DESIGN FLOOD MEMORANDUM

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DATE: May 13, 2016

RE: **Design Flood Memorandum**
Mill River District Shoreline Analysis
City of New Haven
CNH Project No. 15-195-21
RTG Project No. 15103.00

Introduction

The Mill River District (the District) is located between the neighborhoods of Wooster Square and Fair Haven in the City of New Haven, Connecticut (the City) (Figures 1 and 2). Some properties along the Mill River and within the District have been identified for potential redevelopment since they are currently considered an underutilized commercial/community resource. However, these properties lie within an established Federal Emergency Management Agency (FEMA) Flood Zone, and are subject to flooding as a result of storm surge. Accordingly, one hurdle that must first be addressed is the vulnerability of these properties to flooding.

Purpose and Scope

The purpose of this Design Flood Memorandum (DFM) is to present design criteria for the development of flood protection alternatives for properties within the identified Study Area (Figure 2). These alternatives will be presented in an *Alternatives Evaluation Report* to be prepared by RT Group, Inc. (RTG), which will include budget-level cost estimates. The *Alternatives Evaluation Report* will be prepared following the City's review of the DFM.

The Scope-of-Work completed to prepare the DFM included reviewing existing conditions, including obtaining input from existing property owners; a shoreline inspection; topographic and bathymetric surveys; a flood evaluation; and the development of preliminary flood protection alternatives that take into consideration the Management Approaches presented in the *Mill River District Planning Study* (Utile, Inc. and Ninigret Partners, June 2013).

Background

The Mill River (the River), and the surrounding communities that it helped to develop and support, has a long and rich history. First accounts of mill activity along the River, from which the River's name is derived, date back to as early as 1642. Mill development continued into the 19th and 20th centuries, and included factories that produced firearms (Eli Whitney), horse-drawn carriages, and paper.

Development within the District generally took advantage of the available waterfront and rail access. Notable developments within the Study Area included the Powerhouse Building, which was constructed in 1900 and housed generators that powered the City's trolley system; and English Station, which was completed in 1929 and operated as a coal- and then oil-fired power plant until 1992 (Figure 2).

Existing Conditions

There are several small- to medium-sized companies within the Study Area, including but not limited to Radiall Manufacturing, Hillard Bloom Shellfish, and Miller Marine Services. In addition, United Illuminating's Grand Avenue Substation is located within the Study Area directly adjacent to the River (Figure 2).

The Study Area also contains key infrastructure including two (2) main east-west thoroughfares that span over the River (Grand Avenue and Chapel Street), and a key railroad corridor allowing freight and passenger train travel between New Haven Railroad Station (i.e., Union Station) and Hartford/New London (Figure 2).

Despite the companies and infrastructure noted above, much of the land within the Study Area is abandoned (e.g., English Station) and/or undeveloped. In addition, some of the existing waterfront property is utilized for low-revenue generating activities such as salt storage and staging for nearby highway construction (e.g., Gateway Terminal).

Input Received from Property Owners

In March 2016, Data Request Questionnaires (DRQs) were sent by the City & RTG to the owners of selected waterfront properties located within the Study Area. The questionnaire generally requested available site information on the property (e.g., topographic, utility, subsurface, etc.) as well as the extent of flooding observed at the property during past significant storm events. From the responses received (Appendix A), RTG was able to estimate the approximate flood elevations at selected locations within the Study Area and compare them to published flood elevation data.

Subsurface Information

Data related to several previous subsurface investigations that were performed within the Study Area were obtained. These include subsurface investigations performed for the construction of the Chapel Street Bridge, the two (2) Grand Avenue Bridges located to the east and west of Ball Island, the Interstate 91 Northbound Viaduct, and the State Street Bridge (located just north of the Study Area). Available soil boring logs from these investigations are provided in Appendix B.

Based on the soil boring logs, the subsurface soil conditions (from top to bottom) along the River within the Study Area are expected to consist of medium-dense fill, very soft to soft organic silt, and stratified layers of loose to medium dense sand, gravel, and silt. The soil borings were advanced to depths ranging from about 50 to 100 feet below existing ground surface. However, bedrock was not encountered in any of the soil borings, indicating bedrock is located at least 50 to 100 feet below existing grade.

Utility Information

Several utilities and utility crossings (below ground and overhead) are located throughout the Study Area and include, but may not be limited to potable water, sanitary sewer, stormwater, gas, and electric. In addition, there are several municipal stormwater drainage outfalls that are located primarily near the bridges within the Study Area.

FEMA Flood Hazard Information

The established 1% annual chance (i.e., 100-year) flood elevations within the Study Area were obtained from the 2013 FEMA Flood Insurance Rate Map (FIRM) Panels for the area. The Study Area is located within an AE flood zone that extends along the River and beyond its banks (Figure 3). While the existing shoreline structures located between Chapel Street and Grand Avenue are effective at attenuating wave action, the base flood elevations within the Study Area indicate that the existing structures along the River will be completely inundated during the 100-year event flood.

Shoreline Inspection

The existing shoreline along the River and within the Study Area varies considerably with respect to the type and condition of waterfront structures that exist. While a significant portion of the shoreline is protected by timber and steel bulkheads, riprap revetments, and block walls, other sections contain only remnants of previous structures in addition to what now appears to be a natural shoreline.

Level 1 Topside Inspection

RTG completed a Level 1 topside inspection of the existing shoreline along the River and within the Study Area from about Mean Low Water (MLW) to existing grade. A Level 1 inspection generally does not include cleaning of the structures prior to the inspection. A Level II close-up inspection, which did include some spot cleaning of the structures, was performed by RTG at selected locations as time and budget allowed.

The topside inspection was completed from a small work boat by Mr. David Arpin, P.E. /RTG and Mr. Greg Coren/RTG. In general, the shoreline along the River was segmented based on the existing property limits, and RTG utilized a rating system to grade the condition of the existing waterfront structures based on a scale from 0 to 9, with 0 being a “Failed Condition,” and 9 being “Excellent Condition” (Table 1).

The results of the topside inspection are summarized in Table 2, which references site photographs provided in Appendix C. Each shoreline property that was inspected is identified in Table 2 based on the current tenant/use; the Map, Block, and Lot number; and its stationing limits (in reference to the established project baseline) (Figures 2 and 3).

Between Stations 15+00 and 39+00, the project baseline splits in order to follow the east and west branches of the River around Ball Island. Accordingly, the baseline in these areas are designated with either an “E” for east or “W” for west (e.g., Sta. W20+00, Sta. E20+00, etc.) in reference to the branch of the River in which it is located (Figures 2 through 3).

Topographic and Bathymetric Surveys

Concurrent with the shoreline inspection, RTG obtained topographic and bathymetric survey information within the Study Area. In general, topographic survey information was obtained from the 2011 FEMA LiDAR Flood Plain Mapping Survey, and bathymetric survey information was obtained from the 2011 U.S. Army Corps of Engineers (USACE) Shoalest Soundings data.

The above information was supplemented with topographic and bathymetric survey information collected by RTG using a Leica GS-14 Smart-Antenna Global Positioning System (GPS) and a TS-06 Plus Total Station. RTG collected this supplemental information along the shoreline within the Study Area between December 2015 and March 2016.

The survey information collected by RTG showed adequate correlation with the LiDAR and USACE data. The topographic and bathymetric survey information, utility information, FEMA flood hazard information, and shoreline inspection data was combined to develop the Site Plans for the Study Area (Figures 4 through 9).

Flood Evaluation

The flood evaluation included both a coastal flooding analysis and an assessment of future potential sea-level rise. A summary of this evaluation is presented below.

Coastal Flooding Analysis

In order to confirm the flood climate presented in the 2013 FEMA FIRM Panels, RTG’s Sub consultant, Whitecap Engineering, LLC (WCE), performed a coastal flooding analysis of the Study Area (Appendix D). This analysis included a review of published data from past significant storm events as well as the input received via the DRQ’s discussed above.

In general, the coastal flooding analysis confirmed the conditions provided in the current FEMA FIRM Panels for the Study Area. The analysis indicates that the Study Area is mostly shielded from direct wave impacts, and that the wave energy generated from a 100-year storm event is mostly dissipated prior to reaching it.

The above is represented in the FEMA FIRM Panels as the location where the VE Zone diminishes to an AE Zone (Figure 3). Continuing landward from this location, the Study Area is mostly affected by storm surge, with little wave action beyond the hardened structures that exist along the shoreline between Chapel Street and Grand Avenue.

While the Study Area's vulnerability to flooding remains an issue that will need to be addressed via the implementation of flood protection alternatives as further discussed below, the confirmation of the estimated flood elevations presented in the FEMA FIRM Panels via the coastal flooding analysis that was completed provides a high degree of confidence moving forward into the *Alternatives Evaluation Report*.

Future Potential Sea-Level Rise

Because the Study Area is mostly affected by storm surge, future potential sea-level rise could have a significant impact on flood elevations within it. However, there is a great deal of controversy with respect to the potential causes of and the predicted rate of sea-level rise.

Research by the late Professor Jon C. Boothroyd suggests that sea-level rise, which has historically averaged about 2 to 3 mm/year, could increase to about 1 to 1.5 cm/year within the Northeastern United States (Congressional Hazards Caucus Briefing-Washington, DC, November 2009).

Other researchers, such as the Intergovernmental Panel on Climate Change (IPCC AR5 Working Group, 2013), have predicted a sea-level rise ranging from about 0.6 to 1.1 cm/year between now and about 2100. Beyond about 2100, the IPCC predicts the rate will increase to about 0.8 to 1.6 cm/year.

For similar flood proofing projects, RTG has utilized a potential sea-level rise of about 1.5 feet in 50 years. This corresponds to an average sea-level rise of about 0.9 cm/year, which would be at the lower end of the range predicted by Professor Boothroyd, but about 3 times higher than the historical average.

Flood Criteria

Based on the coastal flooding analysis and an estimate of future potential sea-level rise, the minimum recommended flood protection improvements elevations for each property within the Study Area are summarized in Table 3. The established minimum elevations include the FEMA 100-year flood elevation, a future potential sea-level rise of 1.5 feet in 50 years, and 1 foot of freeboard (measured either from the flood elevation to the top of a proposed barrier or to the finish grade/floor elevation of a proposed building).

The minimum recommended flood protection improvements elevations shown in Table 3 should be considered preliminary and may vary. The final recommended elevations will be determined following the City's review of this DFM, and will take into consideration such things as constructability (e.g., the feasibility of raising grade or constructing a flood proofing barrier to the desired elevation), the City's desired design-life time horizon (e.g., 50 or 100 years), cost, risk, and other factors that are beyond the scope of this DFM.

Flood Management Approaches

As presented in the *Mill River District Planning Study* (Utile, Inc. and Ninigret Partners, June 2013), three (3) Management Approaches were recommended in order to address the the Study Area's vulnerability to flooding and promote the redevelopment of existing underutilized and/or abandoned properties. These Management Approaches include (1) Natural Attenuation, (2) Paired Capacity Investment, and (3) Intensive Infrastructure Investment. A brief summary of each Management Approach is presented below, including feasible flood protection alternatives that take into consideration the flood criteria summarized in Table 3. Each of these alternatives will be discussed in more detail within the *Alternatives Evaluation Report*, following the City's review of the DFM.

Natural Attenuation

The Natural Attenuation Management Approach involves minimum intervention with respect to flood protection. Under this approach, the existing waterfront properties would be allowed to flood during severe storm events. It is expected that this flooding, in combination with the associated financial burdens (e.g., making repairs, obtaining flood insurance), would discourage business owners from staying in the Study Area. As a result, ecological succession would be expected to occur over a period of time.

Ecological succession and "seeding" of these sites is considered to be a low-cost flood protection alternative to help protect properties located at the outer limits of the existing FEMA flood zones. This is because the growth and establishment of vegetation is considered to be an effective means of limiting the effects of erosion caused by storm surge and continuous river flow. However, this Management Approach by itself would do little to encourage redevelopment within the Study Area. Potential properties that could be evaluated in the *Alternatives Evaluation Report* under this approach are shown in Figure 10.

Paired Capacity Investment

The Paired Capacity Investment Management Approach involves targeting and protecting specific properties within the Study Area based on their potential value and projected performance. Flood protection alternatives would either stabilize the existing shoreline; elevate proposed buildings above the flood elevation; cut-off flood waters/storm surge via the construction of hardened shoreline structures; and/or wet-proof/dry-proof existing and new buildings to resist the loading associated with flooding and minimize the potential for damage. Potential properties that could be evaluated in the *Alternatives Evaluation Report* under this approach are shown in Figure 11.

Intensive Infrastructure Investment

The Intensive Infrastructure Investment Management Approach involves implementing improvements similar to those described under the Paired Capacity management approach, but on a Study Area wide scale. Accordingly, these improvements would cut-off flood waters/storm surge from entering the Study Area and/or surrounding areas via the construction of large-scale hardened shoreline structures (e.g., flood gates). Potential properties that could be evaluated in the *Alternatives Evaluation Report* under this approach are shown in Figure 12.

Additional Considerations

We understand that the City wishes to help create jobs, stimulate private sector investment, and create additional tax base within the Study Area. In addition to the Flood Management Approaches presented in Figures 10 through 12, which could be implemented to help make properties within the Study Area more attractive for redevelopment, we recommend that the City consider developing Study Area wide uniform development regulations and a site readiness program in order to streamline the permitting process and create pad ready building sites. This could include obtaining the necessary Federal (e.g., USACE, FEMA), State (e.g., CTDEEP), and City permits ahead of time, which would remove some of the uncertainty in the redevelopment process, making selected sites more attractive to potential buyers/developers.

Moving Forward

We look forward to meeting with the City to discuss the DFM and agree on a course of action for preparing the *Alternatives Evaluation Report*. In the meantime, if you should have any questions prior to our meeting, please do not hesitate to contact us.

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Tables

TABLE 1
General Condition Rating for Evaluating Waterfront Structures
Mill River District Shoreline Analysis
City of New Haven, CT

Code	Definition	Description
9	EXCELLENT CONDITION	Like new
8	VERY GOOD CONDITION	No problems noted
7	GOOD CONDITION	Some minor problems
6	SATISFACTORY CONDITION	Component shows some minor deterioration
5	FAIR CONDITION	Component is structurally sound but may have minor section loss, hairline cracking, or superficial spalling
4	POOR CONDITION	Component has up to 25% section loss or cracks up to 1/16” in width
3	SERIOUS CONDITION	Component has up to 50% section loss or cracks up to 1/8” in width
2	CRITICAL CONDITION	Component has up to 75% section loss or cracks up to ½” in width, rebar exposed and corroded
1	IMMINENT FAILURE CONDITION	Component has deteriorated such that obvious signs of movement are visible
0	FAILED CONDITION	Component has failed, broken, or is missing

TABLE 2
Waterfront Structure Rating
Mill River District Shoreline Analysis
City of New Haven, CT

	Property (Map, Block, Lot)[1]	Approximate Shoreline Stationing Limits (Approx. Length)[1,2]	Existing Shoreline Description	General Condition Rating[3]	Notes
Chapel Street South					
East Shore	Criscuolo Park (175, 607, 1)	0+00 - 10+10 (1,010 lf)	Dumped Riprap Slope	5.5	•Vegetation located immediately landward of riprap. •Concrete stub wall at toe of riprap slope, visible at MLW. •Riprap relatively consistent with little to no bare areas observed (Photo No. 1).
West Shore	York Hill Trap Rock Quarry Co. (178, 547, 2)	0+00 - 10+10 (1,010 lf)	Natural Shoreline with Scattered Dumped Rubble	NA	•Dumped rubble is not consistent. •Evidence of erosion (e.g., exposed roots, downed vegetation) observed (Photo No. 2).
West Shore	Utility Pole (NA)	9+18 - 9+60 (170 lf)	Steel Sheet Pile Bulkhead	5.0	•Section loss around MLW observed (Photo No. 3). •Discrete areas of total section loss with exposed retained soil.
River Crossing	Chapel Street Bridge (NA)	10+10 - 10+63 (53 lf)	Concrete Abutments	6.0	•Steel girder turn bridge with concrete abutments and center pier (bridge rotates from center pier) with stone masonry foundations (Photo No. 4). •Timber fender system exists along abutments and center pier.
River Crossing	Chapel Street Seawall (NA)	10+10 (185 lf)	Stone Masonry Seawall	5.5	•Supports Chapel Street beyond the bridge on both east and west sides (Photo No. 5). •Missing pointing along base of seawall (may be intentional to promote equal water elevations behind and in front of seawall).
Chapel Street to Grand Avenue					
East Shore	299 Chapel St (174, 709, 1)	10+63 - 13+10 (247 lf)	Fixed Timber Pier	0.0	•Natural sloped shoreline exists below the pier. •Pier deck appears to have detached from support piles resulting in an irregular deck surface (Photo No. 6). •40-foot-long section of pier deck has collapsed into the river.
East Shore	Saltonstall Ave (NA)	13+10 - 13+65 (55 lf)	Failed Stone/ Concrete Masonry Seawall	0.0 - 1.0	•20-foot-long section has collapsed into the river (Photo No. 7). •Remainder of seawall exhibits some signs of settlement. •Small fixed timber pier exists approx. 10 feet offshore from seawall.
East Shore	Hillard Bloom Shellfish, Inc. (174, 717, 1)	13+65 - E15+44 (179 lf)	Stone Masonry Seawall	0.0 - 4.0	•Southern end of seawall has collapsed with a sloping natural shoreline behind (Photo No. 8). •Remainder of seawall appears to be in satisfactory condition (Photo No. 9).
East Shore	New NRB #3 Corp. (174, 717, 8)	E15+44 - E17+56 (212 lf)	Steel Sheet Pile Bulkhead	4.5	•Timber fender and floating dock exist seaward of bulkhead along most of its length. •Lateral support of bulkhead provided by seaward mounted steel double channel wale and tie-backs. •Up to 25% section loss in wale and bulkhead around MLW (Photo No. 10).
East Shore	Gateway Terminal & O&G South (174, 729, 1)	E17+56 - E22+19 (463 lf)	Steel Sheet Pile Bulkhead	0.0 - 3.0	•Lateral support of bulkhead provided by landward mounted steel double channel wale and tie-backs. •50% and greater section loss in wale and bulkhead around MLW with exposed retained soil (Photo No. 11). •Pockets of settlement behind the bulkhead (Photo No. 12). •Approx. 50-foot-long section of bulkhead has collapsed seaward into the river (Photo No. 13).
East Shore	Gateway Terminal & O&G North (174, 729, 1)	E22+19 - E23+88 (169 lf)	Failed Timber Sheet Pile Bulkhead	0.0	•Bulkhead has collapsed seaward into the river (Photo No. 14). •Retained soil has been completely eroded and natural shoreline has developed with some dumped riprap observed at its top.
East Shore	Powerhouse Building South (174, 736, 1)	E23+88 - E25+83 (195 lf)	Failed Concrete/ Stone Masonry Seawall	0.0	•Seawall has collapsed seaward into the river (Photo No. 15). •Retained soil has been eroded and natural shoreline slope has developed.
East Shore	Powerhouse Building North (174, 736, 1)	E25+83 - E28+22 (239 lf)	Stone Masonry Seawall	6.0	•Remnants of timber fender piles. •Some well established vegetation growing landward of seawall.
Ball Island	English Station (179,567, 8.01)	E18+00 - E28+22 & W17+50 - W32+43 (2,540 lf)	Steel Sheet/King Pile Bulkhead	6.0 - 7.0	•Bulkhead varies in composition from cantilevered sheet & king piles to sheet piles laterally supported by drilled anchors or tie-backs (Photo No. 16). •Historic bulkhead exists just landward of bulkhead in some areas (Photo No. 17).

TABLE 2
Waterfront Structure Rating
Mill River District Shoreline Analysis
City of New Haven, CT

	Property (Map, Block, Lot)[1]	Approximate Shoreline Stationing Limits (Approx. Length)[1,2]	Existing Shoreline Description	General Condition Rating[3]	Notes
West Shore	Gateway Terminal (178, 557, 1)	10+63 - W21+80 (1,050 lf)	Stone Masonry Seawall	0.0 - 6.0	•Remnants of what appears to have been a fixed timber pier exist immediately seaward of seawall (Photo No. 18). •Seawall appears to be bearing on pile supported timber decking at about MLW (Photo No. 19). •Some steel sheet piles exist along the outside corner of the lot immediately seaward of a section of collapsed seawall.
West Shore	Former Simkins (179, 567, 1.1)	W21+80 - W26+36 (495 lf)	Natural Shoreline & some Dumped Riprap	5.0	•Dumped riprap located at the top of natural shoreline slope (Photo No. 20). •Remnants of a timber bulkhead exist in some areas.
West Shore	UL Grand Avenue Substation (179, 567, 8)	W26+36 - W32+43 (6+28 lf)	Steel Sheet Pile Bulkhead	5.0 - 6.0	•Steel channel cap located along entire length of bulkhead. •Bulkhead is comprised of Z- and flat-sheet piles (Photo Nos. 21 & 22). •Lateral support anchor system was not observed (assumed interior). •Delaminating protective coating and heavy section loss in discrete locations around MLW (Photo No. 22).
River Crossing	East Grand Avenue Bridge (NA)	E28+22 - E28+85 (63 lf)	Concrete Abutments & Riprap	6.0	•Bridge consists of concrete abutments supporting concrete girders, decking, and parapet (Photo No. 23). •Dumped riprap exists along both abutments.
River Crossing	East Grand Avenue Bridge Seawall (NA)	E28+22 (54 lf)	Stone Masonry Seawall	6.0	•Supports Grand Avenue beyond the bridge to the west (Photo No. 24).
River Crossing	West Grand Avenue Bridge (NA)	W32+43 - W33+06 (63 lf)	Concrete Abutments & Riprap	6.0	•Bridge consists of concrete abutments supporting concrete girders, decking, and parapet (Photo No. 25). •Dumped riprap exists along both abutments. •A steel truss bridge supporting a utility line exists immediately north of the bridge and is supported by stone masonry abutments.
Grand Avenue to Railroad Crossing					
East Shore	Grand Paint (180, 749, 22)	E28+85 - E32+86 (495 lf)	Natural Shoreline	NA	•Shoreline is vegetated along MHW. •Scattered dumped rubble observed at discrete locations.
East Shore	Clay Street (NA)	E32+86 - E33+21 (52 lf)	Concrete Utility Headwall	6.0	•Headwall for a municipal storm sewer outfall.
East Shore	Radiall South (180, 764, 3)	E33+27 - 39+78 (544 lf)	Natural Shoreline	NA	•Shoreline is vegetated along MHW (Photo No. 26).
East Shore	Radiall North (180, 764, 3)	39+78 - 42+78 (290 lf)	Natural Shoreline	NA	•Shoreline is vegetated along MHW. •Remnants of what appears to have been a timber bulkhead exist (Photo No. 27). •Evidence of erosion (e.g., exposed roots, downed vegetation) observed.
East Shore	Vacant Lot (181, 772, 5.01)	42+78 - 44+68 (260 lf)	Natural Shoreline	NA	•Shoreline is vegetated along MHW. •Remnants of what appears to have been a timber bulkhead exist. •Evidence of erosion (e.g., exposed roots, downed vegetation) observed.
Ball Island	McVac East (180, 585, 1-2)	E28+85 - E36+91 (738 lf)	Natural Shoreline	NA	•Shoreline is vegetated along MHW (Photo No. 28). •Remnants of what appears to have been a timber sheet pile wall exist in one area. •Large boulders exist in one small length of the shoreline. •Evidence of erosion (e.g., exposed roots, downed vegetation) was observed along the northern shoreline of the island.
Ball Island	McVac West (180, 585, 2)	W33+06 - W38+10 (505 lf)	Natural Shoreline	NA	•Shoreline is vegetated along MHW (Photo No. 29). •Remnants of what appears to have been a stone masonry seawall exist in one area. •Dumped rubble (e.g., brick) exists along a portion of the shoreline. •Evidence of erosion (e.g., exposed fence post foundations, exposed roots, downed vegetation) was observed along the entire length of the shoreline.
West Shore	Former St. Gobain South (180, 585, 3)	W33+06 - W35+43 (187 lf)	Timber Sheet Pile Bulkhead	4.5	•Dumped riprap exists along the toe of the bulkhead (Photo No. 30). •A timber fender system exists immediately seaward of bulkhead. •Some gaps observed between the timber sheet piles.
West Shore	Former St. Gobain Mid (180, 585, 8)	W35+43 - W37+47 (204 lf)	Timber Sheet Pile Bulkhead	4.5	•Dumped riprap exists along the toe of the bulkhead. •A timber fender system exists immediately seaward of bulkhead. •Some gaps observed between the timber sheet piles.

TABLE 2
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	Property (Map, Block, Lot)[1]	Approximate Shoreline Stationing Limits (Approx. Length)[1,2]	Existing Shoreline Description	General Condition Rating[3]	Notes
West Shore	Former St. Gobain North (180, 585, 9)	W37+47 - 42+36 (488 lf)	Natural Shoreline	NA	•Shoreline is vegetated along MHW (Photo No. 31). •Dumped rubble exists along discrete portions of the shoreline. •Evidence of erosion (e.g., exposed roots, downed vegetation) was observed along the entire length of the shoreline.
West Shore	Rail Corridor (NA)	42+36 - 44+68 (175 lf)	Natural Shoreline	NA	•Shoreline is vegetated along MHW. •Dumped rubble exists along discrete portions of the shoreline. •Evidence of erosion (e.g., exposed roots, downed vegetation) was observed along the entire length of the shoreline.
River Crossing	Abandoned Rail Bridge (NA)	44+68 - 45+41 (72 lf)	Timber Abutments/Stone Masonry Seawall	1.0 - 2.0	•Evidence of erosion along the base of abutments was observed (Photo No. 32). •Displacement of timbers in west abutment with loss of retained soil was observed (Photo No. 33). •Heavy vegetation behind/through the stone masonry seawall was observed along with displacement of some stones (Photo No. 34).
River Crossing	Active Rail Bridge (NA)	45+41 - 46+52 (108 lf)	Concrete Abutments	3.0 - 4.0	•Two (2) concrete arches span over the river and are supported by concrete abutments and a center pier. •Heavy spalling was observed along the abutments (Photo No. 35).
Railroad Crossing to Interstate 91					
East Shore	Rail Corridor (NA)	46+52 - 50+00 (316 lf)	Earthen Embankment	3.0	•The embankment was observed to be relatively steep (i.e., about 1V:1H) (Photo No. 36). •Evidence of erosion along the base of the slope was observed (e.g., leaning telephone poles, exposed roots, downed vegetation).
East Shore	Billboard Sign (181, 598, 6)	50+00 - 50+20 (68 lf)	Natural Shoreline	NA	•Some dumped rubble observed.
East Shore	470 James St. (181, 603, 11)	50+84 - 57+62 (708 lf)	Natural Shoreline	NA	•Evidence of erosion along the base of the slope was observed (e.g., exposed roots, downed vegetation) (Photo No. 37).
West Shore	Elizabeth Browning (181, 589, 2-4)	46+52 - 47+52 (159 lf)	Natural Shoreline	NA	•The shoreline was observed to be relatively steep (i.e., about 1V:1H) (Photo No. 38). •Evidence of erosion along the base of the slope was observed (e.g., exposed roots, downed vegetation).
West Shore	Hillcrest Properties, LLC (181, 589, 1)	47+52 - 50+20 (246 lf)	Natural Shoreline	NA	•The shoreline was observed to be relatively steep (i.e., about 1V:1H) (Photo No. 38). •Evidence of erosion along the base of the slope was observed (e.g., exposed roots, downed vegetation).
West Shore	Multiple Properties (181, 603, 1-6)	50+84 - 53+93 (332 lf)	Natural Shoreline	NA	•Evidence of erosion along the base of the slope was observed (e.g., exposed roots, downed vegetation).
West Shore	Interstate 91 (NA)	53+93 - 57+62 (283 lf)	Dumped Riprap	6.0	•Some vegetation observed. •Riprap is relatively consistent with little to no bare areas observed (Photo No. 39).
River Crossing	Humphrey Street Bridge (NA)	50+20 - 50+84 (65 lf)	Stone Masonry Abutments	5.0	•Bridge consists of concrete girders, decking, and parapets supported by concrete abutments and piers with stone masonry foundations (Photo No. 40). •A steel girder bridge supporting a utility exists immediately north of the bridge and is supported by concrete abutments and steel piers with stone masonry foundations. •Missing pointing and stones was observed in all of the stone masonry foundations.

Footnotes:
1. Refer to Figures 2 through 9 for additional information.
2. Between Sta. 15+00 and 39+00, the project baseline splits in order to follow the east (E) and west (W) branches of the River around Ball Island.
3. Refer to Table 1 for a description of the ratings.

Notes:
1. Interpretations summarized in this Table are based on limited visual inspections that reflect conditions only at the time of the inspections. Time may alter the conditions observed up to and prior to any planned repairs/improvements. If significant variations become apparent prior to any planned repairs/improvements, the adequacy of the information contained herein should be reviewed.
2. The inspection results presented in this Table were prepared in accordance with generally accepted civil engineering practice as an aid to evaluate the condition of the shoreline within the District and develop repair/improvement alternatives, including estimated costs. No other warranties, either express or implied, are made. Interpretations contained herein were based on the applicable standards of the consulting profession at the time and the place this report was prepared.

