



Basis of Design Report Warner's Pond Dam Removal Concord, Massachusetts

Prepared for



Town of Concord
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LIST OF ACRONYMS AND ABBREVIATIONS

2-D	Two-dimensional
Aterra	Aterra Solutions, LLC.
BFRT	Bruce Freeman Rail Trail
cfs	Cubic feet per second
cm	Centimeter(s)
CMR	Code of Massachusetts Regulations
CWA	Clean Water Act
DEM	Digital elevation model
DOC	Department of Correction
EA	EA Engineering, Science, and Technology, Inc., PBC
EPA	United States Environmental Protection Agency
ESS	ESS Group, Inc.
HEC-RAS	Hydrologic Engineering Center River Analysis System
HEC-HMS	Hydrologic Engineering Center Hydrologic Modeling System
MCP	Massachusetts Contingency Plan
MEPA	Massachusetts Environmental Policy Act
NAVD88	North America Vertical Datum 1988
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
Pare	Pare Corporation
P.E.	Professional Engineer
SGC	SGC Engineering, LLC
TR-55	Technical Release 55
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
USACE	U.S. Army Corps of Engineers
WSEL	Water surface elevation

1. INTRODUCTION

The Town of Concord has contracted EA Engineering, Science, and Technology, Inc., PBC (EA) to provide engineering and design services to advance the dam removal alternative presented in the Alternatives Analysis Report for the Restoration of Warner's Pond (EA 2023).

1.1 SITE BACKGROUND

Warner's Pond is an impoundment of Nashoba Brook – a perennial tributary to the Assabet River – located in the Town of Concord, Massachusetts (Figure 1). The pond is approximately 59 acres in size, including its three islands which together total approximately 7.5 acres. Water flows into the pond through a broad delta of emergent and scrub-shrub wetlands on the western shore and outflow from the pond occurs at the dam spillway located at the pond's southeast corner near the intersection of Commonwealth Avenue and Laws Brook Road. The pond's watershed is approximately 47 square miles in size (resulting in a watershed-to-pond ratio of 612:1) and is located primarily outside of Concord (Figure 2).

Warner's Pond in its current size and shape was created in the 1850s following the construction of a dam on Nashoba Brook approximately 1,300 feet upstream of the brook's confluence with the Assabet River. The dam was constructed by Ralph Warner to power a pail factory located at the intersection of Commonwealth Avenue and Laws Brook Road. A smaller dam had previously been constructed at the same site in 1819 to power a lead pipe factory.

Today, Warner's Pond and its dam are owned and managed by the Town of Concord (the Town); the Town also owns three properties along the Warner's Pond shoreline: (1) the Gerow Recreation Area located on the pond's northern shoreline, (2) a boat and fishing access located off of Commonwealth Avenue on the pond's eastern shoreline, and (3) an informal trail access located off of Pond Street on the pond's southern shoreline. Scout Island (historically known as Isle of Pines), the largest of the pond's three islands, is owned by the Concord Scout House. Approximately 35 residential properties abut the eastern and southern shorelines of the pond, and approximately 20 additional residential properties abut the extensive wetland system located west of the pond. The Massachusetts Department of Correction (DOC) owns a large parcel of land on the pond's northwestern shoreline used for agricultural production. Warner's Pond is also located on the Bruce Freeman Rail Trail (BFRT), a pedestrian and cycling trail which follows the 25-mile route of the former Lowell and Framingham line of the New Haven Railroad.

Prior to the construction of the Warner's Pond dam, sediment and nutrients flowed downstream through Nashoba Brook, into the Assabet River, and beyond. Periods of high flow due to increased rainfall or snowmelt would have mobilized areas of sediment that had accumulated within the channel, helping to maintain the brook as a self-sustaining riverine system. The construction of the Warner's Pond dam formed a barrier preventing sediment from continuing downstream, which over several decades has resulted in significant accumulation of nutrient-laden sediments in the pond. As a result, Warner's Pond is now in an advanced state of eutrophication, a process characterized by increased nutrient inputs to lakes and ponds that results in reduced water depths and excessive growth of aquatic plants.

Over time, sediment accumulation and dense plant growth reduce a system's ecological and recreation value as an open waterbody. While eutrophication is a natural process in lacustrine systems, human development within the Warner's Pond watershed has significantly increased the rate at which this process occurs. Furthermore, as Warner's Pond is a human-created feature owned and managed by the Town, there is a need and responsibility on the part of the Town to manage the system to ensure that it provides ecological, recreational, and community functions and benefits.

The construction of the Warner's Pond dam and subsequent in-filling of the pond with nutrient-rich sediments has resulted in a number of impairments to the ecological, recreational, and community functions and values provided by the system, including:

- Reduced water depths, which degrade habitat for certain species of fish and wildlife and impairs recreational opportunities.
- Extensive growths of the aquatic invasive plant species fanwort (*Cabomba caroliniana*), variable-leaf milfoil (*Myriophyllum heterophyllum*), and water chestnut (*Trapa natans*), which degrade habitat for native fish and wildlife and impair recreational opportunities.
- Restriction of movement of aquatic organisms, including loss of habitat for diadromous fish species.
- Risks to public safety and property associated with the potential for dam failure.
- On-going costs associated with inspection, maintenance, and repair of the dam.

A detailed discussion of existing site conditions is provided in the Alternative Analysis Report (EA 2023).

1.2 PROJECT BACKGROUND

Observations of the adverse effects of eutrophication in Warner's Pond date back to at least the early 1980s. In an effort to adopt a more holistic approach to management of the pond, the Town prepared a Watershed Management Plan for Warner's Pond (ESS 2012) to develop a framework to guide future management decisions for the pond. The Watershed Management Plan recommended a range of options for improving the ecological and recreational value of the pond, including short-term options such as herbicides and biological controls as well as long-term options. Long-term options included (1) controlling nutrient and sediment loading through an educational program for watershed residents and low impact development techniques and (2) sediment removal through dredging. The Watershed Management Plan recommended dredging as the primary focus for management because the vast majority of the pond's watershed lies outside Concord's borders, which limits the ability of the Town to achieve meaningful reductions in nutrient and sediment loading to Warner's Pond.

A Dredging Feasibility Study was subsequently prepared (ESS 2018) that included conceptual level design plans for targeted dredging in two high-priority areas of the pond. In 2021, the dredging project was advanced to final design, and the project was put out for public bid in 2022.

