



# Avery Road Culvert Replacement Project

Philipstown, NY

Basis of Design Report – 50% Designs

**SUBMITTED TO**

**Beth Greco, Walter Hoving Home**

**Jim Katz, NYS DEC**

**DECEMBER 2025**

Approved 12/29/25

This is a New York State Department of Environmental Conservation funded project.

This document was prepared for the Hudson River Estuary Program, New York State Department of Environmental Conservation, with support from the New York State Environmental Protection Fund in cooperation with NEIWPC.

The viewpoints expressed here do not necessarily represent those of NEIWPC or NYS DEC, nor does mention of trade names, commercial products, or causes constitute endorsement or recommendation for use.



# Table of Contents

|                                                                   |           |
|-------------------------------------------------------------------|-----------|
| <b>1. Introduction .....</b>                                      | <b>8</b>  |
| 1.1 Project Overview .....                                        | 8         |
| 1.2 Project Goals and Objectives .....                            | 8         |
| <b>2. Project Description .....</b>                               | <b>8</b>  |
| 2.1 Existing crossing .....                                       | 8         |
| 2.2 watershed .....                                               | 9         |
| 2.3 Philips brook at the subject crossing .....                   | 11        |
| 2.4 features of note near the subject crossing .....              | 12        |
| <b>3. Data Collection .....</b>                                   | <b>13</b> |
| 3.1 Desktop Data Review .....                                     | 13        |
| 3.2 Field Data Collection .....                                   | 14        |
| 3.3 Geotechnical Investigation .....                              | 14        |
| <b>4. Hydrologic and Hydraulic Modeling Analysis .....</b>        | <b>14</b> |
| 4.1 PEAK FLOW ESTIMATES .....                                     | 14        |
| 4.1.1 USGS Regression Equation Method .....                       | 14        |
| 4.1.2 Gage Transfer Method .....                                  | 15        |
| 4.1.3 Summary Figure & Table .....                                | 16        |
| 4.2 hydraulics .....                                              | 18        |
| 4.2.1 Model Geometry .....                                        | 18        |
| 4.2.2 Flow Hydrograph .....                                       | 19        |
| 4.2.3 Downstream Boundary Condition .....                         | 19        |
| 4.2.4 Manning's "n" Roughness Coefficients .....                  | 19        |
| 4.2.5 Computational Settings .....                                | 19        |
| <b>5. Proposed Design .....</b>                                   | <b>20</b> |
| 5.1 Hydraulic model results .....                                 | 20        |
| 5.2 Hydraulic Design .....                                        | 22        |
| 5.3 Estimate of Probable Cost .....                               | 22        |
| <b>6. Construction Sequencing and Phasing .....</b>               | <b>23</b> |
| <b>7. References .....</b>                                        | <b>24</b> |
| Appendix A 100% Design Drawings .....                             | A-1       |
| Appendix B Engineer's Opinion of Probable Construction Cost ..... | B-1       |
| Appendix C Geotechnical Data Memorandum .....                     | C-1       |
| Appendix D Hydraulic Data Tables .....                            | D-3       |



## List of Figures

|                                                                                                                                                                                                            |                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| Figure 1. Map of Philips Brook Dam watershed. Inset map shows Philips Brook through the project site. ....                                                                                                 | 9                                   |
| Figure 2. Aerial of Philips Brook in the project reach. Flow is from east to west. Aerial photography for Putnam County from NYS GIS Clearinghouse.....                                                    | 11                                  |
| Figure 3. Weir 1. Taken on August 7 <sup>th</sup> , 2020.....                                                                                                                                              | <b>Error! Bookmark not defined.</b> |
| Figure 4. Dam. Taken on August 7 <sup>th</sup> , 2020.....                                                                                                                                                 | <b>Error! Bookmark not defined.</b> |
| Figure 5. Failing masonry and low-level outlet on river right (north). Note water pouring through the structure. Taken on August 7 <sup>th</sup> , 2020. ....                                              | <b>Error! Bookmark not defined.</b> |
| Figure 6. Failing masonry on river left (south). Taken on August 7 <sup>th</sup> , 2020.....                                                                                                               | <b>Error! Bookmark not defined.</b> |
| Figure 7. Weir 2 and stone arch footbridge. Taken on August 7 <sup>th</sup> , 2020.....                                                                                                                    | <b>Error! Bookmark not defined.</b> |
| Figure 8. Original wall section missing mortar and undermined. Taken on August 7 <sup>th</sup> , 2020. ....                                                                                                | <b>Error! Bookmark not defined.</b> |
| Figure 9. Weir 3. Taken on August 7 <sup>th</sup> , 2020.....                                                                                                                                              | <b>Error! Bookmark not defined.</b> |
| Figure 10. Looking downstream at the stone arch footbridge between Weir 3 and Avery Road. Taken on August 7 <sup>th</sup> , 2020. ....                                                                     | <b>Error! Bookmark not defined.</b> |
| Figure 11. Looking downstream from a footbridge to Avery Road. Note mature tree growth on the right (northern) bank that is displacing a section of the wall. Taken on August 7 <sup>th</sup> , 2020. .... | <b>Error! Bookmark not defined.</b> |
| Figure 12. Looking upstream along Philips Brook from the Walter Hoving Road bridge                                                                                                                         | <b>Error! Bookmark not defined.</b> |
| Figure 13. Looking south over the impoundment at the dam crest. Taken on August 7 <sup>th</sup> , 2020. ..                                                                                                 | <b>Error! Bookmark not defined.</b> |
| Figure 14. Looking upstream in the impoundment. Taken August 11 <sup>th</sup> , 2023. ....                                                                                                                 | <b>Error! Bookmark not defined.</b> |
| Figure 15. Women from Hoving Home enjoying a swim in Philips Brook, circa 1970s. .                                                                                                                         | <b>Error! Bookmark not defined.</b> |
| Figure 16. FEMA Flood Insurance Rate Map.....                                                                                                                                                              | <b>Error! Bookmark not defined.</b> |
| Figure 17. Sediment sample locations collected on August 11th, 2023.....                                                                                                                                   | <b>Error! Bookmark not defined.</b> |
| Figure 18. Peak flow estimates for Philips Brook using gage transfer method. ....                                                                                                                          | 16                                  |
| Figure 19. Peak discharge frequency relationship for Philips Brook at Philipstown, NY. ....                                                                                                                | 17                                  |
| Figure 20. Philips Brook 2-D hydraulic model domain.....                                                                                                                                                   | <b>Error! Bookmark not defined.</b> |
| Figure 21. Modeled inundation extents at the 1.25-, 10-, and 100-year flood events in existing conditions.....                                                                                             | <b>Error! Bookmark not defined.</b> |
| Figure 22. Flood profiles for existing conditions model. ....                                                                                                                                              | <b>Error! Bookmark not defined.</b> |
| Figure 23. Modeled velocity at the 100-year food event for proposed conditions.....                                                                                                                        | <b>Error! Bookmark not defined.</b> |
| Figure 24. Modeled inundation extents at the 100-year flood event for existing and proposed conditions.....                                                                                                | <b>Error! Bookmark not defined.</b> |
| Figure 25. Proposed grading (blue) overlayed on the results of the Phase IB Archaeological Study. .                                                                                                        | <b>Error! Bookmark not defined.</b> |



List of Tables

|                                                                                                    |                                     |
|----------------------------------------------------------------------------------------------------|-------------------------------------|
| Table 1. Watershed Characteristics .....                                                           | 15                                  |
| Table 2. USGS Gages near Philips Brook. ....                                                       | 15                                  |
| Table 3. Hydrologic Analysis Results: Peak Flow Estimates for Philips Brook at the Study Area..... | 17                                  |
| Table 4. Manning's "n" used in the hydraulic model. ....                                           | <b>Error! Bookmark not defined.</b> |

# 1. Introduction

## 1.1 PROJECT OVERVIEW

Inter-Fluve Engineering, PLLC (Inter-Fluve), was contracted by Walter Hoving Home (Hoving Home) in 2025 to develop replacement designs for the Avery Road stream crossing over Philips Brook. This Basis of Design report summarizes the data collection, analyses, and 100% designs for replacing this crossing. This project builds upon previous work by Inter-Fluve and Hoving Home focused on the design for the removal of Philips Brook Dam and the restoration of Philips Brook. Work completed during the previous work included topographic and bathymetric surveys, hydrologic and hydraulic modeling, archaeological investigations, sediment sampling, a basis of design report, and the development of preliminary designs. Some of the data collected and analyses completed were utilized and built upon for the development of the 100% designs for the Avery Road replacement crossing described in the sections below.

The Avery Road crossing over Philips Brook is owned by the Town of Philipstown (Town). Avery Road is a residential road that meets Snake Hill Road to the south. Philips Brook flows east to west under Avery Road approximately 130 feet north of Snake Hill Road. Avery Road is overtopped periodically during flooding events, with the crossing unable to contain the floodwaters. The primary objective of replacing the crossing is to extend the design life and increase the hydraulic capacity of the crossing.

## 1.2 PROJECT GOALS AND OBJECTIVES

The project designs described in this report have been developed in consideration of the project goal and associated objectives, which are listed here. The primary goal of the project is to replace an aging, undersized stream crossing.

Specific Objectives Include:

- Replace aging infrastructure: The Avery Road crossing over Philips Brook is aging; while repairs were made in 2020, the entire crossing infrastructure was built decades ago. Installation of a new bridge will extend the life of the crossing.
- Increase hydraulic capacity: Replacing the existing crossing with a larger bridge that matches the width of the upstream and downstream walls along the edge of the channel will increase the hydraulic capacity of the crossing, allowing more flood waters to pass under the bridge.

# 2. Project Description

## 2.1 EXISTING CROSSING

The Avery Road stream crossing over Philips Brook is a modern structure owned by the Town of Philipstown. The existing crossing is a single span concrete deck with concrete abutment walls and is 3.6 feet high and 14 feet wide. The Town repaired the footings in 2020, but no changes were made

to the size of the bridge opening or to the elevation of the bed<sup>1</sup>. After severe storm events, maintenance at the crossing is needed to remove accumulated sand, gravel, and woody debris that accumulate in and around the structure, on the road, and along nearby guardrails and fences because the crossing is undersized forcing floodwaters to flow over and around the structure. The crossing supports a one lane asphalt paved roadway and driveways are located adjacent to the stream crossing on either side of the downstream side of the crossing.

## 2.2 WATERSHED

Philips Brook, a tributary of the Hudson River Estuary with a drainage area of approximately 3.7 square miles, originates in the highlands east of the Hudson River. The brook flows westward down steep, forested hillslopes before reaching the lower-gradient terrain of the project site. The project site is downstream of three concrete and stone weirs and a dam between Avery Road and Walter Hoving Road. At the location of the crossing, the drainage area is just over 3.2 square miles (Figure 1).



**Figure 1. Map of Philips Brook Dam watershed. Inset map shows Philips Brook with the Avery Road crossing on the left side of the image and the Walter Hoving Home property north of Snake Hill Road between Avery Road and Walter Hoving Road.**

<sup>1</sup> Carl Frisenda, Highway Superintendent, Town of Philipstown, personal communication on August 13, 2020

Downstream of the project site, Philips Brook continues its course and ultimately drains into Constitution Marsh—a 270-acre tidal marsh located on the east bank of the Hudson River. Managed by Audubon New York, Constitution Marsh is a significant ecological area due to its diverse habitats that support various species of birds, fish, and other wildlife. The marsh plays a crucial role in filtering pollutants, buffering floodwaters, and providing critical habitat within the Hudson River Estuary.

Based on 2021 National Land Cover data, the Philips Brook watershed upstream of Avery Road contains a mix of forested land (76%), residential area (16%), agricultural land (4%), and wetlands and open water (4%)<sup>2</sup>. The upper watershed is predominantly forested, contributing to the brook's cool water temperatures. As the brook descends toward the Hudson River, it passes through developed areas where land-use changes have altered hydrologic responses, potentially increasing runoff and sediment loads during storm events.

The Hoving Home property was once part of the Cedar Crest Estate, owned by J.M. Toucey in the mid-19th century. During this period, several structures were constructed along Philips Brook, including weirs, a dam to form a swimming pond, two stone arch footbridges, and continuous stone walls along both sides of the stream (Figure 2). While these historical structures are architecturally significant, they have degraded over time and now serve as barriers to aquatic organism passage, disrupting the natural ecology of the brook. The stream restoration designs under separate contract to Hoving Home remove these barriers and restore a more natural stream flow along Philips Brook. Avery Road, the subject of the designs described in this document, is at the downstream end of the barriers and proposed stream restoration.

As the brook enters the gentler slopes of the Hoving Home property, the stream energy decreases, causing coarse material like gravel and sand to settle out of the flow and deposit in the channel and on the adjacent floodplains. Under natural conditions, this depositional process would result in the periodic shifting of the channel across the valley, allowing the stream to adjust to changes in sediment load and flow conditions. However, the presence of the stone walls restricts this natural movement, confining the brook to a fixed path from Walter Hoving Road downstream to Route 9D. Vertical walls line the stream channel immediately upstream and downstream of the Avery Road crossing, making replacement of the crossing to full stream crossing standards illogical without the restoration of an appropriately-sized stream and stream banks throughout this section of the river corridor.

---

<sup>2</sup> <https://www.usgs.gov/centers/eros/science/national-land-cover-database>



**Figure 2. Aerial of Philips Brook between Walter Hoving Road and the project site at Avery Road. Flow is from east to west. Aerial photography for Putnam County from NYS GIS Clearinghouse.**

### 2.3 PHILIPS BROOK AT THE SUBJECT CROSSING

Philips Brook flows under Avery Road through a constrained system of stone walls upstream of the crossing, within concrete abutments at the crossing, and between stone walls downstream of the crossing (Figure 3). Philips Brook has gravel and cobble substrate along the channel bed, with small areas of sand deposition in lower-velocity areas upstream and downstream of the crossing. The vertical stone walls do not provide an opportunity for naturally-sloped streambanks, resulting in barriers for some animals that would typically move to and from the stream along the stream banks. The channel between the walls upstream and downstream of the crossing varies in width but is approximately 16 feet wide just upstream of the crossing and abutments.

Under the stream crossing, the concrete bridge abutments extend into the stream bed on either side with a natural stream bed between these abutments. At the upstream end of the crossing, a degrading concrete apron extends across the channel. Downstream of the stream crossing, multiple barriers to flow and fish passage exist throughout the length of Philips Brook.



**Figure 3. Philips Brook at the Avery Road stream crossing. Clockwise from upper left: Looking upstream from Avery Road at the vertical walls, some sediment accumulation and vegetation growing in the walls; looking upstream at the Avery Road crossing; looking downstream under the Avery Road crossing, noting the concrete walls and concrete footings sticking out into the stream; and looking downstream at the Avery Road crossing, noting the vertical walls and degrading concrete apron upstream of the crossing.**

## 2.4 FEATURES OF NOTE NEAR THE SUBJECT CROSSING

Multiple pieces of infrastructure existing on and near the Avery Road stream crossing that are important to note for replacement designs and construction.

- Metal guardrails are on top of the crossing at the upstream and downstream ends
- Private driveways are on both sides of the stream downstream of Avery Road
- Mailboxes exist adjacent to the stream on the downstream end of Avery Road
- Street signs are on both sides of the street leading to the crossing in both directions
- On the southwest side of the crossing, a private driveway leads downslope to a house; a stone wall lines the north side of the driveway separating the driveway from the vertical walls along Philips Brook



**Figure 4. Infrastructure on, and adjacent to, the Avery Road crossing. Clockwise from upper left: looking north, noting street signs and guardrails; looking north on the downstream end of the crossing, noting mailboxes and guardrail; looking south on the downstream end of the crossing, noting mailboxes and guardrail; looking west along the driveway, noting the stone wall separating the driveway from the stream channel.**

## 3. Data Collection

### 3.1 DESKTOP DATA REVIEW

Existing data relevant to the site was reviewed. This information augmented the understanding of site conditions, broader geomorphic context, and potential constraints.

- Aerial photographs (Google Earth and ESRI World Imagery)
- USGS topographic maps
- USGS geologic map
- LiDAR (2019 - 2020 USGS Lidar: NY FEMA Region 2 Central<sup>3</sup>)
- Putnam County Assessor's Parcel Maps (NYS Parcel Dataset<sup>4</sup>)
- Infrastructure data
- Historical data

<sup>3</sup> <https://coast.noaa.gov/dataviewer/#/lidar/search/where:ID=9770/details/9770>

<sup>4</sup> <https://data.gis.ny.gov/maps/8af5cef967f8474a9f262684b8908737/about>

### 3.2 FIELD DATA COLLECTION

Multiple data collection efforts have been completed along Philips Brook and at Avery Road since 2020. A summary of the field data collection efforts for this follow:

- June 2023: Badey & Watson conducted a detailed survey of the terrain and floodplain between Walter Hoving Road and Avery Road. The survey captured stream features including the weirs, the dam and appurtenances, stone walls, pedestrian bridges, and outfalls. Infrastructure elements such as utility poles, markers, and inlets were also included. They documented the location, size, and species of trees, as well as highway infrastructure like roads, signs, manholes, and guardrails. Specific focus was given to capturing important elevations at the Avery Road and Walter Hoving Road culverts, including low and high chords, abutments, wingwalls, and deck. They also surveyed channel cross-sections at 50-foot intervals within the survey limits.
- August 2025: Inter-Fluve completed a topographic survey at Avery Road and along Philips Brook from upstream of Avery Road to downstream of Route 9D.

### 3.3 GEOTECHNICAL INVESTIGATION

Inter-Fluve subcontracted New England Boring Company of Glastonbury, Connecticut to advance soil borings at the site. Two borings were performed on September 2, 2025. The locations of the borings were selected based on the assumed location of the future stream crossing abutments at the time of the investigation. The details of these borings are described in Appendix C, Geotechnical Data Memorandum.

## 4. Hydrologic and Hydraulic Modeling Analysis

### 4.1 PEAK FLOW ESTIMATES

The Project Team used several techniques to estimate peak flood flows at the project site because there is no gage on Philips Brook. The methods included implementing regional regression equations based on watershed characteristics and performing a statistical gage-transfer analysis on the streamflow record of nearby rivers. This section of the report describes the analyses and summarizes the results.

#### 4.1.1 USGS Regression Equation Method

The USGS regional regression method uses characteristics of the contributing watershed including the total contributing area, the mean elevation of the basin, and the total storage in the basin to estimate peak flood discharge frequency curves on ungaged streams. The project site is in New York Region 2, and the applicable regression equation method is described in the 2006 USGS report

titled, “Magnitude and frequency of Floods in New York.”<sup>5</sup> Inter-Fluve used the web-based USGS Streamstats tool to implement this method.

**Table 1. Watershed Characteristics**

| Characteristic           | Value  | Unit          |
|--------------------------|--------|---------------|
| Drainage Area (DRNAREA)  | 3.24   | Square miles  |
| Lag Factor (LAGFACTOR)   | 0.0395 | Dimensionless |
| Storage                  | 0.69   | Percent       |
| Mean Annual Runoff (MAR) | 27.3   | inches        |

#### 4.1.2 Gage Transfer Method

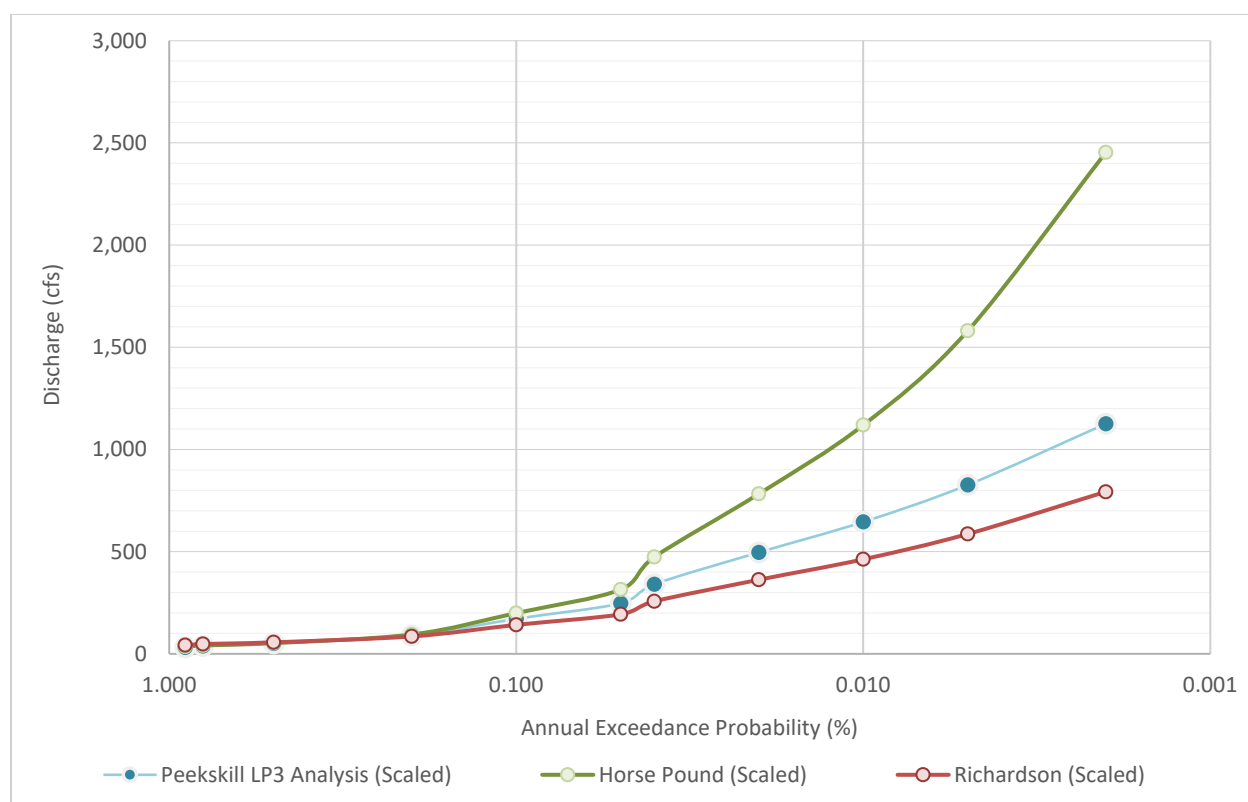
Inter-Fluve identified three gaged streams near Philips Brook with over 20 years of annual peak flow gage data (Table 3). Inter-Fluve performed a Log-Pearson type III statistical analysis on the flow records for these gages using the methods described in WRB 17C<sup>6</sup> to estimate peak flood flow statistics at these gages. Inter-Fluve transferred these flows to Philips Brook by adjusting the flows by the ratio of drainage areas.

**Table 2. USGS Gages near Philips Brook.**

| Gage                                                       | Period of Record | Count |
|------------------------------------------------------------|------------------|-------|
| USGS 01374250 PEEKSKILL HOLLOW CR AT TOMPKINS CORNERS NY   | 1975-2022        | 48    |
| USGS 01374598 HORSE POUND BROOK NEAR LAKE CARMEL NY        | 1997-2022        | 26    |
| USGS 01374559 WEST BRANCH CROTON RIVER AT RICHARDSVILLE NY | 1996-2022        | 27    |

<sup>5</sup> Magnitude and frequency of Floods in New York. Richard Luma, Douglas Freehafer, and Martyn Smith. USGS SIR 2006-5112.

<sup>6</sup> USGS Advisory Committee on Water Information. Guidelines for Determining Flood Flow Frequency, Bulletin #17C. November 2023.



**Figure 5. Peak flow estimates for Philips Brook using gage transfer method.**

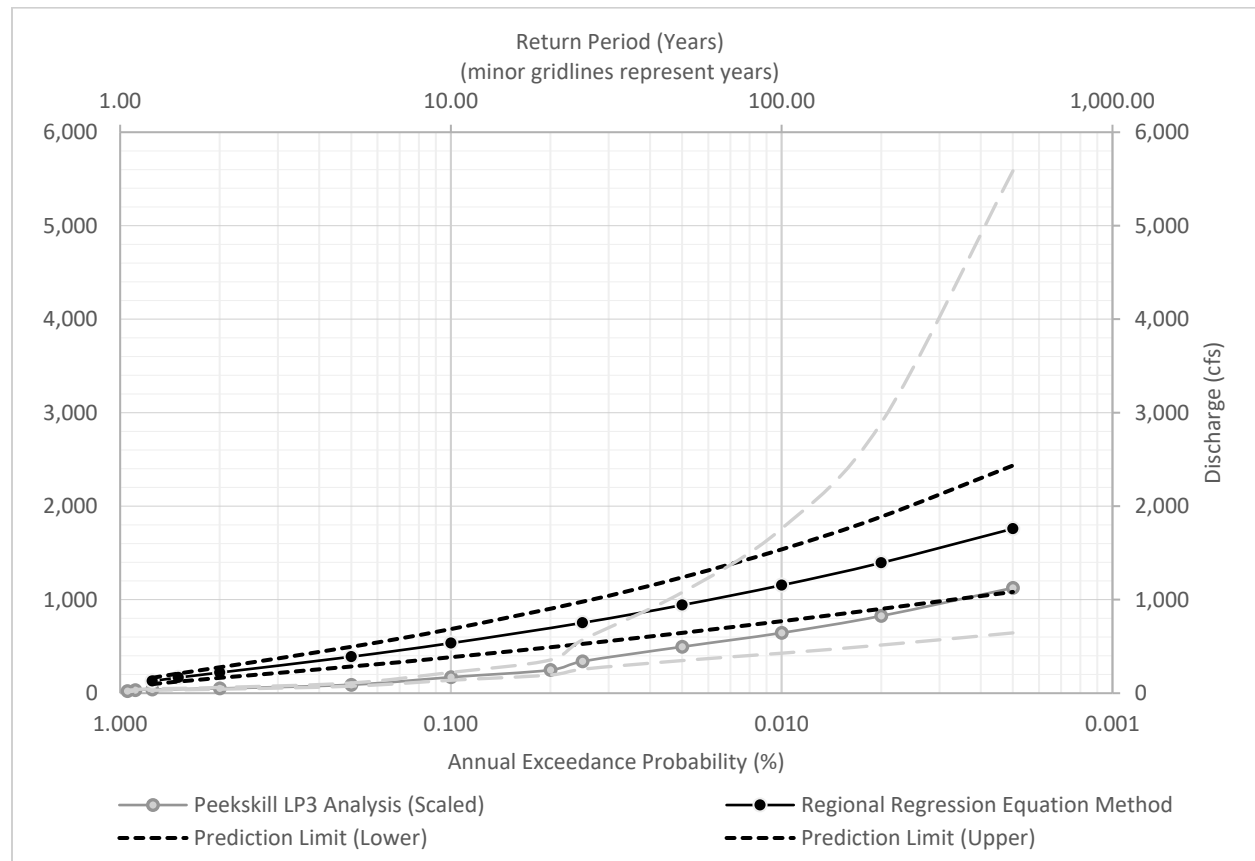
In comparing the gage transfer results, the Horse Pound Brook gage produced higher peak flood flow estimates at larger return periods than those at Peekskill Hollow and West Branch Croton River. This difference could be explained by the lower percentages of impervious area and greater storage (e.g., wetlands and lakes) in the drainage areas of Peekskill Hollow and West Branch Croton River, which tend to mute flood flows during larger events. Inter-Fluve determined that the uncertainty in the results, due to the short period of record, for the gages at Horse Pound Brook and the West Branch Croton River rendered these gages unsuitable for use subsequent work for this project.

