Tighe&Bond

Turney Creek Outfall Replacement Study

DRAFT FOR REVIEW

Fairfield, Connecticut

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Town of Fairfield Conservation Department

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Section 1
Introduction

1.1 Project Background

The Turney Creek Outfall Structure is located along Riverside Drive, adjacent to the Riverside Drive Bridge in Fairfield, CT. It is a critical component of the Town of Fairfield's (the Town's) infrastructure and it is in a deteriorated state. Based on this, the Town retained Tighe & Bond and RT Group, Inc. (RTG) to complete a study of the outfall structure and evaluate potential replacement alternatives. The Scope-of-Services included completing an initial data review; a topographic survey; a geotechnical investigation; preliminary hydrologic, hydraulic, geotechnical, and structural analyses; and preparing this Study Phase Report.

The Turney Creek culverts and the Riverside Drive bridge are critical components of Fairfield's coastal barrier system. These structures protect the Riverside Drive neighborhood from coastal flooding during high tides and coastal storm events, while also functioning as the main outlet for a large inland watershed on the order of 2.4 Square Miles (roughly 1,500 Acres). The proper design and construction of a new culvert and tide gate structure at Turney Creek is crucial to protecting the Riverside Drive neighborhood from both coastal and inland flood events.

Tighe & Bond performed an assessment of all the Town of Fairfield Conservation Department's tide gates and bulkhead structures in 2016 to determine their structural condition and provide recommendations for repairs or replacement. During this assessment, the Turney Creek headwall and tide gate structure was identified as the highest priority for replacement due to its deteriorated condition and the vital function it performs protecting the Riverside Drive area.

Turney Creek (known as Grasmere Brook on the FEMA Flood Insurance Rate Map and Flood Insurance Study) connects to Ash Creek at the Riverside Drive bridge. The original concrete bridge remains, but has been modified at least twice to incorporate culverts and tide gates. The flow passing under the bridge span passes through three 84" diameter culverts (circa 1973) on the northeastern side of the bridge. These culverts have top hinged plywood tide gates at the northeastern ends allowing only ebb tide flows. When viewed at about mid tide when flow would be expected to be highest, these flap gates were only partially open, suggesting the large diameter culverts may be oversized.

Two 48" corrugated metal culverts with self-regulating tide gates were installed by the Town in subsequent projects in an effort to improve the tidal exchange and water quality in the upstream salt marsh. During our condition assessment in 2016, however, we noted that one of the self-regulating tide gates has been removed and replaced with a timber flap gate, which does not allow for tidal exchange. The Ash Creek Estuary Master Plan emphasizes the importance of removing restrictions on tidal flow to increase salinity levels in the upstream marsh and discourage the establishment of invasive species such as Phragmites.

Turney Creek consists of an open water channel and salt marsh from the Riverside Drive bridge to approximately 3,000 feet upstream. Beyond this point, the creek primarily travels underground, extending as far north as the Fairfield Woods neighborhood between Routes 58 and 59 and draining portions of the Grasmere Brook watershed. The location of the existing Riverside Drive bridge and culverts is shown in **Figure A**.

Following a preliminary assessment of outfall structure options, the Town of Fairfield determined that it may be advantageous to replace the entire Riverside Drive bridge in conjunction with the Turney Creek Outfall Replacement project. Replacing the bridge as part of the same project will allow the Town to address several issues within one project – the deteriorating timber bulkhead, replacement or relining of the undersized twin sanitary sewer siphons below the bridge, and the deterioration of the concrete bridge itself. As such, the options developed under the study phase focused on culvert and structure options that would allow for the replacement of the entire Riverside Drive bridge structure.

Section 2
Hydrologic Analysis

2.1 Contributing Drainage Area

Tighe & Bond delineated the approximate drainage area that contributes to the Turney Creek Outfall utilizing the United States Geological Survey (USGS) Stream Stats program. The approximate drainage area is shown in **Appendix A**. The contributing drainage area is 2.38 Square Miles (1,523 Acres). Turney Creek (also known as Grasmere Brook) consists of an open water channel and salt marsh from the Riverside Drive bridge to approximately 3,000 feet upstream. Beyond this point, the creek primarily travels underground, extending as far north as the Fairfield Woods neighborhood between Routes 58 and 59 and draining portions of the Grasmere Brook watershed.

2.2 Precipitation Data

Rainfall data was obtained from NOAA Atlas 14 Point Precipitation Frequency Estimates: CT per the Connecticut Department of Transportation (CTDOT) Drainage Manual Engineering Bulletin EB-2015-2. The 100-Year, 24-Hour rainfall of 8.34 inches was utilized for the hydrologic analysis. See **Appendix A** for the rainfall data for Fairfield from NOAA Atlas 14.

2.3 Peak Flow

The USGS Stream Stats program generates peak flow estimates based on drainage area, main channel slope, precipitation and soil characteristics. This program, however, does not accurately model the effect of impervious cover in urbanized areas on peak flow. The USGS developed regression equations in their publication entitled “Flood Characteristics of Urban Watersheds in the United States” to estimate flood discharges for ungaged urban sites. The USGS urban regression equations utilize a factor called the Basin Development Factor to provide a measure of the efficiency of the drainage systems within an urbanized watershed and estimate the peak flow from the watershed.

Tighe & Bond completed the USGS Regional Regression Equations Worksheet for the Turney Creek drainage area and calculated a 100-Year, peak flow rate of 1,090 cubic feet per second (CFS). The regression equations worksheet is included in **Appendix A**.

Turney Creek (known as Grasmere Brook on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map) is a studied stream in the Fairfield County Flood Insurance Study (FIS). Volume 1 of the FIS lists the peak discharge for Grasmere Brook downstream of Old Field Road as 1,100 CFS in the 100-Year storm (1% annual chance). As such, the FIS peak discharge data appears to confirm the peak discharge calculated utilizing the USGS regression equations. The calculated 100-Year peak discharge of 1,090 CFS was utilized to determine the required culvert sizes for the proposed Turney Creek Outfall Replacement.

Section 3
Hydraulic Analysis

3.1 Culvert Hydraulics

The outlet of the culverts at Turney Creek are tidally influenced. Based on info from NOAA Tide Station 8467150 in Bridgeport, CT, Mean High Water (MHW) in Fairfield occurs at El. 3.2 NAVD 88, and Mean Low Water occurs at El. -3.6 NAVD 88. The Coastal Jurisdiction Line (CJL) established by the Connecticut Department of Energy and Environmental Protection (CTDEEP) for Fairfield is at El. 5.20 NAVD 88. In order to model a "worse case" scenario, the culvert tailwater elevation was set at MHW, El. 3.2 NAVD 88, for the hydraulic analysis. The 100-Year peak discharge of 1,090 CFS was then routed through the culverts using this tailwater elevation.

Tighe & Bond created a hydraulic model of the existing culverts utilizing the Federal Highway Administration's (FHWA) HY-8 culvert modeling software, Version 7.50. The HY-8 software is based on the FHWA publications Hydraulic Design Series 5: Hydraulic Design of Highway Culverts (HDS-5) and Hydraulic Engineering Circular 14: Hydraulic Design of Energy Dissipaters for Culverts and Channels.

The existing culverts consist of three (3) 84" diameter corrugated aluminum culverts and two (2) 48" diameter corrugated aluminum culverts. Although the existing tide gate on one of the 48" culverts has been chained shut and is not operating, all existing culverts were assumed to be operational for the existing conditions analysis. The 100-Year peak discharge was applied to these culverts to determine the maximum water surface in the upstream salt marsh during a high tide tailwater condition. The analysis showed that the maximum water surface elevation in the upstream salt marsh under existing conditions is El. 6.11 NAVD 88. See **Appendix B** for the existing conditions HY-8 analysis.

Tighe & Bond then modeled several proposed culvert sizes and configurations to determine the resulting peak water surface elevation. The goal of the proposed culvert sizing was to minimize the required culvert footprint while not exacerbating any upstream flooding conditions. The culvert configurations analyzed included a mix of larger diameter culverts for peak flow conveyance as well as smaller diameter culverts that will be fitted with self-regulating tide gates to allow for tidal flushing. See Section 3.2 for detailed information on tidal hydraulics.

The minimum design criteria used for the proposed culverts was that the maximum water surface elevation in the upstream salt marsh in the 100-Year storm event would not exceed the existing water surface elevation in the 100-Year storm event. In all of the proposed culvert configurations, we have assumed that at least one smaller diameter (60" or smaller) culvert will remain for use with a self-regulating tide gate, which is discussed later in this report. A summary of the culvert sizes analyzed, with resulting water surface elevation, is shown in **Table 1** below. All calculations assume that standard (non self-regulating) tide gates will be installed on the proposed large diameter culverts.

Table 1
Culvert Options – Tailwater at MHW (El. 3.2 NAVD88)

Description	Culvert 1	Culvert 2	Culvert 3	Culvert 4	Culvert 5	Peak WS Elev. (NAVD 88)
Existing	84" Round	84" Round	84" Round	48" Round	48" Round	6.11
Proposed Option 1	72" Round	72" Round	72" Round	60" Round		6.24
Proposed Option 2	84" Round	84" Round	84" Round	60" Round		5.46
Proposed Option 3	72" Round	72" Round	72" Round	48" Round	48" Round	5.89
Proposed Option 4	84" Round	84" Round	84" Round	48" Round	48" Round	5.27

Proposed Culvert Option 1 was discarded as a potential option as it results in an increased flood elevation in the upstream salt marsh. Culvert Options 2-4 were further analyzed to determine their ability to convey the required tidal prism as detailed in Section 3.2.

Detailed hydraulic calculations for the proposed culvert options are included in **Appendix C**.

3.2 Tidal Prism Hydraulics

The tidal prism is the amount of water that flows into and out of an estuary or bay with the flood and ebb of the tide, excluding contributions from freshwater inflows. The existing Turney Creek culverts originally had two self-regulating tide gates (SRT's) on the 48" culverts to allow for the exchange of the tidal prism. One SRT was subsequently removed due to a failure of the gate. The proper sizing of culverts and SRT's to allow for the exchange of the tidal prism is important to managing the ecology of the upstream salt marsh. The SRT's and culverts will facilitate upstream tidal flushing and enhance wetland functions and values. Re-establishment of proper tidal flushing will lead to a reduction in invasive species such as common reed (Phragmites Australis).

Tighe & Bond utilized LiDAR contour data for the upstream salt marsh to determine the volume of tidal exchange during a tide cycle and estimate the current high tide elevation in the marsh. Based on a review of the LiDAR data overlain on an aerial image, the marsh limits appear to roughly follow the elevation of MHW, El. 3.2 NAVD88.

We then performed stage-storage calculations, based on the contour areas, to calculate the volume of water in the marsh when filled to roughly El. 3.2 (the 3.0 contour was utilized as only one foot contours are available). The salt marsh upstream of the Turney Creek culverts stores approximately 1,294,366 cubic feet of water when filled to El. 3.0 at MHW.

The high and low tides in Fairfield follow a roughly 6-hour, sinusoidal pattern. The majority of flow occurs during the 3-hour period that constitutes mid-tide. In order to simplify the sinusoidal tidal curve, we assumed that the full tidal prism would flow through the proposed culverts during the 3-hour, mid-tide period. We calculated the culvert capacity required to convey the full tidal prism within 3 hours to be approximately 120 cubic feet per second (CFS). A 48" HDPE pipe at 0.5% slope can convey approximately 102 CFS, while a 60" HDPE pipe at 0.5% slope can convey approximately 184 CFS. Thus two 48" culverts or one 60" culvert would be required to convey the full tidal prism.

While significant fish passage is not anticipated in these culverts due to their perched configuration at low tide, flows in excess of 6 feet per second make fish passage very difficult. The option of one 60" culvert with an SRT produced flows in excess of 6 fps and was eliminated from consideration. Two 48" culverts with SRT's limit peak velocities to less

than 5 fps. This configuration was selected as the preferred culvert configuration for tidal prism conveyance.

See Table 2 below for a summary of estimated tidal flows and velocities with various culvert configurations.

Table 2
Culvert Options – Tidal Prism Conveyance

Elevation (NAVD 88)	Area (SF)	Incremental Volume (CF)	Cumulative Volume (CF)	Required Culvert Capacity for 3-Hour* Tidal Prism (CFS)	Velocity (FPS) (2 - 48" Culverts)	Velocity (FPS) (1 - 60" Culvert)	Velocity (FPS) (2 - 60" Culverts)
-2.0	10,988	5,494	10,988	1.0	0.04	0.05	0.03
-1.0	13,384	12,186	23,174	2.1	0.09	0.11	0.05
0.0	224,151	118,768	141,942	13.1	0.52	0.67	0.33
1.0	299,411	261,781	403,723	37.4	1.49	1.90	0.95
2.0	437,510	368,461	772,183	71.5	2.85	3.64	1.82
3.0	**606,856**	**522,183**	**1,294,366**	**119.8**	**4.77**	**6.11**	**3.05**
4.0	753,845	680,351	1,974,717	182.8	7.28	9.32	4.66
5.0	820,472	787,159	2,761,875	255.7	10.18	13.03	6.52
6.0	899,083	859,778	3,621,653	335.3	13.35	17.09	8.54
7.0	998,993	949,038	4,570,691	423.2	16.85	21.56	10.78
* Simplification of 6-Hour sinusoidal tidal prism - assumes majority of flow occurs during 3-Hour mid-tide							

3.3 Culvert Selection

During the design of previous projects with the Town of Fairfield, the Town staff advised that aluminum coated culverts have demonstrated a limited life span in other locations in Town, typically less than 12 years. Due to its high resistance to corrosion from saltwater, a HDPE culvert would be a suitable choice for this application.

Culvert Option 3, which includes three 72” culverts with standard tide gates and two 48” culverts with SRT’s, appears to provide the optimal combination of peak flow conveyance and tidal prism conveyance while minimizing the required footprint. Culvert Option 3 was advanced as the preferred culvert configuration when developing the structural options described further in **Section 5.**

3.4 Self-Regulating Tide Gates

There are multiple types of SRTs and a variety of different manufacturers. In terms of operations, SRTs fall into two main categories: top hinged SRTs, which operate on a float system to close at a pre-determined water surface elevation, and side hinged SRTs which

operate based on draft forces and some form of tension mechanism that can be fine tuned to close the SRT at a specified elevation.

For this application, we would recommend a top hinged SRT such as those manufactured by Waterman Industries or a mitigator fish passage type SRT as manufactured by Nehalem Marine. Information on both of these products is included in **Appendix C**. Top hinged SRT's have been successfully employed in other locations in Fairfield and are the most widely utilized type of SRT. Top hinged SRT's typically require the least maintenance and are not reliant on the intricate lever mechanisms typically involved in side hinged SRT's. When utilized with an HDPE culvert, an endwall is required for proper support and attachment of the SRT.

Selection of the proper water surface "trip" elevation is an important consideration with SRT's. This trip elevation is the elevation of the water surface in the marsh above which the SRT will close and prevent further inundation. Setting the trip elevation too low will result in insufficient tidal flushing that will not accomplish the reclamation goals of an SRT. Setting the trip elevation too high can cause flooding of adjacent properties and damage to lawns and landscaping as these plants absorb the saltwater. Extreme care must be taken to make sure the trip elevation is not set too high, particularly in light of the extreme flooding experienced during Hurricane Sandy. A higher typical water surface elevation in the marsh areas will reduce the storage volume of these areas in an extreme rainfall or storm surge event.

Other SRT's installed in similar salt marsh areas of Fairfield, such as the McLevy SRT south of the study area and the Oyster Road/Ash Creek SRT to the northeast, allow water surface elevations of approximately El. 1.0 NAVD88. Further investigation will be required to determine the proper water surface "trip" elevation for an SRT at the Turney Creek culvert location. A review of the LiDAR information indicates that the existing water surface elevation is likely approximately El. 3.0 NAVD88, based on the extent of the marsh area. More detailed survey of the marsh area will be required to determine the extent of the inundation during a standard tide event.

Section 4
Geotechnical Analysis

4.1 Subsurface Investigation

RTG completed a subsurface investigation in order to characterize the soil and bedrock conditions at the existing outfall and bridge structures. The results of this investigation are summarized below.

4.1.1 Geology

The United States Geological Survey (USGS) Surficial Materials Map of Connecticut indicates that the Riverside Drive Bridge and Turney Creek outfall structure are located in an area of sand overlying fines. The USGS Bedrock Geology Map for the Bridgeport Quadrangle indicates that bedrock at the site is primarily the Golden Hill Schist Member.

4.1.2 Previous Investigations

Cardinal Engineering Associates retained Associated Borings Co., Inc. to complete a total of fifteen (15) soil borings along Riverside Drive and Shoreham Terrace between December 27, 2017, and January 8, 2018 (Soil Borings B-1 through B-10, B-12, and B-14 through B-17). The soil borings were completed as part of the East Trunk Interceptor Sewer Relocation Project. Of these borings, only one (B-17) was located in the immediate vicinity of the Riverside Drive Bridge (Figure 1 and **Appendix D**).

4.1.3 Subsurface Investigation

General Boring, Inc. (GBI) of Prospect, Connecticut completed two (2) soil borings at the site on December 7 and 8, 2017 (Soil Borings RTG-SB-01 and RTG-SB-02). The soil borings were located along the north side of the Riverside Drive Bridge (Figure 1). Supplemental soil borings were completed at the site by New England Boring Contractors (NEB) of Glastonbury, Connecticut between July 12 and 16, 2018 (Soil Borings RTG-SB-03 through RTG-SB-05). These included a confirmatory soil boring near RTG-SB-02 and two (2) soil borings on the south side of the Riverside Drive Bridge (Figure 1 and **Appendix E**).

The soil borings were completed using a truck-mounted drill rig in accordance with the procedures outlined in ASTM D 1586 using a 140-pound safety hammer with a standard fall of 30 inches. Soil samples were collected continuously for the initial 10 feet and at 5-foot-intervals thereafter, unless otherwise shown. The soil borings were advanced to depths of up to 60 feet below existing grade or to refusal, at which point confirmatory bedrock cores were advanced. The rock cores were taken in 5-foot lengths and were obtained using a 2-inch-diameter (nominal) core barrel sampler.

The soil borings were logged in the field and representative split spoon soil samples were collected by RTG personnel. An RTG Geotechnical Engineer visually classified the soil in general accordance with the Unified Soil Classification System (USCS) as outlined in ASTM D 2488. Following the completion of the soil borings, the soil cuttings from the soil borings were used to backfill and abandon them. Soil borings that were completed on existing paved areas were patched with asphalt afterwards.

4.1.4 Laboratory Investigation

Geotechnical laboratory tests were performed on selected soil samples to identify physical properties, perform engineering classification, and determine design parameters. The testing program was developed by RTG and was performed by Thielsch Engineering of

Cranston, Rhode Island. The soil testing performed included grain size analysis (ASTM D 6913), hydrometer analysis (ASTM D 7928), moisture content (ASTM D 2216), and Atterberg limits (ASTSM D 4318) (**Appendix E**).

4.2 Subsurface Conditions

4.2.1 Subsurface Soils

Selected logs from the previous and current subsurface investigations were simplified and combined to develop an understanding of the general stratigraphy within the proposed project limits. This general stratigraphy, from top to bottom, consists of the following strata and is depicted in the generalized soil profiles shown in Figures 2 and 3:

- Stratum 1 – Silty Sand/Sand (Possible Fill)
- Stratum 2 – Sandy Organic Soil
- Stratum 3 – Sand, Silt, and Gravel
- Stratum 4 – Bedrock

Stratum 1 generally consists of very loose to medium dense Silty Sand to Sand. This stratum was observed in all of the soil borings completed. It extends from the existing ground surface to depths of up to about 35 feet below existing grade.

Stratum 2 generally consists of very soft to firm Sandy Organic Soil. This stratum was observed in RTG-SB-02, 03A, and 04, and was encountered along the east side of the Riverside Drive Bridge. It extends from about 24 to 35 feet below existing grade, but there appear to be isolated lenses of this material within Stratum 1.

Stratum 3 generally consists of dense to very dense Sand, Silt, and Gravel. This stratum was observed in all of the soil borings completed, and was encountered immediately below the Sandy Organic Soil at depths of between about 35 and 62 feet (the limit of the soil borings) below existing grade.

Stratum 4 is bedrock which consists of medium to coarse grained Schist. It was observed in soil borings RTG SB-01, -04, and -05 at depths as shallow as 36 feet below existing grade. This stratum appears to slope down towards the southeast. Based on the rock cores completed, the Rock Quality Designation (RQD) ranged from about 54 to 100 percent, indicating fair to very good quality bedrock.

4.2.2 Groundwater

Groundwater was observed to range from about 8.5 to 9.5 feet below the existing ground surface. Groundwater levels are tidal and are expected to fluctuate due to precipitation, creek flows, storm surge, and other factors. Accordingly, groundwater levels at the time of construction could be different than those observed during the subsurface investigation.

4.3 Foundation Selection

The Riverside Drive Bridge and outfall structure were constructed sometime around 1947 and 1973, respectively. Original construction plans for both structures were reviewed and it appears that the bridge abutments, wing walls, retaining walls, and culverts are supported by timber piles (**Appendix D**). The piles extend below the very loose/soft soil layers (Stratums 1 and 2) and bear in the dense to very dense soil below (Stratum 3).

The replacement culverts and associated roadway reconstruction will result in an increased vertical load on the existing soils, most notably where filling is proposed and there are no existing timber piles that could "reinforce" the very loose/soft soil layers. Due to the presence of these very loose/soft soil layers (i.e., Stratums 1 and 2), this load is expected to result in immediate, consolidation, and long-term secondary compression during and following construction.

While much of the immediate settlement is expected to occur during construction, the consolidation and long-term secondary compression will occur over a long period of time following construction (i.e., months to years). Based on preliminary settlement analyses, RTG estimates that the consolidation could be about 4 to 8 inches and the secondary compression could be about 2 to 4 inches (6 to 12 inches total).

If the replacement culverts and their headwalls were supported on a shallow foundation system bearing directly above the very loose/soft soil layers, it is expected that the estimated settlements would result in structure/pavement distress and damage. Accordingly, and similar to the existing bridge and outfall structures, it is recommended that a deep foundation system (e.g., driven timber or steel sheet piles) be utilized to limit settlements to permissible levels.

Section 5
Structural Analysis

While steel H- or Pipe-Piles bearing within Stratum 3 could be utilized as the deep foundation system for the concrete headwalls and replacement culverts, creosote treated timber piles were reportedly used to support the existing bridge and culvert structures, and these piles have apparently performed satisfactory for over 70 and 45 years, respectively. Accordingly, we believe that pressure treated southern yellow pine timber piles, which are readily available, offer a cost-effective solution that should be carried forward into final design.

If timber piles are utilized, it is recommended that they be pressure treated using Chromated Copper Arsenate (CCA) or Ammoniacal Coppery Zinc Arsenate (ACZA) in accordance with American Wood Preservers Association (AWPA) standards. Timber piles treated in accordance with AWPA standards, which for this project would be 1.5 pounds of preservative retention per cubic foot, would be expected to provide a useful service-life of about 50 years in a completely submerged environment such as this.

Steel sheet piles could also be utilized as the deep foundation system for supporting the concrete headwalls. Under this option, a continuous row of interlocking steel sheet piles would be installed below the proposed concrete stem of the headwall, and would extend up and into the stem to provide a positive connection. Steel tie rods would be installed between the upstream and downstream headwalls to help resist the estimated lateral loads, and minimize deflections.

If this option were carried forward into final design, either a hot-rolled or cold-rolled sheet pile section would be appropriate for this application. The steel sheet piles would need to be vibrated/driven into Stratum 3 in order to provide adequate vertical resistance and it is recommended that the piles be coated using a high-solids epoxy coating from their cutoff elevation to about 10 feet below the mudline. Steel sheet piling that conforms to ASTM A572 or A690 (Grade 50 ksi) and tie rods conforming to ASTM A615 (Grade 75 or 150 ksi) are readily available and would be appropriate.

The Fairfield Flood and Erosion Control Board have previously investigated the potential to install a continuous flood control barrier through the Riverside Drive corridor to protect inland properties from coastal inundation. Under this scenario, the downstream concrete headwalls could become part of a future flood control structure installed along Riverside Drive. Based on this, the Town has recommended that the downstream headwall be designed with a top of elevation of 13.0 feet (NAVD88), with the potential to extend the wall an additional 2 feet.

The proposed extension would allow the concrete headwall to match the existing 100-Year Flood Elevation in the project area. At the Town's discretion, this extension could be made during construction or at some point in the future. If it is made in the future, it would require that new reinforcing steel be drilled and grouted into the top of the previously installed concrete headwall, and that the design of the headwall and its foundation system account for the increased loading that results.

Section 6
Structural Alternatives

Based on the subsurface investigation, geotechnical and structural analyses, RTG developed several potential structural options for the Turney Creek culvert structure. These alternatives are described in detail in the sections below. In all of the alternatives, the existing Riverside Drive Bridge structure will be removed and replaced with culverts, and Riverside Drive will be reconstructed within the project limits, including new roadway pavement section, sidewalks and guide rail. Costs to replace or upgrade the existing sanitary sewer siphons are not included in these alternatives. It is assumed that any sanitary sewer work required would be performed under the East Trunk Interceptor Project that is currently in design by the Town of Fairfield.

6.1 Alternative 1 – Pile-Supported Headwalls and Culverts

Alternative 1 includes concrete headwalls at both the upstream and downstream ends of the proposed culverts to minimize the potential for erosion and reduce the impact area for permitting. The headwalls on the downstream end of the culverts will also provide a suitable structure to anchor and support the proposed self-regulating and top-hinged tide gates. See Figures 4 through 6 for details.

The proposed headwalls would be supported on 12" diameter, 30' long timber piles. The proposed piles would extend down through the organic layer and bear on the sand, silt and gravel layer below to provide adequate support. The headwalls will include a support structure at the pivot point of the proposed self-regulating tide gates, similar to the design of the recently completed Pine Creek Culvert project. The proper support of the front pivot point of the SRT's is critical to their long term performance and proper operation. Lack of this support also puts excessive stresses on the anchorages connecting the SRT's to the concrete headwalls.

As detailed above, due to the very loose sand and organic layers below the existing bridge, there is substantial concern that the proposed culverts and fill material above will experience significant settlement due to consolidation of the soils below. Settlement of the culverts could cause joints to open or become mis-aligned and could result in excessive shear stresses at the headwalls if the culverts are not properly supported. Gaps in the culvert joints could allow piping of bedding and fill materials through the culverts and ultimately lead to failure of the roadway and culverts.

To address these significant settlement concerns, Alternative 1 includes timber pile support of the culverts as well. Similar to the headwall foundations, the culverts would be supported on 12" diameter, 30' long timber piles with culvert bents on top of the piles supporting the proposed culverts. This pile support would greatly reduce the potential for culvert settlement.

Riprap aprons are proposed at both the upstream and downstream ends of the culverts to control scour. The existing 48" corrugated metal pipes will be removed or grouted in place to eliminate the potential for future collapse due to degradation of the metal culverts.

Permitting requirements for Alternative 1 are detailed in Section 8.

6.2 Alternative 1A – Anchored Sheet Pile Headwalls and Pile-Supported Culverts

Alternative 1A is largely similar to Alternative 1, but it utilizes steel sheet piles to serve as the foundation for the headwalls. The steel sheet piles would also serve as a cut-off wall to control seepage below the roadway embankment. In this alternative, the culverts would still be supported on timber piles with pile bents to limit potential settlement. Steel tie backs would be installed between the headwalls in this alternative to provide lateral support for the sheet pile foundations. See Figures 7 through 9 for details.

Permitting requirements for Alternative 1A are detailed in Section 8.

6.3 Alternative 2 – Pile-Supported Headwalls and Ground-Supported Culverts

Alternative 2 is largely similar to Alternative 1, but the timber pile supports for the culverts have been eliminated to save costs. The proposed culverts would be bedded in granular backfill material without a deep foundation system.

As detailed in the description of Alternative 1 above, there is a substantial concern for settlement of the proposed culverts and embankment fill above if the culverts are not properly supported due to the very loose and soft soil layers below. While this alternative results in a substantial savings of approximately $400,000, it is our opinion that the potential future maintenance and repair costs from excessive settlement would far outweigh the potential construction savings.

Settlement of the culverts could cause joints to open or become mis-aligned and could result in excessive shear stresses on the culverts at the headwalls due to differential settlement. Gaps in the culvert joints could allow piping of bedding and fill materials through the culverts and ultimately lead to failure of the roadway and culverts. Roadway cracking and settlement would subsequently occur following a culvert failure. See Figures 10 through 12 for details.

Permitting requirements for Alternative 2 are detailed in Section 8.

6.4 Alternative 2A – Anchored Sheet Pile Headwalls and Ground-Supported Culverts

Alternative 2A is largely similar to Alternative 2, but it utilizes steel sheet pile to serve as the foundation for the headwalls. The steel sheet pile would also serve as a cut-off wall to control seepage below the roadway embankment. The proposed culverts would be ground-supported, resulting in the same settlement concerns detailed in the Alternative 2 narrative. Steel tie backs would be installed between the headwalls in this alternative to provide lateral support for the sheet pile foundations. See Figures 13 through 15 for details.

Permitting requirements for Alternative 2A are detailed in Section 8.

6.5 Alternative 3 – Pile-Supported Headwall/Riprap Slope and Ground-Supported Culverts

Alternative 3 involves many of the same elements as Alternative 2, but the upstream (salt marsh side) headwall has been eliminated and replaced with an armored riprap slope. This alternative was explored for potential cost savings, as elimination of the upstream headwall reduces the project cost by approximately $200,000 from Alternative 3. The riprap slope, however, requires significant fill and encroachment in wetland areas and will likely be more difficult to permit.
In Alternative 3, the proposed culverts would be ground-supported, resulting in the same settlement concerns detailed in the Alternative 2 narrative. Please see Figures 16 and 17 for details.

Permitting requirements for Alternative 3 are detailed in Section 8.

6.6 Alternative Evaluation Matrix

To assist in decision making and identify the strengths and weaknesses of each alternative, Tighe & Bond and RTG developed an Alternatives Evaluation Matrix. Points were assigned to each alternative for several variables including Cost, Minimizing the Potential for Roadway/Culvert Settlement, Ease of Permitting, Constructability and Design Life.

The results of the Alternative Evaluation Matrix are detailed in Table 3 below. The results show that Alternative 1 and 1A would be the preferred options utilizing these criteria. These two options, although more costly than some of the other options, scored the most points largely due to their low potential for settlement and long design life.

Table 3
Alternative Evaluation Matrix

Alternative	Cost	Potential for Settlement	Ease of Permitting	Constructability	Design Life	Total Points
Alternative 1 - Pile Supported Headwalls and Culverts	2	10	5	4	8	29
Alternative 1A - Anchored Sheet Pile Headwalls & Pile-Supported Culverts	2	10	5	2	8	27
Alternative 2 - Pile-Supported Headwalls and Ground-Supported Culverts	4	1	5	8	6	24
Alternative 2A - Anchored Sheet Pile Headwalls & Ground-Supported Culverts	4	2	5	6	6	23
Alternative 3 - Pile-Supported Headwall/Riprap Slope and Ground-Supported Culverts	6	1	1	10	4	22
Notes:						
1. Ratings are 1-10, least favorable to most favorable						
2. The above criteria were established by Tighe & Bond and should be considered arbitrary. Prior to final design, these criteria should be reviewed and modified by the Town and Tighe & Bond to establish the most significant success and/or risk factors.						

Section 7
Opinions of Probable Construction Cost

Concept-level Opinions of Probable Construction Cost (OPCC) were prepared (in 2018 U.S. Dollars) for the implementation of each alternative to help allow an informed decision to be made based on funding limitations/other constraints (See detailed summaries in **Appendix F**). The estimates should be considered Conceptual and detailed OPCC's should be prepared for the selected Alternative as part of final design. A summary of the estimated construction costs is presented below:

- Alternative No. 1: $ 3.2 Million
- Alternative No. 1A $ 3.2 Million
- Alternative No. 2: $ 2.9 Million
- Alternative No. 2A: $ 2.8 Million
- Alternative No. 3: $ 2.7 Million

The OPCC's were prepared without the benefit of final plans and specifications. In addition, design, permitting, and construction phase related costs are not included in the estimated construction cost. Design and permitting costs for the project have already been funded through the a CDBG-DR planning grant. If full time construction observation and administration costs will be performed by outside consultants for this project, an additional 10% should be added to the OPCC's.

Tighe & Bond has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's method of pricing. The estimates of probable construction costs are made on the basis of the Tighe & Bond's professional judgment and experience. Tighe & Bond makes no guarantee nor warranty, expressed or implied, that the bids or the negotiated cost of the Work will not vary from this estimate of the Probable Construction Cost. A 35% contingency has been included in the OPCC's due to the Conceptual Level of the design.

Section 8
Permitting Requirements

Installation of new culverts and headwall structures at the Turney Creek Culverts will require permits at the Town, State and Federal levels. The required permits are detailed below. Alternatives 1, 1A, 2 and 2A have largely the same permitting requirements as they all result in a similar amount of filling and encroachment into the tidal wetlands and below the Coastal Jurisdiction Line. The upstream riprap slope and additional fill in Alternative 3 could push the project over the United States Army Corps of Engineers limit for a General Permit and into an Individual Permit category.

8.1 Town of Fairfield Permit Requirements

The proposed culvert falls within an area of tidal wetland soils mapped by the Town of Fairfield. The Town of Fairfield Inland Wetlands Commission does not have jurisdiction over tidal wetlands, only inland, thus an Inland Wetlands Permit is not anticipated.

The Town of Fairfield Zoning Regulations require a Special Permit for any excavation or filling operations in excess of 250 CY. It is anticipated that the proposed project will exceed this limit and will require a Special Permit unless granted an exemption by Fairfield Planning and Zoning.

8.2 State of Connecticut Permit Requirements

The Town of Fairfield has secured a planning grant for the project through the Department of Housing and Urban Development (HUD) CDBG-DR program, which is administered at the State level through the Connecticut Department of Housing, for design and permitting. The Town currently plans to fund construction activities with local bonding, and does not anticipate the use of State funds for construction. As such, we have assumed that the State funding of design and permitting activities does not constitute a "proposed State action" within the floodplain and does not require Flood Management (FM) Certification under CGS 25-68b. If State funds are secured for the construction of the Turney Creek Outfall Replacement, FM Certification would be required.

The project will be subject to permitting by the Connecticut Department of Energy and Environmental Protection's Office of Long Island Sound Programs (OLISP) under the Structures, Dredging and Fill Act (CGS 22a-359 through 22a-363f), the Tidal Wetlands Act (CGS Sections 22a-28 through 22a-35) and the Coastal Management Act (CGS Section 22a-90 through 22a-112). Tighe & Bond anticipates that the following permits will be required from CTDEEP for the project:

1. **Structures, Dredging and Fill Permit** – This permit is required prior to conducting work, including dredging and the placement of fill material, waterward of the Coastal Jurisdiction Line (El. 5.2 NAVD88 in Fairfield) in tidal, coastal or navigable waters of the state.

2. **Tidal Wetlands Permit** – This permit is required prior to conducting work within tidal wetlands as defined in CGS Sections 22a-29.

3. **Section 401 Water Quality Certification** – The project would require a state Water Quality Certificate pursuant to Section 401 of the federal Clean Water Act.

The average processing time for these permits is between 90-180 days per OLISP guidelines, however, similar recent projects have experienced review timeframes in excess of 9 months. The application and approval process for the three CTDEEP permits can be completed concurrently.

8.3 Federal Permit Requirements

Work and structures located in, under or over any navigable water of the U.S. that affects the course, location, condition, or capacity of such waters, or the excavating from or depositing of material in navigable waters is regulated by the United States Army Corps of Engineers (USACOE) under Section 10 of the Rivers and Harbors Act of 1899. We anticipate that the project would be subject to Category 2 authorization under Section 2 of the Connecticut General Permit.

The OLISP permit application to the will be submitted to the USACOE for joint review under Section 10.

Section 9
Recommendations

The Turney Creek culverts and the Riverside Drive bridge are critical components of Fairfield's coastal barrier system. These structures protect the Riverside Drive neighborhood from coastal flooding during high tides and coastal storm events, while also functioning as the main outlet for a large inland watershed. The proper design and construction of a new culvert and tide gate structure at Turney Creek is crucial to protecting the Riverside Drive neighborhood from both coastal and inland flood events.

In order to reduce the impact of future storm surge and inland flooding events on the Riverside Drive neighborhood, we recommend that the Town of Fairfield proceed with Alternative 1 – Pile-Supported Headwalls and Culverts or Alternative 1A – Anchored Sheet Pile Supported Headwalls and Pile-Supported Culverts, which include the following elements:

- Removal of the existing Riverside Drive bridge and bulkhead structure due to its deteriorated state.
- Installation of three 72" HDPE or PE culverts with top-hinged culverts and two 48" HDPE culverts with self-regulating tide gates to convey the 100-Year flood event and convey the full tidal prism.
- Installation of pile-supported or sheet pile supported headwalls on the upstream and downstream ends of the culverts to limit the likelihood of erosion and provide proper anchorage and support for the tide gates.
- Installation of a deep foundation support system for the culverts to reduce the potential for settlement and culvert failure.