The outcome of the public bidding process indicated that the dredging project originally conceived in the Dredging Feasibility Study would be economically infeasible for the Town to undertake. As a result, the Town began exploring alternative approaches to managing Warner's Pond. An Alternatives Analysis Report was issued in March 2023 that evaluated three approaches: (1) no action, (2) limited dredging and filling, and (3) dam removal (EA 2023). Following a review of the Alternatives Analysis Report, the Town proceeded with advancing the dam removal design. After beginning the preliminary dam removal design, the Town of Concord Natural Resources Commission established the Warner's Pond Task Force to evaluate all feasible alternatives to pond management, and to bring forth a recommendation on a course of action forward for the Natural Resources Commission to consider.

1.3 PROJECT GOALS AND OBJECTIVES

The ecological, recreational and community goals for the restoration of Warner's Pond were developed during the Alternatives Analysis Report (EA 2023) based upon goals established by the former Warner's Pond Stewardship Committee and through a collaboration between the Town's Natural Resources Division, Recreation Department, and Engineering Division. The project objectives are the specific outcomes that the Town wishes to achieve by undertaking the project and relate to the Town's overall restoration goals. Project goals and objectives are identified below.

Ecological Goals and Objectives:

- Goal 1: Enhance habitat for native fish and wildlife
 - Objective 1-1: Re-establish aquatic connectivity and aquatic organism passage in Nashoba Brook.
 - Objective 1-2: Restore diadromous fish access to Nashoba Brook and upstream spawning areas.
 - Objective 1-3: Enhance habitat for wood turtle, a state-listed species.
- Goal 2: Manage aquatic invasive species
 - Objective 2-1: Achieve widespread elimination of aquatic invasive species by removing impounding effects of Warner's Pond dam, increasing water velocities, and increasing channel bottom roughness.
- Goal 3: Improve water quality
 - Objective 3-1: Enhance downstream flow of sediment and nutrients.

Recreational Goals and Objectives:

- Goal 4: Enhance recreational infrastructure and accessibility
 - Objective 4-1: Maintain water access to Scout Island.

- Objective 4-2: Maintain recreational access and viewpoints to the restored stream and wetland system from Commonwealth Avenue and Pond Street.
- Goal 5: Increase opportunities for paddle craft use and recreational fishing
 - Objective 5-1: Educate the public regarding new paddling opportunities provided through dam removal.
- Goal 6: Provide water-based recreational opportunities at Gerow Park
 - Objective 6-1: Maintain recreational access and viewpoints to the restored stream and wetland system from the Gerow Recreation Area.

Community Goals and Objectives:

- Goal 7: Enhance climate resilience
 - Objective 7-1: Improve climate resilience by removing vulnerable infrastructure.
- Goal 8: Protect public safety
 - Objective 8-1: Eliminate public safety risk and liability associated with potential for dam failure.
- Goal 9: Minimize long-term operation and maintenance costs
 - Objective 9-1: Eliminate costs associated with future inspection, maintenance, repair, and replacement of the dam.
 - Objective 9-2: Secure state or federal grant funding to offset project costs.

2. DATA COLLECTION, ANALYSIS, AND MODELING

The following data collection, analysis, and modeling efforts were conducted to support the design of the Warner's Pond dam removal.

- Topographic survey
- Bathymetric and sediment depth survey
- Sediment sampling
- Wetland assessment
- Infrastructure assessment
- Hydraulic and hydrologic analysis
- Sediment transport analysis

The methods and results of these analyses are discussed in the following sections.

2.1 TOPOGRAPHIC SURVEY

EA subcontracted SGC Engineering, LLC (SGC), a Massachusetts Licensed Surveyor, to complete a topographic survey for the area upstream and downstream of the dam. SGC also surveyed the dam structures including the main and auxiliary spillways, sluiceway, footings, embankments, and upstream and downstream water elevations. The survey was completed in October 2023 using horizontal datum of North American Datum 83, Massachusetts State Plane and vertical datum of North American Vertical Datum of 88 (NAVD88). Surveying benchmarks and controls points were established in the project area. Water surface elevation (WSEL) measured during the survey completed in October 2023 was approximately 119 feet NAVD88 above the dam and 114.6 feet NAVD88 below the dam. The location of easements and property boundaries were sourced from the Town of Concord's publicly available geographic information system records and tax parcel data. The existing conditions plan is included as Sheet 3 of the 30% Design Drawings provided as Appendix A.

2.2 BATHYMETRY AND SEDIMENT DEPTH SURVEY

EA collected bathymetry and sediment depth data from Warner's Pond in December 2022 and January 2023 as part of a previous phase of this project. Water and sediment depth data was collected at a total of 156 stations throughout the pond. At each station, a 16-foot graduated steel rod was lowered from a small watercraft to the top of sediment to assess water depth. The steel rod was then manually advanced through pond sediments to refusal to measure depth of soft sediment. In areas where the depth exceeded the length of the rod, the sediment depth was estimated. Using geospatial software, EA generated one-foot contours of sediment and water depth, which are presented in the Alternatives Analysis Report (EA 2023).

Under the same mobilization described in Section 2.1, SGC surveyed the bathymetry of Warner's Pond from the spillways to approximately 300 feet upstream. Within the pond, SGC collected seven spot elevations of the bottom and sediment depth thickness. Three cross-sections were surveyed by SGC that were used in the hydrologic and hydraulic analysis summarized in Section 2.6. The bathymetry of Nashoba Brook from the spillways to the Pail Factory Bridge was also surveyed by SGC.

Ten cross-sections of Nashoba Brook between the Pail Factory Bridge and the Assabet River were surveyed by EA in November 2023. Data was collected using an RTK GPS station and was provided to Aterra Solutions, LLC (Aterra) for use during hydrologic and hydraulic modeling. Water depths in the reach of Nashoba Brook upstream of Warner's Pond and downstream of the confluence with Fort Pond Brook were collected by EA in September 2024. Water depth measurements were collected along seven cross-sections within the wadeable portion of the channel.

2.3 SEDIMENT SAMPLING

2.3.1 Historic Sediment Sampling

Sediment coring and sampling was previously performed in June 2017 by ESS as a component of the Dredging Feasibility Study (ESS 2018) to evaluate the potential for dredging sediment from Warner's Pond. Twenty-four samples were collected from potential dredge areas and results were compared to the Massachusetts Contingency Plan (MCP) Method 1 Risk Characterization Soil Standards which apply to upland soils. MCP Method 1 was used to evaluate results of the 2017 sediment sampling under the framework of dredged sediment intended for upland reuse. Composite sediment samples collected from sediment cores throughout targeted areas of the pond indicated that concentrations of metals, polychlorinated biphenyls, and hydrocarbon compounds were below applicable MCP Method 1 standards for surface water and groundwater. One sample, SC4-ABC, collected south of Scout Island, had concentrations of arsenic exceeding MCP Method 1.