#### 4.1.3 Summary Figure & Table

Table 3 and Figure 6 present the results of the analysis estimating the relationship between flood discharge and frequency for Philips Brook at the project site, in tabular and graphical formats, respectively. The USGS Regression Equation Method resulted in higher peak flood estimates than the gage transfer method. Given the two sets of estimates, the higher flows from the USGS Regression Equation Method were chosen to err on the side of conservatism. While this might overpredict flood flow conditions, storms are becoming more intense, and with infrastructure and nearby houses abutting the stream, it is prudent to adopt the higher estimates. Discharge estimates shown in bold text in Table 3 have been selected for use in subsequent work.

**Table 3. Hydrologic Analysis Results: Peak Flow Estimates for Philips Brook at the Study Area**

| Return Period (Years) | AEP (%) | Peak Flow Estimates (cfs)       |                      |
|-----------------------|---------|---------------------------------|----------------------|
|                       |         | USGS Regression Equation Method | Gage Transfer Method |
| 1.05                  | 95%     | -                               | 22                   |
| 1.11                  | 90%     | -                               | 32                   |
| 1.25                  | 80%     | <b>131</b>                      | 39                   |
| 1.5                   | 67%     | <b>167</b>                      | -                    |
| 2                     | 50%     | <b>221</b>                      | 51                   |
| 5                     | 20%     | <b>391</b>                      | 90                   |
| 10                    | 10%     | <b>536</b>                      | 172                  |
| 20                    | 5%      | -                               | 248                  |
| 25                    | 4%      | <b>753</b>                      | 341                  |
| 50                    | 2%      | <b>942</b>                      | 497                  |
| 100                   | 1%      | <b>1150</b>                     | 646                  |
| 200                   | 0.5%    | <b>1390</b>                     | 827                  |
| 500                   | 0.2%    | <b>1760</b>                     | 1126                 |

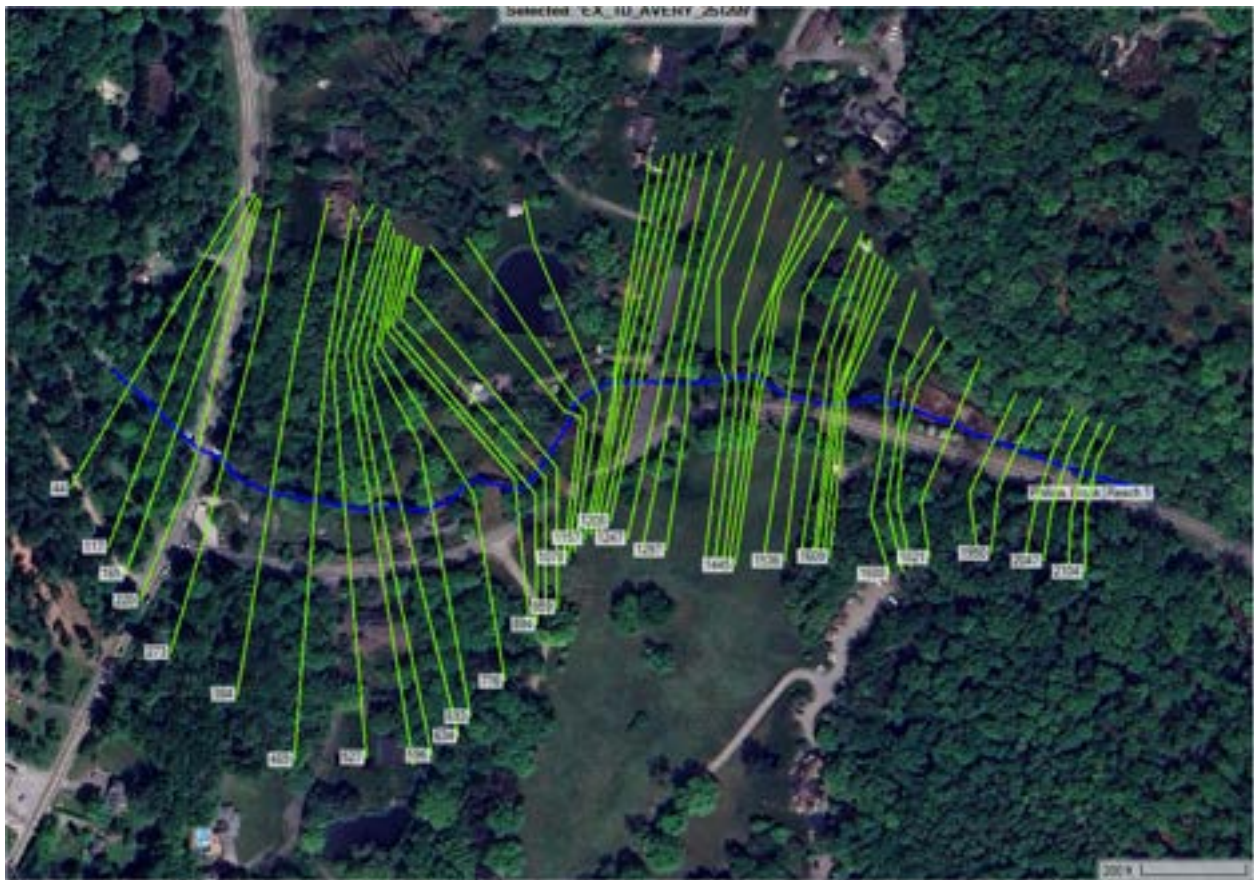

**Figure 6. Peak discharge frequency relationship for Philips Brook at Philipstown, NY.**

## 4.2 HYDRAULICS

For the hydraulic assessment of the Avery Road culvert Inter-Fluve developed both a one-dimensional, steady-flow hydraulic model and a two-dimensional (2-D), unsteady-flow hydraulic model. Both models extend approximately 100 feet upstream of Walter Hoving Road and approximately 180 feet downstream of Route 9D. Both models were developed in the Ras Mapper environment using the U.S. Army Corps of Engineers software HEC-RAS version 6.6. The hydraulic structures in the 1D geometries were setup using the geometric data editor. The models utilize bathymetric data of the river channel, topographic data of the overbank areas, surface roughness coefficients, and flow inputs derived from the hydrologic analysis. The following sections describe the data used to build the hydraulic model of the study area.

### 4.2.1 Model Geometry

The existing and proposed 1-D geometries have a total of 50 cross sections (Figure 8).



**Figure 7. Avery Road 1-D hydraulic model geometry.**

#### *Terrain*

Inter-Fluve developed an existing surface of the channel and floodplain by combining publicly available high-resolution topographic data with field-collected bathymetric data.

The topographic and bathymetric data used in the hydraulic model originate from field data collected in June and August 2023 by Badey & Watson and Inter-Fluve and August 2025 by Inter-Fluve . The LiDAR data used to supplement the survey data is from the 2019-2020 USGS Lidar: NY FEMA Region 2 Central dataset.

Inter-Fluve manipulated the existing conditions terrain using terrain modifications to create the proposed condition surface. The surfaces are referenced to the North American Vertical Datum of 1988 (NAVD88) and the NAD83 State Plane New York – East horizontal coordinate system. Horizontal and vertical units are in feet.

#### *Mesh Dimensions*

The computational mesh of the 2D model consists of 5-foot by 5-foot cells, with a high-resolution refinement area of 2-foot by 2-foot cells at Avery Road Bridge.

#### *Breaklines*

Inter-Fluve added Breaklines to the model to guide mesh generation, ensuring that flow is conveyed within the bounding walls of the Philips Brook channel and to define the Snake Hill Road feature.

#### *Bridge Structures*

Inter-Fluve incorporated Avery Road Bridge, Walter Hoving Road Bridge, two footbridges, and Route 9D bridge into the 2D model using SA/2D connections objects and used the culvert editor in the geometry window to add the structures in the 1-D model. Avery Road Bridge is modeled as a box culvert. Walter Hoving Road Bridge and the two footbridges are modeled as arch culverts.

### 4.2.2 Flow Hydrograph

Inter-Fluve applied a flow hydrograph at the upstream limit of the model. The hydrograph begins by initializing flow in the channel with the peak flow estimated for the 1-year flood event. It holds this flow until the water surface reaches a steady state (between 1 and 3 hours), then ramps up to the flow for the 2-year flood event, and so on. This approach allows the model user to evaluate flow velocities and inundation areas at all flow rates for successively larger storms. It also enables evaluation of the sequence of spill-over events to identify hydraulic constrictions and vulnerable areas along the study reach.

### 4.2.3 Downstream Boundary Condition

Inter-Fluve assumed a normal depth boundary condition for both the 1-D and 2-D model runs. The normal depth is set using a slope of 2% (0.02), which corresponds to the slope of Philips Brook downstream of the study reach.

### 4.2.4 Manning's "n" Roughness Coefficients

Hydraulic roughness is represented in the computational domain using a spatially varied Manning's n layer, with values based on visual inspection of the river channel and publicly available aerial imagery. Manning's n values selected for land cover types are based on guidance found in the HEC-RAS 2-D User's Manual (USACE, 2021) and professional judgement.

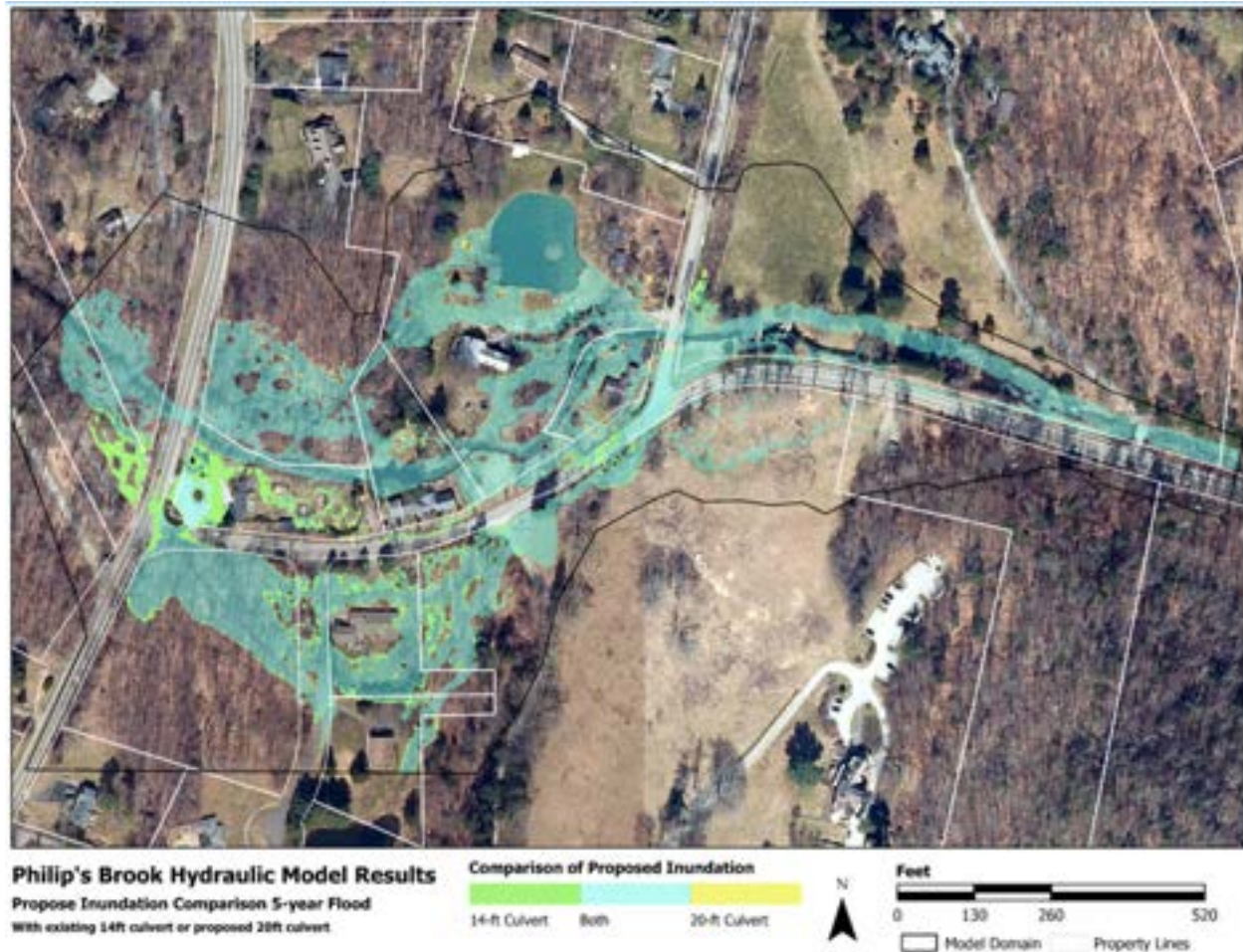
### 4.2.5 Computational Settings

The 2-D model was run using the full momentum computational method to solve flow conditions within the model domain. The time step for each computation was adjusted dynamically within the model using the Courant method. While the 1-D model was run with the subcritical flow regime setting.

## 5. Proposed Design

### 5.1 HYDRAULIC MODEL RESULTS

Inter-Fluve created and ran the 2-D to assess the potential for improving flooding downstream of the Avery Road culvert with a replacement. The results of the 2-D hydraulic model indicated that replacing the Avery Road culvert with up to a 20-foot culvert would not improve flooding upstream or downstream of the culvert at larger floods. At the 5 year flood there was decreased inundation upstream of the culvert, and south of Philips Brook (Figure 8) But at higher flows, there were minimal changes in inundation areas (Figure 9). The 100-year water surface profile there is a slight decrease upstream of the culvert and a slight increase downstream of the culvert (Figure 10).



*Figure 8. Inundation extent comparison for 5-year event.*

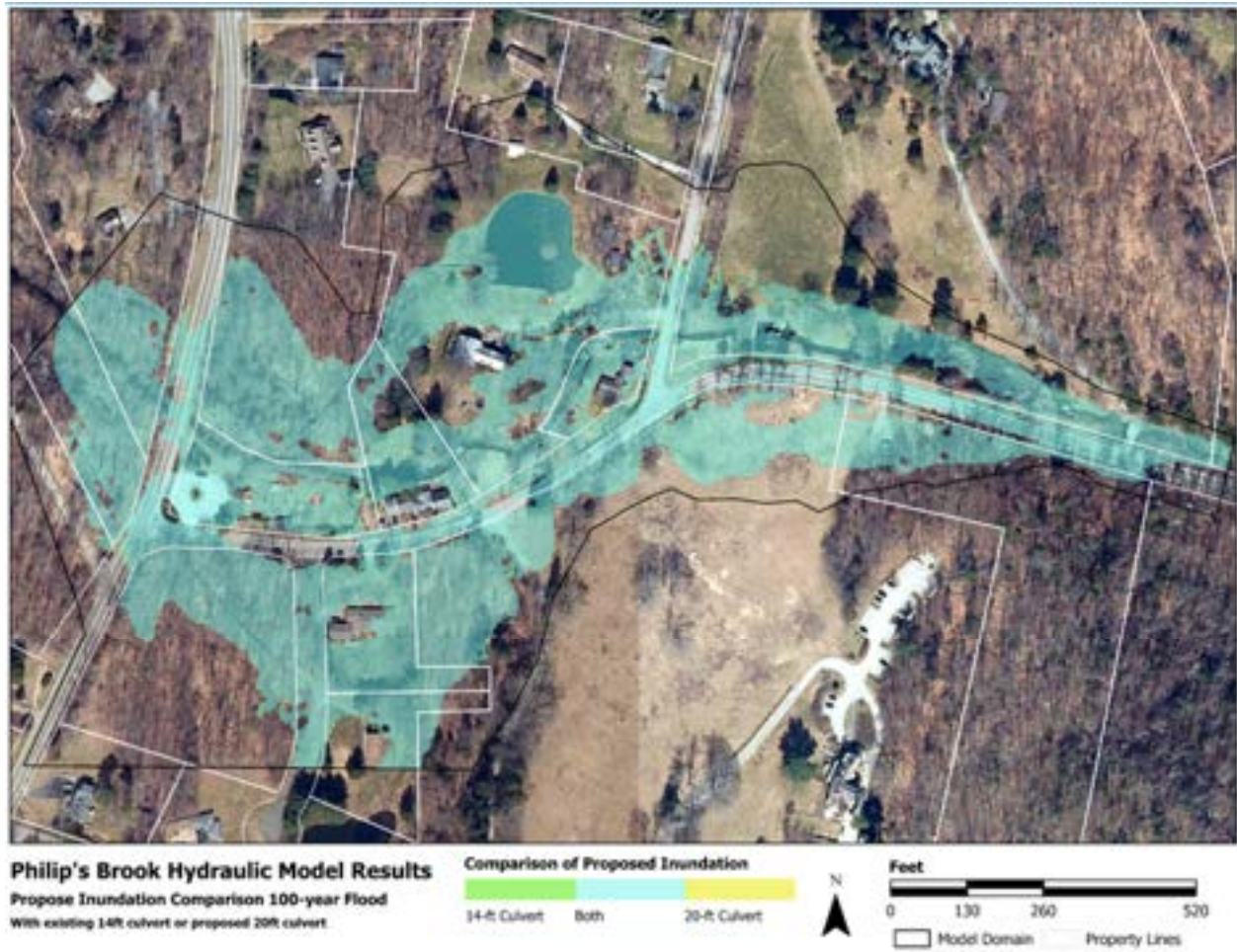
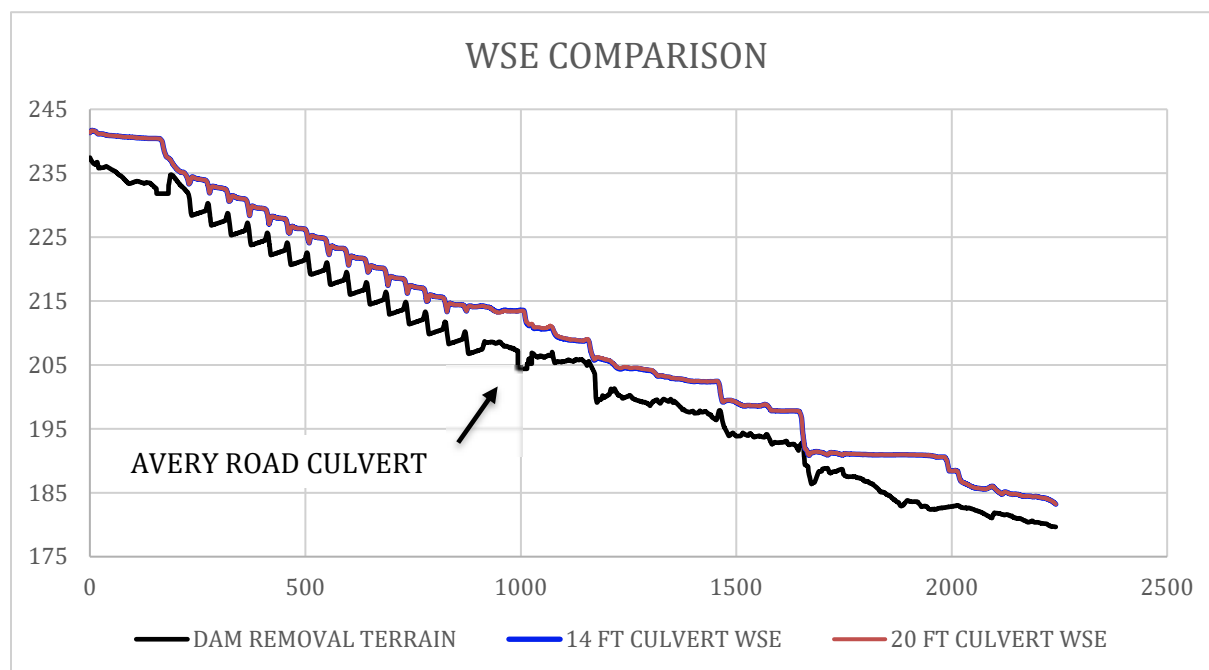


Figure 9. Inundation extent comparison for 100-year event.



**Figure 10. Water surface profile comparison between existing conditions vs if the Avery Road culvert were replaced with a 20 foot culvert.**

## 5.2 HYDRAULIC DESIGN

The design of this crossing is constrained by several factors. The top of the road surface needed to be held at the existing elevation of 213.07 feet NAVD88. The proposed culvert is laterally confined by the surrounding infrastructure, see section 2.4. The vertical walls along Philips Brook downstream of the Avery Road crossing are 16 feet wide. With these constraints in mind Inter-Fluve determined that a 16-ft wide, 4-foot-tall, three-sided concrete box culvert. The invert of the culvert is set to 206.593 feet NAVD88.

The model results indicate that the proposed culvert has the capacity to pass approximately 131 cubic feet per second before the flow begins to overtop the road. Based on the hydrologic analysis, the return period for this flow rate is somewhere between 1 and 1.5 year. This culvert configuration will not meet the minimum standard for the hydraulic capacity for a local road crossing. This crossing also does not meet the bankfull width requirement of the New York State culvert Guidance (NYSDEC 2024).

## 5.3 ESTIMATE OF PROBABLE COST

An Engineer's Opinion of Probable Construction Cost (EOPCC) is included in Appendix B. Prepared as a Class 2 estimate per the Association for the Advancement of Cost Engineering (AACE) standards, the EOPCC includes a cost range of -5% to +20%. A 20% contingency is incorporated into the cost estimate to account for potential variations due to market fluctuations and unforeseen factors. Unit prices are based on bid prices received for similar work in New York State. The total expected cost of the project, including the contingency, ranges between \$480,000 and \$570,000.

The cost opinion has been developed based on a review of construction cost data in the New York State DOT Pay Item Catalog. Actual implementation costs may vary from this estimate due to market fluctuations and other unforeseen factors. The included 20% construction contingency accounts for these potential variations.

## 6. Construction Sequencing and Phasing

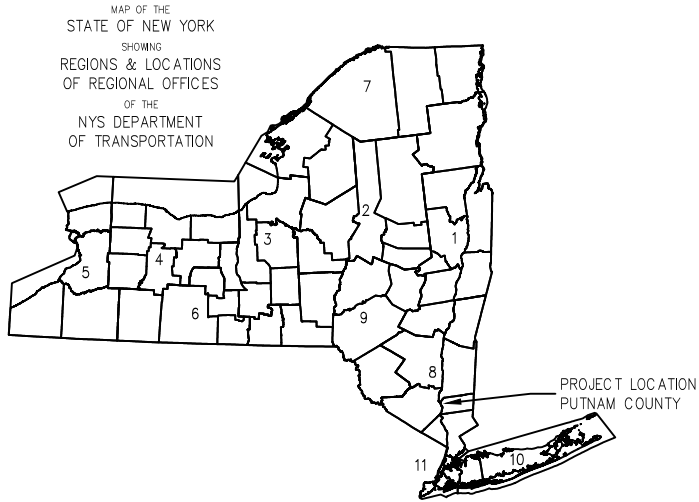
The construction contractor will develop a construction work plan that includes sequencing and a full project schedule. This plan and schedule will be submitted to the Owner and Engineer for review. The construction contractor will develop this work plan and other pre-construction submittals (including, but not limited to, a water control plan, sediment and erosion control plan, spill prevention plan, traffic control plan) to complete the project on time and according to the design drawings, as well as while following applicable permits. While the contractor will develop their preferred sequencing, the following is a suggested sequencing based on past similar projects.

1. Mobilization
  - 1.1. Install traffic control measures
  - 1.2. Install sediment and erosion controls around access and staging areas
  - 1.3. Install access and staging areas
  - 1.4. Survey project limits, areas of excavation, and other necessary boundaries
  - 1.5. Manage utility pole and utilities as appropriate
2. Install water control
3. Complete necessary clearing and grubbing
4. Install crossing foundation
5. Channel and bank construction
  - 5.1. Placement of streambed substrate within and adjacent to the proposed crossing structure
  - 5.2. Complete the channel and bank construction on the section of the new channel that can be completed outside of the active flows in the existing channel
6. Install Crossing and wingwalls
7. Complete filling of the existing channel and final floodplain grading
8. Remove water control
9. Complete plantings
10. Remove access and staging materials and demobilize; restore staging and access areas to pre-construction conditions or better
11. Remove traffic control measures once demobilized
12. Remove sediment and erosion controls when site is stabilized

## 7. References

- AACE 2016. Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries. Rev. March 1, 2016.
- Arcement, G.J. Jr., V.R. Schneider. 1989. Guide for Selecting Manning’s Roughness Coefficients for Natural Channels and Flood Plains. US Geological Survey Water Supply Paper 2339.
- Chow, V. T., Open Channel Hydraulics. McGraw-Hill, New York. 1959.
- England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr. 2018. Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148.
- Hoving Home. Photos of Philips Brook. Digital file sent via email on 15 July 2024.
- Inter-Fluve 2020. Design Concept Technical Memorandum, Philips Brook, Philipstown, NY. December 2020. Updated November 2021.
- Julien, P. Y. 2010. Erosion and Sedimentation (2nd ed.). Cambridge, UK: Cambridge University Press.
- Lumia, Richard, and Baevsky, Y.H. 2000. Development of a contour map showing generalized skew coefficients of annual peak discharges of rural, unregulated streams in New York, excluding Long Island: U.S. Geological Survey Water Resources Investigations Report 2000–4022, 11.  
<https://pubs.er.usgs.gov/publication/wri004022>.
- Lumia, Richard, Freehafer, D.A., and Smith, M.J. 2006. Magnitude and Frequency of Floods in New York: U.S. Geological Survey Scientific Investigations Report.2006–5112, 152.
- [NYSDEC] New York State Department of Environmental Conservation. 2015. Observed and Projected Climate Change in New York State: An Overview. Developed for the Community Risk and Resiliency Act (CRRRA) Drafting Teams. Final version dated December 31, 2015.
- [NYSDEC] New York State Department of Environmental Conservation. 2020. New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act. 100 p.
- [NYSDEC] New York State Department of Environmental Conservation, Division of Fish and Wildlife. 2024. Draft Guidance for the Review of Bridge and Culvert Projects in Nontidal Waters Requiring a Protection of Waters Permit and a Water Quality Certificate, DFW GS 24-01, January 2024. Available from: <https://dec.ny.gov/sites/default/files/2024-01/brdgclvrtguidance.pdf>
- [USGS] U.S. Geological Survey, 2016. The StreamStats program v.4.17. Accessed November 2023. Available from: <http://streamstats.usgs.gov>
- [USGS] U.S. Geological Survey, 20240104, USGS 1 Meter 18 x58y467  
NY\_FEMAR2\_Central\_2018\_D19: U.S. Geological Survey.