TABLE 3
Flood Criteria
Mill River District Shoreline Analysis
City of New Haven, CT

	Property (Map, Block, Lot)[1]	Approximate Shoreline Stationing Limits (Approx. Length)[1,2]	Existing Shoreline Description	Top of Shoreline/ Shoreline Structure Elevation (feet)	FEMA 100-Year Flood Elevation (feet)[3]	Future Potential Sea-Level Rise (feet)[4]	Minimum Recommended Flood Protection Improvements Elevations (feet)[5]
Chapel Street South							
East Shore	Criscuolo Park (175, 607, 1)	0+00 - 10+10 (1,010 lf)	Dumped Riprap Slope	6.0	12.0	1.5	15.0
West Shore	York Hill Trap Rock Quarry Co. (178, 547, 2)	0+00 - 10+10 (1,010 lf)	Natural Shoreline with Scattered Dumped Rubble	10.0	12.0	1.5	15.0
West Shore	Utility Pole (NA)	9+18 - 9+60 (170 lf)	Steel Sheet Pile Bulkhead	8.5	13.0	1.5	16.0
River Crossing	Chapel Street Bridge (NA)	10+10 - 10+63 (53 lf)	Concrete Abutments	13.0	13.0	1.5	17.0[6]
River Crossing	Chapel Street Seawall (NA)	10+10 (185 lf)	Stone Masonry Seawall	13.0	13.0	1.5	17.0[6]
Chapel Street to Grand Avenue							
East Shore	299 Chapel St (174, 709, 1)	10+63 - 13+10 (247 lf)	Fixed Timber Pier	6.0	12.0	1.5	15.0
East Shore	Saltonstall Ave (NA)	13+10 - 13+65 (55 lf)	Failed Stone/ Concrete Masonry Seawall	4.0	12.0	1.5	15.0
East Shore	Hillard Bloom Shellfish, Inc. (174, 717, 1)	13+65 - E15+44 (179 lf)	Stone Masonry Seawall	6.0	12.0	1.5	15.0
East Shore	New NRB #3 Corp. (174, 717, 8)	E15+44 - E17+56 (212 lf)	Steel Sheet Pile Bulkhead	6.5	12.0	1.5	15.0
East Shore	Gateway Terminal & O&G South (174, 729, 1)	E17+56 - E22+19 (463 lf)	Steel Sheet Pile Bulkhead	8.0	12.0	1.5	15.0
East Shore	Gateway Terminal & O&G North (174, 729, 1)	E22+19 - E23+88 (169 lf)	Failed Timber Sheet Pile Bulkhead	5.0	12.0	1.5	15.0
East Shore	Powerhouse Building South (174, 736, 1)	E23+88 - E25+83 (195 lf)	Failed Concrete/ Stone Masonry Seawall	5.5	12.0	1.5	15.0
East Shore	Powerhouse Building North (174, 736, 1)	E25+83 - E28+22 (239 lf)	Stone Masonry Seawall	4.5	12.0	1.5	15.0
Ball Island	English Station (179,567, 8.01)	E18+00 - E28+22 & W17+50 - W32+43 (2,540 lf)	Steel Sheet/King Pile Bulkhead	7.5	12.0	1.5	15.0

TABLE 3
Flood Criteria
Mill River District Shoreline Analysis
City of New Haven, CT

	Property (Map, Block, Lot)[1]	Approximate Shoreline Stationing Limits (Approx. Length)[1,2]	Existing Shoreline Description	Top of Shoreline/ Shoreline Structure Elevation (feet)	FEMA 100-Year Flood Elevation (feet)[3]	Future Potential Sea-Level Rise (feet)[4]	Minimum Recommended Flood Protection Improvements Elevations (feet)[5]
West Shore	Gateway Terminal (178, 557, 1)	10+63 - W21+80 (1,050 lf)	Stone Masonry Seawall	4.5 - 7.5	12.0	1.5	15.0
	Former Simkins (179, 567, 1.1)	W21+80 - W26+36 (495 lf)	Natural Shoreline & some Dumped Riprap	5.0	12.0	1.5	15.0
	UL Grand Avenue Substation (179, 567, 8)	W26+36 - W32+43 (6+28 lf)	Steel Sheet Pile Bulkhead	9.0	12.0	1.5	15.0
River Crossing	East Grand Avenue Bridge (NA)	E28+22 - E28+85 (63 lf)	Concrete Abutments & Riprap	11.0	12.0	1.5	15.0
	East Grand Avenue Bridge Seawall (NA)	E28+22 (54 lf)	Stone Masonry Seawall	11.0	12.0	1.5	15.0
	West Grand Avenue Bridge (NA)	W32+43 - W33+06 (63 lf)	Concrete Abutments & Riprap	7.5	12.0	1.5	15.0
Grand Avenue to Railroad Crossing							
East Shore	Grand Paint (180, 749, 22)	E28+85 - E32+86 (495 lf)	Natural Shoreline	6.0	12.0	1.5	15.0
	Clay Street (NA)	E32+86 - E33+21 (52 lf)	Concrete Headwall	5.0	12.0	1.5	15.0
	Radiall South (180, 764, 3)	E33+27 - 39+78 (544 lf)	Natural Shoreline	6.0	12.0	1.5	15.0
	Radiall North (180, 764, 3)	39+78 - 42+78 (290 lf)	Natural Shoreline	6.0	12.0	1.5	15.0
	Vacant Lot (181, 772, 5.01)	42+78 - 44+68 (260 lf)	Natural Shoreline	8.0	12.0	1.5	15.0
Ball Island	McVac East (180, 585, 1-2)	E28+85 - E36+91 (738 lf)	Natural Shoreline	5.0	12.0	1.5	15.0
	McVac West (180, 585, 2)	W33+06 - W38+10 (505 lf)	Natural Shoreline	8.0	12.0	1.5	15.0
West Shore	Former St. Gobain South (180, 585, 3)	W33+06 - W35+43 (187 lf)	Timber Sheet Pile Bulkhead	5.0	12.0	1.5	15.0
	Former St. Gobain Mid (180, 585, 8)	W35+43 - W37+47 (204 lf)	Timber Sheet Pile Bulkhead	5.0	12.0	1.5	15.0
West Shore	Former St. Gobain North (180, 585, 9)	W37+47 - 42+36 (488 lf)	Natural Shoreline	4.0 - 6.0	12.0	1.5	15.0
	Rail Corridor (NA)	42+36 - 44+68 (175 lf)	Natural Shoreline	5.0	12.0	1.5	15.0

TABLE 3
Flood Criteria
Mill River District Shoreline Analysis
City of New Haven, CT

	Property (Map, Block, Lot)[1]	Approximate Shoreline Stationing Limits (Approx. Length)[1,2]	Existing Shoreline Description	Top of Shoreline/ Shoreline Structure Elevation (feet)	FEMA 100-Year Flood Elevation (feet)[3]	Future Potential Sea-Level Rise (feet)[4]	Minimum Recommended Flood Protection Improvements Elevations (feet)[5]
River Crossing	Abandoned Rail Bridge (NA)	44+68 - 45+41 (72 lf)	Timber Abutments/Stone Masonry Seawall	14.0	12.0	1.5	15.0
River Crossing	Active Rail Bridge (NA)	45+41 - 46+52 (108 lf)	Concrete Abutments	19.0	12.0	1.5	15.0
Railroad Crossing to Interstate 91							
East Shore	Rail Corridor (NA)	46+52 - 50+00 (316 lf)	Earthen Embankment	18.0	9.0	1.5	12.0
East Shore	Billboard Sign (181, 598, 6)	50+00 - 50+20 (68 lf)	Natural Shoreline	5.0	9.0	1.5	12.0
East Shore	470 James St. (181, 603, 11)	50+84 - 57+62 (708 lf)	Natural Shoreline	10.0	9.0	1.5	12.0
West Shore	Elizabeth Browning (181, 589, 2-4)	46+52 - 47+52 (159 lf)	Natural Shoreline	12.0 - 19.0	9.0	1.5	12.0
West Shore	Hillcrest Properties, LLC (181, 589, 1)	47+52 - 50+20 (246 lf)	Natural Shoreline	8.0 - 10.0	9.0	1.5	12.0
West Shore	Multiple Properties (181, 603, 1-6)	50+84 - 53+93 (332 lf)	Natural Shoreline	5.0 - 7.0	9.0	1.5	12.0
West Shore	Interstate 91 (NA)	53+93 - 57+62 (283 lf)	Dumped Riprap	5.0	9.0	1.5	12.0
River Crossing	Humphrey Street Bridge (NA)	50+20 - 50+84 (65 lf)	Stone Masonry Abutments	14.5	9.0	1.5	12.0

Footnotes:
1. Refer to Figures 2 through 9 for additional information.
2. Between Sta. 15+00 and 39+00, the project baseline splits in order to follow the east (E) and west (W) branches of the River around Ball Island.
3. Flood elevations were taken from the FEMA FIRM Panels for the District.
4. A future potential sea-level rise of 1.5 feet in 50 years has been assumed and may vary.
5. The recommended minimum flood protection improvements elevation is the sum of the FEMA 100-year base flood elevation, the future potential sea-level rise, and a recommended freeboard of 1 foot (rounded to the nearest foot) (assumed conservative for those sites where grade may be raised).
6. Includes wave runup in accordance with the WCE Coastal Flooding Analysis.

Note:
1. All of the elevations provided are in reference to NAVD 88 unless noted otherwise.

Figures

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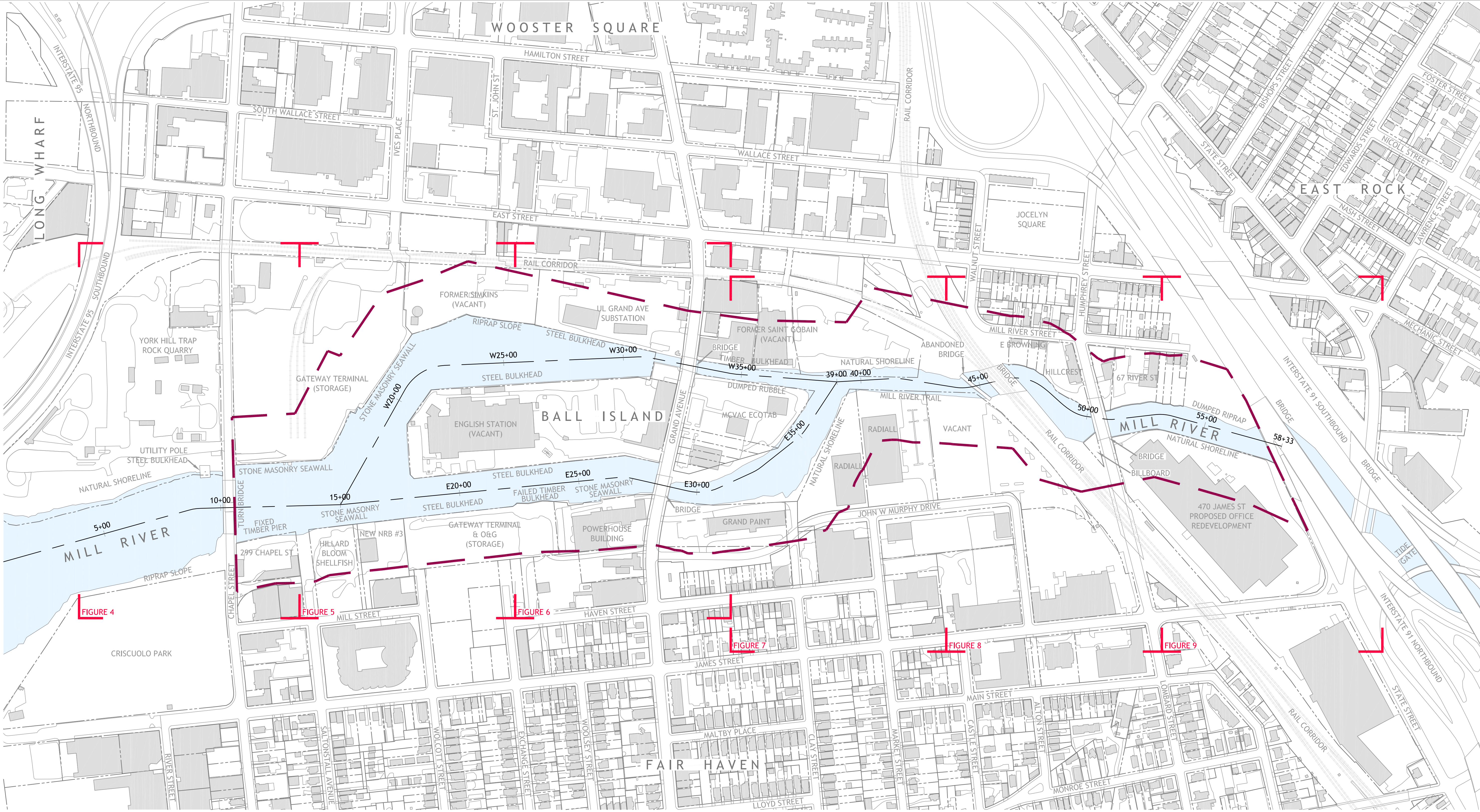
MILL RIVER DISTRICT SHORELINE ANALYSIS
DESIGN FLOOD MEMORANDUM
New Haven, Connecticut

FIGURE 1
LOCUS MAP

SHEET 1 of 12
DATE MAY 2016
PROJ No. 15103.00



NOTE:

1. THE EXISTING PROPERTY LINE/BOUNDARY, PAVEMENT, AND BUILDING DATA SHOWN ON THESE FIGURES WAS OBTAINED FROM THE CITY OF NEW HAVEN GIS SYSTEM PROVIDED TO RTG BY THE CITY OF NEW HAVEN ON DECEMBER 11, 2015.

Graphic Scale 1"=400'

400' 200' 0 400'

LEGEND:

10+00	PROJECT BASELINE
	EXISTING PROPERTY LINE
	EXISTING STRUCTURE
	EXISTING EDGE OF PAVEMENT
	EXISTING RIVER EXTENTS
	STUDY AREA LIMITS
FIGURE 4	EXTENTS OF SUBSEQUENT FIGURE

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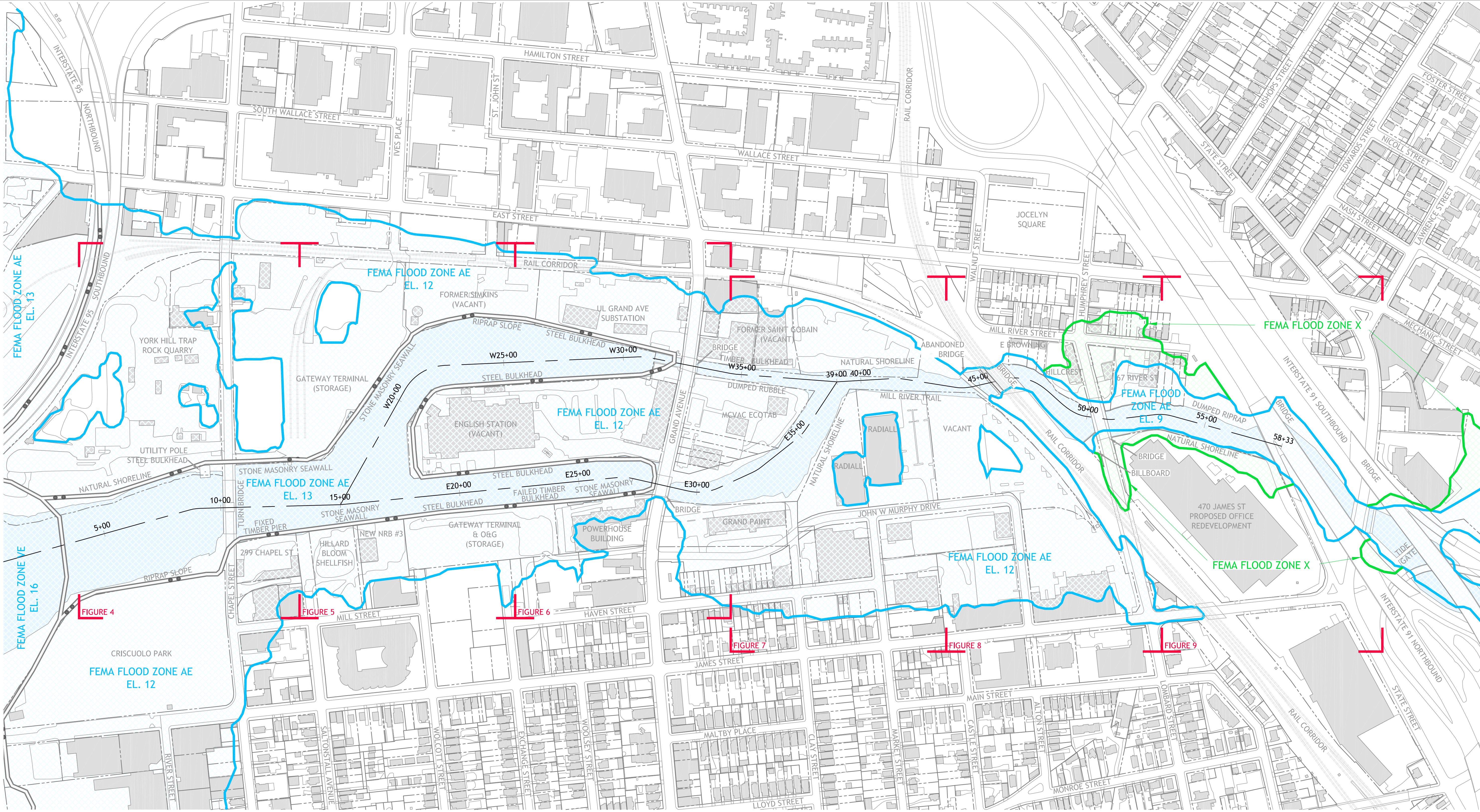
DESIGN FLOOD MEMORANDUM
New Haven, Connecticut

FIGURE 2
STUDY AREA LIMITS PLAN

SHEET 2 of 12
DATE MAY 2016
PROJ No. 15103.00



NOTE:

1. THE FLOOD BOUNDARIES SHOWN ON THESE FIGURES WERE TAKEN FROM FEMA FLOOD INSURANCE RATE MAP NUMBERS 09009C0433J, 09009C0434J, 09009C0441J, AND 09009C0442J, ALL DATED JULY 8, 2013.

LEGEND:

- FEMA SPECIAL FLOOD HAZARD OUTER BOUNDARY FOR AREA SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
- FEMA OTHER FLOOD AREA OUTER BOUNDARY
- FEMA BOUNDARY DIVIDING SPECIAL FLOOD HAZARD AREAS OF DIFFERENT BASE FLOOD ELEVATIONS
- FEMA LIMIT OF MODERATE WAVE ACTION WITH COINCIDENT ZONE BREAK

Graphic Scale 1"=400'

400' 200' 0 400'

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FIGURE 3
FEMA FLOOD BOUNDARY PLAN

SHEET 3 of 12
DATE
MAY 2016
PROJ No.
15103.00

NOTES:

1. THE EXISTING TOPOGRAPHIC AND BATHYMETRIC INFORMATION SHOWN ON THESE FIGURES IS IN REFERENCE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
2. THE EXISTING STORM SEWER DATA SHOWN ON THESE FIGURES WAS OBTAINED FROM THE CITY OF NEW HAVEN GIS SYSTEM PROVIDED TO RTG BY THE CITY OF NEW HAVEN ON DECEMBER 11, 2015.
3. THE EXISTING TOPOGRAPHIC DATA SHOWN ON THESE FIGURES WAS OBTAINED FROM THE 2011 FEMA LIDAR FLOOD PLAIN MAPPING SURVEY PERFORMED AT THE QUINNIPIAC RIVER WATERSHED (CT). THIS DATA WAS SUPPLEMENTED WITH DATA OBTAINED FROM A FIELD SURVEY PERFORMED BY RTG BETWEEN DECEMBER 2015 AND MARCH 2016.
4. THE EXISTING BATHYMETRIC DATA SHOWN ON THESE FIGURES LOCATED SOUTH OF GRAND AVENUE WAS OBTAINED FROM SHOALEST SOUNDINGS COLLECTED FROM HYDROGRAPHIC SURVEYS CONDUCTED DURING MAY 2011 BY THE US ARMY CORPS OF ENGINEERS. BATHYMETRIC INFORMATION SHOWN NORTH OF GRAND AVENUE WAS OBTAINED DURING THE RTG FIELD SURVEY.
5. THE RTG FIELD SURVEY WAS PERFORMED TO HELP DEVELOP THE PROJECT SITE PLAN AND WAS NOT PERFORMED TO ESTABLISH/ VERIFY PROPERTY LINES/ BOUNDARIES.
6. THE OUTFALL INVERT ELEVATIONS SHOWN ON THESE FIGURES WERE OBTAINED DURING THE RTG FIELD SURVEY. THIS DATA IS ONLY REPRESENTATIVE OF WHAT WAS VISIBLE TO RTG DURING THE FIELD SURVEY.

	ABOVE MLW	NAVD 88
MHHW	7.09	3.49
MHW	6.75	3.15
NAVD '88	3.60	0.00
MSL	3.38	-0.22
MLW	0.00	-3.60
MLLW	-0.24	-3.84

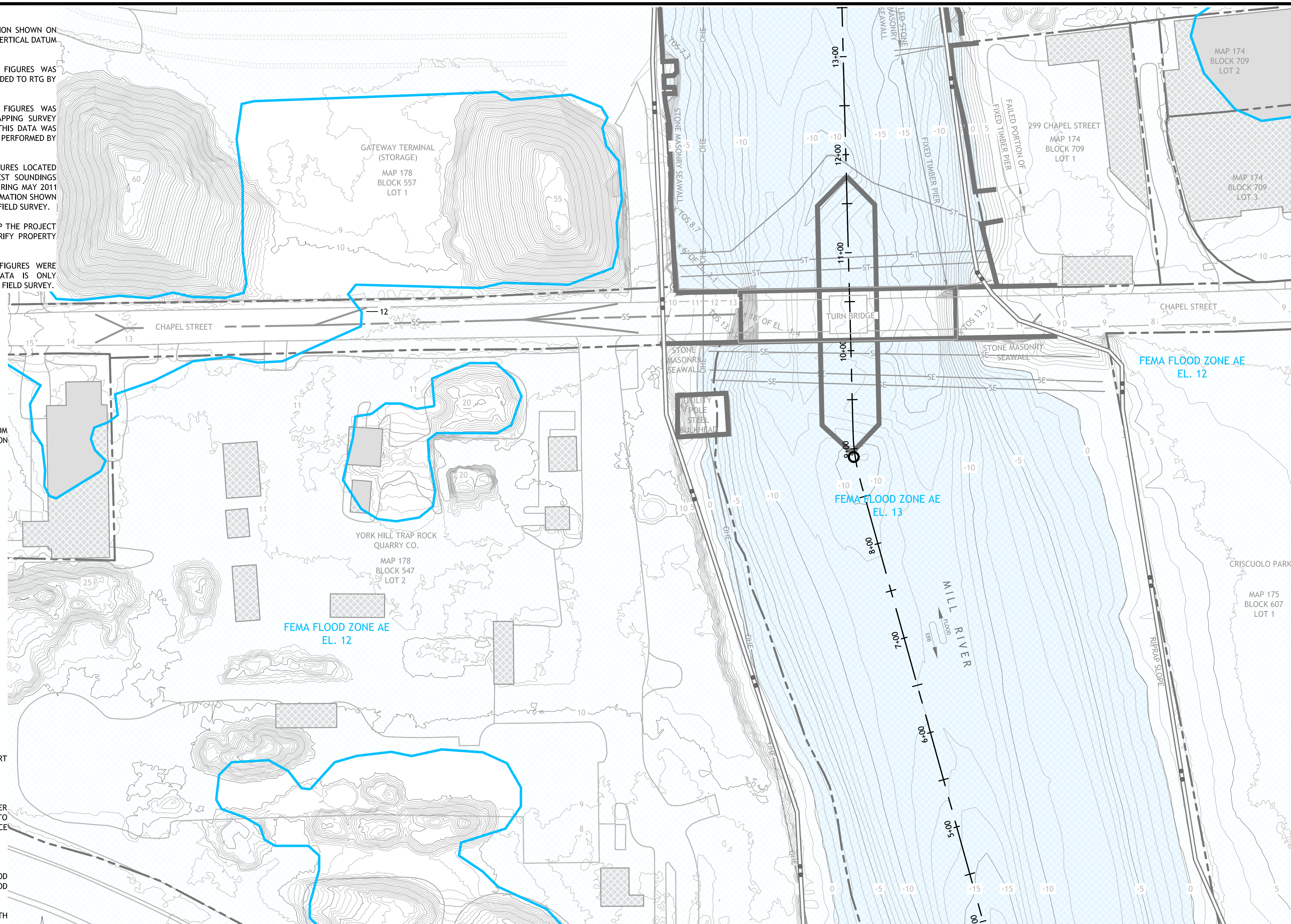
VERTICAL DATUM CONVERSION DIAGRAM

THE ABOVE TIDAL AND DATUM ELEVATION DATA WAS TAKEN FROM THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) DATABASE FOR THE FOLLOWING STATION:

STATION ID: *8467150*
LOCATION: *BRIDGEPORT, CONNECTICUT*
LATITUDE: *41°10.4' N*
LONGITUDE: *073°10.9' W*

LEGEND:

- 10+00 PROJECT BASELINE
- 10 EXISTING CONTOUR
- EXISTING WATERFRONT STRUCTURE
- EXISTING PROPERTY LINE
- EXISTING STRUCTURE
- EXISTING EDGE OF PAVEMENT
- RIVER EXTENTS AT EL. 0 (NAVD 88)
- SS EXISTING STORM SEWER LINE
- OHE EXISTING OVERHEAD ELECTRIC LINE
- SE EXISTING SUBMERGED ELECTRIC LINE
- SG EXISTING SUBMERGED GAS LINE
- ST EXISTING SUBMERGED TELECOM LINE
- x 10" OF EL. 2.8 EXISTING OUTFALL SIZE AND INVERT ELEVATION
- x TOS EL. 6.8 EXISTING TOP OF STRUCTURE ELEVATION
- FEMA SPECIAL FLOOD HAZARD OUTER BOUNDARY FOR AREA SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
- FEMA OTHER FLOOD AREA OUTER BOUNDARY
- FEMA BOUNDARY DIVIDING SPECIAL FLOOD HAZARD AREAS OF DIFFERENT BASE FLOOD ELEVATIONS
- FEMA LIMIT OF MODERATE WAVE ACTION WITH COINCIDENT ZONE BREAK



Graphic Scale 1"=100'

100' 50' 0 100'

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DESIGN FLOOD MEMORANDUM

New Haven, Connecticut

FIGURE 4
SITE PLAN - 1

SHEET 4 of 12
DATE MAY 2016
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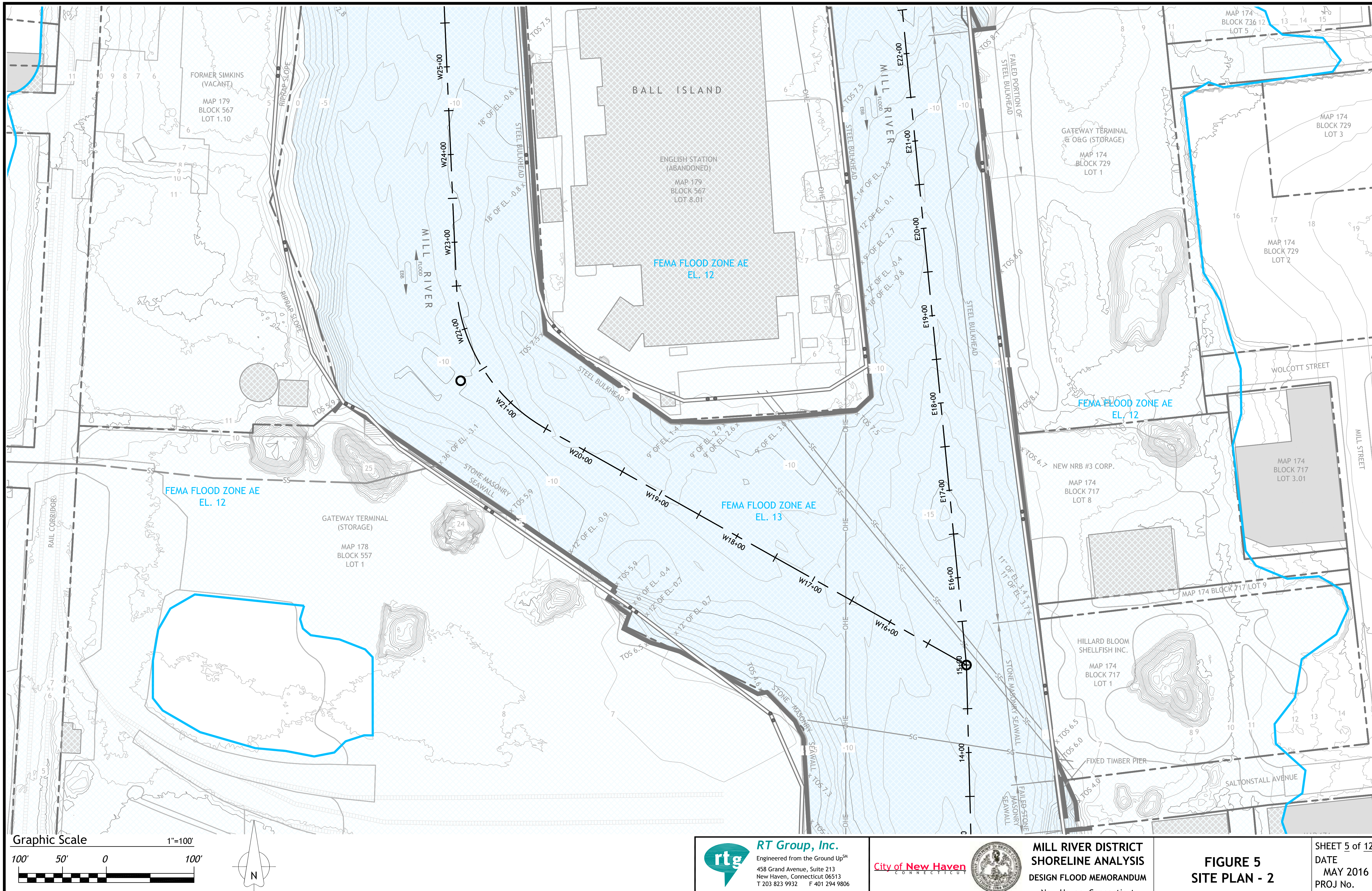

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FIGURE 5
SITE PLAN - 2

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MAY 2016
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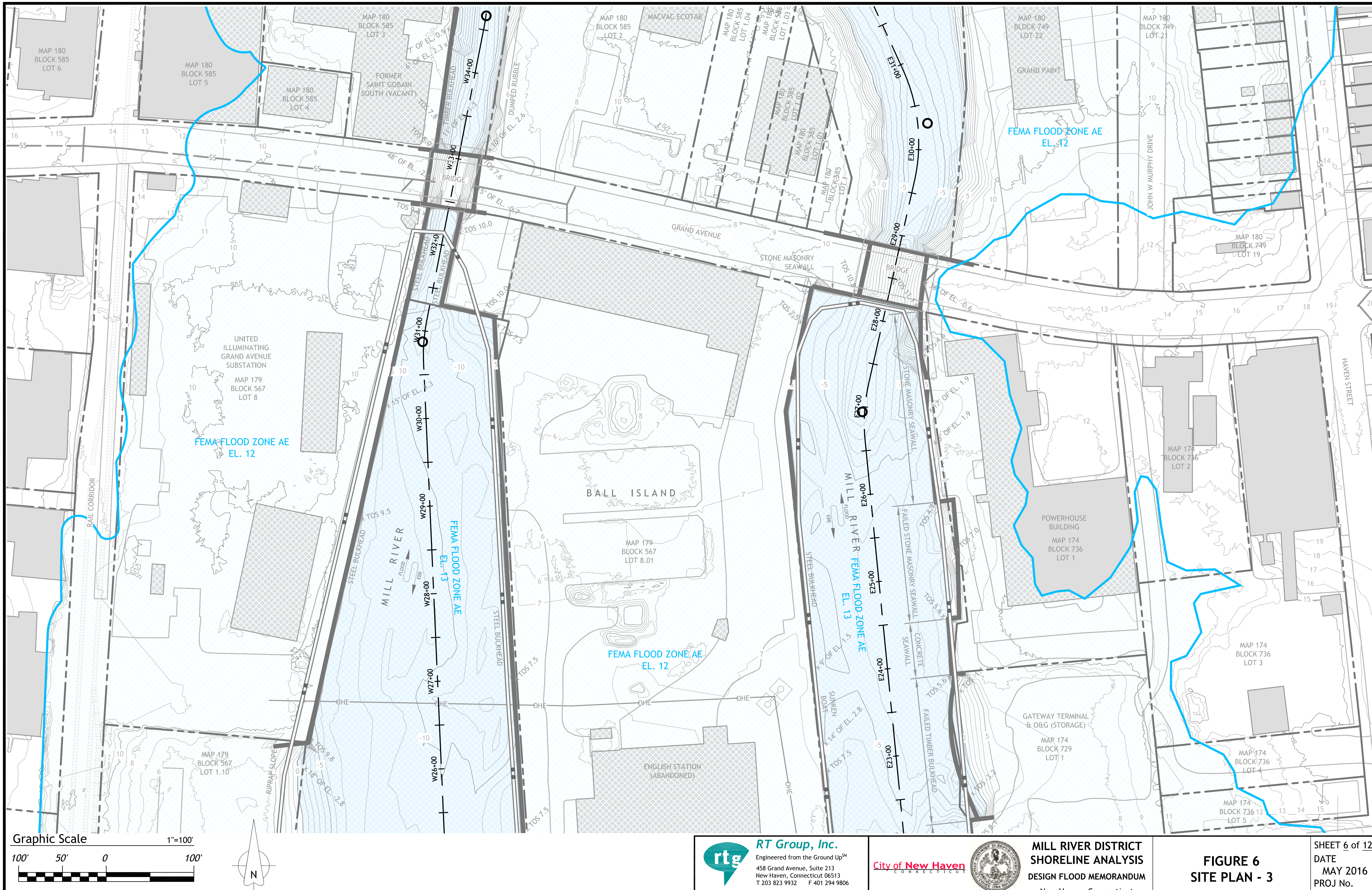