2.3.2 Pre-Design Investigation Sampling Results Discussion

Additional sediment sampling was performed in November 2023 to support sediment management recommendations as part of this design. A full description of the field activities and results was submitted to the Town of Concord in a technical memorandum (EA 2024) and is summarized herein. A copy of the memorandum is provided in Appendix B to this report.

EA collected seven sediment cores from within Warner's Pond and downstream of the dam in Nashoba Brook. Two composite sediment samples were collected downstream: (1) in Nashoba Brook downstream of the dam between the Pail Factory Bridge and confluence with Assabet River and (2) in the Assabet River between Nashoba Brook and Route 2. All sediment samples were analyzed for physical characteristics including bulk density, moisture content, dry density, and grain size analysis by GeoTesting Express, LLC. The downstream composite samples from Nashoba Brook and the Assabet River were also analyzed for heavy metals, polycyclic aromatic hydrocarbons, organochlorine pesticides, polychlorinated biphenyls, extractable and total petroleum hydrocarbons, volatile organic compounds, and total organic carbon by Alpha Analytical.

Chemical analysis of the downstream soil samples indicated that none of the analytes included as part of this study exceeded their respective MCP Method 1 standards. The majority of the sediment samples collected from Warner's Pond indicated that the surficial material is fine silt and clay, with fine sand found at depths greater than 3 to 4 feet. One sample collected approximately 800 feet upstream of the dam contained a substantial amount of gravel. Observations and grain size analysis of sediment core samples collected within Nashoba Brook

indicated that the majority of sediment collected is silty sand with small amounts of organic material. Coarser material was more prevalent in Nashoba Brook than in Warner's Pond. Copies of the physical analysis laboratory reports are presented in Appendix B.

2.4 WETLAND ASSESSMENT

Multiple wetland communities exist in and around Warner's Pond. These communities have been shaped by the impounding effects of the Warner's Pond dam as well as human development and use of shoreline areas. The four main ecological communities within the aquatic system of Warner's Pond are: open water, deep marsh, shrub swamp, and deciduous forest wetland. A full discussion of these areas is presented in the Alternatives Analysis Report (EA 2023) and summarized below:

- **Open water:** Water depths throughout most of Warner's Pond are 5 feet or less, and the pond has a maximum water depth of approximately 12 feet. The pond bottom is heavily vegetated with aquatic plants (predominantly fanwort and coontail [*Ceratophyllum demersum*]). Floating-leaved aquatic plants (predominantly water chestnut) are also present throughout the open water area of the system.
- **Deep marsh:** Areas where Nashoba Brook transitions from a riverine to an impounded system are considered deep marsh. These areas are typically flooded with between 0.5 to 3 feet of water, but water depth may vary within the growing season and from year to year. The specific vegetative community observed at Warner's Pond includes swamp loosestrife (*Decodon verticillatus*), broad-leaf cattail (*Typha latifolia*), sedges (*Carex sp.*), and the invasive purple loosestrife (*Lythrum salicaria*).
- **Shrub swamp:** This wetland community is located in the transitional areas between open water/deep marsh and forested wetlands/uplands. Dominant plant species in shrub swamps often include alders (*Alnus sp.*), buttonbush (*Cephalanthus occidentalis*), silky dogwood (*Swida amomum*), willows (*Salix sp.*), and arrowwood (*Viburnum dentatum*).
- **Deciduous forest wetland:** Forested wetlands are located in a handful of relatively small, discrete patches along the western and southern perimeter of the Nashoba Brook/Warner's Pond system. They are dominated by red maple (*Acer rubrum*) and pin oak (*Quercus palustris*). Shrub and herbaceous vegetation are also present in the understory.

2.5 INFRASTRUCTURE ASSESSMENT

EA performed a high-level field and desktop review of the infrastructure in and around Warner's Pond in 2023 including soliciting information from Concord Public Works and local utilities. The Warner's Pond dam has been rebuilt several times, most recently in 2008. As-built drawings from the 2008 construction were used as a reference for the structural dam assessment and October 2023 survey (CMA Engineers, Inc. 2011).

The most recent dam inspection was performed in June 2023 by Pare Corporation (Pare). According to the Warner's Pond Dam Phase I Inspection/Evaluation Report (Pare 2023), the dam

is in satisfactory condition with minor operational and maintenance deficiencies. The dam has a maximum structural height of 9 feet and maximum storage capacity of approximately 440 acre-feet. In accordance with the Massachusetts Dam Safety Regulations (302 Code of Massachusetts Regulations [CMR] 10.00), the dam is an intermediate sized structure. It is classified as a Significant (Class II) Hazard potential dam, meaning that dam failure may cause loss of life and damage to structures, highways/roads, or cause interruption of use or service of important facilities. The report recommends that the Town complete a hazard classification review to determine whether the dam can be downgraded to a Low Hazard potential dam.

The Warner's Pond dam structures consist of the following:

- 320-foot long earthen embankment
- 40.2-foot long stone masonry weir (main spillway)
- 18-foot long concrete weir (auxiliary spillway)
- 5-foot wide stop log controlled rectangular sluiceway
- 24-inch diameter low level outlet pipe controlled by a gate valve.
- Two embankment sections, one to the left of the main spillways and one between the main and auxiliary spillway. Embankments have a 10-foot wide grassed crest and 3H:1V upstream and downstream slopes. The upstream slopes of both embankments are armored with riprap. The crest and downstream slopes are stabilized with turf reinforced mat and riprap at the toe of the slope intended to provide overtopping protection.
- A toe drain along the right side downstream of the spillway consists of a 4-inch diameter high-density polyethylene pipe embedded within a 2-foot square trench filled with three-quarter inch crushed stone. The toe drain outlets at the end of the spillway right downstream training wall into Nashoba Brook.

Findings from the inspection noted several minor operational and maintenance deficiencies including areas of the grassed crest and downstream slope exhibiting weeds and brush vegetation, dislodged stone and leakage along right training wall downstream of spillway, settlement of isolated area of the riprap toes of the slope between the main and auxiliary spillways, bubbling flow at toe of slope of the downstream end of the left training wall. Additionally, Pare noted areas of crest irregularity, specifically sections that were both 2-inches lower and 4-inches lower than design. Pare reported concerns with performance during the spillway design flood including the lower left abutment overtopping, limited reinforcement with turf mats at the dam crest during overtopping conditions, and areas of the crest that are lower than the design top of dam elevation resulting in higher overtopping water depths than designed. A copy of the 2023 Inspection/Evaluation report is presented in Appendix C.