## Appendix A 100% Design Drawings



AVERY ROAD CULVERT REPLACEMENT PROJECT  
100% DESIGN  
HAMLET OF GARRISON  
PUTNAM COUNTY



SHEET LIST

- 1 COVER SHEET
- 2 GENERAL NOTES
- 3 EXISTING CONDITIONS
- 4 BORING LOCATION PLAN
- 5 INTERPRETIVE SUBSURFACE PROFILE
- 6 BORING LOGS
- 7 DETOUR PLAN
- 8 EROSION AND SEDIMENT CONTROL PLAN
- 9 ROAD PLAN AND PROFILE
- 10 ROAD TYPICAL SECTIONS
- 11 ROAD GRADING SECTIONS (1 OF 3)
- 12 ROAD GRADING SECTIONS (2 OF 3)
- 13 ROAD GRADING SECTIONS (3 OF 3)
- 14 STREAM PLAN AND PROFILE

PROJECT LOCATION  
AVERY ROAD CULVERT REPLACEMENT PROJECT  
CULVERT LOCATED ALONG AVERY RD NEAR THE INTERSECTION WITH SNAKE HILL RD  
COORDINATES:  
LATITUDE: 41° 23'9.14" N  
LONGITUDE: 73° 55'49.57" W  
THE PROJECT COORDINATE SYSTEM IS THE NORTH AMERICAN DATUM OF 1983.  
NEW YORK STATE PLAN, EAST ZONE, US FOOT

|                    |  |
|--------------------|--|
| AFFIX SEAL:<br>ON: |  |
|                    |  |

|  |  |  |         |          |                                             |                 |
|--|--|--|---------|----------|---------------------------------------------|-----------------|
|  |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER |
|  |  |  |         |          | COVER SHEET                                 | 2024-012        |
|  |  |  |         |          |                                             | DRAWING NO. 14  |
|  |  |  |         |          |                                             | SHEET NO. 1     |



220 Concord Avenue, 2nd Floor  
Cambridge, MA 02136  
617.714.5537 | www.interfluv.com

GENERAL NOTES:

THE CONTRACTOR SHALL NOTIFY "DIG-SAFE" (888)-344-7233 AT LEAST 72 HOURS PRIOR TO EXCAVATION. ALL EXCAVATIONS SHALL BE ACCOMPLISHED IN ACCORDANCE WITH NEW YORK DIG SAFE LAW.

ALL EXCAVATION MUST BE ACCOMPLISHED IN ACCORDANCE WITH ALL FEDERAL (E.G., OSHA), STATE, AND LOCAL REGULATIONS.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR SITE SECURITY AND JOB SAFETY, CONSTRUCTION ACTIVITIES.

WORK WITHIN LOCAL RIGHTS-OF-WAY SHALL CONFORM TO LOCAL MUNICIPAL STANDARDS; WORK WITHIN STATE RIGHTS-OF-WAY SHALL CONFORM TO THE LATEST EDITION OF THE STATE HIGHWAY DEPARTMENTS STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES.

ALL PROJECT ACTIVITIES INCLUDING, BUT NOT LIMITED TO, ACTIVE WORK, SITE PREPARATION, STAGING, AND STOCKPILING SHALL TAKE PLACE WITHIN THE LIMIT OF WORK AS SHOWN ON THE PLANS. IF IT IS DETERMINED THAT THE LIMIT OF WORK NEEDS TO BE MOVED OR EXPANDED, NOTIFY THE PROJECT OWNER TO INITIATE COORDINATION WITH RELEVANT REGULATORY AGENCIES. NO WORK SHALL OCCUR OUTSIDE THE LIMIT OF WORK SHOWN ON THE PLANS WITHOUT PROPER APPROVALS.

UPON AWARD OF CONTRACT, CONTRACTOR SHALL MAKE NECESSARY CONSTRUCTION NOTIFICATIONS AND APPLY FOR AND OBTAIN NECESSARY PERMITS, PAY FEES, AND POST BONDS ASSOCIATED WITH THE WORK INDICATED ON THE DRAWINGS, IN THE SPECIFICATIONS, AND IN THE CONTRACT DOCUMENTS (INCLUDING THE PERMITS).

DAMAGE TO PUBLIC AND/OR PRIVATE PROPERTY RESULTING FROM PROJECT WORK SHALL BE REPAIRED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.

AREAS DISTURBED DURING CONSTRUCTION AND NOT WITHIN THE RESTORATION FOOTPRINT SHOWN ON THE DRAWINGS SHALL BE RESTORED TO CONFORM WITH THE PREVIOUS UNDISTURBED CONDITION. DOCUMENT RE-DISTURBANCE CONDITIONS WITH PHOTOGRAPHS TO ASSIST AND INFORM HE RESTORATION ACTIVITIES.

N THE EVENT THAT SUSPECTED CONTAMINATED SOIL, GROUNDWATER, OR OTHER MEDIA ARE ENCOUNTERED DURING EXCAVATION AND CONSTRUCTION ACTIVITIES BASED ON VISUAL, OLFACTORY, OR OTHER EVIDENCE, THE CONTRACTOR SHALL STOP WORK IN THE VICINITY OF THE SUSPECT MATERIAL TO AVOID FURTHER SPREADING OF THE MATERIAL, AND SHALL NOTIFY THE OWNER IMMEDIATELY SO THAT THE APPROPRIATE TESTING AND SUBSEQUENT ACTION CAN BE TAKEN.

DESIGN SPECIFICATIONS:

CONSTRUCTION MATERIALS SPECIFICATIONS: STANDARD SPECIFICATIONS, CONSTRUCTION AND MATERIALS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, OFFICE OF ENGINEERING.

ALL SHOP DRAWNGS SUBMITTED FOR THIS PROJECT SHALL BE IN US CUSTOMARY UNITS.

STREAM PROTECTION NOTE:

DURING THE COURSE OF CONSTRUCTION, THE CONTRACTOR SHALL CONDUCT OPERATIONS IN SUCH A MANNER AS TO PREVENT OR REDUCE TO A MINIMUM ANY DAMAGE TO ANY STREAM FROM POLLUTION BY DEBRIS, SEDIMENT, OR OTHER FOREIGN MATERIAL, OR FROM MANIPULATION OF EQUIPMENT AND/OR MATERIALS IN OR NEAR SUCH STREAMS. THE CONTRACTOR SHALL NOT RETURN DIRECTLY TO A STREAM ANY WATER WHICH HAS BEEN USED FOR WASH PURPOSES OR OTHER SIMILAR OPERATIONS WHICH CAUSE THIS WATER TO BECOME POLLUTED WITH SAND, SILT, CEMENT, OIL OR OTHER IMPURITIES. IF THE CONTRACTOR USES WATER FROM A STREAM, THE CONTRACTOR SHALL CONSTRUCT AN INTAKE OR TEMPORARY DAM REQUIRED TO PROTECT AND MAINTAIN WATER RIGHTS AND TO SUSTAIN FISH LIFE DOWNSTREAM.

SOIL PROTECTION AND EROSION CONTROL METHODS:

CONTRACTOR SHALL BE RESPONSIBLE FOR IDENTIFYING TYPES AND LOCATIONS FOR STORMWATER EROSION AND SEDIMENTATION CONTROL (E&SC) MEASURES THAT MAY BE NECESSARY TO MAINTAIN COMPLIANCE WITH ALL APPROPRIATE PERMITS. ALL E&SC MEASURE SHOULD REMAIN WITHIN THE LIMIT OF WORK SHOWN ON THESE PLANS.

THE CONTRACTOR SHALL COORDINATE WITH THE HISTORICAL RESOURCES CONSULTANT IN SELECTING AND SITING E&SC MEASURES AND COMPLY WITH MEASURES TO AVOID, MINIMIZE, AND MITIGATE POTENTIAL ADVERSE IMPACTS TO THE SUBSURFACE.

PRIOR TO STARTING ANY OTHER WORK ON THE SITE, THE CONTRACTOR SHALL INSTALL EROSION CONTROL MEASURES AS SHOWN ON THE PLANS AND ADDITIONAL MEASURES, IF NECESSARY, AS IDENTIFIED AND/OR REQUIRED IN FEDERAL, STATE, AND LOCAL APPROVAL DOCUMENTS PERTAINING TO THIS PROJECT.

THE CONTRACTOR SHALL CONTROL STORMWATER RUNOFF DURING CONSTRUCTION TO PREVENT ADVERSE IMPACTS TO OFF-SITE AREAS AND SHALL BE RESPONSIBLE TO REPAIR RESULTING DAMAGES IF ANY, AT NO COST TO THE OWNER.

ALL SEDIMENTATION BARRIERS SHALL BE MAINTAINED IN GOOD REPAIR UNTIL ALL DISTURBED AREAS HAVE BEEN FULLY STABILIZED WITH VEGETATION OR OTHER MEANS.EROSION CONTROLS SHALL BE INSPECTED AND MAINTAINED ON A DAILY BASIS UNTIL THE SITE IS STABILIZED. EROSION PROBLEMS SHALL BE REPORTED IN ACCORDANCE WITH ALL RELEVANT PERMITS.

UPON COMPLETION OF CONSTRUCTION AND ESTABLISHMENT OF PERMANENT GROUND COVER OR OTHER VEGETATION, THE CONTRACTOR SHALL REMOVE AND DISPOSE OF EROSION CONTROL MEASURES AND CLEAN SEDIMENT AND DEBRIS FROM THE PROJECT SITE.

TEMPORARY SEED AND MULCH SHALL BE PROVIDED AS SPECIFIED IN PLANS AND ANY ADDITIONAL AREA OF DISTURBANCE. PAYMENT SHALL BE MADE UNDER ITEM 209.1003.

SILT FENCE SHALL BE INSTALLED PER NYSDOT STANDARD SHEET 209-01. PAYMENT SHALL BE MADE UNDER ITEM 209.13.

COFFERDAM AND HYDRAULIC NOTES:

SHOULD THE CONTRACTOR ELECT TO LAY BACK A PORTION OF THE EXISTING EARTH ADJACENT TO AN EXCAVATION REQUIRING A COFFERDAM, ANY REQUIRED EXTENSIONS OF THE COFFERDAM NECESSARY TO KEEP WATER FROM ENTERING THE EXCAVATION SHALL BE FURNISHED AND PLACED AT NO COST TO THE OWNER.

WHERE A COFFERDAM IS USED, THE COST OF DEWATERING THE ENTIRE EXCAVATION, REGARDLESS OF THE SOURCE OF WATER, SHALL BE INCLUDED IN THE UNIT PRICE BID FOR THE COFFERDAM ITEM.

SHOULD FIELD CONDITIONS REQUIRE A CHANGE FROM THE TYPE OF COFFERDAM SYSTEM CALLED FOR ON THE PLANS, THE ENGINEER SHALL CONTACT THE REGIONAL STRUCTURES ENGINEER FOR COORDINATION WITH APPROPRIATE AGENCIES TO APPROVE THE CHANGE.

IF MULTIPLE COFFERDAMS ARE REPLACED BY A SINGLE SYSTEM, AS PERMITTED BY THE REGIONAL HYDRAULICS ENGINEER, PAYMENT WILL BE BASED ON ALL THE APPLICABLE COFFERDAM ITEMS INDICATED ON THE PLANS.

DEWATER THE COFFERDAM BY PUMPING THE WATER TO AN APPROVED UPLAND VEGETATED AREA OUTSIDE OF THE STREAMBED AS SHOWN ON THE PLANS AND/OR APPROVED BY THE ENGINEER/ TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL, SUCH AS STRAW BALES OR APPROVED EQUAL, MAY BE REQUIRED AS DETERMINED BY THE ENGINEER. NO SEDIMENT BASIN SHALL BE CONSTRUCTED.

ORDINARY HIGH WATER ELEVATION: 209.67'

UTILITIES:

THE LOCATIONS, SIZES, AND TYPES OF EXISTING UTILITIES ARE SHOWN AS AN APPROXIMATE REPRESENTATION ONLY. THE OWNER OR ITS REPRESENTATIVE(S) HAVE NOT INDEPENDENTLY VERIFIED THIS INFORMATION AS SHOWN ON THE PLANS. THE UTILITY INFORMATION SHOWN DOES NOT GUARANTEE THE ACTUAL EXISTENCE, SERVICEABILITY, OR OTHER DATA CONCERNING THE UTILITIES, NOR DOES IT GUARANTEE AGAINST THE POSSIBILITY THAT ADDITIONAL UTILITIES MAY BE PRESENT THAT ARE NOT SHOWN ON THE PLANS. PRIOR TO BEGINNING CONSTRUCTION, THE CONTRACTOR SHALL VERIFY AND DETERMINE THE EXACT LOCATIONS, SIZES, AND ELEVATIONS OF THE EXISTING UTILITIES AND, SHALL CONFIRM THAT THERE ARE NO INTERFERENCES WITH EXISTING UTILITIES, INCLUDING ROUTES WITHIN THE PUBLIC RIGHT-OF-WAY.

WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, OR EXISTING CONDITIONS DIFFER FROM THOSE SHOWN, SUCH THAT THE WORK CANNOT BE COMPLETED AS INTENDED, THE LOCATION, ELEVATION, AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR, AND THE INFORMATION FURNISHED IN WRITING TO THE ENGINEER FOR THE RESOLUTION OF THE CONFLICT. CONTRACTOR'S FAILURE TO NOTIFY PRIOR TO PERFORMING ADDITIONAL WORK RELEASES OWNER FROM OBLIGATIONS FOR ADDITIONAL PAYMENTS WITH OTHERWISE MAY BE WARRANTED TO RESOLVE THE CONFLICT.

THE CONTRACTOR SHALL PROTECT EXISTING UTILITIES THAT MAY BE LOCATED WITHIN THE ACCESS ROUTES OR IN THE WORK AREA FROM DAMAGE.

ANY UTILITY INFRASTRUCTURE THAT IS DAMAGED DURING THE PERFORMANCE OF THE WORK SHALL BE REPLACED IN KIND AT NO COST TO THE OWNER.

THE CONTRACTOR SHALL MAKE ARRANGEMENTS FOR AND SHALL BE RESPONSIBLE FOR PAYING FEES FOR ANY RELOCATION, ALTERATION, AND/OR ADJUSTMENT OF UTILITIES, WHETHER WORK IS PERFORMED BY CONTRACTOR OR BY THE UTILITIES COMPANY.

LAYOUT AND MATERIALS:

THE CONTRACTOR SHALL REMOVE AND DISPOSE OF DEMOLITION DEBRIS AND EXISTING MAN-MADE SURFACE FEATURES DESIGNATED FOR REMOVAL ON THE PLANS WITHIN THE LIMIT OF WORK, INCLUDING, BUT NOT LIMITED TO, CONCRETE, METAL, MASONRY AND WOOD, AT AN APPROPRIATE OFF-SITE FACILITY IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL REGULATIONS, ORDINANCES, AND STATUTES.

UNLESS OTHERWISE SPECIFICALLY PROVIDED ON THE PLANS OR IN THE SPECIFICATIONS, THE ENGINEER HAS NOT PREPARED DESIGNS FOR AND SHALL HAVE NO RESPONSIBILITY FOR THE PRESENCE, DISCOVERY, REMOVAL, ABATEMENT OR DISPOSAL OF HAZARDOUS MATERIALS, TOXIC WASTES OR POLLUTANTS AT THE PROJECT SITE. THE ENGINEER SHALL NOT BE RESPONSIBLE FOR ANY CLAIMS OF LOSS, DAMAGE, EXPENSE, DELAY, INJURY OR DEATH ARISING FROM THE PRESENCE OF HAZARDOUS MATERIAL AND CONTRACTOR SHALL INDEMNIFY AND HOLD HARMLESS THE ENGINEER FROM ANY CLAIMS MADE IN CONNECTION THEREWITH. MOREOVER, THE ENGINEER SHALL HAVE NO ADMINISTRATIVE OBLIGATIONS OF ANY TYPE WITH REGARD TO ANY CONTRACTOR AMENDMENT INVOLVING THE ISSUES OF PRESENCE, DISCOVERY, REMOVAL, ABATEMENT OR DISPOSAL OF ASBESTOS OR OTHER HAZARDOUS MATERIALS.

RECONSTRUCTION NOTES:

DUE TO THE NATURE OF RECONSTRUCTION PROJECTS THE EXACT EXTENT OF RECONSTRUCTION WORK CANNOT BE ACCURATELY DETERMINED PRIOR TO THE COMMENCEMENT OF WORK. THESE CONTRACT DOCUMENTS HAVE BEEN PREPARED BASED ON FIELD INSPECTION AND OTHER INFORMATION AVAILABLE AT THE TIME. ACTUAL FIELD CONDITIONS MAY REQUIRE MODIFICATIONS TO CONSTRUCTION DETAILS AND WORK QUANTITIES. THE CONTRACTOR SHALL PERFORM THE WORK IN ACCORDANCE WITH FIELD CONDITIONS.

THE CONTRACTOR SHALL PERFORM ALL WORK WITH CARE SO THAT NAY MATERIALS WHICH ARE TO REMAIN IN PLACE WILL BE DAMAGED. IF THE CONTRACTOR DAMAGES ANY MATERIALS WHICH ARE TO REMAIN IN PLACE, THE DAMAGED MATERIALS SHALL BE REPAIRED OR REPLACED IN A MANNER SATISFACTORY TO THE ENGINEER AT THE EXPENSE OF THE CONTRACTOR.

WHENEVER ITEMS IN THE CONTRACT REQUIRE MATERIALS TO BE REMOVED AND DISPOSED O, THE COST OF SUPPLYING A DISPOSAL AREA AND TRANSPORTATION TO THAT AREA SHALL BE INCLUDED IN THE UNIT PRICES BID FOR THOSE ITEMS.

DURING REMOVAL OPERATIONS, THE CONTRACTOR SHALL NOT DROP WASTE CONCRETE, DEBRIS, AND OTHER MATERIAL TO THE AREA BELOW THE BRIDGE EXCEPT WHERE THE PLANS SPECIFICALLY PERMIT THE DROPPING OF MATERIAL. PLATFORMS, NETS, SCREENS, OR OTHER PROTECTIVE DEVICES SHALL BE USED TO CATCH THE MATERIAL. IF ADEQUATE PROTECTIVE DEVICES ARE NOT BEING EMPLOYED, THE WORK WILL BE STOPPED UNTIL ADEQUATE PROTECTION IS PROVIDED.

ALL MATERIAL FALLING ON THE AREA BELOW AND ADJACENT TO THE CULVERT SHALL BE REMOVED AND DISPOSED OF BY THE CONTRACTOR AT NO COST TO THE OWNER.

RESIDENT ACCESS MUST BE ACCOMMODATED DURING ROAD CLOSURES. BID PRICE FOR ACCOMMODATIONS INCLUDED IN ITEM 619.01

|                    |  |
|--------------------|--|
| AFFIX SEAL:<br>ON: |  |
|                    |  |

|                                                                                       |  |  |         |          |                                             |                                                                                           |
|---------------------------------------------------------------------------------------|--|--|---------|----------|---------------------------------------------|-------------------------------------------------------------------------------------------|
|                                                                                       |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER<br>2024-012                                                               |
|                                                                                       |  |  |         |          | GENERAL NOTES                               | DRAWING NO. 14<br>SHEET NO. 2                                                             |
|  |  |  |         |          |                                             | 220 Concord Avenue, 2nd Floor<br>Cambridge, MA 02136<br>617.714.5537   www.interfluve.com |



PROJECT MANAGER

CHECK

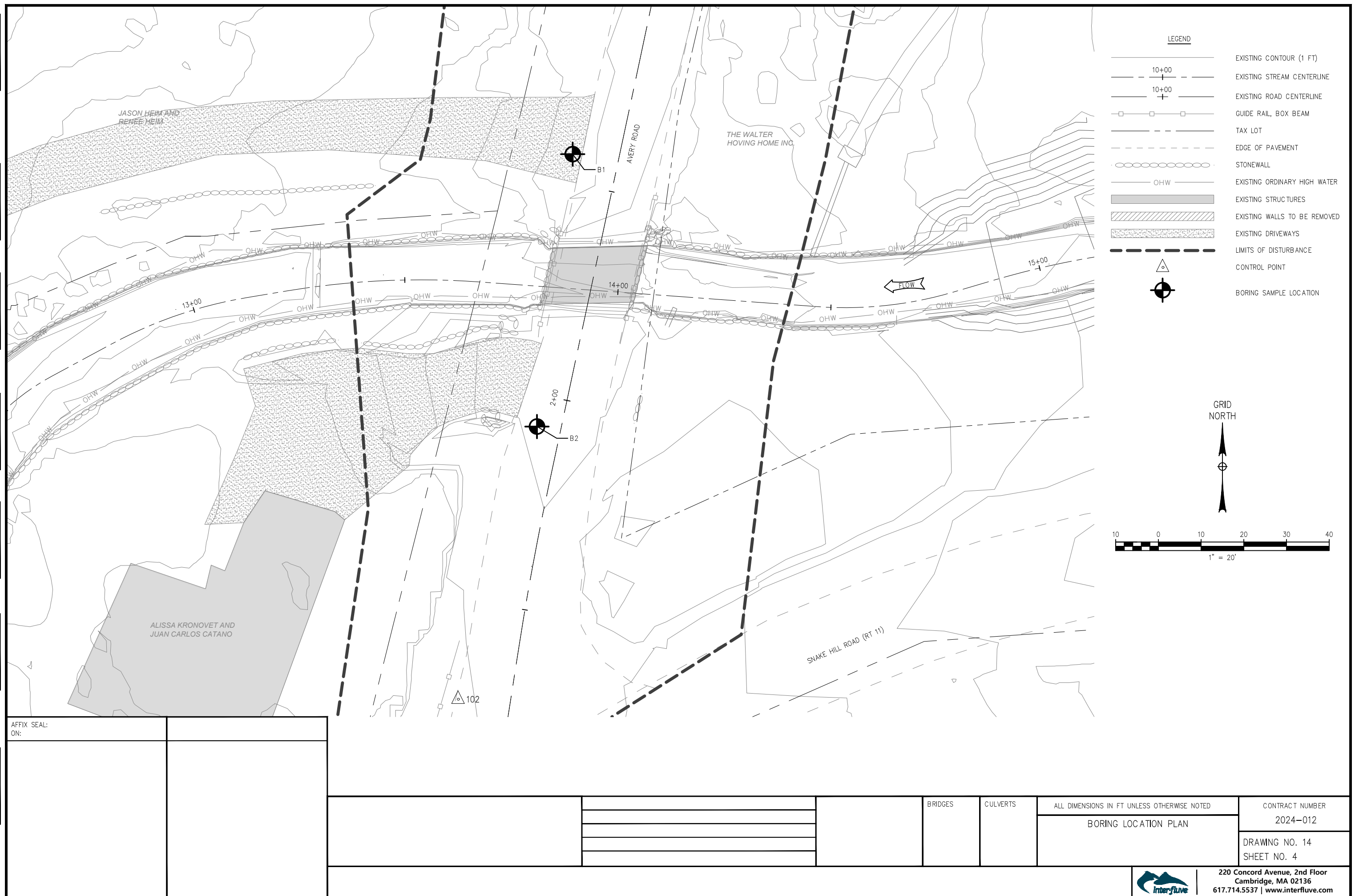
## DRAFTING

**CHECK**

## DESIGN

**JOB MANAGER**

DESIGN SUPERVISOR



PROJECT MANAGER

CHECK

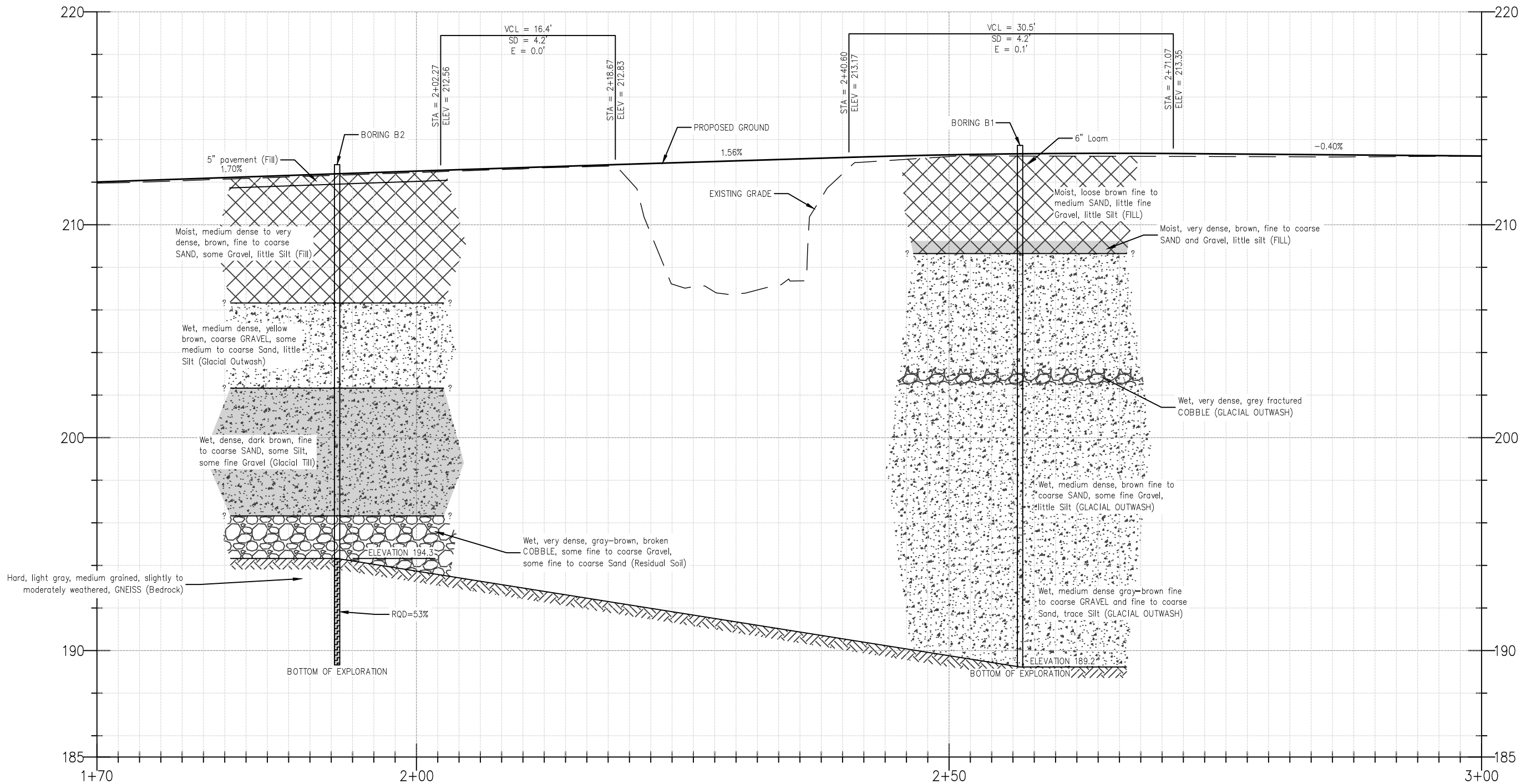
DRAFTING

CHECK

DESIGN

JOB MANAGER

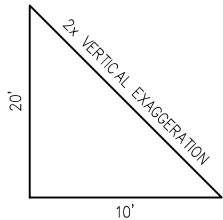
DESIGN SUPERVISOR



BORINGS - PROFILE

NOTES:

1. 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 BORING LOGS.
2. BORING LOGS WERE DEVELOPED FROM BORINGS PERFORMED ON 9/2/2025 BY NEW ENGLAND BORING COMPANY, OBSERVED BY INTER-FLUVE.