FIGURE A
ORTHOPHOTOGRAPH

LEGEND

Contour (5 ft)

Contour (1 ft)

LOCUS MAP

0 100 200

Feet

1:2,400

NOTES

1. Based on 2016 Statewide Orthophotography, Courtesty of CTECO.

Turney Creek Outfall

Fairfield, Connecticut

January 2018

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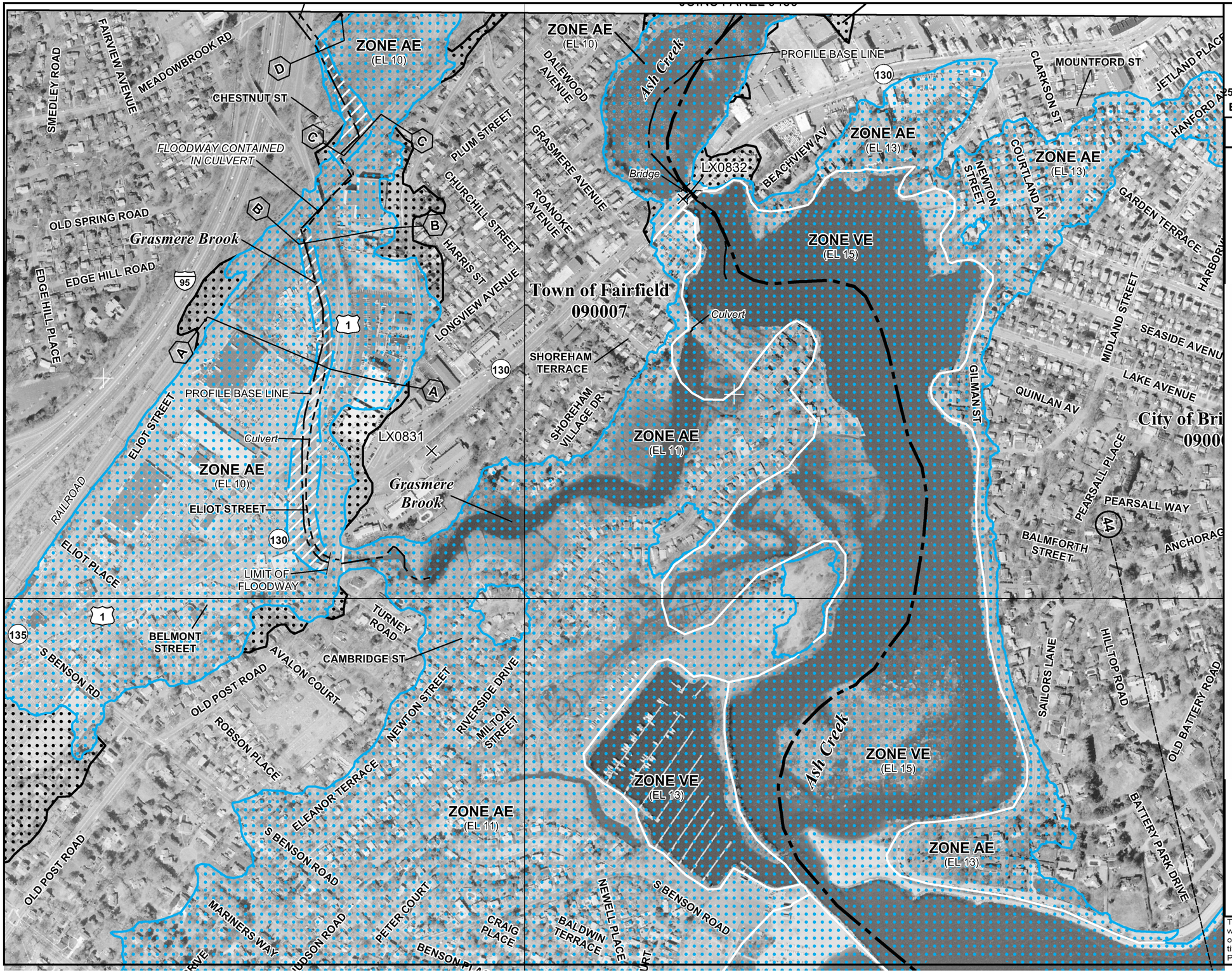
V:\Projects\F\F0439\Lidar_Aerial_Overview.mxd



MAP SCALE 1" = 500'

250 0 500 1000 FEET

NFIP

PANEL 0438G

FIRM

FLOOD INSURANCE RATE MAP

FAIRFIELD COUNTY, CONNECTICUT

(ALL JURISDICTIONS)

PANEL 438 OF 626

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BRIDGEPORT, CITY OF	090002	0438	G
FAIRFIELD, TOWN OF	090007	0438	G

-NOTE-

THIS MAP INCLUDES BOUNDARIES OF THE COASTAL BARRIER RESOURCES SYSTEM ESTABLISHED UNDER THE COASTAL BARRIER RESOURCES ACT OF 1982 AND/OR SUBSEQUENT ENABLING LEGISLATION.

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

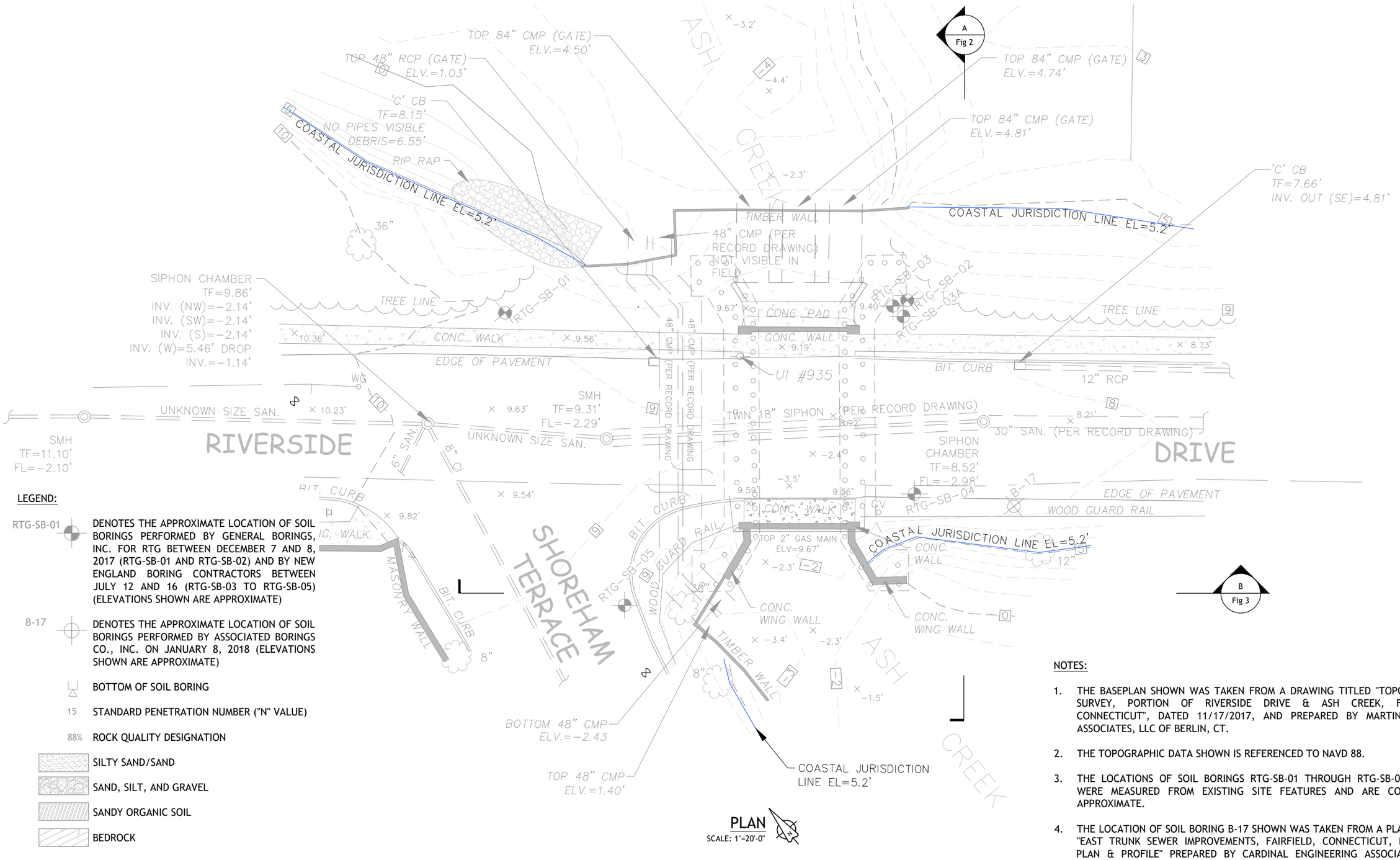
MAP NUMBER
09001C0438G

MAP REVISED
JULY 8, 2013

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

Figure B - FIRM Map



PLAN
SCALE: 1"=20'-0"

LEGEND:

RTG-SB-01 — DENOTES THE APPROXIMATE LOCATION OF SOIL BORINGS PERFORMED BY GENERAL BORINGS, INC. FOR RTG BETWEEN DECEMBER 7 AND 8, 2017 (RTG-SB-01 AND RTG-SB-02) AND BY NEW ENGLAND BORING CONTRACTORS BETWEEN JULY 12 AND 16 (RTG-SB-03 TO RTG-SB-05) (ELEVATIONS SHOWN ARE APPROXIMATE)

B-17 — DENOTES THE APPROXIMATE LOCATION OF SOIL BORINGS PERFORMED BY ASSOCIATED BORINGS CO., INC. ON JANUARY 8, 2018 (ELEVATIONS SHOWN ARE APPROXIMATE)

BOTTOM OF SOIL BORING

15 — STANDARD PENETRATION NUMBER ("N" VALUE)

88% — ROCK QUALITY DESIGNATION

SILTY SAND/SAND

SAND, SILT, AND GRAVEL

SANDY ORGANIC SOIL

BEDROCK

Graphic Scale 1"=20'
20' 10' 0 20' 40'

NOTES:

1. THE BASEPLAN SHOWN WAS TAKEN FROM A DRAWING TITLED "TOPOGRAPHIC SURVEY, PORTION OF RIVERSIDE DRIVE & ASH CREEK, FAIRFIELD, CONNECTICUT", DATED 11/17/2017, AND PREPARED BY MARTIN SURVEY ASSOCIATES, LLC OF BERLIN, CT.
2. THE TOPOGRAPHIC DATA SHOWN IS REFERENCED TO NAVD 88.
3. THE LOCATIONS OF SOIL BORINGS RTG-SB-01 THROUGH RTG-SB-05 SHOWN WERE MEASURED FROM EXISTING SITE FEATURES AND ARE CONSIDERED APPROXIMATE.
4. THE LOCATION OF SOIL BORING B-17 SHOWN WAS TAKEN FROM A PLAN TITLED "EAST TRUNK SEWER IMPROVEMENTS, FAIRFIELD, CONNECTICUT, ROADWAY PLAN & PROFILE" PREPARED BY CARDINAL ENGINEERING ASSOCIATES AND DATED MARCH 2016.

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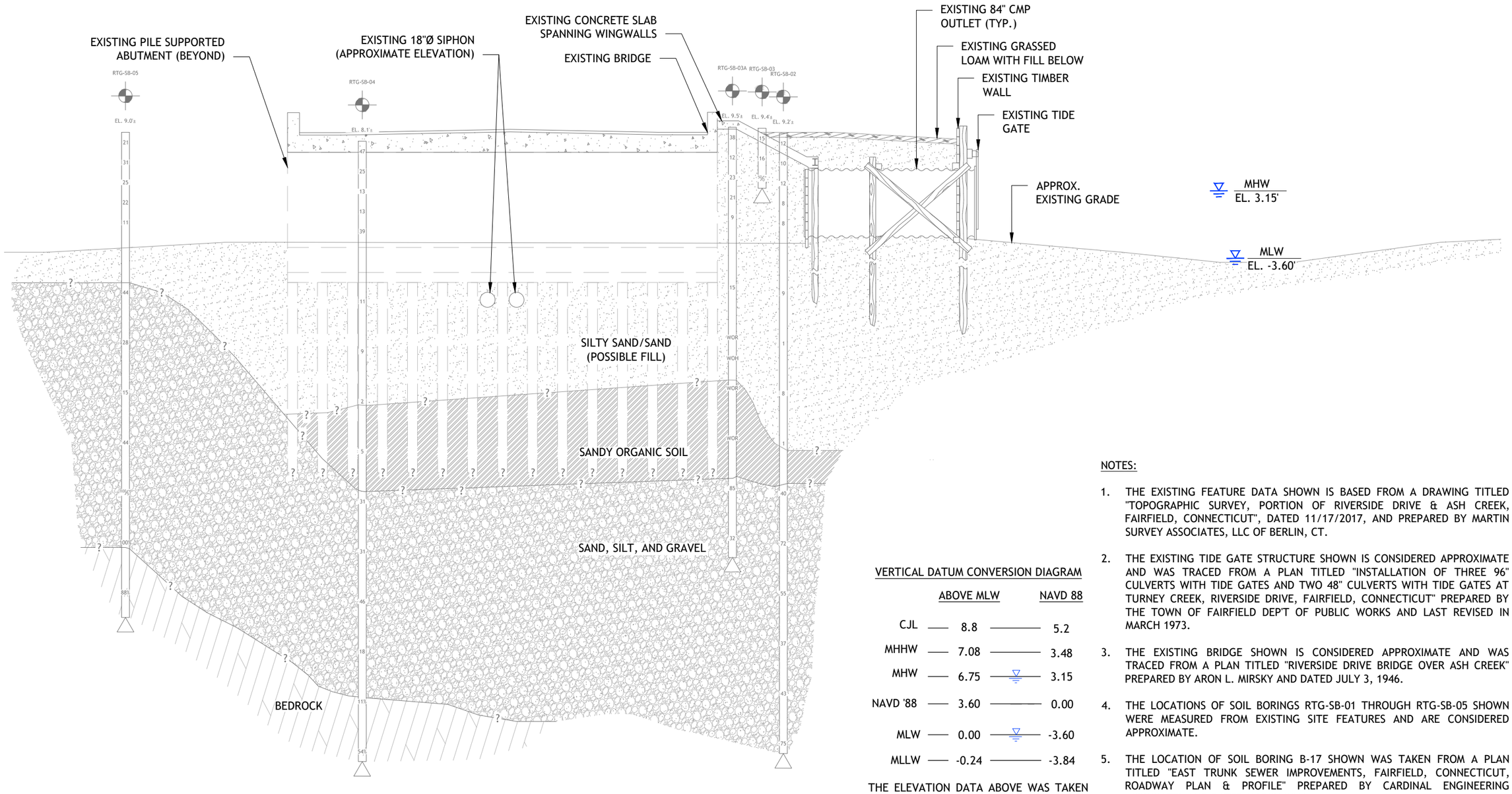
Town of Fairfield
Fairfield, Connecticut

FIGURE 1
EXISTING PLAN

SHEET 1 of 18
DATE AUG. 2018
PROJ No. 17111.00



SECTION
SCALE: 1"=10'-0"

A
Fig 1

Graphic Scale 1"=10'

10' 5' 0 10' 20'

VERTICAL DATUM CONVERSION DIAGRAM

	ABOVE MLW	NAVD 88
CJL	8.8	5.2
MHHW	7.08	3.48
MHW	6.75	3.15
NAVD '88	3.60	0.00
MLW	0.00	-3.60
MLLW	-0.24	-3.84

THE ELEVATION DATA ABOVE WAS TAKEN FROM THE U.S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL OCEAN SERVICE, FROM:
STATION ID: *8467150*
LOCATION: Bridgeport, Connecticut
LATITUDE: *41° 10.5' N*
LONGITUDE: *73° 11' W*

NOTES:

1. THE EXISTING FEATURE DATA SHOWN IS BASED FROM A DRAWING TITLED "TOPOGRAPHIC SURVEY, PORTION OF RIVERSIDE DRIVE & ASH CREEK, FAIRFIELD, CONNECTICUT", DATED 11/17/2017, AND PREPARED BY MARTIN SURVEY ASSOCIATES, LLC OF BERLIN, CT.
2. THE EXISTING TIDE GATE STRUCTURE SHOWN IS CONSIDERED APPROXIMATE AND WAS TRACED FROM A PLAN TITLED "INSTALLATION OF THREE 96" CULVERTS WITH TIDE GATES AND TWO 48" CULVERTS WITH TIDE GATES AT TURNEY CREEK, RIVERSIDE DRIVE, FAIRFIELD, CONNECTICUT" PREPARED BY THE TOWN OF FAIRFIELD DEP'T OF PUBLIC WORKS AND LAST REVISED IN MARCH 1973.
3. THE EXISTING BRIDGE SHOWN IS CONSIDERED APPROXIMATE AND WAS TRACED FROM A PLAN TITLED "RIVERSIDE DRIVE BRIDGE OVER ASH CREEK" PREPARED BY ARON L. MIRSKY AND DATED JULY 3, 1946.
4. THE LOCATIONS OF SOIL BORINGS RTG-SB-01 THROUGH RTG-SB-05 SHOWN WERE MEASURED FROM EXISTING SITE FEATURES AND ARE CONSIDERED APPROXIMATE.
5. THE LOCATION OF SOIL BORING B-17 SHOWN WAS TAKEN FROM A PLAN TITLED "EAST TRUNK SEWER IMPROVEMENTS, FAIRFIELD, CONNECTICUT, ROADWAY PLAN & PROFILE" PREPARED BY CARDINAL ENGINEERING ASSOCIATES AND DATED MARCH 2016.
6. THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN SOIL BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE SPECIFIC LOCATIONS AND ON THE DATES INDICATED. SOIL AND ROCK CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THE BORING LOCATIONS. ALSO THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THE SOIL BORING LOCATIONS.

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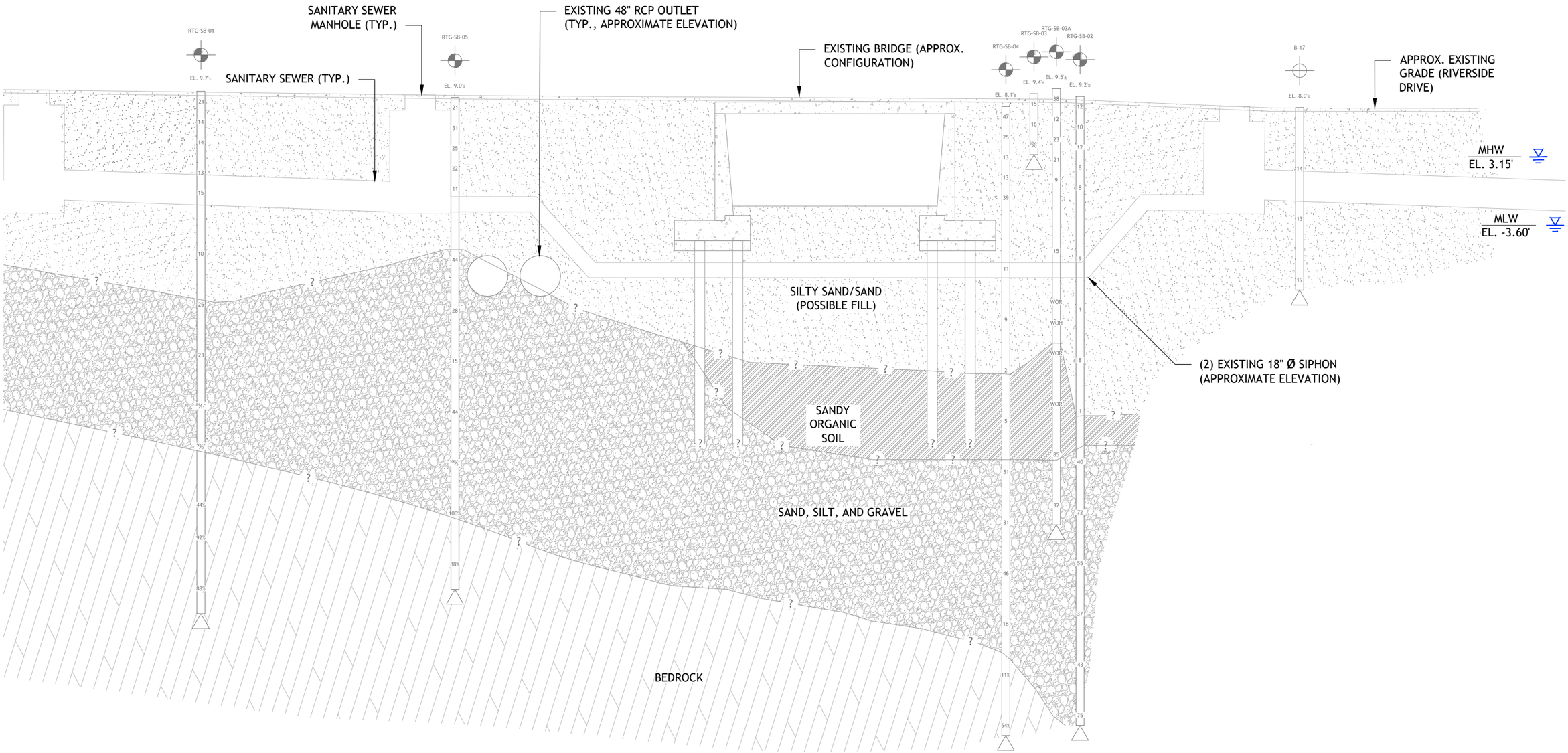
FIGURE 2
EXISTING LONGITUDINAL SECTION

DATE AUG. 2018
PROJ No. 17111.00



SECTION B
SCALE: 1"=10'-0" Fig 1

NOTE:

1. THE EXISTING BRIDGE SHOWN IS CONSIDERED APPROXIMATE AND WAS TRACED FROM A PLAN TITLED "RIVERSIDE DRIVE BRIDGE OVER ASH CREEK" PREPARED BY ARON L. MIRSKY AND DATED JULY 3, 1946.

Graphic Scale 1"=10'

10' 5' 0 10' 20'

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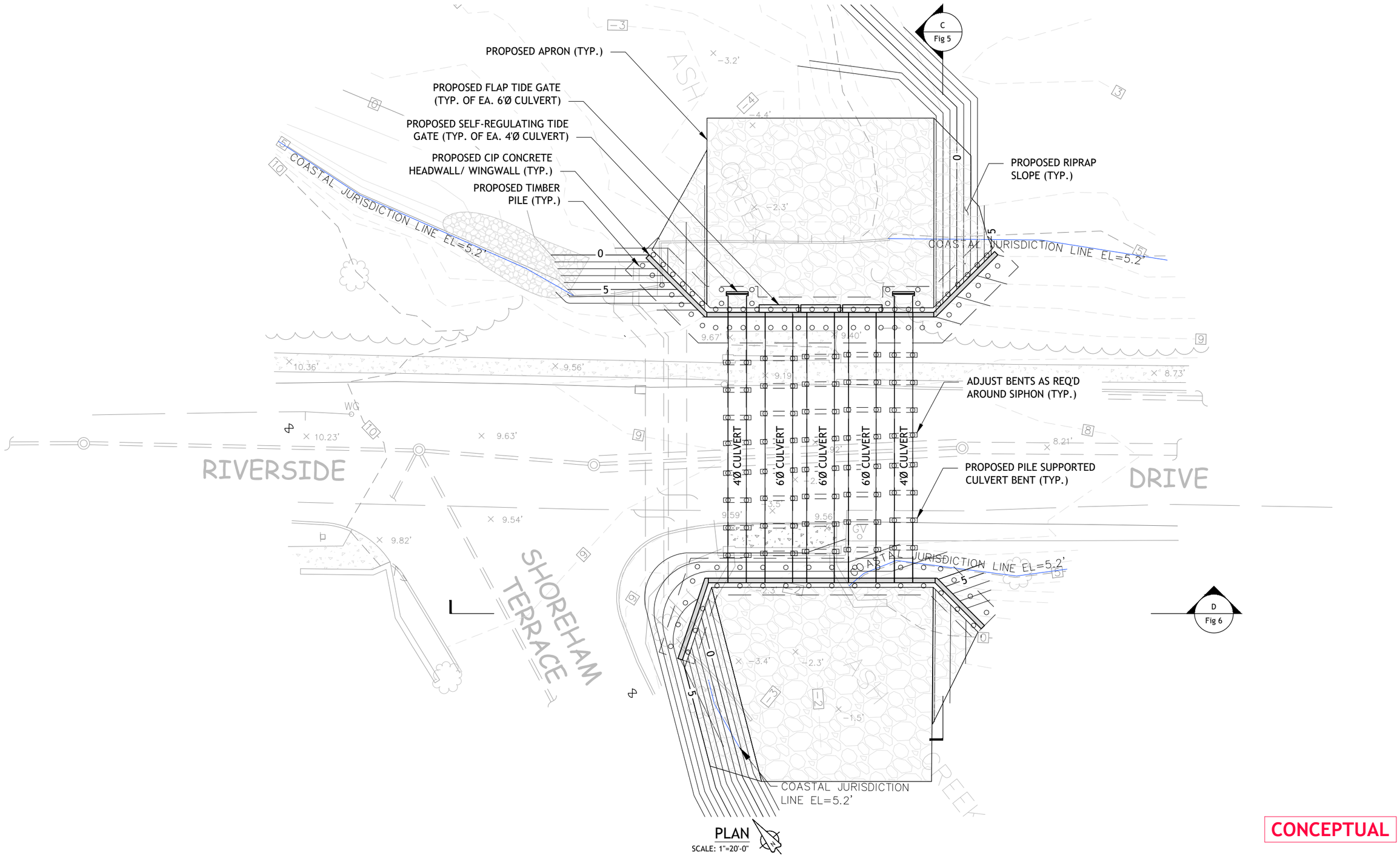
FIGURE 3
EXISTING TRANSVERSE SECTION

SHEET 3 of 18
DATE AUG. 2018
PROJ No. 17111.00



PLAN
SCALE: 1"=20'-0"

Graphic Scale 1"=20'
20' 10' 0 20' 40'

CONCEPTUAL

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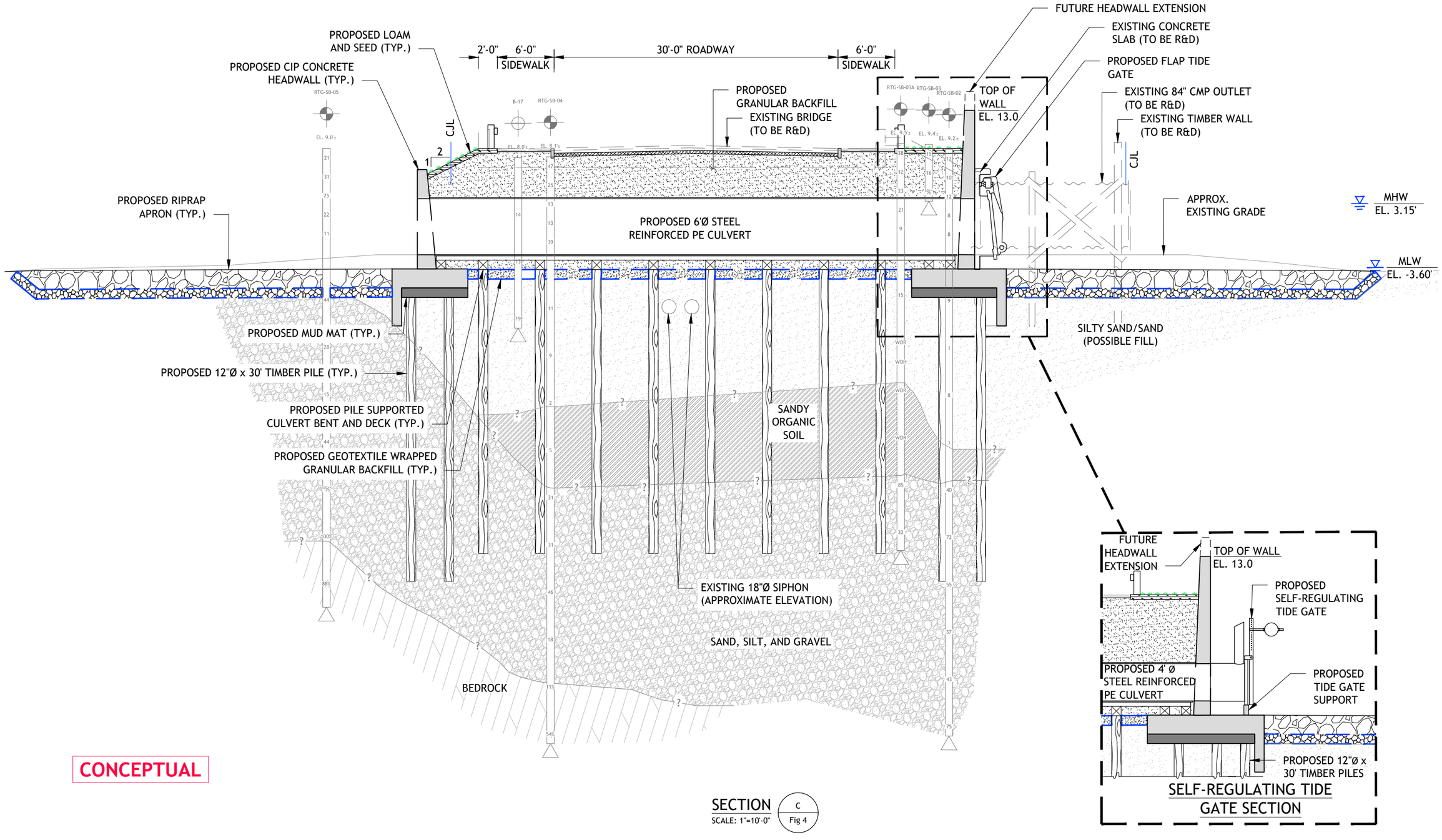
FIGURE 4
PROPOSED IMPROVEMENTS PLAN
ALT. NO. 1 - NEW PILE-SUPPORTED HEADWALLS AND CULVERTS

SHEET 4 of 18
DATE AUG. 2018
PROJ No. 17111.00



SECTION
SCALE: 1"=10'-0"

C
Fig 4

SELF-REGULATING TIDE GATE SECTION

CONCEPTUAL

Graphic Scale 1"=10'

10' 5' 0 10' 20'

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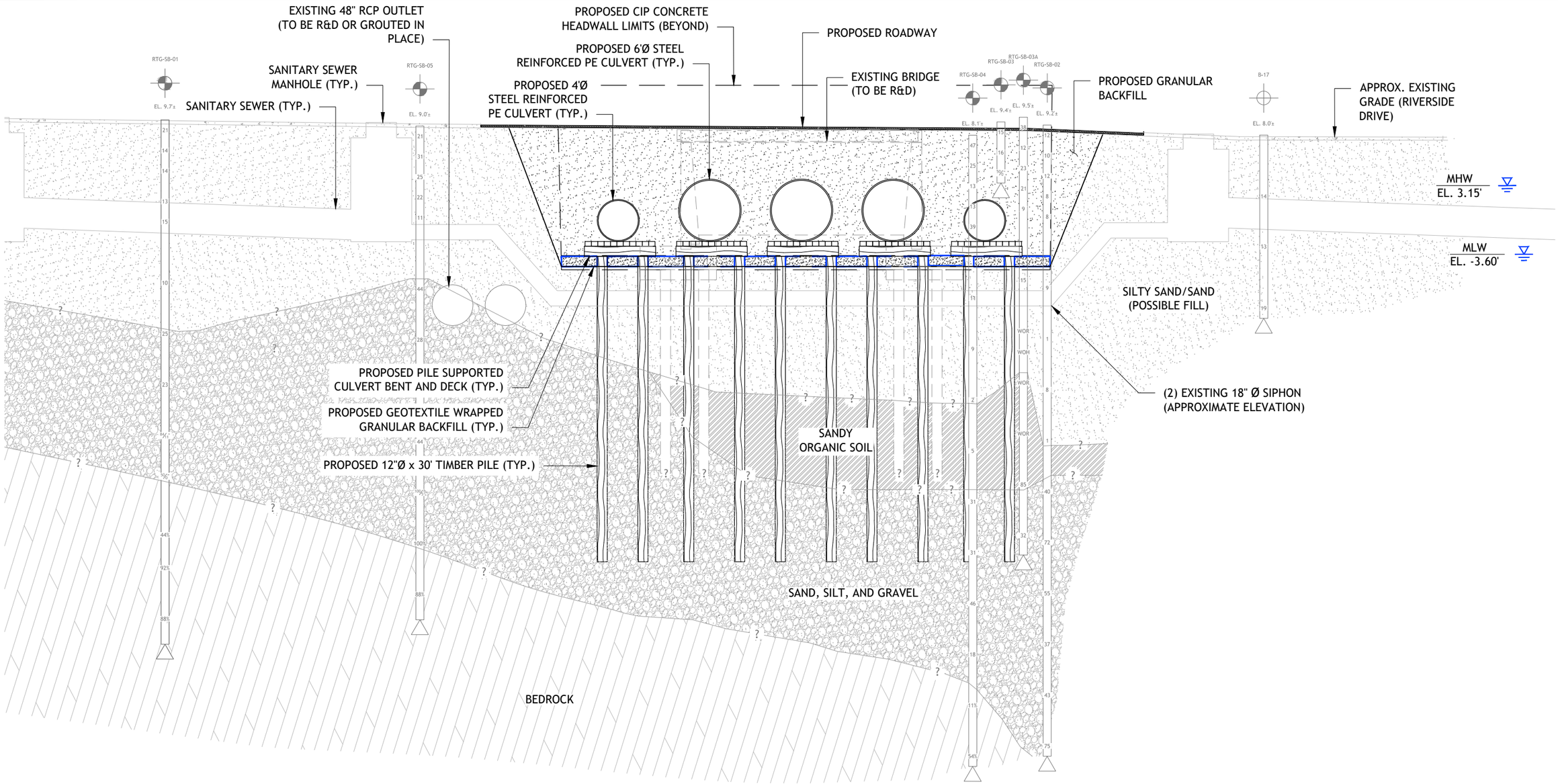
FIGURE 5
PROPOSED LONGITUDINAL SECTION
ALT. NO. 1 - NEW PILE-SUPPORTED HEADWALLS AND CULVERTS

SHEET 5 of 18
DATE AUG. 2018
PROJ No. 17111.00



SECTION D
SCALE: 1"=10'-0"
Fig 4

CONCEPTUAL

Graphic Scale 1"=10'
10' 5' 0 10' 20'

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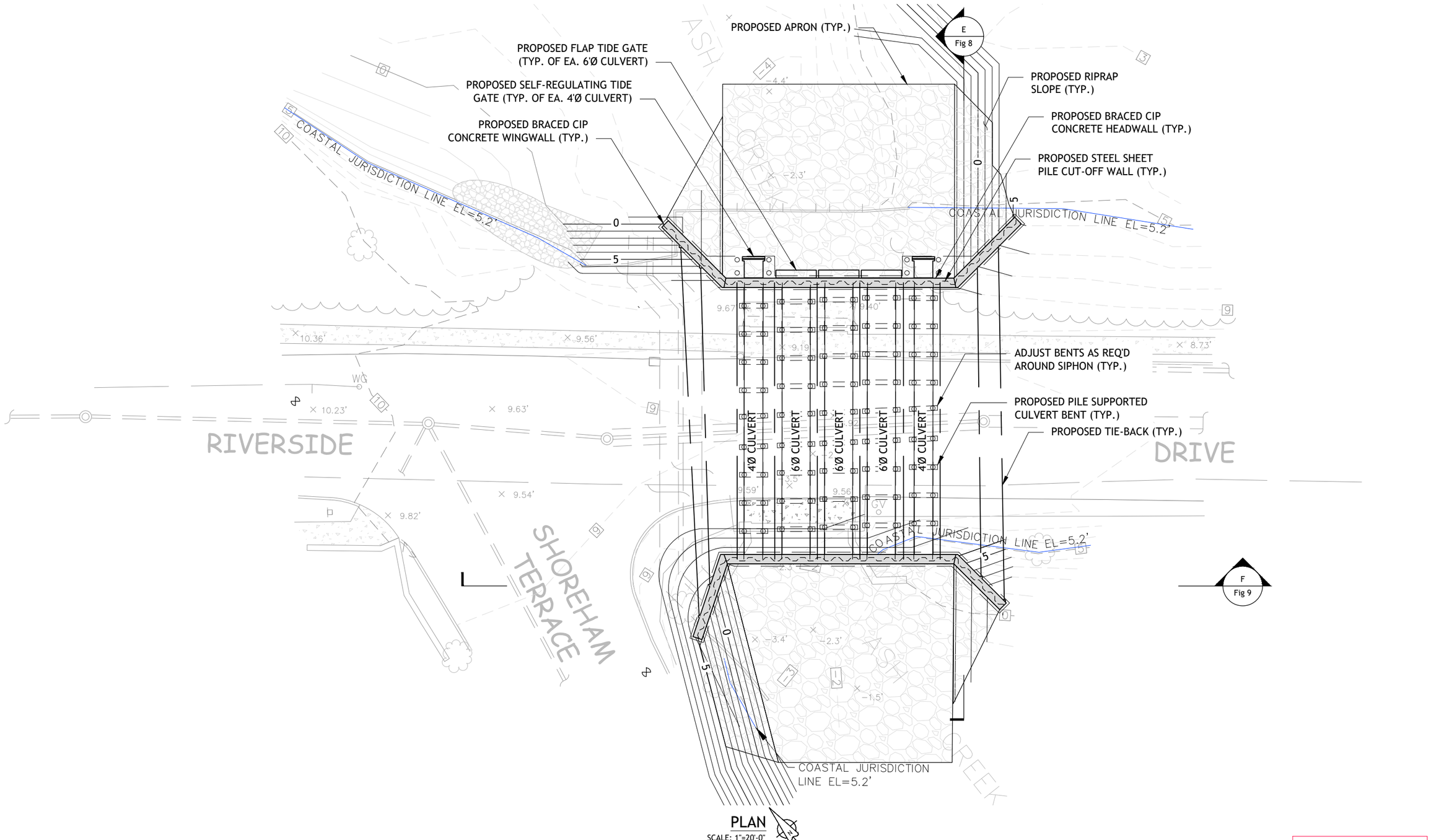
FIGURE 6
PROPOSED TRANSVERSE SECTION
ALT. NO. 1 - NEW PILE-SUPPORTED HEADWALLS AND CULVERTS