Key infrastructure downstream of Warner's Pond includes:

- The Pail Factory (Commonwealth Avenue) bridge located approximately 160 feet downstream of the dam.
- A stone retaining wall approximately 340-feet in length located on the south bank of Nashoba Brook between the Pail Factory Bride and the timber pedestrian bridge.
- An arched timber pedestrian bridge across Nashoba Book, approximately 540-feet downstream of the dam.
- The BFRT bridge located approximately 940-feet downstream of the dam.

Based on a review of the as-built drawings and information provided by the Concord Public Works department, there are no known underground utilities located in the immediate vicinity of the dam. Buried water and sewer lines cross Nashoba Brook immediately downstream of the Pail Factory Bridge, overhead electric and telecommunications lines cross the Pail Factory Bridge, and a water main is located along the Pail Factory Bridge deck/structures.

2.6 HYDROLOGIC AND HYDRAULIC ANALYSIS

Aterra was subcontracted by EA to provide support for the hydrologic and hydraulic modeling for the design. Modeling was performed for existing and post-removal conditions to characterize downstream changes resulting from the removal of the Warner's Pond dam. The model set up, assumptions, and results are presented in the Warner's Pond Dam Removal Hydrologic, Hydraulic and Sediment Transport Analysis Report (Aterra 2024), attached in Appendix D, and summarized below.

2.6.1 Hydrologic Analysis

Aterra developed a U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) model for the Fort Pond Brook and Nashoba Brook watersheds to the confluence with Assabet River, encompassing a watershed area of 47 square miles. The normal pool storage was calculated as 195 acre-feet. The top of dam storage capacity was calculated as 483 acre-feet. The watershed was subdivided into nine sub-watersheds that were delineated using a digital elevation model (DEM) provided by EA. The sub-watersheds were characterized by land cover, soil maps, etc. to develop hydrologic parameters.

Peak Discharge Analysis

The hydrologic model estimated watershed runoff and inflow hydrographs into Warner's Pond for the 2-year, 5-year, 25-year, 100-year, and 500-year 24-hour flood frequencies for existing and post-removal conditions. The associated rainfall values for each of these precipitation frequency events were obtained using the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 (NOAA 2017) and are provided in Table 1.

Table 1. Precipitation Totals of 24-hour Storm Events

Event Frequency	Precipitation (inches)
2-year	3.23
5-year	4.21
25-year	6.14
100-year	7.87
500-year	10.7

Using the United State Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Technical Release 55 (TR-55) (USDA-NRCS 1986), Aterra modeled the runoff in the nine sub-watersheds to predict the peak rate of runoff as well as the total volume and flow hydrographs.

2.6.2 Hydraulic Analysis

Model Set Up and Validation

The USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) was used to complete the hydraulic analysis of the dam, spillway, and downstream area using a two-dimensional (2-D) unsteady flow model to account for spatial variability in terrain and surface roughness. The same DEM used in the hydrologic evaluation was used for the terrain in the existing conditions HEC-RAS model. The model extents included Warner’s Pond and Nashoba Brook down to the confluence with the Assabet River. EA also provided Aterra with post-dam removal grading plans for the berm, the main spillway, and the auxiliary spillway in AutoCAD Civil 3D.

Manning’s n-values for the 2-D model were derived using guidance developed by NRCS (NRCS-Kansas 2016) and estimated using site photos taken during the 2023 survey. The land cover data used as the basis for n-value estimation was a high resolution (1-meter resolution data) data set obtained from NOAA (NOAA 2024). Additionally, Manning’s n-value modifications were assigned to Warner’s Pond and stream channels using data from Chow’s hydraulics textbook (Chow, 1959) and comparison photos from verified roughness characteristics of natural channels (USGS, n.d.). A complete table of the Manning’s n-values used in the HEC-RAS model based on land cover type is presented in Section 3 of Aterra’s Report (Aterra 2024).

The 2-D HEC-RAS model was validated using data from a precipitation event documented on 17-18 December 2023. Precipitation data for each of the sub-watersheds was sourced from Weather Underground, and the average cumulative rainfall recorded from each station in each sub-watershed was used to calibrate the model. EA also provided Aterra with a field photo taken by Town of Concord representatives depicting the reservoir levels at the spillway (timestamped 19 December 2023 at 10:45 AM EST), which was used as a rough reference point for model validation. The photo provided allowed Aterra to estimate the water surface elevation of the pond based upon the known concrete elevation of the auxiliary spillway (121.2 feet NAVD88). In the simulation of the 17-18 December 2023 precipitation event, the water surface elevation downstream of the auxiliary spillway ranged from 119.6 to 117.5 feet NAVD88.

Model Results

Existing and post-dam removal conditions were modeled using the 2-D HEC-RAS model for baseflow conditions (defined as 53 cubic feet per second [cfs]), and flow conditions for the 2-year, 5-year, 25-year, 100-year, and 500-year 24-hour flood frequencies. WSEL for these flow conditions at select locations are presented in Tables 2 and 3.

Table 2. Water Surface Elevation Results for Existing Conditions

Structure Location	Approximate Elevation of Structure (ft NAVD88)	Peak WSEL (ft NAVD88) for select flood recurrence intervals					
		53 cfs	2-year	5-year	25-year	100-year	500-year
Reservoir	N/A	119.2	120.8	122.2	125.4	127.4	129.5
Pail Factory Bridge	129.2	114.6	118.3	120.6	124.7	126.7	129.2
Arched Timber Pedestrian Bridge	127.9	113.6	116.7	118.8	121.8	124.3	128.3
Bruce Freeman Rail Trail Bridge	127.0	112.9	115.0	116.6	118.8	120.7	125.6

Notes:

cfs = Cubic feet per second

ft NAVD88 = Survey feet, North American Vertical Datum 1988

N/A = Not applicable

WSEL = Water surface elevation

Table 3. Water Surface Elevation Results for Post Dam Removal Conditions

Structure Location	Approximate Elevation of Structure (ft NAVD88)	Peak WSEL (ft NAVD88) for select flood recurrence intervals					
		53 cfs	2-year	5-year	25-year	100-year	500-year
Reservoir	N/A	115.0	118.5	120.8	125.0	127.3	129.5
Pail Factory Bridge	129.2	114.9	118.3	120.4	124.4	126.6	129.2
Arched Timber Pedestrian Bridge	127.9	113.9	116.7	118.6	121.6	124.3	128.3
Bruce Freeman Rail Trail Bridge	127.0	113.0	115.1	116.6	118.8	121.1	125.8