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FIGURE 6
SITE PLAN - 3

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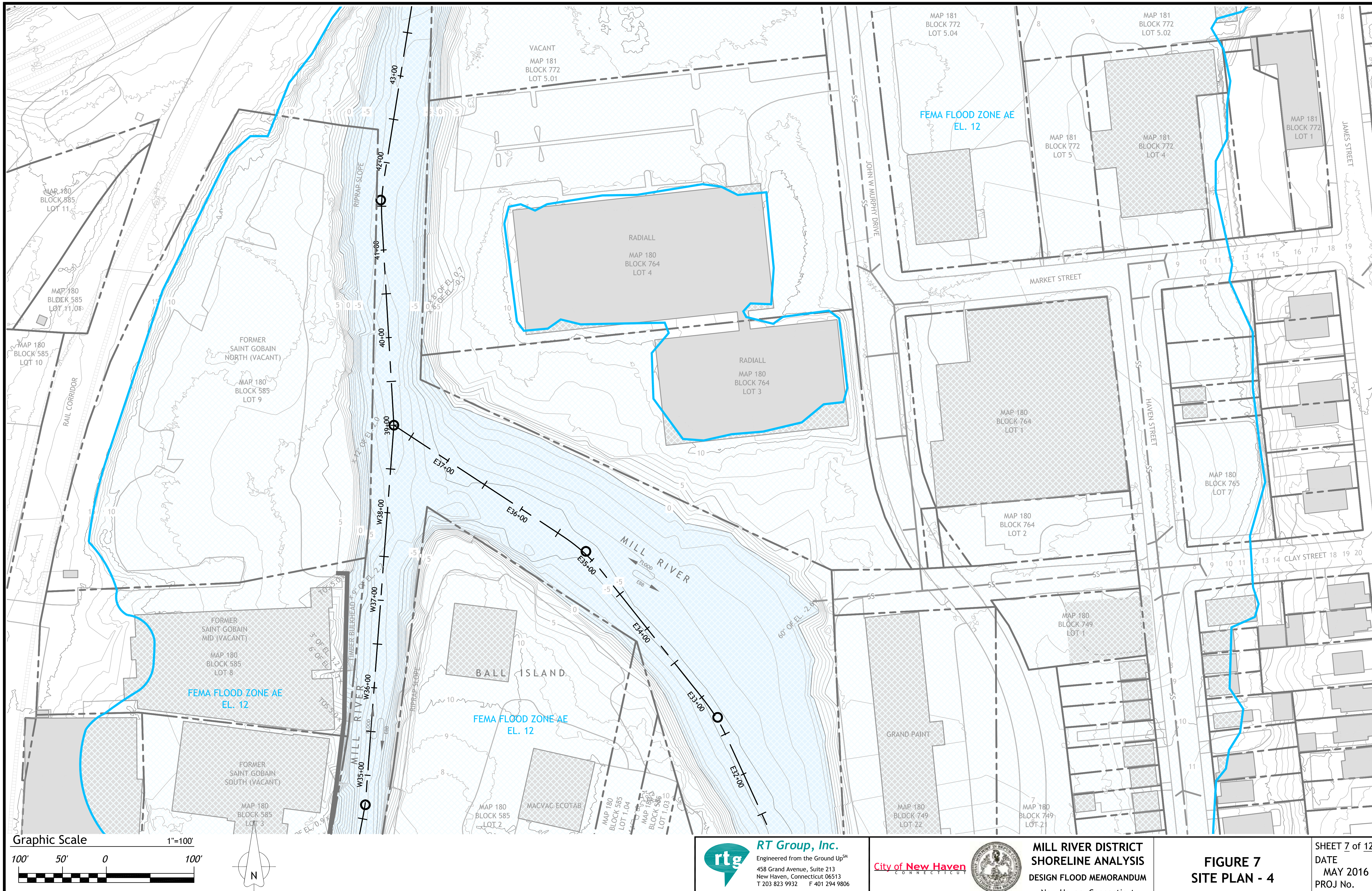

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FIGURE 7
SITE PLAN - 4

SHEET 7 of 12
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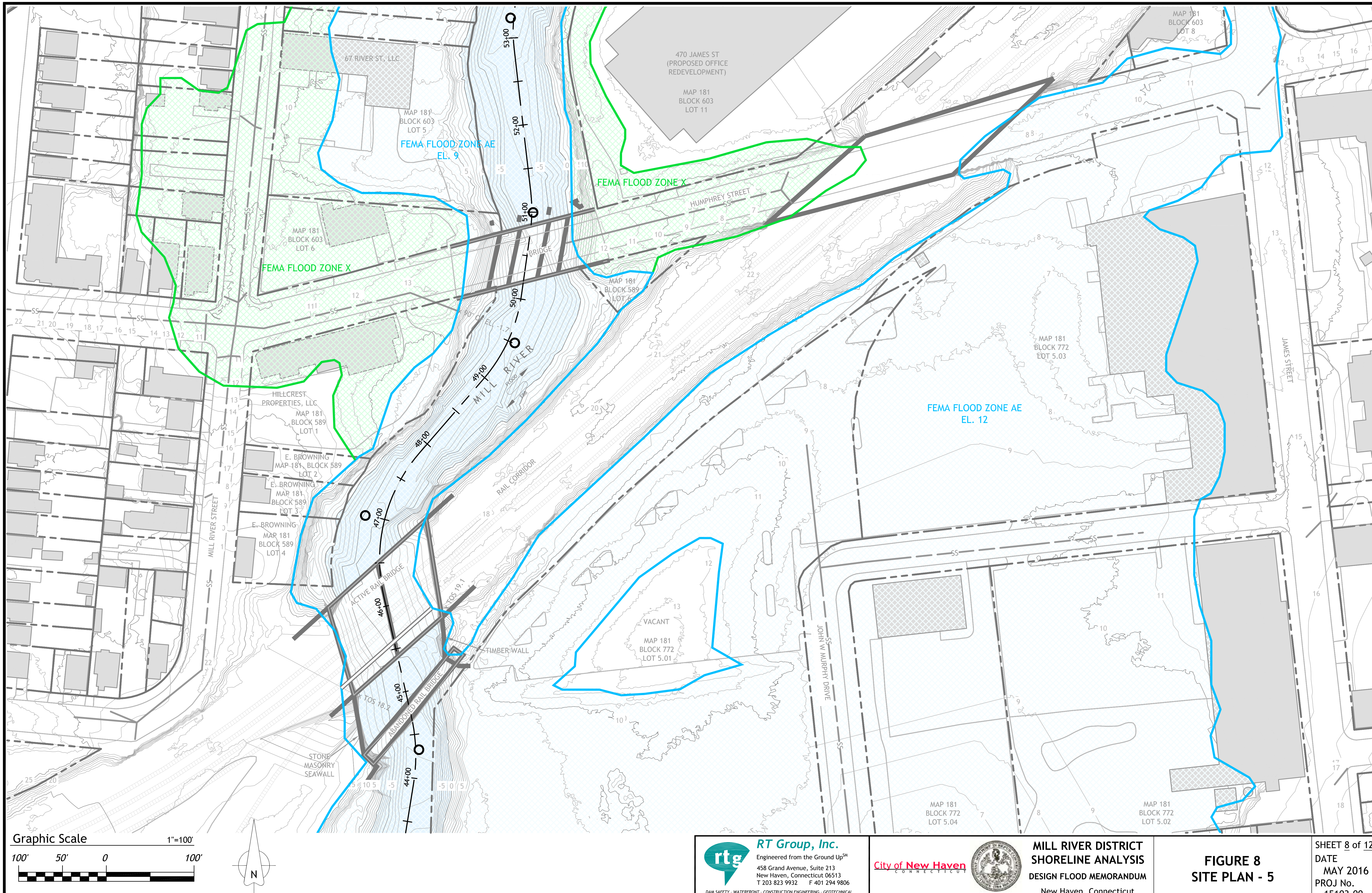

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**FIGURE 8
SITE PLAN - 5**

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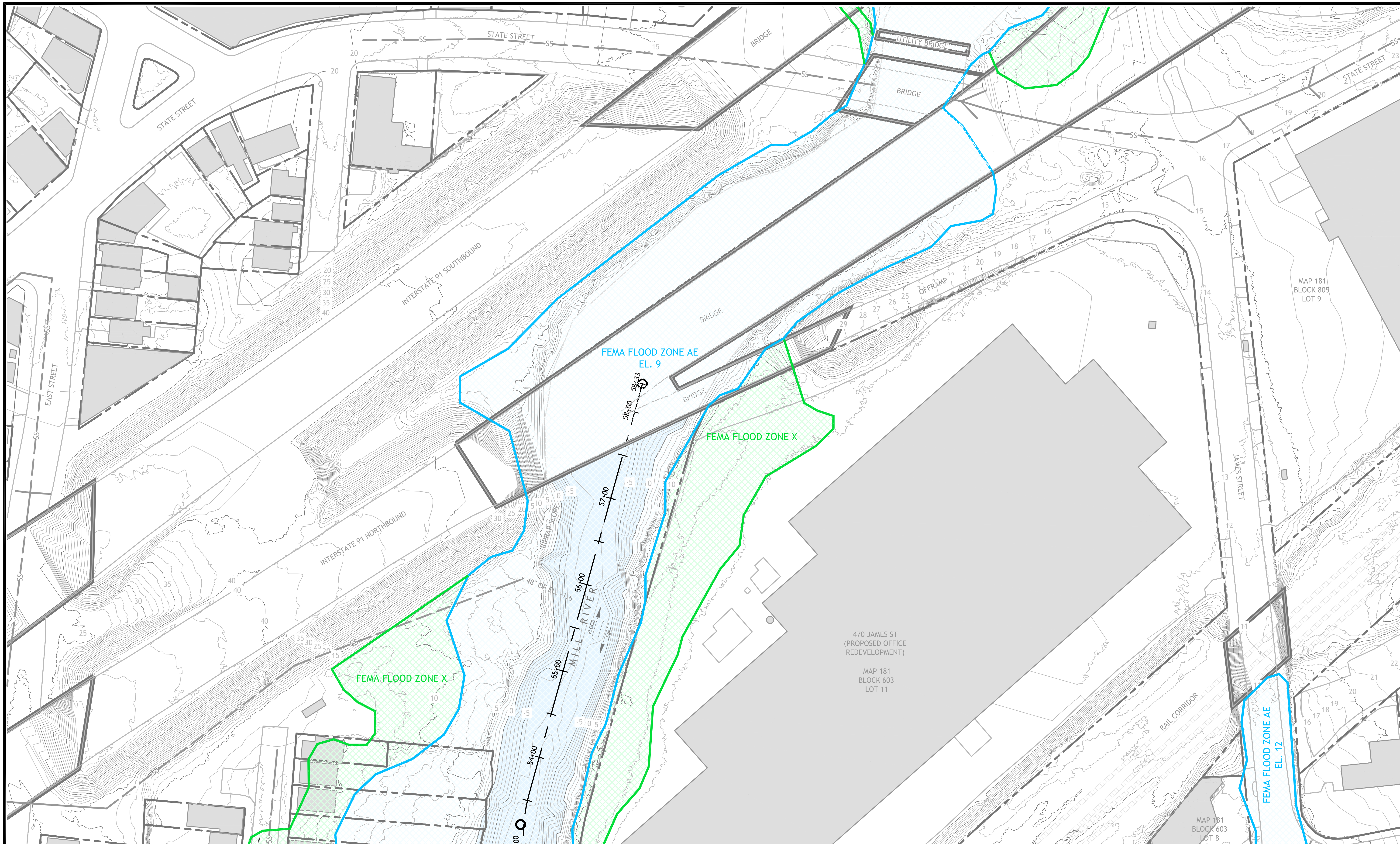

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100' 50' 0 100'

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FIGURE 9
SITE PLAN - 6

SHEET 9 of 12
DATE
MAY 2016
PROJ No.
15103.00

Natural Attenuation

Ecological Succession

- *Essentially the "do nothing" approach.*
- *Properties located along the shoreline within the District would be left as is and flooding and associated damage would be allowed to continue.*

Seeding Sites

- *Demolish existing structures and pavement located within selected sites.*
- *Develop the sites with new vegetation and access/walking trails.*
- *Flooding and associated damage would continue to occur, but with less potential for scour on the subject property.*

Potential properties that could be evaluated in the Alternatives Evaluation Report[1]:

- *Former Simkins*
- *Former St. Gobain*

Footnote:

1. Final property selection will be determined following the City's review of the Design Flood Memorandum.

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Paired Capacity Investment

Shoreline Stabilization

- *Install new shoreline stabilization improvements (e.g., riprap, articulating concrete block, etc.).*
- *This alternative would help prevent future erosion of properties with existing natural shoreline.*
- *This alternative by itself (i.e., without ancillary improvements) would be most effective for properties with their developments located outside of the 100-year flood zone.*

Potential properties that could be evaluated in the Alternatives Evaluation Report[1]:

- *Properties located north of the Rail Corridor, for example:*
  - *470 James Street*
  - *West shoreline north of the Railroad Crossing*

Raise Grade

- *Raise grade within the selected property limits to a suitable elevation above the design flood elevation.*
- *Install new shoreline stabilization improvements (e.g., riprap, articulating concrete block, etc.) to prevent future erosion and/or new shoreline structures to allow grade to be raised.*
- *Following construction, new structures could be built in the area above the design flood elevation and subsequently with less stringent flood requirements.*
- *This alternative is not considered feasible for properties wishing to maintain their existing structures.*

Potential properties that could be evaluated in the Alternatives Evaluation Report[1]:

- *299 Chapel Street*
- *Hillard Bloom Shellfish*
- *New NRB #3*
- *Gateway Terminal & O&G (East)*
- *English Station*
- *Gateway Terminal (West)*
- *Former Simkins*
- *Former St. Gobain*

Flood Proofing Barrier

- *Construct a flood proofing barrier (e.g., riprap berm, sheet pile wall, concrete wall, etc.) with its top located at a suitable elevation above the design flood elevation.*
- *Install the barrier along the outside perimeter of the selected property where it is located within a 100-year flood zone.*
- *Install new shoreline stabilization improvements (e.g., riprap, articulating concrete block, etc.) along the existing shoreline to prevent future erosion.*
- *This alternative would be ideal for properties wishing to maintain their existing structures, but would also allow the construction of new structures with less stringent flood requirements.*

Potential properties that could be evaluated in the Alternatives Evaluation Report[1]:

- *Powerhouse Building*
- *UL Grand Ave Substation*
- *Grand Paint*
- *Radiall (North & South)*
- *Vacant Property north of Radiall*
- *McVac Ecotab*

"Wet-Proof" Development

- *Proposed site developments within the selected property would consist of new multi-level "wet-proof" structures.*
- *The first floor of these structures would be designed to allow flooding up to suitable elevation above the design flood elevation and would withstand the associated loading. The floor(s) above the first floor would be designed as normal.*
- *Additional work may include the installation of shoreline stabilization structures (e.g., riprap, articulating concrete block, etc.) to prevent future erosion.*

Potential properties that could be evaluated in the Alternatives Evaluation Report[1]:

- *299 Chapel Street*
- *Hillard Bloom Shellfish*
- *New NRB #3*
- *Gateway Terminal & O&G (East)*
- *English Station*
- *Gateway Terminal (West)*
- *Former Simkins*
- *Former St. Gobain*
- *McVac Ecotab*
- *Vacant Property north of Radiall*

"Dry-Proof" Development

- *Proposed site developments within the selected property would consist of new "dry-proof" structures.*
- *Existing structures would be retrofitted with "dry-proof" improvements.*
- *These improvements would be designed to prevent flood waters up a suitable elevation above the design flood elevation from entering by sealing their exterior walls and openings and designing them to withstand the associated loading.*
- *Additional work may include the installation of shoreline stabilization structures (e.g., riprap, articulating concrete block, etc.) to prevent future erosion.*

Potential properties that could be evaluated in the Alternatives Evaluation Report[1]:

- *299 Chapel Street*
- *Hillard Bloom Shellfish*
- *New NRB #3*
- *Gateway Terminal & O&G (East)*
- *Powerhouse Building*
- *English Station*
- *Gateway Terminal (West)*
- *Former Simkins*
- *Grand Paint*
- *Radiall (North & South)*
- *Vacant Property north of Radiall*
- *McVac Ecotab*
- *Former St. Gobain*
- *67 River Street*

Ancillary Development:

The lowering of nearby properties along the River may be required for these alternatives in order to accept storm surge diverted by the improvements in an effort to prevent additional flooding downstream.

Footnote:

1. Final property selection will be determined following the City's review of the Design Flood Memorandum.

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MILL RIVER DISTRICT SHORELINE ANALYSIS
DESIGN FLOOD MEMORANDUM
New Haven, Connecticut

FIGURE 11
PAIRED CAPACITY INVESTMENT MANAGEMENT APPROACH

SHEET 11 of 12
DATE MAY 2016
PROJ No. 15103.00

Intensive Infrastructure Investment

Chapel Street Flood Proofing Barrier

- *Construct a flood proofing barrier at the southern end of the District along Chapel Street spanning the length of the FEMA 100-year flood zone in this area.*
- *The top of barrier elevation would be set at a suitable elevation above the design flood elevation.*
- *During normal conditions, flood gates located within the barrier and across the River would be left open to allow tidal River flow and boat traffic.*
- *During a significant storm event, the flood gates would be closed and pumps would be utilized to maintain the effluent River flow.*
- *This barrier would essentially prevent storm surge from entering locations north of it and any existing or new developments in this area would be protected from flooding during significant storm events.*

Flood Proofing Barrier along the banks of the Mill River

- *Install a flood proofing barrier (e.g., riprap berm, sheet pile wall, concrete wall, etc.) along the outer banks of the River with its top at a suitable elevation above the design flood elevation.*
- *Areas located within the barrier would be subject to flooding during significant storm events and would eventually be converted to parks and recreational areas.*
- *Areas located outside of the barrier would be protected from flooding during significant storm events and could be considered for redevelopment.*

Flood Proofing Barrier along Groups of Properties

- *Install a flood proofing barrier (e.g., riprap berm, sheet pile wall, concrete wall, etc.) along the bank of the River along a selected number of adjacent properties with its top at a suitable elevation above the design flood elevation.*
- *The barrier would protect the selected properties and properties located further inland from flooding during significant storm events.*

Potential properties that could be evaluated in the Alternatives Evaluation Report[1]:

- *Grand Paint, Radiall (North & South), and the Vacant Property north of Radiall*

Footnote:

1. Final property selection will be determined following the City's review of the Design Flood Memorandum.

RT Group, Inc.
Engineered from the Ground Up[SM]
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

City of New Haven CONNECTICUT

MILL RIVER DISTRICT SHORELINE ANALYSIS
DESIGN FLOOD MEMORANDUM
New Haven, Connecticut

FIGURE 12
INTENSIVE INFRASTRUCTURE INVESTMENT MANAGEMENT APPROACH

SHEET 12 of 12
DATE MAY 2016
PROJ No. 15103.00

Appendix A
Data Request Questionnaires

67 River Street, LLC
67 Mill River Street, New Haven

March 8, 2016

Data Request Questionnaire
Mill River District Shoreline Analysis

1. **What type of facility is located at the Subject Property, what is the subject property's primary function, and how many people does it employ?**

   Manufacturing
   Light production of machine parts

2. **What structures currently exist at the Subject Property and what are their approximate ages?**

   Self Standing 8000 sq ft. Brick/Block 1 story
   Original building 1917

3. **Has the Subject Property ever been flooded during past storm events? If yes, please identify the subject storm(s) and the flood impact (i.e., horizontal and vertical extent of flooding).**

   Only upto parking lot, (During Sandy)
   never into the building

4. **What type of waterfront currently exists at the Subject Property (e.g., stone revetment, sheet pile bulkhead, natural shoreline, etc.)?**

   Natural Shoreline

rtg

5. **Does the facility located at the Subject Property require its waterfront access to maintain functionality? If yes, what is the minimum water depth required to accommodate vessels accessing the Subject Property?**

Currently there is no vessels accessing waterfront

6. **Do active or abandoned subsurface utilities (e.g., electric, sewer, sanitary, water) or outfalls draining into the river exist within the Subject Property? If yes, please provide the utility type, size, and location.**

Not to my knowledge

7. **Have any improvements projects been completed at the Subject Property (e.g., structures, drainage improvements, etc.)? If yes, please provide a description and/or plans that depict the improvements (we can make arrangements to pick up, copy, and return the original plans).**

No.

8. **Have any types of investigative programs been conducted at the Subject Property (e.g., soil borings, topographic survey/site mapping, soil remediation, etc.)? If yes, please provide a description and/or the investigation program data (we can make arrangements to pick up, copy, and return the original data).**

2 separate Environmental Site Assessments 1998, 2012

9. Do you know of any site plans that exist for the Subject Property (e.g., utility plans, topographic plans, etc.)? If yes, please provide the plans (we can make arrangements to pick up, copy, and return the original plans).

No.

10. For further questions on the Subject Property, please provide the name, telephone number, and email address of the appropriate contact person(s).

Dan Nolan

203-865-8160

nolanindustries@cs.com

Please complete and return by Friday April, 8, 2016.

 March 8, 2016

Data Request Questionnaire
Mill River District Shoreline Analysis

1. **What type of facility is located at the Subject Property, what is the subject property's primary function, and how many people does it employ?**

#21 is a garage, workshop, storage facility commercially zoned

#27 is my home

#29 is a single family residential property
These properties do not employ anyone

2. **What structures currently exist at the Subject Property and what are their approximate ages?**

#21 - was originally a municipal livery facility now converted into a garage, workshop, storage facility - over 130 years old

#27 - Residential single family house moved to this location in the 1870's - approximately 200 yr old

#29 - Residential single family house moved to this location in the 1870's approximately 200 yrs old.

3. **Has the Subject Property ever been flooded during past storm events? If yes, please identify the subject storm(s) and the flood impact (i.e., horizontal and vertical extent of flooding).**

#21 - no

#27 - no

#29 - no

4. **What type of waterfront currently exists at the Subject Property (e.g., stone revetment, sheet pile bulkhead, natural shoreline, etc.)?**

Natural shoreline of the Mill River

5. **Does the facility located at the Subject Property require its waterfront access to maintain functionality? If yes, what is the minimum water depth required to accommodate vessels accessing the Subject Property?**

   #21 - no

   #27 - no

   #29 - no

6. **Do active or abandoned subsurface utilities (e.g., electric, sewer, sanitary, water) or outfalls draining into the river exist within the Subject Property? If yes, please provide the utility type, size, and location.**

   #21 - no

   #27 - no

   #29 - no

7. **Have any improvements projects been completed at the Subject Property (e.g., structures, drainage improvements, etc.)? If yes, please provide a description and/or plans that depict the improvements (we can make arrangements to pick up, copy, and return the original plans).**

   #21 - no

   #27 - no

   #29 - no

8. **Have any types of investigative programs been conducted at the Subject Property (e.g., soil borings, topographic survey/site mapping, soil remediation, etc.)? If yes, please provide a description and/or the investigation program data (we can make arrangements to pick up, copy, and return the original data).**

   #21 - no

   #27 - no

   #29 - no

9. Do you know of any site plans that exist for the Subject Property (e.g., utility plans, topographic plans, etc.)? If yes, please provide the plans (we can make arrangements to pick up, copy, and return the original plans).

#21 - no

#27 - no

#29 - no

10. For further questions on the Subject Property, please provide the name, telephone number, and email address of the appropriate contact person(s).

ELIZABETH BROWNING (203) 865-4048

Email: Angeli Bruck at aol.com

Please complete and return by Friday April, 8, 2016.

Gannett Outdoor Co of Connecticut
130 Humphrey Street, New Haven

March 8, 2016

Data Request Questionnaire
Mill River District Shoreline Analysis

1. What type of facility is located at the Subject Property, what is the subject property's primary function, and how many people does it employ?

We are billboard operators.
On Humphrey St. we have one billboard structure

2. What structures currently exist at the Subject Property and what are their approximate ages?

Billboard Structure, panel #'s 0235, & 0236
State permit #2757

3. Has the Subject Property ever been flooded during past storm events? If yes, please identify the subject storm(s) and the flood impact (i.e., horizontal and vertical extent of flooding).

No

4. What type of waterfront currently exists at the Subject Property (e.g., stone revetment, sheet pile bulkhead, natural shoreline, etc.)?

don't know of any

5. Does the facility located at the Subject Property require its waterfront access to maintain functionality? If yes, what is the minimum water depth required to accommodate vessels accessing the Subject Property?

don't Know of any water front
at this site

6. Do active or abandoned subsurface utilities (e.g., electric, sewer, sanitary, water) or outfalls draining into the river exist within the Subject Property? If yes, please provide the utility type, size, and location.

n|a

7. Have any improvements projects been completed at the Subject Property (e.g., structures, drainage improvements, etc.)? If yes, please provide a description and/or plans that depict the improvements (we can make arrangements to pick up, copy, and return the original plans).

n|a

8. Have any types of investigative programs been conducted at the Subject Property (e.g., soil borings, topographic survey/site mapping, soil remediation, etc.)? If yes, please provide a description and/or the investigation program data (we can make arrangements to pick up, copy, and return the original data).

n|a

9. **Do you know of any site plans that exist for the Subject Property (e.g., utility plans, topographic plans, etc.)? If yes, please provide the plans (we can make arrangements to pick up, copy, and return the original plans).**

   No

10. **For further questions on the Subject Property, please provide the name, telephone number, and email address of the appropriate contact person(s).**

    Annette Pettersen, Manager of Real Estate
    203-404-6123
    annette.pettersen@outfrontmedia.com
    (out of the office 03/16 – 04/08)

Please complete and return by Friday April, 8, 2016.

Hillard Bloom Shellfish, Inc.
Mill River Front, New Haven

March 8, 2016

Data Request Questionnaire
Mill River District Shoreline Analysis

1. What type of facility is located at the Subject Property, what is the subject property's primary function, and how many people does it employ?

   SHELLFISH FARM - BOAT + EQUIPMENT STORAGE
   45 EMPLOYEES

2. What structures currently exist at the Subject Property and what are their approximate ages?

   NONE

3. Has the Subject Property ever been flooded during past storm events? If yes, please identify the subject storm(s) and the flood impact (i.e., horizontal and vertical extent of flooding).

   NO

4. What type of waterfront currently exists at the Subject Property (e.g., stone revetment, sheet pile bulkhead, natural shoreline, etc.)?

   SHEETPILE + WOOD BULKHEAD

5. Does the facility located at the Subject Property require its waterfront access to maintain functionality? If yes, what is the minimum water depth required to accommodate vessels accessing the Subject Property?

YES – 10' AT MEAN LOW WATER

6. Do active or abandoned subsurface utilities (e.g., electric, sewer, sanitary, water) or outfalls draining into the river exist within the Subject Property? If yes, please provide the utility type, size, and location.

UNKNOWN

7. Have any improvements projects been completed at the Subject Property (e.g., structures, drainage improvements, etc.)? If yes, please provide a description and/or plans that depict the improvements (we can make arrangements to pick up, copy, and return the original plans).

NO

8. Have any types of investigative programs been conducted at the Subject Property (e.g., soil borings, topographic survey/site mapping, soil remediation, etc.)? If yes, please provide a description and/or the investigation program data (we can make arrangements to pick up, copy, and return the original data).

NO

9. Do you know of any site plans that exist for the Subject Property (e.g., utility plans, topographic plans, etc.)? If yes, please provide the plans (we can make arrangements to pick up, copy, and return the original plans).

CITY TAX + LAND RECORDS

10. For further questions on the Subject Property, please provide the name, telephone number, and email address of the appropriate contact person(s).

STEPHEN LUBRANO

203-515-8070

Please complete and return by Friday April, 8, 2016.

Hillcrest Properties, LLC
142 Humphrey Street, New Haven

March 8, 2016

Data Request Questionnaire
Mill River District Shoreline Analysis

1. What type of facility is located at the Subject Property, what is the subject property's primary function, and how many people does it employ?

   7 unit apartment
   2 churches in mixed use retail area

2. What structures currently exist at the Subject Property and what are their approximate ages?

   Brick bldg - ca. 1900

3. Has the Subject Property ever been flooded during past storm events? If yes, please identify the subject storm(s) and the flood impact (i.e., horizontal and vertical extent of flooding).

   No

4. What type of waterfront currently exists at the Subject Property (e.g., stone revetment, sheet pile bulkhead, natural shoreline, etc.)?

   natural shoreline

rtg

5. **Does the facility located at the Subject Property require its waterfront access to maintain functionality? If yes, what is the minimum water depth required to accommodate vessels accessing the Subject Property?**

NO

6. **Do active or abandoned subsurface utilities (e.g., electric, sewer, sanitary, water) or outfalls draining into the river exist within the Subject Property? If yes, please provide the utility type, size, and location.**

NO

7. **Have any improvements projects been completed at the Subject Property (e.g., structures, drainage improvements, etc.)? If yes, please provide a description and/or plans that depict the improvements (we can make arrangements to pick up, copy, and return the original plans).**

fence

8. **Have any types of investigative programs been conducted at the Subject Property (e.g., soil borings, topographic survey/site mapping, soil remediation, etc.)? If yes, please provide a description and/or the investigation program data (we can make arrangements to pick up, copy, and return the original data).**

NO

9. **Do you know of any site plans that exist for the Subject Property (e.g., utility plans, topographic plans, etc.)? If yes, please provide the plans (we can make arrangements to pick up, copy, and return the original plans).**

Have some unused site plans / survey

10. **For further questions on the Subject Property, please provide the name, telephone number, and email address of the appropriate contact person(s).**

c/o Sheldon D. Hosen, Esq.
130 Everit St.,
New Haven, CT 06511
(203) 776-5552 s.d.hosen@sbcglobal.net

Please complete and return by Friday April, 8, 2016.

New NRB #3 Corporation
50 Mill Street, New Haven

March 8, 2016

Data Request Questionnaire
Mill River District Shoreline Analysis

1. **What type of facility is located at the Subject Property, what is the subject property's primary function, and how many people does it employ?**

We are a shellfish farming company. We bring our product back to the dock daily. We have approximately 20 employees.

2. **What structures currently exist at the Subject Property and what are their approximate ages?**

There is one building on our property and we are unsure how old it is.

3. **Has the Subject Property ever been flooded during past storm events? If yes, please identify the subject storm(s) and the flood impact (i.e., horizontal and vertical extent of flooding).**

No.

4. **What type of waterfront currently exists at the Subject Property (e.g., stone revetment, sheet pile bulkhead, natural shoreline, etc.)?**

Sheet pile bulkhead

rtg

5. **Does the facility located at the Subject Property require its waterfront access to maintain functionality? If yes, what is the minimum water depth required to accommodate vessels accessing the Subject Property?**

Yes! Since we are a water dependent company. We need a minimum of 8-10 feet in water depth.

6. **Do active or abandoned subsurface utilities (e.g., electric, sewer, sanitary, water) or outfalls draining into the river exist within the Subject Property? If yes, please provide the utility type, size, and location.**

7. **Have any improvements projects been completed at the Subject Property (e.g., structures, drainage improvements, etc.)? If yes, please provide a description and/or plans that depict the improvements (we can make arrangements to pick up, copy, and return the original plans).**

8. **Have any types of investigative programs been conducted at the Subject Property (e.g., soil borings, topographic survey/site mapping, soil remediation, etc.)? If yes, please provide a description and/or the investigation program data (we can make arrangements to pick up, copy, and return the original data).**

Not to our knowledge

9. **Do you know of any site plans that exist for the Subject Property (e.g., utility plans, topographic plans, etc.)? If yes, please provide the plans (we can make arrangements to pick up, copy, and return the original plans).**

10. **For further questions on the Subject Property, please provide the name, telephone number, and email address of the appropriate contact person(s).**

Robert Bloom 203-858-2947

Please complete and return by Friday April, 8, 2016.

Radiall USA, Inc.
90 & 104 John W Murphy Drive, New Haven

March 8, 2016

Data Request Questionnaire
Mill River District Shoreline Analysis

1. **What type of facility is located at the Subject Property, what is the subject property's primary function, and how many people does it employ?**

   Manufacturing of Electronic connectors and Military Antennas.
   100-125 employees

2. **What structures currently exist at the Subject Property and what are their approximate ages?**

   Metal fabricated buildings, (2)
   90 John W. Murphy Dr = 25,000 square feet, single story on slab
   104 John W Murphy Dr = 40,000 sq feet, single story on slab

3. **Has the Subject Property ever been flooded during past storm events? If yes, please identify the subject storm(s) and the flood impact (i.e., horizontal and vertical extent of flooding).**

   Hurricanes Sandy & Irene
   John W Murphy Drive was flooded from Grand Ave past Market st intot he 90* curve on John Murphy Dr. River water back flowed from the street storm drains and rose above the river banks into the parking lots on the property. No water entered the buildings.

4. **What type of waterfront currently exists at the Subject Property (e.g., stone revetment, sheet pile bulkhead, natural shoreline, etc.)?**

   Natural riverbank along the Mill River

5. **Does the facility located at the Subject Property require its waterfront access to maintain functionality? If yes, what is the minimum water depth required to accommodate vessels accessing the Subject Property?**

   No

6. **Do active or abandoned subsurface utilities (e.g., electric, sewer, sanitary, water) or outfalls draining into the river exist within the Subject Property? If yes, please provide the utility type, size, and location.**

   Yes- 104 has 3 rooftop leaders into an underground drain which empties into the Mill River. This is just rooftop rain water run off. No interior drains to the river.