SHEET 6 of 18
DATE AUG. 2018
PROJ No. 17111.00



CONCEPTUAL

Graphic Scale 1"=20'

20' 10' 0 20' 40'

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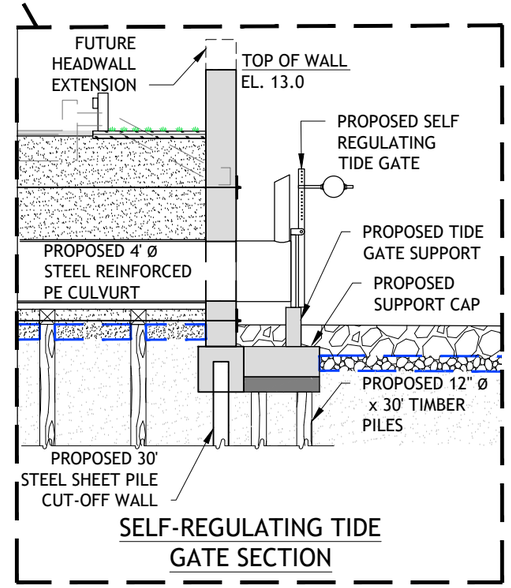
FIGURE 7
PROPOSED IMPROVEMENTS PLAN
ALT. NO. 1a - NEW ANCHORED SHEET PILE HEADWALLS AND PILE-SUPPORTED CULVERTS

SHEET 7 of 18
DATE AUG. 2018
PROJ No. 17111.00

2'-0"
6'-0" SIDEWALK
30'-0" ROADWAY
6'-0" SIDEWALK
EXISTING CONCRETE SLAB (TO BE R&D)
FUTURE HEADWALL EXTENSION
PROPOSED FLAP TIDE GATE
EXISTING 84" CMP OUTLET (TO BE R&D)
EXISTING TIMBER WALL (TO BE R&D)
PROPOSED LOAM AND SEED (TYP.)
PROPOSED BRACED CIP CONCRETE HEADWALL (TYP.)
PROPOSED GRANULAR BACKFILL
EXISTING BRIDGE (TO BE R&D)
TOP OF WALL EL. 13.0
C.J.L.
PROPOSED RIPRAP APRON (TYP.)
PROPOSED 6'Ø STEEL REINFORCED PE CULVERT
APPROX. EXISTING GRADE
MHW EL. 3.15'
MLW EL. -3.60'
PROPOSED CIP CONCRETE PILE CAP (TYP.)
SILTY SAND/SAND (POSSIBLE FILL)
PROPOSED 30' STEEL SHEET PILE CUT-OF WALL (TYP.)
PROPOSED TIE-BACK (TYP.)
PROPOSED PILE SUPPORTED CULVERT BENT AND DECK (TYP.)
SANDY ORGANIC SOIL
PROPOSED GEOTEXTILE WRAPPED GRANULAR BACKFILL (TYP.)
PROPOSED 12"Ø x 30' TIMBER PILE (TYP.)
EXISTING 18"Ø SIPHON (APPROXIMATE ELEVATION)
SAND, SILT, AND GRAVEL
BEDROCK

CONCEPTUAL

SECTION E
SCALE: 1"=10'-0"
Fig 7



SELF-REGULATING TIDE GATE SECTION

Graphic Scale 1"=10'
10' 5' 0 10' 20'

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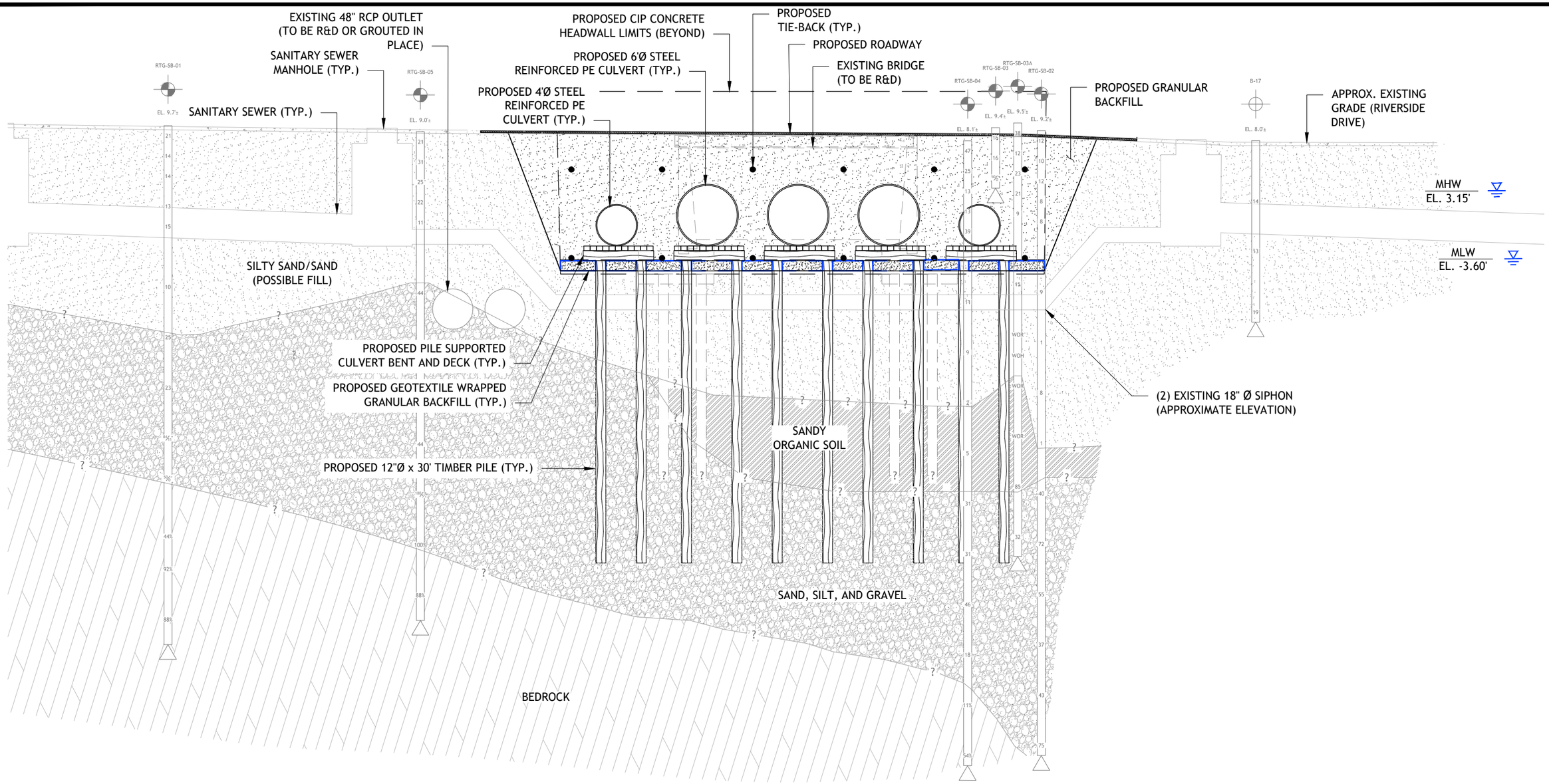
FIGURE 8
PROPOSED LONGITUDINAL SECTION ALT. NO. 1a - NEW ANCHORED SHEET PILE HEADWALLS AND PILE-SUPPORTED CULVERTS

SHEET 8 of 18
DATE AUG. 2018
PROJ No. 17111.00



SECTION F
SCALE: 1"=10'-0" Fig 7

CONCEPTUAL

Graphic Scale 1"=10'

10' 5' 0 10' 20'

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FIGURE 9
PROPOSED TRANSVERSE SECTION
ALT. NO. 1a - NEW ANCHORED SHEET PILE HEADWALLS AND PILE-SUPPORTED CULVERTS

SHEET 9 of 18
DATE AUG. 2018
PROJ No. 17111.00

PROPOSED FLAP TIDE GATE
(TYP. OF EA. 6'Ø CULVERT)

PROPOSED SELF-REGULATING TIDE
GATE (TYP. OF EA. 4'Ø CULVERT)

PROPOSED CIP CONCRETE
HEADWALL/ WINGWALL (TYP.)

PROPOSED TIMBER
PILE (TYP.)

PROPOSED APRON (TYP.)

PROPOSED RIPRAP
SLOPE (TYP.)

G
Fig 11

COASTAL JURISDICTION LINE EL=5.2'

4Ø CULVERT

6Ø CULVERT

6Ø CULVERT

6Ø CULVERT

4Ø CULVERT

RIVERSIDE DRIVE

SHOREHAM TERRACE

ASH CREEK

H
Fig 12

PLAN
SCALE: 1"=20'-0"

CONCEPTUAL

Graphic Scale 1"=20'
20' 10' 0 20' 40'

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REPLACEMENT PROJECT
STUDY PHASE REPORT
Town of Fairfield
Fairfield, Connecticut

FIGURE 10
PROPOSED IMPROVEMENTS PLAN
ALT. NO. 2 - NEW PILE-SUPPORTED
HEADWALLS AND GROUND
SUPPORTED CULVERTS

SHEET 10 of 18
DATE
AUG. 2018
PROJ No.
17111.00

PROPOSED LOAM AND SEED (TYP.)
PROPOSED CIP CONCRETE HEADWALL (TYP.)
2'-0"
6'-0" SIDEWALK
30'-0" ROADWAY
6'-0" SIDEWALK
EXISTING CONCRETE SLAB (TO BE R&D)
FUTURE HEADWALL EXTENSION
PROPOSED FLAP TIDE GATE
EXISTING 84" CMP OUTLET (TO BE R&D)
EXISTING TIMBER WALL (TO BE R&D)
PROPOSED GRANULAR BACKFILL
EXISTING BRIDGE (TO BE R&D)
TOP OF WALL EL. 13.0
CJL
PROPOSED RIPRAP APRON (TYP.)
PROPOSED 6'Ø STEEL REINFORCED PE CULVERT
APPROX. EXISTING GRADE
MHW EL. 3.15'
MLW EL. -3.60'
PROPOSED MUD MAT (TYP.)
PROPOSED 12"Ø x 30' TIMBER PILE (TYP.)
SILTY SAND/SAND (POSSIBLE FILL)
SANDY ORGANIC SOIL
SAND, SILT, AND GRAVEL
EXISTING 18"Ø SIPHON (APPROXIMATE ELEVATION)
BEDROCK

SECTION G / Fig 10
SCALE: 1"=10'-0"

FUTURE HEADWALL EXTENSION
TOP OF WALL EL. 13.0
PROPOSED SELF-REGULATING TIDE GATE
PROPOSED 4' Ø STEEL REINFORCED PE CULVERT
PROPOSED TIDE GATE SUPPORT
PROPOSED 12"Ø x 30' TIMBER PILES

SELF-REGULATING TIDE GATE SECTION

CONCEPTUAL

Graphic Scale 1"=10'
10' 5' 0 10' 20'

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STUDY PHASE REPORT
Town of Fairfield
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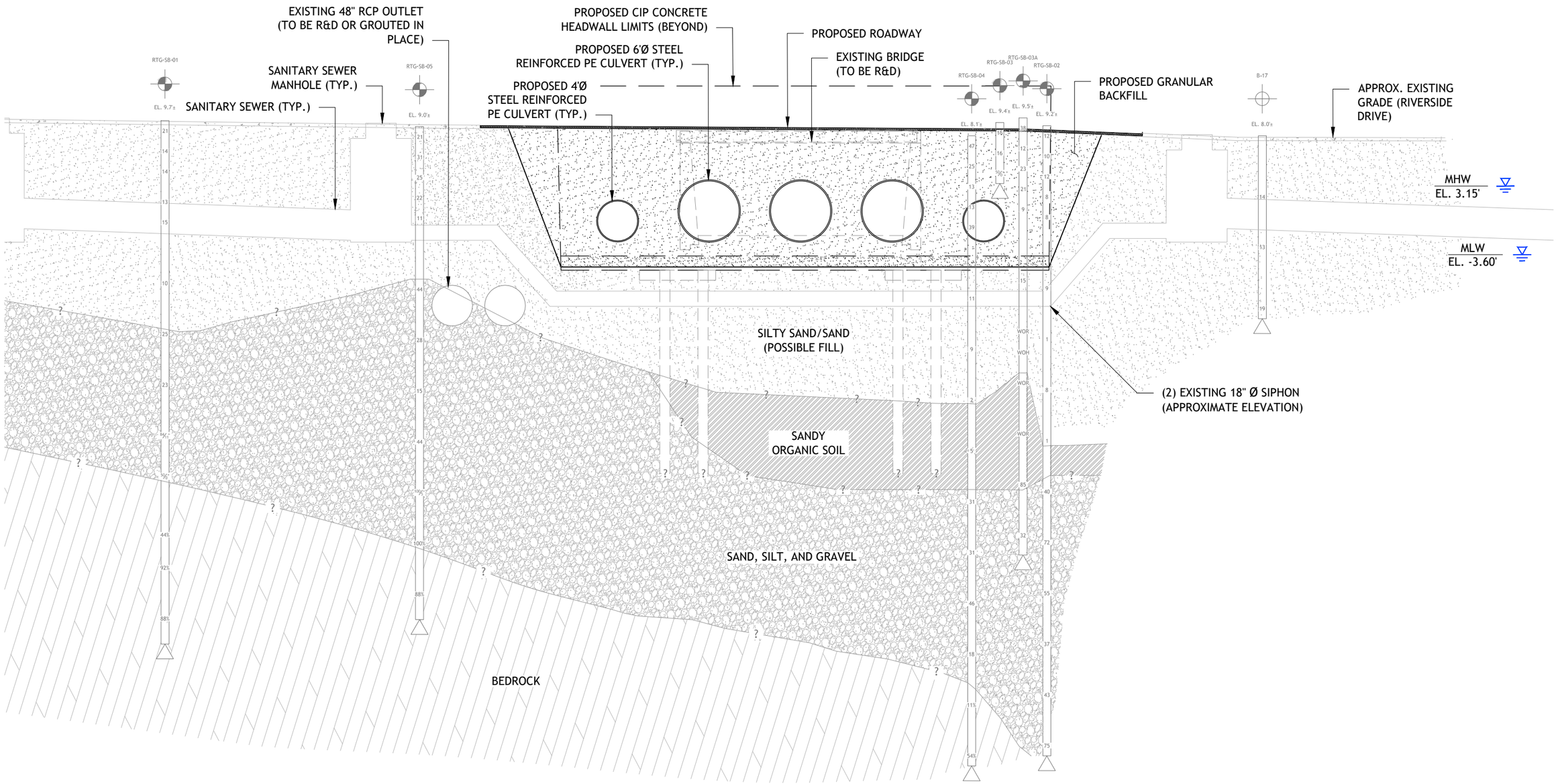
FIGURE 11
PROPOSED LONGITUDINAL SECTION
ALT. NO. 2 - NEW PILE-SUPPORTED HEADWALLS AND GROUND SUPPORTED CULVERTS

SHEET 11 of 18
DATE AUG. 2018
PROJ No. 17111.00



SECTION H
SCALE: 1"=10'-0" Fig 10

CONCEPTUAL

Graphic Scale 1"=10'
10' 5' 0 10' 20'

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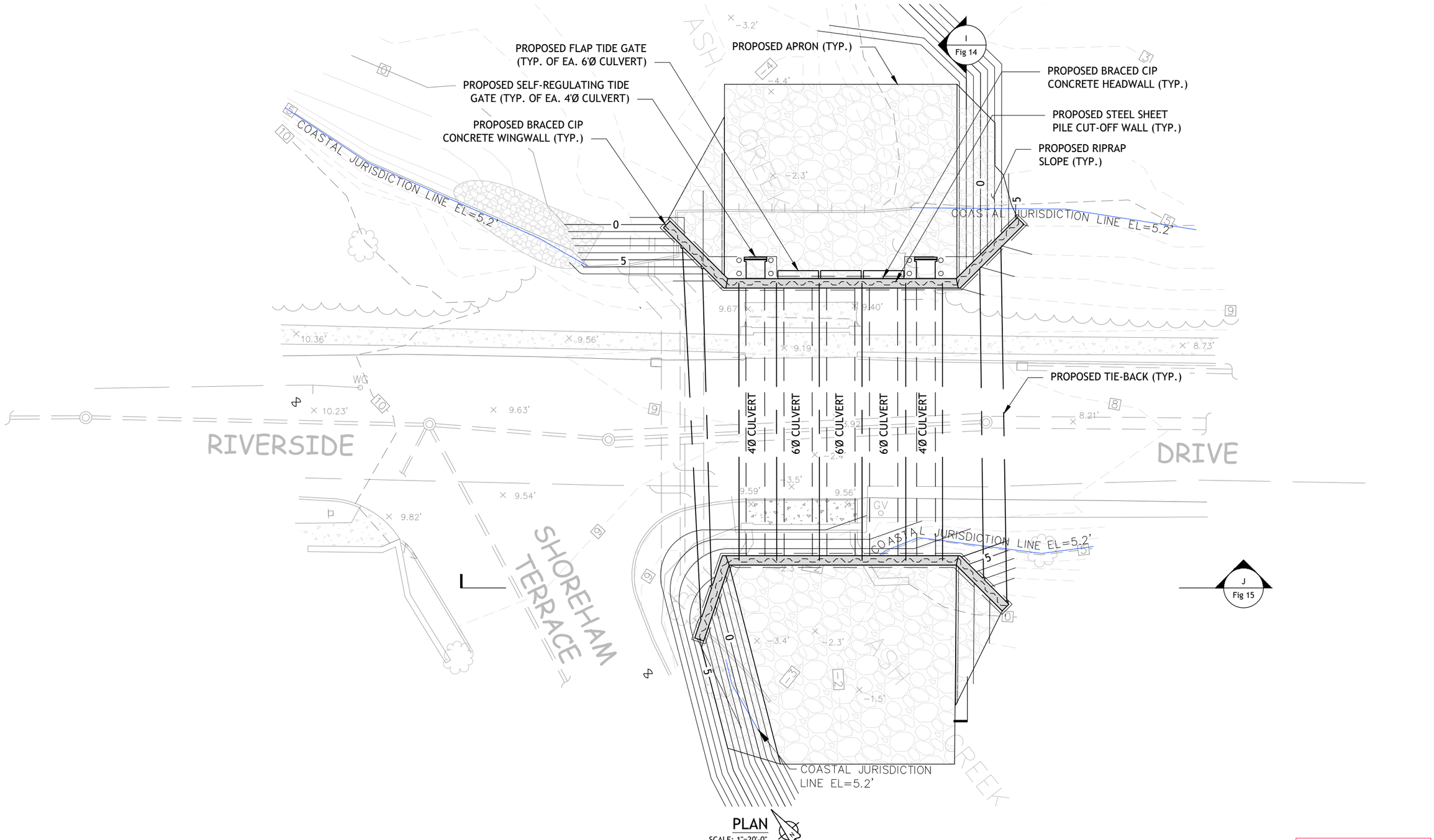
FIGURE 12
PROPOSED TRANSVERSE SECTION
ALT. NO. 2 - NEW PILE-SUPPORTED HEADWALLS AND GROUND SUPPORTED CULVERTS

SHEET 12 of 18
DATE AUG. 2018
PROJ No. 17111.00



CONCEPTUAL

Graphic Scale 1"=20'

20' 10' 0 20' 40'

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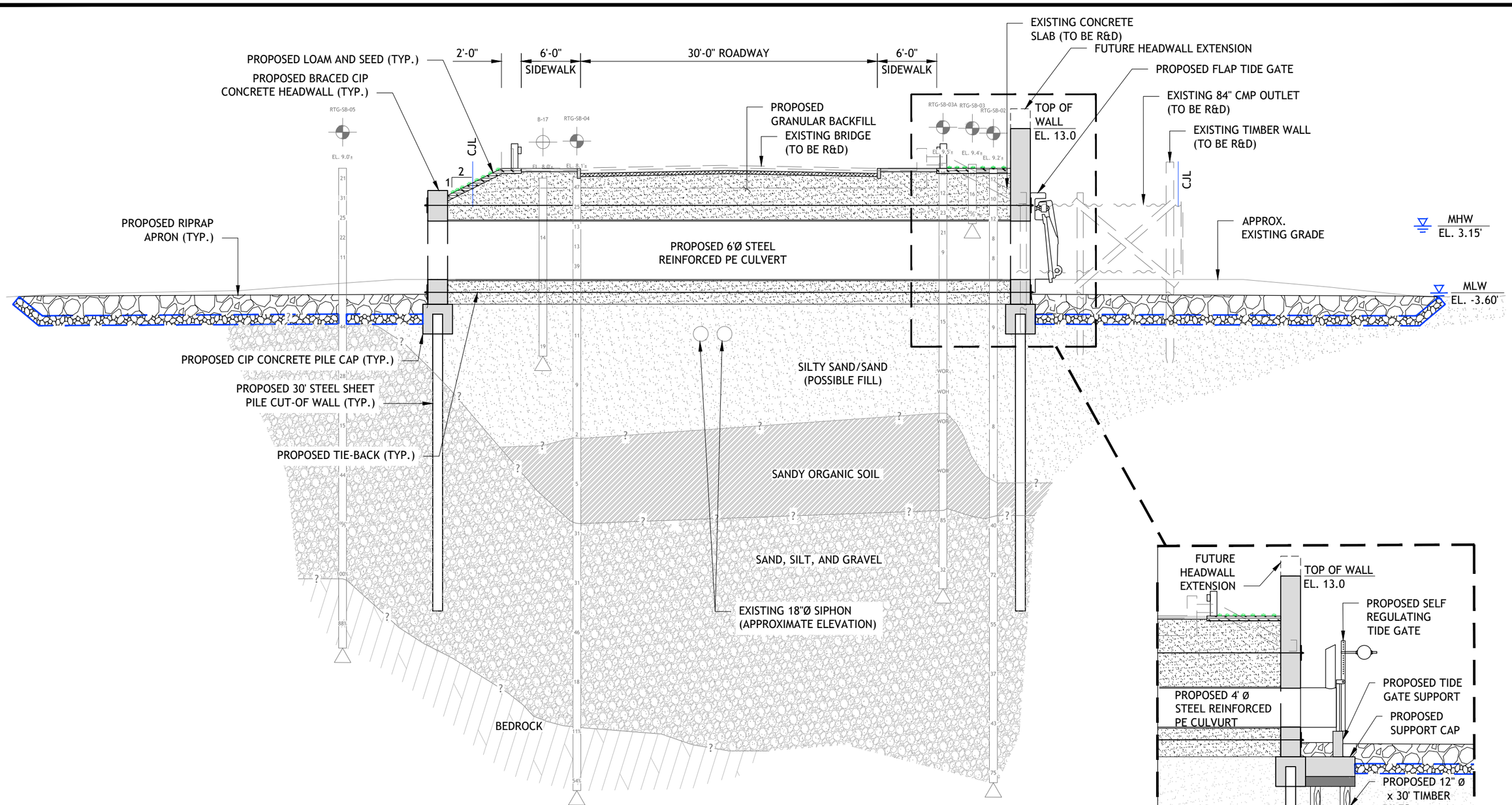
FIGURE 13
PROPOSED IMPROVEMENTS PLAN
ALT. NO. 2a - NEW ANCHORED SHEET PILE HEADWALLS AND GROUND SUPPORTED CULVERTS

SHEET 13 of 18
DATE AUG. 2018
PROJ No. 17111.00



SELF-REGULATING TIDE GATE SECTION

SECTION I
SCALE: 1"=10'-0"
Fig 13

CONCEPTUAL

Graphic Scale 1"=10'
10' 5' 0 10' 20'

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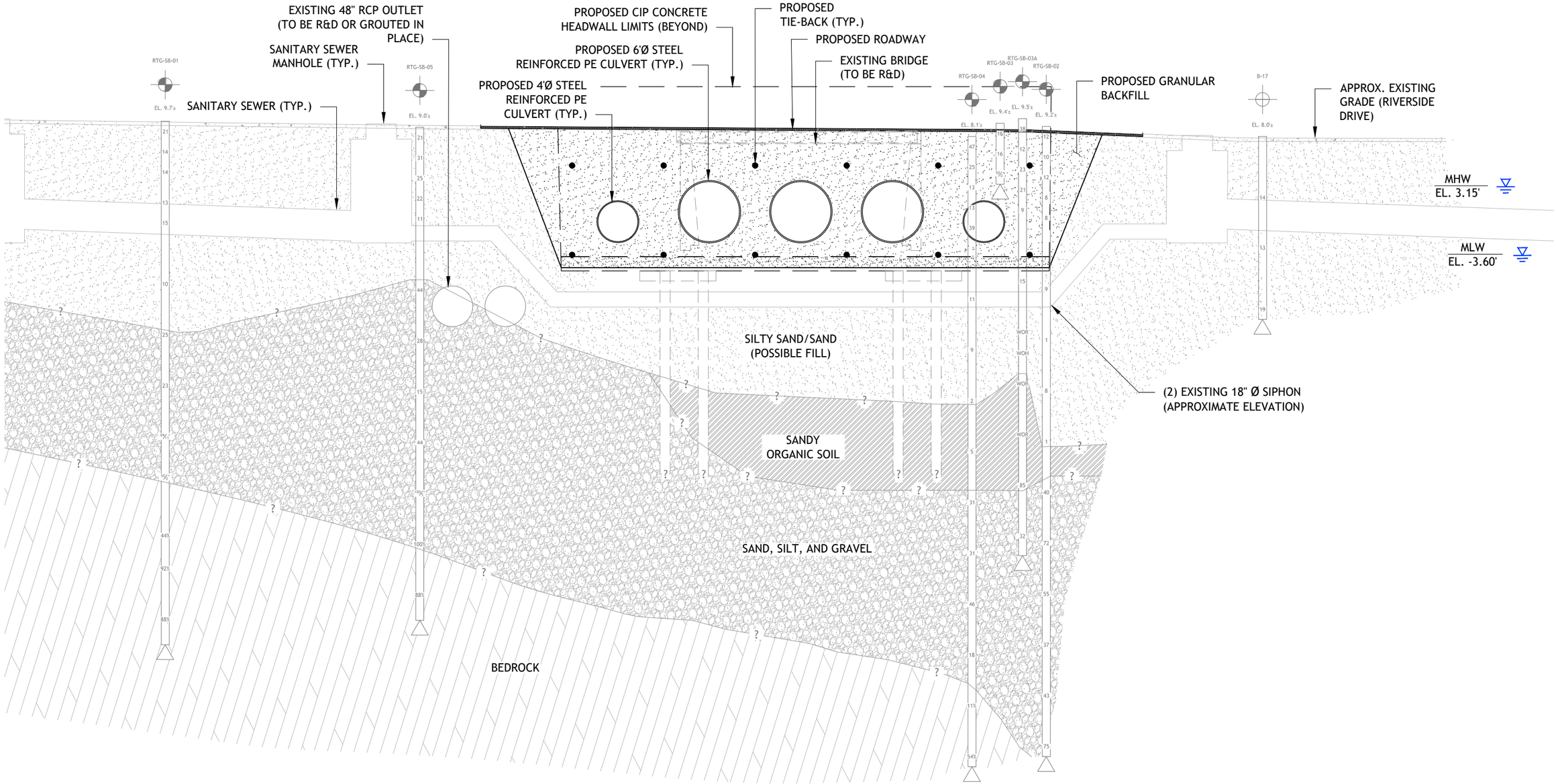
FIGURE 14
PROPOSED LONGITUDINAL SECTION
ALT. NO. 2a - NEW ANCHORED SHEET PILE HEADWALLS AND GROUND SUPPORTED CULVERTS

SHEET 14 of 18
DATE AUG. 2018
PROJ No. 17111.00



SECTION J
SCALE: 1"=10'-0" Fig 13

CONCEPTUAL

Graphic Scale 1"=10'

10' 5' 0 10' 20'

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FIGURE 15
PROPOSED TRANSVERSE SECTION
ALT. NO. 2a - NEW ANCHORED SHEET PILE HEADWALLS AND GROUND SUPPORTED CULVERTS

SHEET 15 of 18
DATE AUG. 2018
PROJ No. 17111.00

PROPOSED APRON (TYP.)

K
Fig 17

PROPOSED FLAP TIDE GATE
(TYP. OF EA. 6'Ø CULVERT)

PROPOSED SELF-REGULATING TIDE
GATE (TYP. OF EA. 4'Ø CULVERT)

PROPOSED RIPRAP
SLOPE (TYP.)

COASTAL JURISDICTION LINE EL=5.2'

RIVERSIDE DRIVE

SHOREHAM TERRACE

4Ø CULVERT

6Ø CULVERT

6Ø CULVERT

6Ø CULVERT

4Ø CULVERT

PROPOSED RIPRAP
REVETMENT

COASTAL JURISDICTION LINE EL=5.2'

L
Fig 18

COASTAL JURISDICTION
LINE EL=5.2'

PLAN
SCALE: 1"=20'-0"

CONCEPTUAL

Graphic Scale 1"=20'

20' 10' 0 20' 40'

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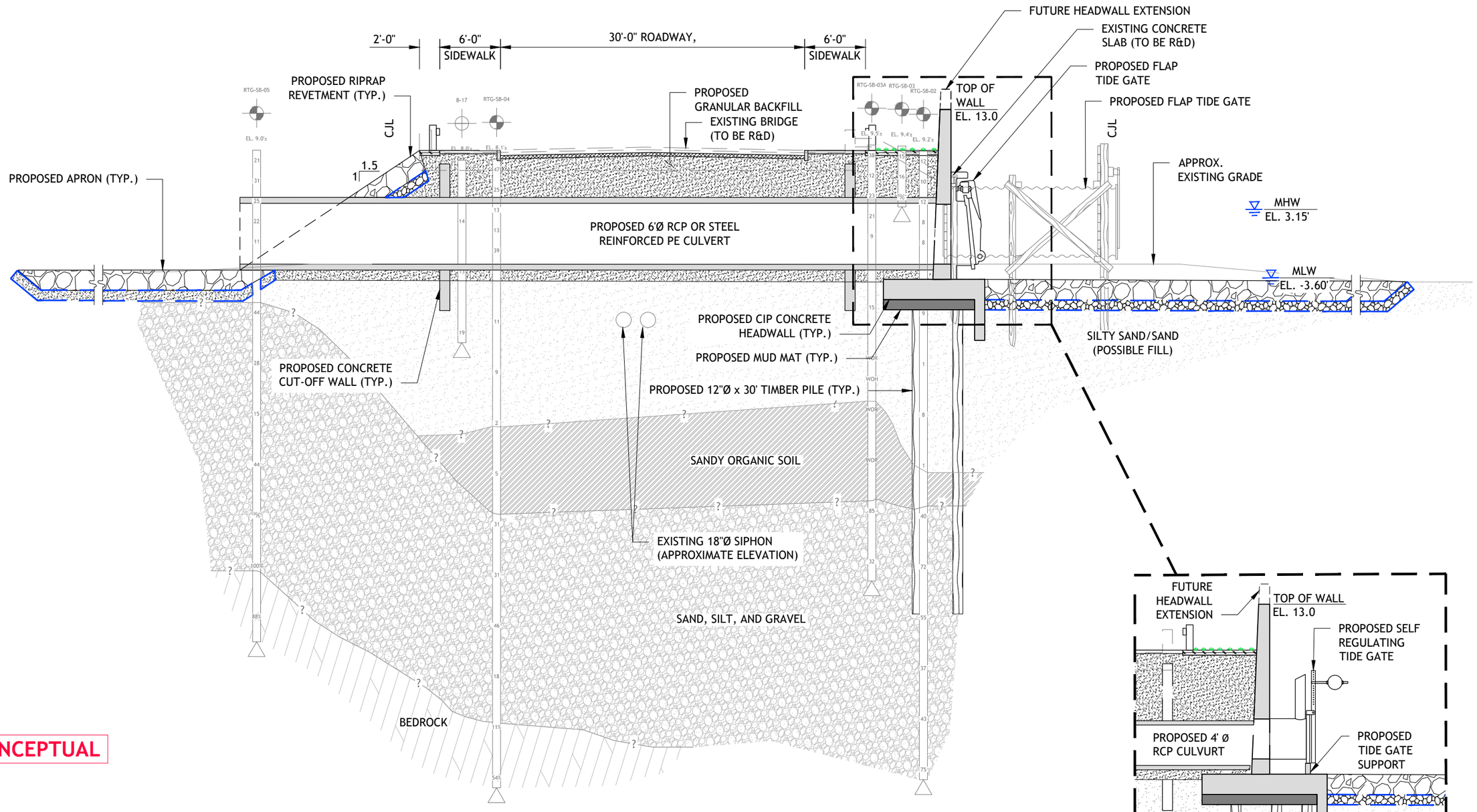
FIGURE 16
PROPOSED IMPROVEMENTS PLAN ALT.
NO. 3 - NEW PILE-SUPPORTED
HEADWALL / RIPRAP SLOPE AND
GROUND SUPPORTED CULVERTS

SHEET 16 of 18
DATE AUG. 2018
PROJ No. 17111.00



CONCEPTUAL

SECTION K
SCALE: 1"=10'-0" Fig 16

SELF-REGULATING TIDE GATE SECTION

Graphic Scale 1"=10'
10' 5' 0 10' 20'

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Town of Fairfield
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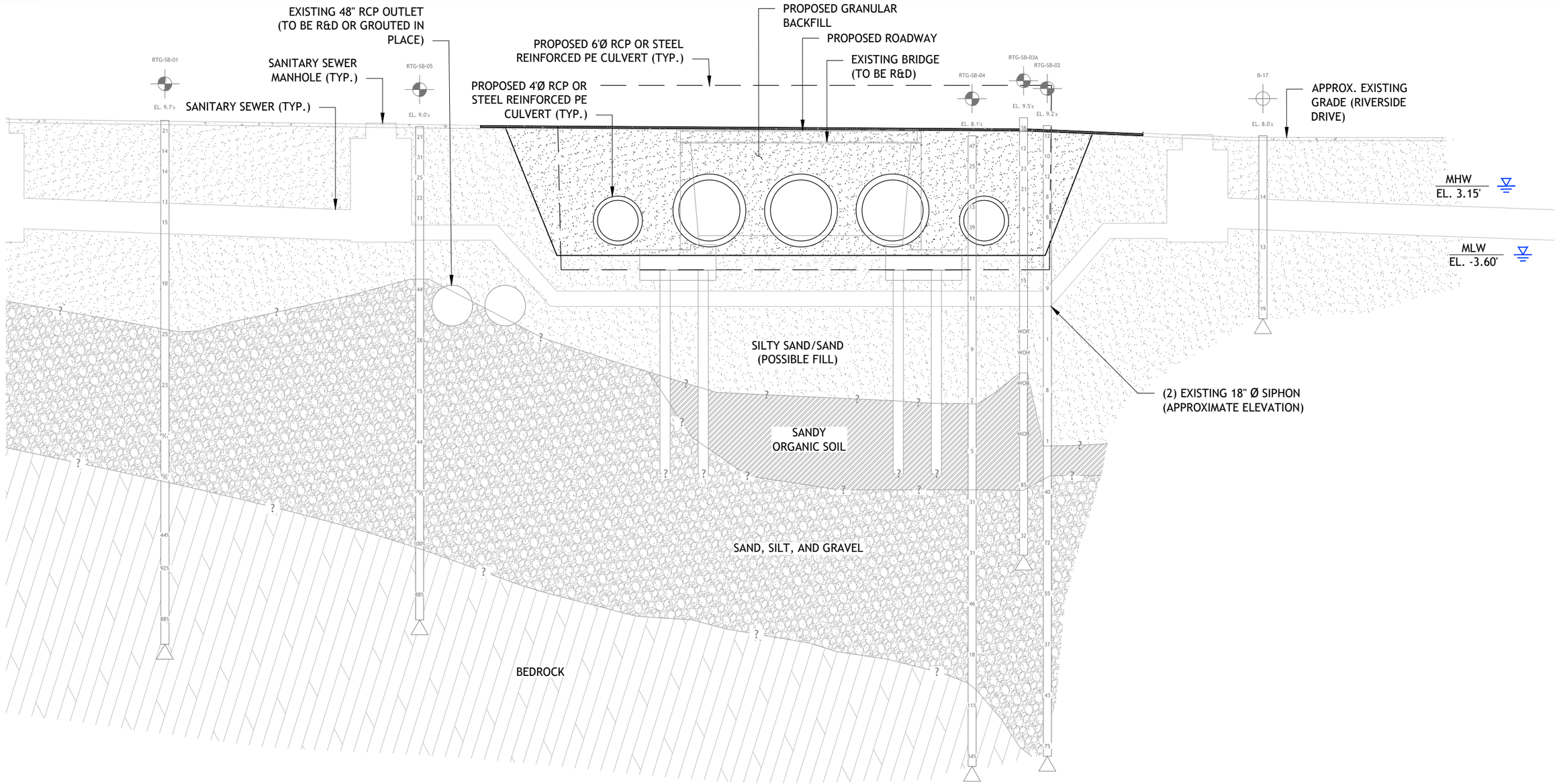
FIGURE 17
PROPOSED LONGITUDINAL SECTION
ALT. NO. 3 - NEW PILE-SUPPORTED HEADWALL / RIPRAP SLOPE AND GROUND SUPPORTED CULVERTS

SHEET 17 of 18
DATE AUG. 2018
PROJ No. 17111.00



SECTION (L / Fig 16)
SCALE: 1"=10'-0"

CONCEPTUAL

Graphic Scale 1"=10'
10' 5' 0 10' 20'