Notes:

cfs = Cubic feet per second

ft NAVD88 = Survey feet, North American Vertical Datum 1988

N/A = Not applicable

WSEL = Water surface elevation

These modeling results indicate that the removal of the dam will likely have minimal effect on the downstream WSEL. In post-dam removal conditions, the WSEL in the reservoir (i.e. Warner's Pond) is expected to decrease from 119.2 feet NAVD88 to 115.0 feet NAVD88, while the WSEL downstream of the spillways is not expected to change. The effects of dam removal are anticipated to be less noticeable as flow increases; that is, it is expected that the former footprint of Warner's Pond will continue to be temporarily inundated during the 25-year, 100-year, and 500-year flood frequencies. The extents of inundation in post-dam removal conditions during the 25-year, 100-year, and 500-year events are nearly equal to existing conditions. During the higher frequency 2-year and 5-year events, the flood conditions of Warner's Pond are expected to slightly decrease, particularly in the south and southwestern extents of the pond. This

is because Nashoba Brook is constricted by downstream infrastructure (e.g., Pail Factory Bridge) and is tailwater controlled. Inundation maps for each flood recurrence interval listed in Table 2 and Table 3 are presented in Appendix B of Aterra's report (Aterra 2024). Water surface elevation profiles for each of the recurrence intervals are also presented in Appendix C of Aterra's report (Aterra 2024).

2.7 SEDIMENT TRANSPORT ANALYSIS

The Warner's Pond dam impounds sediment and impedes natural sediment transport processes, causing sediment to accumulate in Warner's Pond and depriving downstream waters (Nashoba Brook and the Assabet River) of sediment. Using the data collected in previous phases of this project, the total volume of unconsolidated, potentially mobile sediment within the impoundment was estimated by EA. Aterra also prepared a sediment transport model to assess the movement of suspended sediment and bed material, assess changes to channel geometry (cross sections and profiles), and identify areas of potential erosion and deposition. The model set up, assumptions, and results are presented in the Warner's Pond Dam Removal Hydrologic, Hydraulic and Sediment Transport Analysis Report (Aterra 2024), attached in Appendix D, and summarized below.

2.7.1 Mobile Sediment Volume

The bottom of the impoundment contains a layer of unconsolidated sediment that consists mostly of fine particles that have been deposited upstream of the spillway. This deposition occurs in most dam impoundments and is a result of lower velocities in the impoundment that do not have the energy to carry the sediments downstream, as well as the physical barrier of the spillway blocking sediment movement. This unconsolidated sediment has the potential to mobilize and be flushed downstream post-dam removal since the physical barrier would be removed and the velocities through the impoundment would increase. The total amount of sediment that will be mobilized depends on a variety of factors such as the water levels in the impoundment at the time of dam removal, the intensity and frequency of rain events that occur post-dam removal, the presence of vegetation, and the location and geometry of the channel that will be formed through the impoundment. However, a conservative estimate of the volume of potential mobile sediment can be made by calculating the volume of unconsolidated sediment within the impoundment.

The potentially mobile sediment volume calculation was completed using the sediment depth probing data collected by EA in December 2022 and January 2023, and AutoCAD Civil 3D. The sediment depths were converted into elevations using a temporary datum. The mobile sediment volume was calculated using two methods: a volume surface in AutoCAD Civil 3D and the average-end area method. The volume surface method consists of creating a surface of the top of sediment and a surface of the bottom of sediment and then a volume surface that calculates the volume in-between the top and bottom of sediment surfaces. The average-end area method determines a volume by taking the average of adjacent cross-sectional areas and multiplying it by the distance in-between cross-sections. This is completed for all adjacent cross-sections, and the total volume is calculated by summing up the individual volume estimates between each set of adjacent cross-sections. Eighteen cross-sections consisting of top of sediment and bottom of sediment points were identified throughout the project site from just upstream of the dam to the

northwest corner of Warner's Pond. The cross-sections, cross-sectional areas, and distances between cross-sections were determined in AutoCAD Civil 3D.

Additionally, the volume estimates for each method were contained within the extent of water in the post-dam removal base flow conditions. The average-end area method resulted in a more conservative value; therefore, that method was chosen for the final estimate. The resulting volume of potentially mobile sediment in the dam impoundment using the average-end area method is approximately 175,000 cubic yards. As stated above, this value is the volume of unconsolidated sediment within the impoundment; a total of 175,000 cubic yards of sediment may not necessarily be mobilized. Backup documentation of the mobile sediment volume calculation is provided in Appendix E.

It is important to note that the volume of mobile sediment represents a temporary impact to the downstream system. The mobile sediment would be flushed downstream from the impoundment during and shortly following dam removal as a new channel is established. Typically, channels downstream of dams are considered sediment starved because sediment that would normally be flowing through the system and deposited downstream is retained behind the spillways. Allowing sediment to be released will return Nashoba Brook and Assabet River to a natural cycle of sediment transport. The sediment transport modeling performed by Aterra showed little change in depositional and erosional zones from existing conditions to post-dam removal conditions.

As discussed in Section 2.6.1, 2017 sediment sampling efforts identified a localized area of arsenic-impacted sediment. Given the age of the sampling data, the area should be resampled prior to construction. If updated sampling results determine that the material is still impacted, a limited removal action may need to be performed prior to dam breach.

2.7.2 Transport Analysis

The sediment transport model to evaluate the effects of dam removal was conducted using the sediment transport module in HEC-RAS. The 2-D HEC-RAS model developed and discussed in Section 2.6 of this report was slightly modified to simulate sediment transport. Flow scenarios for sediment transport evaluated included the bank-full discharge (obtained from U.S. Geological Survey [USGS] StreamStats) of 533 cfs, 10 percent of the bank-full discharge equating to 53 cfs (to represent an estimated baseflow), and the 2-year and 5-year 24-hour frequency storm events.

Using the sediment samples collected by EA in November 2023 (Section 2.3), the grain size distribution of the analyzed samples was used to define the bed material in the model. Through discussions with EA, Aterra grouped areas of similar material where sampling data was not available. For example, sediment core 4 collected to the northwest of Scout Island was extrapolated to assume similar grain size for bed material along the west of Scout Island and the upstream portion of Nashoba Brook. Additionally, material downstream of sediment core 5 was grouped together ranging from the sample location down to the confluence with the Assabet River.

2.7.2.1 Transport Methodologies Overview

Two methods were used to qualitatively analyze the effects of dam removal on sediment transport patterns in Nashoba Brook and the Assabet River. The models discussed below were

evaluated to understand the stream bed's initial response to dam removal under low-flow (53 cfs) and bankfull conditions (533 cfs). They were also used to compare sediment transport patterns under existing conditions and following dam removal during high-flow conditions (2-year and 5-year flood frequencies).