7. **Have any improvements projects been completed at the Subject Property (e.g., structures, drainage improvements, etc.)? If yes, please provide a description and/or plans that depict the improvements (we can make arrangements to pick up, copy, and return the original plans).**

   Nothing since initial construction in 1989 and 2001.

8. **Have any types of investigative programs been conducted at the Subject Property (e.g., soil borings, topographic survey/site mapping, soil remediation, etc.)? If yes, please provide a description and/or the investigation program data (we can make arrangements to pick up, copy, and return the original data).**

   Yes, soil testing was done in 2005. I do not have the reports.

9. **Do you know of any site plans that exist for the Subject Property (e.g., utility plans, topographic plans, etc.)? If yes, please provide the plans (we can make arrangements to pick up, copy, and return the original plans).**

Please contact the Facilities Manager, Gary Ramadei to discuss your needs.

10. **For further questions on the Subject Property, please provide the name, telephone number, and email address of the appropriate contact person(s).**

Gary Ramadei, Facilities Manager, 203-776-2813 x 139 gary.ramadei@radiall.com

Bill Neale, 203-776-2813 x136, Bill.Neale@radiall.com

Please complete and return by Friday April, 8, 2016.

SOUTHERN CONNECTICUT GAS COMPANY March 8, 2016
347 CHAPEL ST

Data Request Questionnaire
Mill River District Shoreline Analysis

1. What type of facility is located at the Subject Property? What is the Subject Property's primary function? How many people does the Subject Property employ?

   The primary function of the subject property is an intermodal yard, with cargo moving in and out by rail, barge and truck from marine vessels to assist in reducing the amount of over the road truck traffic. Depending on the daily activities, the number of employees working on the property can vary from 5 to 15 and even more on some days. The Subject Property supports significant secondary transportation employment.

2. What structures currently exist on the Subject Property? What are their approximate ages?

   There are three buildings on the Subject Property, an administration building (est. construction 1923-1938), a small warehouse/former boiler building (est. construction 1923-1938), and a storage garage/former laboratory (est. construction 1993).

3. Has the Subject Property ever been flooded during past storm events? If "yes", please identify the subject storm(s) and the flooding impact (i.e., horizontal and vertical extent of the flooding).

   SCG is not aware of flooding at the Subject Property. As the occupant of the Subject Property since 1998 Gateway Terminal has not witnessed any flooding during past storm events, including Super Storm Sandy.

4. What type of waterfront currently exists at the Subject Property (e.g., stone revetment, sheet pile bulkhead, natural shoreline, etc.)?

   Stone seawall is present along the entire waterfront of the Subject Property.

5. Does the facility located at the Subject Property require its waterfront access to maintain functionality? If "yes"' what is the minimum water depth required to accommodate vessels accessing the Subject Property?

   Yes, the facility located at the Subject Property requires waterfront access to function, barge and tug traffic. The existing water depth of 7' – 8' approaches the minimum that we can function, but 12 feet at MLW would be an ideal depth.

6. Do active or abandoned subsurface utilities (e.g., electric, sewer, sanitary, water) or outfalls draining into the river exist within the Subject Property? If "yes", please provide utility type, size, and locations.

   "Yes" active and abandoned subsurface utilities exist within the Subject Property.

   Subsurface electric utilities are believed to be abandoned. Please provide detailed request to Kenneth Quirke for additional information.

   An active City of New Haven 30" storm sewer passes through the Subject Property. Please provide detailed request to Kenneth Quirke for additional information.

   An inactive facility wide storm sewer system exists on the Subject Property. Please provide detailed request to Kenneth Quirke for additional information.

   Inactive sanitary sewers are believed to exist on the Subject Property. Please provide detailed request to Kenneth Quirke for additional information.

   Active subsurface water utilities exist on the Subject Property. Please provide detailed request to Kenneth Quirke for additional information.

7. Have any improvement projects been completed at the Subject Property (e.g., structures, drainage improvements, etc.) If "yes", please provide a description and/or pans that depict the improvements.

   No improvements meeting the description have been completed at the Subject Property.

8. Have any types of investigative programs been conducted at the Subject Property (e.g., soil borings, topographic surveys/site mapping, soil remediation, etc.)? If "yes", please provide a description and/or the site investigation program data.

   There have been several investigative programs fitting the description. Please provide detailed request to Kenneth Quirke for additional information.

9. Do you know of any site plans that exist for the Subject Property (e.g., utility plans, topographic pans, etc.)? If "yes" please provide the plans.

   Yes, there are plans fitting this description. Please provide detailed request to Kenneth Quirke for additional information.

10. For further questions on the Subject Property, please provide the name, telephone number, and email address of the appropriate contact person(s).

    Kenneth Quirke, Lead Environmental Analyst, 203-926-4729, Kenneth.quirke@uinet.com

    Sandra Butler, Associate Real Estate Analyst, 203-926-4693, Sandy.butler@uinet.com

York Hill Trap Rock Quarry Company
340 Chapel Street, New Haven

March 8, 2016

Data Request Questionnaire
Mill River District Shoreline Analysis

1. What type of facility is located at the Subject Property, what is the subject property's primary function, and how many people does it employ?

   Ready Mix Concrete Production Facility
   two regular employees
   4-20 mixer drivers are batched out of this plant

2. What structures currently exist at the Subject Property and what are their approximate ages?

   2 Concrete Plants (1. over 60 yrs old; 2. 30 yrs old)
   1 concrete recycling plants

3. Has the Subject Property ever been flooded during past storm events? If yes, please identify the subject storm(s) and the flood impact (i.e., horizontal and vertical extent of flooding).

   No

4. What type of waterfront currently exists at the Subject Property (e.g., stone revetment, sheet pile bulkhead, natural shoreline, etc.)?

   all of the above examples.

5. **Does the facility located at the Subject Property require its waterfront access to maintain functionality? If yes, what is the minimum water depth required to accommodate vessels accessing the Subject Property?**

   No

6. **Do active or abandoned subsurface utilities (e.g., electric, sewer, sanitary, water) or outfalls draining into the river exist within the Subject Property? If yes, please provide the utility type, size, and location.**

   No

7. **Have any improvements projects been completed at the Subject Property (e.g., structures, drainage improvements, etc.)? If yes, please provide a description and/or plans that depict the improvements (we can make arrangements to pick up, copy, and return the original plans).**

   No

8. **Have any types of investigative programs been conducted at the Subject Property (e.g., soil borings, topographic survey/site mapping, soil remediation, etc.)? If yes, please provide a description and/or the investigation program data (we can make arrangements to pick up, copy, and return the original data).**

   Have some. Would need time to locate. All over 10 years old

9. Do you know of any site plans that exist for the Subject Property (e.g., utility plans, topographic plans, etc.)? If yes, please provide the plans (we can make arrangements to pick up, copy, and return the original plans).

Yes over 10 years old

10. For further questions on the Subject Property, please provide the name, telephone number, and email address of the appropriate contact person(s).

Len Suzio
203 237-8421
lhsuzio@suzioyorkhill.com

Please complete and return by Friday April, 8, 2016.

Appendix B
Soil Boring Logs

Reference Data Set No. 1

Reference Data Set No. 1

Subsurface soil conditions reportedly encountered during soil borings performed in 1981 for the construction of the existing Chapel Street Swing Bridge over the Mill River are summarized in the following soil boring logs.

(C 22)

CLIENT: Hardesty & Hanover	**General Borings, Inc.** P.O. BOX 7135 PROSPECT, CT 06712	SHEET 1 OF 3 HOLE NO. PPE-1
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER J.D. E.P.	LOCATION New Haven, CT	STATION
INSPECTOR M.M.		OFFSET

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		Start	Finish
AT 17 FT. AFTER 0 HOURS	TYPE	BW	SS	NXM	DATE	9/2	9/11/81
	SIZE I.D.	$2\frac{1}{2}$"	1-3/8"	2-1/8"	SURFACE ELEV.		
AT ___ FT. AFTER ___ HOURS	HAMMER WT.	after	140 LBS.	BIT	GROUND WATER ELEV.		
	HAMMER FALL	38.5'	30"	Carbide			

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO.	TYPE	PEN	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
										6			
										7		Run	
										5		#1	
		1	C	48"	36"	4.0'				11		4.0'	Run #1 Cored Rock 0.0'-4.0'.
5										8			Recovered 36" red-brown Sand-
										7		Run	stone and Conrete.
										10		#2	
										8			
		2	C	60"	44"	9.0'				11		9.0'	Run #2 Cored Rock 4.0'-9.0'.
10										8			Recovered 44" red-brown Sand-
										8		Run	stone and Concrete.
										2		#3	
		3	C	48"	44"	13.0'				2		13.0'	Run #3 Cored Rock 9.0'-13.0'.
										6			Recovered 44" Red-brown Sand-
15										5		Run	stone and Concrete. (changed to
										5		#4	Concrete at 11.0')
		4	C	48"	12"	17.0'				3		17.0'	NOTE: 13.0' drilled Steel Plate.
										4			Run #4 Cored Rock 13.0'-17.0'.
										6		Run	Recovered 12" red-brown Sand-
20										5		#5	stone, Concrete and Steel.
										5			
		5	C	60"	60"	22.0'				4		22.0'	Run #5 Cored Rock 17.0'-22.0'.
										5			Recovered 60" Concrete.
										3		Run	
25										3		#6	
										5			
		6	C	60"	60"	27.0'				5		27.0'	Run #6 Cored Rock 22.0'-27.0'.
										5			Recovered 60" Concrete.
										4		Run	
30										3.5		#7	
										4			
		7	C	60"	59"	32.0'				3		32.0'	Run #7 Cored Rock 27.0'-32.0'.
										4			Recovered 59" Concrete.
										4		Run	
35										7		#8	
										7			
		8	C	60"	60"	37.0'				5		37.0'	Run #8 Cored Rock 32.0'-37.0'.
										5		Run #9	Recovered 60" Concrete.
		9	C	24"	18"	39.0'				1		39.0'	Run #9 Cored Rock 37.0'-39.0'.

Recovered 18" Concrete.
NOTE: 38.5' End of Concrete.

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

(C22)

General Borings, Inc.

P.O. BOX 7135 PROSPECT, CT 06712

CLIENT: Hardesty & Hanover		SHEET 2 OF 3
		HOLE NO. PPE-1
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER J.D. E.P.	LOCATION New Haven, CT	STATION
INSPECTOR M.M.		OFFSET

GROUND WATER OBSERVATIONS

AT 17 FT. AFTER 0 HOURS

AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE	BW	SS	NXM
SIZE I.D.	$2\frac{1}{2}$"	1-3/8"	2-1/8"
HAMMER WT.	after	140 LBS.	BIT
HAMMER FALL	38.5'	30"	Carbide

	Start	Finish
DATE	9/2	9/11/81
SURFACE ELEV.		
GROUND WATER ELEV.		

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO	TYPE	PEN	REC	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. / MOIST	STRATA CHANGE DEPTH / ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		1	SS	24"	24"	41.0'	18	23	10	7	Wet Medium		1) Gray-brown coarse-fine Sand, trace fine Gravel.
45' 5			SS	24"	0"	46.0'	14	10	10	10	"		No recovery - brown fine-medium Sand in wash.
50' 10		2	SS	24"	10"	51.0'	9	9	15	14	"		2) Red-brown coarse-medium Sand, some fine Gravel.
15		3	SS	24"	16"	56.0'	13	12	13	15	"		3) Red-brown fine-coarse Sand, trace fine Gravel, trace Silt.
60' 20		4	SS	24"	18"	61.0'	12	16	20	20	Wet Dense		4) Red-brown fine-coarse Sand, little fine Gravel, trace Silt.
65' 25		5	SS	24"	8"	67.0'	13	13	14	16	"		5) Red-brown fine-coarse Sand.
70' 30			SS	24"	0"	72.0'	14	13	16	13	Wet Medium		No recovery - red-brown fine-coarse Sand in wash.
75' 35		6	SS	24"	24"	77.0'	10	16	20	22	Wet Dense		6) Red-brown fine-coarse Sand, trace fine Gravel.
80'		7	SS	24"	24"	82.0'	13	19	26	29	Wet Very Dense		7) Red-brown coarse-fine Sand, trace fine Gravel, trace Silt.

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

(C22)

CLIENT: Hardesty & Hanover	**General Borings, Inc.** P.O. BOX 7135 PROSPECT, CT 06712	SHEET 3 OF 3 HOLE NO. PPE-1
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER J.D. E.P.	LOCATION New Haven, CT	STATION
INSPECTOR M.M.		OFFSET

GROUND WATER OBSERVATIONS
AT 17 FT. AFTER 0 HOURS
AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE	BW	SS	NXM
SIZE I.D.	2½"	1-3/8"	2/1-8"
HAMMER WT.	after	140 LBS.	BIT
HAMMER FALL	38.5'	30"	Carbide

DATE Start 9/2 Finish 9/11/81
SURFACE ELEV.
GROUND WATER ELEV.

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO.	TYPE	PEN	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. / MOIST	STRATA CHANGE DEPTH / ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
85' / 5		8	SS	24"	24"	87.0'	12	15	26	28	Wet Very Dense		8) Red-brown coarse-fine Sand, trace fine Gravel, trace Silt.
90' / 10		9	SS	24"	19"	92.0'	13	21	22	21	Wet Dense		9) Same as sample #8.
15		10	SS	24"	19"	97.0'	14	19	23	21	"		10) Same as sample #8.
100' / 20		11	SS	24"	24"	102.0'	12	16	19	22	"		11) Same as sample #8.
												102.0' EOB	
105' / 25													END OF BORING 102.0'
													63.0' Soil 39.0' Rock
30													
35													

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

(C23)

CLIENT: Hardesty & Hanover

General Borings, Inc.

P.O. BOX 7135 PROSPECT, CT 06712

SHEET 1 OF 2
HOLE NO. PPE-2

GBI JOB NO.	PROJECT NAME	LINE
63-81	Chapel Street Bridge	
FOREMAN-DRILLER: J.D. D.T.	LOCATION: New Haven, CT	STATION
INSPECTOR		OFFSET

GROUND WATER OBSERVATIONS
AT 19 FT. AFTER 0 HOURS
AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE		SS	NXM
SIZE I.D.		1-3/8"	2-1/8"
HAMMER WT.		140 LBS.	BIT
HAMMER FALL		30"	Diamond

DATE Start 9/16 Finish 9/18/81
SURFACE ELEV.
GROUND WATER ELEV.

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO	TYPE	PEN	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. / MOIST	STRATA CHANGE DEPTH / ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
										6			
										6		Run	
										6		#1	
										5			
5		1	C	60"	60"	5.0'				5		5.0'	Run #1 Cored Rock 0.0'-5.0'.
										6			Recovered 60" red, brown Sand-
										6		Run	stone block and concrete.
										6		#2	
										8			
10		2	C	60"	58"	10.0'				8		10.0'	Run #2 Cored Rock 5.0'-10.0'.
										6			Recovered 58" red, brown Sand-
										5		Run	stone block and Concrete.
										5		#3	NOTE: 11.0' Cement and Stone.
										5			
15		3	C	60"	48"	15.0'				4		15.0'	Run #3 Cored Rock 10.0'-15.0'.
										6			Recovered 48" - Top 1.0' same
										6		Run	as run #2 - Bottom gray Cement
										5		#4	and Stone.
										4			
20		4	C	60"	36"	20.0'				3		20.0'	Run #4 Cored Rock 15.0'-20.0'.
										3			Recovered 36" gray Cement and
										2		Run	Stone.
										2		#5	
										2			
25		5	C	60"	33"	25.0'				2		25.0'	Run #5 Cored Rock 20.0'-25.0'.
										3			Recovered 33" same as run #4.
										2		Run	
										2		#6	
										2			
30		6	C	60"	60"	30.0'				2		30.0'	Run #6 Cored Rock 25.0'-30.0'.
										2			Recovered 60" same as run #4.
										2		Run	
										2		#7	
										2			
35		7	C	60"	49"	35.0'				2		35.0'	Run #7 Cored Rock 30.0'-35.0'.
										2		Run #8	Recovered 49" same as run #4.
		8	C	24"	18"	37.0'				2		37.0'	Run #8 Cored Rock 35.0'-37.0'.
													Recovered 18" same as run #4.
		1	SS	24"	10"	39.0'	8	9	12	14	Wet		1) Red-brown coarse-fine Sand,
											Medium		trace fine Gravel.

TYPE OF SAMPLES:
D=DRY W=WASHED C=CORED A=AUGER SS=SPLIT SPOON
UB=UNDISTURBED BALL CHECK UP=UNDISTURBED PISTON VT=VANE SPOON
PROPORTIONS USED TRACE=0-10% LITTLE=10-20% SOME=20-35%, AND=35-50%

(C23)

CLIENT: Hardesty & Hanover	**General Borings, Inc.** P.O. BOX 7135 PROSPECT, CT 06712	SHEET 2 OF 2 HOLE NO. PPE-2
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER J.D. D.T.	LOCATION New Haven, CT	STATION
INSPECTOR		OFFSET

GROUND WATER OBSERVATIONS
AT 19 FT. AFTER 0 HOURS
AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE		SS	NXM
SIZE I.D.		1-3/8"	2-1/8"
HAMMER WT.		140 LBS.	BIT
HAMMER FALL		30"	Diamond

	Start	Finish
DATE	9/16	9/18/81

SURFACE ELEV.
GROUND WATER ELEV.

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO	TYPE	PEN	REC	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
45'		2	SS	24"	12"	47.0'	9	12	16	14	Wet Dense		2) Same as sample #1, trace medium Gravel.
5												47.0' EOB	
10													END OF BORING 47.0'
15													
20													
25													
30													
35													

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

(C24)

CLIENT: Hardesty & Hanover	**General Borings, Inc.** P.O. BOX 7135 PROSPECT, CT 06712	SHEET 1 OF 2 HOLE NO. ABI-W B-1
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER F.C. T.B.	LOCATION New Haven, CT	STATION
INSPECTOR		OFFSET

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		
AT 10 FT. AFTER 0 HOURS	TYPE		SS	NXM	DATE	Start 9/22 Finish 9/23/81
	SIZE I.D.		1-3/8"	2-1/8"	SURFACE ELEV.	
AT ___ FT. AFTER ___ HOURS	HAMMER WT.		140 LBS.	BIT	GROUND WATER ELEV.	
	HAMMER FALL		30"	Diamond		

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO	TYPE	PEN	REC	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
										9			
										9		Run	
										7		#1	
										6			
5		1	C	60"	57"	5.0'				6		5.0'	Run #1 Cored Rock 0.0'-5.0'. Recovered 57" Concrete.
										8			
										8		Run	
										7		#2	
										9			
10		2	C	60"	58"	10.0'				12		10.0'	Run #2 Cored Rock 5.0'-10.0'. Recovered 58" Concrete.
										9			
										12		Run	
										12		#3	
										7			
15		3	C	60"	60"	15.0'				8		15.0'	Run #3 Cored Rock 10.0'-15.0'. Recovered 60" Concrete.
										10			
										9		Run	
										7		#4	
										7			
20		4	C	60"	46"	20.0'				8		20.0'	Run #4 Cored Rock 15.0'-20.0'. Recovered 46" Concrete. NOTE: $1\frac{1}{4}$" steel at 20.0'.
										10			
										4		Run	
										4		#5	
										3			
25		5	C	60"	0"	25.0'				3		25.0'	Run #5 Cored Rock 20.0'-25.0'. Recovered 0".
										4			
										3		Run	
										3		#6	
										3			
30		6	C	60"	20"	30.0'				4		30.0'	Run #6 Cored Rock 25.0'-30.0'. Recovered 20" Concrete.
										4			
										5		Run	
										4		#7	
										4			
35		7	C	60"	30"	35.0'				4		35.0'	Run #7 Cored Rock 30.0'-35.0'. Recovered 30" Concrete.
										3			
										3		Run	
										4		#8	
										3			
		8	C	60"	0"	40.0'				3		40.0'	Run #8 Cored Rock 35.0'-40.0'. Recovered 0".

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

(C24)

CLIENT: Hardesty & Hanover

General Borings, Inc.

P.O. BOX 7135 PROSPECT, CT 06712

SHEET 2 OF 2
HOLE NO. ABI-W B-1

GBI JOB NO. 63-81

PROJECT NAME Chapel Street Bridge

LINE

FOREMAN-DRILLER F.C. T.B.

LOCATION New Haven, CT

STATION

INSPECTOR

OFFSET

GROUND WATER OBSERVATIONS
AT 10 FT. AFTER 0 HOURS
AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE		SS	NXM
SIZE I.D.		1-3/8"	2-1/8"
HAMMER WT.		140 LBS.	BIT
HAMMER FALL		30"	Diamond

DATE Start 9/22 Finish 9/23/81
SURFACE ELEV.
GROUND WATER ELEV.

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO	TYPE	PEN	REC	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
41'		9	SS	18"	6"	42.5'	16	14	13		Wet Medium	41.0'	NOTE: 41.0' end of Coring 9) Black-brown fine-coarse Sand and fine-coarse Gravel, some Silt.
45'													
50'													
		10	SS	18"	7"	52.5'	8	6	8		Wet Medium	52.5' EOB	10) Brown medium-coarse Sand, some fine-medium Gravel, trace Silt.
													END OF BORING 52.5'

TYPE OF SAMPLES:
D=DRY W=WASHED C=CORED A=AUGER SS=SPLIT SPOON
UB=UNDISTURBED BALL CHECK UP=UNDISTURBED PISTON VT=VANE SPOON
PROPORTIONS USED TRACE=0-10% LITTLE=10-20% SOME=20-35%, AND=35-50%

C25

General Borings, Inc.

P.O. BOX 7135 PROSPECT, CT 06712

CLIENT: Hardesty & Hanover		SHEET 1 OF 2 HOLE NO. ABI-W B-2
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER F.C. J.W.	LOCATION New Haven, CT	STATION
INSPECTOR		OFFSET

GROUND WATER OBSERVATIONS
AT 13.5 FT. AFTER 0 HOURS
AT ______ FT. AFTER ______ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE		SS	NXM
SIZE I.D.		1-3/8"	2-1/8"
HAMMER WT.		140 LBS.	BIT
HAMMER FALL		30"	Diamond

DATE Start 9/29 Finish 9/30/81
SURFACE ELEV.
GROUND WATER ELEV.

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO	TYPE	PEN	REC.	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
										10		Run #1	
										6			
										5			
										5			
5		1	C	60"	29"	5.0'				6		5.0'	Run #1 Cored Rock 0.0'-5.0'. Recovered 29" Concrete.
										6		Run #2	
										8			
										8			
										11			
10		2	C	60"	42"	10.0'				8		10.0'	Run #2 Cored Rock 5.0'-10.0'. Recovered 42" Concrete.
										5		Run #3	
										10			
										7			
										8			
15		3	C	60"	24"	15.0'				7		15.0'	Run #3 Cored Rock 10.0'-15.0'. Recovered 24" Concrete.
										7		Run #4	
										9			
										10			
										9			
20		4	C	60"	57"	20.0'				8		20.0'	Run #4 Cored Rock 15.0'-20.0'. Recovered 57" Concrete.
										9		Run #5	
										12			
										13			
										13			
25		5	C	60"	60"	25.0'				13		25.0'	Run #5 Cored Rock 20.0'-25.0'. Recovered 60" Concrete.
										14		Run #6	
										13			
										2			
										6			
30		6	C	60"	32"	30.0'				6		30.0'	Run #6 Cored Rock 25.0'-30.0'. Recovered 32" Concrete.
										3		Run #7	
										3			
										4			
										2			
35		7	C	60"	5"	35.0'				3		35.0'	Run #7 Cored Rock 30.0'-35.0'. Recovered 5" Concrete.
										4		Run #8	
										1			
										2			
										2			
40		8	C	60"	12"	40.0'				2		40.0'	Run #8 Cored Rock 35.0'-40.0'. Recovered 12" Concrete.

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

C25

CLIENT: Hardesty & Hanover	**General Borings, Inc.** P.O. BOX 7135 PROSPECT, CT 06712	SHEET 2 OF 2 HOLE NO. ABI-W B-2
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER F.C. J.W.	LOCATION New Haven, CT	STATION
INSPECTOR		OFFSET

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		
AT 13.5' FT. AFTER 0 HOURS	TYPE		SS	NXM	DATE	Start 9/29 Finish 9/30/81
	SIZE I.D.		1-3/8"	2-1/8"	SURFACE ELEV.	
AT ____ FT. AFTER ____ HOURS	HAMMER WT.		140 LBS.	BIT	GROUND WATER ELEV.	
	HAMMER FALL		30"	Diamond		

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO.	TYPE	PEN	REC.	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. / MOIST	STRATA CHANGE DEPTH / ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
										2			
										2		Run	
										1		#9	
										2			
45 / 5		9	C	60"	17"	45.0'				1		45.0'	Run #9 Cored Rock 40.0'-45.0'.
										2		Run	Recovered 17" Concrete.
										3		#10	
		10	C	36"	27"	48.0'				2		48.0'	Run #10 Cored Rock 45.0'-48.0'.
		11	SS	18"	4"	49.5'	9	3	4		Wet		Recovered 27" Concrete.
50' / 10											Loose		11) Black-brown fine-coarse Sand and Wood, trace Silt.
55 / 15													
		12	SS	18"	5"	59.5'	4	6	4		Wet		12) Black-brown medium-coarse
60' / 20											Medium	59.5' EOB	Sand, trace fine Gravel, trace Silt.
25													
30													END OF BORING 59.5'
35													
40													

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

C26

General Borings, Inc.

P.O. BOX 7135 PROSPECT, CT 06712

CLIENT: Hardesty & Hanover		SHEET 1 OF 2
		HOLE NO. ABI-E B-3
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER F.C. T.B.	LOCATION New Haven, CT	STATION
INSPECTOR		OFFSET

GROUND WATER OBSERVATIONS

AT 8.75 FT. AFTER ____ HOURS
Time 10:25

AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE		SS	NXM
SIZE I.D.		1-3/8"	2-1/8"
HAMMER WT.		140 LBS.	BIT
HAMMER FALL		30"	Diamond

	Start	Finish
DATE	9/23	9/27/81
SURFACE ELEV.		
GROUND WATER ELEV.		

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO	TYPE	PEN	REC	DEPTH @ BOT	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
0-5		1	C	60"	53"	5.0'				9, 8, 9, 8, 8		Run #1 5.0'	Run #1. Cored Rock 0.0'-5.0'. Recovered 53" Concrete.
5-10		2	C	60"	59"	10.0'				7, 7, 8, 7, 9		Run #2 10.0'	Run #2 Cored Rock 5.0'-10.0'. Recovered 59" Concrete.
10-15		3	C	60"	59"	15.0'				9, 8, 8, 9, 7		Run #3 15.0'	Run #3 Cored Rock 10.0'-15.0'. Recovered 59" Concrete.
15-17.5		4	C	30"	27"	17.5'				9, 8, 3/6"		Run #4 17.5'	NOTE: Steel plate at 17.5'.
17.5-24												22.0'	NOTE: 17.5'-22.0' black organic fine-medium Sand from wash. Run #4 Cored Rock 15.0'-17.5'. Recovered 27" Concrete.
												24.0'	NOTE: 0.0'-24.0' ran NX casing.
24-29		5	C	60"	28"	29.0'				2, 3, 5, 4, 7		Run #5 29.0'	Run #5 Cored Rock 24.0'-29.0'. Recovered 28" Concrete.
29-34		6	C	60"	24"	34.0'				4, 3, 2, 3, 3		Run #6 34.0'	Run #6 Cored Rock 29.0'-34.0'. Recovered 24" Concrete.
34-39		7	C	60"	14"	39.0'				3, 3, 2, 2, 2		Run #7 39.0'	Run #7 Cored Rock 34.0'-39.0'. Recovered 14" Concrete.

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

(C26)

CLIENT: Hardesty & Hanover	**General Borings, Inc.** P.O. BOX 7135 PROSPECT, CT 06712	SHEET 2 OF 2 HOLE NO. ABI-E B-3
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER F.C. T.B.	LOCATION New Haven, CT	STATION
INSPECTOR		OFFSET

GROUND WATER OBSERVATIONS
AT 8.75 FT. AFTER ____ HOURS
Time 10:25
AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE		SS	NXM
SIZE I.D.		1-3/8"	2-1/8"
HAMMER WT.		140 LBS.	BIT
HAMMER FALL		30"	Diamond

	Start	Finish
DATE	9/23	9/27/81
SURFACE ELEV.		
GROUND WATER ELEV.		

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO.	TYPE	PEN	REC.	DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE) 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
										2		Run #8	
		8	C	42"	8"	42.5'				3		42.5'	Run #8 Cored Rock 39.0'-42.5'. Recovered 8" Concrete.
										3			
45'		9	SS	18"	6"	44.0'	11	5	5	2/6"	Wet Medium		9) Back-brown medium-coarse Sand and Wood, trace Silt.
5													
50' 10													
		10	SS	18"	5"	54.0'	7	6	7		"	54.0'	10) Red-brown medium-coarse Sand trace fine Gravel, trace Silt.
												EOB	
55 15													
20													END OF BORING 54.0'
25													
30													
35													
40													

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

C 27

General Borings, Inc.
P.O. BOX 7135 PROSPECT, CT 06712

CLIENT: Hardesty & Hanover		SHEET 1 OF 2 HOLE NO. ABI-E B-4
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER F.C. J.W.	LOCATION New Haven, CT	STATION
INSPECTOR		OFFSET

GROUND WATER OBSERVATIONS
AT 16.3 FT. AFTER ____ HOURS
Time: 7:00 P.M.
AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE		SS	NXM
SIZE I.D.		1-3/8"	2-1/8"
HAMMER WT.		140 LBS.	BIT
HAMMER FALL		30"	Diamond

DATE Start 9/27 Finish 9/28/81
SURFACE ELEV.
GROUND WATER ELEV.

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO	TYPE	PEN	REC	DEPTH @ BOT.	BLOWS PER 6" 0-6	6-12	12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
										8			
										8		Run	
										7		#1	
										8			
5		1	C	60"	56"	5.0'				6		5.0'	Run #1 Cored Rock 0.0'-5.0'. Recovered 56" Concrete.
										6			
										7		Run	
										6		#2	
										10			
10		2	C	60"	48"	10.0'				7		10.0'	Run #2 Cored Rock 5.0'-10.0'. Recovered 48" Concrete.
										5			
										5		Run	
										7		#3	
										8			
15		3	C	60"	36"	15.0'				7		15.0'	Run #3 Cored Rock 10.0'-15.0'. Recovered 36" Concrete.
										8			
										7		Run	
										6		#4	
										9			
20		4	C	60"	42"	20.0'				10		20.0'	Run #4 Cored Rock 15.0'-20.0'. Recovered 42" Concrete.
										10			
										9		Run	
										9		#5	
										7		24.0'	
25		5	C	60"	47"	25.0'				2		25.0'	Run #5 Cored Rock 20.0'-25.0'. Recovered 47" Concrete.
										1			
										1		Run	
										1		#6	
										1		29.0'	
30		6	C	60"	10"	30.0'				2		30.0'	Run #6 Cored Rock 25.0'-30.0'. Recovered 10" Concrete.
										2			NOTE: 0.0'-30.0' ran Casing.
										2		Run	NOTE: 24.0'-29.0' - 5.0' seam
										3		#7	coarse Sand and coarse Gravel.
										2			
35		7	C	60"	5"	35.0'				3		35.0'	Run #7 Cored Rock 30.0'-35.0'. Recovered 5" Concrete.
										3			
										2		Run	
										1		#8	
										2			
		8	C	60"	4"	40.0'				1		40.0'	Run #8 Cored Rock 35.0'-40.0'. Recovered 4" Concrete.

TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

(C27)

CLIENT: Hardesty & Hanover	**General Borings, Inc.** P.O. BOX 7135 PROSPECT, CT 06712	SHEET 2 OF 2 HOLE NO. ABI-E B-4
GBI JOB NO. 63-81	PROJECT NAME Chapel Street Bridge	LINE
FOREMAN-DRILLER F.C. J.W.	LOCATION New Haven, CT	STATION
INSPECTOR		OFFSET

GROUND WATER OBSERVATIONS
AT 16.3 FT. AFTER ____ HOURS
Time: 7:00 P.M.
AT ____ FT. AFTER ____ HOURS

	CASING	SAMPLER	CORE BAR.
TYPE		SS	NXM
SIZE I.D.		1-3/8"	2-1/8"
HAMMER WT.		140 LBS.	BIT
HAMMER FALL		30"	Diamond

DATE Start 9/27 Finish 9/28/81
SURFACE ELEV.
GROUND WATER ELEV.