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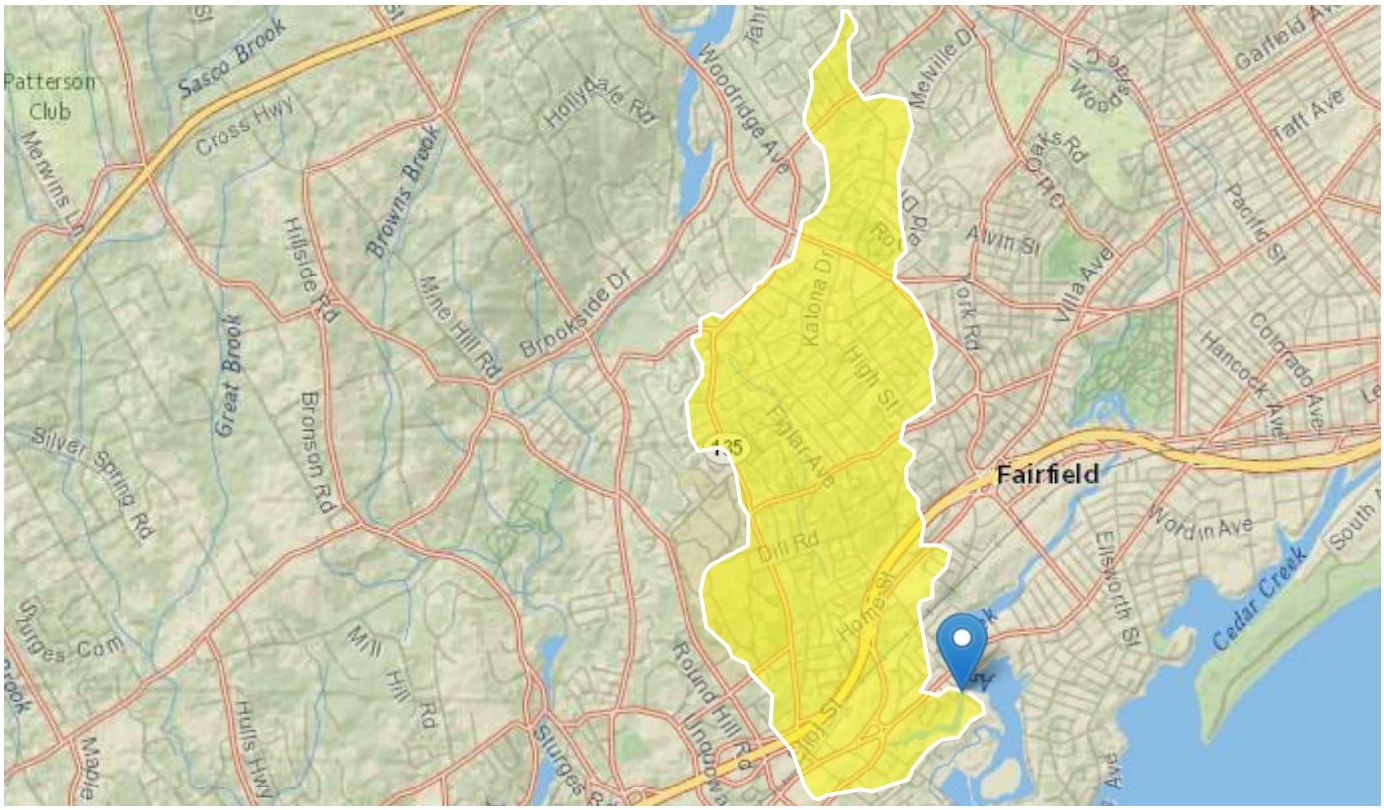
FIGURE 18
PROPOSED TRANSVERSE SECTION ALT. NO. 3 - NEW PILE-SUPPORTED HEADWALL / RIPRAP SLOPE AND GROUND SUPPORTED CULVERTS

SHEET 18 of 18
DATE AUG. 2018
PROJ No. 17111.00

APPENDIX A

StreamStats Report

Region ID: CT
Workspace ID: CT20180110201013307000
Clicked Point (Latitude, Longitude): 41.15165, -73.23705
Time: 2018-01-10 15:10:26 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.38	square miles
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precitation intensity index	3.562	inches
ELEV	Mean Basin Elevation	106	feet
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	5.305	inches
I24H25Y	Maximum 24-hour precipitation that occurs on average once in 25 years	6.67	inches
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	7.93	inches
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	9.44	inches
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	862847.7	
CENTROIDY	Basin centroid vertical (y) location in state plane units	621728.8	
CRSDFT	Percentage of area of coarse-grained stratified drift	0	percent

Parameter Code	Parameter Description	Value	Unit
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	98.8	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	39.7	percent
MAPM	Mean Annual Precip Basin Average	47.618	
NOVAVPRE	Mean November Precipitation	4.1	inches
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	865875	
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	616365	
PRCWINTER	Mean annual precipitation for December through February	3.6	inches
SGSL	Total stream length intersecting sand and gravel deposits (in miles)	2.1	
SOILPERM	Average Soil Permeability	3.161	inches per hour
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	6.36	miles
WETLAND	Percentage of Wetlands	0.73	percent

Peak-Flow Statistics Parameters [Statewide Multiparameter]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.38	square miles	1.69	715
I24H2Y	24 Hour 2 Year Precipitation	3.562	inches	2.95	3.82
ELEV	Mean Basin Elevation	106	feet	169	1310
I24H10Y	24 Hour 10 Year Precipitation	5.305	inches	4.15	5.53
I24H25Y	24 Hour 25 Year Precipitation	6.67	inches	4.93	7
I24H50Y	24 Hour 50 Year Precipitation	7.93	inches	5.62	8.36
I24H100Y	24 Hour 100 Year Precipitation	9.44	inches	6.41	9.99

Peak-Flow Statistics Disclaimers [Statewide Multiparameter]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Statewide Multiparameter]

Statistic	Value	Unit
2 Year Peak Flood	91.9	ft^3/s
10 Year Peak Flood	212	ft^3/s
25 Year Peak Flood	292	ft^3/s
50 Year Peak Flood	357	ft^3/s
100 Year Peak Flood	422	ft^3/s
500 Year Peak Flood	550	ft^3/s

Peak-Flow Statistics Citations

Ahearn, E.A.,2004, Regression Equations for Estimating Flood Flows for the 2-, 10-, 25-, 50-, 100-, and 500-Year Recurrence Intervals in Connecticut: U.S. Geological Survey SRI 2004-5160, 62 p. (http://water.usgs.gov/pubs/sir/2004/5160/)

NOAA Atlas 14, Volume 10, Version 2
Location name: Fairfield, Connecticut, USA*
Latitude: 41.1413°, Longitude: -73.2489°
Elevation: 10.72 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.354** (0.281-0.441)	**0.420** (0.333-0.524)	**0.528** (0.417-0.660)	**0.617** (0.485-0.776)	**0.740** (0.561-0.970)	**0.835** (0.618-1.12)	**0.929** (0.666-1.29)	**1.04** (0.707-1.48)	**1.19** (0.776-1.75)	**1.31** (0.828-1.96)
10-min	**0.502** (0.399-0.625)	**0.595** (0.472-0.742)	**0.747** (0.591-0.936)	**0.874** (0.687-1.10)	**1.05** (0.794-1.38)	**1.18** (0.876-1.58)	**1.32** (0.943-1.83)	**1.48** (1.00-2.10)	**1.69** (1.10-2.49)	**1.85** (1.17-2.78)
15-min	**0.590** (0.469-0.735)	**0.700** (0.555-0.873)	**0.879** (0.695-1.10)	**1.03** (0.808-1.29)	**1.23** (0.935-1.62)	**1.39** (1.03-1.86)	**1.55** (1.11-2.15)	**1.74** (1.18-2.47)	**1.99** (1.29-2.92)	**2.18** (1.38-3.27)
30-min	**0.824** (0.655-1.03)	**0.977** (0.775-1.22)	**1.23** (0.970-1.54)	**1.44** (1.13-1.81)	**1.72** (1.30-2.26)	**1.94** (1.44-2.60)	**2.16** (1.55-2.99)	**2.42** (1.64-3.43)	**2.76** (1.79-4.05)	**3.02** (1.91-4.52)
60-min	**1.06** (0.840-1.32)	**1.25** (0.995-1.56)	**1.58** (1.25-1.97)	**1.84** (1.45-2.32)	**2.21** (1.67-2.89)	**2.49** (1.84-3.33)	**2.77** (1.98-3.83)	**3.10** (2.10-4.40)	**3.53** (2.29-5.18)	**3.85** (2.44-5.78)
2-hr	**1.37** (1.09-1.69)	**1.64** (1.31-2.03)	**2.08** (1.65-2.58)	**2.44** (1.93-3.05)	**2.94** (2.25-3.84)	**3.33** (2.48-4.43)	**3.72** (2.68-5.13)	**4.20** (2.86-5.92)	**4.83** (3.15-7.05)	**5.31** (3.37-7.90)
3-hr	**1.57** (1.26-1.94)	**1.89** (1.52-2.33)	**2.41** (1.93-2.99)	**2.84** (2.26-3.54)	**3.44** (2.63-4.47)	**3.90** (2.92-5.17)	**4.35** (3.15-6.00)	**4.94** (3.37-6.94)	**5.72** (3.73-8.31)	**6.30** (4.01-9.34)
6-hr	**1.98** (1.60-2.42)	**2.39** (1.93-2.93)	**3.06** (2.47-3.76)	**3.62** (2.89-4.47)	**4.38** (3.38-5.66)	**4.97** (3.75-6.56)	**5.56** (4.06-7.62)	**6.34** (4.34-8.85)	**7.38** (4.83-10.6)	**8.16** (5.21-12.0)
12-hr	**2.44** (1.99-2.96)	**2.95** (2.40-3.59)	**3.78** (3.07-4.61)	**4.47** (3.60-5.49)	**5.43** (4.21-6.96)	**6.16** (4.68-8.08)	**6.89** (5.06-9.40)	**7.89** (5.42-10.9)	**9.21** (6.05-13.2)	**10.2** (6.53-14.9)
24-hr	**2.85** (2.34-3.43)	**3.47** (2.85-4.19)	**4.50** (3.68-5.45)	**5.35** (4.34-6.52)	**6.53** (5.11-8.33)	**7.43** (5.68-9.71)	**8.34** (6.18-11.3)	**9.63** (6.64-13.3)	**11.3** (7.48-16.1)	**12.6** (8.11-18.3)
2-day	**3.16** (2.61-3.78)	**3.92** (3.24-4.70)	**5.18** (4.26-6.22)	**6.22** (5.08-7.51)	**7.65** (6.03-9.73)	**8.76** (6.75-11.4)	**9.86** (7.38-13.4)	**11.6** (7.99-15.8)	**13.8** (9.12-19.5)	**15.5** (9.97-22.3)
3-day	**3.41** (2.83-4.06)	**4.25** (3.52-5.06)	**5.62** (4.64-6.73)	**6.77** (5.55-8.14)	**8.34** (6.60-10.6)	**9.55** (7.39-12.4)	**10.8** (8.09-14.6)	**12.6** (8.77-17.2)	**15.1** (10.0-21.3)	**17.0** (11.0-24.4)
4-day	**3.65** (3.04-4.33)	**4.54** (3.77-5.39)	**5.99** (4.96-7.14)	**7.19** (5.91-8.62)	**8.84** (7.02-11.2)	**10.1** (7.85-13.1)	**11.4** (8.58-15.4)	**13.4** (9.29-18.1)	**16.0** (10.6-22.4)	**18.0** (11.6-25.7)
7-day	**4.36** (3.65-5.14)	**5.31** (4.44-6.27)	**6.87** (5.73-8.15)	**8.17** (6.76-9.73)	**9.95** (7.93-12.5)	**11.3** (8.82-14.5)	**12.7** (9.57-17.0)	**14.7** (10.3-19.9)	**17.4** (11.6-24.3)	**19.5** (12.6-27.7)
10-day	**5.05** (4.25-5.93)	**6.04** (5.08-7.11)	**7.67** (6.42-9.06)	**9.03** (7.50-10.7)	**10.9** (8.69-13.5)	**12.3** (9.60-15.7)	**13.8** (10.4-18.2)	**15.8** (11.0-21.2)	**18.5** (12.3-25.6)	**20.5** (13.3-29.0)
20-day	**7.12** (6.03-8.31)	**8.22** (6.96-9.60)	**10.0** (8.44-11.7)	**11.5** (9.63-13.6)	**13.6** (10.9-16.6)	**15.1** (11.8-19.0)	**16.7** (12.5-21.7)	**18.6** (13.1-24.8)	**21.2** (14.2-29.1)	**23.1** (15.0-32.4)
30-day	**8.84** (7.52-10.3)	**10.0** (8.51-11.6)	**11.9** (10.1-13.9)	**13.5** (11.4-15.9)	**15.7** (12.6-19.1)	**17.4** (13.6-21.6)	**19.1** (14.3-24.5)	**20.9** (14.8-27.7)	**23.4** (15.7-32.0)	**25.2** (16.4-35.2)
45-day	**11.0** (9.38-12.7)	**12.2** (10.4-14.2)	**14.3** (12.1-16.6)	**16.0** (13.5-18.7)	**18.3** (14.8-22.2)	**20.2** (15.8-24.8)	**22.0** (16.4-27.9)	**23.7** (16.8-31.2)	**26.1** (17.6-35.5)	**27.8** (18.2-38.7)
60-day	**12.8** (10.9-14.7)	**14.1** (12.1-16.2)	**16.3** (13.9-18.8)	**18.0** (15.3-21.0)	**20.5** (16.6-24.7)	**22.4** (17.6-27.5)	**24.3** (18.2-30.7)	**26.1** (18.5-34.1)	**28.4** (19.2-38.4)	**30.1** (19.7-41.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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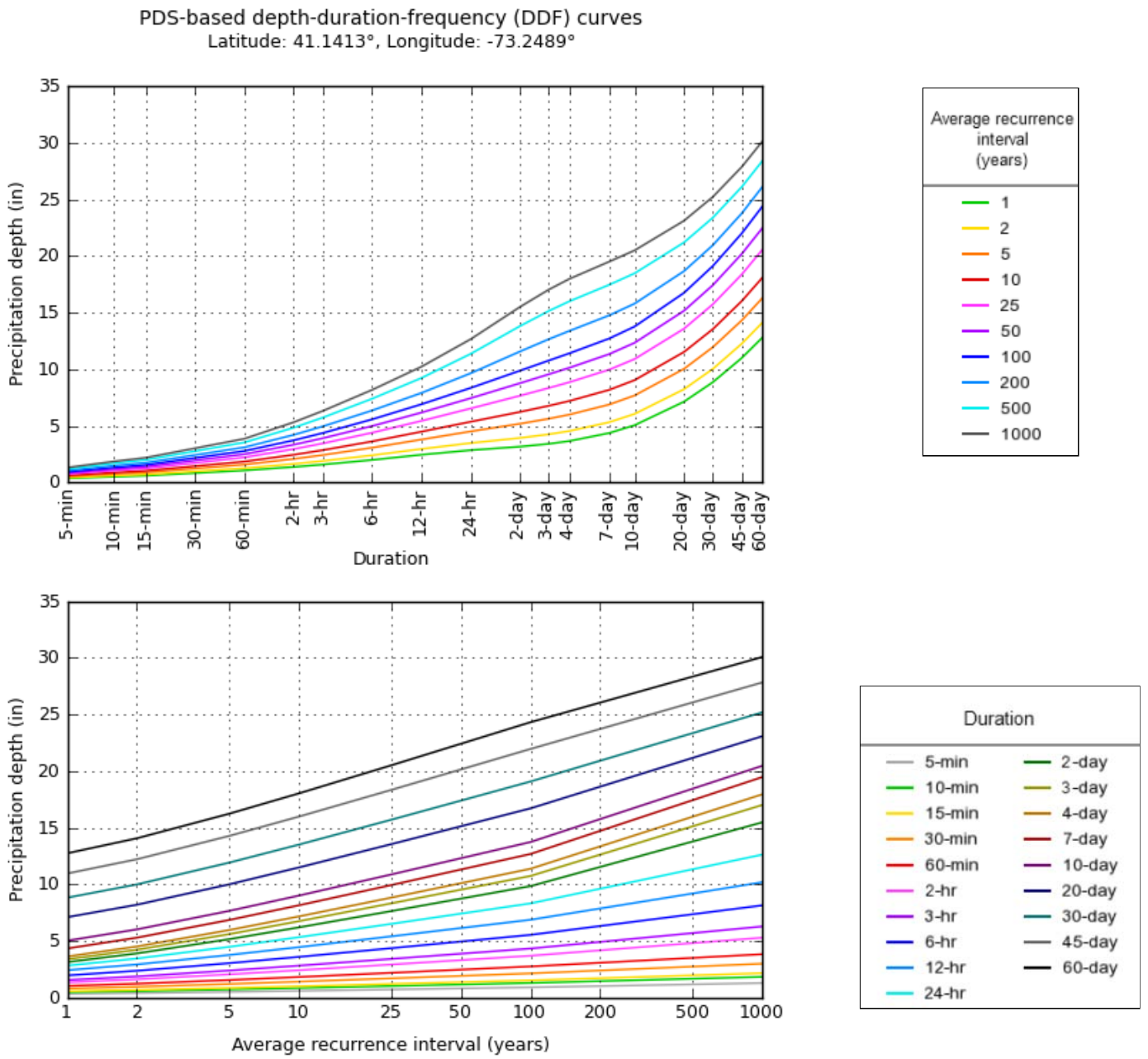
PF graphical



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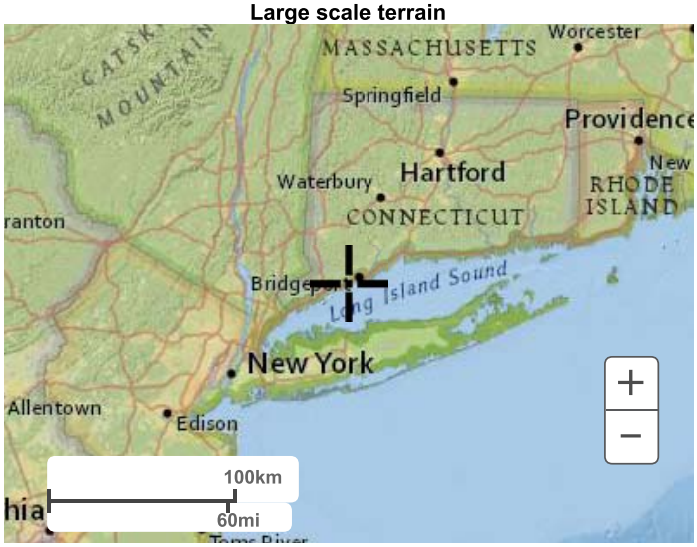
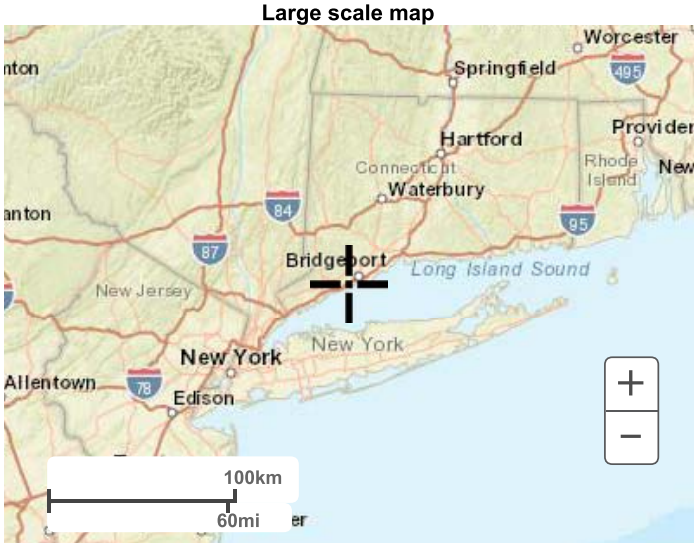
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

USGS Regional Regression Equations Worksheet

Turney Creek at Riverside Drive

January 10, 2018

Input Parameters

DA, Drainage Area	2.38 mi2
P2	3.47 inches
P10	5.35 inches
P25	6.53 inches
P50	7.43 inches
P100	8.34 inches
EL, Mean Basin Elevation, NAVD88	106 feet
SL, Channel Slope	50.8 ft/mi
R2	1.7 inches
ST, Basin Storage	0 percent
BDF, Basin Development Factor	10
IA, Impervious area	39.7 percent

Regression Equations (Non-Urbanized)

RQ2	85 cfs
RQ10	217 cfs
RQ25	279 cfs
RQ50	317 cfs
RQ100	345 cfs
RQ500	550 cfs

Urbanized Equations

UQ2	392 cfs
UQ10	740 cfs
UQ25	879 cfs
UQ50	989 cfs
UQ100	1090 cfs
UQ500	1506 cfs

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT ANNUAL CHANCE	0.2-PERCENT ANNUAL CHANCE
FERRY CREEK/LONG BROOK					
At Tide Gates at Broad Street	2.08	518	691	758	930
At Stratford Square	1.10	227	303	330	400
FIVE MILE RIVER					
At Tokeneke Road	12.50	1,300	3,050	4,600	8,800
Upstream of Keelers Brook confluence	9.83	1,100	2,600	3,800	8,200
Downstream of Boston Post Road	8.96	1,000	2,400	3,600	7,600
Approximately 1,950 feet downstream of Florsheim Pond	7.46	910	2,100	3,100	6,700
At State Route 15	6.58	680	1,160	1,410	2,500
At Old Norwalk Road	5.25	540	920	1,120	2,000
At Mill Pond	4.50	460	790	960	1,710
At State Route 123	3.28	340	580	700	1,250
Upstream of Country Club Road	0.83	150	260	310	550
GOODWIVES RIVER					
Upstream of confluence with Stony Brook 1	2.00	290	410	495	780
Upstream of Boston Post Road	1.37	210	300	360	565
GRASMERE BROOK					
Downstream of Old Field Road	2.4	690	940	1,100	1,600
Above Kings Highway Cutoff	1.92	600	790	880	1,350
Above Home Street	1.20	440	530	580	820
Above confluence of tributary, downstream of Glenarden Drive	0.94	354	427	467	660
HALFWAY RIVER					
At confluence with Lake Zoar	10.80	1,038	1,871	2,337	3,752

APPENDIX B

Turney Creek Outfall
Fairfield, CT

Existing Conditions
HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 85 cfs

Design Flow: 1090 cfs

Maximum Flow: 1506 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Culvert 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
3.22	85.00	72.31	13.53	0.00	10
3.34	227.10	191.56	36.37	0.00	6
3.56	369.20	310.63	58.90	0.00	5
3.89	511.30	430.23	81.13	0.00	5
4.31	653.40	550.52	103.01	0.00	4
4.82	795.50	671.25	124.30	0.00	4
5.41	937.60	792.74	145.07	0.00	3
6.06	1079.70	914.72	165.16	0.00	3
6.11	1090.00	923.45	166.57	0.00	3
7.64	1363.90	1158.44	205.59	0.00	5
8.74	1506.00	1275.95	229.81	0.00	8
9.00	1536.70	1301.63	235.07	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 1

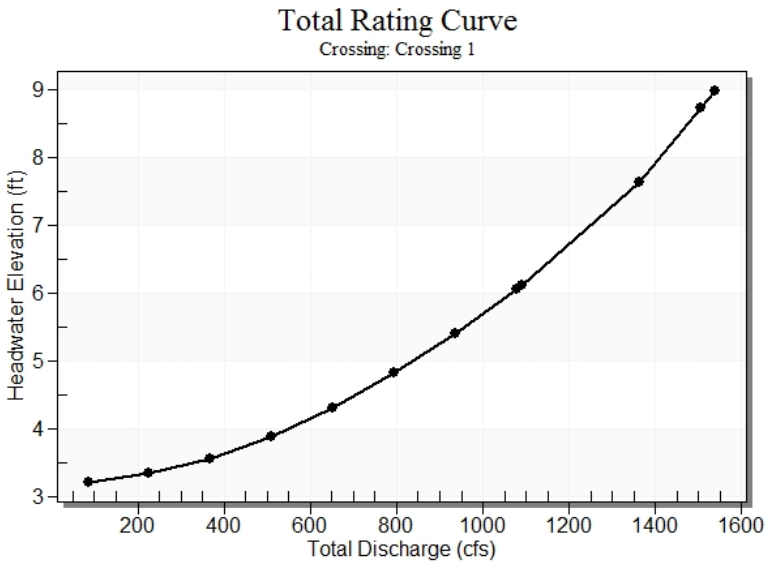

Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	72.31	3.22	1.810	5.520	3-M1t	1.734	1.231	5.700	5.700	0.718	0.000
227.10	191.56	3.34	3.015	5.640	3-M1t	2.898	2.032	5.700	5.700	1.903	0.000
369.20	310.63	3.56	3.922	5.864	3-M1t	3.847	2.612	5.700	5.700	3.086	0.000
511.30	430.23	3.89	4.741	6.191	3-M1t	4.808	3.097	5.700	5.700	4.274	0.000
653.40	550.52	4.31	5.521	6.613	3-M2t	7.000	3.525	5.700	5.700	5.468	0.000
795.50	671.25	4.82	6.297	7.122	3-M2t	7.000	3.905	5.700	5.700	6.668	0.000
937.60	792.74	5.41	7.102	7.708	3-M2t	7.000	4.260	5.700	5.700	7.874	0.000
1079.70	914.72	6.06	7.963	8.363	3-M2t	7.000	4.591	5.700	5.700	9.086	0.000
1090.00	923.45	6.11	8.027	8.412	3-M2t	7.000	4.613	5.700	5.700	9.173	0.000
1363.90	1158.44	7.64	9.936	9.902	3-M2t	7.000	5.177	5.700	5.700	11.507	0.000
1506.00	1275.95	8.74	11.043	10.863	7-M2t	7.000	5.426	5.700	5.700	12.674	0.000

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Straight Culvert

Inlet Elevation (invert): -2.30 ft, Outlet Elevation (invert): -2.50 ft

Culvert Length: 50.00 ft, Culvert Slope: 0.0040

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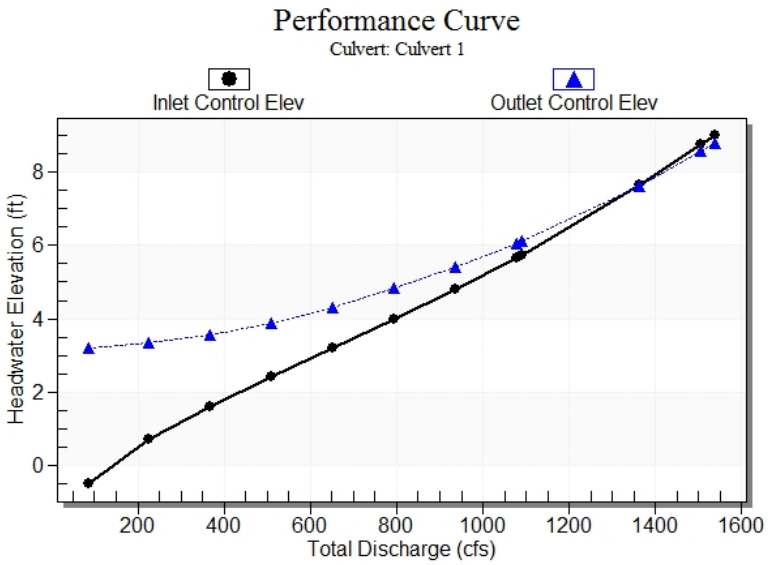
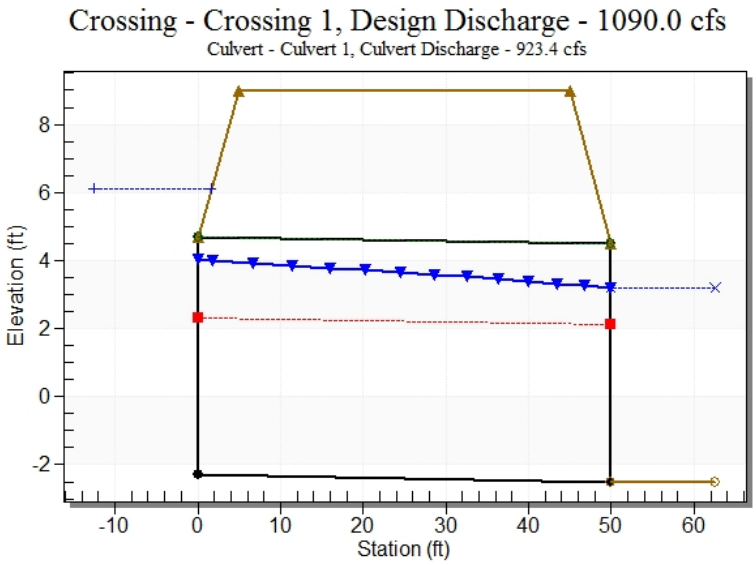
Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: -2.30 ft

Outlet Station: 50.00 ft

Outlet Elevation: -2.50 ft

Number of Barrels: 3

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 7.00 ft

Barrel Material: Corrugated Aluminum

Embedment: 0.00 in

Barrel Manning's n: 0.0310

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Culvert Summary Table: Culvert 2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	13.53	3.22	1.106	5.819	4-FFf	1.086	0.752	4.000	5.700	0.538	0.000
227.10	36.37	3.34	1.860	5.939	4-FFf	1.848	1.248	4.000	5.700	1.447	0.000
369.20	58.90	3.56	2.430	6.164	4-FFf	2.494	1.606	4.000	5.700	2.344	0.000
511.30	81.13	3.89	2.943	6.491	4-FFf	4.000	1.902	4.000	5.700	3.228	0.000
653.40	103.01	4.31	3.431	6.913	4-FFf	4.000	2.150	4.000	5.700	4.099	0.000
795.50	124.30	4.82	3.913	7.421	4-FFf	4.000	2.374	4.000	5.700	4.946	0.000
937.60	145.07	5.41	4.412	8.009	4-FFf	4.000	2.571	4.000	5.700	5.772	0.000
1079.70	165.16	6.06	4.935	8.662	4-FFf	4.000	2.751	4.000	5.700	6.571	0.000
1090.00	166.57	6.11	4.974	8.712	4-FFf	4.000	2.763	4.000	5.700	6.628	0.000
1363.90	205.59	7.64	6.160	10.236	4-FFf	4.000	3.067	4.000	5.700	8.180	0.000
1506.00	229.81	8.74	7.029	11.342	4-FFf	4.000	3.232	4.000	5.700	9.144	0.000

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Straight Culvert

Inlet Elevation (invert): -2.60 ft, Outlet Elevation (invert): -2.97 ft

Culvert Length: 85.00 ft, Culvert Slope: 0.0044

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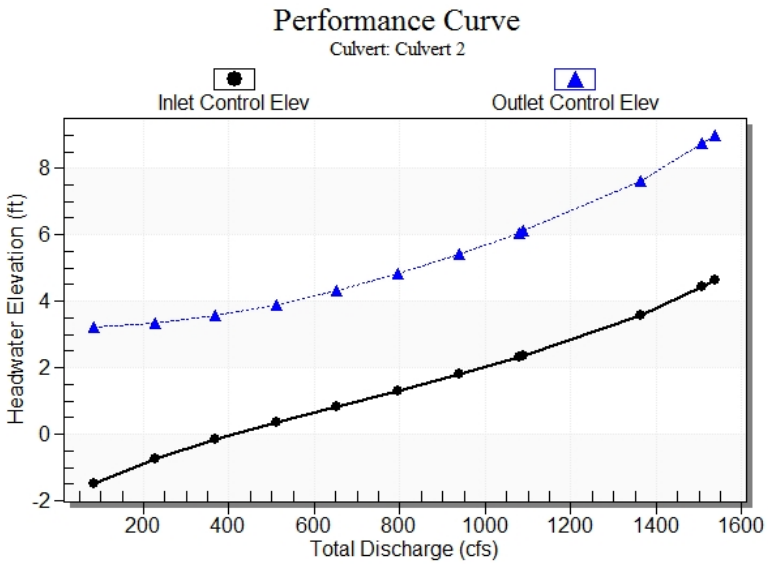
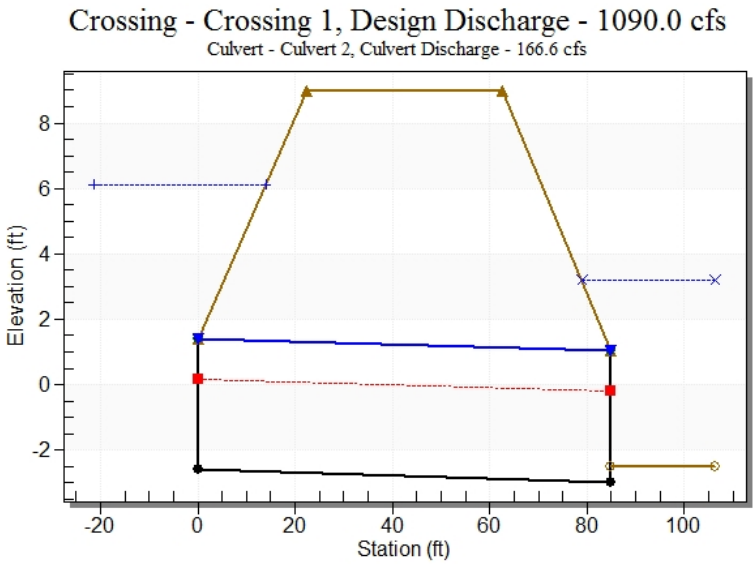
Culvert Performance Curve Plot: Culvert 2



Water Surface Profile Plot for Culvert: Culvert 2



Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: -2.60 ft

Outlet Station: 85.00 ft

Outlet Elevation: -2.97 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 2

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Corrugated Aluminum

Embedment: 0.00 in

Barrel Manning's n: 0.0310

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 4 - Downstream Channel Rating Curve (Crossing: Crossing 1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
85.00	3.20	5.70
227.10	3.20	5.70
369.20	3.20	5.70
511.30	3.20	5.70
653.40	3.20	5.70
795.50	3.20	5.70
937.60	3.20	5.70
1079.70	3.20	5.70
1090.00	3.20	5.70
1363.90	3.20	5.70
1506.00	3.20	5.70

Tailwater Channel Data - Crossing 1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 3.20 ft

Roadway Data for Crossing: Crossing 1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 9.00 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

APPENDIX C

Turney Creek Outfall
Fairfield, CT

Proposed Culvert Option 1
HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 85 cfs

Design Flow: 1090 cfs

Maximum Flow: 1506 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Culvert 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
3.22	85.00	69.34	16.36	0.00	10
3.33	227.10	183.72	44.28	0.00	6
3.54	369.20	297.80	71.78	0.00	5
3.86	511.30	412.05	99.33	0.00	5
4.27	653.40	526.64	126.95	0.00	4
4.79	795.50	641.17	154.41	0.00	4
5.40	937.60	755.83	181.80	0.00	4
6.17	1079.70	868.63	211.14	0.00	5
6.24	1090.00	876.34	213.68	0.00	3
8.61	1363.90	1097.54	266.31	0.00	8
9.41	1506.00	1162.20	280.45	63.11	4
9.00	1403.14	1129.80	273.34	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 1

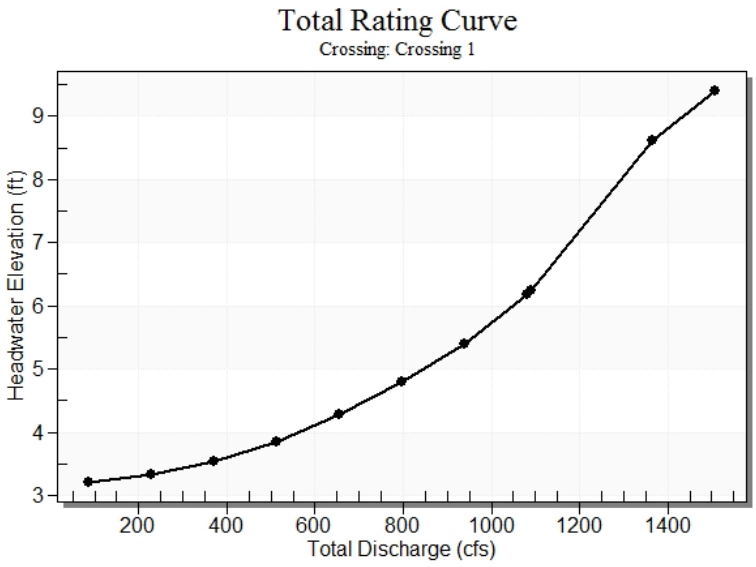


Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	69.34	3.22	1.718	5.219	1-S1t	1.054	1.260	5.450	5.700	0.842	0.000
227.10	183.72	3.33	2.871	5.331	1-S1t	1.718	2.080	5.450	5.700	2.232	0.000
369.20	297.80	3.54	3.866	5.544	1-S1t	2.216	2.679	5.450	5.700	3.618	0.000
511.30	412.05	3.86	4.719	5.858	1-S1t	2.652	3.172	5.450	5.700	5.007	0.000
653.40	526.64	4.27	5.507	6.274	1-S1t	3.060	3.607	5.450	5.700	6.399	0.000
795.50	641.17	4.79	6.311	6.790	1-S1t	3.459	3.996	5.450	5.700	7.790	0.000
937.60	755.83	5.40	7.191	7.403	1-S1t	3.866	4.343	5.450	5.700	9.183	0.000
1079.70	868.63	6.17	8.172	8.098	5-S1t	4.299	4.652	5.450	5.700	10.554	0.000
1090.00	876.34	6.24	8.244	8.148	5-S1t	4.331	4.672	5.450	5.700	10.648	0.000
1363.90	1097.54	8.61	10.605	9.733	3-M2t	6.000	5.158	5.450	5.700	13.560	0.000
1506.00	1162.20	9.41	11.409	10.240	3-M2t	6.000	5.273	5.450	5.700	14.359	0.000