|                    |  |
|--------------------|--|
| AFFIX SEAL:<br>ON: |  |
|                    |  |

|                                                                                       |  |  |         |          |                                             |                                                                                           |
|---------------------------------------------------------------------------------------|--|--|---------|----------|---------------------------------------------|-------------------------------------------------------------------------------------------|
|                                                                                       |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER<br>2024-012                                                               |
|                                                                                       |  |  |         |          | INTERPRETIVE SUBSURFACE PROFILE             | DRAWING NO. 14<br>SHEET NO. 5                                                             |
|  |  |  |         |          |                                             | 220 Concord Avenue, 2nd Floor<br>Cambridge, MA 02136<br>617.714.5537   www.interfluve.com |

PROJECT MANAGER

CHECK

DRAFTING

CHECK

DESIGN

JOB MANAGER

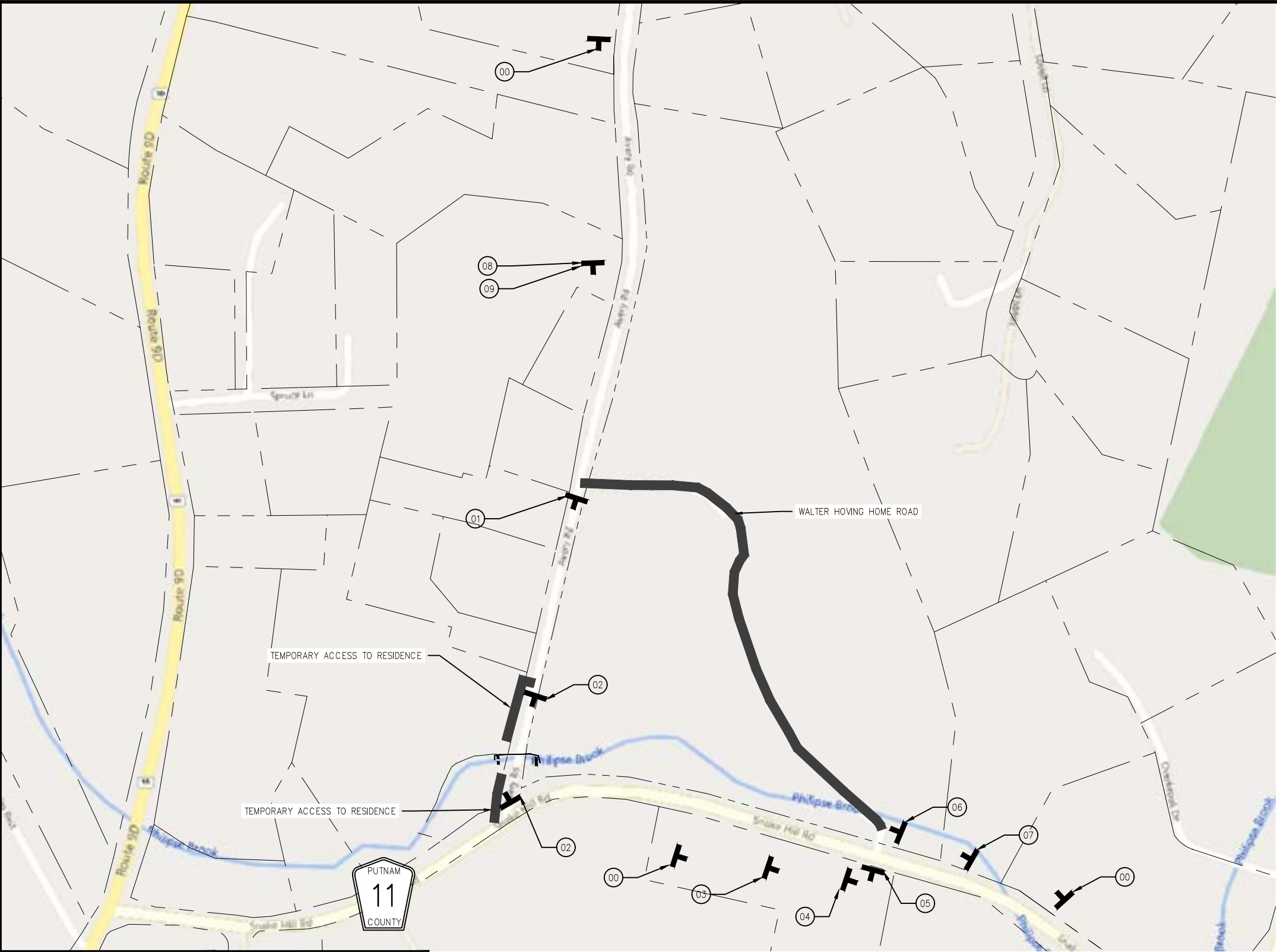
DESIGN SUPERVISOR

|                                                                                                                                                                                                                                                                                                                                                                                                           |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------|----------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------|---------|
| Boring Log<br>Project: Avery Road<br>Location: Garrison, NY                                                                                                                                                                                                                                                                                                                                               |            |                   |          |                | Boring ID: B1<br>Sheet 1 of 1<br>Project No.:                                                                                                                                                                                                                                                                  |                    |             |         |
| Contractor: New England Boring Company<br>Operator: Rick Posa<br>Observer: Andrea Judge<br>Drilling Method: 6" solid stem auger, casing wash & drive<br>Sampling Method: SPT<br>Hammer WL: 140 lbs                      Hammer Fall (in.): 30<br>Boring Location: Avery Road left abutment, grassed shoulder<br>Ground Elevation: 121 feet<br>Date Start: 9/2/25                      Date Finish: 9/2/25 |            |                   |          |                | Water Level Measurements                                                                                                                                                                                                                                                                                       |                    |             |         |
|                                                                                                                                                                                                                                                                                                                                                                                                           |            |                   |          |                | Date                                                                                                                                                                                                                                                                                                           | Ref. Pt.           | Depth       | Time    |
|                                                                                                                                                                                                                                                                                                                                                                                                           |            |                   |          |                | 9/2/2025                                                                                                                                                                                                                                                                                                       | Ground             | 4.5         | 340     |
|                                                                                                                                                                                                                                                                                                                                                                                                           |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
|                                                                                                                                                                                                                                                                                                                                                                                                           |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
|                                                                                                                                                                                                                                                                                                                                                                                                           |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
|                                                                                                                                                                                                                                                                                                                                                                                                           |            |                   |          |                | Time & Date of Completion: 9/2/2025 340p                                                                                                                                                                                                                                                                       |                    |             |         |
| Depth (ft)                                                                                                                                                                                                                                                                                                                                                                                                | Sample No. | Sample Depth (ft) | Rec/ Pen | Blows/ 6"      | Sample Description                                                                                                                                                                                                                                                                                             | Strata Change      | USCS Class. | Remarks |
| 0                                                                                                                                                                                                                                                                                                                                                                                                         | S1         | 0-2               | 10/24    | 5 5            | 6" loam                                                                                                                                                                                                                                                                                                        |                    |             |         |
| 1                                                                                                                                                                                                                                                                                                                                                                                                         |            |                   |          | 2 6            |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 2                                                                                                                                                                                                                                                                                                                                                                                                         | S2         | 2-4               | 6/24     | 3 5            | Moist, loose brown fine to medium SAND, little fine Gravel, little Silt                                                                                                                                                                                                                                        | FILL               | SW          |         |
| 3                                                                                                                                                                                                                                                                                                                                                                                                         |            |                   |          | 4 4            |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 4                                                                                                                                                                                                                                                                                                                                                                                                         | S3         | 4' - 4'7"         | 2/7      | 7 80/1*        | Moist, very dense, brown, fine to coarse SAND and Gravel, little silt                                                                                                                                                                                                                                          | FILL               | SW          | 1       |
| 5                                                                                                                                                                                                                                                                                                                                                                                                         |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 6                                                                                                                                                                                                                                                                                                                                                                                                         |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 7                                                                                                                                                                                                                                                                                                                                                                                                         |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 8                                                                                                                                                                                                                                                                                                                                                                                                         | S4         | 8 - 10            | 8/24     | 16 13<br>11 15 | Wet, medium dense brown f-c GRAVEL, some fine to coarse Sand, little Silt                                                                                                                                                                                                                                      | GLACIAL<br>OUTWASH | GW          |         |
| 9                                                                                                                                                                                                                                                                                                                                                                                                         |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 10                                                                                                                                                                                                                                                                                                                                                                                                        | S5         | 10- 10' 9"        | 2/9      | 22 80/3*       | Wet, very dense, grey fractured COBBLE                                                                                                                                                                                                                                                                         | GLACIAL<br>OUTWASH | N/A         | 2       |
| 11                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 12                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 13                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 14                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 15                                                                                                                                                                                                                                                                                                                                                                                                        | S6         | 15- 17            | 8/24     | 9 6            | Wet, medium dense, brown fine to coarse SAND, some fine Gravel, little Silt.                                                                                                                                                                                                                                   | GLACIAL<br>OUTWASH | SW/SM       | 3       |
| 16                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          | 12 11          |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 17                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 18                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 19                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 20                                                                                                                                                                                                                                                                                                                                                                                                        | S7         | 20 - 22           | 8/24     | 8 7            | Wet, medium dense gray-brown f-c GRAVEL, and f-c Sand, trace Silt                                                                                                                                                                                                                                              | GLACIAL<br>OUTWASH | GW          | 4       |
| 21                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          | 12 8           |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 22                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| 23                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             | 5       |
| 24                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                | Bottom of exploration @ 24' BGS (Casing and roller bit refusal)                                                                                                                                                                                                                                                |                    |             |         |
| 25                                                                                                                                                                                                                                                                                                                                                                                                        |            |                   |          |                |                                                                                                                                                                                                                                                                                                                |                    |             |         |
| MINOR CONSTITUENT PROPORTIONS:<br>Trace    0 to 10%    Some 20 to 35%<br>Little    10 to 20%    And 35 to 50%                                                                                                                                                                                                                                                                                             |            |                   |          |                | REMARKS: Automatic Hammer<br>1. Augered boulders/cobbles between 5 to 8 feet below ground surface.<br>2. Low recovery due to cobbles.<br>3. Change from auger to wash and drive at 14 feet below ground surface<br>4. Gravel in drilling wash<br>5. Casing refusal at 23.5' BGS, roller bit refusal at 24' BGS |                    |             |         |

AFFIX SEAL:  
ON:

|                                                                                                                                                                                                                                                                                                                                                                                                   |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------|----------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------|----------------|
| Boring Log<br>Project: Avery Road<br>Location: Garrison, NY                                                                                                                                                                                                                                                                                                                                       |            |                   |          |              | Boring ID: B2<br>Sheet 1 of 1<br>Project No.:                                                                                                                                                                                                                                                                                                              |                    |             |                |
| Contractor: New England Boring Company<br>Operator: Rick Posa<br>Observer: Andrea Judge<br>Drilling Method: 6" solid stem auger, casing wash & drive<br>Sampling Method: SPT<br>Hammer WL: 140 lbs                      Hammer Fall (in.): 30<br>Boring Location: Avery Road right abutment, roadway<br>Ground Elevation: 121 feet<br>Date Start: 9/2/25                      Date Finish: 9/2/25 |            |                   |          |              | Water Level Measurements                                                                                                                                                                                                                                                                                                                                   |                    |             |                |
|                                                                                                                                                                                                                                                                                                                                                                                                   |            |                   |          |              | Date                                                                                                                                                                                                                                                                                                                                                       | Ref. Pt.           | Depth       | Time           |
|                                                                                                                                                                                                                                                                                                                                                                                                   |            |                   |          |              | 9/2/2025                                                                                                                                                                                                                                                                                                                                                   | Ground             | 5.3'        | 1200p          |
|                                                                                                                                                                                                                                                                                                                                                                                                   |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
|                                                                                                                                                                                                                                                                                                                                                                                                   |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
|                                                                                                                                                                                                                                                                                                                                                                                                   |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
|                                                                                                                                                                                                                                                                                                                                                                                                   |            |                   |          |              | Time & Date of Completion: 9/2/2025 1200p                                                                                                                                                                                                                                                                                                                  |                    |             |                |
| Depth (ft)                                                                                                                                                                                                                                                                                                                                                                                        | Sample No. | Sample Depth (ft) | Rec/ Pen | Blows/ 6"    | Sample Description                                                                                                                                                                                                                                                                                                                                         | Strata Change      | USCS Class. | Remarks        |
| 0                                                                                                                                                                                                                                                                                                                                                                                                 | S1         | 0.5 - 2           | 10/18    | 15 15        | 5" pavement                                                                                                                                                                                                                                                                                                                                                | FILL               |             |                |
| 1                                                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          | 8            | moist medium dense-dense brown f-c SAND and f-c Gravel, little Silt                                                                                                                                                                                                                                                                                        |                    | SW-SM       |                |
| 2                                                                                                                                                                                                                                                                                                                                                                                                 | S2         | 2-4               | 14/24    | 5 11         | moist, medium dense brown f-c SAND, little f Gravel, little Silt                                                                                                                                                                                                                                                                                           | FILL               |             |                |
| 3                                                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          | 11 9         |                                                                                                                                                                                                                                                                                                                                                            |                    | SW-SM       |                |
| 4                                                                                                                                                                                                                                                                                                                                                                                                 | S3         | 4-6               | 12/24    | 6 26         | Top 6": Wet, medium dense, m-c SAND, some f Gravel, little Silt                                                                                                                                                                                                                                                                                            | FILL               |             |                |
| 5                                                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          | 22 13        | Bottom: Wet v dense m-c SAND some f Gravel, little Silt                                                                                                                                                                                                                                                                                                    |                    | SP          |                |
| 6                                                                                                                                                                                                                                                                                                                                                                                                 | S4         | 6-8               | 10/24    | 15 27        | Wet, m-d, yellow brown, coarse GRAVEL, some m-c Sand, little Silt, Alluvial deposits                                                                                                                                                                                                                                                                       | GLACIAL<br>OUTWASH | GW-SW       | Broken cobbles |
| 7                                                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          | 10 10        |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 8                                                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 9                                                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 10                                                                                                                                                                                                                                                                                                                                                                                                | S5         | 10-12             | 16/24    | 14 25        | Wet, dense, dark brown, f-c SAND and f GRAVEL, some Silt                                                                                                                                                                                                                                                                                                   | GLACIAL<br>TILL    | SM          | 1              |
| 11                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          | 19 24        |                                                                                                                                                                                                                                                                                                                                                            |                    |             | 2              |
| 12                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 13                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 14                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 15                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 16                                                                                                                                                                                                                                                                                                                                                                                                | S6         | 16-18             | 11/17    | 7 13         | Top 10": Wet, v dense broken COBBLES, some f-c Gravel, some f-c Sand                                                                                                                                                                                                                                                                                       | RESIDUAL<br>SOIL   | GP          | 3              |
| 17                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          | 80.5" min/ft | Bottom 10": Wet, gray-brown, f-c SAND, some f Gravel, some Silt                                                                                                                                                                                                                                                                                            | RESIDUAL<br>SOIL   | SM          | 4              |
| 18                                                                                                                                                                                                                                                                                                                                                                                                | C-1        | 18-23             | 47/60    | 2.5 min      | Hard, light grey, medium grained, slightly to moderately weathered, GNEISS                                                                                                                                                                                                                                                                                 | BEDROCK            | ROCK        |                |
| 19                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          | 1 min        |                                                                                                                                                                                                                                                                                                                                                            |                    |             | 5              |
| 20                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          | 3.5 min      |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 21                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          | 4 min        |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 22                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          | 3 min        |                                                                                                                                                                                                                                                                                                                                                            |                    |             | 6              |
| 23                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          |              | Bottom of boring at 23'                                                                                                                                                                                                                                                                                                                                    |                    |             |                |
| 24                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| 25                                                                                                                                                                                                                                                                                                                                                                                                |            |                   |          |              |                                                                                                                                                                                                                                                                                                                                                            |                    |             |                |
| MINOR CONSTITUENT PROPORTIONS:<br>Trace    0 to 10%    Some 20 to 35%<br>Little    10 to 20%    And 35 to 50%                                                                                                                                                                                                                                                                                     |            |                   |          |              | REMARKS:<br>Hammer type: Automatic<br>1. Switched from auger to cased boring, wash & drive<br>2. Losing drilling water @ 13' BGS - high infiltration to soil<br>3. Dense drilling @ 15' BGS<br>4. Split spoon refusal, changing stratum @ 17' BGS<br>5. Bedrock @ 17.5' BGS, NX core barrel<br>6. Borehole grouted @ completion, finished flush with grout |                    |             |                |

|         |          |                                             |                               |
|---------|----------|---------------------------------------------|-------------------------------|
| BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER<br>2024-012   |
|         |          | BORING LOGS                                 | DRAWING NO. 14<br>SHEET NO. 6 |



GRID NORTH

LEGEND

DETOUR ROUTE

SIGN (TEMPORARY)

NOTES

00 — SIGN IDENTIFICATION.

1. ALL SIGNS AND WORK ZONE TRAFFIC CONTROL DEVICES SHALL MEET THE REQUIREMENTS OF THE MUTCD, THE SUPPLEMENT TO THE MUTCD, NYSDOT STANDARD SHEETS AND THE NYS STANDARD SPECIFICATIONS.

2. AT EACH APPROACH TO THE WORK ZONE, TYPE III BARRICADES SHALL BE PLACED IN CONJUNCTION WITH "ROAD CLOSED" (R11-2) SIGNS. EACH BARRICADE SHALL BE EQUIPPED WITH 2 TYPE A LOW INTENSITY FLASHING WARNING LIGHTS, UNPINNED TEMPORARY.

3. ALL PERMANENT SIGNS THAT ARE IN CONFLICT WITH THOSE SHOWN ON THIS SHEET SHALL BE COVERED IN ACCORDANCE WITH STANDARD SPECIFICATION 619.02 SECTION H.

4. ALL SIGNAGE SHOWN AND ANY ADDITIONAL SIGNAGE AOBSE SHALL BE INCLUDED IN THE PRICE BID FOR ITEM 619.01.

00

DETOUR AHEAD

W20-02A  
(36 X 36)

05

END DETOUR

M4-8a  
(24 X 18)

01

ROAD CLOSED  
XXXX FEET AHEAD  
LOCAL TRAFFIC ONLY

R11-3aR  
(48 X 30)

DETOUR

M4-10L  
(48 X 30)

06

DETOUR  
AVERY ROAD

M4-8  
(24 X 12)  
M3-3  
(30 X 12)  
M6-1R  
(21 X 15)

02

ROAD CLOSED

R11-2  
(48 X 30)

07

DETOUR  
AVERY ROAD

M4-8  
(24 X 12)  
M3-3  
(30 X 12)  
M5-1R  
(21 X 15)

03

DETOUR  
AVERY ROAD

M4-8  
(24 X 12)  
M3-3  
(30 X 12)  
M5-1L  
(21 X 15)

08

DETOUR  
PUTNAM 11

M4-8  
(24 X 12)  
M1-6  
(24 X 24)  
M5-1L  
(21 X 15)

04

DETOUR  
AVERY ROAD

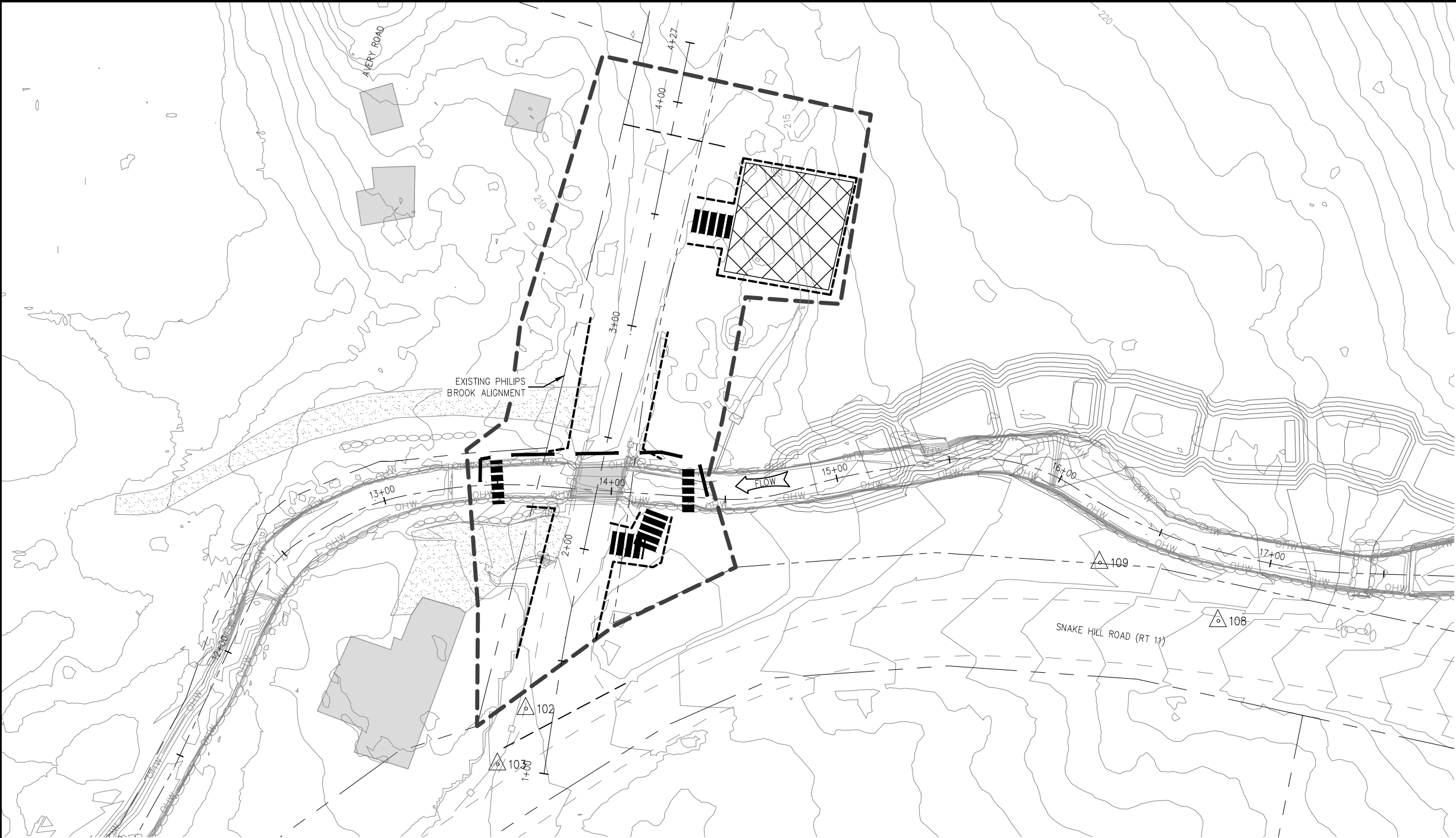
M4-8  
(24 X 12)  
M3-3  
(30 X 12)  
M5-1R  
(21 X 15)

09

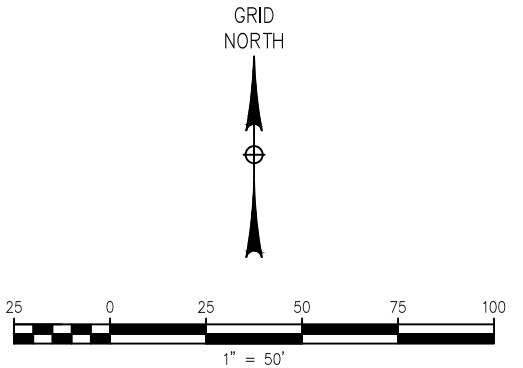
ROAD CLOSED  
1000 FT

W20-03RF  
(36 X 36)

|                                                                                                                                      |  |                                                  |  |  |  |         |          |                                             |                               |
|--------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------------------|--|--|--|---------|----------|---------------------------------------------|-------------------------------|
| AFFIX SEAL:<br>ON:                                                                                                                   |  | <div>1250125250375500</div> <div>1" = 250'</div> |  |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER<br>2024-012   |
|                                                                                                                                      |  |                                                  |  |  |  |         |          | DETOUR PLAN                                 | DRAWING NO. 14<br>SHEET NO. 7 |
| <div><div>interfluv</div><div>220 Concord Avenue, 2nd Floor<br/>Cambridge, MA 02136<br/>617.714.5537   www.interfluv.com</div></div> |  |                                                  |  |  |  |         |          |                                             |                               |



- LEGEND
- EXISTING CONTOUR (1 FT)
  - EXISTING STREAM CENTERLINE
  - EXISTING ROAD CENTERLINE
  - GUIDE RAIL, BOX BEAM
  - TAX LOT
  - EDGE OF PAVEMENT
  - STONEWALL
  - EXISTING ORDINARY HIGH WATER
  - EXISTING STRUCTURES
  - EXISTING WALLS TO BE REMOVED
  - EXISTING DRIVEWAYS
  - LIMITS OF DISTURBANCE
  - COFFERDAM
  - SILT FENCE
  - PUMPAROUND
  - TEMPORARY ACCESS
  - CONTROL POINT