DEPTH	CASING BLOWS PER FOOT	SAMPLE NO	TYPE	PEN	REC	DEPTH @ BOT	BLOWS 0-6	BLOWS 6-12	BLOWS 12-18	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. / MOIST	STRATA CHANGE DEPTH / ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
										1			
										1			
										1		Run #9	
45'										3			
5		9	C	60"	5"	45.0'				2		45.0'	Run #9 Cored Rock 40.0'-45.0'. Recovered 5" Concrete.
										2			
										1		Run #10	
										3			
50'		10	C	48"	4"	49.0'				2		49.0'	Run #10 Cored Rock 45.0'-49.0'. Recovered 4" Concrete.
10		11	SS	18"	9"	50.5'	4	6	6		Wet Medium		11) Black-brown coarse-medium Sand, trace Silt.
55' 15													
60' 20		12	SS	18"	7"	60.5'	6	6	5		"	60.5' EOB	12) Black-brown coarse-medium Sand, trace Silt, trace fine Gravel.
65' 25													END OF BORING 60.5'
30													
35													
40													

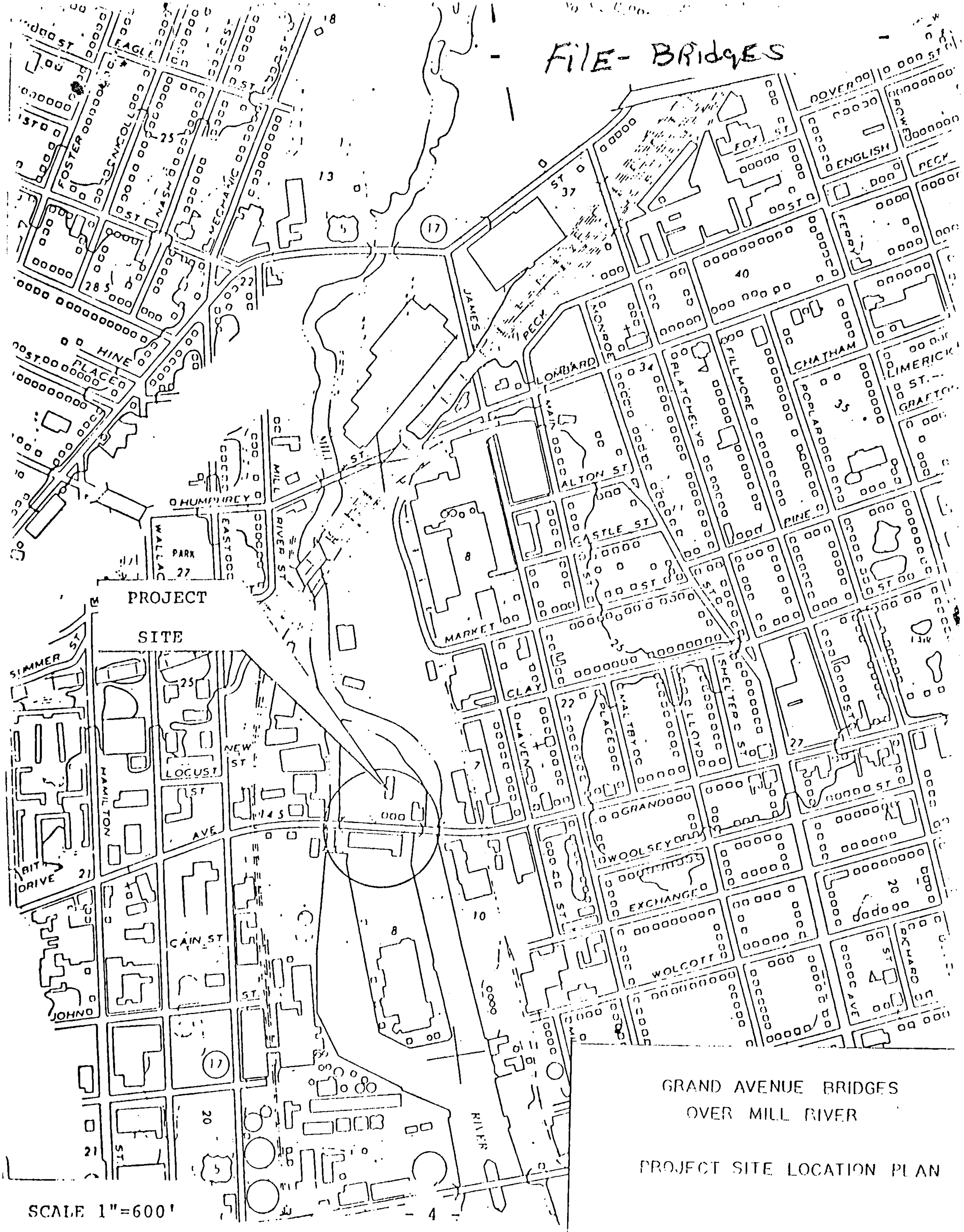
TYPE OF SAMPLES:
D = DRY W = WASHED C = CORED A = AUGER SS = SPLIT SPOON
UB = UNDISTURBED BALL CHECK UP = UNDISTURBED PISTON VT = VANE SPOON
PROPORTIONS USED TRACE = 0-10% LITTLE = 10-20% SOME = 20-35%, AND = 35-50%

Reference Data Set No. 2

Reference Data Set No. 2

Subsurface soil conditions reportedly encountered during soil borings performed in 1977 for the construction of the existing Grand Avenue Bridges over the Mill River are summarized in the following site plans and soil boring logs.

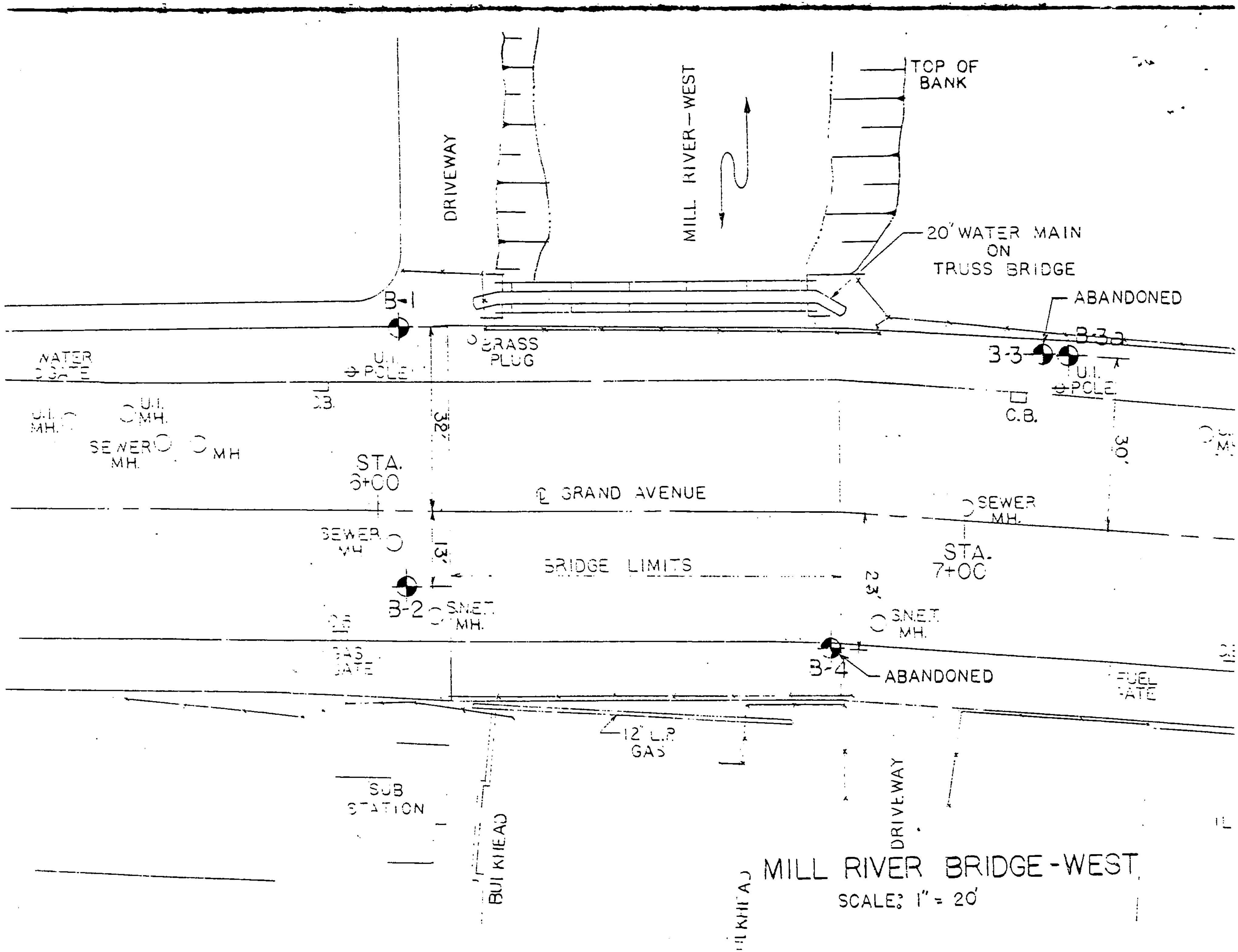
File- Bridges



GRAND AVENUE BRIDGES
OVER MILL RIVER

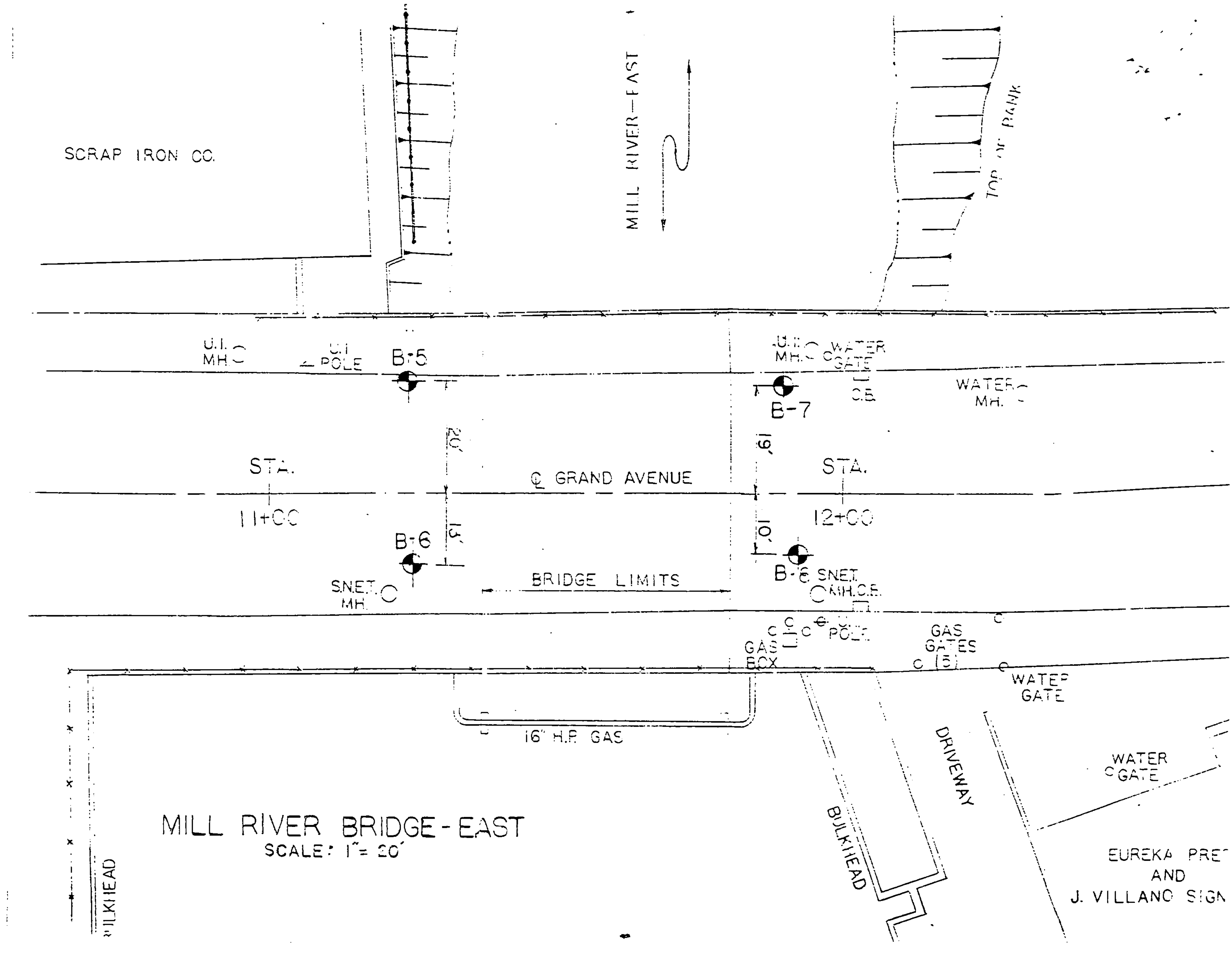
PROJECT SITE LOCATION PLAN

SCALE 1"=600'

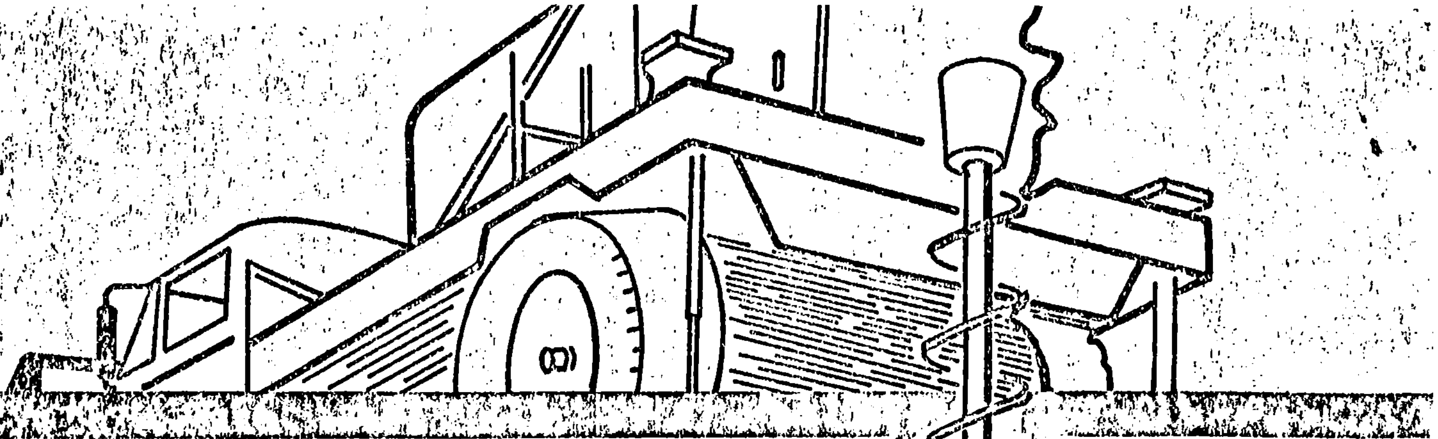


MILL RIVER BRIDGE-WEST

SCALE: 1" = 20'



MILL RIVER BRIDGE - EAST
SCALE: 1" = 20'



Connecticut Test Borings, Inc.

SUB-SURFACE SPECIALISTS P.O. BOX 69. SEYMOUR, CONN.

SERVING: Connecticut, Massachusetts, Rhode Island, Vermont
Maine, New Hampshire, New York, New Jersey, Pennsylvania

INTEGRITY EXPERIENCE

Client CITY OF NEW HAVEN, CONNECTICUT

Project GRAND AVENUE 76-72-1 & 76-73-1

Location NEW HAVEN, CT.

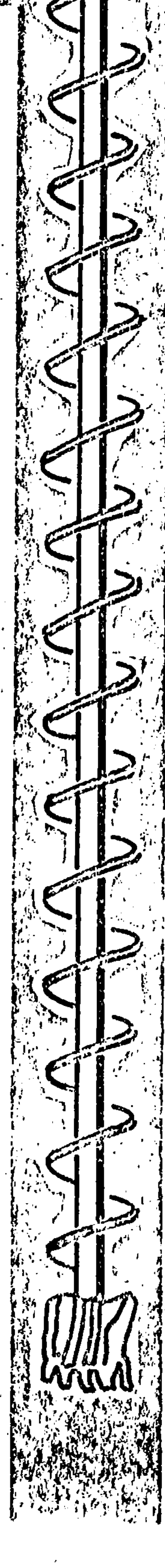
Architect

Engineer

Driller g.s. j.d.

Driller Assistant r.h.. f.d.

Jar samples and/or rock core samples delivered upon request.



Hollow Stem Auger Borings

Dry Sample Borings

Piston Samples

Rock Coring

Shelby Tubes

Piezometers

Well Points

Mineral Exploration

Seismic Surveys

Shallow Caissons

Engineering Reports

G14

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

DATE START 7/12/77
DATE FINISH 7/12/77
WEIGHT OF HAMMER 140 XX
HAMMER FALL 30" XX

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/12/77	1:30 P.M.	8' Tidal

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG HYDRAULIC ROTARY

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CT.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

SHEET 1 of 1
PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave.
XXXXXX New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B-1

	CASING	SAMPLER	CORE BAR
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
							.66'	Concrete			
	5' to 6.5'	SS	13	12	6	M. Comp Wet		Red Brown and Grey C-F Sand, Cinders and Ashes, Misc. Fill	1	1.5	.6
							8.0'				
10	10' to 11.5'	SS	1	0	2	Soft Wet		Gray C-F Sand and Organic Silt Trace of Sea Shells	2	1.5	[illegible]
							14.0'				
	15' to 16.5'	SS	10	13	11	M. Comp Wet		Red Brown F-C Sand, Little F-C Gravel, Trace Silt	3	1.5	1[illegible]
20	20' to 21.5'	SS	1	1	1	Soft Wet	20.0'	Gray Clayey Organic Silt with Sea Shells	4	1.5	1.
	25' to 26.5'	SS	W	O	H	Soft Wet		SAME AS ABOVE WITH TRACE M-F SAND	5	1.5	1.
30	30' to 31.5'	SS	1	0	1	Soft Wet		Same as Sample #5	6	1.5	1.
	35' to 36.5	SS	5	14	15	Soft	35.25'	Red Brown Fine Sand, Little F-M Gravel, Trace Silt	7	1.5	1.
40											

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

DRILLER: J.D
HELPER: F..D.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 61.5 Ft.
Rock Coring Ft.
HOLE NO.

5/73

G14

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

SHEET 2 of 2

DATE START 7/12/77
DATE FINISH 7/12/77
WEIGHT OF HAMMER 140 ~~300~~
HAMMER FALL 30" ~~XX~~"

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/12/77	1:30 P.M.	8'
		Tidal

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CT.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave.
~~XXXX~~ & STA. New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B- 1

	CASING	SAMPLER	CORE BA
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	RE
	40' to 41.5'	SS	6	4	5	Loose Wet		Red Brown Fine Sand, Trace Silt	8	1.5	1
	45' to 46.5'	SS	5	4	6	Loose Wet		Same as Sample #8	9	1.5	1.
50	50' to 51.5'	SS	4	6	5	M.Comp Wet		Same as Sample #9	10	1.5	1.
	55' to 56.5'	SS	5	6	6	M.Comp Wet		Same as Sample # 10	11	1.5	.9
60	60' to 61.5'	SS	6	7	6	M.Comp Wet	61.5'	Same as Sample # 11	12	1.5	11
								BOTTOM OF BORING 61.5'			
70											
80											

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: J. D.
HELPER: F. D.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 61.5 Ft.
Rock Coring Ft.
HOLE NO.

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

5/73

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

DATE START	7/14/77
DATE FINISH	7/15/77
WEIGHT OF HAMMER	140
HAMMER FALL	30"

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/14/77	0 HRS	7.08' Tidal

SAMPLER O.D. 2" I.D. 1 3/8"

TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CT.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

SHEET 1 of 2

PROJ. NO.	76-72-1 & 76-73-1
LOCATION	Grand Ave.
LINE & STA.	New Haven, Ct.
OFFSET	
GROUND ELEVATION	
HOLE NO.	B- 2

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	SS	
SIZE I.D.	2¼"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	6-12	To 12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
							1.5'	Asphalt			
	5' to 6.5'	SS	6	6	6	M.Comp Moist	6.0'	Brown C-F Sand, Little Fine Gravel, Trace Cobbles, (Fill)	1	1.5	.[illegible]
							8.0'	Red Brown C-F Sand, Little Silt, Trace Seashells, Fine Gravel			
10	10' to 11.5'	SS	21	18	10	M.Comp Wet	10.0'	Grey Organic Sandy Silt, Trace Seashells	2	1.5	.3
	15' to 16.5'	SS	8	7	6	M.Comp Wet		Red Brown C-F Sand, Little M-F Gravel, Trace Silt	3	1.5	.8
20	20' to 21.5'	SS	9	5	3	Loose Wet	23.0'	Red Brown C-F Sand, Little Silt, Trace Fine Gravel	4	1.5	1.
	25' to 26.5'	SS	2	2	2	Soft Moist		Grey Organic Silt, Trace Clay	5	1.5	1.
30	30' to 31.5'	SS	3	3	4	Soft Moist	34.0'	SAME AS SAMPLE # 5 WITH TRACE FINE SAND	6	1.5	1.
	35' to 36.5'	SS	16	19	21	Dense Wet		Red Brown C-F Sand, Little Silt, Trace Fine Gravel	7	1.5	.4
40											

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: G.S. A.F.
HELPER: R.H.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 61.5' Ft.
Rock Coring Ft.
HOLE NO.

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

5/73

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

(G15) SHEET 2 of 2

DATE START	7/15/77
DATE FINISH	7/15/77
WEIGHT OF HAMMER	140 ~~300~~
HAMMER FALL	30" ~~24~~

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/14/77	0 HRS	7.08'
		Tidal

SAMPLER O.D. 2" I.D. 1 3/8"

TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CONN.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT

PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave.
LINE & STA.
OFFSET
GROUND ELEVATION
HOLE NO. B- 2

	CASING	SAMPLER	CORE BARR
TYPE	HSA	SS	
SIZE I.D.	2¼"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
	40' to 41.5'	SS	8	10	12	M.Comp Wet		Red Brown C-F Sand, Trace Fine Gravel	8	1.5	.1
	45' to 46.5'	SS	11	9	10	M.Comp Wet	47.0'	Red Brown C-F Sand	9	1.5	.2
50	50' to 51.5'	SS	7	9	10	M.Comp Wet		Red Brown Fine Sand, Little Silt	10	1.5	.6
	55' to 56.5'	SS	8	7	12	M.Comp Wet		Same as SAMPLE # 10	11	1.5	.8
60	60' to 61.5'	SS	9	8	10	M.Comp Wet	61.5'	SAME AS SAMPLE # 11	12	1.5	.7
70											
80											

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: G.S. A.F.
HELPER: R.H.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 61.5 Ft.
Rock Coring Ft.
HOLE NO.

5/73

(G16)

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

DATE START 7/12/77
DATE FINISH 7/12/77
WEIGHT OF HAMMER 140 ~~300~~
HAMMER FALL 30" ~~24"~~

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/12/77	0 HRS	8.0'

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG HYDRAULIC ROTARY

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CONN.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

SHEET 1 of 1
PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Avenue
~~LINE & STA.~~ New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B- 3

	CASING	SAMPLER	CORE BARR
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
								1" Black Top			
	5' to 6.5'	SS	5	4	2	Loose		Miscellanous Fill	1	1.5	1
							7.0'				
10	10' to 11.5'	SS	1	0	1	Soft Wet		Grey Organic Silt mixed with F-C Sand, Some Gravel	2	1.5	.1
							14.0'				
	15' to 15.92'	SS	14	50/5"		Very Dense	16.0'	Augered into a Wood Pier from 14.0' to 16.0'	3	.92	.8
								REFUSAL ON HSA			
								BOTTOM OF BORING 16.0'			
20											
30											
40											

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: J.d.
HELPER: f.d.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 16.0 Ft.
Rock Coring Ft.
HOLE NO.

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

5/73

DATE START 7/13/77

DATE FINISH 7/13/77

WEIGHT OF HAMMER 140 300

HAMMER FALL 30"

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/13/77	2:30 p.m.	6.0'
		Tidal

SAMPLER O.D. 2" I.D. 1 3/8"

TYPE OF RIG Hydraulic Rotary

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists

P. O. Box 69

SEYMOUR, CONNECTICUT

(203) 888-3857

ESPECIALLY COMPILED FOR

CITY OF NEW HAVEN, CONN.

BUREAU OF ENGINEERING

200 ORANGE STREET

NEW HAVEN, CT.

G17

SHEET 1 of 2

PROJ. NO. 76-72-1 & 76-73-1

LOCATION Grand Ave

LINE & STA. New Haven, Ct.

OFFSET

GROUND ELEVATION

HOLE NO. B- 3a

	CASING	SAMPLER	CORE BARR
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC.
								1/2" Black Top			
							.25'	Concrete			
								REFER TO BORING B-3			
10											
20	20'to 21.5'	SS	2	1	2	Soft Wet		Grey Organic Silt and Seashells	1	1.5	.9
	25'to 26.5'	SS	1	?	1	Soft		Grey Clayey Silt, Trace Fine Gravel	2	1.5	12
30	30'to 31.5'	SS	2	3	3	Soft Wet		Grey Silty Fine Sand	3	1.5	1.
	35'to 36.5'	SS	8	6	12	M Comp Wet	35.0'		4	1.5	1.
							37.0'	Red Brown Fine Sand, Little Silt			
40											

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: f.d. f.d.

HELPER:

SOILS ENGINEER:

DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE: 61.5

Earth Boring Ft.

Rock Coring Ft.

HOLE NO.

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

5/73

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

G17

SHEET 2 of 2

DATE START 7/13/77
DATE FINISH 7/13/77
WEIGHT OF HAMMER 140 ~~300~~
HAMMER FALL 30" ~~24"~~

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/13/77	2:30 p.m.	6.0' Tidal

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CONN.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave
~~LINE & STA.~~ New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B-3a

	CASING	SAMPLER	CORE BARR
TYPE	HSA	SS	
SIZE I.D.	2¼"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC.
	40' to 41.5'	SS	14	22	16	Dense Wet		Red Brown F-C Sand and F-C Gravel,	5	1.5	1.
	45' to 46.5'	SS	16	18	20	Dense Wet		SAME AS SAMPLE # 5	6	1.5	1.
50	50' to 51.5'	SS	9	9	8	M.Comp Wet		Red Brown Fine Sand, Trace Silt	7	1.5	13
	55' to 56.5'	SS	8	6	12	M Comp Wet		SAME AS SAMPLE # 7	8	1.5	11
60	60' to 61.5'	SS	7	9	10	M.Comp Wet	61.5'	SAME AS SAMPLE # 8	9	1.5	12
70											
80											

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: J.d.
HELPER: f.d.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 61.5 Ft.
Rock Coring Ft.
HOLE NO.

5/73

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Seymour 888-3857

SUB-SURFACE SPECIALISTS • P. O. BOX 69, SEYMOUR, CONN.
SERVING: Connecticut, Massachusetts, Rhode Island, Vermont, Maine, New Hampshire, New York, New Jersey, Pennsylvania

Connecticut Test Borings, Inc.

PENETRATION RESISTANCE & SOIL PROPERTIES

Predominant sand and gravel COHESIONLESS SOILS		Predominant silt and clay COHESIVE SOILS		COMPRESSIVE
Blows per foot	Relative Density	Blows per foot	Consistency	Strength (qu*)
0 to 4	very loose	0 to 2	very soft	below .25
4 to 10	loose	2 to 4	soft	.25 to .50
10 to 30	medium	4 to 8	medium	.50 to 1.0
30 to 50	dense	8 to 15	stiff	1 to 2
over 50	very dense	15 to 30	very stiff	2 to 4
		over 30	hard	over 4

NOTES:
Above based on 2" O.D. sampler x 1-3/8" I.d. 140 Wt. x 30" Fall (qu*) = Tons per square Foot

STATE OF CONNECTICUT BASIC BUILDING CODE

TABLE 15. PRESUMPTIVE SURFACE BEARING VALUES OF FOUNDATION MATERIALS

	CLASS OF MATERIAL	Tons per Square Foot
1	Massive crystalline bed rock including granite, diorite, gneiss, trap rock hard limestone and dolomite.	100
2	Foliated rock including bedded limestone, schist and slate in sound condition.	40
3	Sedimentary rock including hardshales, sandstones, and thoroughly cemented conglomerates.	25
4	Soft or broken bed rock (excluding shale) and soft limestone.	10
5	Compacted, partially cemented gravels, sand and hardpan overlying rock.	10
6	Gravel and sand-gravel mixtures.	6
7	Loose gravel, hard dry clay, compact coarse sand, and soft shales.	4
8	Loose, coarse sand and sand-gravel mixtures and compact fine sand (confined).	3
9	Loose medium sand (confined), stiff clay.	2
10	Soft broken shale, soft clay.	1.5

(G13)

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

SHEET 1 of 1

DATE START	7/15/77
DATE FINISH	7/15/77
WEIGHT OF HAMMER	140 XX
HAMMER FALL	30" XX

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/15/77	0 HRS	DRY

SAMPLER O.D. 2" I.D. 1 3/8"

TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
City of New Haven, Conn.
Bureau of Engineering
200 Orange Street
New Haven, Ct.

PROJ. NO. 76-72-1 & 76-73-1

LOCATION Grand Ave.
~~LINE & STA.~~ New Haven, Ct.

OFFSET

GROUND ELEVATION

HOLE NO. B-4

	CASING	SAMPLER	CORE BAR
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
								CONCRETE			
							3.0'				
								REFUSAL ON HSA BOTTOM OF BORING 3.0'			
								NOTE: UNABLE TO OFFSET HOLE DUE TO UTILITIES			
10											
20											
30											
40											

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: A.F.
HELPER: R.H.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 3.0 Ft.
Rock Coring Ft.
HOLE NO.

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

5/73

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

(G19)

SHEET 1 of 2

DATE START 7/13/77
DATE FINISH 7/13/77
WEIGHT OF HAMMER 140 300
HAMMER FALL 30" 24

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/13/77	11:45 a.m.	9.0'

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG HYDRAULIC ROTARY

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CONN.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave.
LINE & STA. New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B-5

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	SS	
SIZE I.D.	2¼"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
							.42'	Black Top			
	5' to 6.5'	SS	3	3	7	M Comp		FILL	1	1.5	.8
							7.0'				
								Seashells, Some Silt, Some Sand			
10	10' to 11.5'	SS	2	1	1	Loose Wet			2	1.5	.3
	15' to 16.5'	SS	1	0	1	Loose Wet		SAME AS SAMPLE # 2	3	1.5	.2
20	20' to 21.5'	SS	2	2	3	Soft Wet		Gray Sandy Silt, Some Seashells	4	1.5	1.2
	25' to 26.5'	SS	2	2	2	Soft Wet		SAME AS SAMPLE # 4	5	1.5	1.
30	30' to 31.5'	SS	1	0	1	Soft Wet		Grey Organic Clayey Silt	6	1.5	1.
							33.0'				
	35' to 36.5'	SS	2	1	2	Loose Wet		Grey Brown C-F Sand, Some Organic Silt	7	1.5	1.
40											

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: J.J.
HELPER: F.d.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE 81.5
Earth Boring Ft.
Rock Coring Ft.
HOLE NO.