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Straight Culvert

Inlet Elevation (invert): -2.00 ft, Outlet Elevation (invert): -2.25 ft

Culvert Length: 50.00 ft, Culvert Slope: 0.0050

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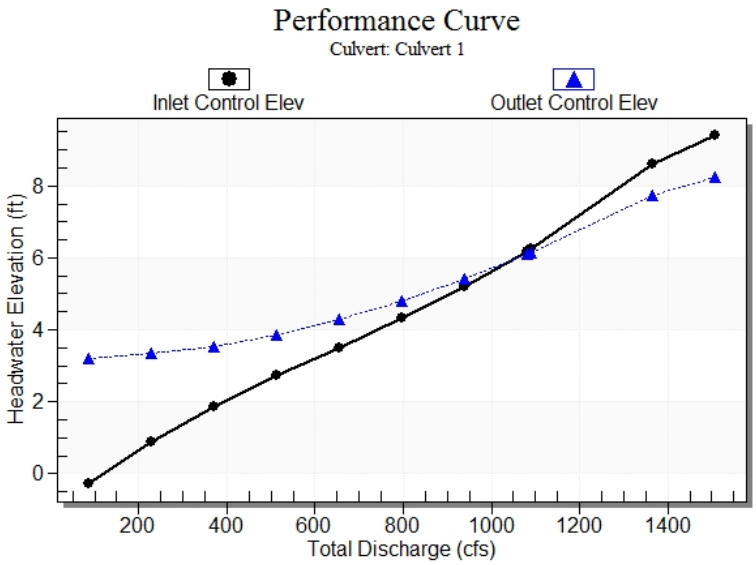
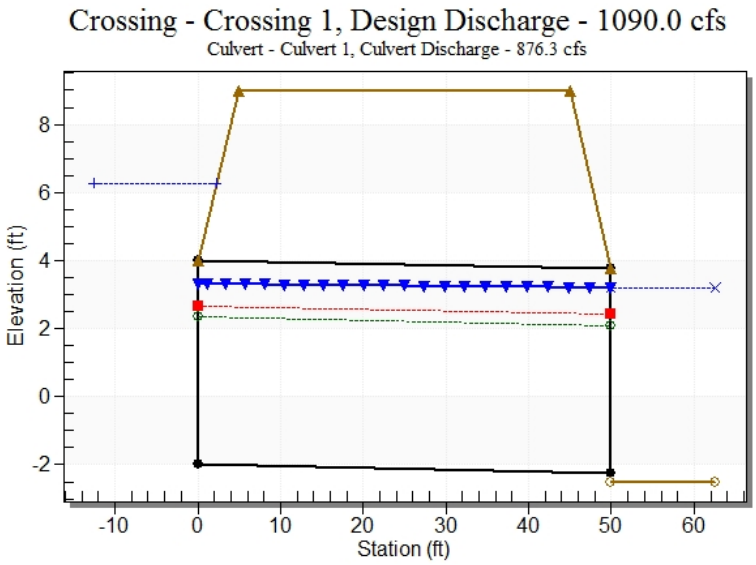
Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: -2.00 ft

Outlet Station: 50.00 ft

Outlet Elevation: -2.25 ft

Number of Barrels: 3

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 6.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Culvert Summary Table: Culvert 2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	16.36	3.22	1.514	5.218	4-FFf	0.941	1.111	5.000	5.700	0.833	0.000
227.10	44.28	3.33	2.582	5.331	4-FFf	1.558	1.857	5.000	5.700	2.255	0.000
369.20	71.78	3.54	3.494	5.543	4-FFf	2.017	2.394	5.000	5.700	3.656	0.000
511.30	99.33	3.86	4.267	5.858	4-FFf	2.427	2.831	5.000	5.700	5.059	0.000
653.40	126.95	4.27	5.018	6.274	4-FFf	2.819	3.221	5.000	5.700	6.466	0.000
795.50	154.41	4.79	5.825	6.789	4-FFf	3.214	3.558	5.000	5.700	7.864	0.000
937.60	181.80	5.40	6.746	7.403	4-FFf	3.646	3.859	5.000	5.700	9.259	0.000
1079.70	211.14	6.17	7.901	8.172	4-FFf	5.000	4.132	5.000	5.700	10.753	0.000
1090.00	213.68	6.24	8.010	8.244	4-FFf	5.000	4.154	5.000	5.700	10.882	0.000
1363.90	266.31	8.61	10.605	9.927	4-FFf	5.000	4.518	5.000	5.700	13.563	0.000
1506.00	280.45	9.41	11.409	10.443	4-FFf	5.000	4.589	5.000	5.700	14.283	0.000

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Straight Culvert

Inlet Elevation (invert): -2.00 ft, Outlet Elevation (invert): -2.25 ft

Culvert Length: 50.00 ft, Culvert Slope: 0.0050

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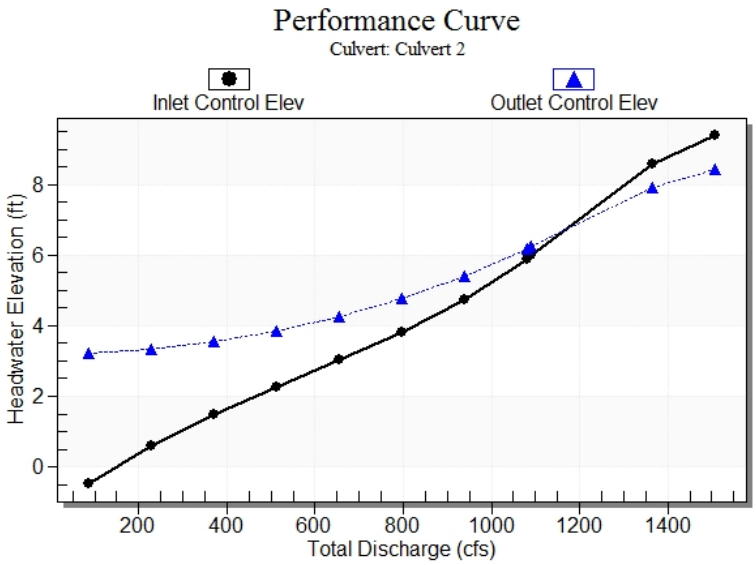
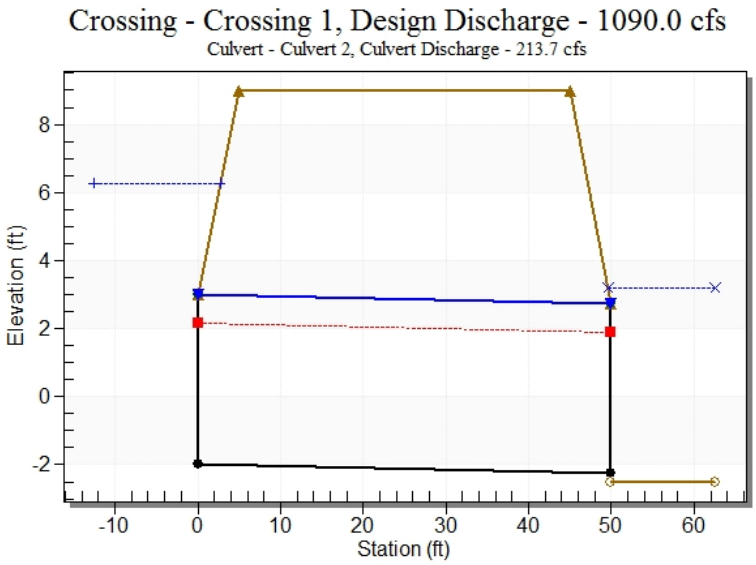
Culvert Performance Curve Plot: Culvert 2



Water Surface Profile Plot for Culvert: Culvert 2



Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: -2.00 ft

Outlet Station: 50.00 ft

Outlet Elevation: -2.25 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 2

Barrel Shape: Circular

Barrel Diameter: 5.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 4 - Downstream Channel Rating Curve (Crossing: Crossing 1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
85.00	3.20	5.70
227.10	3.20	5.70
369.20	3.20	5.70
511.30	3.20	5.70
653.40	3.20	5.70
795.50	3.20	5.70
937.60	3.20	5.70
1079.70	3.20	5.70
1090.00	3.20	5.70
1363.90	3.20	5.70
1506.00	3.20	5.70

Tailwater Channel Data - Crossing 1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 3.20 ft

Roadway Data for Crossing: Crossing 1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 9.00 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Turney Creek Outfall
Fairfield, CT

Proposed Culvert Option 2
HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 85 cfs

Design Flow: 1090 cfs

Maximum Flow: 1506 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Culvert 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
3.21	85.00	71.43	14.00	0.00	11
3.30	227.10	189.97	38.35	0.00	6
3.46	369.20	307.57	62.14	0.00	5
3.69	511.30	425.42	86.01	0.00	5
4.01	653.40	543.69	110.02	0.00	4
4.40	795.50	661.70	133.97	0.00	4
4.86	937.60	779.67	158.00	0.00	4
5.41	1079.70	897.49	182.25	0.00	4
5.46	1090.00	905.95	184.01	0.00	3
6.57	1363.90	1139.02	224.89	0.00	4
7.42	1506.00	1262.13	243.94	0.00	3
9.00	1735.02	1461.68	273.34	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 1

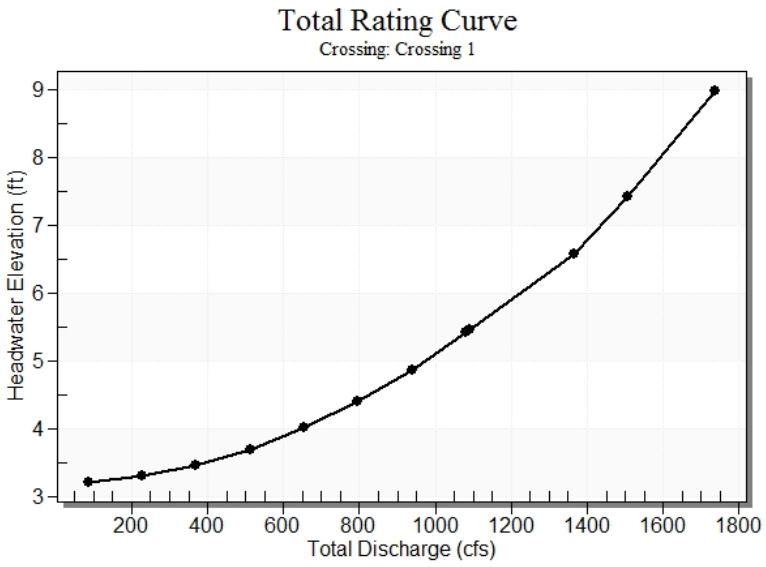


Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	71.43	3.21	1.665	5.214	1-S1t	1.019	1.223	5.450	5.700	0.722	0.000
227.10	189.97	3.30	2.777	5.298	1-S1t	1.654	2.023	5.450	5.700	1.921	0.000
369.20	307.57	3.46	3.611	5.458	1-S1t	2.116	2.598	5.450	5.700	3.110	0.000
511.30	425.42	3.69	4.431	5.694	1-S1t	2.511	3.078	5.450	5.700	4.302	0.000
653.40	543.69	4.01	5.152	6.007	1-S1t	2.870	3.502	5.450	5.700	5.498	0.000
795.50	661.70	4.40	5.814	6.396	1-S1t	3.207	3.876	5.450	5.700	6.691	0.000
937.60	779.67	4.86	6.455	6.864	1-S1t	3.530	4.224	5.450	5.700	7.884	0.000
1079.70	897.49	5.41	7.106	7.414	1-S1t	3.848	4.546	5.450	5.700	9.076	0.000
1090.00	905.95	5.46	7.153	7.457	1-S1t	3.870	4.568	5.450	5.700	9.161	0.000
1363.90	1139.02	6.57	8.571	7.617	5-S2n	4.507	5.134	4.840	5.700	13.001	0.000
1506.00	1262.13	7.42	9.425	8.167	5-S2n	4.866	5.398	5.155	5.700	13.484	0.000

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Straight Culvert

Inlet Elevation (invert): -2.00 ft, Outlet Elevation (invert): -2.25 ft

Culvert Length: 50.00 ft, Culvert Slope: 0.0050

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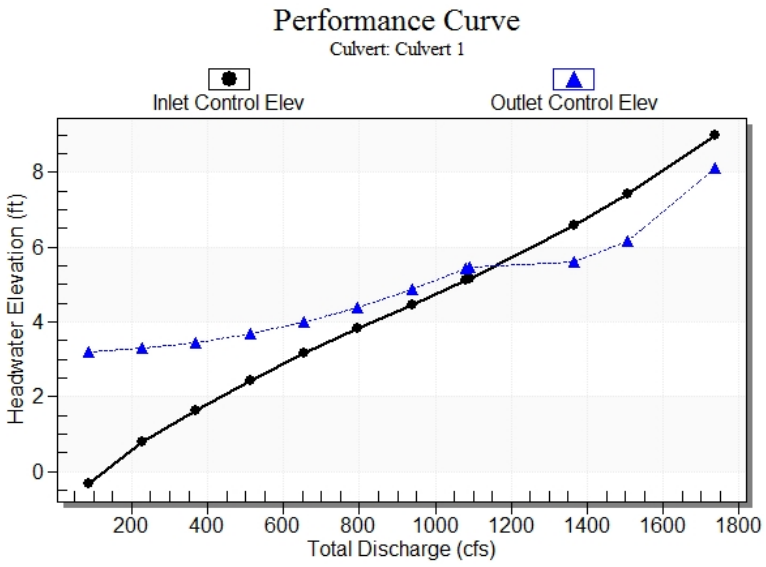
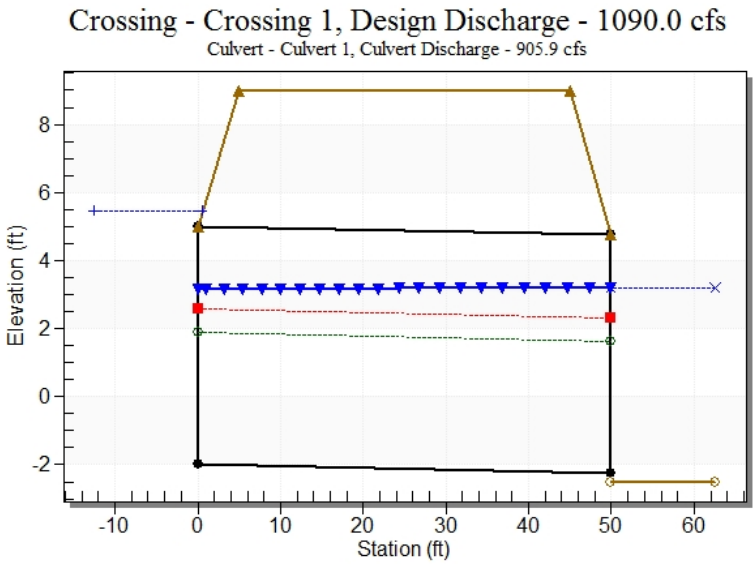
Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: -2.00 ft

Outlet Station: 50.00 ft

Outlet Elevation: -2.25 ft

Number of Barrels: 3

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 7.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Culvert Summary Table: Culvert 2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	14.00	3.21	1.397	5.213	4-FFf	0.871	1.025	5.000	5.700	0.713	0.000
227.10	38.35	3.30	2.376	5.298	4-FFf	1.445	1.722	5.000	5.700	1.953	0.000
369.20	62.14	3.46	3.197	5.457	4-FFf	1.864	2.218	5.000	5.700	3.165	0.000
511.30	86.01	3.69	3.903	5.693	4-FFf	2.233	2.627	5.000	5.700	4.381	0.000
653.40	110.02	4.01	4.555	6.007	4-FFf	2.579	2.988	5.000	5.700	5.603	0.000
795.50	133.97	4.40	5.216	6.396	4-FFf	2.918	3.311	5.000	5.700	6.823	0.000
937.60	158.00	4.86	5.938	6.864	4-FFf	3.268	3.600	5.000	5.700	8.047	0.000
1079.70	182.25	5.41	6.762	7.414	4-FFf	3.654	3.864	5.000	5.700	9.282	0.000
1090.00	184.01	5.46	6.826	7.457	4-FFf	3.685	3.882	5.000	5.700	9.371	0.000
1363.90	224.89	6.57	8.510	8.571	4-FFf	5.000	4.245	5.000	5.700	11.454	0.000
1506.00	243.94	7.42	9.424	9.167	4-FFf	5.000	4.383	5.000	5.700	12.424	0.000

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Straight Culvert

Inlet Elevation (invert): -2.00 ft, Outlet Elevation (invert): -2.25 ft

Culvert Length: 50.00 ft, Culvert Slope: 0.0050

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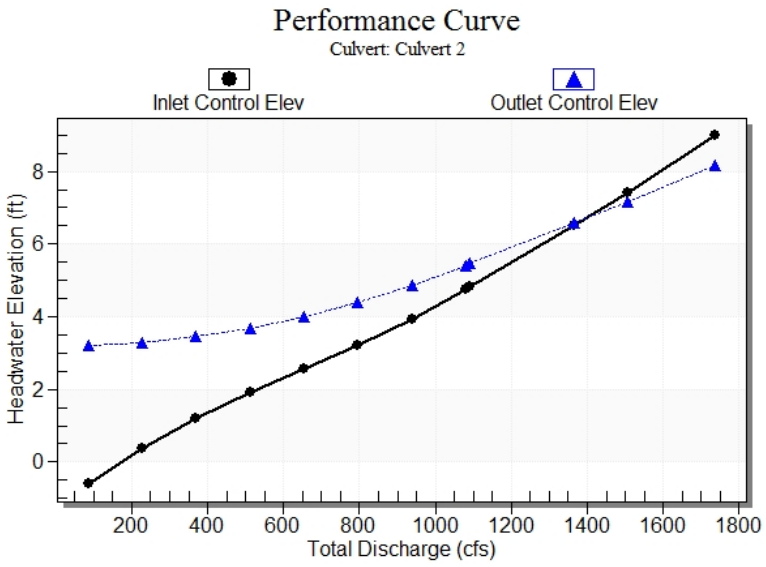
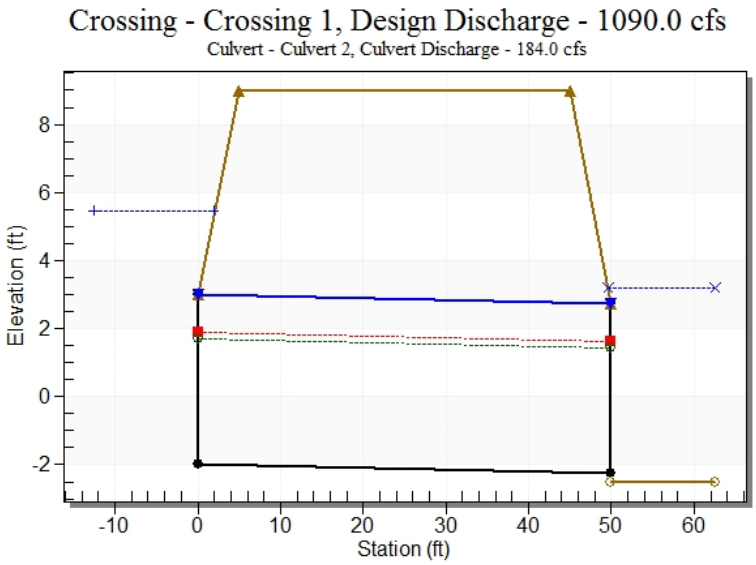
Culvert Performance Curve Plot: Culvert 2



Water Surface Profile Plot for Culvert: Culvert 2



Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: -2.00 ft

Outlet Station: 50.00 ft

Outlet Elevation: -2.25 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 2

Barrel Shape: Circular

Barrel Diameter: 5.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 4 - Downstream Channel Rating Curve (Crossing: Crossing 1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
85.00	3.20	5.70
227.10	3.20	5.70
369.20	3.20	5.70
511.30	3.20	5.70
653.40	3.20	5.70
795.50	3.20	5.70
937.60	3.20	5.70
1079.70	3.20	5.70
1090.00	3.20	5.70
1363.90	3.20	5.70
1506.00	3.20	5.70

Tailwater Channel Data - Crossing 1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 3.20 ft

Roadway Data for Crossing: Crossing 1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 9.00 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Turney Creek Outfall
Fairfield, CT

Proposed Culvert Option 3
HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 85 cfs

Design Flow: 1090 cfs

Maximum Flow: 1506 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Culvert 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
3.22	85.00	65.97	19.62	0.00	10
3.32	227.10	174.87	53.16	0.00	6
3.51	369.20	283.50	86.09	0.00	5
3.80	511.30	392.25	119.15	0.00	5
4.17	653.40	501.39	152.24	0.00	4
4.64	795.50	610.34	185.24	0.00	4
5.20	937.60	719.48	218.16	0.00	4
5.84	1079.70	828.90	250.85	0.00	4
5.89	1090.00	836.81	253.22	0.00	3
7.84	1363.90	1031.60	332.32	0.00	4
9.07	1506.00	1135.62	365.59	4.56	9
9.00	1493.83	1129.80	364.03	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 1

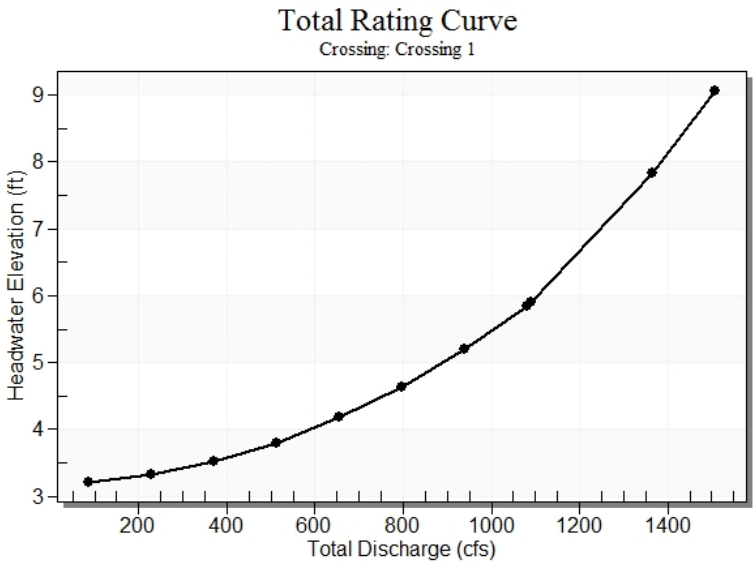


Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	65.97	3.22	1.673	5.217	1-S1t	1.027	1.228	5.450	5.700	0.802	0.000
227.10	174.87	3.32	2.796	5.319	1-S1t	1.675	2.027	5.450	5.700	2.125	0.000
369.20	283.50	3.51	3.750	5.512	1-S1t	2.159	2.610	5.450	5.700	3.445	0.000
511.30	392.25	3.80	4.578	5.797	1-S1t	2.579	3.094	5.450	5.700	4.766	0.000
653.40	501.39	4.17	5.335	6.174	1-S1t	2.971	3.517	5.450	5.700	6.092	0.000
795.50	610.34	4.64	6.090	6.641	1-S1t	3.351	3.896	5.450	5.700	7.416	0.000
937.60	719.48	5.20	6.901	7.198	1-S1t	3.735	4.237	5.450	5.700	8.742	0.000
1079.70	828.90	5.84	7.811	7.844	1-S1t	4.140	4.549	5.450	5.700	10.071	0.000
1090.00	836.81	5.89	7.882	7.893	1-S1t	4.171	4.570	5.450	5.700	10.167	0.000
1363.90	1031.60	7.84	9.839	9.237	3-M2t	6.000	5.030	5.450	5.700	12.745	0.000
1506.00	1135.62	9.07	11.072	10.028	3-M2t	6.000	5.227	5.450	5.700	14.031	0.000

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Straight Culvert

Inlet Elevation (invert): -2.00 ft, Outlet Elevation (invert): -2.25 ft

Culvert Length: 50.00 ft, Culvert Slope: 0.0050

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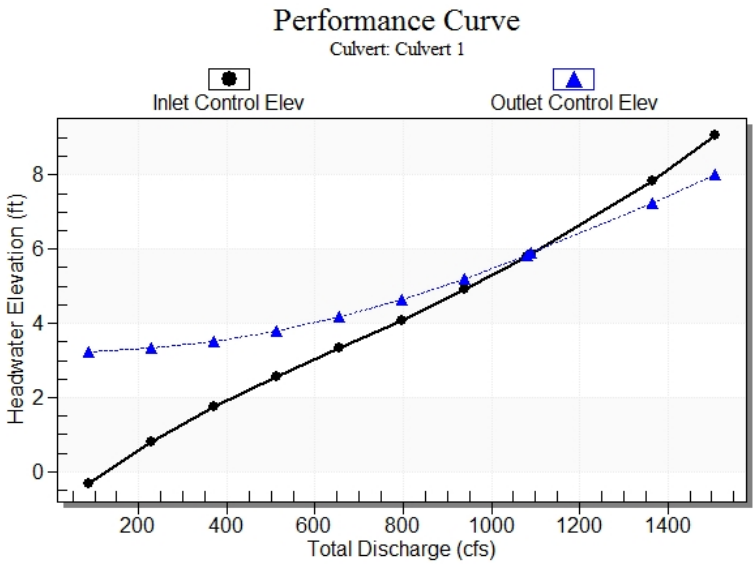
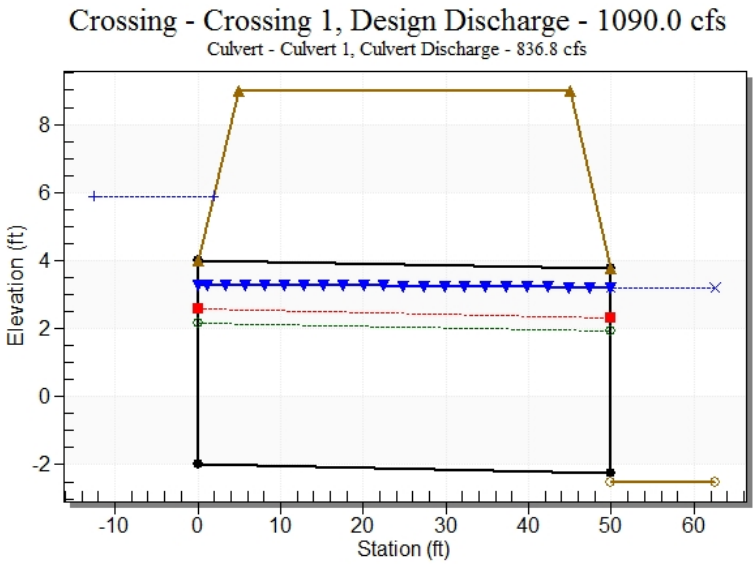
Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: -2.00 ft

Outlet Station: 50.00 ft

Outlet Elevation: -2.25 ft

Number of Barrels: 3

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 6.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Culvert Summary Table: Culvert 2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	19.62	3.22	1.242	5.216	4-FFf	0.784	0.907	4.000	5.700	0.781	0.000
227.10	53.16	3.32	2.129	5.319	4-FFf	1.302	1.521	4.000	5.700	2.115	0.000
369.20	86.09	3.51	2.876	5.511	4-FFf	1.691	1.962	4.000	5.700	3.425	0.000
511.30	119.15	3.80	3.516	5.796	4-FFf	2.041	2.320	4.000	5.700	4.741	0.000
653.40	152.24	4.17	4.150	6.174	4-FFf	2.381	2.639	4.000	5.700	6.057	0.000
795.50	185.24	4.64	4.848	6.642	4-FFf	2.736	2.914	4.000	5.700	7.371	0.000
937.60	218.16	5.20	5.657	7.199	4-FFf	3.158	3.155	4.000	5.700	8.680	0.000
1079.70	250.85	5.84	6.599	7.843	4-FFf	4.000	3.359	4.000	5.700	9.981	0.000
1090.00	253.22	5.89	6.673	7.893	4-FFf	4.000	3.372	4.000	5.700	10.075	0.000
1363.90	332.32	7.84	9.595	9.839	4-FFf	4.000	3.706	4.000	5.700	13.223	0.000
1506.00	365.59	9.07	11.072	10.814	4-FFf	4.000	3.791	4.000	5.700	14.546	0.000

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Straight Culvert

Inlet Elevation (invert): -2.00 ft, Outlet Elevation (invert): -2.25 ft

Culvert Length: 50.00 ft, Culvert Slope: 0.0050

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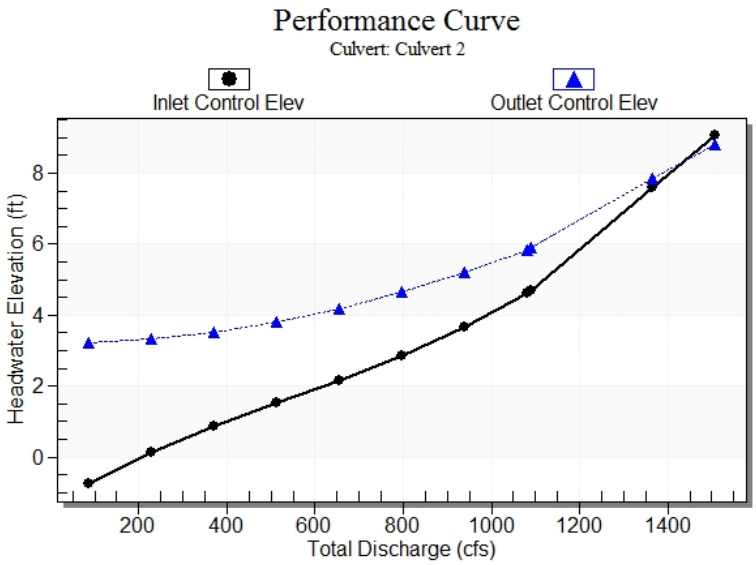
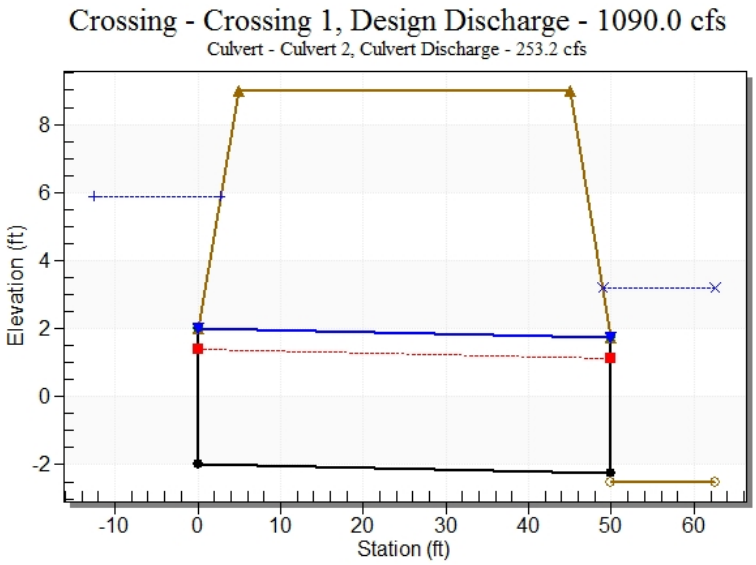
Culvert Performance Curve Plot: Culvert 2



Water Surface Profile Plot for Culvert: Culvert 2



Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: -2.00 ft

Outlet Station: 50.00 ft

Outlet Elevation: -2.25 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 2

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 4 - Downstream Channel Rating Curve (Crossing: Crossing 1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
85.00	3.20	5.70
227.10	3.20	5.70
369.20	3.20	5.70
511.30	3.20	5.70
653.40	3.20	5.70
795.50	3.20	5.70
937.60	3.20	5.70
1079.70	3.20	5.70
1090.00	3.20	5.70
1363.90	3.20	5.70
1506.00	3.20	5.70

Tailwater Channel Data - Crossing 1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 3.20 ft

Roadway Data for Crossing: Crossing 1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 9.00 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Turney Creek Outfall
Fairfield, CT

Proposed Culvert Option 4
HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 85 cfs

Design Flow: 1090 cfs

Maximum Flow: 1506 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Culvert 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
3.21	85.00	68.58	17.16	0.00	10
3.29	227.10	181.99	46.19	0.00	6
3.44	369.20	294.69	75.06	0.00	5
3.65	511.30	407.61	103.81	0.00	5
3.94	653.40	521.02	132.75	0.00	4
4.30	795.50	634.00	161.66	0.00	4
4.73	937.60	747.01	190.67	0.00	4
5.23	1079.70	859.94	219.80	0.00	4
5.27	1090.00	868.05	221.93	0.00	3
6.28	1363.90	1093.41	270.56	0.00	3
7.02	1506.00	1204.71	301.38	0.00	3
9.00	1825.71	1461.68	364.03	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 1

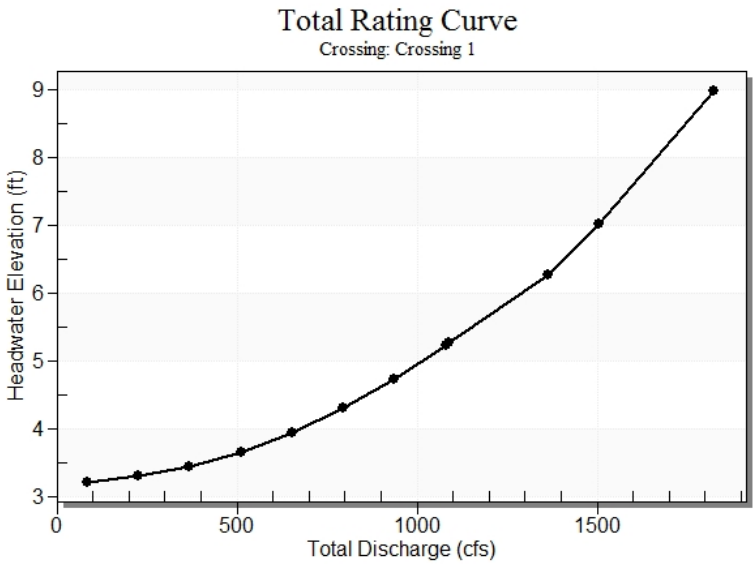


Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	68.58	3.21	1.630	5.213	1-S1t	0.999	1.202	5.450	5.700	0.694	0.000
227.10	181.99	3.29	2.713	5.290	1-S1t	1.620	1.979	5.450	5.700	1.840	0.000
369.20	294.69	3.44	3.513	5.437	1-S1t	2.069	2.540	5.450	5.700	2.980	0.000
511.30	407.61	3.65	4.315	5.653	1-S1t	2.454	3.008	5.450	5.700	4.122	0.000
653.40	521.02	3.94	5.020	5.941	1-S1t	2.803	3.426	5.450	5.700	5.269	0.000
795.50	634.00	4.30	5.662	6.298	1-S1t	3.129	3.792	5.450	5.700	6.411	0.000
937.60	747.01	4.73	6.278	6.727	1-S1t	3.441	4.131	5.450	5.700	7.554	0.000
1079.70	859.94	5.23	6.895	7.230	1-S1t	3.747	4.447	5.450	5.700	8.696	0.000
1090.00	868.05	5.27	6.941	7.269	1-S1t	3.769	4.469	5.450	5.700	8.778	0.000
1363.90	1093.41	6.28	8.276	7.427	5-S2n	4.380	5.030	4.723	5.700	12.820	0.000
1506.00	1204.71	7.02	9.016	7.903	5-S2n	4.696	5.277	5.008	5.700	13.261	0.000

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Straight Culvert

Inlet Elevation (invert): -2.00 ft, Outlet Elevation (invert): -2.25 ft

Culvert Length: 50.00 ft, Culvert Slope: 0.0050

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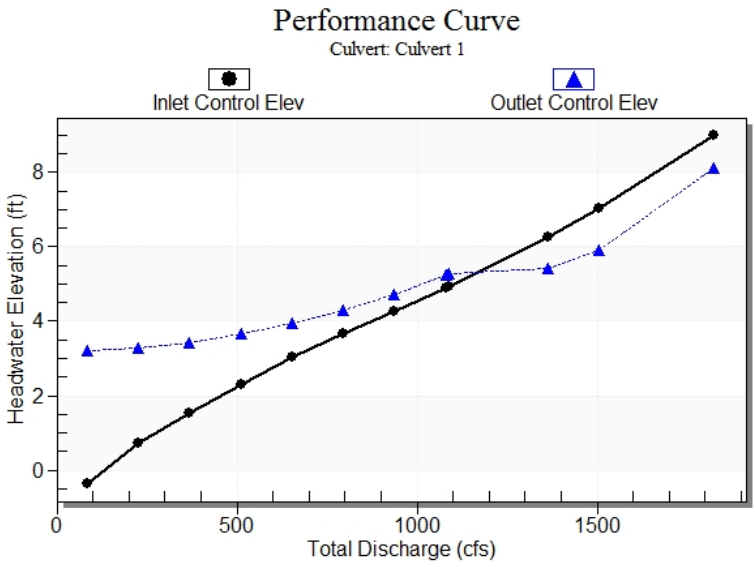
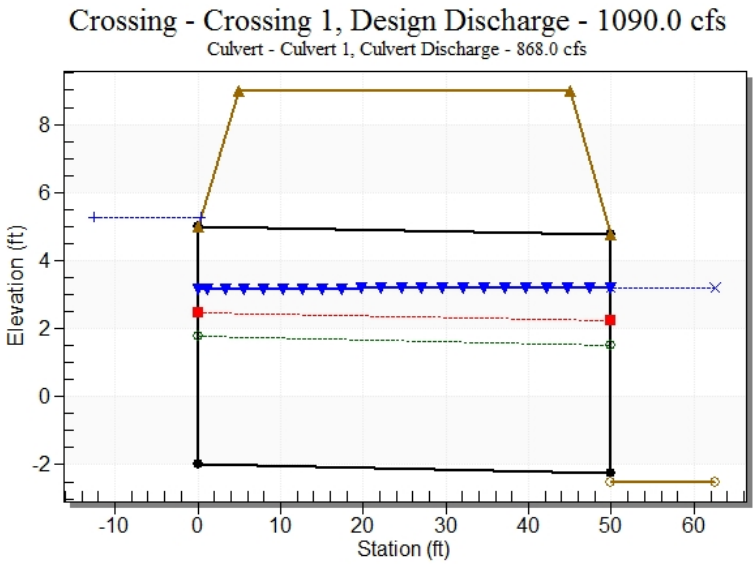
Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: -2.00 ft