Capacity Only Method

The capacity only method provides a total transport capacity flux for existing and post-dam removal conditions. This method utilized a fixed bed in the sediment model. In this method, sediment transport capacity is calculated for all grain sizes and does not factor in transport, bed sorting, and bed layering equations. An equilibrium load, which assumes that the inflow sediment load equals the outflow sediment load, was established as the boundary condition and assigned to both Warner's Pond and the Assabet River outflow locations. The capacity only method was conducted for existing and post-dam removal conditions. Results from both conditions were compared to identify areas of potential erosion or deposition.

Mobile Bed Transport Analysis Method

A mobile bed transport analysis was conducted for the post-dam removal conditions. Unlike the capacity only method, the mobile bed transport analysis considers transport, bed sorting, and bed layering equations. A sediment load rating curve was used at the Warner's Pond and Assabet River outflow locations for the mobile bed scenario. The rating curve specifies a sediment load expressed in tons per day as a function of discharge (e.g., flow rate). Aterra estimated the rating curve from the Rating Curve Calculation in the Hydraulic Design Functions tool in HEC-RAS, which imports data from USGS gauges and the Assabet River at Maynard, Massachusetts gauge (#01097000).

2.7.2.2 Sediment Modeling Results

Under the baseflow and bankfull flow conditions, both methods show that an incised channel is expected to start forming between 500 feet and 800 feet upstream of the dam following its removal. Downstream of the dam, sediment is expected to be transported past the confluence with the Assabet River. Isolated areas of deposition are expected along the banks downstream of the dam, near the BFRT crossing, and just downstream of the confluence with the Assabet River. In the mobile bed transport analysis, the stream bed elevation upstream of the dam post removal is anticipated to be lowered by up to 2 feet, with decreases in bed elevation also occurring at the former dam and near the Pail Factory Bridge.

Under the 2-year and 5-year flood frequency scenarios, both models show sediment being transported through the main channel upstream and downstream of the dam until the peak of the storm passes, after which sediment is expected to deposit downstream of the dam. The mobile bed simulations show an estimated decrease in bed elevation upstream of the dam, post-dam removal, between 0 feet and 4 feet, with decreases in bed elevation also occurring at the former dam and near the Pail Factory Bridge.

2.8 REFERENCE REACH INVESTIGATION

EA conducted a field investigation of Nashoba Brook upstream of Warner's Pond and downstream of Fort Pond Brook on September 25, 2024. It is anticipated that the restored stream

channel formed following dam removal will resemble this section of Nashoba Brook. This anticipated similarity is due to several factors including: similar position in the watershed (e.g. watershed size), similar hydrology (including lack of significant tributaries contributing directly to the pond other than Nashoba Brook), similar soil/surficial geology characteristics, relatively consistent slopes along the reach, and lack of structures/hardening along the bank throughout this reach. Additionally, the modeling shows that this section of Nashoba Brook is upstream of the influence of the backwater effect of the Warner's Pond Dam. The backwater length was also approximated through the hydrologic and hydraulic analysis discussed in Section 2.6. EA evaluated water surface elevations modeled for varying flows in the 2-D HEC-RAS model under the existing condition (dam in place) and post-dam removal.

Further, the reach of Nashoba Brook downstream of the Warner's Pond dam is constricted by a road crossing, structures, and channelization located between Commonwealth Avenue and the confluence with the Assabet River, which affects the hydraulics. Therefore, this reach of Nashoba Brook is not anticipated to be an appropriate reference reach for the new channel within the impoundment.

Channel dimensions were measured along seven transects using a graduated rod. Water depth measurements were collected by wading into the channel from its eastern bank with a tape measure and the graduated rod. Water depth measurements were collected periodically along the transect and the distance along the transect of each measurement was noted using the tape measure. At each transect, the channel became too deep to wade at approximately one-third to one-half of the distance across the channel from its eastern bank. The average maximum water depth measured within the channel was approximately 4.25 feet (range 3.75 feet to 5.0 feet); however, these values do not include the deepest portion of the channel because this area could not be accessed by wading. The average wadeable distance into the channel from its eastern bank was approximately 23.0 feet (range 13.0 feet to 34.0 feet). The average bankfull width of the channel based on field observations collected on September 25, 2024 is estimated at 47.4 feet (range 26.8 feet to 68.0 feet). It should be noted that, according to the National Weather Service, the Boston area received 0.90 inches of rain on September 21, 2024. During the month of September prior to that date, the Boston area received less than 0.10 inches of rain. Field notes and photographs of the reference reach are included in Appendix F.

3. CONCEPTUAL DESIGN

3.1 DESIGN OVERVIEW

Dam removal would restore the Nashoba Brook system to its pre-alteration state as a free-flowing river and bordering vegetated wetland complex by removing the impounding effects of the Warner's Pond dam. The pre-alteration alignment of Nashoba Brook would naturally be restored through the existing impounded area, and the majority of existing open water areas would be converted to one or more vegetated community types. Removal of the Warner's Pond dam is expected to restore approximately 4,750 linear feet (0.9 miles) of stream channel and re-establish approximately 35 acres of new vegetated wetlands. An approximately 4.5-acre open water area which corresponds with the existing pond's deep hole is anticipated to remain in the northern portion of the current impoundment limits.

3.2 DESIGN CRITERIA

The design criteria represent the technical factors considered critical for the project's ability to successfully achieve the project objectives.

- **Extent of spillway removal:** In order to be eligible for a Restoration Order of Conditions under the Massachusetts Wetlands Protection Act, the project must provide for (1) the removal of the full vertical extent of the dam such as no remnant of the dam will remain at or below the streambed and (2) the removal of enough of the horizontal extent of the dam such that after removal, no water will be impounded during the 500-year flood event. The spillway removal and grading plan depicted on the 30% Design Drawings removes the full vertical and horizontal structure of the dam. Therefore, the project is anticipated to be eligible for a Restoration Order of Conditions. It should be noted that the 2-D HEC-RAS modeling of post-dam removal conditions shows that constrictions due to downstream structures (e.g., Pail Factory Bridge) is such that both higher frequency (2-year) and lower frequency flood events (100-year and 500-year) are retained by these structures.
- **Material reuse and disposal:** Removal of the spillways and embankment will generate approximately 3,000 cubic yards of earth, stone, and other materials which will need to either be reused or disposed offsite. To help offset project costs, aggregate from the dam removal and large stone may be salvaged for use on other Town of Concord projects.
- **Water Management:** Cofferdams would be constructed upstream of each spillway as proposed on Sheet 4 of the 30% Design Drawings. Areas between the cofferdam and the spillway would be dewatered so that mechanical removal of the spillway and excavation could occur in the dry. Given the two spillways, use of a pump-around system or auxiliary channel would not be needed to manage flow from Nashoba Brook.
- **Sediment Management:** This 30% design proposes in-stream management of sediment. Sediment removal will be limited to areas immediately upstream of the dam – the areas between coffer dams and spillways – to allow for mechanical removal of the dam structures and minor grading activities. Excavated material will