5/73

(G19)

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

SHEET 2 of 2

DATE START 7/13/77
DATE FINISH 7/13/77
WEIGHT OF HAMMER 140 300X
HAMMER FALL 30" X24"

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/13/77	11:45 a.m.	9.0'

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG HYDRAULIC ROTARY

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CT.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave.
LINE & STA. New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B- 5

	CASING	SAMPLER	CORE BAR
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	RE
	40' to 41.5'	SS	3	6	12	M Comp Wet		Grey Brown C-F Sand, Some Organic Silt	8	1.5	1.
	45' to 46.5'	SS	7	10	13	M Comp Wet		Grey Brown C-F Sand, Trace Organic Silt	9	1.5	1
10	50' to 51.5'	SS	6	5	6	M Comp		Red Brown Fine Sand, Trace Silt			
	55' to 56.5'	SS	5	6	7	M Comp Wet		Same as Above			
20	60' to 61.5'	SS	6	7	6	M. Comp Wet	60.0'	Same as Above			
								BOTTOM OF BORING 61.5'			
30											
40											

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: J.d.
HELPER: F.d.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE: 61.5
Earth Boring Ft.
Rock Coring Ft.
HOLE NO.

5/73

(G20)

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

SHEET 1 of 2

DATE START 7/14/77
DATE FINISH 7/14/77
WEIGHT OF HAMMER 140 300
HAMMER FALL 30" 24"

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/14/77	0 HRS	9.5'
		Tidal

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
city of new haven
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave.
LINE & STA. New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B-6

	CASING	SAMPLER	CORE BARR
TYPE	HSA	SS	
SIZE I.D.	2¼"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
								2" Asphalt			
							1.0'	Brown C-F Sand, Some C-F Gravel and Cobbles (fill)			
	5' to 6.5'	SS	9	6	5	M. Comp Dry		Red Brown Fine Sand, Trace Silt	1	1.5	.3
							8.0'				
10	10' to 11.5'	SS	2	2	2	Loose Wet		Red Brown C-F Sand, Some Silt, Trace Fine Gravel	2	1.5	.4
	15' to 16.5'	SS	2	2	3	Loose Wet	16.5'	Red Brown Fine Sand, Some Silt, Trace Seashells	3	1.5	.5
20	20' to 21.5'	SS	2	2	2	Soft Wet		Grey Organic Sandy Silt, Little Seashells	4	1.5	12
	25' to 26.5'	SS	3	3	3	Soft Wet		SAME AS SAMPLE # 4	5	1.5	12
30	30' to 31.5'	SS	3	3	2	Soft Wet		SAME AS SAMPLE # 5	6	1.5	13
	35' to 36.5'	SS	2	3	8	M. Comp Wet	36.0'		7	1.5	.6
								Grey C-F Sand			
40											

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: B.B.
HELPER: r.h.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 61.5' Ft.
Rock Coring Ft.
HOLE NO.

5/73

(G20)

SOIL SAMPLING LOG
CONNECTICUT TEST BORINGS, INC.
Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

SHEET 2 of 2

DATE START 7/14/77
DATE FINISH
WEIGHT OF HAMMER 140 300
HAMMER FALL 30" 24"

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/14/77	0 HRS	9.5'
		Tidal

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CONN.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave
LINE & STA. New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B-6

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	SS	
SIZE I.D.	2¼"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
	40' to 41.5'	SS	5	8	7	M.Comp Wet		Grey C-F Sand, Trace Silt, Fine Gravel	8	1.5	1.
	45' to 46.5'	SS	6	7	6	M.Comp Wet		SAME AS SAMPLE # 8	9	1.5	.3
50	50' to 51.5'	SS	8	5	7	M Comp Wet		SAME AS SAMPLE # 9	10	1.5	.
							54.0'				
	55' to 56.5'	SS	5	8	7	M.Comp Wet		Red Brown Fine Sand, Some Silt	11	1.5	.3
60	60' to 61.5'	SS	4	6	9	M.Comp Wet	61.5'	SAME AS SAMPLE # 11	12	1.5	.3
								BOTTOM OF BORING 61.5'			
70											
80											

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: G. S.
HELPER: r.h.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 61.5 Ft.
Rock Coring Ft.
HOLE NO.

5/73

G21

DATE START 7/14/77

DATE FINISH 7/14/77

WEIGHT OF HAMMER 140 X300

HAMMER FALL 30" X24"

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/14/77	1:45 p.m.	10.0'
		Tidal

SAMPLER O.D. 2" I.D. 1 3/8"

TYPE OF RIG Hydraulic Rotary

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists

P. O. Box 69

SEYMOUR, CONNECTICUT

(203) 888-3857

ESPECIALLY COMPILED FOR

CITY OF NEW HAVEN, CONN.

BUREAU OF ENGINEERING

200 ORANGE STREET

NEW HAVEN, CT.

SHEET 1 of 2

PROJ. NO. 76-72-1 &
76-73-1

LOCATION Grand Ave.

LINE & STA. New Haven, Ct.

OFFSET

GROUND ELEVATION

HOLE NO. B- 7

	CASING	SAMPLER	CORE BA
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	Blows per 6" on Sampler 0-6	6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	RE
								4" Black Top			
	5' to 6.5'	SS	13	9	2	M. Comp		Red Brown C-F Sand, Trace M-F Gravel, (fill)	1	1.5	.
							7.5'				
10	10' to 11.5'	SS	1	1	1	Soft Wet		Grey Brown Organic Silt and Seashells	2	1.5	1.
	15' to 16.5'	SS	7	1	2	Soft Wet		Grey Brown Organic Silt, Trace Seashells	3	1.5	12
20	20' to 21.5'	SS	3	3	2	Soft Wet		Grey Organic Silt, and Seashells, Little C-F Sand	4	1.5	1.
								GRADUALLY CHANGING TO			
	25' to 26.5'	SS	3	2	2	Loose Wet		Grey and Red Brown C-F Sand, Little F-M Gravel, Trace Organic Silt, Trace Wood	5	1.5	1.
30	30' to 31.5'	SS	12	10	5	M. Comp Wet		Same as Sample #5	6	1.5	1.
							33.0'				
	35' to 36.5'	SS	3	4	4	Loose Wet		Grey Brown Fine Sand, Trace Organic Silt, Trace Wood	7	1.5	1.
40											

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: C. C.
HELPER: M. K.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE 61.5
Earth Boring Ft.
Rock Coring Ft.
HOLE NO.

5/73

(G21)

SOIL SAMPLING LOG
CONNECTICUT TEST BORINGS, INC.
Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

SHEET 2 of 2

DATE START 7/14/77
DATE FINISH 7/14/77
WEIGHT OF HAMMER 140 300
HAMMER FALL 30" 24"

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/14/77	1:45 p.m.	10.0'

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CONN.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT.

PROJ. NO. 76-72-1 &
76-73-1
LOCATION Grand Ave.
LINE & STA. New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B- 7

	CASING	SAMPLER	CORE BARR
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC.
	40' to 41.5'	SS	4	4	4	Loose Wet		Red Brown Fine Sand, Trace Organic Silt, Trace Wood	8	1.5	1.
	45' to 46.5'	SS	3	4	4	Loose Wet		Red Brown Very Fine Sand, Trace Silt	9	1.5	1.
10	50' to 51.5'	SS	4	6	4	Loose Wet		SAME AS SAMPLE #9	10	1.5	1.
	55' to 56.5'	SS	5	5	5	Loose Wet		SLIPPED SAMPLE	11	1.5	0
20	60' to 61.5'	SS	6	4	6	Loose Wet	61.5'	Red Brown Fine Sand, Trace Silt	12	1.5	1.
								BOTTOM OF BORING 61.5'.			
30											
40											

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: g.w.
HELPER: m.h.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE 61.5
Earth Boring Ft.
Rock Coring Ft.
HOLE NO.

5/73

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

(G 22)

SHEET 1 of 3

DATE START 7/14/77
DATE FINISH 7/15/77
WEIGHT OF HAMMER 140 300X
HAMMER FALL 30" X24"X

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/14/77	3:00	11.0'

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
CITY OF NEW HAVEN, CONN.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT

PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave
LINE & STA. New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B- 8

	CASING	SAMPLER	CORE BAR
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	Blows 0-6	Blows 6-12	Blows 12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
						Very Dense	.42'	Black Top			
							2.5'	Cobbles			
	5' to 6.5'	SS	21	14	13	M. Comp		Sand, Silt, Seashells, Gravel	1	1.5	.5
10	10' to 11.5'	SS	4	2	2	Loose Wet		Same as Sample #1	2	1.5	.9
							12.0'				
	15' to 16.5'	SS	2	1	0	Soft Wet		Grey Silty F-C Sand, Some Seashells	3	1.5	1.
20	20' to 21.5'	SS	W	O	H	Soft Wet		SAME AS SAMPLE # 3	4	1.5	1.1
	25' to 26.5'	SS	1	0	1	Soft Wet		Same as Sample #4	5	1.5	
							29.0'				
30	30' to 31.5'	SS	7	5	3	Loose Wet		Red Brown Fine Sand, Trace Silt	6	1.5	1.
	35' to 36.5'	SS	2	2	4	Loose Wet		Same as Sample # 6	7	1.5	1.
40											

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: J. D.
HELPER: F. D.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 31.5 Ft.
Rock Coring Ft.
HOLE NO.

5/73

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists

P. O. Box 69

SEYMOUR, CONNECTICUT

(203) 888-3857

Gold

SHEET 2 of 3

DATE START 7/14/77

DATE FINISH 7/16/77

WEIGHT OF HAMMER 140 XXX

HAMMER FALL 30" XXX

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/14/77	3:00	11.0'

SAMPLER O.D. 2" I.D. 1 3/8"

TYPE OF RIG HYDRAULIC ROTARY

ESPECIALLY COMPILED FOR

CITY OF NEW HAVEN, CONN.
BUREAU OF ENGINEERING
200 ORANGE STREET
NEW HAVEN, CT

PROJ. NO. 76-72-1 & 76-73-1

LOCATION Grand Ave.

LINE & STA. New Haven, Ct.

OFFSET

GROUND ELEVATION

HOLE NO. B-8

	CASING	SAMPLER	CORE BAR
TYPE	HSA	SS	
SIZE I.D.	2¼"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
	40' to 41.5'	SS	4	4	4	Loose Wet		Red Brown Fine Sand, Trace Silt	8	1.5	1.
	45' to 46.5'	SS	5	4	5	Loose Wet		Red Brown Fine Sand, Some Silt	9	1.5	1.
10	50' to 51.5'	SS	5	6	7	M.Comp Wet		Red Brown Fine Sand, Little Silt	10	1.5	1.
	55' to 56.5'	SS	7	11	15	M.Comp Wet		SAME AS SAMPLE # 20	11	1.5	1.
20	60' to 61.5'	SS	10	11	13	M.Comp Wet		SAME AS SAMPLE # 11	12	1.5	1.
	65' to 66.5'	SS	5	7	9	M.Comp Wet		Red Brown Very Fine Sand, Little Silt	13	1.5	1.
30	70' to 71.5'	SS	6	7	8	M.Comp Wet		SAME AS SAMPLE # 13	14	1.5	1.
	75' to 76.5'	SS	8	7	7	M.Comp Wet		SAME AS SAMPLE # 14	15	1.5	1.
40											

NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: J. D.

HELPER: " D.

SOILS ENGINEER:

DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 81.5' Ft.
Rock Coring Ft.
HOLE NO.

5/73

SOIL SAMPLING LOG

CONNECTICUT TEST BORINGS, INC.

Sub-Surface Specialists
P. O. Box 69
SEYMOUR, CONNECTICUT
(203) 888-3857

(Gdd) SHEET 3 of 3

DATE START 7/14/77
DATE FINISH 7/15/77
WEIGHT OF HAMMER 140 300X
HAMMER FALL 30" X24"

GROUND WATER OBSERVATIONS

DATE	TIME	DEPTH
7/14/77	3:00	11.0'

SAMPLER O.D. 2" I.D. 1 3/8"
TYPE OF RIG Hydraulic Rotary

ESPECIALLY COMPILED FOR
City of New Haven, Conn.
Bureau of Engineering
200 Orange Street
New Haven, Ct.

PROJ. NO. 76-72-1 & 76-73-1
LOCATION Grand Ave.
LINE & STA. New Haven, Ct.
OFFSET
GROUND ELEVATION
HOLE NO. B-8

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	SS	
SIZE I.D.	2½"	1 3/8"	

Depth Below Surface	SAMPLE NO. DEPTHS ELEV. FT.	Type of Sample	BLOWS PER 6" ON SAMPLER From 0-6	To 6-12	12-18	DENSITY OR CONSIST. MOISTURE	PROFILE CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOILS REMARKS	SAMPLE NO.	PEN	REC
	80' to 81.5'	SS	7	7	7	M.Comp Wet	81.5'	Red Brown Very Fine Sand, Little Silt	16	1.5	1.
								BOTTOM OF BORING 81.5'			
10											
20											
30											
40											

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

DRILLER: J.D.
HELPER: T.D.
SOILS ENGINEER:
DRILLING INSPECTOR:

SAMPLE TYPE
C = CORED W = WASHED
SS = SPLIT SPOON
UP = UNDISTURBED PISTON
TP = TEST PIT
UT = UNDISTURBED THINWALL

COHESIONLESS DENSITY
0-10 LOOSE
10-30 MED. COMP.
30-50 DENSE
50+ VERY DENSE

TOTAL FOOTAGE:
Earth Boring 81.5 Ft.
Rock Coring Ft.
HOLE NO.

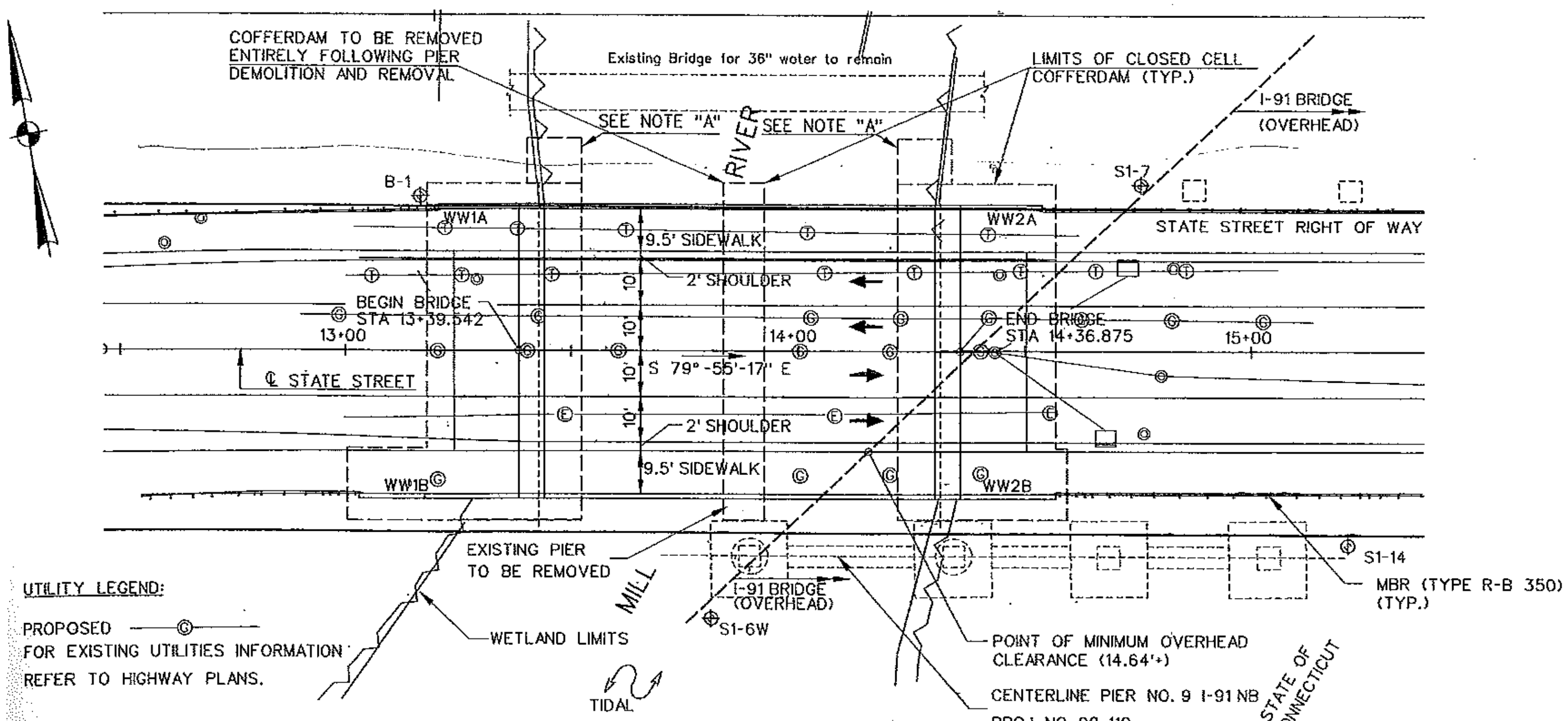
NOT RESPONSIBLE FOR SAMPLE STORAGE AFTER 30 DAYS

5/73

Reference Data Set No. 3

Reference Data Set No. 3

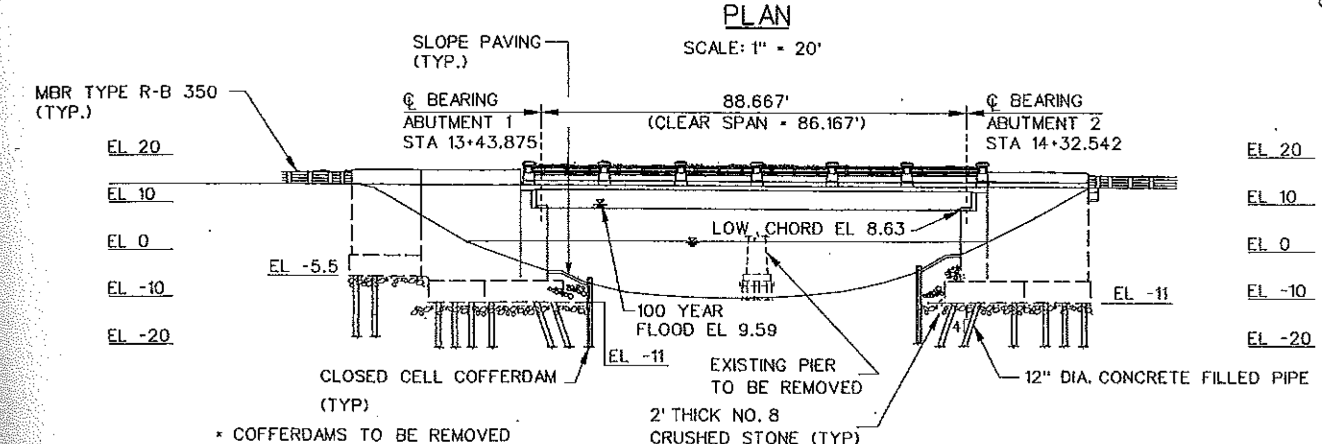
Subsurface soil conditions reportedly encountered during soil borings performed in 2002 for the construction of the existing State Street Bridge over the Mill River are summarized in the following site plan and soil boring logs.



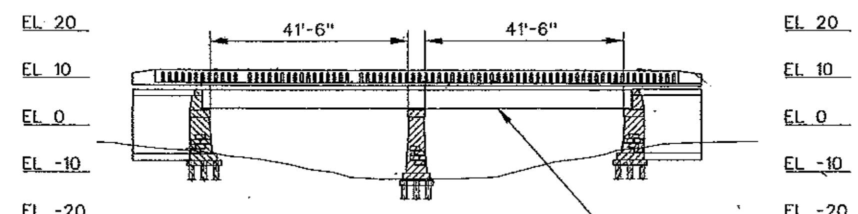
UTILITY LEGEND:

PROPOSED
FOR EXISTING UTILITIES INFORMATION REFER TO HIGHWAY PLANS.

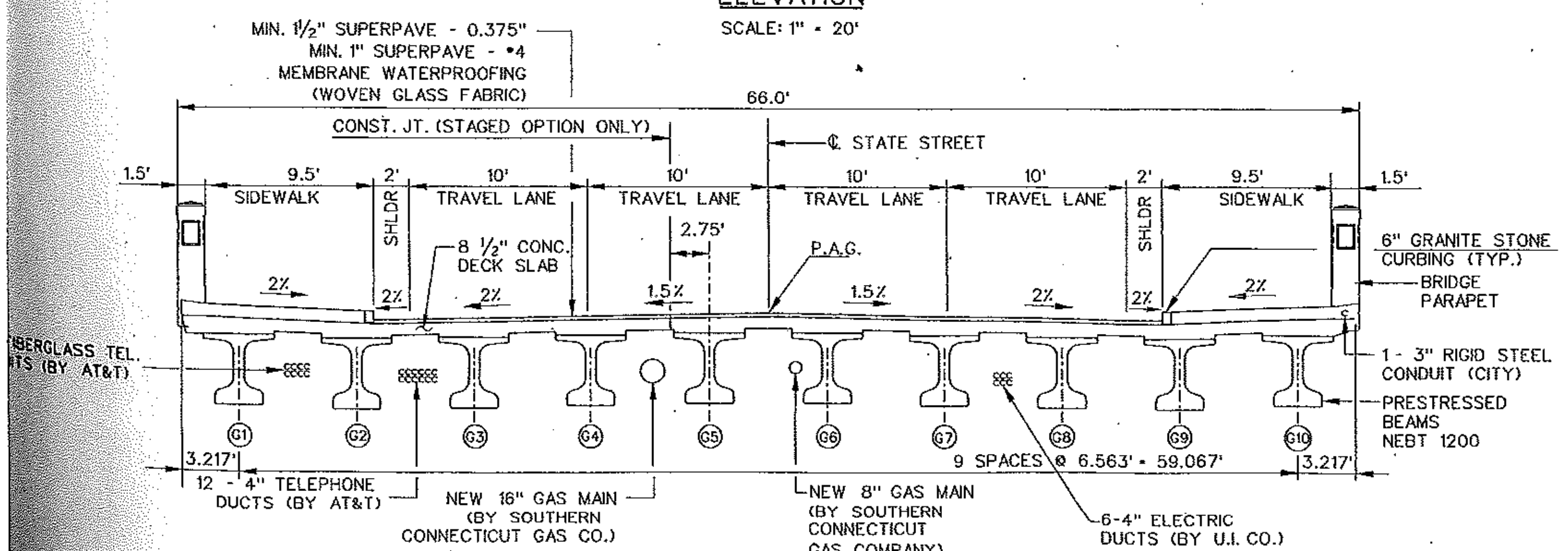
PLAN
SCALE: 1" = 20'



ELEVATION
SCALE: 1" = 20'



EXISTING STATE ST. BRIDGE ELEVATION
SCALE: 1" = 20'



TYPICAL BRIDGE CROSS SECTION
(LOOKING UPSTATION)

SCALE: 3/16" = 1'-0"

NOTE "A"
THE EXISTING WALL (WW-2A) AND SLOPE PAVING (WW-1A) BEYOND THE LIMITS OF COFFERDAM SHALL BE REMOVED AND RECONSTRUCTED IN ACCORDANCE WITH THE DETAILS SHOWN ON SHEET S-10 & S-11. THE DETAILS OF WALL SLOPE PAVING WITHIN THE COFFERDAM IS AS SHOWN ON THE WINGWALL ELEVATIONS AND OTHER DETAILS WHICH ARE LOCATED ON SHEET S-10.

HYDRAULIC DATA	
MEAN LOW WATER	-2.4 (FT)
MEAN HIGH WATER	+3.8 (FT)
HIGH TIDE LINE (1-YR. TIDE)	+4.2 (FT)
5-YEAR TIDE	+7.2(FT)
10-YEAR TIDE	8.6 (FT)
100-YEAR TIDE	10.5 (FT)
DESIGN FREQUENCY/EVENT	10-YR.TIDAL/100-YR. RIVERINE
DESIGN DISCHARGE	4365 (cfs)
DESIGN WATER SURFACE ELEVATION - AT UPSTREAM FACE OF BRIDGE	9.59 (FT)
MAXIMUM SCOUR ELEVATION	-9.5 (FT)
FREQUENCY/EVENT DISCHARGE	10YR. TIDAL/500-YR. RIVERINE 6800 (cfs)
WORST CASE SCOUR SUB-STRUCTURE UNIT	ABUTMENT #2

COORDINATES		
STATION	NORTHING	EASTING
13+00.000	176060.576	557066.236
15+00.000	176025.576	557263.149

CONCRETE DISTRIBUTION		
SUPERSTRUCTURE	CY	419
SUBSTRUCTURE	CY	625
FOOTINGS	CY	530
TOTAL	CY	1574

INSPECTION OF FIELD WELD		
METHOD	UNIT	QUANTITY
ULTRASONIC	IN	0
MAGNETIC PARTICLE	FEET	0

TRANSPORTATION DIMENSIONS AND MASS				
MEMBER	SHIPPING LENGTH	SHIPPING HEIGHT	SHIPPING WIDTH	SHIPPING MASS
G1 THRU G10	91 FEET	4 FEET	4 FEET	38 TONS

NOTE TO BRIDGE INSPECTORS

BRIDGE SAFETY PROCEDURES REQUIRE THIS BRIDGE TO BE INSPECTED FOR, BUT NOT LIMITED TO, ALL APPROPRIATE COMPONENTS INDICATED IN THE GOVERNING MANUALS FOR BRIDGE INSPECTION. ATTENTION MUST BE GIVEN TO INSPECTING THE FOLLOWING SPECIAL COMPONENTS AND DETAILS. (THE LISTING OF COMPONENTS FOR SPECIFIC ATTENTION SHALL NOT BE CONSTRUED TO REDUCE THE IMPORTANCE OF INSPECTION OF ANY OTHER COMPONENT OF THE STRUCTURE). THE FREQUENCY OF INSPECTION OF THIS STRUCTURE SHALL BE IN ACCORDANCE WITH THE GOVERNING MANUALS FOR BRIDGE INSPECTION, UNLESS OTHERWISE DIRECTED BY THE MANAGER OF THE CITY.

COMPONENT OR DETAILS	BRIDGE SHEET REFERENCE
FOLLOW NORMAL INSPECTION PROCEDURE	

DESIGNER: N. VYAS /RL

STATE OF CONNECTICUT

PROJECT TITLE: REPLACEMENT OF

TOWN: NEW HAVEN

PROJECT NO.: 92-561

HOLE B-1
STATE STREET ℄ STA 13+16
OFFSET = 34 FEET LEFT

CLARENCE WELTI ASSOC., INC. P.O. BOX 397 GLASTONBURY, CONN 06033	CLIENT DTC	PROJECT NAME: STATE STREET BRIDGE OVER MILL RIVER LOCATION: NEW HAVEN, CT

	AUGER	CASING	SAMPLER	CORE BAR.
TYPE	HSA		SS	
SIZE I.D.	3.75"		1.5"	
HAMMER WT.			140lbs	
HAMMER FALL			30"	

OFFSET
LINE & STA.
N. COORDINATE
E. COORDINATE

SURFACE ELEV. 12 | HOLE NO. B-1

GROUND WATER OBSERVATIONS: AT 13.0FT. AFTER 0 HOURS; AT FT. AFTER HOURS

START DATE 11/18/02 | FINISH DATE 11/18/02

SAMPLE NO.	BLOWS/6"	DEPTH
1	3-4-20	5.00'-6.50'
2	6-8-8	10.00'-11.50'
3	2-1-2	15.00'-16.50'
4	1-2-1	20.00'-21.50'
5	1-1-1	25.00'-26.50'
6	2-6-9	30.00'-31.50'

STRATUM DESCRIPTION + REMARKS	
BLACK FINE-MED. SAND, LITTLE SILT	1.0
RED/BR. FINE-MED. SAND, SOME FINE-CRS. GRAVEL-FILL	8.0
RED/BR. FINE-CRS. SAND, LITTLE FINE-CRS. GRAVEL-FILL	18.0
GRAY ORGANIC SILT	27.0
RED/BR. FINE-CRS. SAND, LITTLE FINE GRAVEL, TRACE SILT	

DEPTH: 0, 5, 10, 15, 20, 25, 30, 35
ELEV.: 10, 5, 0, -5, -10, -15, -20

LEGEND: COL. A:
SAMPLE TYPE:D-DRY A-AUGER C-CORE U-UNDISTURBED PISTON S-SPLIT SPOON
PROPORTIONS USED:TRACE-0-10% LITTLE-10-20% SOME-20-35% AND-35-50%

DRILLER: BROMLEY
INSPECTOR:

SHEET 1 OF 3 | HOLE NO. B-1

HOLE B-1 (CONT.)
STATE STREET ℄ STA 13+16
OFFSET = 34 FEET LEFT

CLARENCE WELTI ASSOC., INC. P.O. BOX 397 GLASTONBURY, CONN 06033	CLIENT DTC	PROJECT NAME: STATE STREET BRIDGE OVER MILL RIVER LOCATION: NEW HAVEN, CT

SAMPLE NO.	BLOWS/6"	DEPTH
7	11-12-13	35.00'-36.50'
8	12-13-12	40.00'-41.50'
9	11-12-14	45.00'-46.50'
10	10-11-13	50.00'-51.50'
11	21-14-15	55.00'-56.50'
12	10-9-11	60.00'-61.50'
13	13-12-12	65.00'-66.50'
14	16-22-21	70.00'-71.50'

STRATUM DESCRIPTION + REMARKS	
	45.0
RED/BR. STRATIFIED FINE-CRS.SAND,LITTLE FINE-MED. GRAVEL,TRACE SILT	

DEPTH: 40, 45, 50, 55, 60, 65, 70, 75
ELEV.: -25, -30, -35, -40, -45, -50, -55, -60

LEGEND: COL. A:
SAMPLE TYPE:D-DRY A-AUGER C-CORE U-UNDISTURBED PISTON S-SPLIT SPOON
PROPORTIONS USED:TRACE-0-10% LITTLE-10-20% SOME-20-35% AND-35-50%

DRILLER: BROMLEY
INSPECTOR:

SHEET 2 OF 3 | HOLE NO. B-1

HOLE B-1 (CONT.)
STATE STREET ℄ STA 13+16
OFFSET = 34 FEET LEFT

CLARENCE WELTI ASSOC., INC. P.O. BOX 397 GLASTONBURY, CONN 06033	CLIENT DTC	PROJECT NAME: STATE STREET BRIDGE OVER MILL RIVER LOCATION: NEW HAVEN, CT

SAMPLE NO.	BLOWS/6"	DEPTH
15	13-10-8	75.00'-76.50'
16	11-9-8	80.00'-81.50'
17	12-11-13	85.00'-86.50'
18	18-14-17	90.00'-91.50'
19	17-12-11	95.00'-96.50'
20	15-13-15	100.00'-101.50

STRATUM DESCRIPTION + REMARKS	
	101.5
BOTTOM OF BORING @ 101.5'	

DEPTH: 80, 85, 90, 95, 100, 105, 110, 115
ELEV.: -65, -70, -75, -80, -85, -90, -95, -100

LEGEND: COL. A:
SAMPLE TYPE:D-DRY A-AUGER C-CORE U-UNDISTURBED PISTON S-SPLIT SPOON
PROPORTIONS USED:TRACE-0-10% LITTLE-10-20% SOME-20-35% AND-35-50%

DRILLER: BROMLEY
INSPECTOR:

SHEET 3 OF 3 | HOLE NO. B-1

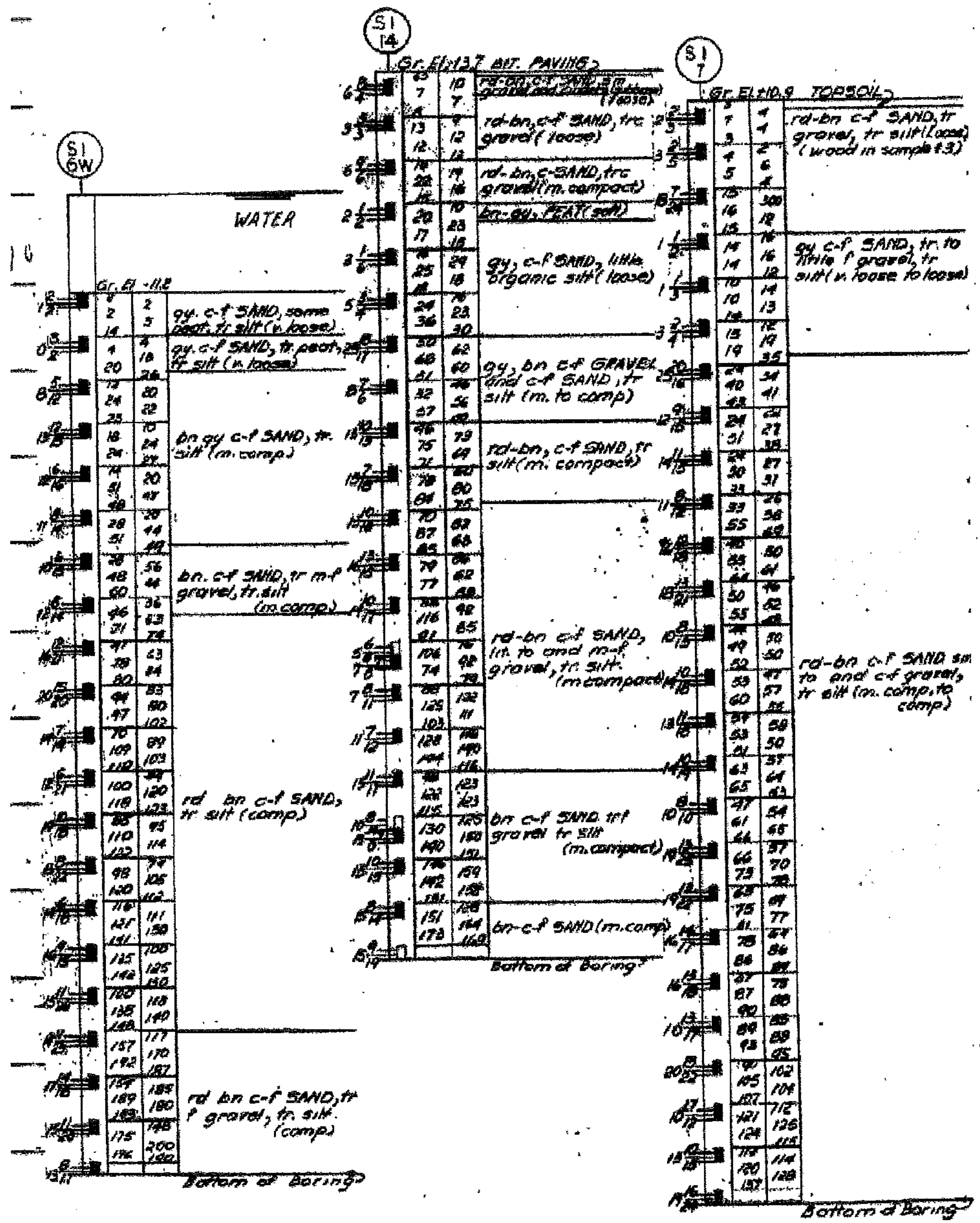
BORING B-1 COORDINATES
N. COORDINATE: N176091.248
E. COORDINATE: E557087.942

DESIGNER: C. WELTI | STATE OF CONNECTICUT | PROJECT TITLE: REPLACEMENT OF | TOWN: NEW HAVEN | PROJECT NO.: 92-561

Reference Data Set No. 4

Reference Data Set No. 4

Subsurface soil conditions reportedly encountered during soil borings performed in circa 1962 for the construction of the existing Interstate Route 91 Viaduct (Northbound) over the Mill River are summarized in the following site plans and soil boring logs.