Outlet Station: 50.00 ft

Outlet Elevation: -2.25 ft

Number of Barrels: 3

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 7.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Culvert Summary Table: Culvert 2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
85.00	17.16	3.21	1.159	5.212	4-FFf	0.735	0.850	4.000	5.700	0.683	0.000
227.10	46.19	3.29	1.954	5.290	4-FFf	1.210	1.415	4.000	5.700	1.838	0.000
369.20	75.06	3.44	2.644	5.437	4-FFf	1.567	1.826	4.000	5.700	2.986	0.000
511.30	103.81	3.65	3.225	5.653	4-FFf	1.881	2.158	4.000	5.700	4.131	0.000
653.40	132.75	3.94	3.773	5.940	4-FFf	2.180	2.456	4.000	5.700	5.282	0.000
795.50	161.66	4.30	4.340	6.298	4-FFf	2.479	2.721	4.000	5.700	6.432	0.000
937.60	190.67	4.73	4.973	6.727	4-FFf	2.798	2.956	4.000	5.700	7.586	0.000
1079.70	219.80	5.23	5.701	7.229	4-FFf	3.183	3.166	4.000	5.700	8.746	0.000
1090.00	221.93	5.27	5.758	7.269	4-FFf	4.000	3.180	4.000	5.700	8.830	0.000
1363.90	270.56	6.28	7.239	8.275	4-FFf	4.000	3.464	4.000	5.700	10.765	0.000
1506.00	301.38	7.02	8.349	9.016	4-FFf	4.000	3.601	4.000	5.700	11.992	0.000

****
****
****

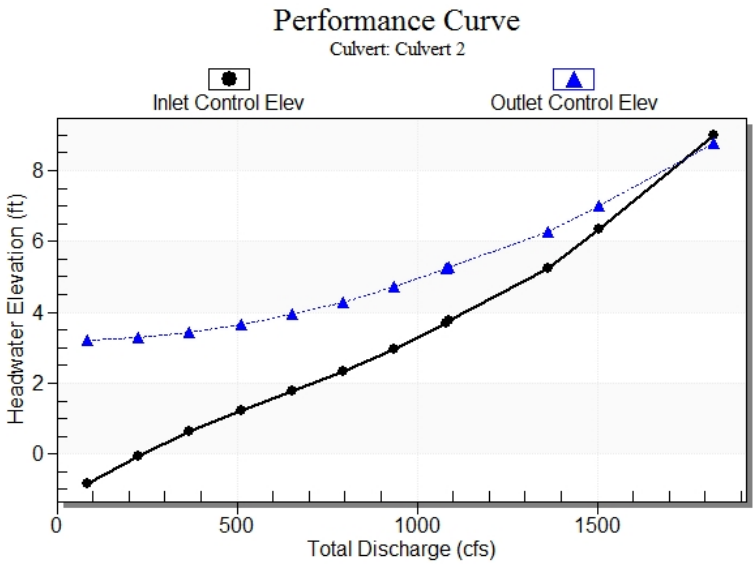
Straight Culvert

Inlet Elevation (invert): -2.00 ft, Outlet Elevation (invert): -2.25 ft

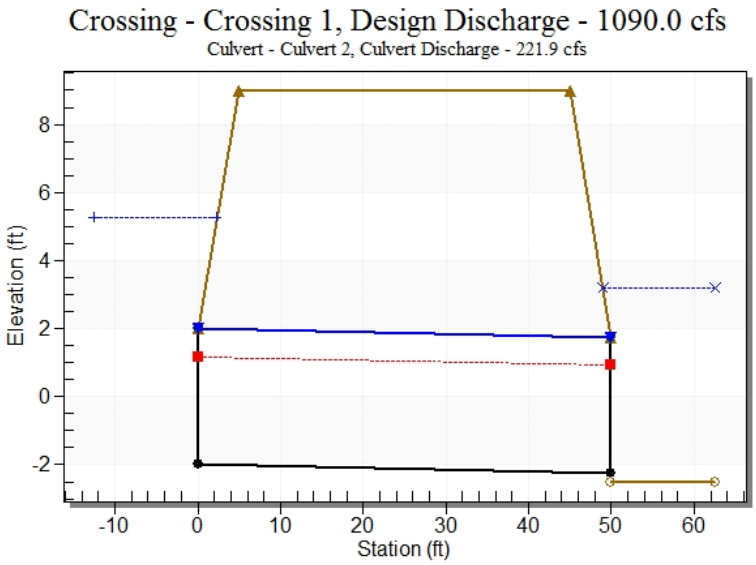
Culvert Length: 50.00 ft, Culvert Slope: 0.0050

****
****
****

Culvert Performance Curve Plot: Culvert 2



Water Surface Profile Plot for Culvert: Culvert 2



S

Inlet Station: 0.00 ft

Inlet Elevation: -2.00 ft

Outlet Station: 50.00 ft

Outlet Elevation: -2.25 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 2

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 4 - Downstream Channel Rating Curve (Crossing: Crossing 1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
85.00	3.20	5.70
227.10	3.20	5.70
369.20	3.20	5.70
511.30	3.20	5.70
653.40	3.20	5.70
795.50	3.20	5.70
937.60	3.20	5.70
1079.70	3.20	5.70
1090.00	3.20	5.70
1363.90	3.20	5.70
1506.00	3.20	5.70

Tailwater Channel Data - Crossing 1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 3.20 ft

Roadway Data for Crossing: Crossing 1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 9.00 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

APPENDIX D

SCALE IN FEET
0 20 40
SCALE 1" = 20'

JAN 1 0 2018

SHOREHAM TERRACE

TURNEY CREEK

PROPOSED COFFER DAM

SMH-1

SMH-2

SMH-3

SMH-4

SMH-5

SMH-6

SMH-7

SMH-8

18" DIP OVERFLOW SIPHON

18" PVC

TWIN 18" CIP

EXIST. SIPHON CHAMBER (EAST)

EXIST. SIPHON CHAMBER (WEST)

B-17

B-16

B-1

B-15

B-14

P-12

limit of tidal wetlands

FLOOD

EBB

wood guard rail

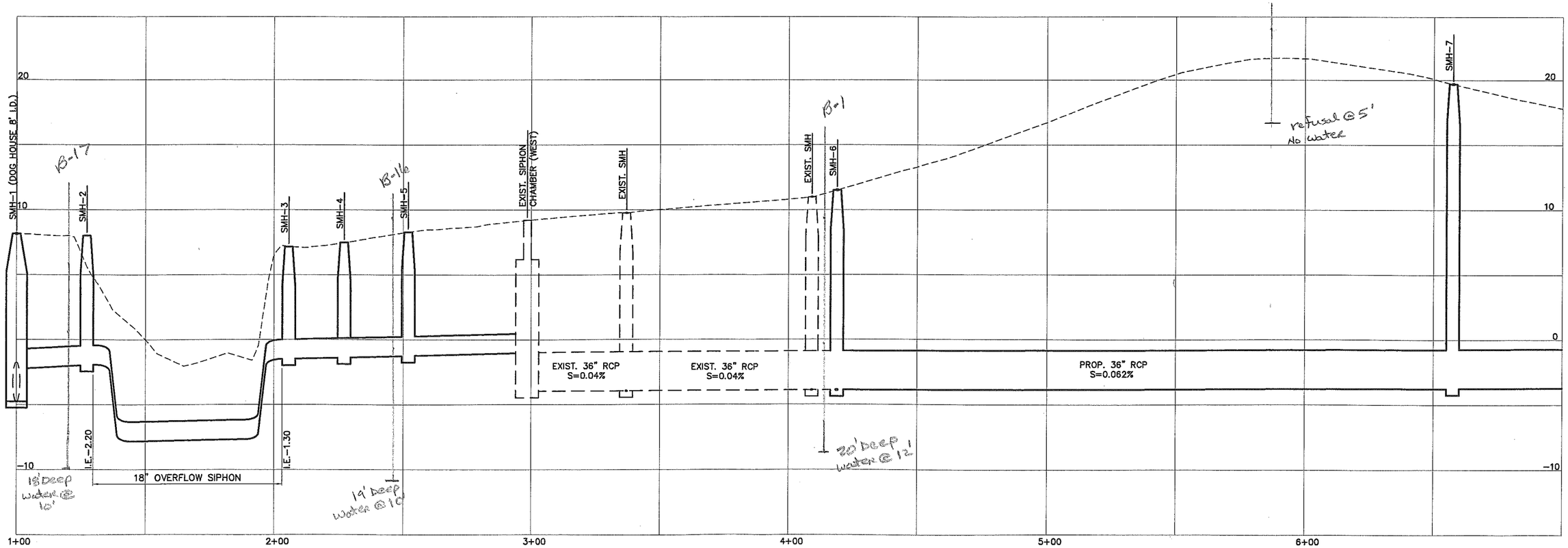
ASH CREEK

RIVERSIDE DRIVE

POST ROAD

PLAN

B-15



PRELIMINARY DESIGN

DATE: MARCH 2016
SCALE: AS NOTED
DESIGNED BY:
DRAWN BY:
CHECKED BY:

CARDINAL ENGINEERING ASSOCIATES

EAST TRUNK SEWER IMPROVEMENTS
FAIRFIELD, CONNECTICUT
ROADWAY PLAN & PROFILE

East Trunk Interceptor Sewer Relocation Project
Fairfield, CT

Proposed Boring Table
12/19/2017

Boring Number	Boring Minimum Estimated Depth (FT.)	Bottom of Pipe Estimated Depth (FT.)
B1	17 (in location of previous P13 – Riverside Drive)	13.5
B2	12	8.5
B3	15	12
B4	23	20
B5	25	22
B6	24	20.5
B7	21	18
B8	24	21
B9	23	20
B10	20 (possible rock at 8')	17
B11	12 (possible rock at 8')	10
B12	21 (possible rock at 10')	18
B13	23	20
B14	23 (possible rock at 8')	20
B15	29	25.5
B16	18	8
B17	18	11

Assumptions

1. Assume no rock coring required.
2. Soil samples to be taken to check for "casting sands".
3. Borings to be used to sample existing soil under pipe (to a minimum 2-feet under invert).
4. Pavement thickness to be recorded at each boring.
5. Depths shown are approximate and are based upon checking the soil conditions at least 2-feet below the proposed pipe. In the case of Boring B16 and B17, the intent is to determine the soil conditions under the creek that may be encountered by the new siphon pipe.

Note: Possible rock elevations taken from old record plans provided by the Town.

SUMMARY OF BORINGS FOR EAST TRUCK SEWER LINE, FAIRFIELD, CT

BORING	DEPTH
B-1	20
B-2	9
B-3	12.5
B-4	15
B-5	25
B-6	24
B-7	22
B-8	24
B-9	23
B-10	6.5
B-11	DELETED
B-12	13
B-13	DELETED
B-14	15
B-15	5
B-16	19
B-17	18
TOTALS	251

Jaime Lloret	**TEST BORING REPORT**							SHEET 1 OF 1	
DRILLER	**ASSOCIATED BORINGS CO., INC.**								
	119 MARGARET CIRCLE, NAUGATUCK, CT 06770							CME-45B	
INSPECTOR	**Tel (203) 729-5435 Fax (203) 729-5116**							DRILLING EQUIPMENT	
	PROJECT NAME: East Trunk Sewers							Cardinal Engineering, Inc.	
SOILS ENGINEER	PROJECT NUMBER:							CLIENT	
Surface Elevation:	LOCATION: Fairfield, Connecticut								
Date Started: 1/8/2018			Auger		Casing	Sampler	Core Bar	Hole No. **B-17**	
Date Finished: 1/8/2018	Type		HSA			SS	NQ-2	Line & Station	
Groundwater Observations	Size I. D.		2 1/4	in		2 in		Offset	
AT 10 ' AFTER 0 HRS	Hammer					140 lb	Bit	N Coordinate	
AT ' AFTER HRS	Fall					30 in		E. Coordinate	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. INCH	REC. INCH	TYPE	BLOWS PER 6 INCHES ON SAMPLER 0 - 6	6 - 12	12-18	18-24	STRATA CHANGE: DEPTH, ELEV.	FIELD IDENTIFICATION OF SOIL, REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
											7"	Bituminous Concrete
												Br. M-F Sand, Some C-F Gravel, Tr. Silt
5		5.0 - 7.0	1	24	7	D	3	5	9	5		
10		10.0 - 12.0	2	24	4	D	3	8	5	2	10	
												Gr. F. Sand and Silt, Little F. Gravel
15											15	
		16.0 - 18.0	3	24	10	D	12	11	8	12		Gr. F. Sand and Silt
											18	
												End of Boring - 18.0
20												
25												
30												
35												
40												

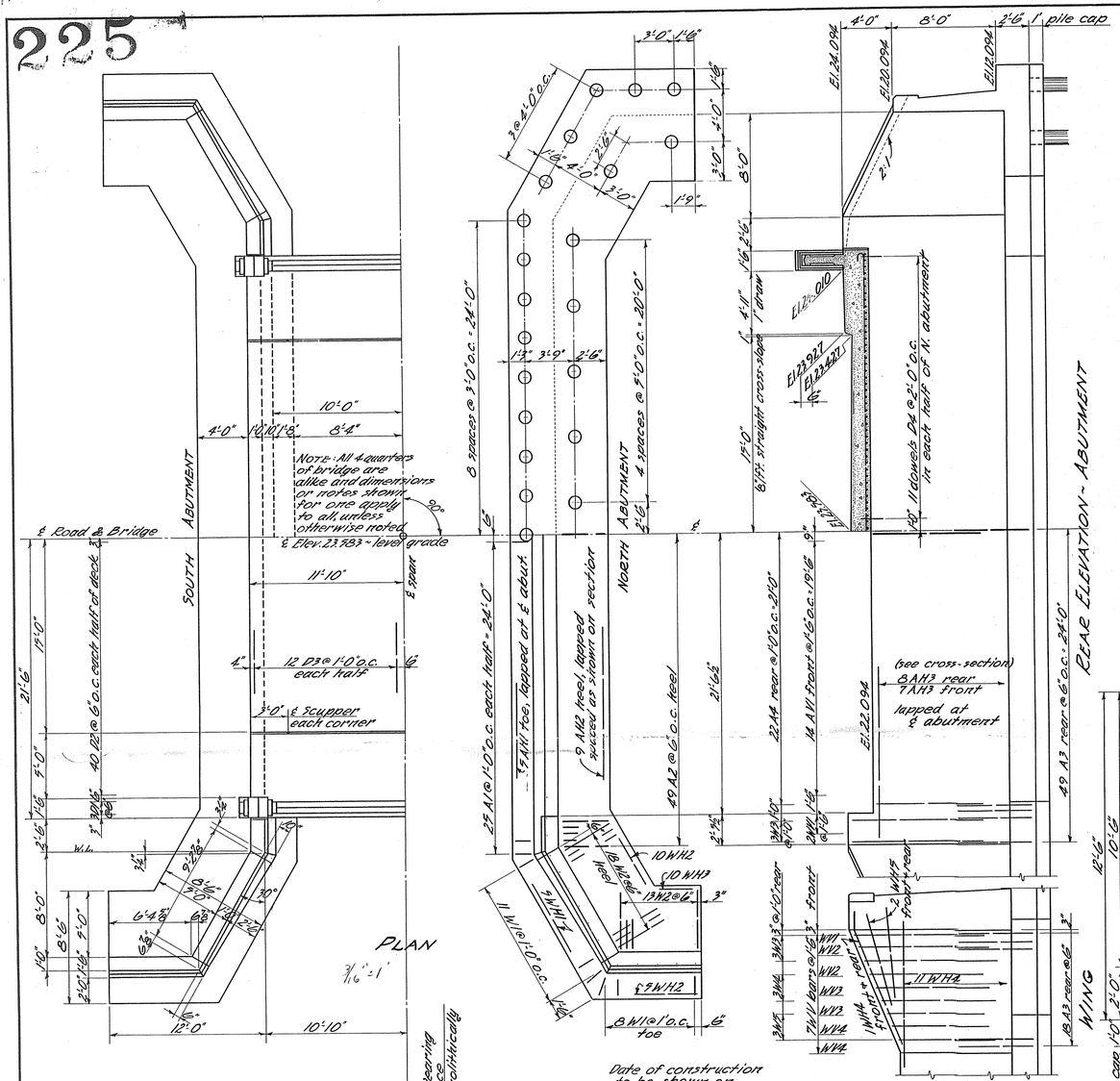
From Ground Surface to Feet Used Inch Casing Then Inch Casing For Feet

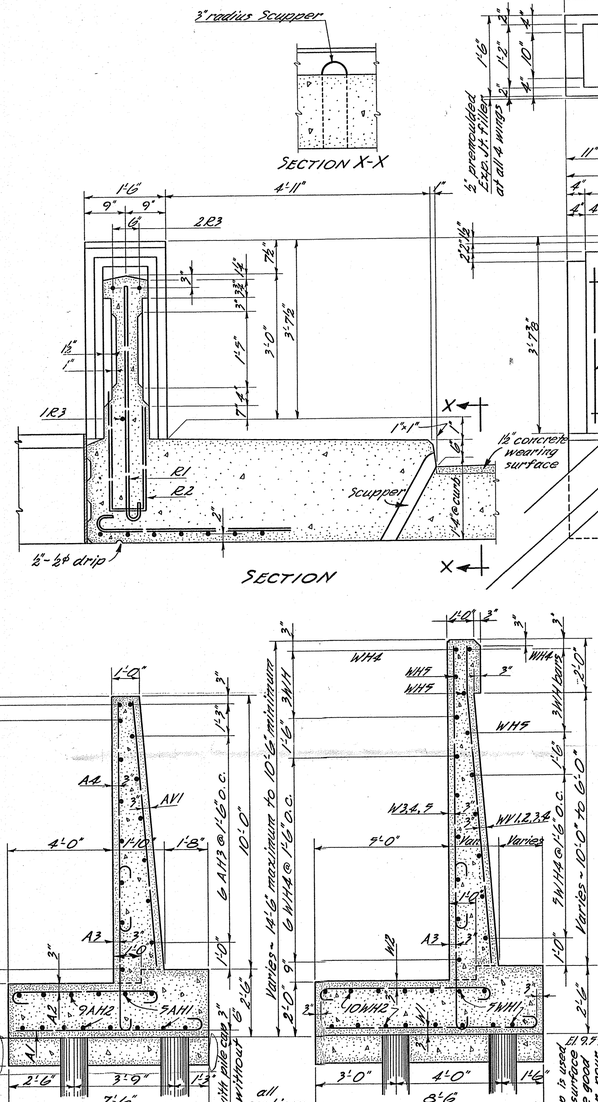
Footage in Earth 18.0 Footage in Rock 0.0 No. of Samples 3 Hole No. **B-17**

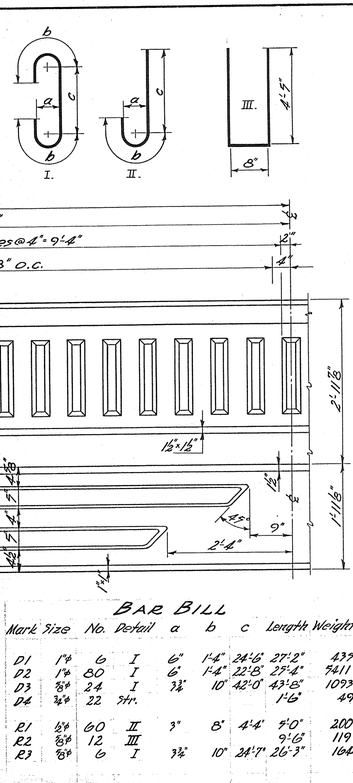
SAMPLE TYPE CODING: D = DRIVEN C = CORE A = AUGER UP = UNDISTURBED PISTON

PROPORTIONS USED: TRACE = 1-10% LITTLE = 10-20% SOME = 20-35% AND = 35-50%

225



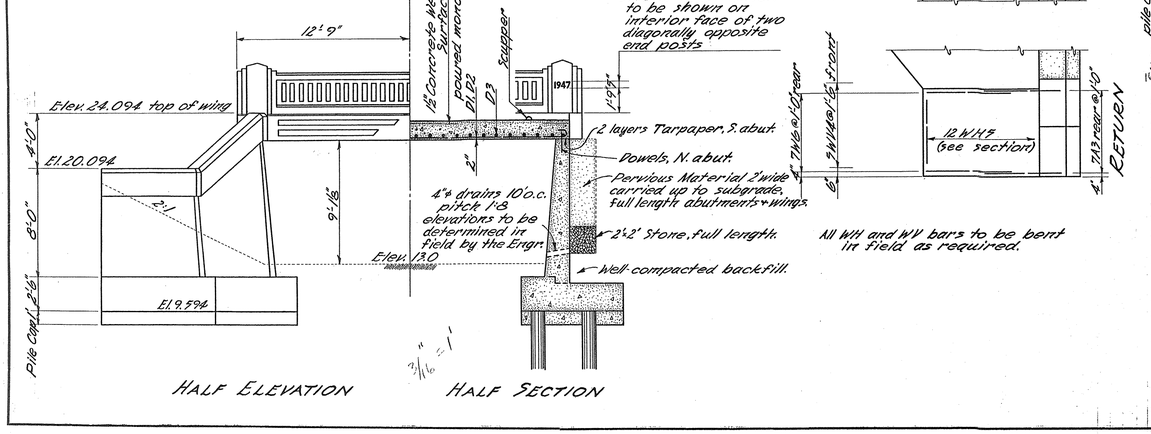




BAR BILL

Mark	Size	No.	Detail	a	b	c	Length	Weight
D1	1"ϕ	6	I	6"	1'-4"		24'-6"	27'-2"	435
D2	1"ϕ	80	I	6"	1'-4"		22'-8"	25'-4"	5811
D3	⅝"ϕ	24	I	3¾"	10"		42'-0"	43'-8"	1093
D4	¾"ϕ	22	Str.					1'-6"	49
R1	⅝"ϕ	60	II	3"	8"		4'-4"	5'-0"	200
R2	⅝"ϕ	12	III					9'-6"	119
R3	⅝"ϕ	6	I	3¾"	10"		24'-7"	26'-3"	164
A1	⅝"ϕ	100	II	3¾"	10"		6'-8"	7'-6"	782
A2	⅝"ϕ	194	I	3¾"	10"		4'-10"	6'-6"	1315
A3	⅝"ϕ	294	I	3¾"	10"		7'-10"	7'-6"	2300
A4	⅝"ϕ	86	II	3¾"	10"		8'-2"	9'-0"	807
AH1	⅝"ϕ	20	Str.					27'-0"	563
AH2	⅝"ϕ	36	Str.					24'-0"	901
AH3	⅝"ϕ	60	Str.					25'-6"	1022
AV1	⅝"ϕ	96	Str.					9'-9"	569
W1	⅝"ϕ	76	II	3¾"	10"		7'-8"	8'-6"	674
W2	⅝"ϕ	124	I	A2	1'-0"		6'-0"	8'-0"	1490
W3	⅝"ϕ	24	II	3¾"	10"		10'-2"	11'-0"	277
W4	⅝"ϕ	12	II	3"	8"		8'-8"	9'-4"	75
W5	⅝"ϕ	12	II	3"	8"		7'-4"	8'-0"	64
W6	⅝"ϕ	28	II	3"	8"		6'-1"	6'-9"	126
WH1	⅝"ϕ	20	Str.					10'-6"	219
WH2	⅝"ϕ	60	Str.					8'-0"	501
WH3	⅝"ϕ	40	Str.					6'-0"	250
WH4	⅝"ϕ	72	Str.					11'-0"	382
WH5	⅝"ϕ	64	Str.					8'-0"	342
WV1	⅝"ϕ	12	Str.					11'-9"	147
WV2	⅝"ϕ	8	Str.					10'-3"	85
WV3	⅝"ϕ	8	Str.					9'-0"	75
WV4	⅝"ϕ	28	Str.					7'-9"	226

Total deformed steel bars 20,661 pounds.



NOTES

Design - AASHO 1944 with latest revisions.
Live Load: H20. Impact: 30%.
All materials, workmanship, and details to conform to the latest specifications and standard practices of the Conn. State Highway Dept.
All concrete to be Class A, except that wearing surface and bridge rail to be Class C.
All exposed concrete edges to be bevelled 1"x1" unless otherwise shown.
Reinforcement to consist of deformed steel bars of an approved type.
Cost of Tarpaper, ½" premoulded expansion joint filler for bridges, and forming scuppers and drains, to be included in general cost of project.
Treated timber piles are estimated 20' long. See Special Provisions for treatment.
Maximum pile load about 15 tons per pile. Maximum soil pressure if no piles used about 3800 psf. Footings same for both cases except as noted.
Quantities shown hereon are approximate only and bidders should check them before preparing bids.
23 C.Y. of Broken Stone for Drains are included in, and will be paid for at unit price bid for, item of Pervious Material.

All WH and WV bars to be bent in field as required.

QUANTITIES

Bridge Excavation	est.	750 C.Y.
Deformed Steel Bars		20,661 Lb.
Class A Concrete		282 C.Y.
Class C Concrete (wearing surface)		4 C.Y.
Concrete Bridge Rail		91 L.F.
Portland Cement		472 Bbl.
Pervious Material (gravel backfill)		87 C.Y.
Waterproof Painting (2 coats asphalt)		177 S.Y.
Removal of Superstructure		L.S.
Furnishing Treated Timber Piles		1,640 L.F.
Driving Treated Timber Piles		1,640 L.F.
Loading Test Piles		2 Ea.
Test Piles		2 Ea.
Furnishing Equipment for Driving Test Piles		L.S.

REVISIONS		
NO.	DATE	DESCRIPTION

TOWN OF FAIRFIELD, CONN.

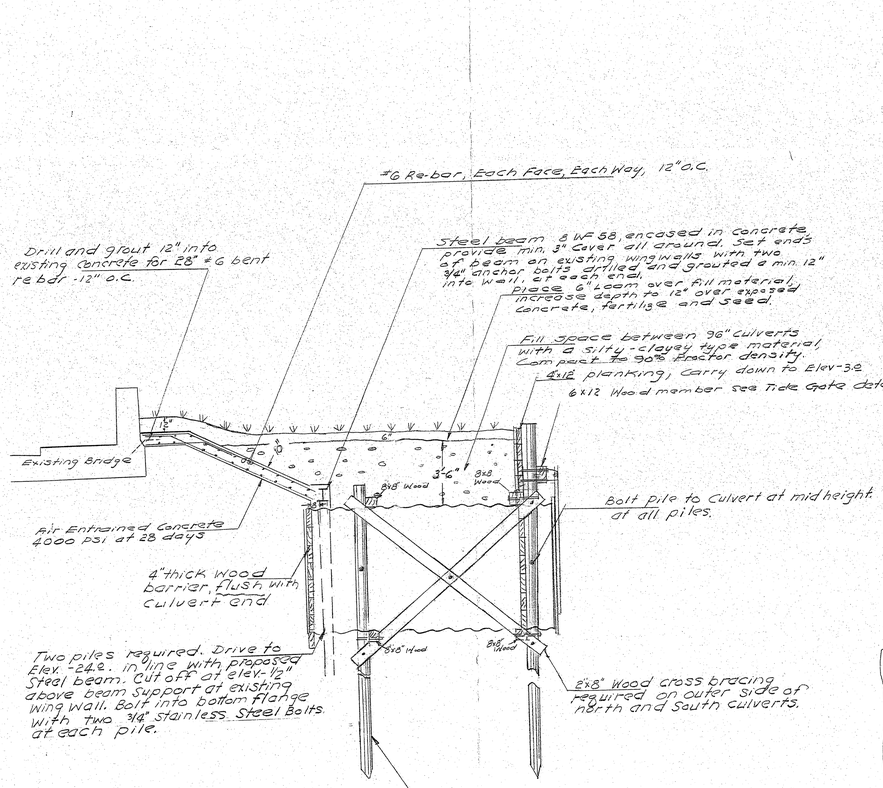
RIVERSIDE DRIVE BRIDGE
OVER
ASH CREEK

REINFORCED CONCRETE SLAB ON R.C. SUBSTRUCTURE

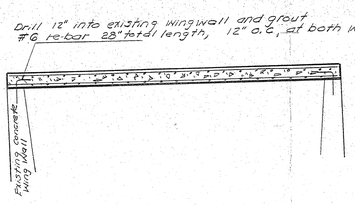
DESIGNED BY Aron L. Mirsky
SCALES 3/16" - 3/8" - 3/4" - 1'-0"
MADE BY Aron L. Mirsky DATE 7-3-46
CHECKED BY H.B. Olmstead DATE 7-12-46
APPROVED DATE
BRIDGE SHEET NO. 1 OF 1

225

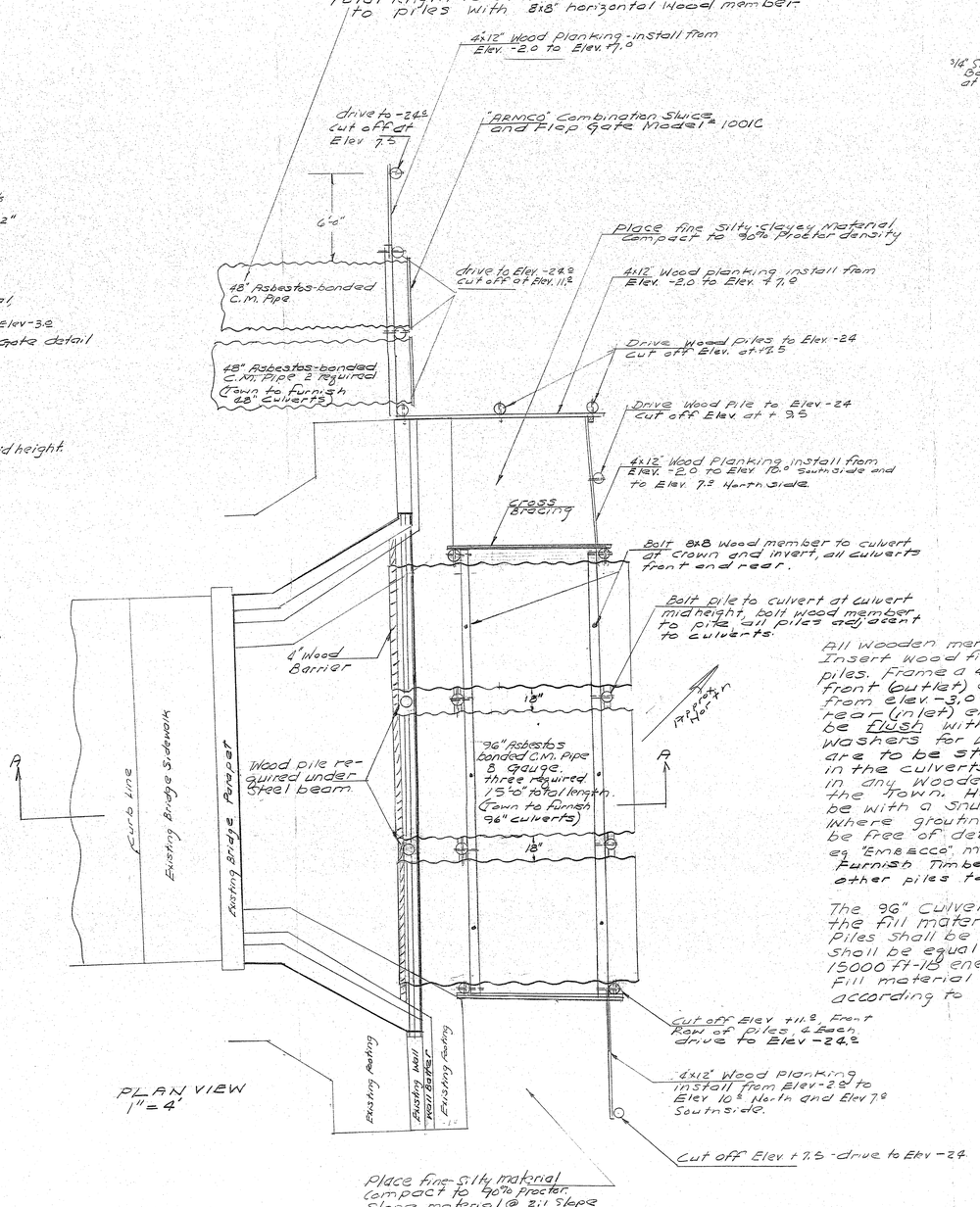
provide a wood walk way from the existing dyke to the sluice gates. Walk to be 4'-0" wide with one handrail, 2x6" planking on two 4x8" wood stringers. total length to be 12 Ft at Elev. 10.5. Secure walk to piles with 8x8" horizontal wood member.



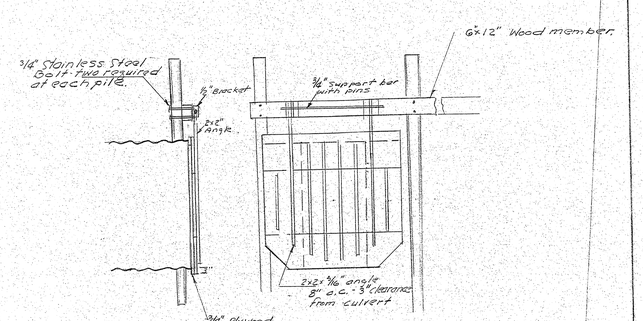
SECTION A-A
No scale



SECTION B-B
No Scale



PLAN VIEW
1" = 4'



Wood tide gate - three required. Fabricate using 3/4" Marine Plywood, Creosoted, total thickness to be 1½". Fasten 2x2 x 3/16" Steel angles at 8" o.c. both sides of gate, using ½" Steel bolts with washers, 8" o.c. Hang gate on ½" Steel bracket with 3/4" Horizontal steel support bar - All steel for support bracket, bar and gate to be galvanized. Contractor to supply the Town with Shop drawings on the tide gates, showing the method of fastening to the culvert wood support frame.

All Wooden members shown on these plans are to be pressure creosoted. Insert wood filler blocks between the center culvert and adjacent piles. Frame a 4" wood barrier from elev. -3.2 to elev. +10.5 along the front (outlet) end of the culverts. Frame a 4" wood barrier from elev. -3.0 to the bottom of proposed concrete at the rear (inlet) end of the culverts, with the wood barrier to be flush with the end of the culverts. Metal bolts, nuts, and washers for use through the piles, culverts, and cross bracing are to be stainless steel, 1" diameter. Seal any holes made in the culverts with a bituminous material. Splices made in any wooden members shall require the prior approval from the Town. Holes through piles, wood members and culverts shall be with a snug fit to receive bolts. Washers to be large enough to span corrugations. Where grouting of reinforcing bars is required, drilled holes shall be free of debris, dust, etc. before grouting with a non-shrink grout eg "Embecco" manufactured by Masters Building Co, or equal.

Furnish Timber piles 40 ft long, 9 required, for front row of piles, all other piles to be furnished 35 ft long.

The 96" culverts shall be strutted the entire length until after the fill material is placed to final elevation.

Piles shall be driven to the elevations noted or until refusal, which shall be equal to or greater than 5 blows per inch with a VULCAN # 1 15000 ft-lb energy hammer.

Fill material shall be compacted as noted to 90% proctor density according to ASTM. T-180 Method D.

TOWN OF FAIRFIELD
DEP'T. OF PUBLIC WORKS

INSTALLATION OF THREE 96" CULVERTS WITH TIDE GATES AND TWO 48" CULVERTS WITH TIDE GATES AT TURNEY CREEK, RIVERSIDE DRIVE, FAIRFIELD, CONNECTICUT

DRAWN BY: R.A.C. CHK'D BY:
DATE: Dec 15-73 BY ROHAN-73 FILE NO. Flood Control
SCALE: AS Noted MAP NO. 2 of 2

1330

Install Town Furnished 48" Twin Metal Culverts

move existing Concrete Wingwall
Elev -1.5 (top of existing footing)

ve Wood piles to Elev -2.4 or refusal
g: Wood planking 4"x12" from Elev -2.0
Elev 16.5 - Cut off piles at Elev 1.5
t invert of 48" culverts at Elev -1.5
ck fill with pervious material
ber to span 2 or more piles)
stall 50 LF of 2 Cable Guide Wire (Wood posts)

cavate to Elev -2.0

Edge of Road

Edge of Bank

TOWN OF FAIRFIELD

Edge of creek at Low Tide (Elev. 0.0)

TURNEY CREEK direction of flow

N/F Maria, Ralph, Antony, Patsy, Robert and Euphrasyne Cascella

Lot 213 See Town Clerk Map 173

N/F William R and Barbara Young, and Orestes Regas

Lot 306 See Town Clerk Map 143

Install Town furnished Armco Sluice Gates Model 1001-C Set invert Elev -1.5

Mud Flats

Elev. 3.5

Remove existing 48" Concrete Pipes with Wood cribbing and earth berm.

Install three 96" Asbestos bonded CMP with Wood Tide gates Set inverts at Elev -2.0 (Town to furnish culverts)

Approx. Limit of Channel at Low Tide

Existing Spot Elev

San Siphon Chamber

Hole 1

Hole 2

Bench Mark

Hole 3

Hole 4

Wing walls cut back to elev 3.5

Two 18" Siphon Sanitary Sewers

Existing 18" Sanitary Sewer

Existing 18" Sanitary Sewer

San Siphon Chamber

Excavate to Elev -2.0, Fill Channel to -3.0 (See profile below)

Fill With fine silty material To Elev 1.0 at culvert - Slope to existing ground at 3:1 Slope for South Culvert. Slope to Elev 6.5 at North culvert

Top of Salt Marsh

Mud Flats

Lot 212

Lot 211 - Refer to: T.C. Map 173 for Lot line

N/F Helen Hollo, Andrew William Chuma and Rita Claire Hernadez

Lot line and Bulkhead Line

Refer to T.C. Map 3157 for Bulkhead Line

Bulkhead Line

CSO Center Line

Street Line

Easterly edge of Top of Bank

RIVERSIDE DRIVE

50' R.O.W.