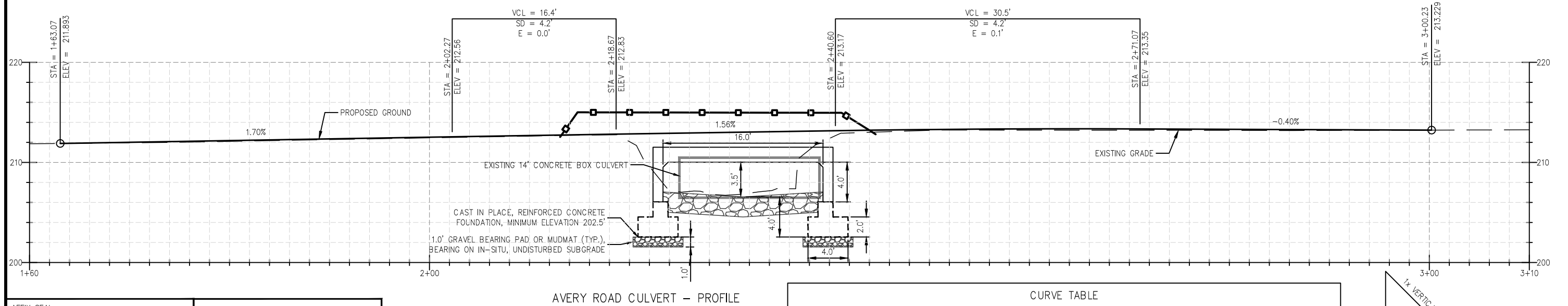
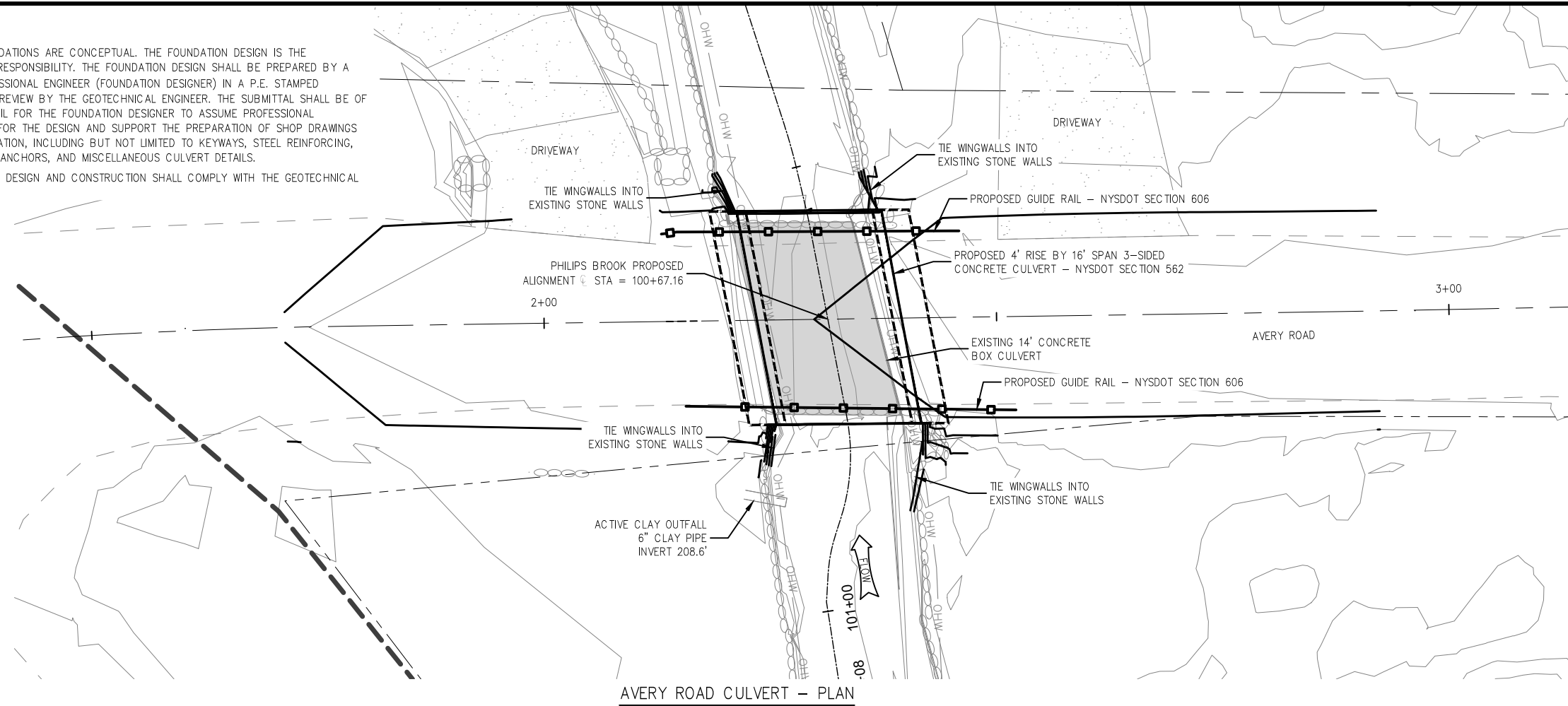


|                    |  |
|--------------------|--|
| AFFIX SEAL:<br>ON: |  |
|                    |  |

|  |  |  |         |          |                                                                                  |                               |
|--|--|--|---------|----------|----------------------------------------------------------------------------------|-------------------------------|
|  |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED<br>EROSION AND SEDIMENT CONTROL PLAN | CONTRACT NUMBER<br>2024-012   |
|  |  |  |         |          |                                                                                  | DRAWING NO. 14<br>SHEET NO. 8 |
|  |  |  |         |          |                                                                                  |                               |
|  |  |  |         |          |                                                                                  |                               |

NOTES:

1. PROPOSED FOUNDATIONS ARE CONCEPTUAL. THE FOUNDATION DESIGN IS THE CONTRACTOR'S RESPONSIBILITY. THE FOUNDATION DESIGN SHALL BE PREPARED BY A LICENSED PROFESSIONAL ENGINEER (FOUNDATION DESIGNER) IN A P.E. STAMPED SUBMITTAL FOR REVIEW BY THE GEOTECHNICAL ENGINEER. THE SUBMITTAL SHALL BE OF SUFFICIENT DETAIL FOR THE FOUNDATION DESIGNER TO ASSUME PROFESSIONAL RESPONSIBILITY FOR THE DESIGN AND SUPPORT THE PREPARATION OF SHOP DRAWINGS FOR THE FOUNDATION, INCLUDING BUT NOT LIMITED TO KEYWAYS, STEEL REINFORCING, SHIMS, DOWELS, ANCHORS, AND MISCELLANEOUS CULVERT DETAILS.
2. THE FOUNDATION DESIGN AND CONSTRUCTION SHALL COMPLY WITH THE GEOTECHNICAL DESIGN REPORT.



| CURVE TABLE |         |         |         |         |                  |        |       |        |      |
|-------------|---------|---------|---------|---------|------------------|--------|-------|--------|------|
| CURVE #     | P.C.    | P.I.    | P.T.    | RADIUS  | DC               | ANGLE  | T     | LENGTH | E    |
| C1          | 2+72.86 | 2+96.21 | 3+19.55 | 5230.00 | N11° 49' 41.48"E | 179.49 | 23.35 | 46.69  | 0.05 |
| C2          | 1+41.77 | 1+60.31 | 1+78.84 | 665.00  | N10° 29' 12.79"E | 176.81 | 18.54 | 37.07  | 0.26 |

AFFIX SEAL:  
ON:

|  |  |  |         |          |                                             |                 |
|--|--|--|---------|----------|---------------------------------------------|-----------------|
|  |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER |
|  |  |  |         |          | ROAD PLAN AND PROFILE                       | 2024-012        |
|  |  |  |         |          |                                             | DRAWING NO. 14  |
|  |  |  |         |          |                                             | SHEET NO. 9     |
|  |  |  |         |          |                                             |                 |



PROJECT MANAGER NN/LP

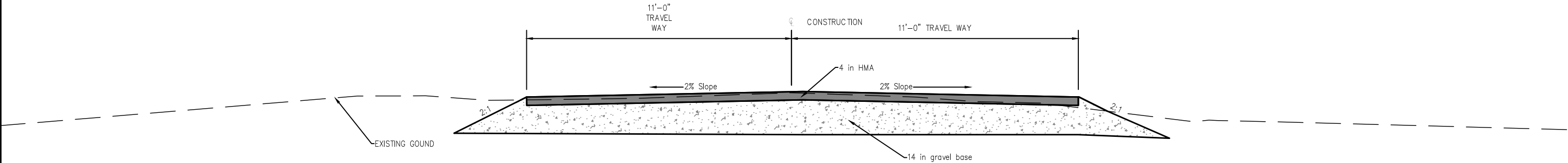
CHECK MYS/JK/AJ

DRAFTING LP/EYS/AT

CHECK MYS/JK/AJ

DESIGN MYS/LP/AJ

DATE 12/20/2025

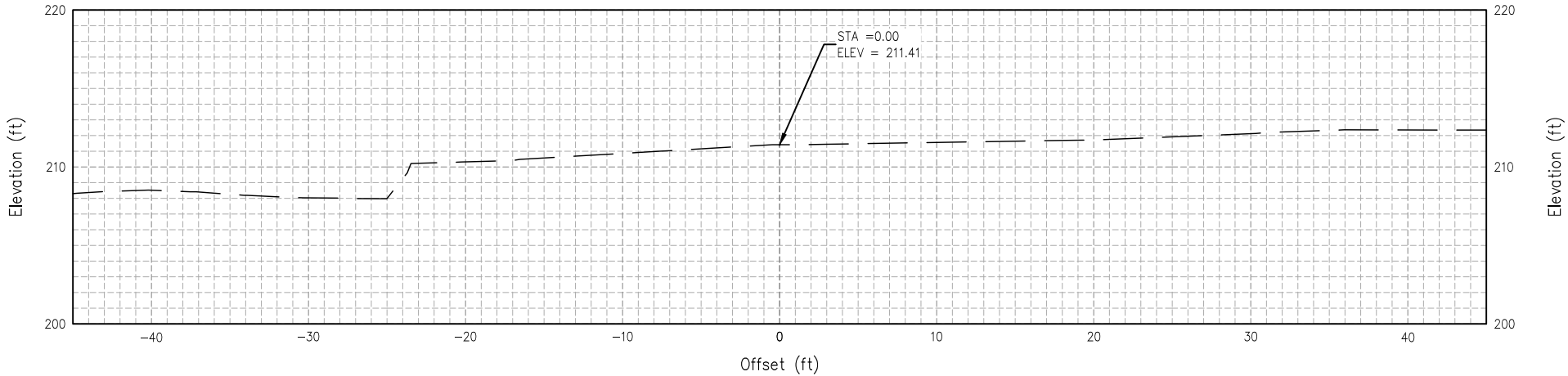


| ROAD QUANTITIES |                 |
|-----------------|-----------------|
| HMA             | 50 TONS         |
| GRAVEL BASE     | 130 CUBIC YARDS |

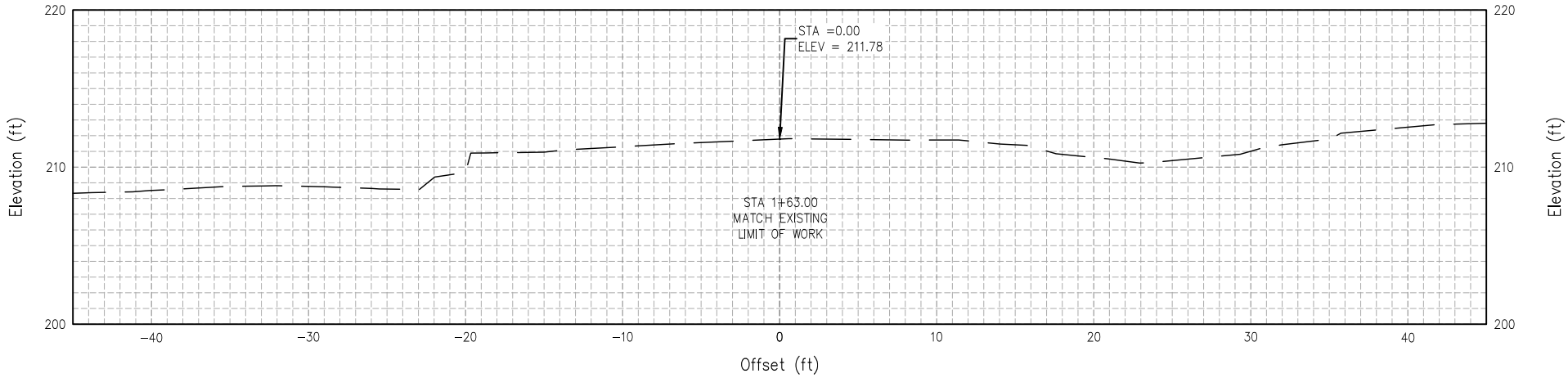
|                    |  |
|--------------------|--|
| AFFIX SEAL:<br>ON: |  |
|                    |  |

|                                                                                       |  |  |         |          |                                             |                                                                                           |
|---------------------------------------------------------------------------------------|--|--|---------|----------|---------------------------------------------|-------------------------------------------------------------------------------------------|
|                                                                                       |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER<br>2024-012                                                               |
|                                                                                       |  |  |         |          | ROAD TYPICAL SECTIONS                       | DRAWING NO. 14<br>SHEET NO. 10                                                            |
|  |  |  |         |          |                                             | 220 Concord Avenue, 2nd Floor<br>Cambridge, MA 02136<br>617.714.5537   www.interfluve.com |

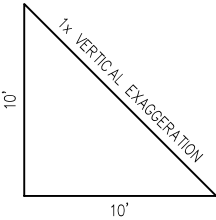
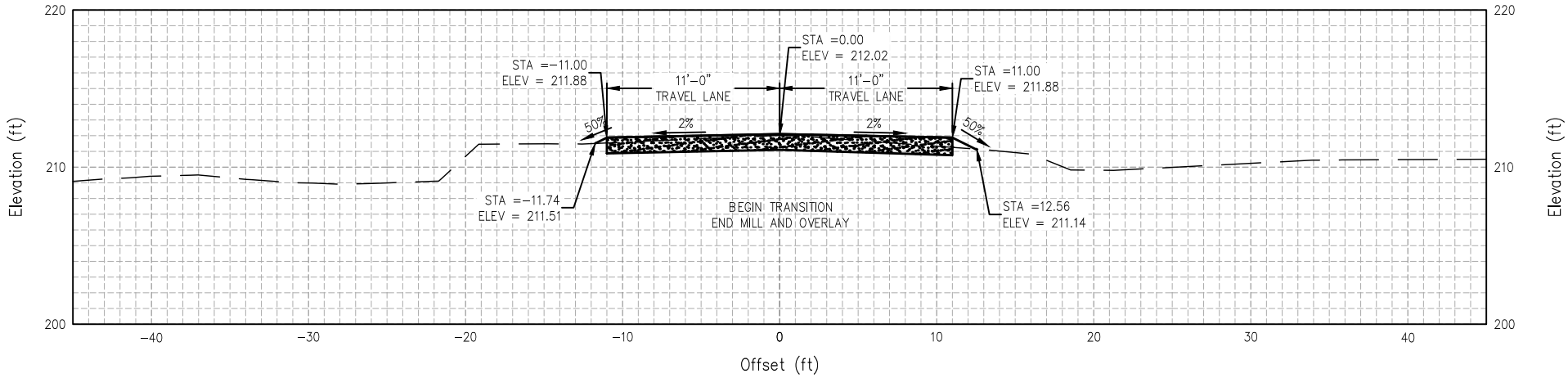
STA 1+25



STA 1+50



STA 1+75

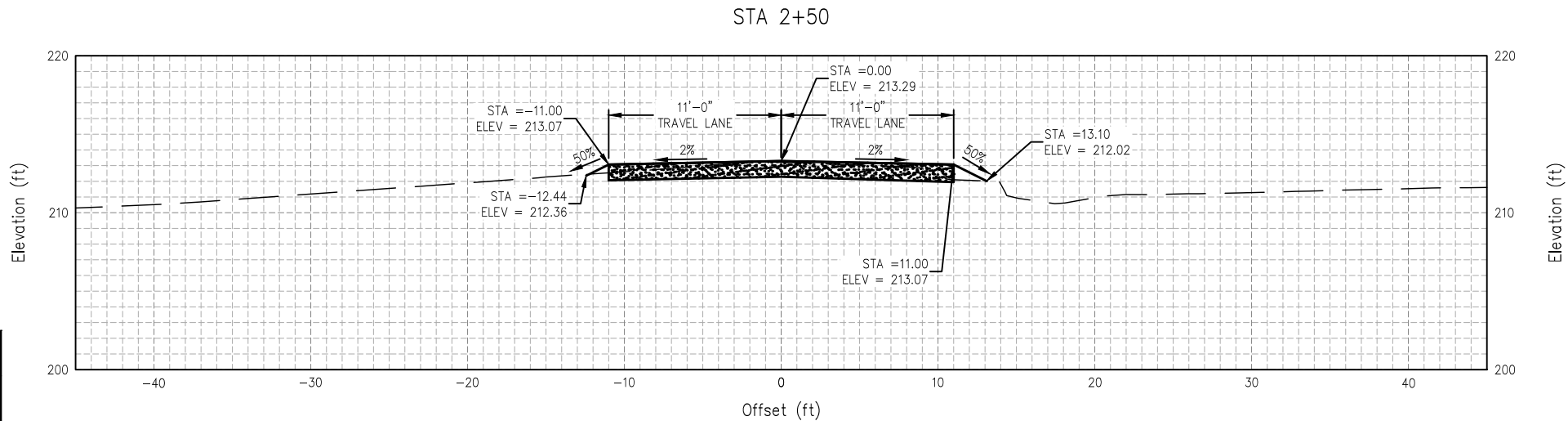
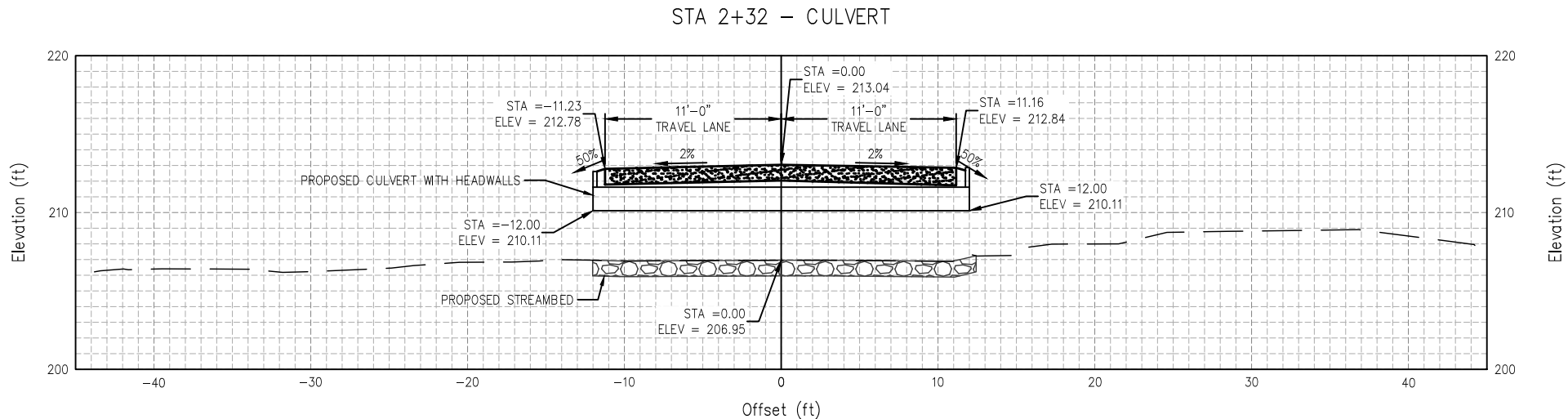
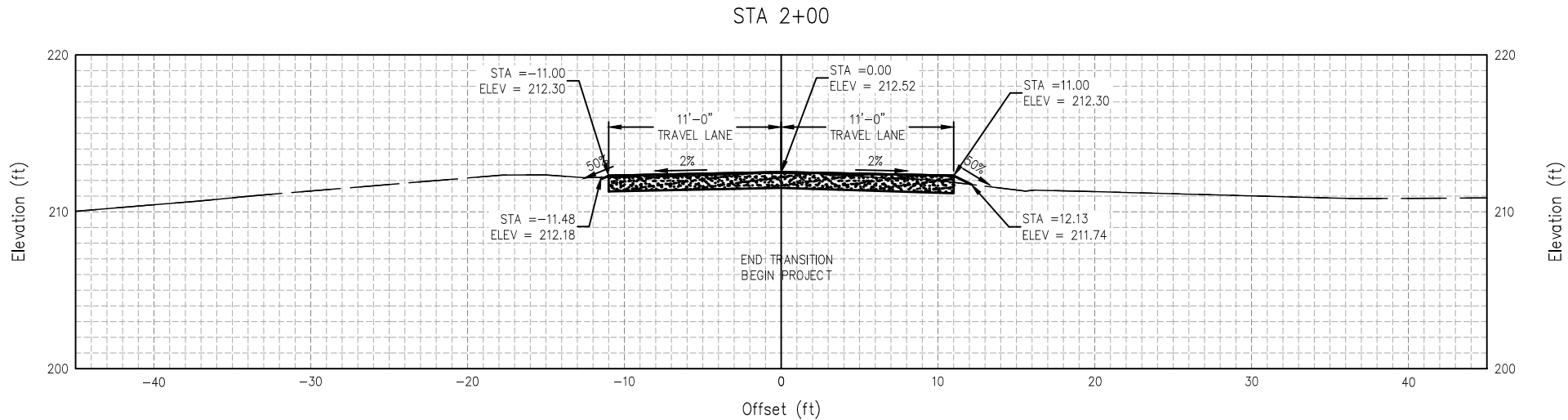


AFFIX SEAL:  
ON:

|  |  |  |         |          |                                             |                             |
|--|--|--|---------|----------|---------------------------------------------|-----------------------------|
|  |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER<br>2024-012 |
|  |  |  |         |          |                                             |                             |
|  |  |  |         |          | ROAD GRADING SECTIONS (1 OF 3)              | DRAWING NO. 14              |
|  |  |  |         |          |                                             | SHEET NO. 11                |



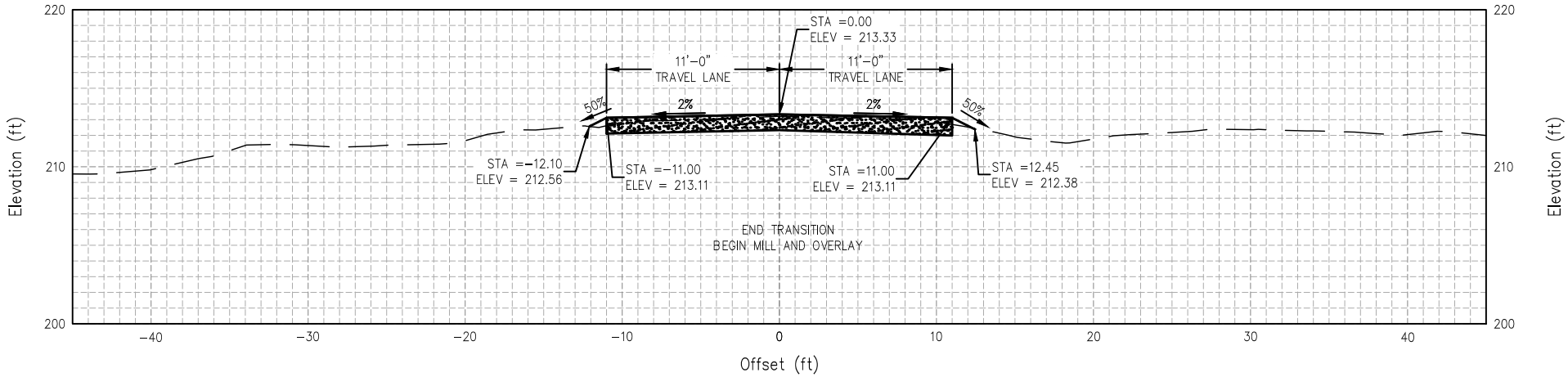
220 Concord Avenue, 2nd Floor  
Cambridge, MA 02136  
617.714.5537 | www.interfluve.com



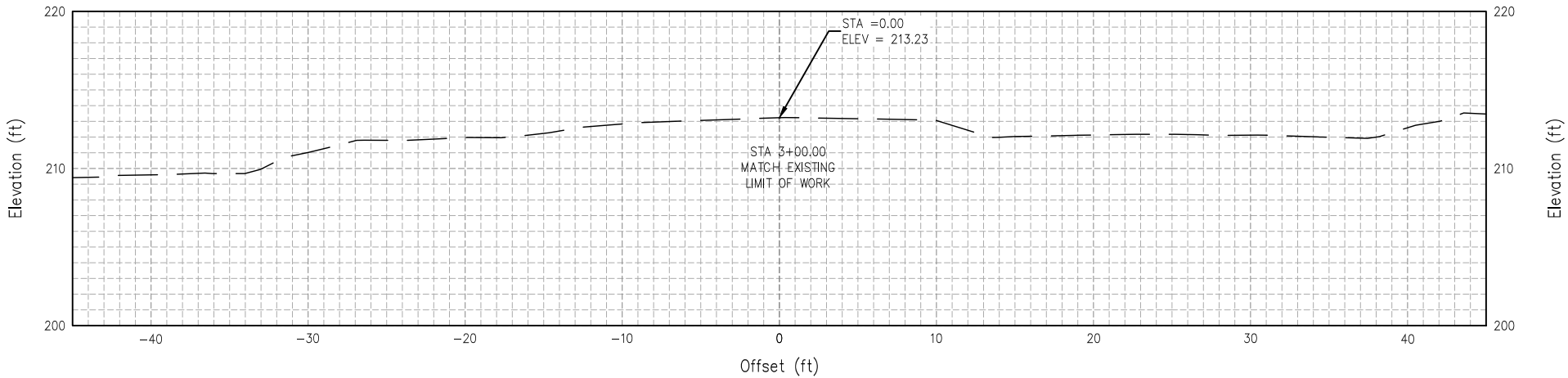
AFFIX SEAL:  
ON:

|  |  |  |         |          |                                             |                                                                                       |                                                                                                                                 |
|--|--|--|---------|----------|---------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
|  |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER<br>2024-012                                                           |                                                                                                                                 |
|  |  |  |         |          | ROAD GRADING SECTIONS (2 OF 3)              |                                                                                       |                                                                                                                                 |
|  |  |  |         |          |                                             | DRAWING NO. 14                                                                        |                                                                                                                                 |
|  |  |  |         |          |                                             | SHEET NO. 12                                                                          |                                                                                                                                 |
|  |  |  |         |          |                                             |                                                                                       |                                                                                                                                 |
|  |  |  |         |          |                                             |  | 220 Concord Avenue, 2nd Floor<br>Cambridge, MA 02136<br>617.714.5537   <a href="http://www.interfluv.com">www.interfluv.com</a> |

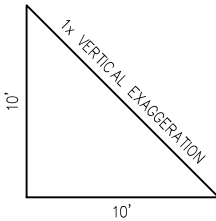
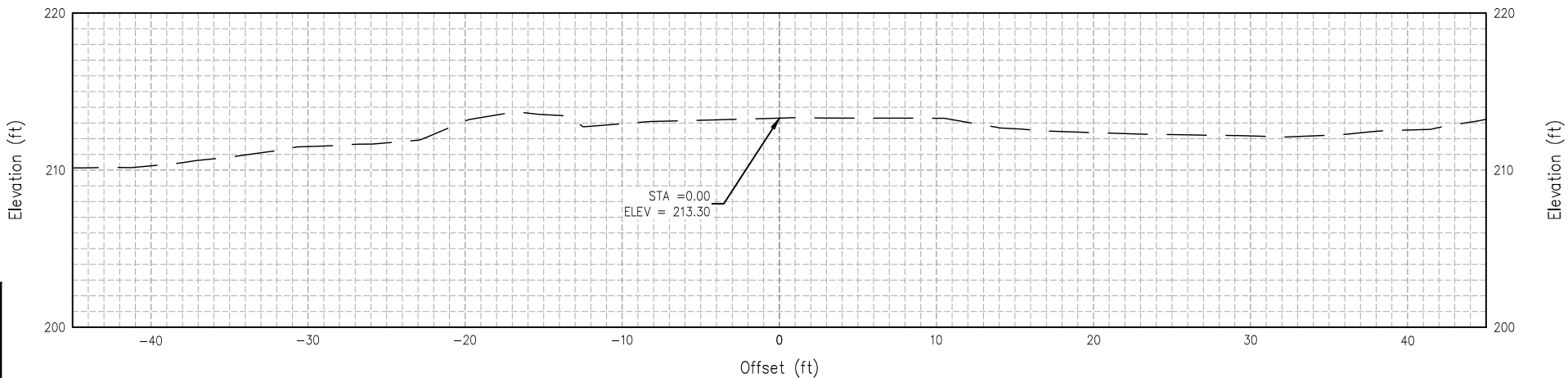
STA 2+75



STA 3+00



STA 3+25



AFFIX SEAL:  
ON:

|  |  |
|--|--|
|  |  |
|--|--|

|  |  |  |         |          |                                             |                                |
|--|--|--|---------|----------|---------------------------------------------|--------------------------------|
|  |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER<br>2024-012    |
|  |  |  |         |          |                                             |                                |
|  |  |  |         |          | ROAD GRADING SECTIONS (3 OF 3)              | DRAWING NO. 14<br>SHEET NO. 13 |
|  |  |  |         |          |                                             |                                |