BORING LOGS FROM
EXISTING I-91 NB VIADUCT OVER MILL RIVER
STATE PROJECT 92-110, 1962

DESIGNER: C. WELTI	STATE OF CONNECTICUT	PROJECT TITLE: REPLACEMENT OF	TOWN: NEW HAVEN	PROJECT NO.: 92-561

Appendix C
Photographs

<u>Photo No. 1:</u>
Riprap shoreline along Criscuolo Park,
looking east, photo taken on April 14, 2016.

<u>Photo No. 2:</u>
Natural shoreline along York Hill Trap Quarry Co.,
looking west, photo taken on April 14, 2016.

Photo No. 3:
Bulkhead for United Illuminating Utility Pole,
looking south, photo taken on March 18, 2016.

Photo No. 4:
Chapel Street Bridge, looking south,
photo taken March 18, 2016.

Photo No. 5:
Chapel Street stone masonry seawall, looking north,
photo taken April 14, 2016.

Photo No. 6:
Fixed timber pier along 299 Chapel Street, looking southeast,
photo taken March 18, 2016.

Photo No. 7:
Stone/concrete masonry seawall and fixer timber pier along Saltonstall Ave, looking south, photo taken March 18, 2016.

Photo No. 8:
Stone masonry seawall along Hillard Bloom Shellfish, Inc., looking north, photo taken March 18, 2016.

Photo No. 9:
Stone masonry seawall along Hillard Bloom Shellfish, Inc., looking south, photo taken March 18, 2016.

Photo No. 10:
Steel sheet pile bulkhead along New NRB #3 Corp., looking northeast, photo taken April 14, 2016.

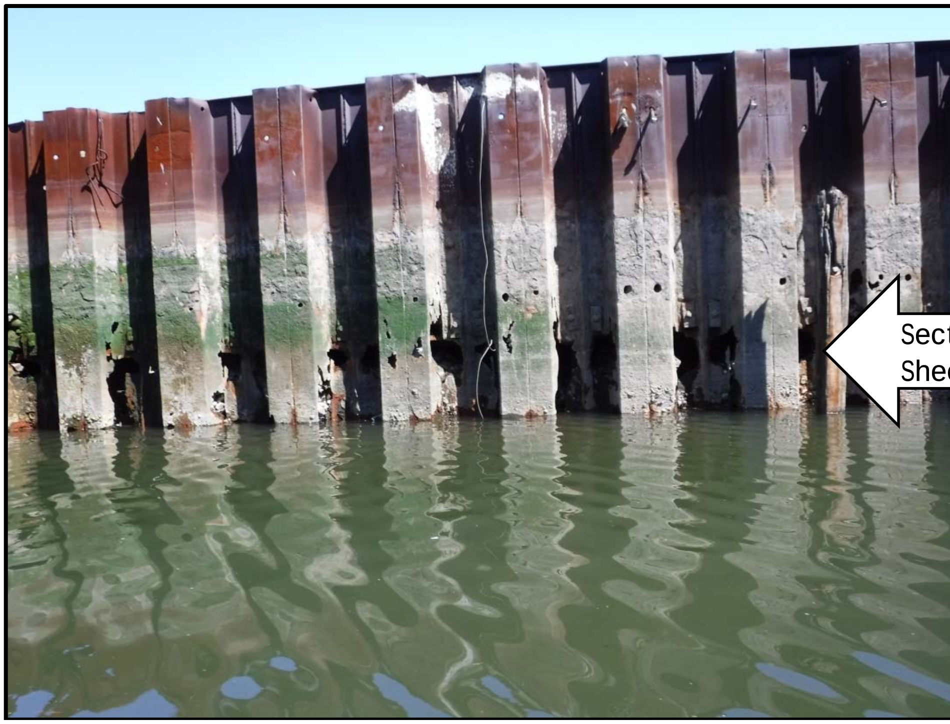


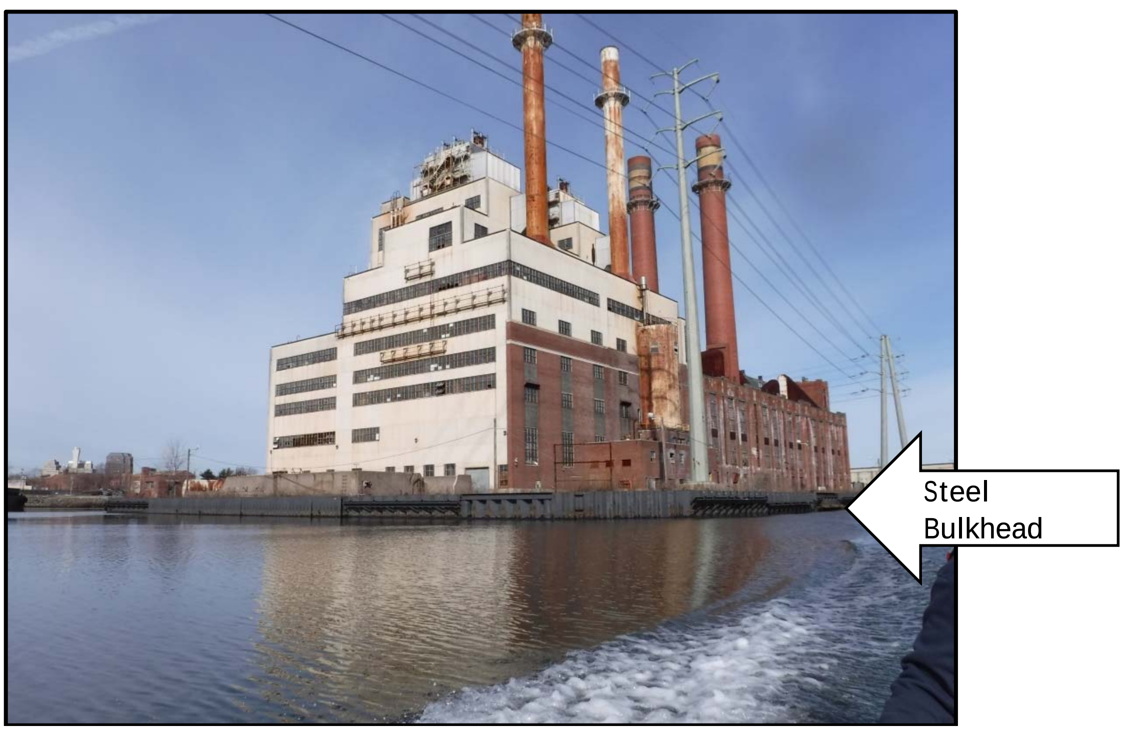
Photo No. 11:
Steel sheet pile bulkhead along Gateway Terminal,
looking east, photo taken April 14, 2016.

Photo No. 12:
Steel sheet pile bulkhead along Gateway Terminal,
looking north, photo taken January 8, 2016.

Photo No. 13:
Steel sheet pile bulkhead along Gateway Terminal,
looking northwest, photo taken January 8, 2016.

Photo No. 14:
Failed timber sheet pile bulkhead along Gateway Terminal,
looking northeast, photo taken April 14, 2016.

<u>Photo No. 15:</u>
Stone masonry seawall along the Powerhouse Building, looking northeast, photo taken April 14, 2016.



<u>Photo No. 16:</u>
Steel bulkhead along Ball Island south of Grand Avenue, looking northwest, photo taken February 19, 2016.

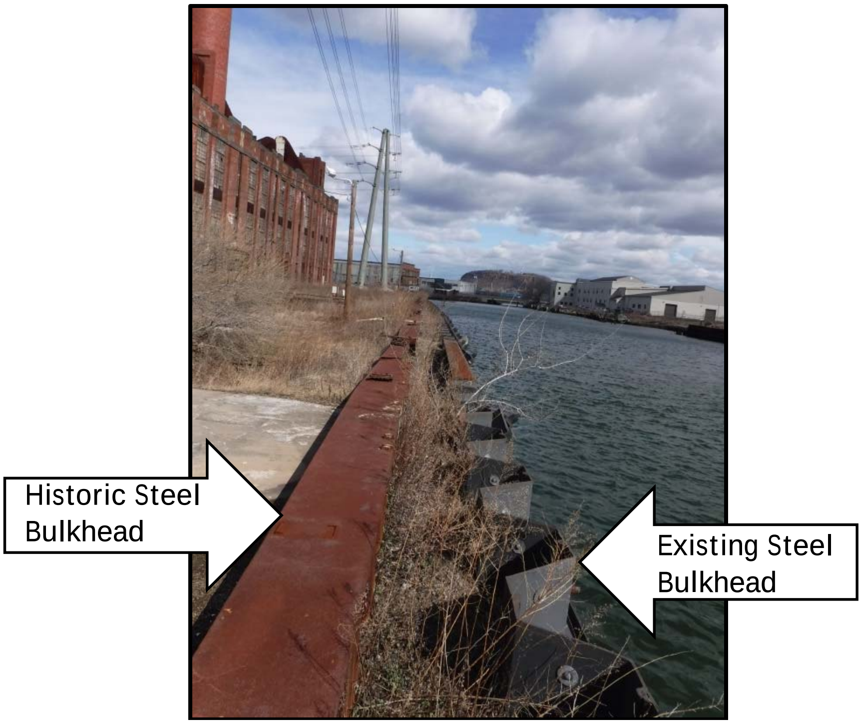


Photo No. 17:
Historic and existing bulkheads along Ball Island, looking north,
photo taken March 18, 2016.

Photo No. 18:
Stone masonry seawall along Gateway Terminal, looking southwest,
photo taken April 14, 2016.

Photo No. 19:
Stone masonry seawall supported by timber decking along Gateway Terminal, looking southwest, photo taken March 18, 2016.

Photo No. 20:
Natural shoreline with riprap at top along former Simkins, looking southwest, photo taken April 14, 2016.

Photo No. 21:
Steel sheet pile bulkhead along UL Grand Avenue Substation,
looking northwest, photo taken April 14, 2016.

Photo No. 22:
Section loss in steel sheet pile bulkhead along UL Grand Avenue Substation,
looking northwest, photo taken April 14, 2016.

<u>Photo No. 23:</u>
Grand Avenue Bridge over the East Branch of the Mill River, looking west, photo taken March 18, 2016.

<u>Photo No. 24:</u>
Grand Avenue stone masonry seawall, looking northwest, photo taken April 14, 2016.

Photo No. 25:
Grand Avenue Bridge over the West Branch of the Mill River, looking west,
photo taken February 19, 2016.

Photo No. 26:
Shoreline along Radiall, looking west,
photo taken March 18, 2016.

Photo No. 27:
Remnants of a timber bulkhead along Radiall, looking north, photo taken February 4, 2016.

Photo No. 28:
Shoreline along east side of Ball Island and north of Grand Avenue, looking west, photo taken February 4, 2016.

<u>Photo No. 29:</u>
Shoreline along west side of Ball Island and north of Grand Avenue, looking southeast, photo taken February 19, 2016.

<u>Photo No. 30:</u>
Timber bulkhead with riprap at toe along former St. Gobain, looking southwest, photo taken February 19, 2016.

Photo No. 31:
Shoreline along former St. Gobain, looking northwest,
photo taken April 14, 2016.

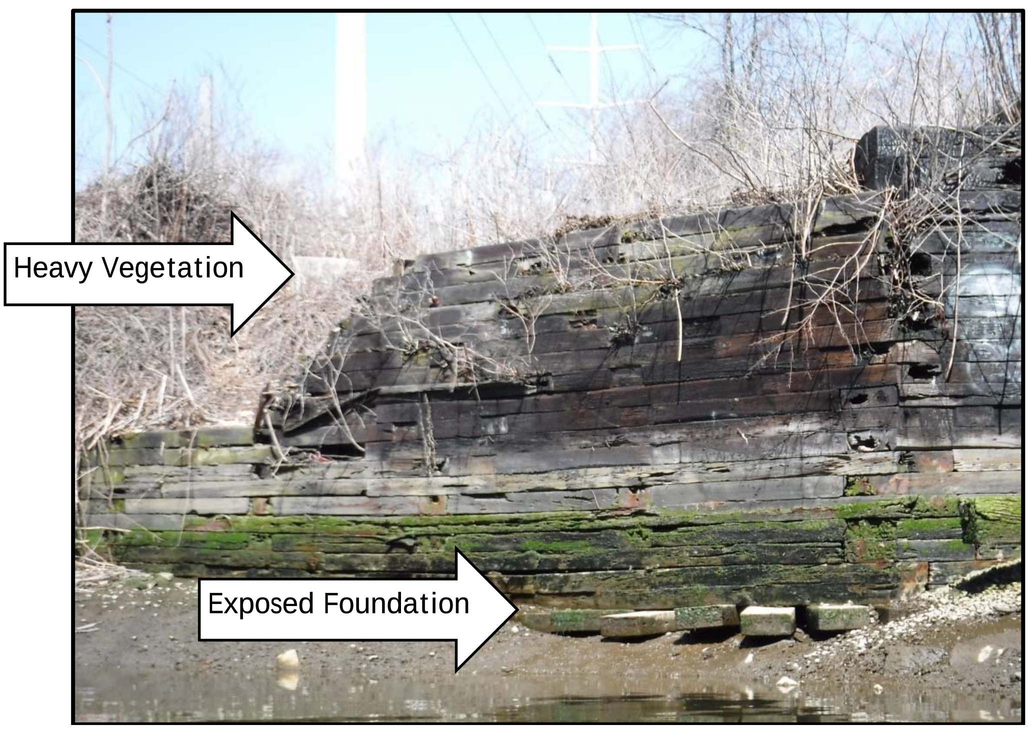
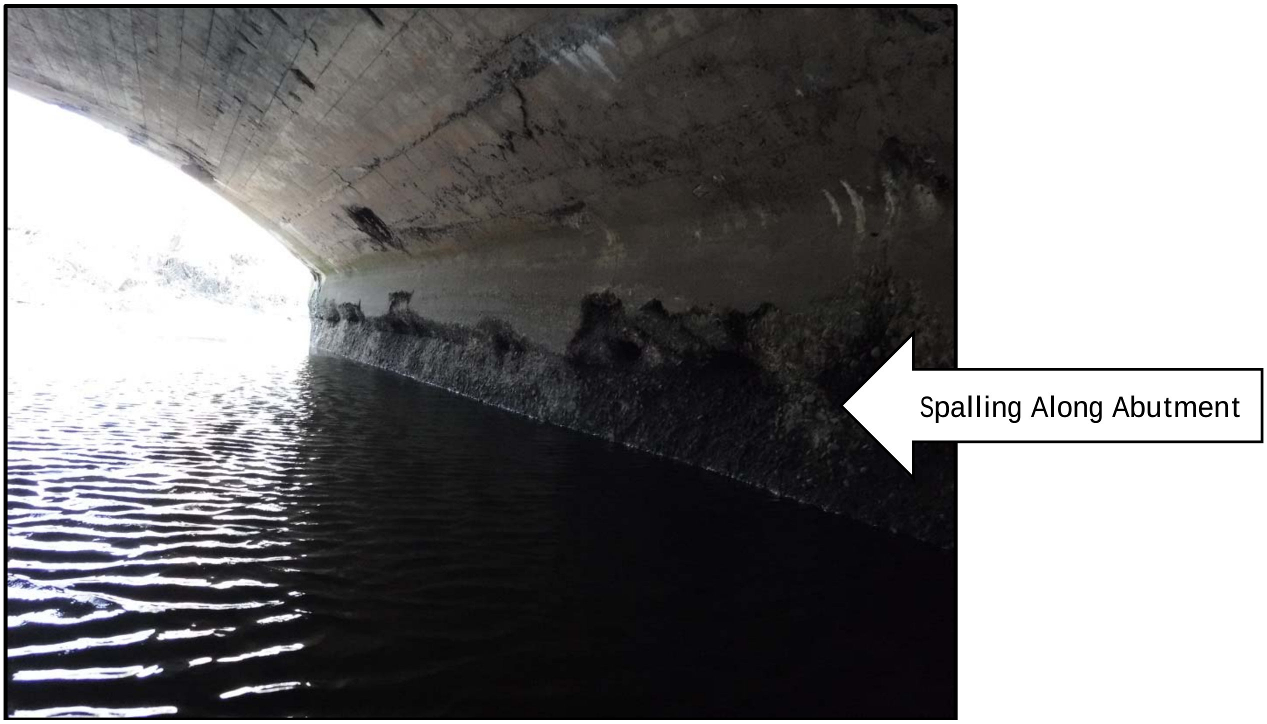


Photo No. 32:
East timber abutment of abandoned rail crossing, looking east,
photo taken April 14, 2016.

Photo No. 33:
West timber abutment of abandoned rail crossing, looking northwest, photo taken February 19, 2016.

Photo No. 34:
Stone masonry seawall between the abandoned and active rail crossings, looking west, photo taken April 14, 2016.



<u>Photo No. 35:</u>
West abutment of the active rail crossing over the Mill River, looking south, photo taken April 14, 2016.

<u>Photo No. 36:</u>
Earthen embankment along rail corridor, looking northeast, photo taken April 14, 2016.

Photo No. 37:
Shoreline along 470 James Street, looking southeast,
photo taken April 14, 2016.

Photo No. 38:
Shoreline along Elizabeth Browning and Hillcrest Properties, LLC,
looking southwest, photo taken April 14, 2016.

Photo No. 39:
Dumped riprap along Interstate 91, looking northwest,
photo taken April 14, 2016.

Photo No. 40:
Humphrey Street Bridge and Utility Bridge over the Mill River,
looking southeast, photo taken April 14, 2016.

Appendix D
Coastal Flooding Analysis

May 13, 2016

Mr. David Arpin, P.E.
RT Group, Inc.
458 Grand Avenue, Suite 213
New Haven, CT 06513

RE: Coastal Flooding Analysis Report
Mill River District Shoreline Analysis
City of New Haven
New Haven, CT
RTG Project No. 15103.00

Dear David:

In accordance with our Agreement, Whitecap Engineering, LLC (WCE) is pleased to present the results of its Coastal Flooding Analysis for the Mill River District (the District). As part of this project, WCE completed the following Tasks:

1. Performed a review of available past storm data;
2. Performed wave modeling to establish the design waves for the District;
3. Performed a Coastal Flooding Analysis of the District and compared the results to the existing FEMA FIRM Panels; and
4. Determined the minimum recommended flood protection improvements elevations (not including sea-level rise or freeboard).

A summary of the above completed Tasks is provided below.

Review of Past Storm Data

To help verify the design input data for the Coastal Flooding Analysis, WCE performed a review of storm surge, wave, and wind data recorded during past significant storm events. While none of the storm data obtained occurred during an event considered to be equal to or greater than the 100-year design storm, this data was still considered useful from a comparison standpoint (i.e., direct scaling) to verify that reasonable assumptions were being made in regard to the input for the Coastal Flooding Analysis. The past data reviewed included water elevations in and around the District and wave and wind data located offshore in Long Island Sound. This data is summarized below.

Storm Surge

The National Oceanic and Atmospheric Administration (NOAA) maintains a water level gauge located in New Haven Harbor that was established in August 1999. The maximum water level elevations during Hurricanes Irene and Sandy (i.e., the most significant storm events since the gauge was established) were obtained from this gauge and compared to those interpreted from the flood accounts provided by the District property owners during these storms. In addition, this data was compared to the stillwater elevations provided in the most current

FEMA Flood Insurance Study (FIS) for the area. Upon review of the data, there appears to be good correlation between all sources, as shown in Table 1.

TABLE 1
Storm Surge Comparison

	FEMA FIS 100-Year Storm Still Water Elevation (feet)[1]	FEMA FIS 100-Year Storm Total Water Elevation (feet)[1,2]	Approx. Water Level during Hurricane Irene, August 28, 2011 (feet)[1]	Approx. Water Level During Hurricane Sandy, Oct 30, 2012 (feet)[1]
New Haven Harbor	8.9[3]	12.5[3]	8.0[4]	8.7[4]
Radiall	- -	- -	7.0 - 8.0[5]	7.0 - 8.0[5]
67 Mill River St.	- -	- -	- -	7.0[5]

Footnotes:
1. The elevation provided is in reference to NAVD 88.
2. The Total Water Elevation includes the Still Water Level, the wave setup, and the wave runup.
3. The elevation provided was obtained from Transect 21 in FEMA FIS 09009CV001C, revised October 16, 2013.
4. The elevation provided was obtained from water level data from NOAA Station 8465705 measured in Mean Sea Level with datum conversions referencing NOAA Tide Station #8467150 located in Bridgeport, CT.
5. The approximate elevation provided was determined by correlating flooding accounts from property owners within the District to the topographic data at that property.

Wave Data

The University Of Connecticut Department Of Marine Sciences owns and maintains a buoy located in Central Long Island Sound. The buoy has recorded site elevation, air temperature, wind speed, sea temperature, and water depth data fairly consistently since February 2004. Review of the available data from 2004 through 2015 indicates that the maximum wave heights occurred on December 27, 2012 during a nor’easter referred to as the “Christmas Storm”. For comparison, wind and wave data during Hurricanes Irene and Sandy were also obtained from this buoy and this data is summarized in Table 2.

TABLE 2 Central Long Island Sound Relevant Buoy Data						
Date	**Time (hr:min)**	**Wind Direction (degrees)**	**Wind Speed (MPH)**	**Wind Gust (MPH)**	**Wave Height (feet)**	**Wave Period (sec)**
Christmas Storm						
12-27-2012	6:30	90	44	56	9.8	7
12-27-2012	7:00	90	41	51	10.2	8
Hurricane Sandy						
10-30-2012	17:45	50	41	53	7.2	6
10-30-2012	18:30	50	41	53	7.2	7
Hurricane Irene						
8-29-2011	01:00	250	36.9	51.9	9.2	7
8-29-2011	01:15	260	38.0	51.9	9.2	7

Note:
1. The above data was taken from Central Long Island Sound – Buoy Station #44039 with data ranging from 2004 to 2015.

Wave Modeling

In order to perform the Coastal Flooding Analysis, data representative of the wave climate within the District was first required. This data included the geometry of the coastal features in and around New Haven Harbor, as well as geostrophic wind conditions representative of the area. Using this data, two representative design waves were generated: (1) a deep water *duration limited* wave and (2) a deep water *fetch limited* wave. The development of these theoretical design waves is discussed in more detail below.

Design Wave Determination

Both the deep water *duration* and *fetch limited* design waves were determined using the US Army Corps of Engineers' (USACE's) Automated Coastal Engineering Software (ACES). Fetch distances were required for input into ACES to determine the characteristics of both waves and were generated from a single nodal point located just south of the District, with measurements taken in 5 degree increments (Exhibit 1).

For the deep water *duration limited* design wave determination, a geostrophic wind speed and wind duration of 105 MPH and 1 hour were used, respectively. These design input values have been acceptable to FEMA in the past for determining new flood maps and flood zones.

For the deep water *fetch limited* design wave determination, a geostrophic wind speed and wind duration of 105 MPH and 3 hours were used, respectively. The 3 hour duration is longer than what is typically required by FEMA and is assumed to be conservative. However, this provides that the resultant wave is *fetch limited* (as opposed to duration limited) and that the maximum possible wave height and period is calculated.

For comparison purposes, an additional wave was determined by back-calculating wave characteristics from the 100-year design flood and stillwater elevations, as determined from the current FEMA Flood Insurance Rate Map (FIRM) and FIS for the area, respectively. The characteristics from the design waves, the FEMA FIRM/FIS wave, and the past wave data obtained during Hurricanes Irene and Sandy and the Christmas Storm are provided in Table 3.

TABLE 3
Wave Characteristics

Wave	Wave Period (seconds)	Wind Direction (degrees)	Offshore Wave Height (feet)	Offshore Wavelength (feet)	Breaking Height (feet)	Breaking Wavelength (feet)
Deep Water Fetch Limited	7.0	182	12.5	250	13.3	152
Deep Water Duration Limited	4.8	182	6.2	118	6.5	73
FEMA FIRM/FIS[1]	6.2 ±	182 ±	9.3 ±	197 ±	10.1 ±	115 ±
Christmas Storm 2012[2]	8.0	90	10.2	325	12.4	170
Hurricane Sandy[2]	7.0	50	7.2	250	8.8	125
Hurricane Irene[2]	7.0	260	9.2	248	10.8	137

Footnotes:
1. Deepwater wave conditions were generated using an iterative approach with ACES and are representative of the deepwater conditions that would produce breaking wave conditions that would satisfy the data provided in the FEMA FIRM and FIS.
2. Wave transformations are based on linear wave theory.

Design Wave Comparison

Based on Table 3, the two design waves show good correlation with the FEMA FIRM/FIS and past recorded storm wave characteristics. As a general comparison, the magnitude of the FEMA FIRM/FIS wave characteristics is between the two design waves. In reviewing the past recorded storm wave characteristics, it is interesting to note that these waves have significantly higher heights and periods than the deep water *duration limited* design wave. This can be attributed to the direction of the wind which created the waves and the corresponding fetch distances. For all three past storms, the winds were generally orientated east-west (i.e., 45 mile ± fetch distance from the Central Long Island Sound Buoy); while the deep water *duration limited* design wave considers wind direction almost due South (i.e., 23 mile ± fetch distance from New Haven Harbor). Accordingly, the duration limited design wave and period is significantly smaller than the recorded storm waves due to the shorter distance over which the wave energy can develop.

Coastal Flooding Analysis

The Coastal Flooding Analysis was performed utilizing FEMA's Coastal Hazard Analysis Modeling Program (CHAMP). The program considered the design waves discussed above, the FEMA FIS water levels for the area, and the topographic/bathymetric features of the District. Using this data, the CHAMP Model calculated flood boundaries and base flood elevations throughout the District. These boundaries were then compared with those provided in the FEMA FIRM. The Coastal Flooding Analysis is discussed in more detail below.

CHAMP Model Input

Based on their correlation with the back-calculated FEMA FIRM/FIS wave and design guidance from FEMA, the design waves were considered practical and were used in the Coastal Flooding Analysis. Three (3) representative transects extending throughout the length of the Study Area (Exhibit 2) were generated utilizing topographic and bathymetric data obtained previously by RT Group, Inc. (RTG) as part of this project. These transects were then imported into CHAMP as individual flooding cases.

The design waves and Total Water Level (TWL) for the 100-year storm were applied to each transect in the CHAMP Model. The TWL is comprised of three components: (1) the Still Water Level, (2) the wave setup, and (3) wave runup. For these cases, the Total Water Level (FIS Transect 21 Elevation 12.5 feet) was divided into the Still Water Level (FIS Transect 21 Elevation 8.9 feet), average wave runup (0.5 feet of runup calculated with a 1.0 foot wave in a Non-Coastal A Flood Zone, deep water duration limited wave period of 4.8 seconds, and nearshore slope of 1:25), and wave setup (remaining 3.1 feet) (all elevations in this letter are referenced to NAVD 88 unless noted otherwise).

CHAMP Model Results

The results of the CHAMP Model for the three representative transects are presented in Exhibits 3 through 5. The FEMA FIRM Panel flood zones and base flood elevations are also shown on these Exhibits for comparison. In general, the results of the CHAMP Model are in agreement with the FEMA FIRM Panels for the District.

Deep Water Duration Limited Design Wave

The deep water *duration limited* case most closely matched the existing FIRM. These results are expected as the deep water duration limited case is based on a 100-year storm for this area, similar to the FEMA FIRM. This independent confirmation of the FIRM provides a high confidence level in both flood modeling efforts.

For the west transect (Exhibit 3), both the CHAMP Model and the FEMA FIRM Panels indicate the maximum wave crest height at the shoreline of New Haven Harbor of El. 16 feet (i.e., VE EL. 16 Flood Zone). Progressing landward (i.e., north), the FEMA FIRM Panels maintain an AE El. 13 Flood Zone while the CHAMP Model is slightly lower at an AE El. 12 Flood Zone. Between about Sta. 20+00 ± and 27+00 ±, both models show intermittent X Flood Zones in different locations. This is due to the varying locations of the salt piles within the Gateway Terminal property at the time the CHAMP Model and FIRM Panels were completed. Progressing further landward, both the CHAMP Model and FEMA FIRM Panels indicate an AE El. 12 Flood Zone.

Similar to the west transect, the CHAMP Model for the middle transect (Exhibits 4A and 4B) indicates a maximum wave crest of El. 16 feet (i.e., VE El. 16 Flood Zone) along the shoreline of New Haven Harbor. Progressing landward (i.e., north), the CHAMP Model and FEMA FIRM Panels coincide relatively well with respect to the locations of the flood zones and their elevations. Similar to the west transect, the X Flood Zone locations vary slightly due to the varying salt piles locations. While the FEMA FIRM Panels indicate an AE El. 13 Flood Zone where the middle transect crosses over the Mill River (i.e., approximately Sta. 25+00 ± to 28+00±), this Flood Zone was not developed in the CHAMP Model. This dissimilarity can be attributed to the mapping procedures for FEMA, where flooding characteristics generated at a specific transect are then interpolated to the surrounding geographic features. The CHAMP Model, on the other hand, is a specific model run over existing topographic data across a transect line. In any case, the AE El. 13 Flood Zone is in the River itself and has no effect on upland Flood Zones.

For the east transect (Exhibit 5), the CHAMP Model indicates a VE El. 16 Flood Zone at the shoreline of the Mill River near the New NRB #3 parcel. This is larger than that shown in the FEMA FIRM Panels at this location and is because the CHAMP Model for this transect begins at the Mill River shoreline (i.e., north of Chapel Street, Exhibit 5) and does not take into account the Chapel Street Bridge. Extending the transect past the Chapel Street Bridge would reduce this to an AE El. 12 Flood Zone, which corresponds with the FEMA FIRM Panels. Progressing landward (i.e., north), the CHAMP Model and FEMA FIRM Panels show excellent correlation, both displaying X Flood Zones on both sides of Grand Avenue and at the Radiall property.

