow with a maximum particle size of 4 inches. The granular borrow bedding and backfill material 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, the bedding and backfill soil shall be compacted to at least 92 percent of the AASHTO T-180 maximum dry density. All subgrade surfaces should be protected from construction traffic in order to limit disturbance.

6.2 Settlement

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

6.3 Scour and Riprap

Both the inlet and outlet of the polymer coated structural steel pipe arch culvert 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 bedding material 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.

6.4 Oversteepened Slopes

A 1.5V:1V cut backslope is proposed from Stations 111+50 to 111+87.5. The oversteepened slope shall be armored with 3-feet of plain riprap. The riprap shall be underlain by a non-woven Class 1

erosion control geotextile that meets the requirements for MaineDOT Standard Specification 722.03 that is underlain by a 1-foot layer of protective aggregate cushion conforming to MaineDOT Standard Specification 703.19 Granular Borrow Material for Underwater Backfill.

6.5 Seismic Design Considerations

In conformance with LRFD Article 3.10.1, seismic analysis is not required for buried structures, except where they cross active faults. There are no known active faults in Maine; therefore, seismic analysis is not required.

6.6 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 polymer coated structural steel pipe arch 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 the soil 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 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.

7.0 CLOSURE

This report has been prepared for the use of the MaineDOT Highway Program and their project design consultant for specific application to the proposed replacement of an existing large culvert (#911957) under Route 115 in North Yarmouth, 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.

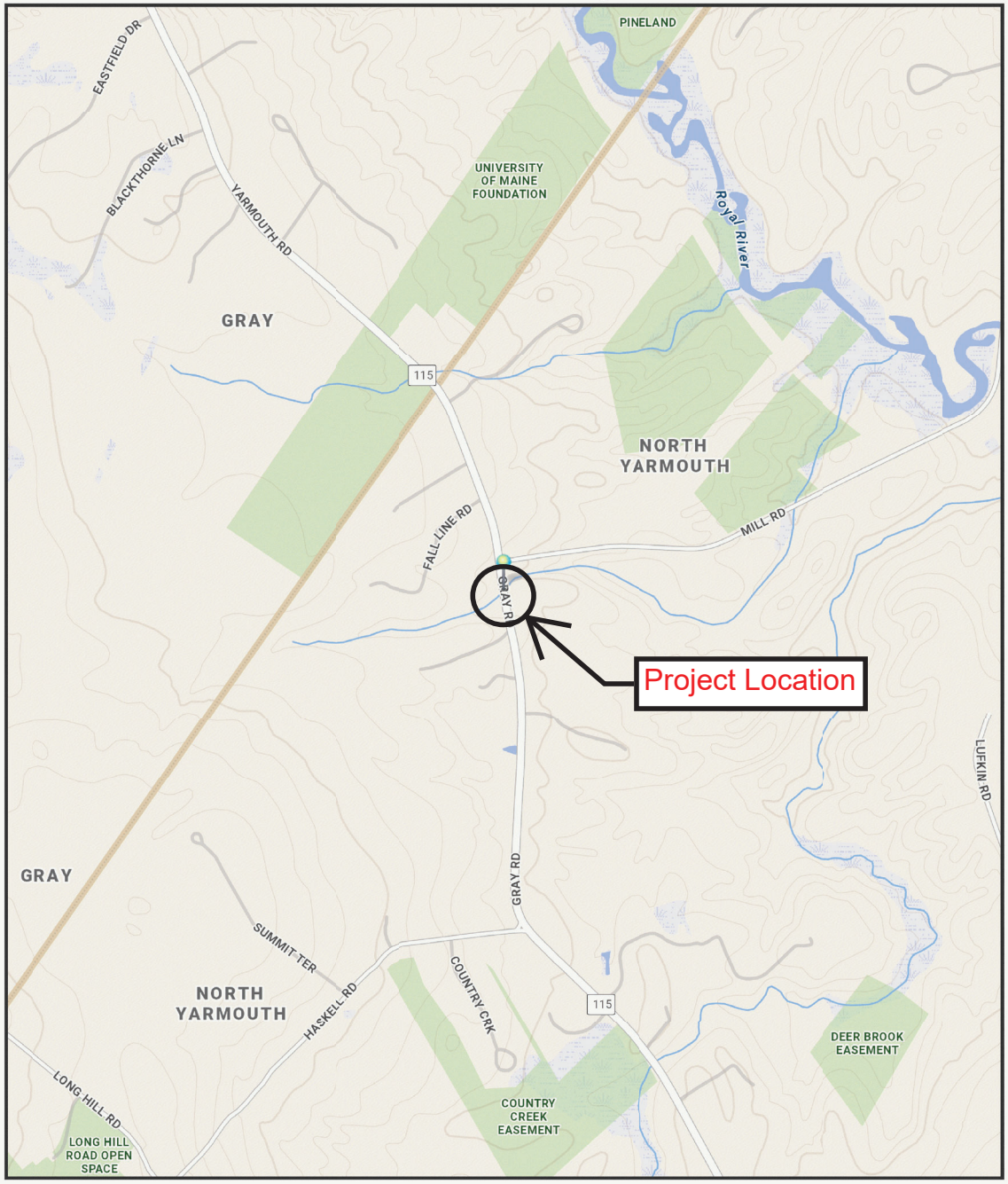
Sheets

Date:3/22/2023

Division: GEOTECH

Username: terry.white

NORTH YARMOUTH, MAINE



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0.25 Miles

1 inch = 0.28 miles

Date: 3/17/2023
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SHEET NUMBER 1 OF 2	NORTH YARMOUTH ROUTE 115 LOCATION MAP	STATE OF MAINE DEPARTMENT OF TRANSPORTATION 23693.00 WIN 23693.00 HIGHWAY PLANS