be staged for dewatering followed by offsite disposal. The remainder of fine grained material currently impounded in Warner's Pond will be allowed to erode and deposit downstream in Nashoba Brook and the Assabet River through natural processes. With in-stream management, short-term impacts to the downstream reaches of Nashoba Brook and the Assabet River are expected with initially turbid flows occurring shortly after removal. Longer-term, variable flow events within the channel will distribute the sediment downstream providing influx of organic matter that will improve benthic habitats and have long term ecological benefits. As described in Section 2.7.1.2 of this report, erosion and depositional areas are expected to remain consistent between existing conditions and post-dam removal conditions.

- **Protection of infrastructure and utilities:** Dewatering and construction methods will ensure no adverse impacts to downstream infrastructure (including the Pail Factory Bridge, BFRT bridge, pedestrian footbridge, stone retaining wall, and private properties) and utilities. Mechanical excavation and removal of the impoundment structures will not impact known utilities.
- **Water surface elevation and depth:** In general, dam removal is not anticipated to alter downstream WSELs; which was confirmed through the 2-D HEC-RAS for Nashoba Brook. As discussed previously, the restored stream channel will form overtime following dam removal as sediment is mobilized downstream. The existing conditions (sediment thickness and channel elevations) are expected to decrease as a new stream channel develops through Warner's Pond. A further discussion is presented in Section 4.1
- **Channel location and dimensions:** Based on the results of the bathymetric survey and a review of publicly available aerial photographs of the pond, EA believes that the restored stream channel is likely to pass between the Gerow Recreation Area and Myrica Island. Further discussion is presented in Section 4.1.

3.3 DESIGN APPROACH

Construction access and staging areas will be located adjacent to the main spillway and auxiliary spillway, respectively. An access road will need to be constructed between Commonwealth Ave. and the area behind residential properties along the east bank of Warner's Pond. Staging and processing areas will be located to the north of the main spillway and to the southeast of the auxiliary spillway. These areas will be used to stockpile excavated material and dewater dredged sediment prior to offsite disposal.

For demolition and removal of the main spillway, a cofferdam will be positioned between the earthen berm and the island between the two spillways as shown on Sheet 4 of the 30% Design Drawings. Water between the cofferdam and main spillway structures will be pumped out and discharged downstream. Sediment will be mechanically removed and placed in the dewatering area to the north. During removal of the main spillway, Nashoba Brook would continue to flow over the auxiliary spillway. The main spillway will be breached and demolished through mechanical means. Once the main spillway is demolished, the cofferdam dam will be removed, restoring the flow of Nashoba Brook through the main spillway area. A second cofferdam is

anticipated between the island and southern bank of Warner's Pond to isolate the auxiliary spillway. Like the process of the main spillway removal, the area will be dewatered and excess sediment mechanically dredged and stockpiled in the dewatering area to the east.

Once both spillways are demolished, water surface elevation upstream of the former spillway locations will drop to approximately 115 feet NAV88, allowing the remaining excavation and grading work to be performed in drier conditions. The 320-foot earthen embankment to the north of the main spillway will also be removed and regraded.

It is assumed that all material from the demolished spillway, excavated sediment, and embankment will be transported and disposed of offsite. However, some of the material may be chemically tested and reused in other ongoing Town of Concord improvement projects. Additionally, concrete, brick, and aggregate could be transported to a recycling facility for beneficial reuse.

After the dam has been removed, the water will recede and expose much of the impoundment bottom sediment. The exposed sediment is expected to naturally re-vegetate via the existing seedbank and natural dispersal of adjacent vegetation. Careful monitoring and adaptive management will be critical for ensuring that the formerly impounded area vegetates appropriately, and that invasive species are kept to a minimum, especially given that invasive purple loosestrife is present in the wetland areas surrounding the pond. Seeding and planting within the impoundment are not expected as part of the initial restoration actions but should be included in an adaptive management plan if these actions become necessary to promote the development of a native wetland plant community.

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4. ANTICIPATED EFFECTS

Removal of the Warner's Pond dam will restore the aquatic system to a free-flowing river and bordering vegetated wetland complex by removing the impoundment effects of the dam. This fundamental change to the nature of the aquatic system will affect the ecological, recreational, and community functions and values that the system provides. The Alternatives Analysis Report (EA 2023) provides a discussion of the anticipated effects of the dam removal to a variety of resources including water supply, flood control, storm damage prevention, water quality, fish and wildlife habitat, recreation, and aesthetics. The following sections provide additional detail related to the anticipated effects of dam removal on a targeted subset of these resources based on the additional information developed during this phase of the project.

4.1 RESTORED CHANNEL DIMENSIONS, WATER SURFACE ELEVATION, AND DEPTH

Once the dam is removed, Nashoba Brook will be allowed to form naturally through the former pond's footprint; the current design does not include earthwork, grading, hardscaping, etc. to create an engineered channel alignment. For this reason, there is some uncertainty with respect to the restored channels' path, width, depth, bedform, etc. In a dynamic river system, channel location and dimensions are continually evolving over time due to different flow conditions, storm events, channel obstructions (e.g., large woody debris, etc.), and erosional and depositional forces. The inherent unpredictability of these forces and the impact that climate change may have upon them makes predicting the precise location and dimensions of the restored stream channel through the formerly impounded area challenging. The information provided below is useful for developing a general characterization of potential future channel conditions, with the understanding that such conditions will invariably change over time as the restored reach of Nashoba Brook regains equilibrium and responds to events within its watershed.

Immediately following dam removal, the stream channel is expected to be wide and relatively shallow until a more stable stream channel forms. To conceptualize this initial channel, EA used the 2-D HEC-RAS model to estimate dimensions of the initial channel formed shortly after dam removal. EA extracted a stream profile from Nashoba Brook through Warner's Pond, terminating at the dam. The path of the profile follows the deepest sections of terrain (bathymetry) through the pond. Three flow conditions were modeled:

- Baseflow (53 cfs)
- Average flow in August (41 cfs)
- August 50 percent exceedance flow (11 cfs)

The average flow in August was derived from historical USGS stream gauge data from Nashoba Brook immediately downstream of the Warner's Pond dam. The USGS stream gauge record includes data from August 2006 through 2009. Data for the month of August was averaged across all four years (2006 through 2009). The August 50 percent exceedance flow was derived from StreamStats which provides flow duration statistics report for varying flow conditions. A 50 percent flow exceedance indicates that the stream flow of 11 cfs is exceeded 50 percent of the time.