Deep Water Fetch Limited Design Wave

The deep water *fetch limited* case produced a maximum wave crest at El. 19 feet (i.e., VE El. 19 Flood Zone) at the shoreline of New Haven Harbor. Further inland (north) the CHAMP Model shows AE El. 13 and AE EL. 14 Flood Zones. The *fetch limited* wave characteristics were greater than those representative of a 100-year storm, resulting in flood zones greater than that determined for the deep water *duration limited* case and as shown on the FEMA FIRM. Accordingly, the CHAMP Model for the *fetch limited* case was not considered.

Based on the results, the flood zones provided in the FEMA FIRM Panels were confirmed and are considered representative of the anticipated flooding resulting from the 100-year storm event. As such, we recommend that the flood elevations provided in the FEMA FIRM Panels be utilized as the basis for the development of the flood protection improvement alternatives.

Recommended Minimum Design Elevations

The minimum recommended design elevation for a given flood protection improvement alternative is dependent on its location within the District. Accordingly, and in order to provide a basis for design, three (3) representative flood protection improvement alternatives were selected and evaluated based on the results of the Coastal Flooding Analysis completed above. These alternatives include the following:

1. The construction of a District-Wide Flood Proofing Barrier located along Chapel Street;
2. The construction of a Flood Proofing Barrier along the shoreline of selected parcels located within the District; and
3. Raising grade within selected parcels located within the District.

District-Wide Flood Proofing Barrier

The first representative flood protection alternative includes the construction of an impermeable barrier along Chapel Street. The barrier would consist of a bridge spanning over the Mill River with flood gates below, and berms extending from either side of the bridge to the limits of the flood zone. In addition, pumps would be installed to maintain effluent river flow during a storm event while the gates are closed.

The above barrier would be constructed such that the overtopping rate of any waves or storm surge would be less than 0.0001 cubic feet per second per linear foot of structure. This maximum overtopping rate is required by FEMA and would allow the area located landward of the barrier (i.e., north) to be mapped as an X Flood Zone.

Based on the existing FEMA FIRM Panels, the Limit of Moderate Wave Action (LiMWA) line follows the shoreline of the River from the southern end of the District up to Grand Avenue (Exhibit 2). This line is the delineation between a Coastal A Flood Zone and a Non-Coastal A Flood Zone, which represents the location during a storm that would support a wave height of 1.5 feet. For reference, a Non-Coastal A Flood Zone supports wave heights less than 1.5 feet, a Coastal A Flood Zone supports wave heights between 1.5 and 3 feet, and a V Flood Zone supports wave heights greater than 3 feet.

The western and eastern portions of the proposed barrier located beyond the bridge would be positioned landward of the LiMWA line (i.e., Non-Coastal A Flood Zone). The portion of the proposed barrier that crosses the Mill River would be located seaward of the LiMWA line in an AE EL. 13 Flood Zone (i.e., Coastal A Flood Zone). Based on this, a maximum wave height of 1.5 feet was assumed for the western and eastern portions of the proposed barrier and a wave height of 3 feet was assumed for the portion of the barrier that crosses the Mill River.

Based on the above, and assuming a 1.5 foot wave would impact the barrier with a wave period of 4.8 seconds (as calculated under the *duration limited* case) in a water depth of 1.92 feet (the minimum depth of water required to support a 1.5 foot wave), the required top of the western and eastern portions of the barrier would be approximately El. 15 feet ±. This elevation would allow areas located landward of the barrier to be remapped as an X Flood Zone and would fulfill the FEMA requirement of providing a minimum of 1.0 foot of freeboard over the AE El. 12 Flood Zone.

In regard to the portion of the proposed barrier that crosses the Mill River, a top of barrier equal to El. 15 feet ± would allow some wave overtopping. However, the overtopping would end up in the River on the upstream side of the barrier and would subsequently be pumped outboard along with the effluent River flow.

The analysis above satisfies criteria for FEMA in terms of Flood Mapping according to the most recent and available data. The analysis does not take into consideration climate change or a future potential increase in sea-level rise. Any potential future sea-level rise estimates would need to be added to the overall height of the berm.

Single Property Flood Proofing Barrier

Because the properties within the District are located landward of the LiMWA line, the minimum design elevation for flood proofing barriers on individual properties would be compared to the base flood elevations at the property and would have minimal added effects from wave runup. As such, a minimum design elevation equal to the Base Flood Elevation plus 1 foot of freeboard is considered sufficient to protect from overtopping.

Radiall was selected as a representative property for determining the minimum elevation for a flood proofing barrier. The existing FEMA FIRM Panel indicates an AE El. 12 Flood Zone in this area. Accordingly, a top of barrier elevation of 13 feet would be appropriate for the Radiall property. Similar to the District-Wide Flood Proofing Barrier above, this top of barrier elevation does not take into account potential future sea-level rise.

Raising Grade within a Single Property

The final representative flood proofing alternative consists of raising grade within a selected property to elevate it above a flood zone. In accordance with FEMA guidelines, the finish floor elevation of a new structure would be required to be equal to or greater than the base flood elevation in the area. Based on this, the minimum fill elevation for Radiall would be El. 12 feet. Again, this elevation does not take into account any potential future sea-level rise.

If you have any questions, please do not hesitate to contact me.

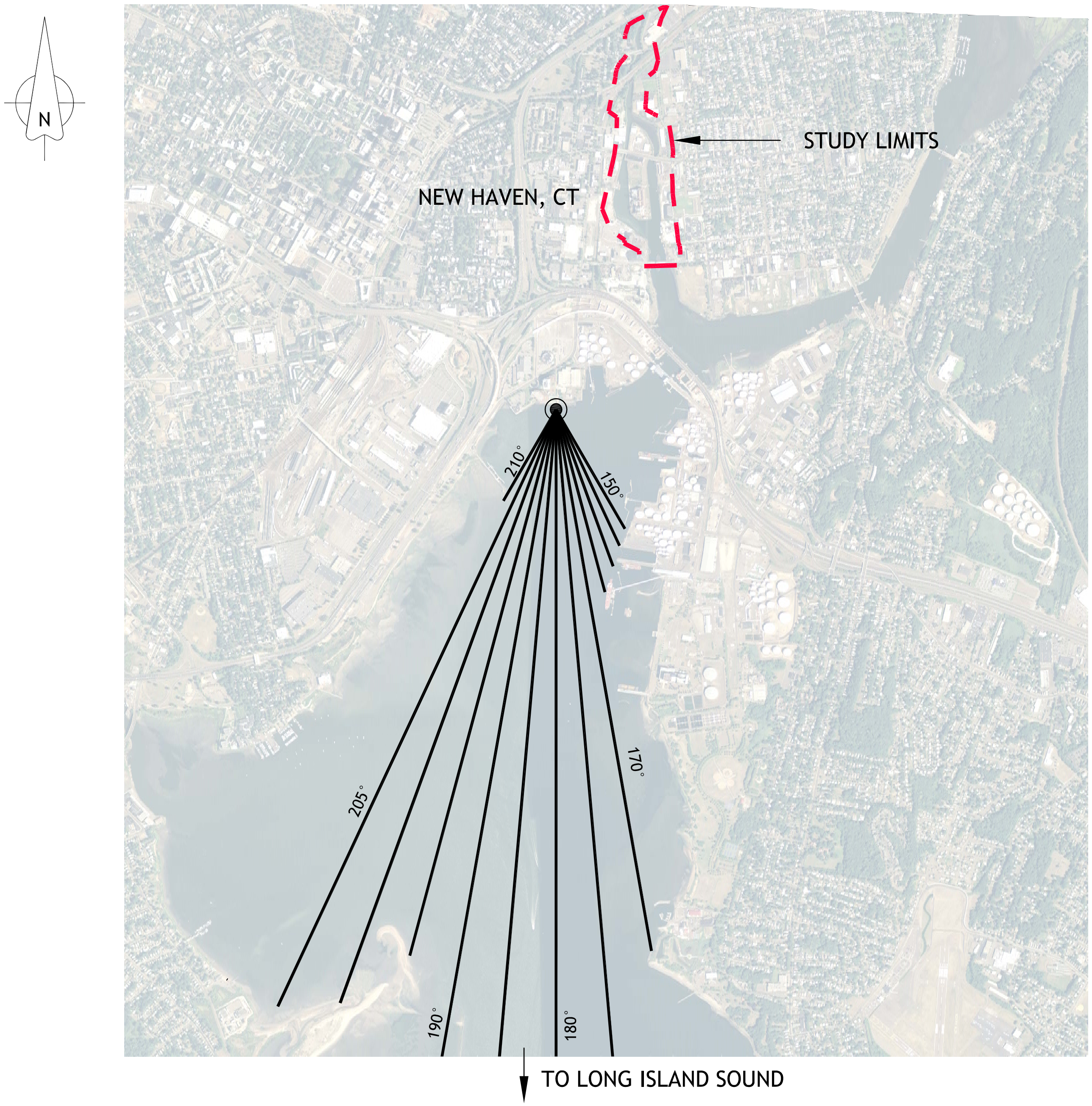
Sincerely,

Gregory J. Roebuck

Gregory J. Roebuck, P.E.
Principal

Attachments

Exhibits



FETCH DISTANCES		
ANGLE (DEGREES)	FETCH DISTANCE (FEET)	FETCH DISTANCE (MILES)
150	2,369	0.45
155	2,586	0.49
160	2,869	0.54
165	3,251	0.62
170	9,456	1.79
175	121,931	23.09
180	122,756	23.25
185	122,536	23.21
190	123,727	23.43
195	9,725	1.84
200	10,863	2.06
205	11,329	2.15
210	1,813	0.34

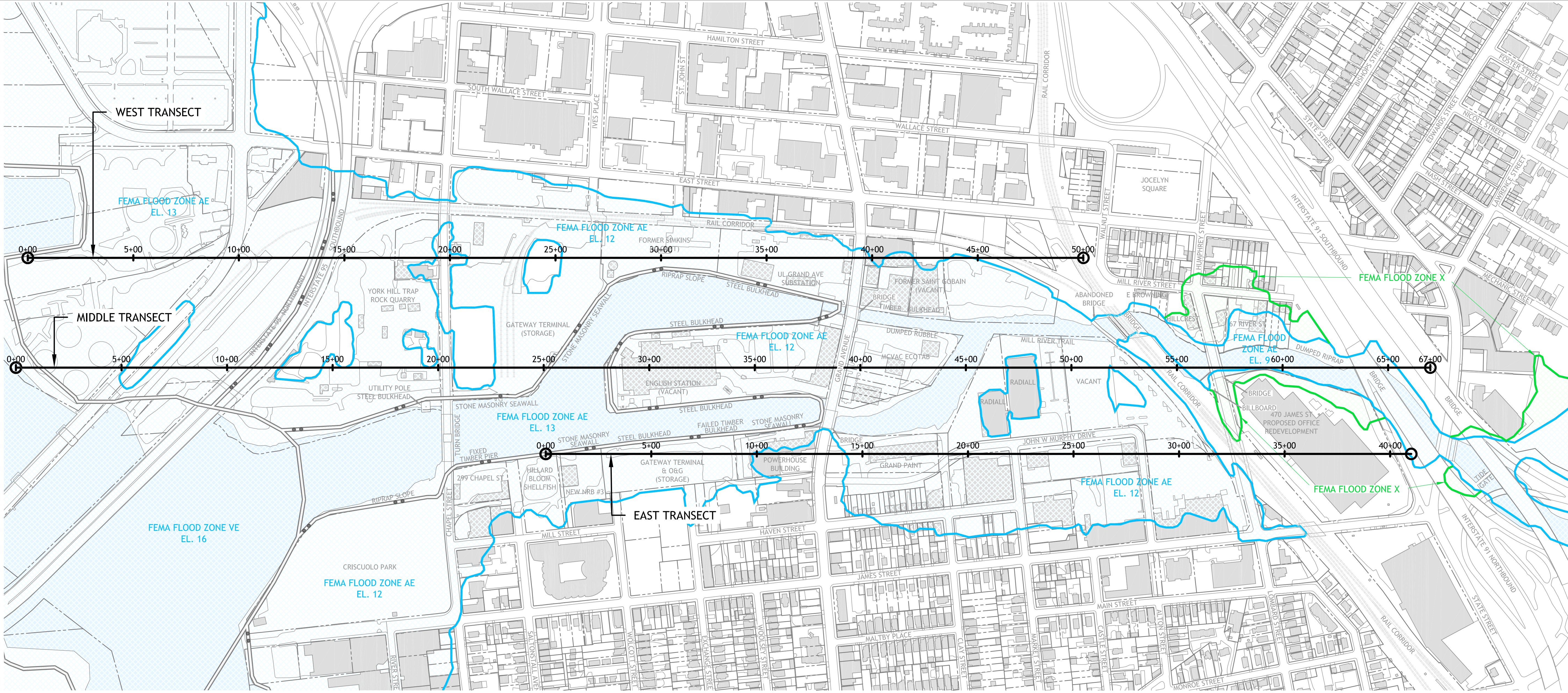
WHITECAP ENGINEERING, LLC
18 PERRYWINKLE ROAD
WAKEFIELD, RI 02879

City of New Haven
CONNECTICUT

MILL RIVER DISTRICT SHORELINE ANALYSIS
New Haven, Connecticut

EXHIBIT 1
FETCH DISTANCES

SHEET 1 of 6
DATE
MAY 2016
PROJ No.
15103.00



NOTE:

1. THE FLOOD BOUNDARIES SHOWN ON THESE FIGURES WERE TAKEN FROM FEMA FLOOD INSURANCE RATE MAP NUMBERS 09009C0433J, 09009C0434J, 09009C0441J, AND 09009C0442J, ALL DATED JULY 8, 2013.

LEGEND:

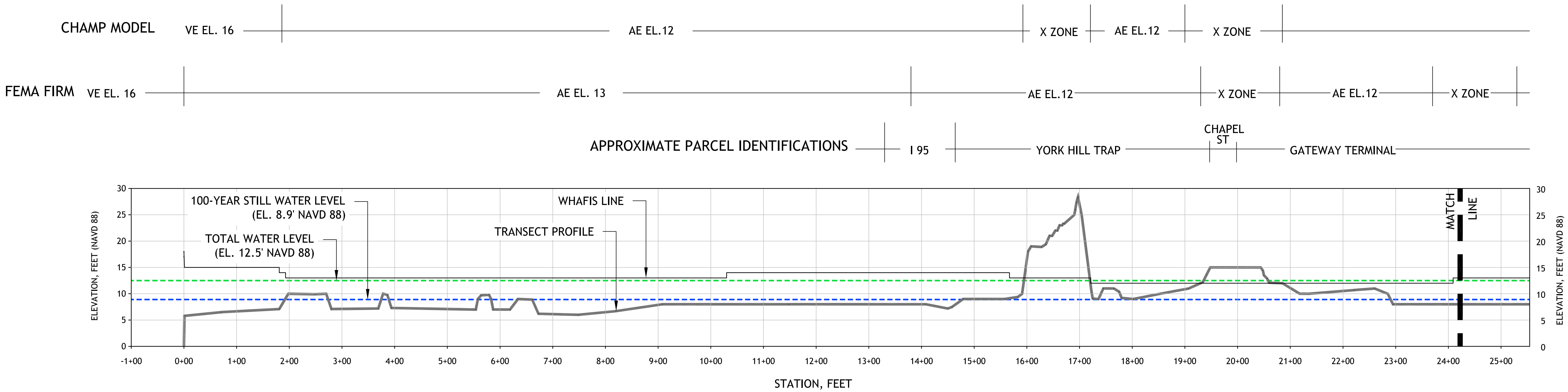
- FEMA SPECIAL FLOOD HAZARD OUTER BOUNDARY FOR AREA SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
- FEMA OTHER FLOOD AREA OUTER BOUNDARY
- FEMA BOUNDARY DIVIDING SPECIAL FLOOD HAZARD AREAS OF DIFFERENT BASE FLOOD ELEVATIONS
- FEMA LIMIT OF MODERATE WAVE ACTION WITH COINCIDENT ZONE BREAK

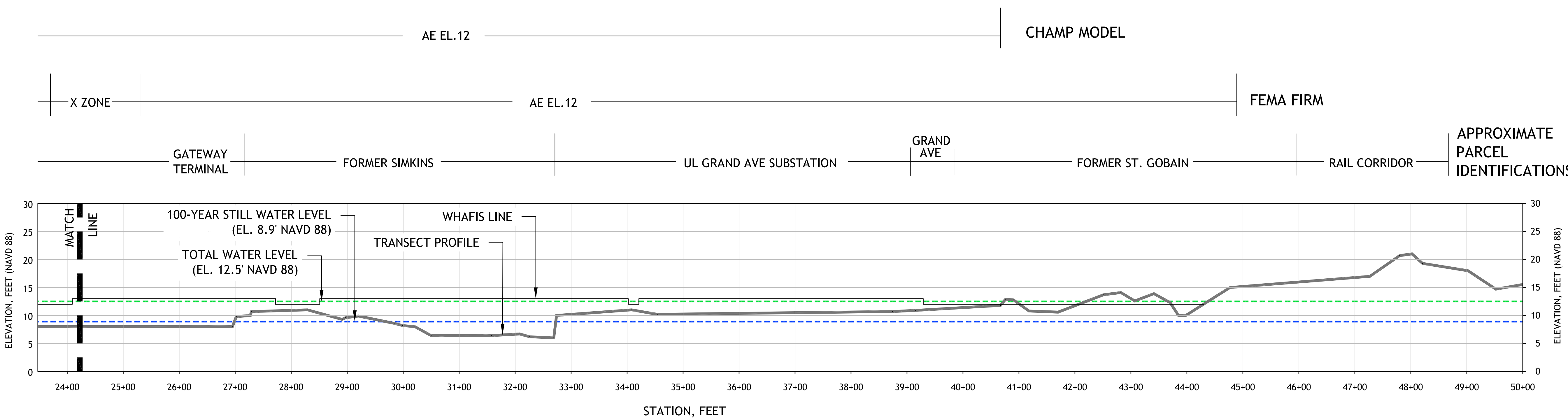
Graphic Scale 1"=500'

500' 250' 0 500'

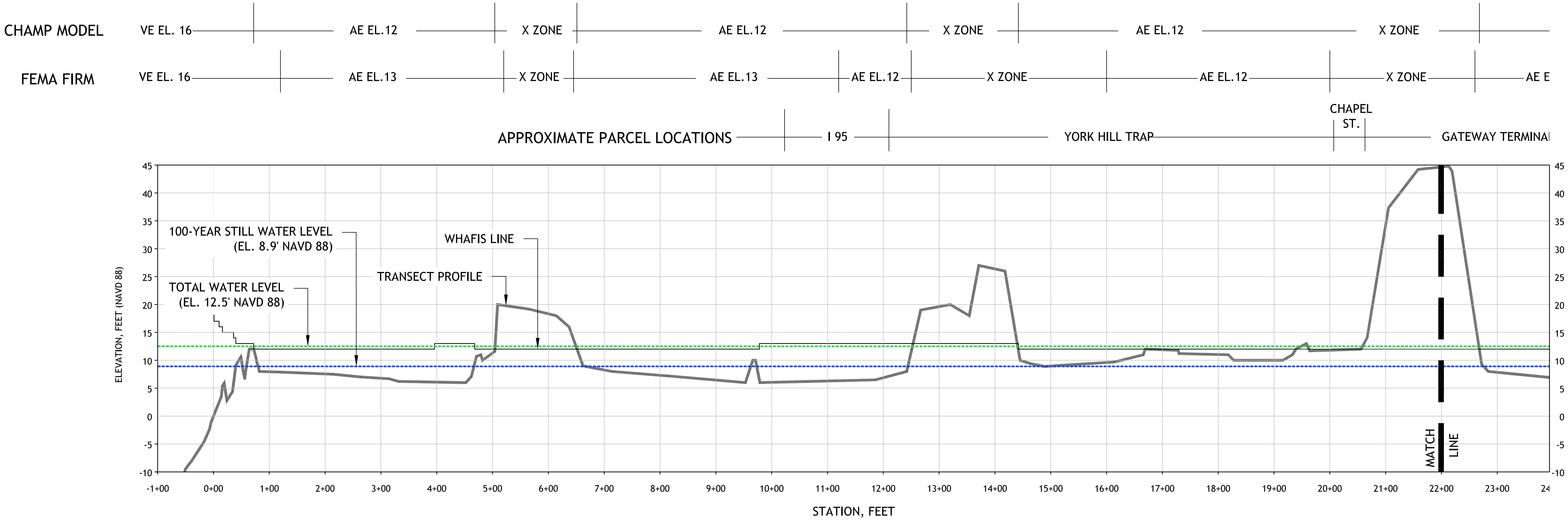
N

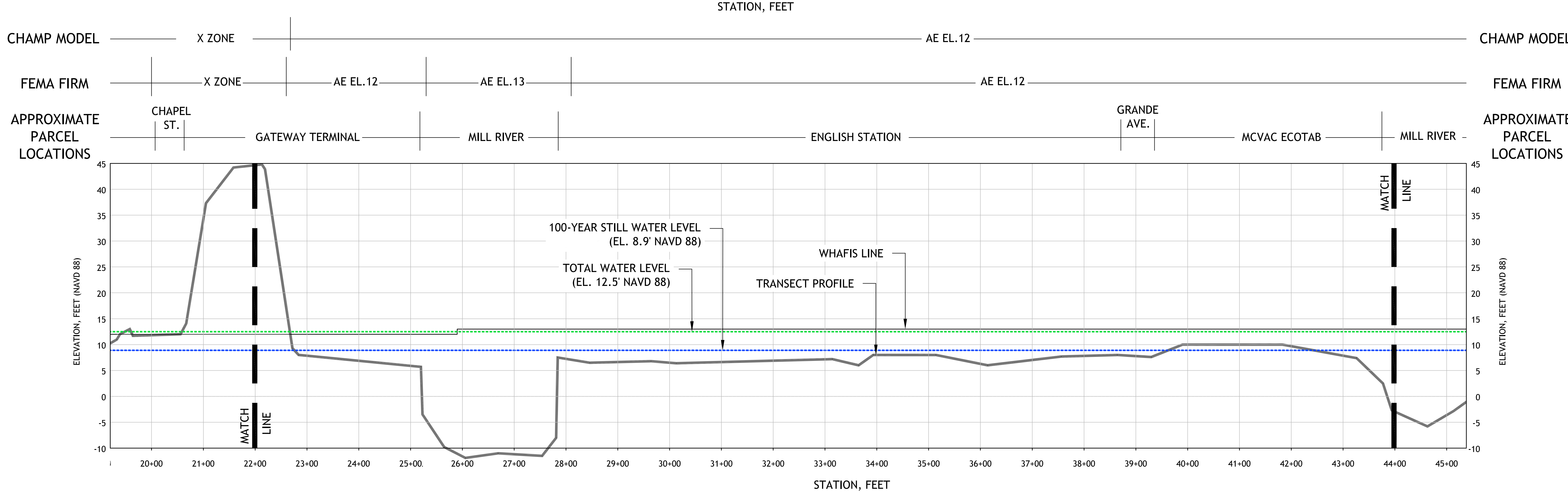
WHITECAP ENGINEERING, LLC 18 PERRYWINKLE ROAD WAKEFIELD, RI 02879	City of New Haven CONNECTICUT	MILL RIVER DISTRICT SHORELINE ANALYSIS New Haven, Connecticut	EXHIBIT 2 TRANSECT LOCATION PLAN	SHEET 2 of 6 DATE MAY 2016 PROJ No. 15103.00



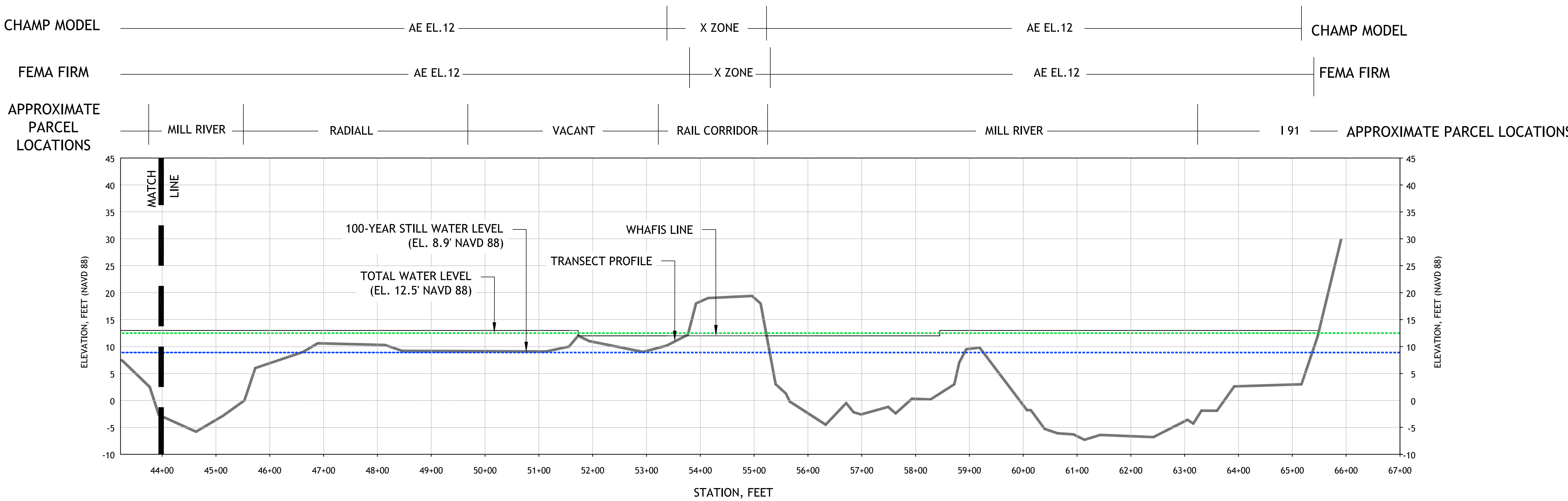


WHITECAP ENGINEERING, LLC 18 PERRYWINKLE ROAD WAKEFIELD, RI 02879	City of New Haven CONNECTICUT	MILL RIVER DISTRICT SHORELINE ANALYSIS New Haven, Connecticut	EXHIBIT 3 WEST TRANSECT	SHEET 3 of 6 DATE MAY 2016 PROJ No. 15103.00

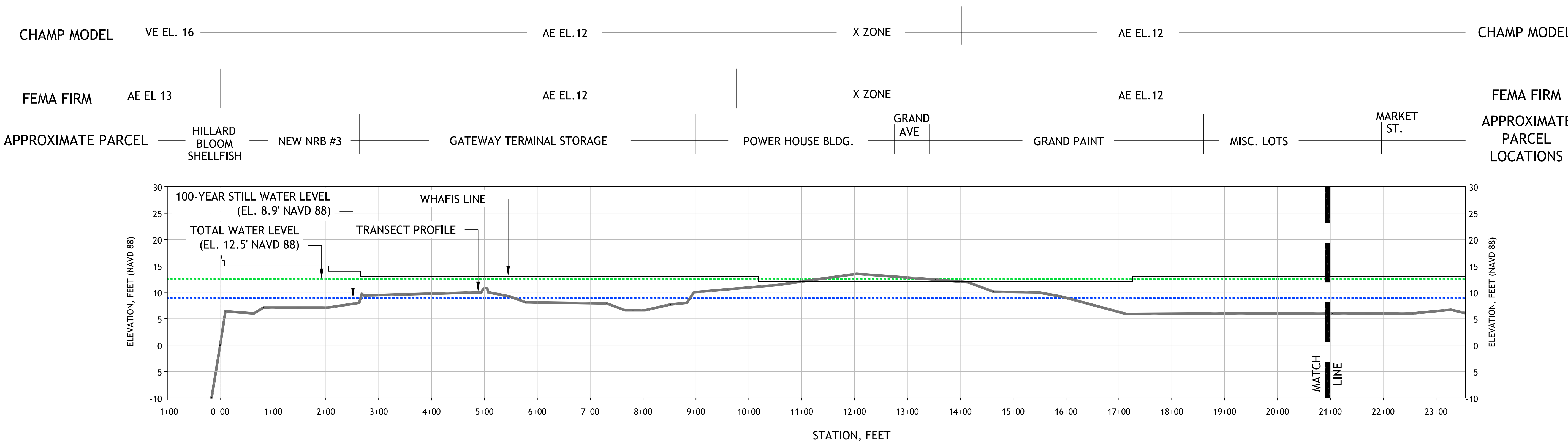


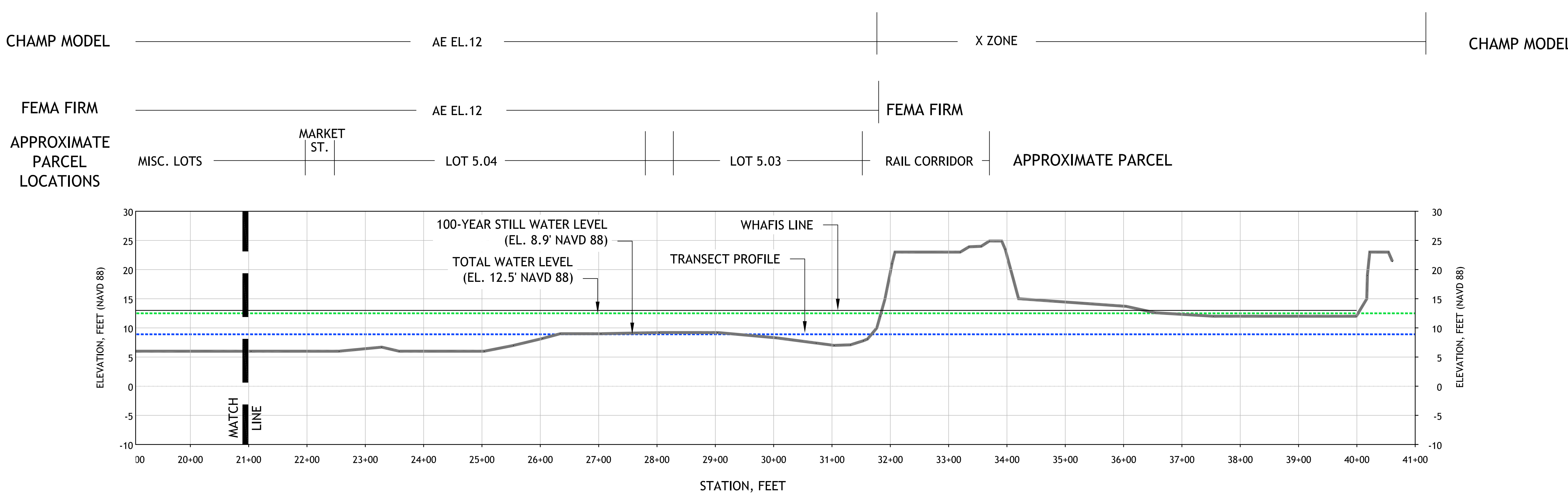


WHITECAP ENGINEERING, LLC 18 PERRYWINKLE ROAD WAKEFIELD, RI 02879	City of New Haven CONNECTICUT	MILL RIVER DISTRICT SHORELINE ANALYSIS New Haven, Connecticut	EXHIBIT 4A MIDDLE TRANSECT	SHEET 4 of 6 DATE MAY 2016 PROJ No. 15103.00



WHITECAP ENGINEERING, LLC 18 PERRYWINKLE ROAD WAKEFIELD, RI 02879	City of New Haven CONNECTICUT	**MILL RIVER DISTRICT SHORELINE ANALYSIS** New Haven, Connecticut	**EXHIBIT 4B MIDDLE TRANSECT**	SHEET 5 of 6 DATE MAY 2016 PROJ No. 15103.00





WHITECAP ENGINEERING, LLC
18 PERRYWINKLE ROAD
WAKEFIELD, RI 02879

City of New Haven
CONNECTICUT

MILL RIVER DISTRICT SHORELINE ANALYSIS
New Haven, Connecticut

EXHIBIT 5
EAST TRANSECT

SHEET 6 of 6
DATE
MAY 2016
PROJ No.
15103.00