Elevations shown on this Sheet are based on mean Sea Level Benchmark is a square cut on top of northerly end of East Wall of Bridge = Elev 13.61 mean sea level (Town Datum = Elev 27.00)

SCALE 1" = 20'

GENERAL NOTES

- Remove Wood cribbing, earth dike in the vicinity of construction, and portion of Westerly concrete wing wall, excavate for 48" culverts across Riverside Drive, excavate in Channel as noted. Dispose of material off site - (obtain permit from D.P.W. Engineering Section to dispose at Fairfield Dump.) Remove existing 48" Concrete culverts and bring to Town Garage, One Reef Hwy, Fairfield.
- Place 48" Metal Culverts on 12" bed of sand - backfill and tamp in 12" lifts - Replace road with 3" bituminous material on 12" Gravel Base. Make neat cuts with saw or air hammer on Roadway
- Lots 211, 212 and 213 located South of the bridge are within the limits of the Wet Lands (tidal) see "CONN STATE DRAWING 13-3-1 Project 4231 dated DEC 1970 Ecological unit 13 Subdivision 1, Ash Creek Bridgeport - Fairfield Conn - by Storch Engineers" Lot 211, 212 are in Wet Land parcel Lot 213 is in Wet Land parcel 37.
- All lumber shall be pressure creosoted.
- Within 5ft of either inverted 18" Sanitary Siphon and below Elev. -1.0 the contractor shall halt any mechanical excavation on Riverside Drive and verify the location and elevation of the sanitary lines before proceeding to excavate for the cross culvert.
- Before award of contract, the successful bidder shall submit plans showing what method he proposes to seal off Turney Creek should perigee tide, or other excessive tides occur between the dismantling of the existing tide gates and the construction of the proposed tide gates. The Director of Public Works reserves the right to authorize the emergency closing of Turney Creek when the Elev of Ash Creek is forecast to rise above Elev 3.5 or whenever damage might occur with an open channel.
- Holes 1, 2, 3, 4 refer to borings obtained by Hardiman Drilling Co of Bpt Ct
- Install single posts 2"ø g.a.c. on north and South sides of 96" culverts posts to be equal to State Hwy Dept 8" diam. Wood Standard Sheet 217-DCHD total number required = 10, location to be as directed by the Town

10

Existing Ground

Top of Existing Wing Wall

ARMCO SLUICE Gate Model 1001-C

Proposed 48" Asbestos bonded C.M.P. (Two culverts)

Invert -1.5

Invert -1.5

existing 18" Sanitary Siphons according to design drawings

PROFILE SHOWING PROPOSED 48" CULVERT
Vert 1" = 4'
Horz 1" = 20'

Proposed Concrete Deck

Existing Concrete Bin Wall

Existing Timber Sheeting

Approx. High Water Level - June 19, 1972

Existing Earth Berm

New 96" Dia. CMP

Install 96" Metal Culvert (Town furnished culvert)

Water at normal low tide

O = Mean Sea Level

Fill Channel to this Grade under bridge

Existing Conc. Pipe with Wood Headgate

Fill channel to this Elev (-3.0)

Remove 3 ± Cu. Yds. of Organic Material within limits of Replace with fine material

PROFILE SHOWING PROPOSED 96" CULVERTS
Vert 1" = 4'
Horz 1" = 20'

½ Profile under bridge

Water at normal low tide

Profile along ℄ of existing Channel

Bottom of Bridge Slab = Elev. 9.4

-20.0-

Existing 48" Conc. Pipe

Existing 48" Conc. Pipe

Concrete Abutment & Wingwall Typical

Concrete Abutment & Wingwall Typical

Bridge Abutment and Wing Walls as per plans according to design drawings

SECTION SHOWING EASTERLY END OF EXISTING 48" CULVERTS
1" = 4' Vert & Horz

TOWN OF FAIRFIELD
DEP'T. OF PUBLIC WORKS

INSTALLATION OF THREE 96" CULVERTS WITH TIDE GATES AND TWO 48" CULVERTS WITH TIDE GATES AT TURNEY CREEK, RIVERSIDE DRIVE, FAIRFIELD, CONN.

DRAWN BY: RAC
DATE: DEC 18-72
SCALE: AS NOTED
CHK'D BY:
FILE NO. Fairfield Conn 96
MAP NO. 1 of 2

1330

Tighe&Bond

APPENDIX E

RT Group, Inc.
Engineered from the Ground Up℠
70 Romano Vineyard Way, Suite 134
North Kingstown, Rhode Island 02852
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SOIL BORING LOG

BORING NUMBER: RTG-SB-01
DATE(S): 12/7/2017
PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Replacement
LOCATION: Northwest of bridge (refer to boring location plan)
ELEVATION: 9.7' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates
DRILLING CONTRACTOR: General Borings, Inc.
DRILLING METHOD AND EQUIPMENT: 3" hollow stem auger and driven casing/rotary wash, truck mounted Diedrich Drill Co. D-50 drill rig
WATER LEVEL AND DATE: 9.5' below grade 8:30AM 12/8/17
START: 8:30AM 12/7/17
FINISH: 4:30PM 12/7/17
LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0.0						Begin drilling at 8:30 AM, 12/7/17
	0-2	SS S-1	0.8	2-8-13-14	SANDY SILT WITH GRAVEL, (ML), brown, moist, very stiff, fine sand, fine gravel	Topsoil and organics present
	2-4	SS S-2	0.6	11-8-6-5	SILTY SAND WITH GRAVEL, (SM), brown, dry, medium dense, fine sand, fine gravel	
5.0	4-6	SS S-3	1.2	5-7-7-50/5"	SILTY SAND WITH GRAVEL, (SM), brown, dry, medium dense, fine sand, fine gravel	Auger grinding at 6 feet below grade
						Gravel spoils
	7-9	SS S-4	1.0	8-8-5-4	SILTY SAND WITH GRAVEL, (SM), brown, dry, medium dense, fine sand, fine gravel	Asphalt found in split spoon
10.0	9-11	SS S-5	0.7	3-7-8-8	SILTY SAND WITH GRAVEL, (SM), brown, wet, medium dense, fine sand, fine gravel	
						3" auger removed, begin 4" driven casing
15.0						4" casing driven to 13 feet below grade
	15-17	SS S-6	0.7	5-4-6-11	POORLY GRADED SAND, (SP), gray, wet, loose, fine sand	
20.0						
	20-22	SS S-7	1.0	10-16-9-6	POORLY GRADED SAND WITH GRAVEL, (SP), brown, wet, medium dense, fine to medium sand, fine gravel	Roller bit chattering at 20 feet below grade
25.0						
	25-27	SS S-8	1.7	7-10-13-15	POORLY GRADED SAND, (SP), light brown, wet, medium dense, fine sand	4" casing driven to 18 feet below grade
30.0						
	30-31.5	SS S-9	1.0	15-34-50/5"	POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM), light brown, wet, very dense, fine to coarse gravel, fine to coarse sand	
35.0						Assumed top of weathered bedrock at 35 feet below grade
	35	SS S-10	0.0	50/0"	No recovery	Poorly graded gravel wash found in split spoon
						4" casing refusal at 35 feet below grade
40.0						Roller bit advanced to 40 feet below grade

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SOIL BORING LOG

BORING NUMBER: RTG-SB-01
DATE(S): 12/7/2017
PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Replacement
LOCATION: Northwest of bridge (refer to boring location plan)
ELEVATION: 9.7' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates
DRILLING CONTRACTOR: General Borings, Inc.
DRILLING METHOD AND EQUIPMENT: 3" hollow stem auger and driven casing/rotary wash, truck mounted Diedrich Drill Co. D-50 drill rig
WATER LEVEL AND DATE: 9.5' below grade 8:30AM 12/8/17
START: 8:30AM 12/7/17
FINISH: 4:30PM 12/7/17
LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
40.0						
	40-41.5	NX C-1	0.7	3:15 min/ft 4:00 min/6"	Light gray medium to coarse grained SCHIST RQD=8"/18"=44%	Begin Rock Core
45.0	41.5-46.5	NX C-2	5.0	3:45 min/ft 2:15 min/ft 2:00 min/ft 3:00 min/ft 2:15 min/ft	Light gray medium to coarse grained SCHIST RQD=55"/60"=92%	Assumed top of bedrock at 41.5 feet below grade
50.0	46.5-51.5	NX C-3	5.0	3:00 min/ft 2:35 min/ft 2:30 min/ft 3:45 min/ft 3:15 min/ft	Light gray medium to coarse grained SCHIST RDQ=53"/60"=88%	
55.0					END BORING AT 51.5 FEET BELOW GRADE	End drilling at 4:30 PM, 12/7/17
60.0						
65.0						
70.0						
75.0						
80.0						

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SOIL BORING LOG

BORING NUMBER: RTG-SB-02
DATE(S): 12/8/2017
PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Replacement
LOCATION: Northeast of bridge (refer to boring location plan)
ELEVATION: 9.2' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates
DRILLING CONTRACTOR: General Borings, Inc.
DRILLING METHOD AND EQUIPMENT: 3" hollow stem auger, truck mounted Diedrich Drill Co. D-50 drill rig
WATER LEVEL AND DATE: Not measured
START: 9:00 AM 12/8/17
FINISH: 3:00 PM 12/8/17
LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0.0						Begin drilling at 9:00 AM, 12/8/17
	0-2	SS S-1	1.2	3-5-7-4	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), brown, moist, medium dense, fine sand, fine gravel	6" Topsoil, Silt with organics
	2-4	SS S-2	0.7	4-5-5-4	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), brown, moist, loose, fine sand, fine gravel	Organic odor
5.0	4-6	SS S-3	1.0	3-4-8-6	SILTY SAND WITH GRAVEL, (SM), brown, dry, medium dense, fine to medium sand, fine gravel	
	6-8	SS S-4	0.7	4-4-4-3	Same as above but loose	
10.0	8-10	SS S-5	0.4	3-5-3-1	Same as above, but moist	
15.0						Auger grinding at 12 feet below grade Coarse gravel spoils
	15-17	SS S-6	0.0	3-4-5-2	No recovery	
20.0						
	20-22	SS S-7	2.0	2-1-WOH-WOH	POORLY GRADED SAND, (SP), gray, wet, very loose, fine sand	Organic odor Possible blow-in
25.0						
	25-27	SS S-8	1.2	3-4-4-1	POORLY GRADED SAND, (SP), gray, wet, loose, fine sand	Organic odor Wood chips present in split spoon
30.0						
	30-32	SS S-9	0.8	4-1-WOH-1	POORLY GRADED SAND, (SP), gray, wet, very loose, fine sand (top 8"), LEAN CLAY (CL), gray, wet, very soft (bottom 2")	Organic odor Possible blow-in
35.0						
	35-37	SS S-10	1.5	17-15-25-43	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), brown, wet, dense, fine to coarse sand, fine to coarse gravel	
40.0						

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SOIL BORING LOG

BORING NUMBER: RTG-SB-02
DATE(S): 12/8/2017
PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Replacement
LOCATION: Northeast of bridge (refer to boring location plan)
ELEVATION: 9.2' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates
DRILLING CONTRACTOR: General Borings, Inc.
DRILLING METHOD AND EQUIPMENT: 3" hollow stem auger, truck mounted Diedrich Drill Co. D-50 drill rig
WATER LEVEL AND DATE: Not measured
START: 9:00 AM 12/8/17
FINISH: 3:00 PM 12/8/17
LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
40.0						
	40-42	SS S-11	0.5	35-53-19-6	POORLY GRADED SAND WITH GRAVEL, (SP), brown, wet, very dense, fine sand, fine gravel	Rock fragments found in split spoon
45.0	45-47	SS S-12	2.0	6-25-30-32	POORLY GRADED SAND WITH GRAVEL, (SP), brown, wet, very dense, fine to medium sand, fine gravel	
50.0	50-52	SS S-13	0.8	7-16-21-12	POORLY GRADED SAND WITH GRAVEL, (SP), brown, wet, dense, fine to medium sand, fine gravel	
55.0	55-57	SS S-14	1.3	17-14-29-25	SILTY SAND WITH GRAVEL, (SM), brown, wet, dense, fine to coarse sand, fine to coarse gravel	Soil blow back into drill hole
60.0	60-62	SS S-15	2.0	17-37-38-47	SILTY SAND WITH GRAVEL, (SM), brown, wet, very dense, fine to coarse sand, fine to coarse gravel	
65.0					END BORING AT 62 FEET BELOW GRADE	End drilling at 3:00 PM, 12/8/17
70.0						
75.0						
80.0						

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SOIL BORING LOG

BORING NUMBER: RTG-SB-03
DATE(S): 7/13/2018
PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Additional Subsurface Investigation
LOCATION: Northeast of bridge (refer to boring location plan)
ELEVATION: 9.4' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates
DRILLING CONTRACTOR: New England Boring Contractors
DRILLING METHOD AND EQUIPMENT: Driven Casing and wash, truck mounted drill rig
WATER LEVEL AND DATE: N/A
START: 10:00AM 7/13/2018
FINISH: 11:00AM 7/13/2018
LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0.0					4" topsoil	Began drilling at 10:00AM, 7/13/2018
	0-2	SS S-1	0.9	4-7-8-7	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), light brown, dry, medium dense, fine gravel	Organics Present (wood)
	2-4	SS S-2	1.0	8-8-8-24	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), light brown, dry, medium dense, fine, f-c sand, fine gravel	4" casing to 4'; Start wash; Wood chips in wash
5.0	5	SS S-3	0.0	50/0"	Spoon rebounding, No recovery	Roller bit through to 5', Bit grinding
10.0					END BORING AT 5' BELOW GRADE RELOCATED TO RTG-SB-03A	End drilling at 11:00 AM, 7/13/2018
15.0						
20.0						
25.0						
30.0						
35.0						
40.0						

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SOIL BORING LOG

BORING NUMBER: RTG-SB-03A
DATE(S): 7/13/2018
PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Additional Subsurface Investigation
LOCATION: Northeast of bridge (refer to boring location plan)
ELEVATION: 9.5' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates
DRILLING CONTRACTOR: New England Boring Contractors
DRILLING METHOD AND EQUIPMENT: Driven Casing and wash, truck mounted drill rig
WATER LEVEL AND DATE: N/A
START: 11:00AM 7/13/2018
FINISH: 3:00PM 7/13/2018
LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0.0						Began drilling at 11:00AM, 7/13/2018
	0-2	SS S-1	1.1	2-12-26-16	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), light brown, dry, dense, f-c sand, fine gravel	Asphalt Present
	2-4	SS S-2	1.0	8-6-6-12	SANDY SILT WITH GRAVEL, (ML), light brown, dry, stiff, f-c sand, fine gravel	Mica in tip 4" casing to 4'; Start wash
5.0	4-6	SS S-3	1.2	10-6-17-16	Same as above, but very stiff	
	6-8	SS S-4	0.8	18-9-12-20	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), brown, wet, medium dense, fine sand	Glass present
10.0	8-10	SS S-5	0.4	16-6-3-6	SILTY SAND WITH GRAVEL, (SM), grey, wet, loose, f-c sand, fine gravel	4" casing to 10'
15.0						
	15-17	SS S-6	0.0	6-9-6-9	No recovery	4" casing to 15'
20.0						
	20-22	SS S-7	0.0	W.O.R.	No recovery	4" casing to 20'
	22-24	SS S-8	0.5	W.O.H.	SILTY SAND, (SM), grey, wet, very loose, f-m sand (top 3"), SANDY ORGANIC SOIL (OH), brown, wet, very soft (bottom 3")	Sampler sank to 30'
25.0						
	25-27	SS S-9	0.0	W.O.R.	No recovery	
30.0						
	30-32	SS S-10	2.0	W.O.R.	SANDY ORGANIC SOIL (OH), brown, wet, very soft	Organic odor, shells present 4" casing to 30'
35.0						
	35-37	SS S-11	0.6	78-41-44-52	POORLY GRADED SAND WITH GRAVEL, (SP), brown to black, wet, very dense, f-m sand, fine gravel	4" casing to 35'
40.0						

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SOIL BORING LOG

BORING NUMBER: RTG-SB-03A
DATE(S): 7/13/2018
PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Additional Subsurface Investigation
LOCATION: Northeast of bridge (refer to boring location plan)
ELEVATION: 9.5' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates
DRILLING CONTRACTOR: New England Boring Contractors
DRILLING METHOD AND EQUIPMENT: Driven Casing and wash, truck mounted drill rig
WATER LEVEL AND DATE: N/A
START: 11:00AM 7/13/2018 **FINISH:** 3:00PM 7/13/2018 **LOGGER:** T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
40.0						
	40-42	SS S-12	0.7	38-15-17-16	SILTY SAND, (SM), light brown, wet, dense	4" casing to 40'
					END BORING AT 42' BELOW GRADE	End drilling at 3:00 PM 7/13/2018
45.0						
50.0						
55.0						
60.0						
65.0						
70.0						
75.0						
80.0						

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SOIL BORING LOG

BORING NUMBER: RTG-SB-04

DATE(S): 7/12/2018-7/13/2018

PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Additional Subsurface Investigation

LOCATION: Northeast of bridge (refer to boring location plan)

ELEVATION: 9.2' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates

DRILLING CONTRACTOR: New England Boring Contractors

DRILLING METHOD AND EQUIPMENT: Driven Casing and wash, truck mounted drill rig

WATER LEVEL AND DATE: 9' below grade 7:40AM 7/13/2018

START: 7:40AM 7/12/2018

FINISH: 9:00AM 7/13/2018

LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0.0						Began drilling at 7:40AM, 7/12/2018
					6" asphalt pavement	
	1-3	SS S-1	2.0	18-25-22-20	WELL GRADED SAND WITH GRAVEL, (SW), light brown, dry, dense, fine gravel	Hole collapse
5.0	3-5	SS S-2	1.0	11-13-12-9	Same as above, medium dense	
	5-7	SS S-3	0.7	11-7-6-8	SILTY SAND WITH GRAVEL, (SM), brown, moist, medium dense, fine sand and gravel	4" casing to 5'
	7-9	SS S-4	1.2	10-7-6-14	SILTY SAND, (SM), brown, moist, medium dense, f-m Sand	
10.0	9-11	SS S-5	0.3	35-27-12-11	Same as above, but dense	4" casing to 10'
15.0						
	15-17	SS S-6	0.6	8-6-5-6	POORLY GRADED SAND WITH SILT, (SP-SM), dark grey, wet, medium dense, fine sand	4" casing to 15', organic odor
20.0						
	20-22	SS S-7	0.8	3-4-5-6	Same as above, but loose	4" casing to 20'
25.0						
	25-27	SS S-8	1.3	5-2-W.O.R.-W.O.R.	SILT WITH SAND, (ML), grey, wet, very soft, fine sand	4" casing to 25', organic odor, Sandy organic soil in tip
30.0						
	30-32	SS S-9	2.0	W.O.R.-W.O.R.-5-6	SANDY ORGANIC SOIL (OH), grey, wet, firm	4" casing to 30'
35.0						
	35-37	SS S-10	0.4	11-10-21-15	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), grey, wet, dense, f-m sand	4" casing to 35'
40.0						

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SOIL BORING LOG

BORING NUMBER: RTG-SB-04

DATE(S): 7/12/2018-7/13/2018

PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Additional Subsurface Investigation

LOCATION: Northeast of bridge (refer to boring location plan)

ELEVATION: 9.2' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates

DRILLING CONTRACTOR: New England Boring Contractors

DRILLING METHOD AND EQUIPMENT: Driven Casing and wash, truck mounted drill rig

WATER LEVEL AND DATE: 9' below grade 7:40AM 7/13/2018

START: 7:40AM 7/12/2018

FINISH: 9:00AM 7/13/2018

LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
40.0						
	40-42	SS S-11	1.1	11-16-15-18	POORLY GRADED SAND WITH SILT, (SP-SM), brown, wet, dense, f-m sand	4" casing to 40'
45.0						
	45-47	SS S-12	0.9	15-22-24-25	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), light brown, wet, dense, fine sand, f-m gravel	4" casing to 45'
50.0						
	50-52	SS S-13	1.0	19-8-10-50/1"	POORLY GRADED SAND WITH SILT, (SP-SM), light brown, wet, medium dense, fine sand	4" casing to 50', weathered rock in tip Assumed top of weathered bedrock at 51.5 feet below grade
55.0						Roller bit to 54'
	54-58	NX C-1	0.8	1:25 min/ft 0:30 min/ft 0:45 min/ft 2:30 min/ft	Light gray medium to coarse grained SCHIST Cobbles (4"-8" cores), 1"-2" rounded fragments RQD=5.3"/48"=11%	Break through, sandy wash Roller bit to 58'
	58	SS S-14	0.0	50/0"	Well graded sand backwash returned	Spoon bouncing, assumed top of bedrock at 58 feet below grade
60.0	58-62	NX C-2	3.3	3:05 min/ft 3:40 min/ft 4:30 min/ft 2:30 min/ft	Light gray medium to coarse grained SCHIST RQD=26"/48"=54%	
65.0					END BORING AT 62' BELOW GRADE	End drilling at 9:00 AM, 7/13/2018
70.0						
75.0						
80.0						

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SOIL BORING LOG

BORING NUMBER: RTG-SB-05
DATE(S): 7/16/2018
PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Additional Subsurface Investigation
LOCATION: Northeast of bridge (refer to boring location plan)
ELEVATION: 9.0' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates
DRILLING CONTRACTOR: New England Boring Contractors
DRILLING METHOD AND EQUIPMENT: Driven Casing and wash, truck mounted drill rig
WATER LEVEL AND DATE: 8.5' below grade 1:PM 7/16/2018
START: 8:00 AM 7/16/2018
FINISH: 2:00 PM 7/16/2018
LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0.0					6"-8" asphalt pavement	Began drilling at 8:00 AM, 7/16/2018
	1-3	SS S-1	0.6	10-12-9-10	POORLY GRADED SAND, (SP), brown, dry, medium dense, fine sand	
	3-5	SS S-2	0.7	12-11-20-14	SILTY GRAVEL WITH SAND, (GM), brown, dry, dense, fine sand and gravel	
5.0						4" casing to 5'; Start wash
	5-7	SS S-3	0.5	15-13-12-13	Same as above, but medium dense	
	7-9	SS S-4	0.7	13-10-12-9	Same as above	Mica present
10.0	9-11	SS S-5	0.6	9-3-8-7	SILTY SAND WITH GRAVEL, (SM), grey, wet, medium dense, fine sand and gravel	4" casing to 10'
15.0						
	15-17	SS S-6	0.6	13-23-21-14	POORLY GRADED SAND WITH GRAVEL, (SP), grey, wet, dense, f-m sand, fine gravel	4" casing to 15'
20.0						
	20-22	SS S-7	0.8	21-12-16-25	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), brown, wet, medium dense, fine sand	4" casing to 20'
25.0						
	25-27	SS S-8	1.0	8-6-9-17	Same as above	4" casing to 25'
30.0						
	30-32	SS S-9	0.0	29-18-26-40	No recovery	4" casing to 30'
35.0						
	35-36	SS S-10	0.5	75-100/5"	POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM), grey to brown, wet, very dense, f-m sand, fine gravel	4" casing to 35', fractured/weathered rock Assumed top of bedrock at 36 feet below grade
	38.5-43.5	NX C-1	5.0	6:10 min/ft 3:15 min/ft	Light gray medium to coarse grained SCHIST RQD=60"/60"=100%	4" casing refusal at 38.5'
40.0						

RT Group, Inc.
Engineered from the Ground Up℠
70 Romano Vineyard Way, Suite 134
North Kingstown, Rhode Island 02852
T 401 438 3100 F 401 294 9806
DAM SAFETY · WATERFRONT · CONSTRUCTION ENGINEERING · GEOTECHNICAL
GEO-ENVIRONMENTAL · STRUCTURAL · CIVIL

SOIL BORING LOG

BORING NUMBER: RTG-SB-05
DATE(S): 7/16/2018
PROJECT NUMBER: 17111.00

PROJECT: Turney Creek Outfall Additional Subsurface Investigation
LOCATION: Northeast of bridge (refer to boring location plan)
ELEVATION: 9.0' ± (NAVD 88), per 11/17/2017 survey by Martin Survey Associates
DRILLING CONTRACTOR: New England Boring Contractors
DRILLING METHOD AND EQUIPMENT: Driven Casing and wash, truck mounted drill rig
WATER LEVEL AND DATE: 8.5' below grade 1:PM 7/16/2018
START: 8:00 AM 7/16/2018
FINISH: 2:00 PM 7/16/2018
LOGGER: T. Alpaio

DEPTH BELOW SURFACE (FT)	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"- 6"- 6"- 6"	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
40.0						
	38.5-43.5	NX C-1	5.0	3:55 min/ft 3:35 min/ft 4:05 min/ft	Light gray medium to coarse grained SCHIST RQD=53"/60"=88%	
45.0	43.5-48.5	NX C-2	4.7	4:00 min/ft 5:00 min/ft 3:15 min/ft 3:15 min/ft 3:50 min/ft		
50.0					END BORING AT 48.5' BELOW GRADE	End drilling at 2:00 PM 7/16/2018
55.0						
60.0						
65.0						
70.0						
75.0						
80.0						

Geotechnical Laboratory Data

THIELSCH ENGINEERING
195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
thielsch.com
Let's Build a Solid Foundation

Client Information:
RT Group
North Kingstown, RI 02852
PM: Trevin Alpai0
Assigned By: Trevin Alpio
Collected By: Client

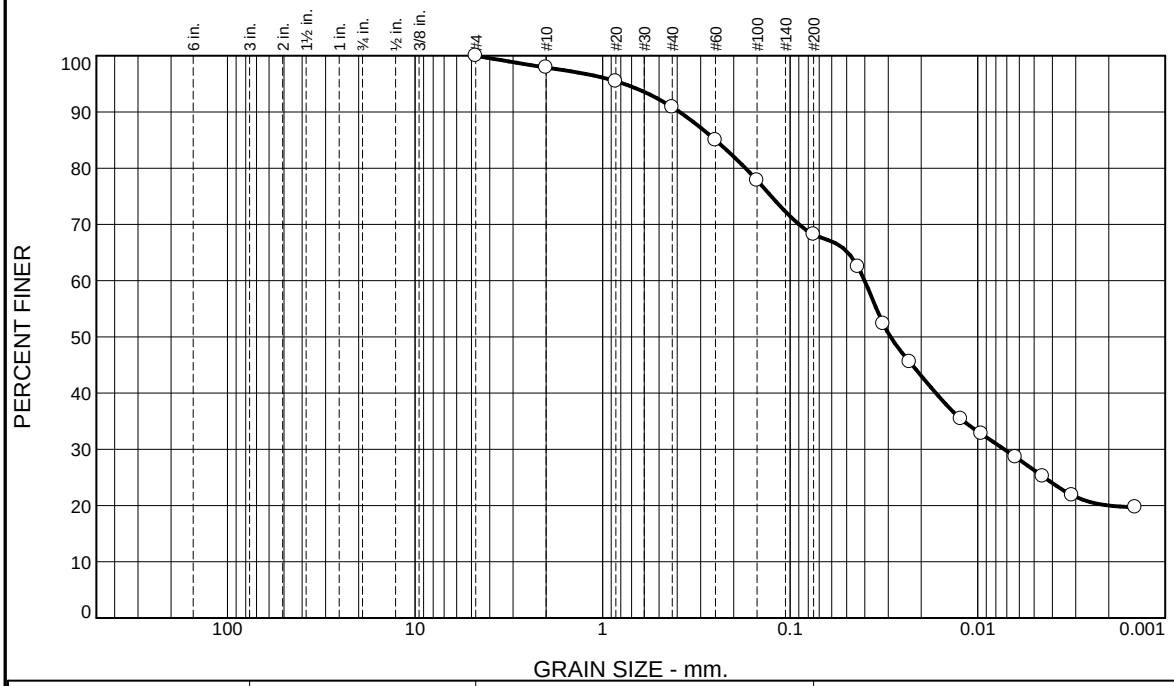
Project Information:
Turney Creek
Fairfield, CT
TEI Project Number: 74-18-0002.09
Summary Page: 1 of 1
Report Date: 08.06.18

LABORATORY TESTING DATA SHEET

Boring ID	Sample No.	Depth (ft)	Laboratory No.	Identification Tests								Proctor / CBR / Permeability Tests								Laboratory Log and Soil Description
				Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G_s	Dry unit wt. pcf	Test Water Content %	γ_d MAX (pcf) W_{opt} (%)	γ_d MAX (pcf) W_{opt} (%) (Corr.)	Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Perme-ability (cm/sec)	
				D2216	D4318		D6913			D2874	D854			D1557			D1883			
03A	S-10	30-32	18-S-1080	59.6	75	39	0.0	31.8	68.2											Brown sandy organic silt
03A	S-12	40-42	18-S-1081				0.0	52.6	47.4											Light Brown silty sand
04	S-7	20-22	18-S-1082				1.6	86.1	12.3											Dark Grey silty sand
04	S-9	30-32	18-S-1083	66.7	73	38	0.0	24.6	75.4											Grey sandy organic silt
04	S-11	40-42	18-S-1084				4.1	84.8	11.1											Brown poorly graded sand with silt
05	S-2	03-05	18-S-1085				48.8	32.1	19.1											Brown silty gravel with sand
05	S-7	20-22	18-S-1086				17.0	70.2	12.8											Brown silty sand with gravel

Reviewed By _____ 08.07.2018

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	2.1	7.0	22.7	48.2	20.0

Test Results (D7928 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	97.9		
#20	95.5		
#40	90.9		
#60	85.0		
#100	77.8		
#200	68.2		
0.0436 mm.	62.5		
0.0319 mm.	52.3		
0.0231 mm.	45.6		
0.0123 mm.	35.4		
0.0096 mm.	32.8		
0.0063 mm.	28.6		
0.0045 mm.	25.2		
0.0031 mm.	21.9		
0.0014 mm.	19.7		

* (no specification provided)

Material Description

Brown sandy organic silt

Atterberg Limits (ASTM D 4318)

PL= 39 **LL=** 75 **PI=** 36

Classification

USCS (D 2487)= MH **AASHTO (M 145)=** A-7-5(26)

Coefficients

D_{90}= 0.3884 D_{85}= 0.2500 D_{60}= 0.0401
D_{50}= 0.0292 D_{30}= 0.0072 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 07.30.18 **Date Tested:** 08.06.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: Borings **Depth:** 30-32' **Date Sampled:**
Sample Number: 03A / S-10

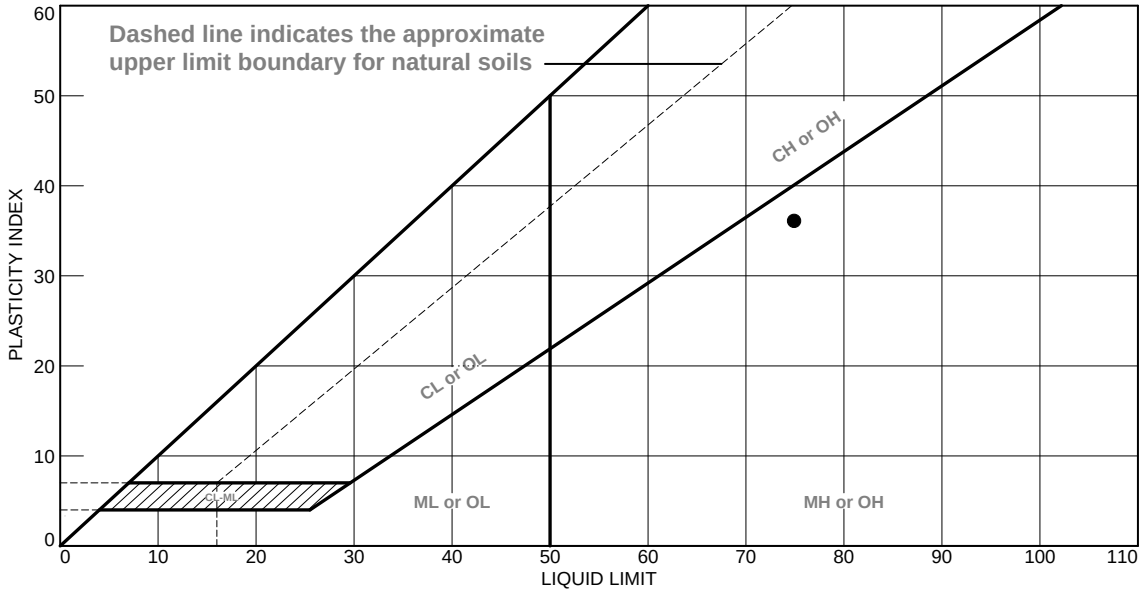
Thielsch Engineering Inc.

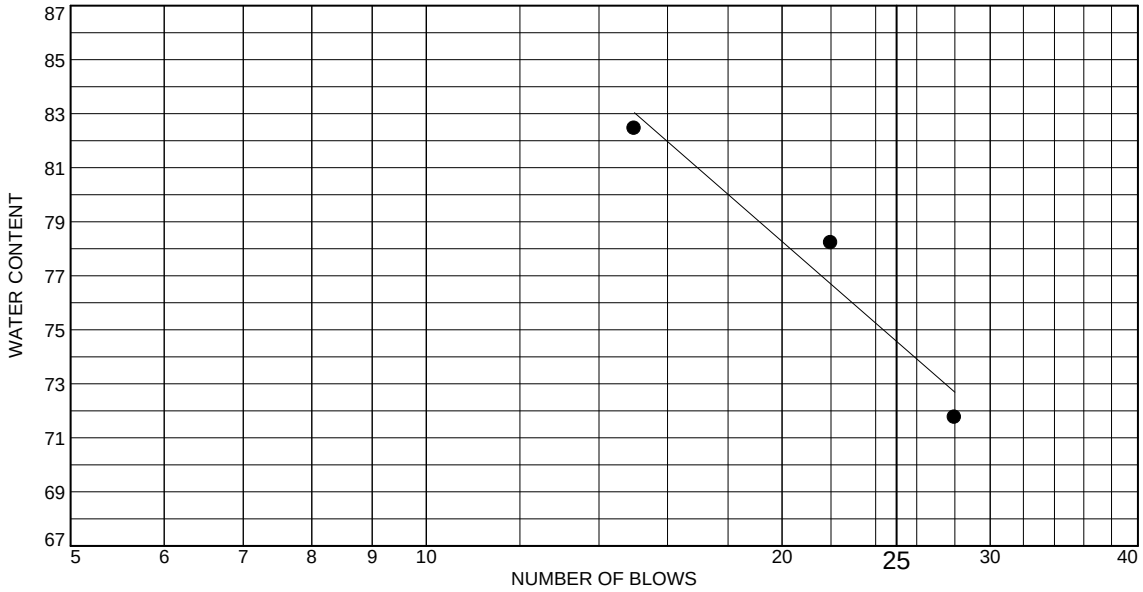
Cranston, RI

Client: RT Group
Project: Turney Creek
Fairfield, CT

Project No: 74-18-0002.09 **Figure** 18-S-1080

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown sandy organic silt	75	39	36	90.9	68.2	MH

Project No. 74-18- **Client:** RT Group

Project: Turney Creek

Fairfield, CT

Source of Sample: Borings **Depth:** 30-32'

Sample Number: 03A / S-10

Thielsch Engineering Inc.

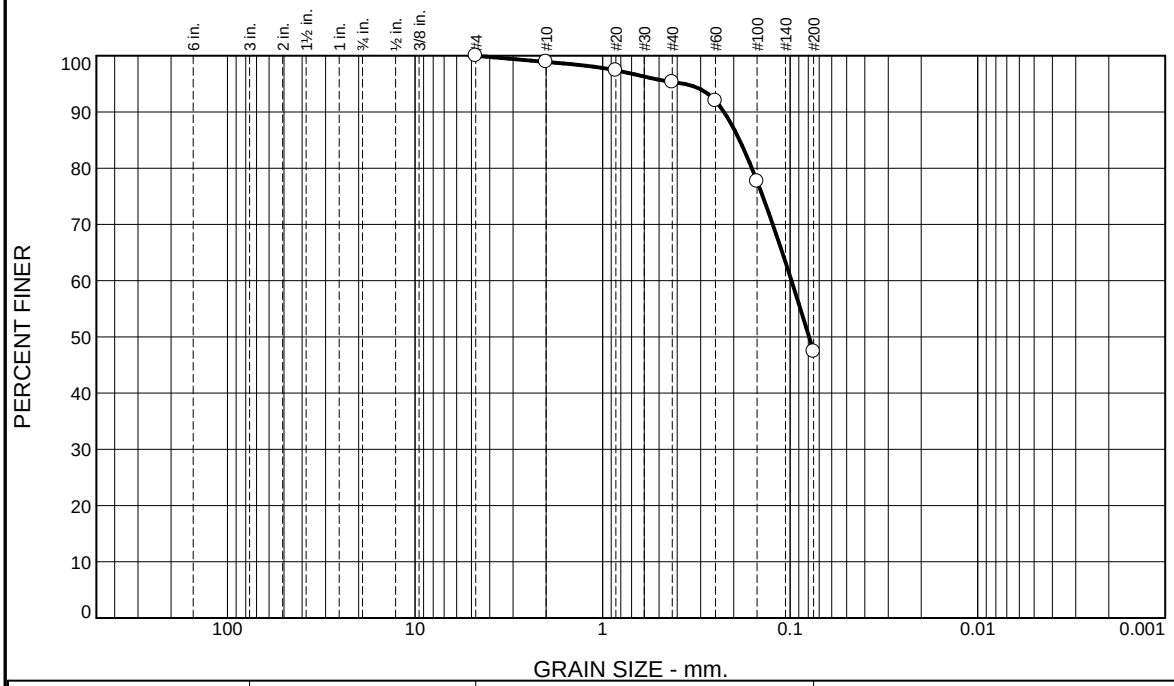
Cranston, RI

Remarks:

Figure 18-L-1080

Tested By: MN **Checked By:** RR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.1	3.6	47.9	47.4	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	98.9		
#20	97.4		
#40	95.3		
#60	92.0		
#100	77.7		
#200	47.4		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.2251 D_{85}= 0.1860 D_{60}= 0.0984
D_{50}= 0.0793 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as non-plastic.