220 Concord Avenue, 2nd Floor  
Cambridge, MA 02136  
617.714.5537 | www.interfluv.com

PROJECT MANAGER NN/LP

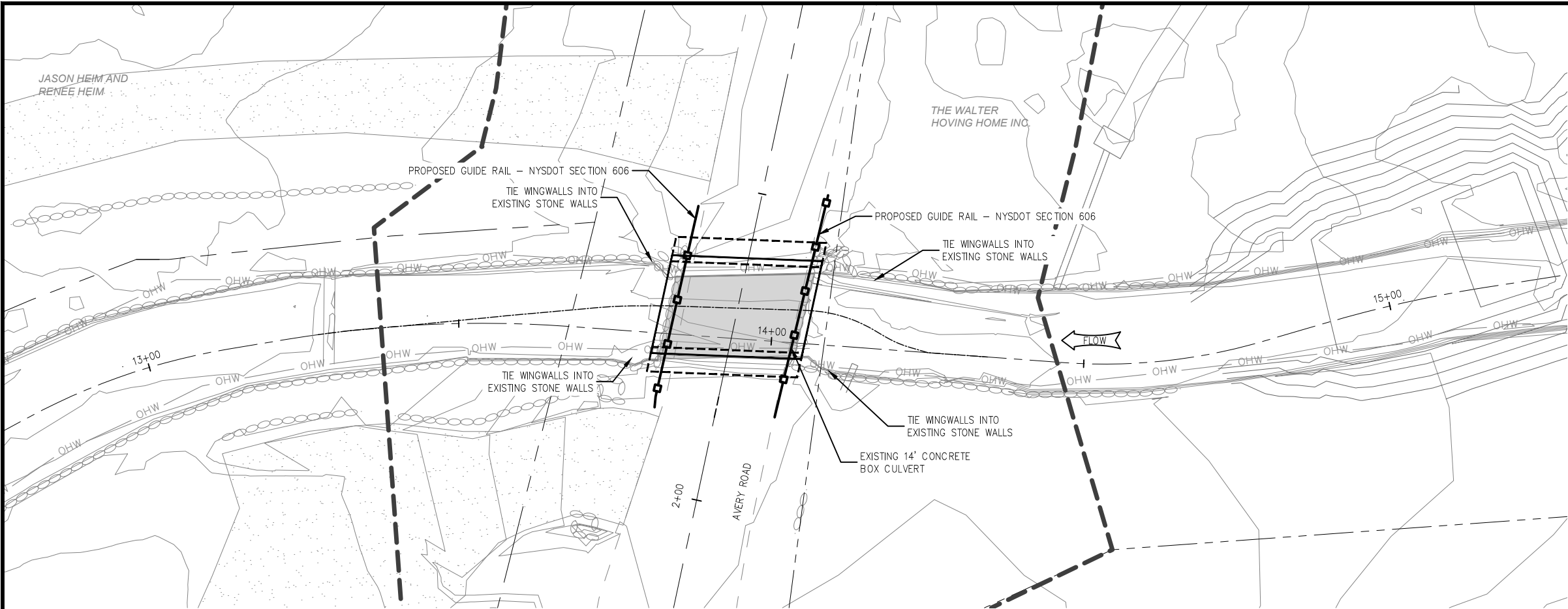
CHECK MYS/K/AJ

DRAFTING LP/EYS/AT

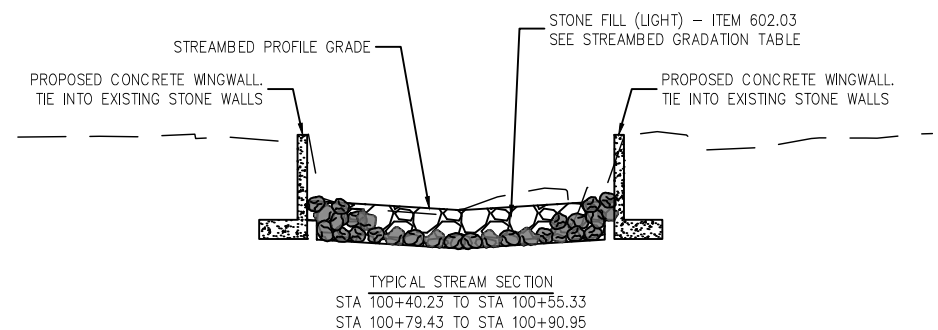
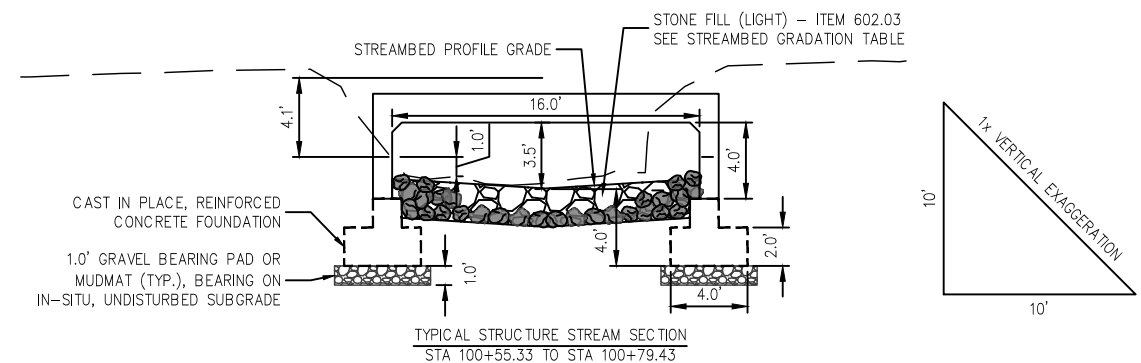
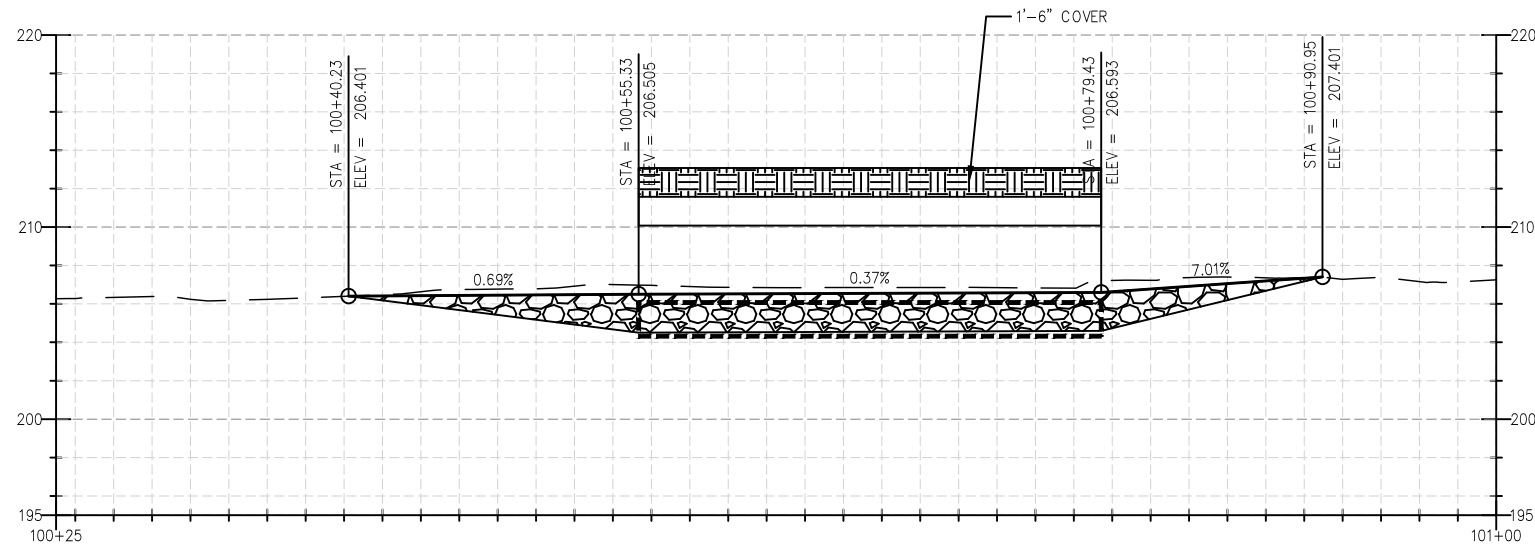
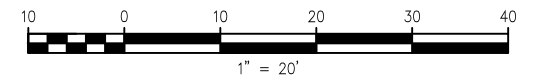
CHECK MYS/JK/AJ

DESIGN MYS/LP/AJ

DATE 12/20/2025



- LEGEND
- EXISTING CONTOUR (1 FT)
  - EXISTING STREAM CENTERLINE
  - EXISTING ROAD CENTERLINE
  - GUIDE RAIL, BOX BEAM
  - TAX LOT
  - EDGE OF PAVEMENT
  - WALL
  - STONEWALL
  - EXISTING ORDINARY HIGH WATER
  - EXISTING CULVERT
  - EXISTING DRIVEWAYS
  - LIMIT OF DISTURBANCE
  - PROPOSED STREAM CENTERLINE
  - PROPOSED CULVERT
  - PROPOSED CULVERT
  - PROPOSED STREAMBED MATERIAL



| STREAMBED GRADATION |                              |
|---------------------|------------------------------|
| SIZE CLASS          | SIZE PERCENT FINER THAN (IN) |
| D5                  | 0.3                          |
| D16                 | 1.6                          |
| D50                 | 8                            |
| D84                 | 10                           |
| D100                | 12                           |

AFFIX SEAL:  
ON:

|  |  |  |         |          |                                             |                                |
|--|--|--|---------|----------|---------------------------------------------|--------------------------------|
|  |  |  | BRIDGES | CULVERTS | ALL DIMENSIONS IN FT UNLESS OTHERWISE NOTED | CONTRACT NUMBER<br>2024-012    |
|  |  |  |         |          | STREAM PLAN AND PROFILE                     | DRAWING NO. 14<br>SHEET NO. 14 |

220 Concord Avenue, 2nd Floor  
Cambridge, MA 02136  
617.714.5537 | www.interfluve.com



## Appendix B Engineer's Opinion of Probable Construction Cost

# Avery Road Culvert Replacement Project

Garrison, NY  
NYSDOT REGION 1



## 100% Design - Engineer's Opinion of Probable Construction Cost

Created by LP  
December 16, 2025

| Construction Cost Items        |                 |                                                                        |          |      |            |                   | Notes                                                                                                                                                                                                 |
|--------------------------------|-----------------|------------------------------------------------------------------------|----------|------|------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No.                            | NYSDOT Item No. | Item                                                                   | Quantity | Unit | Unit Cost  | Total Cost        |                                                                                                                                                                                                       |
| 1                              | 201.07          | Clearing and Grubbing                                                  | 815      | SY   | \$ 14      | \$ 11,403         | Area to be cleared for culvert project                                                                                                                                                                |
| 2                              | 203.20          | Select Granular Subgrade                                               | 4        | CY   | \$ 55      | \$ 244            | Subgrade base beneath footing of culvert. 12 inch depth X 24ft length X 5ft width                                                                                                                     |
| 3                              | 203.21          | Select Structural Fill                                                 | 150      | CY   | \$ 46      | \$ 6,900          | backfill; used this as opposed to select fill since this fill will be behind the culvert structure and retaining walls;                                                                               |
| 4                              | 206.0201        | Trench and Culvert Excavation                                          | 450      | CY   | \$ 50      | \$ 22,500         | Chose this item instead of structure excavation (206.01) because this culvert is under 20ft; item 206.01 is meant for bridges (in NYS that's a structure greater than 20ft)                           |
| 5                              | 209.1003        | Seed and Mulch - Temporary                                             | 815      | SY   | \$ 1       | \$ 815            | Area to be seeded, same as what will be cleared                                                                                                                                                       |
| 6                              | 209.01          | Erosion and Sediment Control                                           | 1        | LS   | \$ 20,000  | \$ 20,000         |                                                                                                                                                                                                       |
| 7                              | 209.13          | Silt Fence - Temporary                                                 | 517      | LF   | \$ 7       | \$ 3,618          |                                                                                                                                                                                                       |
| 8                              | 209.22          | Stabilized Construction Access                                         | 53       | SY   | \$ 30      | \$ 1,591          | assumed 2 access points north and south of the road on the updataram side; both assumed to be 10' wide                                                                                                |
| 9                              | 553.02          | Cofferdams (Type 2)                                                    | 2        | EACH | \$ 15,700  | \$ 31,400         | Used pricing for type 2 as these are used for up to 8' of water depth (water depth at the 2 year event is ~1.98' upstream of the Avery Road crossing and ~2.4' downstream of the Avery Road crossing) |
| 10                             | 553.03          | Temporary Wateryway Diversion Structures                               | 1        | EACH | \$ 2,000   | \$ 2,000          | small culvert project in this region was \$1,000; average for other projects is around \$4,000                                                                                                        |
| 11                             | 562.01          | Reinforced Concrete Span Units                                         | 42       | SY   | \$ 1,535   | \$ 64,502         | 3 sided concrete box culvert component                                                                                                                                                                |
| 12                             | 562.02          | Invert Slab With Cut-Off Wall                                          | 32       | SY   | \$ 700     | \$ 22,400         | 3 sided concrete box culvert component                                                                                                                                                                |
| 13                             | 562.03          | Wing Wall with Footing                                                 | 3        | SY   | \$ 1,050   | \$ 2,858          | 3 sided concrete box culvert component                                                                                                                                                                |
| 15                             | 585.01          | Structural Lifting Operations - Type A                                 | 3        | EACH | \$ 5,500   | \$ 16,500         | for placement of the proposed structure                                                                                                                                                               |
| 17                             | 602.03          | Stone Filling (Light)                                                  | 60       | CY   | \$ 150     | \$ 9,000          | Material for streambed                                                                                                                                                                                |
| 19                             | 606.1           | Box Beam Guide Railing                                                 | 69       | LF   | \$ 35      | \$ 2,428          | Includes attachment of guide rail to concrete headwall of proposed structure                                                                                                                          |
| 20                             | 606.120101      | Box Beam End Piece                                                     | 4        | EACH | \$ 760     | \$ 3,040          |                                                                                                                                                                                                       |
| 21                             | 619.01          | Basic Work Zone Traffic Control                                        | 1        | LS   | \$ 100,000 | \$ 100,000        | This is a special operation work category (road closure); this includes temporary signage; used culvert replacements/repairs in this area as guidance for price.                                      |
| 22                             | 619.04          | Type III Construction Barricades                                       | 3        | EACH | \$ 65      | \$ 195            | See detour plan in drawings                                                                                                                                                                           |
| 23                             | 619.27          | Mailboxes                                                              | 2        | EACH | \$ 650     | \$ 1,300          |                                                                                                                                                                                                       |
| 24                             | 633.11          | Cleaning Existing Pavement and/or Shoulders                            | 350      | SY   | \$ 0.25    | \$ 88             | Plan view area of road work                                                                                                                                                                           |
| 25                             | 647.31          | Relocate Sign Panel, Sign Panel Assembly Size 1 (Under 30 square feet) | 3        | EACH | \$ 130     | \$ 390            | for the 3 signs at the Avery Road crossing                                                                                                                                                            |
| 26                             | 404             | HMA                                                                    | 50       | TONS | \$ 73      | \$ 3,650          |                                                                                                                                                                                                       |
| 27                             | 203.20          | Select Granular Subgrade                                               | 130      | CY   | \$ 55      | \$ 7,150          | Gravel subgrade base for road work                                                                                                                                                                    |
| 28                             | 699.040001      | Mobilization                                                           | 1        | LS   | \$ 139,000 | \$ 139,000        | USED PRICES FROM CULVERT PROJECTS ACROSS THE STATE                                                                                                                                                    |
| <b>Total Construction Cost</b> |                 |                                                                        |          |      |            | <b>\$ 472,972</b> |                                                                                                                                                                                                       |

## Appendix C Geotechnical Data Memorandum

# TECHNICAL MEMORANDUM



---

To: Walter Hoving Home, Inc.

From: Marcel Young Scaggs<sup>1</sup>, Andrea Judge<sup>2</sup>

Date: November 7, 2025 Project: Avery Road, Garrison, New York

Re: Geotechnical Data Memorandum

---

This geotechnical data memorandum presents the results of Inter-Fluve's subsurface exploration and geotechnical engineering services performed for the Avery Road Stream Crossing Replacement at Phillips Brook in Garrison, New York. The purpose of these services is to provide information and geotechnical engineering recommendations related to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Potential foundation systems and future design considerations

The geotechnical engineering Scope of Services for this project included one day of geotechnical borings on the road. Within the scoped timeframe, two (2) soil borings were completed at each side of the proposed stream crossing to approximately 25 feet below the existing ground surface.

Figures depicting the site and exploration locations (Figure 1), and boring logs (B-1 and B-2) are included in Attachment B. Results of the laboratory testing performed on select soil samples obtained from the site during the field exploration are included in Attachment C.

## PROJECT UNDERSTANDING

The project site consists of the Avery Road stream crossing, which conveys vehicular traffic over Phillips Brook. The culvert is being evaluated for replacement to more closely align with the stream crossing standards.

## EXISTING CONDITIONS

The existing crossing is a single span concrete deck with concrete abutment walls and is 3.6 feet high and 14 feet wide. The existing Avery Road stream crossing supports a one lane asphalt paved roadway. Paved driveways are located adjacent to the stream crossing on either side of the downstream side of the existing culvert. The channel is lined with deteriorated concrete walls upstream and downstream of the crossing.

---

<sup>1</sup> Inter-Fluve, Project Engineer.

<sup>2</sup> Inter-Fluve, Geotechnical Engineer

## **SUBSURFACE CONDITIONS**

### **DESCRIPTION OF LOCAL GEOLOGY**

The USGS Surficial Materials Map of New York State (2016) identifies the geology in the immediate vicinity of the site as Till, variable texture (clay, silt-clay, boulder- clay), usually poorly sorted diamict, deposition beneath glacier ice, relatively impermeable (loamy matrix), variable clast content – ranging from abundant well rounded diverse lithologies in valley tills, sandy in areas underlain by gneiss.

Near the downstream side of Avery Road, the surficial geology is identified as Kame deposits (including kames, eskers, terraces, and deltas), ranging from coarse to fine gravel and/or sand, deposition adjacent to ice, lateral variability in sorting, coarseness, and thickness.

The Bedrock Geologic Map of Dutchess, Putnam, and northern Westchester Counties, New York, and western Connecticut (1936) depicts bedrock in the vicinity of the site as Pre-Cambrian Gneiss.

The conditions observed during the subsurface investigation were consistent with the local USGS geological maps.

### **SUBSURFACE EXPLORATION PROGRAM**

Inter-Fluve subcontracted New England Boring Company of Glastonbury, Connecticut to advance soil borings at the site. Two borings were performed on September 2, 2025. The locations of the borings are depicted in Figure 1. Boring locations were selected based on the assumed location of the future stream crossing abutments at the time of the investigation.

Inter-Fluve personnel provided boring layout. The boring locations were field located tape measurements to nearby structural features. Ground surface elevations at each boring were interpolated from the topographic survey completed by Inter-Fluve in August 2025.

Soil borings B-1 and B-2 were advanced to depths of approximately 24 and 23 feet below the existing ground surface, respectively. Borings were advanced using a truck-mounted Mobile B-57 drill rig with 6-inch outside diameter solid stem auger or 6" outside diameter flush-wall casing, and tricone roller bit. Soil samples were obtained continuously throughout the roadway embankment fill soils and at intervals of 5 feet thereafter. B-1 terminated at a depth of 24 feet due to roller bit refusal. In B-2, split spoon sampler refusal was encountered at a depth of approximately 17 feet. A rock core was obtained from 18 to 23 feet. The rock core confirmed the presence of bedrock. B-2 was terminated at a depth of 23 feet.

The split-barrel sampling procedure was used to take soil samples in the test borings in accordance with ASTM D1586-99. The number of blows required to advance a standard 2-inch outer diameter split-barrel sampling spoon from 6 to 18 inches of the 24-inch sampler is the Standard Penetration Test (SPT) resistance value "N". This "N" value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils. An automatic SPT hammer was used to advance the split-barrel sampler.

Soil samples were placed in labeled jars and the rock core was placed in a wooden core box and taken to our office for further review, laboratory testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, relative density and/or consistency evaluations,

boring depth, sampling intervals, and groundwater conditions. Boring B-1, completed on the grassed shoulder, was backfilled with soil cuttings and raked smooth. Boring B-2 was backfilled with soil cuttings to the existing road grade and grouted at the road surface.

## LABORATORY TESTING

Descriptive classifications of the soils indicated on the logs are in general accordance with ASTM D2488 using the modified Burmister Classification System. Unified Soil Classification System (USCS) symbols are also shown on the logs for the native material. Classification of the soil was generally by visual/manual procedures, confirmed by laboratory testing.

The modified Burmister Classification System describes soil composition based upon the percentage of soil particle size present in the sample with the major soil particle size listed first following other soil components described as “and” (indicating 35-50% by weight), “some” (indicating 20-35% by weight), “little” (indicating 10-20% by weight), or “trace” (indicating 0-10% by weight).

Laboratory testing consisted of three grain size distribution tests (ASTM D6913) on representative soil samples from the borings. Results of the laboratory testing are summarized in Table 1. The laboratory results are included in Attachment 2. Particles determined to be gravel size based on sieve analyses may consist of fractured cobbles disturbed by the sampling process. Fractured cobbles were frequently noted in the glacial deposits.

**Table 1: Soil particle gradation test results**

| Boring/Sample No./Depth | Stratum         | Description (USCS)                                                      | Percent Passing Particle Size (%) |      |       |
|-------------------------|-----------------|-------------------------------------------------------------------------|-----------------------------------|------|-------|
|                         |                 |                                                                         | Gravel                            | Sand | Fines |
| B2, S2, 2-4'            | Fill            | Moist, dark brown sand with silt and gravel.,                           | 33.2                              | 58.4 | 8.4   |
| B1, S6, 15-17'          | Glacial Outwash | Moist, dark yellowish brown silty sand with gravel, Angular sand/gravel | 35.5                              | 45.1 | 19.4  |
| B2, S6, 16-17'5"        | Glacial Till    | Moist, dark yellowish brown silty gravel with sand                      | 55.5                              | 31.5 | 13.0  |

## SUBSURFACE PROFILE

A generalization of the subsurface conditions was developed based on the field exploration, laboratory data, known geologic conditions, and our understanding of the project. Conditions encountered at each exploration are indicated on the individual logs. The generalized subsurface profile is described in Table 2. The individual logs can be found in Attachment 2.

**Table 2: Generalized subsurface profile description**

| Description                     | Approximate Depth to Bottom of Stratum (feet)           | General Description (USCS)                                                                                |
|---------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Granular Fill                   | 5 (B1) – 6 (B2)                                         | Medium dense, dark brown sand with silt and gravel                                                        |
| Glacial Outwash                 | 23 (B1) – 10 (B2)                                       | Dense, dark yellowish brown sandy gravel with silt ranging to silty sand with gravel, Angular sand/gravel |
| Glacial Till                    | 16 (B2)                                                 | Dense, dark yellowish brown silty gravel with sand                                                        |
| Weathered Bedrock/Residual Soil | 18 (B2)                                                 | Very dense, grey, gravelly cobbles with sand and silt                                                     |
| Bedrock/ Refusal                | Top of Bedrock or Refusal ranges from 24 (B1) – 18 (B2) | Hard, moderately weathered Gneiss                                                                         |

## GROUNDWATER

Groundwater measurements were taken at the completion of drilling activities within the borehole. The water levels are summarized on the boring logs in Attachment 2 and Table 3. Water was added to the borehole as a drilling fluid to advance the tricone roller bit and core barrel and the water levels below may be inaccurate. The readings appear to coincide with the water level at Phillips Brook at the time of the investigation.

**Table 3: Groundwater measurements**

| Exploration No. | Approximate Depth to Groundwater (feet) |
|-----------------|-----------------------------------------|
| B1              | 4.5                                     |
| B2              | 5.3                                     |

Groundwater level fluctuations can occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the explorations were performed. Therefore, groundwater levels during construction or at other times in the life of the proposed structure may be higher or lower than the levels indicated on the logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. Observation wells were not installed as part of the exploration program.

## LIQUEFACTION

The soil encountered beneath the observed water table consists of medium dense to dense sands, sandy gravel, gravelly sands, and cobbles. Water loss was observed during the addition of drilling fluid,

suggesting that the soil is well drained. The gravel particles were generally observed to be angular to sub angular. However, particles described as gravel size based on sieve analyses may consist of fractured cobbles. Considering the density, fraction of cobbles and gravel within the soil based on the sieve analyses, the angularity, and free draining characteristics of the soil, the soil characteristics are generally not considered predictive for liquefaction (New York Department of Transportation, 2015).

## **RECOMMENDED FOUNDATION SYSTEM**

The following recommendations are provided for foundation design. Foundations will be designed to resist lateral and vertical loads. Vertical loads consist of downward pressures due to the dead weight of the bridge and live traffic loads. Uplift pressures and lateral loads will be generated due to overturning loads (such as backfill soil loads, wind loads, seismic forces, and flood conditions). All foundations should be designed according to requirements provided in the NYSDOT Geotechnical Design Manual (GDM) and the 2017 AASHTO LRFD Bridge Design Specifications (AASHTO).

## **REUSE OF EXISTING FOUNDATION SYSTEMS**

The existing foundation system of the bridge is unknown. There were no construction plans of the existing foundations for review at the time that this report was prepared. Therefore, opportunities to retain or modify the existing foundations to receive the new superstructure were not evaluated.

## **SHALLOW FOUNDATION RECOMENDATIONS**

Upon review of the subsurface data collected during our geotechnical investigation, the following recommendations may be applied for the proposed bridge foundations.

- Granular fill was observed between 5 to 6 feet below the existing ground surface. The existing fill is not suitable to support the proposed site features in its current state as it is not known if the fill was placed in a controlled manner and is variable in consistency and density. Structures bearing on the existing, granular fill in its current state would be vulnerable to excessive total and differential settlement. Therefore, it is not recommended that foundations or prepared subgrade be situated over the existing fill in its current condition.
- Foundations should be designed to effectively transfer loads from the superstructure to the underlying native/undisturbed medium dense to dense Glacial Outwash, Glacial Till, Residual Soil, or Bedrock.
- The recommended maximum bearing resistance for spread foundations bearing on Glacial Outwash or Glacial Till is 4 kips per square foot. This recommendation is based on the unified soils criteria (UNIFIED FACILITIES CRITERIA (UFC) FOUNDATIONS AND EARTH STRUCTURES (DM 7.2) Department of Defense, 2025) presumptive bearing capacity and requires a minimum spread foundation width of 3 feet. Higher bearing resistance is likely if the spread foundations bear on Residual Soil or Bedrock. However, the observed depth of these layers poses significant challenges and expense associated with excavation to the Residual Soil and Bedrock compared to the glacial deposits. Therefore, specific recommendations for bearing resistances for shallow spread foundations on Residual Soil and Bedrock were not considered for the site.

- The bottom of the spread foundation should be below frost depth at the lowest exposed ground surface, which is the bottom of the channel. At this site, the minimum frost protection depth is 48 inches.

## **DEEP FOUNDATION RECOMMENDATIONS**

The Glacial Outwash and Glacial Till are anticipated to be suitable to support the proposed stream crossing using a shallow/spread foundation system. Since a relatively cost-effective approach is feasible to support the proposed stream crossing, deep foundations were not considered for this site.

## **COMPACTION REQUIREMENTS**

Prior to the placement of any engineered fill below abutments, we recommend that the subgrade be thoroughly proof compacted by a minimum of six passes using a 6,000-pound vibratory roller. To facilitate compaction, the moisture content of the on-Site material should be maintained at or near the optimum moisture content as determined by ASTM D1557. Compacted fill should be placed in loose lifts ranging in thickness between 6 and 12 inches, depending on the size and type of equipment, and compacted to at least 95% of the Modified Proctor dry density as defined in ASTM D1557, Method C.

## **LATERAL EARTH PRESSURES AND RETAINING WALL DESIGN**

For the design of new retaining or abutment walls with level backfill, recommended lateral earth pressure coefficients are provided in . A unit weight of 125 pounds per cubic foot (pcf) and an internal friction angle ( $\phi$ ) of 35° for imported free draining Granular Fill is recommended. The lateral earth pressure coefficient should be increased where the ground surface slopes up behind the wall, if applicable. The retaining walls should be designed to withstand surcharge loading which may be induced over the life of the structure. These would include traffic loads, as well as loads from storage, fill or construction equipment which may be placed adjacent to the wall. The influence zone behind the wall can be defined by a 1.5 horizontal to 1 vertical line extending upward from 2 feet outside of the edge of the wall footing. The magnitude of lateral earth pressure against retaining walls is dependent upon the type of backfill, method of fill placement, drainage provisions, and the amount of displacement the wall is permitted to undergo after the placement of the backfill. Pare recommends that the retaining walls be backfilled with a free draining compacted "Granular Fill", as defined herein. The lateral earth pressure distribution against the retaining wall should be computed using the appropriate value of K, the coefficient of lateral earth pressure. Recommended values of K are presented in the table below. Friction factors are also presented for use in checking resistance to unbalanced forces on walls.

To develop either the active or passive condition, horizontal displacement of the wall is necessary. To develop the active condition in sandy material, the horizontal movement required ranges from 0.001 to 0.004 times the exposed wall height, depending on the density of the material. The horizontal movement required to develop the passive condition in sand material range from 0.02 to 0.06 times the wall height. For retaining walls with no allowable movement, the At-Rest Coefficient shall be used in calculating wall loads. Passive resistance should be ignored for soil depths of less than 5 feet or rock depths less than 2 feet.

## **EXCAVATIONS**

The need for temporary earth support should be evaluated by the contractor. Sloping and earth support may be needed during demolition, the removal of debris soils, the installation of utilities, and if foundations are extended to depths greater than four feet below existing grade. The upper unconsolidated native soils encountered at the site are estimated to be Type C soils for slope stability purposes. The maximum allowable slope for excavations of Class C soils is 1.5H:1V (34°). In areas where sloping is not feasible, the excavations may require temporary earth support systems during construction. The design and engineering of these systems should be the responsibility of the contractor. Prior to construction, we recommend that the contractor evaluate the need for a temporary earth support system to protect the existing roadway, canal, and personnel during construction.

## **LIMITATIONS**

### **EXPLORATIONS**

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.
2. The generalized soil profile described in the text 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 transitions are probably more erratic. For specific information, refer to the boring logs.
3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors occurring since the time measurements were made.

### **REVIEW**

1. If any changes in the nature, design or location of the proposed stream crossing are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by Inter-Fluve Engineering, PLLC. It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

### **CONSTRUCTION**

1. It is recommended that this firm be retained to provide soil engineering services during construction of the excavation and foundation phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes if subsurface conditions differ from those anticipated prior to start of construction.

## **USE OF REPORT**

1. This report has been prepared for the exclusive use of the Walter Hoving Home, Inc. Garrison, New York for specific application to the proposed Avery Road Culvert Assessment in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.
2. This soil and foundation engineering report has been prepared for this project by Inter-Fluve. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.

## REFERENCES

Department of Defense (DoD). (2025). *Unified Facilities Criteria (UFC) Foundations and Earth Structures (DM 7.2)*.

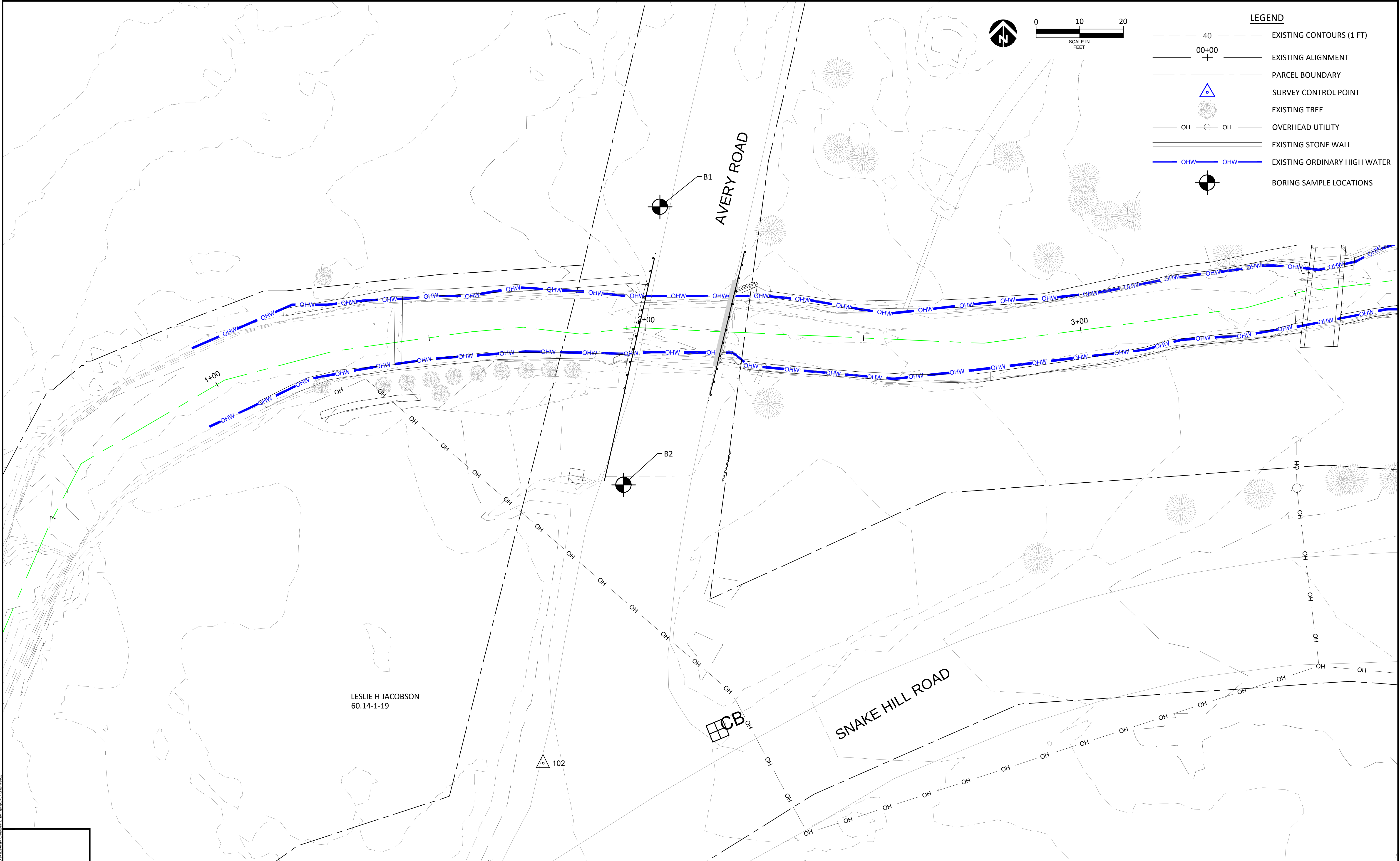
New York Department of Transportation. (2015). *Liquefaction Potential of Cohesionless Soils Geotechnical Design Procedure GDP-9*.

## ATTACHMENTS

*Boring Location Plan*

*Boring Logs*

*Laboratory Testing*



LESLIE H JACOBSON  
60.14-1-19

102

CB

SNAKE HILL ROAD

AVERY ROAD

B1

B2

|  |  |  |  |                |  |  |                   |  |  |                    |  |  |                                                                         |  |  |  |                                                                                            |  |                      |  |                 |  |
|--|--|--|--|----------------|--|--|-------------------|--|--|--------------------|--|--|-------------------------------------------------------------------------|--|--|--|--------------------------------------------------------------------------------------------|--|----------------------|--|-----------------|--|
|  |  |  |  | EYS<br>DRAWN   |  |  | SS<br>DESIGNED    |  |  | SS/NN<br>CHECKED   |  |  | WALTER HOVING HOME, INC.<br>AVERY ROAD AT PHILIPS BROOK<br>GARRISON, NY |  |  |  | 220 Concord Avenue, 2nd Floor<br>Cambridge, MA 02138<br>617.714.5537<br>www.interfluve.com |  | BORING LOCATION PLAN |  | SHEET<br>FIG. 1 |  |
|  |  |  |  | --<br>APPROVED |  |  | JUNE 2025<br>DATE |  |  | 24-07-3<br>PROJECT |  |  |                                                                         |  |  |  |                                                                                            |  |                      |  |                 |  |
|  |  |  |  | NO.            |  |  | BY                |  |  | DATE               |  |  | REVISION DESCRIPTION                                                    |  |  |  |                                                                                            |  |                      |  |                 |  |

Walter Hoving Home, Inc. 60.14-1-19

|                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------|---------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------------------------------------------------|----------------|--|
| <b>Boring Log</b><br><b>Project: Avery Road</b><br><b>Location: Garrison, NY</b>                                                                                                                                                                                                                                                                                                                           |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          | <b>Boring ID: B1</b><br><b>Sheet 1 of 2</b><br><b>Project No.:</b> |                |  |
| Contractor: New England Boring Company<br>Operator: Rick Posa<br>Observer: Andrea Judge<br>Drilling Method: 6" solid stem auger, casing wash & drive<br>Sampling Method: SPT<br>Hammer Wt.: 140 lbs                      Hammer Fall (in.): 30<br>Boring Location: Avery Road left abutment, grassed shoulder<br>Ground Elevation: 121 feet<br>Date Start: 9/2/25                      Date Finish: 9/2/25 |                       |                                  |                     |                      | Water Level Measurements                                                                                                                                                                                               |                          |                                                                    |                |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                                  |                     |                      | Date                                                                                                                                                                                                                   | Ref. Pt.                 | Depth                                                              | Time           |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                                  |                     |                      | 9/2/2025                                                                                                                                                                                                               | Ground                   | 4.5                                                                | 340            |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| Time & Date of Completion: 9/2/2025 340p                                                                                                                                                                                                                                                                                                                                                                   |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| <b>Depth<br/>(ft)</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>Sample<br/>No.</b> | <b>Sample<br/>Depth<br/>(ft)</b> | <b>Rec/<br/>Pen</b> | <b>Blows/<br/>6"</b> | <b>Sample Description</b>                                                                                                                                                                                              | <b>Strata<br/>Change</b> | <b>USCS<br/>Class.</b>                                             | <b>Remarks</b> |  |
| 0                                                                                                                                                                                                                                                                                                                                                                                                          | S1                    | 0-2                              | 10/24               | 5 5                  | 6" loam                                                                                                                                                                                                                |                          |                                                                    |                |  |
| 1                                                                                                                                                                                                                                                                                                                                                                                                          |                       |                                  |                     | 2 6                  |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 2                                                                                                                                                                                                                                                                                                                                                                                                          | S2                    | 2-4                              | 6/24                | 3 5                  | Moist, loose brown fine to medium SAND<br>little fine Gravel, little Silt                                                                                                                                              | FILL                     | SW                                                                 |                |  |
| 3                                                                                                                                                                                                                                                                                                                                                                                                          |                       |                                  |                     | 4 4                  |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 4                                                                                                                                                                                                                                                                                                                                                                                                          | S3                    | 4' -<br>4'7"                     | 2/7                 | 7 80/1"              | Moist, very dense, brown, fine to coarse<br>SAND and Gravel, little silt                                                                                                                                               | FILL                     | SW                                                                 | 1              |  |
| 5                                                                                                                                                                                                                                                                                                                                                                                                          |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 6                                                                                                                                                                                                                                                                                                                                                                                                          |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 7                                                                                                                                                                                                                                                                                                                                                                                                          |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 8                                                                                                                                                                                                                                                                                                                                                                                                          | S4                    | 8 - 10                           | 8/24                | 16 13<br>11 15       | Wet, medium dense brown fine GRAVEL<br>some fine to coarse Sand, little Silt                                                                                                                                           | GLACIAL<br>OUTWASH       | GW                                                                 |                |  |
| 9                                                                                                                                                                                                                                                                                                                                                                                                          |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 10                                                                                                                                                                                                                                                                                                                                                                                                         | S5                    | 10-<br>10' 9"                    | 2/9                 | 22 80/3"             | Wet, very dense, grey fractured COBBLE                                                                                                                                                                                 | GLACIAL<br>OUTWASH       | N/A                                                                | 2              |  |
| 11                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 12                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 13                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 14                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                                  |                     |                      |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| 15                                                                                                                                                                                                                                                                                                                                                                                                         | S6                    | 15- 17                           | 8/24                | 9 6                  | Wet, medium dense, brown fine to coarse<br>SAND, some fine Gravel, little Silt.                                                                                                                                        | GLACIAL<br>OUTWASH       | SW/SM                                                              | 3              |  |
| 16                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                                  |                     | 12 11                |                                                                                                                                                                                                                        |                          |                                                                    |                |  |
| <b>MINOR CONSTITUENT PROPORTIONS:</b><br><b>Trace      0 to 10%      Some 20 to 35%</b><br><b>Little     10 to 20%     And 35 to 50%</b>                                                                                                                                                                                                                                                                   |                       |                                  |                     |                      | <b>REMARKS: Automatic Hammer</b><br>1. Augered boulders/cobbles between 5 to 8 feet below ground surface.<br>2. Low recovery due to cobbles.<br>3. Change from auger to wash and drive at 14 feet below ground surface |                          |                                                                    |                |  |

|                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  |                                          |          |                                                                    |      |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|------------------------------------------|----------|--------------------------------------------------------------------|------|--|
| <b>Boring Log</b><br><b>Project: Avery Road</b><br><b>Location: Garrison, NY</b>                                                                                                                                                                                                                                                                                                                           |  |  |  |  |                                          |          | <b>Boring ID: B1</b><br><b>Sheet 1 of 2</b><br><b>Project No.:</b> |      |  |
| Contractor: New England Boring Company<br>Operator: Rick Posa<br>Observer: Andrea Judge<br>Drilling Method: 6" solid stem auger, casing wash & drive<br>Sampling Method: SPT<br>Hammer Wt.: 140 lbs                      Hammer Fall (in.): 30<br>Boring Location: Avery Road left abutment, grassed shoulder<br>Ground Elevation: 121 feet<br>Date Start: 9/2/25                      Date Finish: 9/2/25 |  |  |  |  | <b>Water Level Measurements</b>          |          |                                                                    |      |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  | Date                                     | Ref. Pt. | Depth                                                              | Time |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  | 9/2/2025                                 | Ground   | 4.5                                                                | 340  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  |                                          |          |                                                                    |      |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  |                                          |          |                                                                    |      |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  |                                          |          |                                                                    |      |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  |                                          |          |                                                                    |      |  |
|                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  | Time & Date of Completion: 9/2/2025 340p |          |                                                                    |      |  |

| Depth<br>(ft) | Sample<br>No. | Sample<br>Depth<br>(ft) | Rec/<br>Pen | Blows/<br>6" | Sample Description                                                      | Strata<br>Change   | USCS<br>Class. | Remarks |
|---------------|---------------|-------------------------|-------------|--------------|-------------------------------------------------------------------------|--------------------|----------------|---------|
| 17            |               |                         |             |              |                                                                         |                    |                |         |
| 18            |               |                         |             |              |                                                                         |                    |                |         |
| 19            |               |                         |             |              |                                                                         |                    |                |         |
| 20            | S7            | 20 - 22                 | 8/24        | 8 7          | Wet, medium dense gray-brown fine to coarse GRAVEL and fine Sand, trace | GLACIAL<br>OUTWASH | GW             | 4       |
| 21            |               |                         |             | 12 8         | Silt                                                                    |                    |                |         |
| 22            |               |                         |             |              |                                                                         |                    |                |         |
| 23            |               |                         |             |              |                                                                         |                    |                | 5       |
| 24            |               |                         |             |              | Bottom of exploration @ 24' BGS<br>(Casing and roller bit refusal)      |                    |                |         |
| 25            |               |                         |             |              |                                                                         |                    |                |         |
| 26            |               |                         |             |              |                                                                         |                    |                |         |
| 27            |               |                         |             |              |                                                                         |                    |                |         |
| 28            |               |                         |             |              |                                                                         |                    |                |         |
| 29            |               |                         |             |              |                                                                         |                    |                |         |
| 30            |               |                         |             |              |                                                                         |                    |                |         |
| 31            |               |                         |             |              |                                                                         |                    |                |         |
| 32            |               |                         |             |              |                                                                         |                    |                |         |
| 33            |               |                         |             |              |                                                                         |                    |                |         |

|                                                                                                                                           |                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>MINOR CONSTITUENT PROPORTIONS:</b><br><b>Trace      0 to 10%      Some 20 to 35%</b><br><b>Little     10 to 20%      And 35 to 50%</b> | <b>REMARKS:</b><br>4. Gravel in drilling wash<br>5. Casing refusal at 23.5 ' BGS, Roller bit refusal at 24' BGS |
|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|

| <b>Boring Log</b><br><b>Project: Avery Road</b><br><b>Location: Garrison, NY</b>                                                                                                                                                                                                                                                                                   |            |                   |          |           |                                                                                                                                                                                                                          |                 | <b>Boring ID: B2</b><br><b>Sheet 1 of 2</b><br><b>Project No.:</b> |                |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------|----------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------------------------------------------------------|----------------|--|
| Contractor: New England Boring Company<br>Operator: Rick Posa<br>Observer: Andrea Judge<br>Drilling Method: 6" solid stem auger, casing wash & drive<br>Sampling Method: SPT<br>Hammer Wt.: 140 lbs      Hammer Fall (in.): 30<br>Boring Location: Avery Road right abutment, roadway<br>Ground Elevation: 121 feet<br>Date Start: 9/2/25      Date Finish: 9/2/25 |            |                   |          |           | Water Level Measurements                                                                                                                                                                                                 |                 |                                                                    |                |  |
|                                                                                                                                                                                                                                                                                                                                                                    |            |                   |          |           | Date                                                                                                                                                                                                                     | Ref. Pt.        | Depth                                                              | Time           |  |
|                                                                                                                                                                                                                                                                                                                                                                    |            |                   |          |           | 9/2/2025                                                                                                                                                                                                                 | Ground          | 5.3'                                                               | 1200p          |  |
|                                                                                                                                                                                                                                                                                                                                                                    |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
|                                                                                                                                                                                                                                                                                                                                                                    |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
|                                                                                                                                                                                                                                                                                                                                                                    |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
|                                                                                                                                                                                                                                                                                                                                                                    |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
| Time & Date of Completion: 9/2/2025 1200p                                                                                                                                                                                                                                                                                                                          |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
| Depth (ft)                                                                                                                                                                                                                                                                                                                                                         | Sample No. | Sample Depth (ft) | Rec/ Pen | Blows/ 6" | Sample Description                                                                                                                                                                                                       | Strata Change   | USCS Class.                                                        | Remarks        |  |
| 0                                                                                                                                                                                                                                                                                                                                                                  | S1         | 0.5 - 2           | 10/18    | 15 15     | 5" pavement                                                                                                                                                                                                              | FILL            |                                                                    |                |  |
| 1                                                                                                                                                                                                                                                                                                                                                                  |            |                   |          | 8         | moist medium dense - dense brown f-c SAND and f-c Gravel, little Silt                                                                                                                                                    |                 | SW-SM                                                              |                |  |
| 2                                                                                                                                                                                                                                                                                                                                                                  | S2         | 2-4               | 14/24    | 5.11      | moist, medium dense                                                                                                                                                                                                      | FILL            |                                                                    |                |  |
| 3                                                                                                                                                                                                                                                                                                                                                                  |            |                   |          | 11 9      | brown f-c SAND little Gravel, little Silt                                                                                                                                                                                |                 | SW-SM                                                              |                |  |
| 4                                                                                                                                                                                                                                                                                                                                                                  | S3         | 4-6               | 12/24    | 6 26      | Top 6": Wet, medium dense, m-c SAND, some fine Gravel, little Silt                                                                                                                                                       | FILL            |                                                                    |                |  |
| 5                                                                                                                                                                                                                                                                                                                                                                  |            |                   |          | 22 13     | Bottom: Wet v dense m-c SAND some f Gravel, little Silt                                                                                                                                                                  |                 | SP                                                                 |                |  |
| 6                                                                                                                                                                                                                                                                                                                                                                  | S4         | 6-8               | 10/24    | 15 27     | Wet, m-d, yellow brown, coarse GRAVEL, some m-c Sand, little Silt                                                                                                                                                        | GLACIAL OUTWASH | GW-SW                                                              | Broken cobbles |  |
| 7                                                                                                                                                                                                                                                                                                                                                                  |            |                   |          | 10 10     |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
| 8                                                                                                                                                                                                                                                                                                                                                                  |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
| 9                                                                                                                                                                                                                                                                                                                                                                  |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
| 10                                                                                                                                                                                                                                                                                                                                                                 | S5         | 10-12             | 16/24    | 14 25     | Wet, dense, dark brown, fine to coarse SAND, some Silt, some fine Gravel                                                                                                                                                 | GLACIAL TILL    | SM                                                                 | 1              |  |
| 11                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          | 19 24     |                                                                                                                                                                                                                          |                 |                                                                    | 2              |  |
| 12                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
| 13                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
| 14                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
| 15                                                                                                                                                                                                                                                                                                                                                                 |            |                   |          |           |                                                                                                                                                                                                                          |                 |                                                                    |                |  |
| 16                                                                                                                                                                                                                                                                                                                                                                 | S6         | 16-18             | 11/17    | 7 13      | Top 10": Wet, grey, v dense broken COBBLE some f-c gravel some of f-c sand                                                                                                                                               |                 | GP                                                                 | 3              |  |
| <b>MINOR CONSTITUENT PROPORTIONS:</b><br>Trace    0 to 10%      Some 20 to 35%<br>Little    10 to 20%      And 35 to 50%                                                                                                                                                                                                                                           |            |                   |          |           | <b>REMARKS:</b><br>Hammer type:                      Automatic<br>1. Switched from auger to cased boring, wash & drive<br>2. Loosing drilling water @ 13' BGS - high infiltration to soil<br>3. Dense drilling @ 15' BGS |                 |                                                                    |                |  |

|                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  |                                                                    |          |       |       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--------------------------------------------------------------------|----------|-------|-------|
| <b>Boring Log</b><br><b>Project: Avery Road</b><br><b>Location: Garrison, NY</b>                                                                                                                                                                                                                                                                                                                   |  |  |  |  |  |  | <b>Boring ID: B2</b><br><b>Sheet 2 of 2</b><br><b>Project No.:</b> |          |       |       |
| Contractor: New England Boring Company<br>Operator: Rick Posa<br>Observer: Andrea Judge<br>Drilling Method: 6" solid stem auger, casing wash & drive<br>Sampling Method: SPT<br>Hammer Wt.: 140 lbs                      Hammer Fall (in.): 30<br>Boring Location: Avery Road right abutment, roadway<br>Ground Elevation: 121 feet<br>Date Start: 9/2/25                      Date Finish: 9/2/25 |  |  |  |  |  |  | <b>Water Level Measurements</b>                                    |          |       |       |
|                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  | Date                                                               | Ref. Pt. | Depth | Time  |
|                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  | 9/2/2025                                                           | Ground   | 5.3'  | 1200p |
|                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  |                                                                    |          |       |       |
|                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  |                                                                    |          |       |       |
|                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  |                                                                    |          |       |       |
|                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  |                                                                    |          |       |       |
|                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  |                                                                    |          |       |       |
|                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |  |  | Time & Date of Completion: 9/2/2025 1200p                          |          |       |       |