Date Received: 07.30.18 **Date Tested:** 08.06.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: Borings **Depth:** 40-42' **Date Sampled:**
Sample Number: 03A / S-12

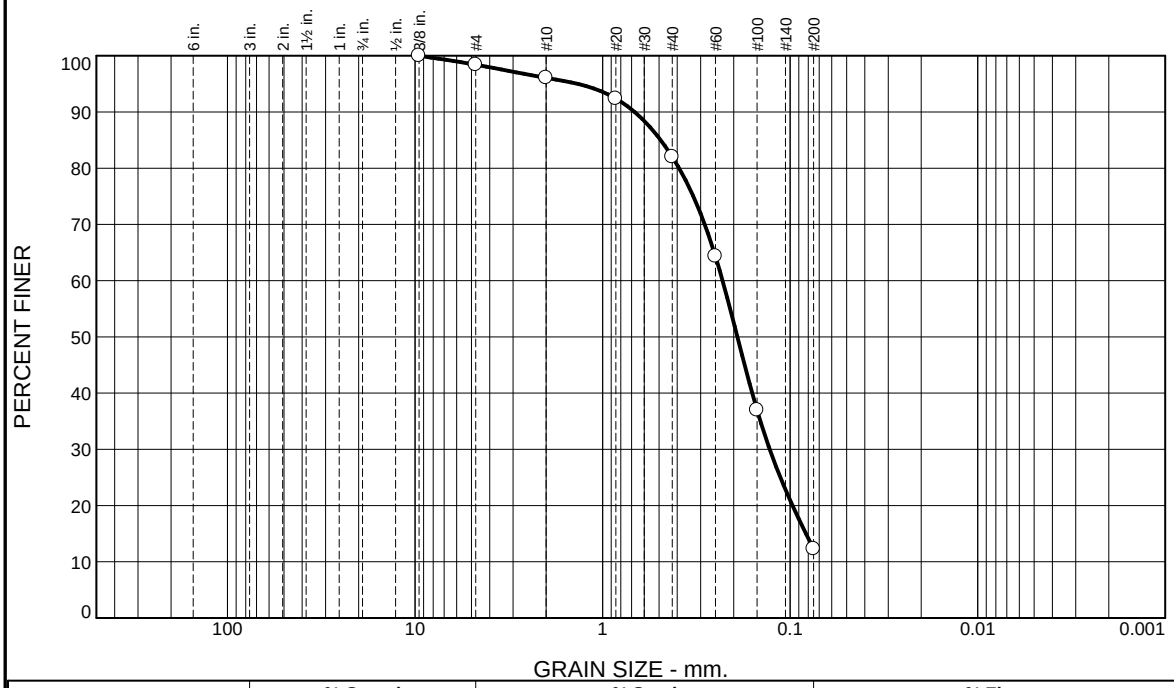
Thielsch Engineering Inc.

Cranston, RI

Client: RT Group
Project: Turney Creek
Fairfield, CT

Project No: 74-18-0002.09 **Figure** 18-S-1081

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.6	2.3	14.1	69.7	12.3	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375"	100.0		
#4	98.4		
#10	96.1		
#20	92.4		
#40	82.0		
#60	64.3		
#100	37.0		
#200	12.3		

* (no specification provided)

Material Description

Dark Grey silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.6745 D_{85}= 0.4900 D_{60}= 0.2292
D_{50}= 0.1910 D_{30}= 0.1285 D_{15}= 0.0824
D_{10}= C_u= C_c=

Remarks

Date Received: 07.30.18 **Date Tested:** 08.06.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: Borings **Depth:** 20-22' **Date Sampled:**
Sample Number: 04 / S-7

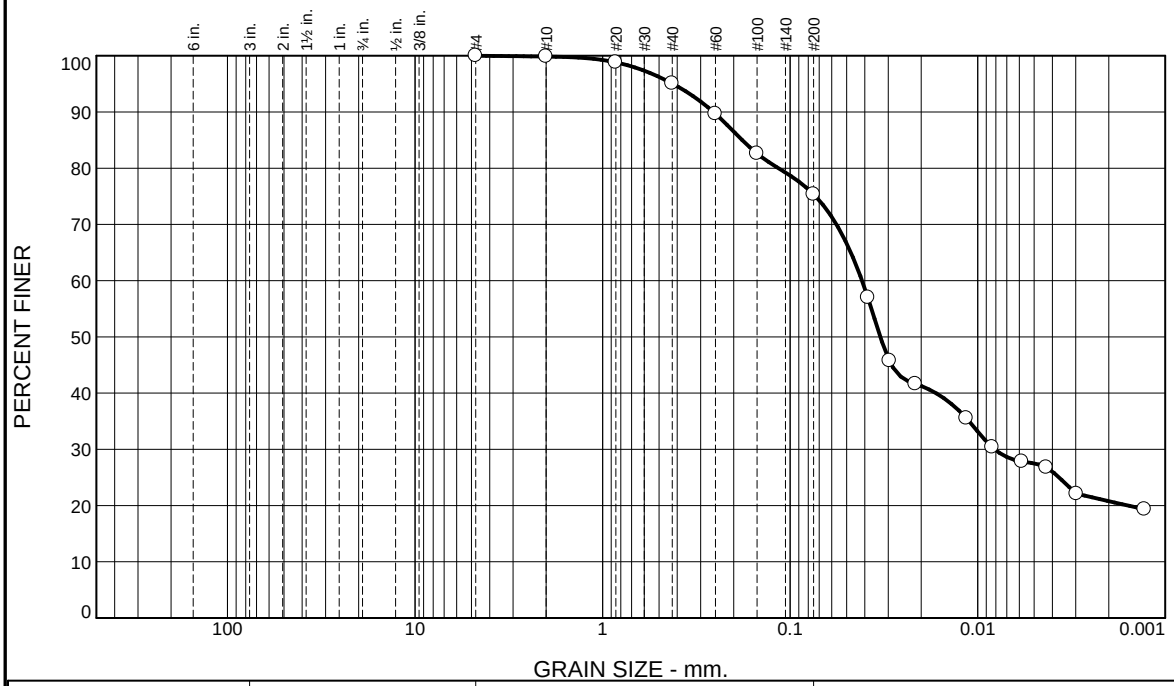
Thielsch Engineering Inc.

Cranston, RI

Client: RT Group
Project: Turney Creek
Fairfield, CT

Project No: 74-18-0002.09 **Figure** 18-S-1082

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	4.8	19.7	54.6	20.8

Test Results (D7928 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.9		
#20	98.8		
#40	95.1		
#60	89.7		
#100	82.6		
#200	75.4		
0.0385 mm.	57.0		
0.0295 mm.	45.7		
0.0214 mm.	41.6		
0.0115 mm.	35.5		
0.0084 mm.	30.4		
0.0058 mm.	27.8		
0.0043 mm.	26.8		
0.0030 mm.	22.1		
0.0013 mm.	19.3		

* (no specification provided)

Material Description

Grey sandy organic silt

Atterberg Limits (ASTM D 4318)

PL= 38 **LL=** 73 **PI=** 35

Classification

USCS (D 2487)= MH **AASHTO (M 145)=** A-7-5(30)

Coefficients

D_{90}= 0.2564 D_{85}= 0.1800 D_{60}= 0.0413
D_{50}= 0.0330 D_{30}= 0.0081 D_{15}=
D_{10}= C_u= C_c=

Remarks

Hydrometer was conducted using previously tested (atterberg) material.

Date Received: 07.30.18 **Date Tested:** 08.06.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: Borings **Depth:** 30-32' **Date Sampled:**
Sample Number: 04 / S-9

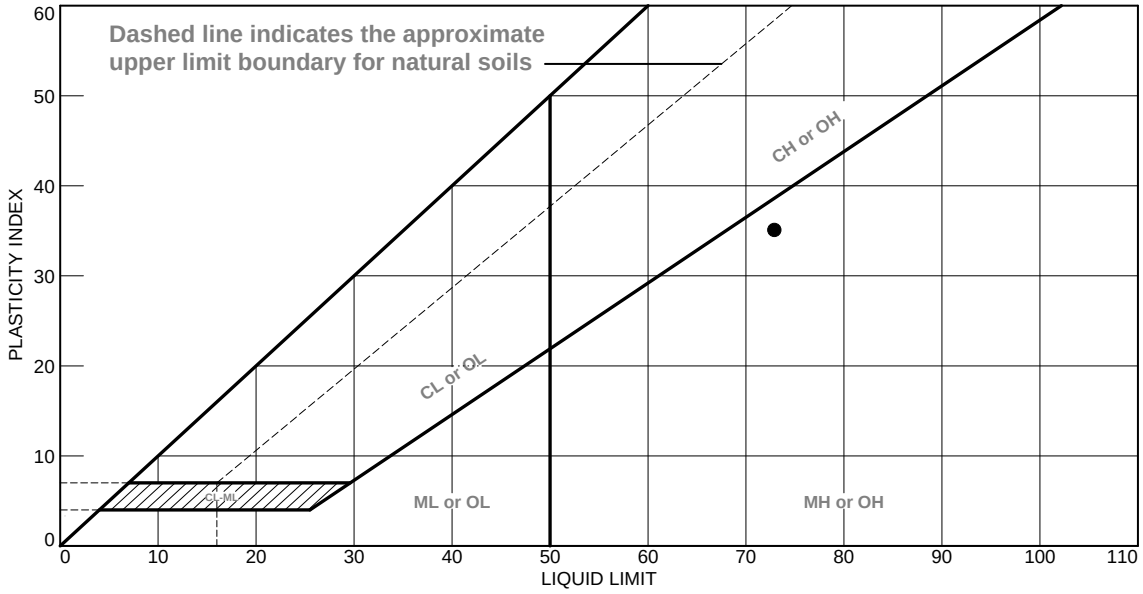
Thielsch Engineering Inc.

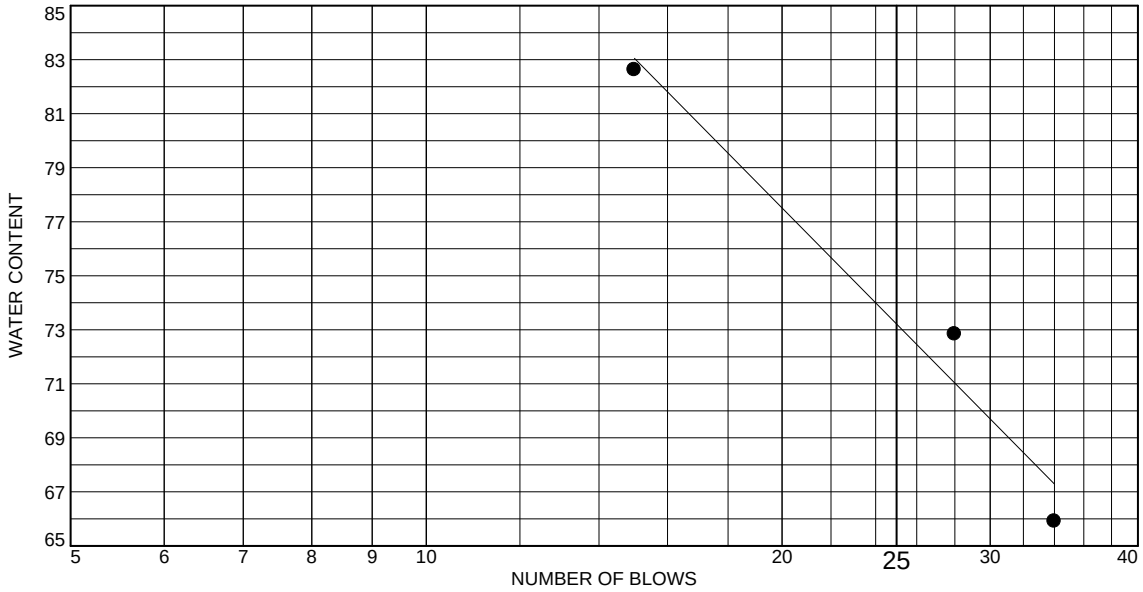
Cranston, RI

Client: RT Group
Project: Turney Creek
Fairfield, CT

Project No: 74-18-0002.09 **Figure** 18-S-1083

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Grey sandy organic silt	73	38	35	95.1	75.4	MH

Project No. 74-18- **Client:** RT Group

Project: Turney Creek

Fairfield, CT

Source of Sample: Borings **Depth:** 30-32'

Sample Number: 04 / S-9

Thielsch Engineering Inc.

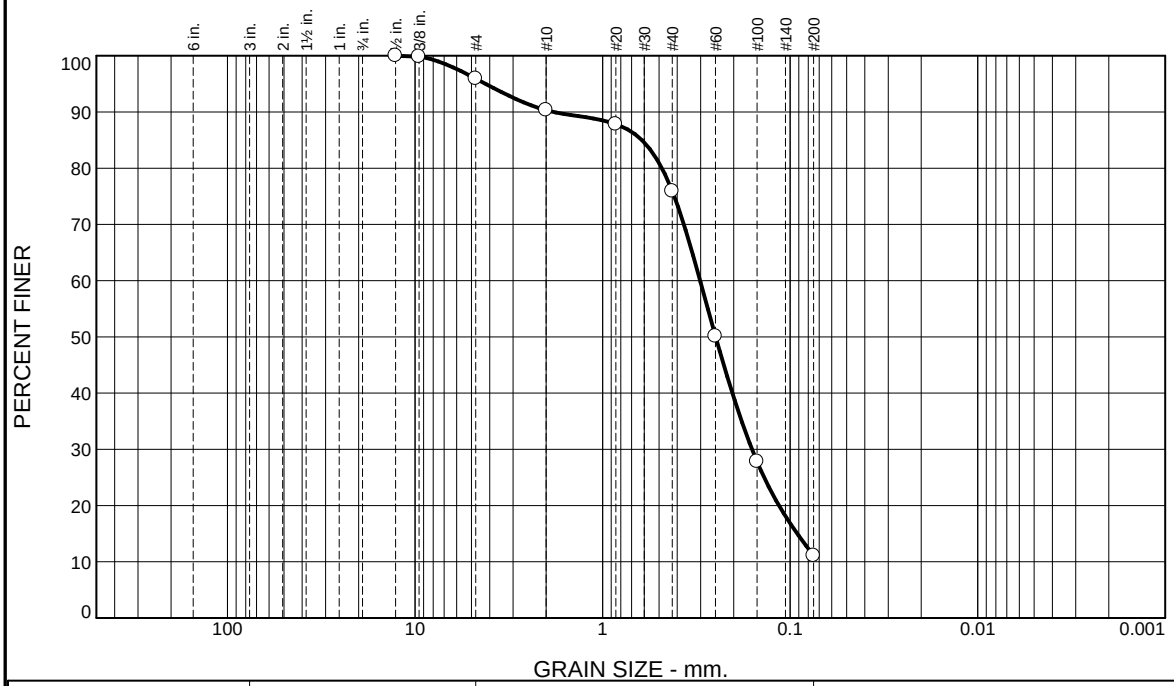
Cranston, RI

Remarks:

Figure 18-L-1083

Tested By: MN **Checked By:** RR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.1	5.6	14.4	64.8	11.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5"	100.0		
0.375"	99.8		
#4	95.9		
#10	90.3		
#20	87.8		
#40	75.9		
#60	50.1		
#100	27.8		
#200	11.1		

* (no specification provided)

Material Description

Brown poorly graded sand with silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 1.8243 D_{85}= 0.6168 D_{60}= 0.3018
D_{50}= 0.2495 D_{30}= 0.1596 D_{15}= 0.0917
D_{10}= C_u= C_c=

Remarks

Date Received: 07.30.18 **Date Tested:** 08.06.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

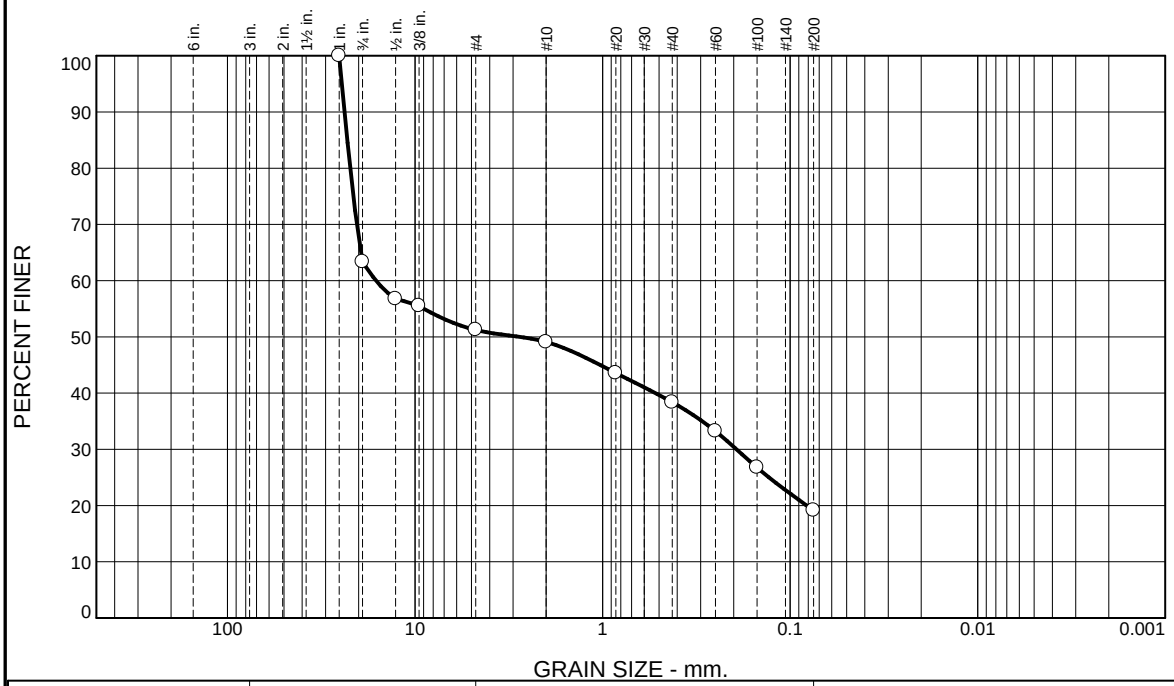
Source of Sample: Borings **Depth:** 40-42' **Date Sampled:**
Sample Number: 04 / S-11

Thielsch Engineering Inc.

Cranston, RI

Client: RT Group
Project: Turney Creek
Fairfield, CT
Project No: 74-18-0002.09 **Figure** 18-S-1084

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	36.7	12.1	2.1	10.7	19.3	19.1	

Test Results (D7928 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	63.3		
0.5"	56.8		
0.375"	55.5		
#4	51.2		
#10	49.1		
#20	43.6		
#40	38.4		
#60	33.2		
#100	26.8		
#200	19.1		

* (no specification provided)

Material Description

Brown silty gravel with sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 23.7678 D_{85}= 22.9654 D_{60}= 16.1542
D_{50}= 2.7558 D_{30}= 0.1931 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 07.30.18 **Date Tested:** 08.06.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

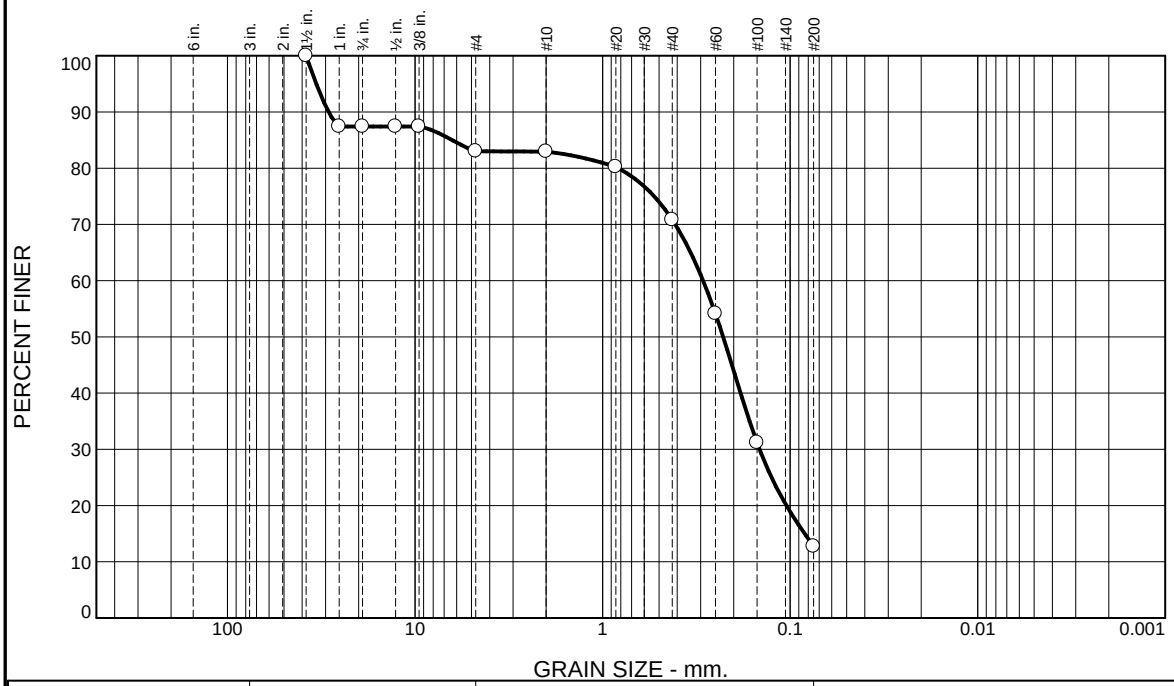
Source of Sample: Borings **Depth:** 3-5' **Date Sampled:**
Sample Number: 05 / S-2

Thielsch Engineering Inc.

Cranston, RI

Client: RT Group
Project: Turney Creek
Fairfield, CT
Project No: 74-18-0002.09 **Figure** 18-S-1085

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.6	4.4	0.0	12.2	58.0	12.8	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	87.4		
0.75"	87.4		
0.5"	87.4		
0.375"	87.4		
#4	83.0		
#10	83.0		
#20	80.2		
#40	70.8		
#60	54.1		
#100	31.2		
#200	12.8		

* (no specification provided)

Material Description

Brown silty sand with gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 28.8909 D_{85}= 6.3408 D_{60}= 0.2909
D_{50}= 0.2276 D_{30}= 0.1455 D_{15}= 0.0837
D_{10}= C_u= C_c=

Remarks

Date Received: 07.30.18 **Date Tested:** 08.06.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: Borings **Depth:** 20-22' **Date Sampled:**
Sample Number: 05 / S-7

Thielsch Engineering Inc.

Cranston, RI

Client: RT Group
Project: Turney Creek
Fairfield, CT
Project No: 74-18-0002.09 **Figure** 18-S-1086

APPENDIX F

Tighe&Bond
Consulting Engineers
Environmental Specialists

Prep'd Date 9/17/2018 By RTG
Ch'kd Date 9/17/2018 By JAR
Town of Farfield
Funds
Town No.
Project No. 15-0439-11
Sheet No. 1 of 1

Opinion of Probable Cost
for the Construction of

Project Description Turney Creek Outfall - Alternative 1
Pile Supported Headwalls & Culverts

Conceptual

FROM STA **TO STA**
A LENGTH **FEET AS SHOWN ON THE PLANS**

No.	Item	Unit	Quantity	Price	Amount
1	Clearing & Grubbing	LS	1	$25,000.00	$25,000
2	Sediment and Erosion Control	LS	1	$25,000.00	$25,000
3	Water Handling & Dewatering	LS	1	$150,000.00	$150,000
4	Cofferdam (Two Phases)	LF	400	$1,000.00	$400,000
5	Bridge & Bulkhead Demolition	LS	1	$200,000.00	$200,000
6	Excavation and Backfill	CY	2,000	$80.00	$160,000
7	Rip Rap Aprons	CY	1,000	$100.00	$100,000
8	Structural Concrete (Including Rebar)	CY	325	$1,000.00	$325,000
9	Timber Piles	LF	5,365	$61.50	$329,948
10	Cap Beams & Decking for Culvert Support	LS	1	$60,000.00	$60,000
11	72" Steel Reinfoced PE Culverts (3 Barrels)	LF	180	$350.00	$63,000
12	48" HDPE Culverts (2 Barrels)	LF	120	$200.00	$24,000
13	Self-Regulating Tide Gates	Each	2	$60,000.00	$120,000
14	Top-Hinged Tide Gates	Each	3	$20,000.00	$60,000
15	Processed Aggregate Base	CY	150	$60.00	$9,000
16	Bituminous Concrete	Ton	150	$150.00	$22,500
17	Concrete Curb	LF	200	$50.00	$10,000
18	Concrete Sidewalk	SF	500	$15.00	$7,500
19	Timber Guiderail	LF	200	$200.00	$40,000
20	Furnish and Place Topsoil	SY	550	$10.00	$5,500
21	Turf Establishment	SY	550	$4.00	$2,200
22	Chain Link Fence	LF	175	$75.00	$13,125
23	Mobilization/Demobilization (5%)	LS	1	$107,600.00	$107,600
24	Construction Staking (2.5%)	LS	1	$53,800.00	$53,800
25	Wetland Mitigation (2.5%)	LS	1	$58,000.00	$58,000
	SUB-TOTAL				$2,370,000
	Contingency (35%)				$829,500
	TOTAL			SAY	$3,200,000

Notes/Assumptions:

1. Replacement or rehabilitation of the sanitary sewer siphons below the existing bridge is not included.
2. OPC assumes Riverside Drive can be closed during demolition and construction. Costs for phased construction are not included.
3. Design & permitting costs, construction observation and construction administration are not included.

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Consulting Engineers
Environmental Specialists

Prep'd Date 9/17/2018 By RTG
Ch'kd Date 9/17/2018 By JAR
Town of Farfield
Funds
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Project No. 15-0439-11
Sheet No. 1 of 1

Opinion of Probable Cost
for the Construction of

Project Description Turney Creek Outfall - Alternative 1A
Anchored Sheet Pile Headwalls & Pile-Supported Culverts

Conceptual

FROM STA _____ **TO STA** _____
A LENGTH _____ **FEET AS SHOWN ON THE PLANS**

No.	Item	Unit	Quantity	Price	Amount
1	Clearing & Grubbing	LS	1	$25,000.00	$25,000
2	Sediment and Erosion Control	LS	1	$25,000.00	$25,000
3	Water Handling & Dewatering	LS	1	$150,000.00	$150,000
4	Cofferdam (Two Phases)	LF	400	$1,000.00	$400,000
5	Bridge & Bulkhead Demolition	LS	1	$200,000.00	$200,000
6	Excavation and Backfill	CY	2,000	$80.00	$160,000
7	Rip Rap Aprons	CY	1,000	$100.00	$100,000
8	Structural Concrete (Including Rebar)	CY	250	$1,000.00	$250,000
9	Timber Piles	LF	2,850	$61.50	$175,275
10	Steel Sheet Pile (Furnish)	LB	116,820	$1.10	$128,502
11	Steel Sheet Pile (Installation)	LF	175	$200.00	$35,000
12	Shear Studs	Each	1,600	$10.00	$16,000
13	Tie Rods	Each	20	$1,500.00	$30,000
14	Cap Beams & Decking for Culvert Support	LS	1	$60,000.00	$60,000
15	72" Steel Reinfoced PE Culverts (3 Barrels)	LF	180	$350.00	$63,000
16	48" HDPE Culverts (2 Barrels)	LF	120	$200.00	$24,000
17	Self-Regulating Tide Gates	Each	2	$60,000.00	$120,000
18	Top-Hinged Tide Gates	Each	3	$20,000.00	$60,000
19	Processed Aggregate Base	CY	150	$60.00	$9,000
20	Bituminous Concrete	Ton	150	$150.00	$22,500
21	Concrete Curb	LF	200	$50.00	$10,000
22	Concrete Sidewalk	SF	500	$15.00	$7,500
23	Timber Guiderail	LF	200	$200.00	$40,000
24	Furnish and Place Topsoil	SY	550	$10.00	$5,500
25	Turf Establishment	SY	550	$4.00	$2,200
26	Chain Link Fence	LF	175	$75.00	$13,125
27	Mobilization/Demobilization (5%)	LS	1	$106,600.00	$106,600
28	Construction Staking (2.5%)	LS	1	$53,300.00	$53,300
29	Wetland Mitigation (2.5%)	LS	1	$57,000.00	$57,000
	SUB-TOTAL				$2,350,000
	Contingency (35%)				$822,500
	TOTAL			SAY	$3,200,000

Notes/Assumptions:

1. Replacement or rehabilitation of the sanitary sewer siphons below the existing bridge is not included.
2. OPC assumes Riverside Drive can be closed during demolition and construction. Costs for phased construction are not included.
3. Design & permitting costs, construction observation and construction administration are not included.

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Environmental Specialists

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Town of Farfield
Funds
Town No.
Project No. 15-0439-11
Sheet No. 1 of 1

Opinion of Probable Cost
for the Construction of

Project Description Turney Creek Outfall - Alternative 2
Pile Supported Headwalls & Ground Supported Culverts

Conceptual

FROM STA _____ **TO STA** _____
A LENGTH _____ **FEET AS SHOWN ON THE PLANS**

No.	Item	Unit	Quantity	Price	Amount
1	Clearing & Grubbing	LS	1	$25,000.00	$25,000
2	Sediment and Erosion Control	LS	1	$25,000.00	$25,000
3	Water Handling & Dewatering	LS	1	$150,000.00	$150,000
4	Cofferdam (Two Phases)	LF	400	$1,000.00	$400,000
5	Bridge & Bulkhead Demolition	LS	1	$200,000.00	$200,000
6	Excavation and Backfill	CY	2,000	$80.00	$160,000
7	Rip Rap Aprons	CY	1,000	$100.00	$100,000
8	Structural Concrete (Including Rebar)	CY	325	$1,000.00	$325,000
9	Timber Piles	LF	3,045	$61.50	$187,268
10	Cap Beams & Decking for Culvert Support	LS	0	$60,000.00	$0
11	72" Steel Reinfoced PE Culverts (3 Barrels)	LF	180	$350.00	$63,000
12	48" HDPE Culverts (2 Barrels)	LF	120	$200.00	$24,000
13	Self-Regulating Tide Gates	Each	2	$60,000.00	$120,000
14	Top-Hinged Tide Gates	Each	3	$20,000.00	$60,000
15	Processed Aggregate Base	CY	150	$60.00	$9,000
16	Bituminous Concrete	Ton	150	$150.00	$22,500
17	Concrete Curb	LF	200	$50.00	$10,000
18	Concrete Sidewalk	SF	500	$15.00	$7,500
19	Timber Guiderail	LF	200	$200.00	$40,000
20	Furnish and Place Topsoil	SY	550	$10.00	$5,500
21	Turf Establishment	SY	550	$4.00	$2,200
22	Chain Link Fence	LF	175	$75.00	$13,125
23	Mobilization/Demobilization (5%)	LS	1	$97,500.00	$97,500
24	Construction Staking (2.5%)	LS	1	$48,700.00	$48,700
25	Wetland Mitigation (2.5%)	LS	1	$52,000.00	$52,000
	SUB-TOTAL				$2,150,000
	Contingency (35%)				$752,500
	TOTAL			SAY	$2,900,000

Notes/Assumptions:

1. Replacement or rehabilitation of the sanitary sewer siphons below the existing bridge is not included.
2. OPC assumes Riverside Drive can be closed during demolition and construction. Costs for phased construction are not included.
3. Design & permitting costs, construction observation and construction administration are not included.

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Town of Farfield
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Town No.
Project No. 15-0439-11
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Opinion of Probable Cost
for the Construction of

Project Description Turney Creek Outfall - Alternative 2A
Anchored Sheet Pile Headwalls & Ground Supported Culverts

Conceptual

FROM STA _____ **TO STA** _____
A LENGTH _____ **FEET AS SHOWN ON THE PLANS**

No.	Item	Unit	Quantity	Price	Amount
1	Clearing & Grubbing	LS	1	$25,000.00	$25,000
2	Sediment and Erosion Control	LS	1	$25,000.00	$25,000
3	Water Handling & Dewatering	LS	1	$150,000.00	$150,000
4	Cofferdam (Two Phases)	LF	400	$1,000.00	$400,000
5	Bridge & Bulkhead Demolition	LS	1	$200,000.00	$200,000
6	Excavation and Backfill	CY	2,000	$80.00	$160,000
7	Rip Rap Aprons	CY	1,000	$100.00	$100,000
8	Structural Concrete (Including Rebar)	CY	250	$1,000.00	$250,000
9	Timber Piles	LF	232	$61.50	$14,268
10	Steel Sheet Pile (Furnish)	LB	116,820	$1.10	$128,502
11	Steel Sheet Pile (Installation)	LF	175	$200.00	$35,000
12	Shear Studs	Each	1,600	$10.00	$16,000
13	Tie Rods	Each	20	$1,500.00	$30,000
14	Cap Beams & Decking for Culvert Support	LS	0	$60,000.00	$0
15	72" Steel Reinfoced PE Culverts (3 Barrels)	LF	180	$350.00	$63,000
16	48" HDPE Culverts (2 Barrels)	LF	120	$200.00	$24,000
17	Self-Regulating Tide Gates	Each	2	$60,000.00	$120,000
18	Top-Hinged Tide Gates	Each	3	$20,000.00	$60,000
19	Processed Aggregate Base	CY	150	$60.00	$9,000
20	Bituminous Concrete	Ton	150	$150.00	$22,500
21	Concrete Curb	LF	200	$50.00	$10,000
22	Concrete Sidewalk	SF	500	$15.00	$7,500
23	Timber Guiderail	LF	200	$200.00	$40,000
24	Furnish and Place Topsoil	SY	550	$10.00	$5,500
25	Turf Establishment	SY	550	$4.00	$2,200
26	Chain Link Fence	LF	175	$75.00	$13,125
27	Mobilization/Demobilization (5%)	LS	1	$95,500.00	$95,500
28	Construction Staking (2.5%)	LS	1	$47,800.00	$47,800
29	Wetland Mitigation (2.5%)	LS	1	$51,000.00	$51,000
	SUB-TOTAL				$2,100,000
	Contingency (35%)				$735,000
	TOTAL			SAY	$2,800,000

Notes/Assumptions:

1. Replacement or rehabilitation of the sanitary sewer siphons below the existing bridge is not included.
2. OPC assumes Riverside Drive can be closed during demolition and construction. Costs for phased construction are not included.
3. Design & permitting costs, construction observation and construction administration are not included.

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Opinion of Probable Cost
for the Construction of

Project Turney Creek Outfall - Alternative 3
Description Pile Supported Headwall/Riprap Slope & Ground Supported Culverts

Conceptual

FROM STA **TO STA**
A LENGTH **FEET AS SHOWN ON THE PLANS**

No.	Item	Unit	Quantity	Price	Amount
1	Clearing & Grubbing	LS	1	$25,000.00	$25,000
2	Sediment and Erosion Control	LS	1	$25,000.00	$25,000
3	Water Handling & Dewatering	LS	1	$150,000.00	$150,000
4	Cofferdam (Two Phases)	LF	400	$1,000.00	$400,000
5	Bridge & Bulkhead Demolition	LS	1	$200,000.00	$200,000
6	Excavation and Backfill	CY	2,000	$80.00	$160,000
7	Rip Rap Aprons	CY	1,000	$100.00	$100,000
8	Rip Rap Slope	Ton	400	$80.00	$32,000
9	Structural Concrete (Including Rebar)	CY	185	$1,000.00	$185,000
10	Timber Piles	LF	2,030	$61.50	$124,845
11	Cap Beams & Decking for Culvert Support	LS	0	$60,000.00	$0
12	72" Steel Reinforced PE Culverts (3 Barrels)	LF	225	$350.00	$78,750
13	48" HDPE Culverts (2 Barrels)	LF	150	$200.00	$30,000
14	Self-Regulating Tide Gates	Each	2	$60,000.00	$120,000
15	Top-Hinged Tide Gates	Each	3	$20,000.00	$60,000
16	Processed Aggregate Base	CY	150	$60.00	$9,000
17	Bituminous Concrete	Ton	150	$150.00	$22,500
18	Concrete Curb	LF	200	$50.00	$10,000
19	Concrete Sidewalk	SF	500	$15.00	$7,500
20	Timber Guiderail	LF	200	$200.00	$40,000
21	Furnish and Place Topsoil	SY	550	$10.00	$5,500
22	Turf Establishment	SY	550	$4.00	$2,200
23	Chain Link Fence	LF	175	$75.00	$13,125
24	Mobilization/Demobilization (5%)	LS	1	$90,000.00	$90,000
25	Construction Staking (2.5%)	LS	1	$45,000.00	$45,000
26	Wetland Mitigation (2.5%)	LS	1	$48,000.00	$48,000
	SUB-TOTAL				$1,980,000
	Contingency (35%)				$693,000
	TOTAL			SAY	$2,670,000

Notes/Assumptions:

1. Replacement or rehabilitation of the sanitary sewer siphons below the existing bridge is not included.
2. OPC assumes Riverside Drive can be closed during demolition and construction. Costs for phased construction are not included.
3. Design & permitting costs, construction observation and construction administration are not included.