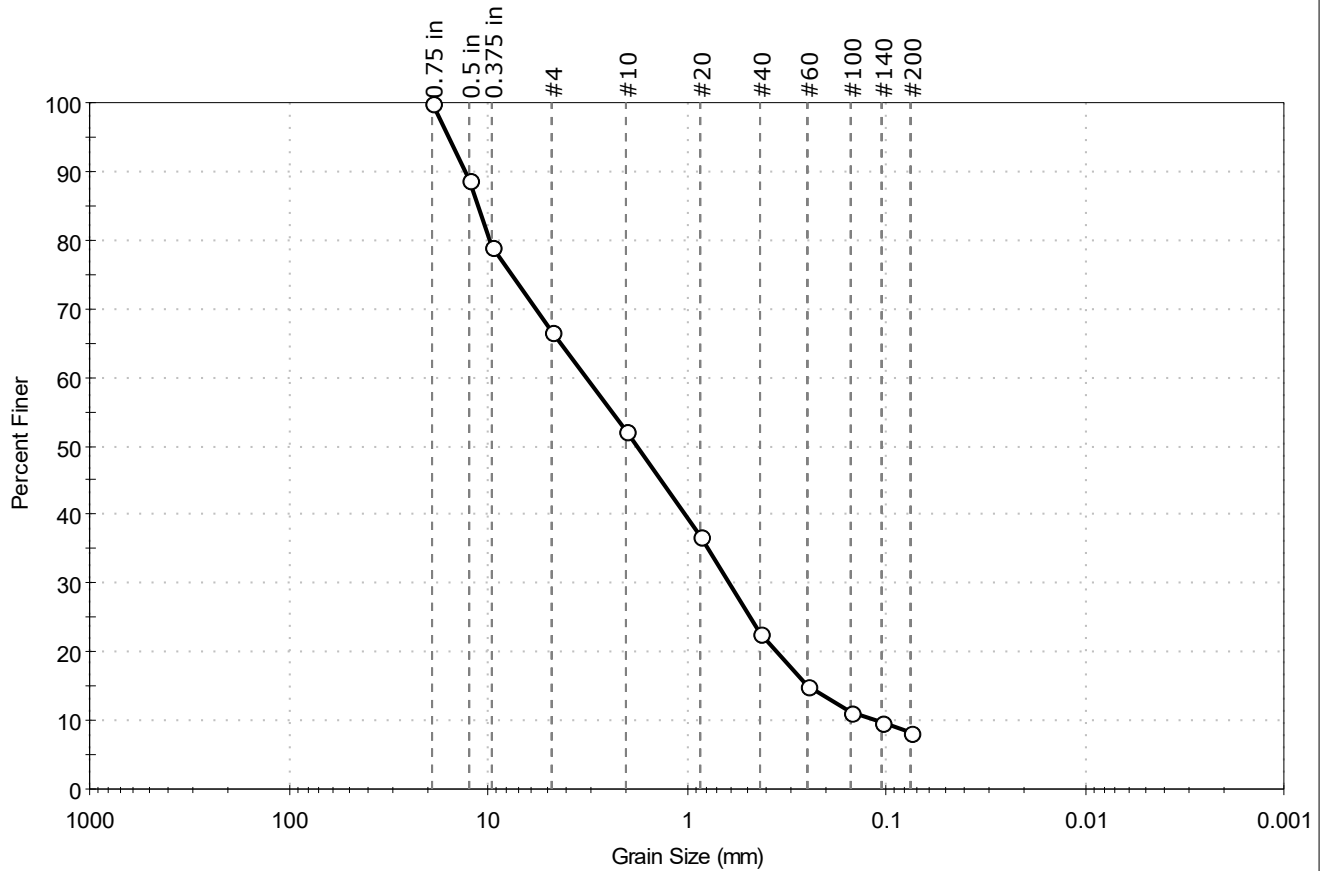
| Depth<br>(ft) | Sample<br>No. | Sample<br>Depth<br>(ft) | Rec/<br>Pen | Blows/<br>6"           | Sample Description                                                            | Strata<br>Change | USCS<br>Class. | Remarks |
|---------------|---------------|-------------------------|-------------|------------------------|-------------------------------------------------------------------------------|------------------|----------------|---------|
| 17            |               |                         |             | 80/5"<br><u>min/ft</u> | ': Moist, V. Dense, Gray-brown, f-c SAND<br>Gravel, some Silt.                | RESIDUAL<br>SOIL | SM             | 4<br>5  |
| 18            | C-1           | 18-23                   | 47/60       | 2.5 min                | Hard, light grey, medium grained,<br>slightly to moderately weathered, GNEISS | BEDROCK          | ROCK           |         |
| 19            |               |                         |             | 1 min                  | RQD = 25/47 = 53%                                                             |                  |                |         |
| 20            |               |                         |             | 3.5 min                |                                                                               |                  |                |         |
| 21            |               |                         |             | 4 min                  |                                                                               |                  |                |         |
| 22            |               |                         |             | 3 min                  |                                                                               |                  |                | 6       |
| 23            |               |                         |             |                        | Bottom of boring at 23'                                                       |                  |                |         |
| 24            |               |                         |             |                        |                                                                               |                  |                |         |
| 25            |               |                         |             |                        |                                                                               |                  |                |         |
| 26            |               |                         |             |                        |                                                                               |                  |                |         |
| 27            |               |                         |             |                        |                                                                               |                  |                |         |
| 28            |               |                         |             |                        |                                                                               |                  |                |         |
| 29            |               |                         |             |                        |                                                                               |                  |                |         |
| 30            |               |                         |             |                        |                                                                               |                  |                |         |
| 31            |               |                         |             |                        |                                                                               |                  |                |         |
| 32            |               |                         |             |                        |                                                                               |                  |                |         |
| 33            |               |                         |             |                        |                                                                               |                  |                |         |

|                                                                                                                                           |                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MINOR CONSTITUENT PROPORTIONS:</b><br><b>Trace      0 to 10%      Some 20 to 35%</b><br><b>Little     10 to 20%      And 35 to 50%</b> | <b>REMARKS:</b><br>4. Split spoon refusal, changing stratum @17' BGS<br>5. Bedrock @ 17.5' BGS, NX core barrel<br>6. Borehole grouted at pavement surface |
|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                 |                        |                 |
|-----------------------------------------------------------------|------------------------|-----------------|
| Client: Inter-Fluve                                             | Project No: GTX-321918 |                 |
| Project: Avery Road                                             |                        |                 |
| Location: Garrison, NY                                          |                        |                 |
| Boring ID: B1                                                   | Sample Type: Bag       | Tested By: ajl  |
| Sample ID: S6 (Top)                                             | Test Date: 10/06/25    | Checked By: ank |
| Depth: 15-17'                                                   | Test Id: 837109        |                 |
| Test Comment: ---                                               |                        |                 |
| Visual Description: Moist, dark brown sand with silt and gravel |                        |                 |
| Sample Comment: ---                                             |                        |                 |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 33.2     | 58.4   | 8.4                |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 0.75 in    | 19.00          | 100           |               |          |
| 0.5 in     | 12.50          | 89            |               |          |
| 0.375 in   | 9.50           | 79            |               |          |
| #4         | 4.75           | 67            |               |          |
| #10        | 2.00           | 52            |               |          |
| #20        | 0.85           | 37            |               |          |
| #40        | 0.42           | 23            |               |          |
| #60        | 0.25           | 15            |               |          |
| #100       | 0.15           | 11            |               |          |
| #140       | 0.11           | 10            |               |          |
| #200       | 0.075          | 8.4           |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

$D_{85} = 11.2341 \text{ mm}$        $D_{30} = 0.6061 \text{ mm}$   
 $D_{60} = 3.1687 \text{ mm}$        $D_{15} = 0.2464 \text{ mm}$   
 $D_{50} = 1.7620 \text{ mm}$        $D_{10} = 0.1148 \text{ mm}$   
 $C_u = 27.602$        $C_c = 1.010$

### Classification

ASTM N/A

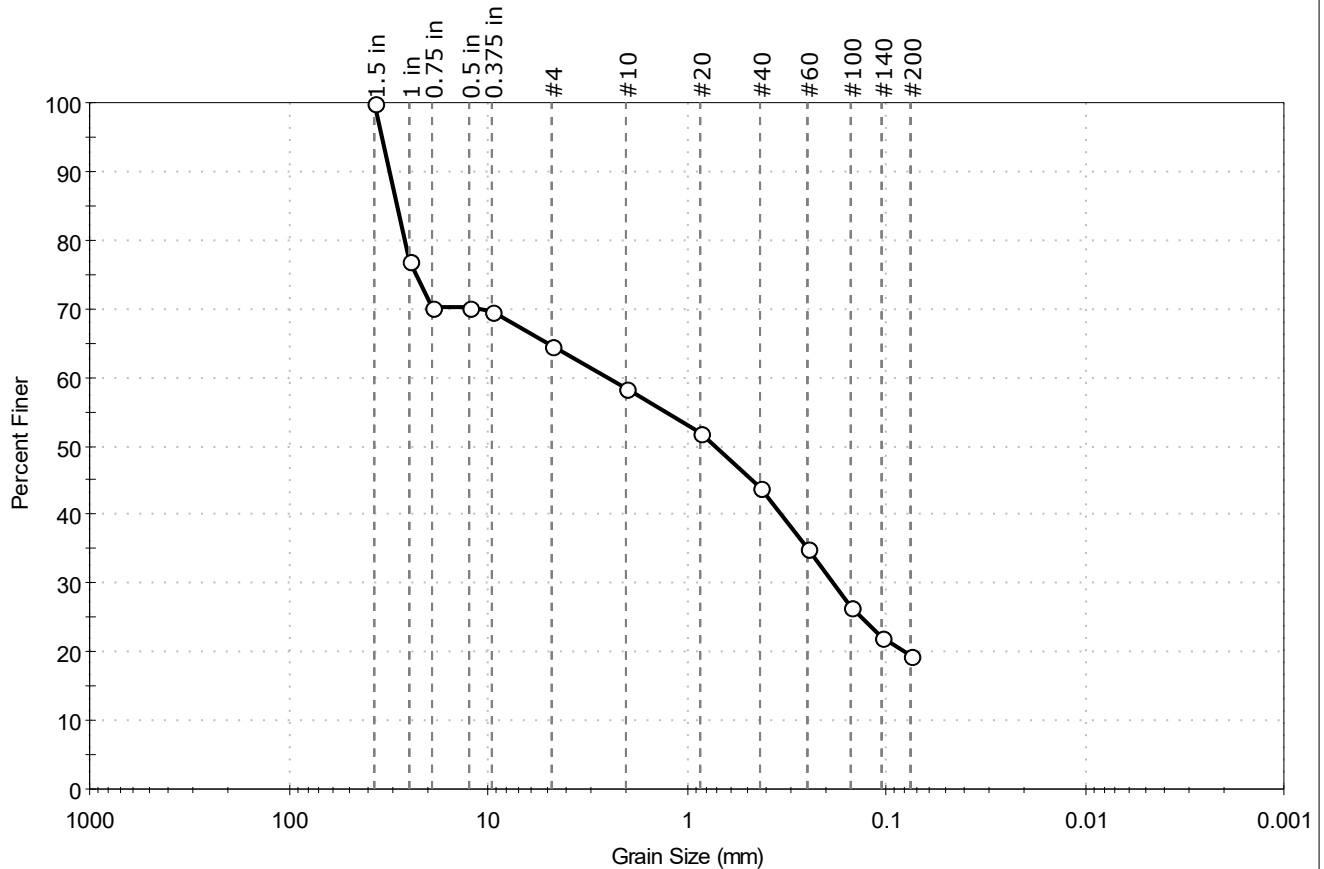
AASHTO Stone Fragments, Gravel and Sand (A-1-b (1))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

|                                                                        |                        |
|------------------------------------------------------------------------|------------------------|
| Client: Inter-Fluve                                                    | Project No: GTX-321918 |
| Project: Avery Road                                                    |                        |
| Location: Garrison, NY                                                 |                        |
| Boring ID: B2                                                          | Sample Type: Bag       |
| Sample ID: S2                                                          | Test Date: 10/06/25    |
| Depth: 2-4'                                                            | Test Id: 837108        |
| Test Comment: ---                                                      | Tested By: ajl         |
| Visual Description: Moist, dark yellowish brown silty sand with gravel | Checked By: ank        |
| Sample Comment: ---                                                    |                        |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 35.5     | 45.1   | 19.4               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 1.5 in     | 37.50          | 100           |               |          |
| 1 in       | 25.00          | 77            |               |          |
| 0.75 in    | 19.00          | 70            |               |          |
| 0.5 in     | 12.50          | 70            |               |          |
| 0.375 in   | 9.50           | 70            |               |          |
| #4         | 4.75           | 64            |               |          |
| #10        | 2.00           | 58            |               |          |
| #20        | 0.85           | 52            |               |          |
| #40        | 0.42           | 44            |               |          |
| #60        | 0.25           | 35            |               |          |
| #100       | 0.15           | 26            |               |          |
| #140       | 0.11           | 22            |               |          |
| #200       | 0.075          | 19            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

$D_{85} = 28.7792 \text{ mm}$        $D_{30} = 0.1849 \text{ mm}$   
 $D_{60} = 2.5003 \text{ mm}$        $D_{15} = \text{N/A}$   
 $D_{50} = 0.7232 \text{ mm}$        $D_{10} = \text{N/A}$   
 $C_u = \text{N/A}$        $C_c = \text{N/A}$

### Classification

ASTM N/A

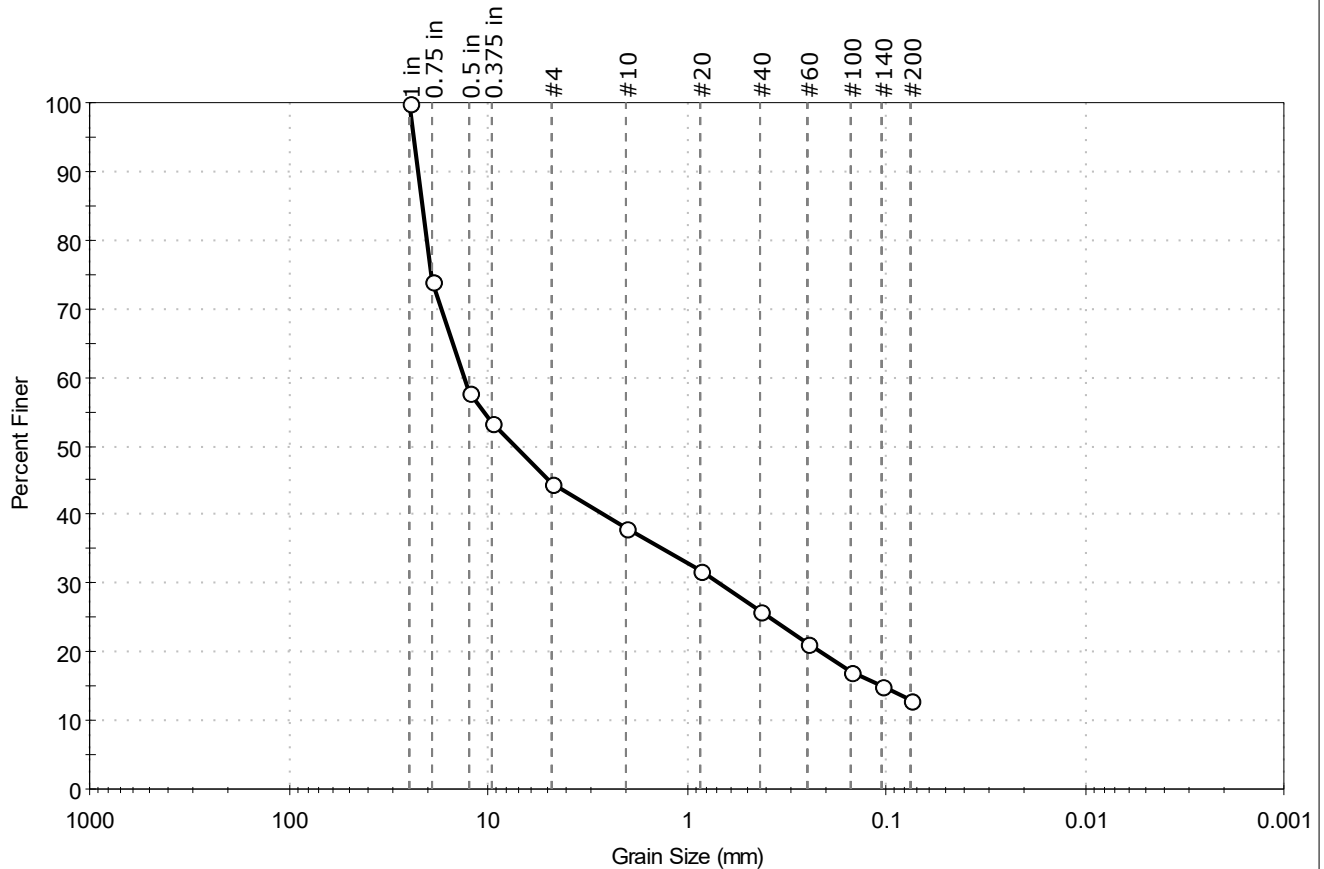
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

|                                                                        |                        |                 |
|------------------------------------------------------------------------|------------------------|-----------------|
| Client: Inter-Fluve                                                    | Project No: GTX-321918 |                 |
| Project: Avery Road                                                    |                        |                 |
| Location: Garrison, NY                                                 |                        |                 |
| Boring ID: B2                                                          | Sample Type: Bag       | Tested By: ajl  |
| Sample ID: S6                                                          | Test Date: 10/06/25    | Checked By: ank |
| Depth: 16-17'5"                                                        | Test Id: 837110        |                 |
| Test Comment: ---                                                      |                        |                 |
| Visual Description: Moist, dark yellowish brown silty gravel with sand |                        |                 |
| Sample Comment: ---                                                    |                        |                 |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 55.5     | 31.5   | 13.0               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 1 in       | 25.00          | 100           |               |          |
| 0.75 in    | 19.00          | 74            |               |          |
| 0.5 in     | 12.50          | 58            |               |          |
| 0.375 in   | 9.50           | 53            |               |          |
| #4         | 4.75           | 45            |               |          |
| #10        | 2.00           | 38            |               |          |
| #20        | 0.85           | 32            |               |          |
| #40        | 0.42           | 26            |               |          |
| #60        | 0.25           | 21            |               |          |
| #100       | 0.15           | 17            |               |          |
| #140       | 0.11           | 15            |               |          |
| #200       | 0.075          | 13            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

$D_{85} = 21.3504 \text{ mm}$        $D_{30} = 0.6882 \text{ mm}$   
 $D_{60} = 13.2453 \text{ mm}$        $D_{15} = 0.1076 \text{ mm}$   
 $D_{50} = 7.2764 \text{ mm}$        $D_{10} = \text{N/A}$   
 $C_u = \text{N/A}$        $C_c = \text{N/A}$

### Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

## Appendix D Hydraulic Data Tables

100yr

100 yr cross sectional data freom HECRAS (US to DS)

| Reach   | River Sta | Profile | Q Total<br>(cfs) | Min Ch El<br>(ft) | W.S. Elev<br>(ft) | Vel Chnl<br>(ft/s) | Flow Area<br>(sq ft) | Top Width<br>(ft) | Froude # | C Shear<br>(lb/sq ft) | Char Hydr<br>(ft) | Depth<br>(ft) | E.G. Slope<br>(ft/ft) |
|---------|-----------|---------|------------------|-------------------|-------------------|--------------------|----------------------|-------------------|----------|-----------------------|-------------------|---------------|-----------------------|
| Reach 1 | 2104      | 100yr   | 1155             | 232.66            | 240.97            | 4.26               | 335.04               | 103.67            | 0.3      | 0.31                  |                   | 3.23          | 0.000878              |
| Reach 1 | 2081      | 100yr   | 1155             | 231.22            | 241.02            | 3.47               | 424.76               | 116.06            | 0.23     | 0.2                   |                   | 3.66          | 0.000525              |
| Reach 1 | 2064      |         | Culvert          |                   |                   |                    |                      |                   |          |                       |                   |               |                       |
| Reach 1 | 2047      | 100yr   | 1155             | 232.35            | 237.37            | 8.95               | 134.17               | 64.97             | 0.92     | 1.76                  |                   | 2.07          | 0.010281              |
| Reach 1 | 2017      | 100yr   | 1155             | 231.97            | 236.1             | 9.45               | 129.84               | 55.88             | 0.97     | 1.93                  |                   | 2.32          | 0.01063               |
| Reach 1 | 1950      | 100yr   | 1155             | 230.5             | 234.19            | 10.82              | 145.41               | 113.92            | 1.11     | 2.59                  |                   | 1.28          | 0.015469              |
| Reach 1 | 1906      | 100yr   | 1155             | 229               | 232.49            | 7.93               | 157.14               | 86.75             | 0.94     | 1.5                   |                   | 1.81          | 0.011274              |
| Reach 1 | 1821      | 100yr   | 1155             | 229.21            | 231.67            | 1.78               | 498.03               | 211.18            | 0.24     | 0.08                  |                   | 2.36          | 0.000818              |
| Reach 1 | 1736      | 100yr   | 1155             | 228               | 231.21            | 5                  | 230.93               | 86.43             | 0.54     | 0.57                  |                   | 2.67          | 0.003577              |
| Reach 1 | 1719      | 100yr   | 1155             | 226.26            | 231.36            | 3.07               | 375.8                | 93.85             | 0.27     | 0.19                  |                   | 4             | 0.000804              |
| Reach 1 | 1697      |         | Inl Struct       |                   |                   |                    |                      |                   |          |                       |                   |               |                       |
| Reach 1 | 1688      | 100yr   | 1155             | 219.31            | 222.76            | 9.95               | 116.12               | 37.82             | 1        | 2.15                  |                   | 3.07          | 0.012176              |
| Reach 1 | 1609      | 100yr   | 1155             | 216.22            | 222.96            | 5.68               | 270.83               | 258.34            | 0.42     | 0.62                  |                   | 2.11          | 0.002461              |
| Reach 1 | 1600      | 100yr   | 1155             | 218.45            | 222.96            | 5.48               | 276.84               | 285.8             | 0.47     | 0.61                  |                   | 2.14          | 0.0028                |
| Reach 1 | 1593      | 100yr   | 1155             | 215.14            | 223.03            | 4.48               | 356.71               | 333.84            | 0.3      | 0.36                  |                   | 2.68          | 0.001187              |
| Reach 1 | 1587      | 100yr   | 1155             | 214.9             | 222.73            | 6.67               | 271.95               | 334.53            | 0.47     | 0.85                  |                   | 0.85          | 0.003268              |
| Reach 1 | 1578.5    |         | Culvert          |                   |                   |                    |                      |                   |          |                       |                   |               |                       |
| Reach 1 | 1570      | 100yr   | 1155             | 213.16            | 219.53            | 13.91              | 83.01                | 158.76            | 1        | 3.42                  |                   | 6.02          | 0.010365              |
| Reach 1 | 1536      | 100yr   | 1155             | 213.39            | 219.96            | 7.12               | 235.45               | 311.7             | 0.53     | 0.98                  |                   | 2.02          | 0.003924              |
| Reach 1 | 1502      | 100yr   | 1155             | 213.83            | 218.68            | 11.25              | 137.26               | 339.53            | 0.96     | 2.72                  |                   | 1.74          | 0.014937              |
| Reach 1 | 1445      | 100yr   | 1155             | 213.46            | 217.41            | 9.82               | 143.05               | 324.28            | 1.07     | 2.25                  |                   | 1.67          | 0.015576              |
| Reach 1 | 1432      | 100yr   | 1155             | 215.1             | 217.57            | 6.32               | 315.72               | 407.61            | 0.71     | 0.97                  |                   | 0.77          | 0.007708              |
| Reach 1 | 1413      | 100yr   | 1155             | 208.39            | 216.67            | 7.91               | 221.35               | 320.7             | 0.52     | 1.18                  |                   | 0.69          | 0.0044                |
| Reach 1 | 1389      | 100yr   | 1155             | 209.12            | 216.85            | 7.11               | 333.25               | 390.16            | 0.53     | 0.97                  |                   | 1.05          | 0.003837              |
| Reach 1 | 1378.5    |         | Culvert          |                   |                   |                    |                      |                   |          |                       |                   |               |                       |
| Reach 1 | 1368      | 100yr   | 1155             | 208.13            | 215.2             | 11.6               | 132.68               | 66.7              | 0.84     | 2.46                  |                   | 2.13          | 0.008309              |
| Reach 1 | 1297      | 100yr   | 1155             | 208.34            | 214.65            | 3.25               | 646.33               | 429.87            | 0.24     | 0.2                   |                   | 1.5           | 0.000804              |
| Reach 1 | 1275      | 100yr   | 1155             | 207.52            | 214.66            | 2.18               | 794.99               | 440.57            | 0.15     | 0.09                  |                   | 2.39          | 0.000302              |
| Reach 1 | 1248      | 100yr   | 1155             | 207.52            | 214.67            | 1.49               | 1229.35              | 479.97            | 0.11     | 0.04                  |                   | 2.56          | 0.000115              |
| Reach 1 | 1232      |         | Culvert          |                   |                   |                    |                      |                   |          |                       |                   |               |                       |
| Reach 1 | 1208      | 100yr   | 1155             | 206.72            | 213.81            | 8.62               | 309.24               | 195.57            | 0.61     | 1.33                  |                   | 1.58          | 0.004232              |
| Reach 1 | 1193      | 100yr   | 1155             | 206.17            | 212.11            | 9.16               | 239.19               | 190               | 0.87     | 1.81                  |                   | 1.63          | 0.009917              |
| Reach 1 | 1172      | 100yr   | 1155             | 206.31            | 210.85            | 7.93               | 351.84               | 429.64            | 0.69     | 1.32                  |                   | 1.31          | 0.006708              |
| Reach 1 | 1164      | 100yr   | 1155             | 206.36            | 210.8             | 4.04               | 520.18               | 409.92            | 0.36     | 0.35                  |                   | 1.97          | 0.001779              |
| Reach 1 | 1157      | 100yr   | 1155             | 205.21            | 210.15            | 8.93               | 310.57               | 186.98            | 0.79     | 1.65                  |                   | 1.66          | 0.008098              |
| Reach 1 | 1122      | 100yr   | 1155             | 205.1             | 209.66            | 1.34               | 1561.31              | 608.44            | 0.13     | 0.04                  |                   | 3.26          | 0.000216              |

AVERY ROAD CULVERT

|         |            |         |        |        |       |         |        |      |      |      |          |
|---------|------------|---------|--------|--------|-------|---------|--------|------|------|------|----------|
| Reach 1 | 1078 100yr | 1155    | 205.14 | 209.65 | 1.1   | 1943.55 | 613.48 | 0.1  | 0.02 | 3.17 | 0.000116 |
| Reach 1 | 1053 100yr | 1155    | 199.53 | 206.63 | 13.3  | 86.86   | 15.77  | 1    | 3.55 | 5.51 | 0.01585  |
| Reach 1 | 959 100yr  | 1155    | 199.31 | 206.11 | 5.92  | 558.18  | 442.46 | 0.47 | 0.67 | 1.26 | 0.002514 |
| Reach 1 | 928 100yr  | 1155    | 199.24 | 205.36 | 8.34  | 169.51  | 219.37 | 0.82 | 1.51 | 1.91 | 0.008569 |
| Reach 1 | 894 100yr  | 1155    | 199.3  | 204.07 | 7.41  | 274.76  | 478.83 | 0.76 | 1.2  | 1.28 | 0.006827 |
| Reach 1 | 871 100yr  | 1155    | 198.62 | 203.47 | 7.82  | 233.33  | 407.95 | 0.8  | 1.33 | 1.45 | 0.007543 |
| Reach 1 | 776 100yr  | 1155    | 196.55 | 202.22 | 6.74  | 403.5   | 659.49 | 0.58 | 0.92 | 1    | 0.004241 |
| Reach 1 | 693 100yr  | 1155    | 193.8  | 198.78 | 10.77 | 126.53  | 243.82 | 0.94 | 2.33 | 2.53 | 0.010409 |
| Reach 1 | 634 100yr  | 1155    | 192.54 | 197.31 | 8.64  | 182.5   | 215.81 | 0.87 | 1.61 | 1.79 | 0.008935 |
| Reach 1 | 596 100yr  | 1155    | 192.21 | 197.88 | 3.29  | 788.12  | 322.13 | 0.26 | 0.21 | 3.1  | 0.000832 |
| Reach 1 | 586        | Culvert |        |        |       |         |        |      |      |      |          |
| Reach 1 | 577 100yr  | 1155    | 192.7  | 197.87 | 1.82  | 1238.04 | 824.84 | 0.17 | 0.07 | 1.5  | 0.000386 |
| Reach 1 | 527 100yr  | 1155    | 187.85 | 192.6  | 9.93  | 116.26  | 37.93  | 1    | 2.14 | 3.07 | 0.012047 |
| Reach 1 | 469 100yr  | 1155    | 186.64 | 190.91 | 9.36  | 123.42  | 45.32  | 1    | 1.95 | 2.72 | 0.011845 |
| Reach 1 | 384 100yr  | 1155    | 184.53 | 190.26 | 6.16  | 413.45  | 350.34 | 0.56 | 0.77 | 1.33 | 0.003514 |
| Reach 1 | 273 100yr  | 1155    | 182.22 | 187.42 | 12.83 | 102.85  | 55.18  | 1.04 | 3.04 | 2.47 | 0.010481 |
| Reach 1 | 260        | Culvert |        |        |       |         |        |      |      |      |          |
| Reach 1 | 220 100yr  | 1155    | 182.86 | 187.93 | 8.81  | 262.09  | 178.06 | 0.72 | 1.46 | 1.65 | 0.005358 |
| Reach 1 | 165 100yr  | 1155    | 181.69 | 185.59 | 10.12 | 190.55  | 265.27 | 1.13 | 2.34 | 0.94 | 0.015189 |
| Reach 1 | 117 100yr  | 1155    | 181.58 | 185.22 | 7.88  | 322     | 241.18 | 0.84 | 1.38 | 1.34 | 0.008234 |
| Reach 1 | 44 100yr   | 1155    | 180.29 | 184.06 | 8.18  | 276.81  | 189.19 | 0.92 | 1.54 | 1.46 | 0.010251 |