The model results presented and discussed below are based on the existing terrain:

- Under baseflow conditions (53 cfs), water depths generally range from 1 to 3 feet within the channel, with select areas that are 4 to 8.5 feet deep where the terrain is lower. The minimum water depth along this profile is 1 foot. Channel widths where the water is at least 1 foot deep range from 70 to 400 feet wide.
- Under the average August flow condition (41 cfs), water depths generally range from 0.9 to 2.5 feet, with smaller areas that are 3.5 to 8.5 feet where the terrain is lower. The minimum water depth along this profile is 0.9 feet. Channel widths where the water is at least 1 foot deep range from 50-400 feet wide.
- Under the August 50 percent exceedance flow (11 cfs), water depths generally range from 0.2 to 2 feet, with deeper areas from 2.5 to 8 feet where the existing terrain is lower. The minimum water depth along the profile is 0.2 feet. Channel widths where the water is at least 1 foot deep range from 20-350 feet wide.

It is important to note that these values are based on the existing terrain, and post-dam removal channel-forming processes are expected to establish a narrower and deeper channel over time. Exports from the HEC-RAS model depicting the stream profile and water depths are presented in Appendix G. Results of the sediment modeling described in Section 2.7 indicate that sediment will be mobilized following dam removal and that a restored channel will develop upstream of the dam through the former footprint of Warner's Pond. Channel bed elevations upstream of the dam may decrease up to two feet under baseflow conditions due to the downstream mobilization of sediment from the impoundment. As stated in Section 2.7.2, under the 2-year and 5-year flood frequency scenarios, both models show mobile sediment being transported through the main channel until the peak of the storm passes, after which sediment is expected to be deposited downstream of the existing dam location. Channel bed elevations are expected to be further reduced (up to 4 feet) following dam removal at the first few occurrences of a 2-year or 5-year storm event.

Based on the results of the bathymetric survey described in Section 2.2 and a review of publicly available aerial photographs of the pond, EA believes that the restored stream channel is likely to pass between the Gerow Recreation Area and Myrica Island. In this case, the bank of the restored channel is anticipated to be within approximately 100 feet of the shoreline of the Gerow Recreation Area. This path represents the lowest bed elevations within the existing impoundment. The Watershed Management Plan indicates that the primary flow path of water through Warner's Pond is between Scout Island and Myrica Island based on field observations made in 2011/2012. This difference may be due to the time of year and/or flow conditions that existed at the time that field observations were made. It is also likely that the dominant flow path through the pond has shifted over time as sediment has accumulated within the channels. While the initial location of the restored channel is expected to pass around the northern side of Myrica Island, rivers are dynamic systems, and the channel location is expected to change over time. Without intervention, natural stream channels migrate laterally by eroding one bank and depositing on the opposite bank.

As stated in Section 2.8, the restored channel dimensions (width and depth) are anticipated to resemble the reach of Nashoba Brook located upstream of Warner's Pond and downstream of its

confluence of Fort Pond Brook. It is important to note that the restored reach of Nashoba Brook through the formerly impounded area may not share identical dimensions to the reach upstream of the impoundment; however, understanding conditions in the reach upstream of the impoundment can provide a general approximation of the potential future restored channel dimensions. Based on field measurement of the upstream portion of Nashoba Brook in September 2024, the bankfull width of the restored channel width may range between 26.8 feet and 68.0 feet with water depths ranging from 3.75 feet to 5.0 feet (water depth values do not include the deepest portion of the channel because this area could not be accessed by wading).

4.2 FLOOD CONTROL

From the 2-D HEC-RAS modeling described in Section 3, inundation maps were created for various flood frequency events (Appendix B, Aterra 2024). With no significant drop in water level upstream of the dam and the remaining constrictions downstream of the dam, Nashoba Brook is expected to continue to utilize its floodplain (including the footprint of Warner's Pond) during both higher frequency and lower frequency flood events. During the higher frequency 2-year and 5-year events, the flood conditions of Warner's Pond are expected to slightly decrease, particularly in the south and southwestern extents of the Pond. The extents of inundation in post-dam removal conditions during the 25-year, 100-year, and 500-year events are nearly equal to existing conditions. Overall, there will be no increase to the 100-year and 500-year flood plain as a result of dam removal.

4.3 FISH AND SHELLFISH HABITAT

As stated in the Alternatives Analysis Report (EA 2023), an estimated 17.3 miles of aquatic habitat would be reconnected through removal of Warner's Pond dam. Nashoba Brook flows downstream from the Warner's Pond dam for approximately 0.2 miles before meeting the Assabet River, which in turn flows for approximately 2.8 miles before meeting the Sudbury River at Old Calf Pasture and forming the Concord River. From there, the Concord River flows generally north for approximately 16.5 miles before discharging to the Merrimack River in Lowell. The Merrimack River then flows generally northeast for approximately 38 miles before emptying into the Gulf of Maine.

Massachusetts Division of Ecological Restoration ranks the Warner's Pond dam in the 60th percentile for ecological benefit of removal. In the 57.5 river miles between Warner's Pond and the Gulf of Maine, there are currently four dams present. Three of these dams have had fish passage reestablished. The Talbot Mills dam in Billerica, which is presently an obstacle to fish passage, is currently slated for removal. Following removal of the Talbot Mills dam, there will be no remaining obstacles to diadromous fish migration between the Gulf of Maine and Warner's Pond dam.

The target species identified for restoration in the Concord River Diadromous Fish Restoration Feasibility Study (Gomez and Sullivan 2016) include those that migrate between freshwater and marine environments (diadromous species) such as river herring (blueback herring and alewife, American shad, American eel, and sea lamprey). The Concord and Sudbury Rivers and their tributaries are estimated to contain over 840 miles of spawning and rearing habitat. As Nashoba Brook is a tributary to the Concord River, EA evaluated the compatibility of post-dam removal conditions with these target species including channel depth, channel slope, and channel width.

The USFWS Fish Passage Engineering Design Criteria guidance document presents a table with design criteria thresholds for various target species (USFWS 2019). Table 4 shows the criteria for the project target species with the limiting threshold for each category in bold.

Table 4. Target Species Design Thresholds

Species	Minimum Pool/Channel Depth (ft)	Minimum Pool/Channel Width (ft)	Maximum Channel Slope
Blueback Herring	2.00	5.0	1:20
Alewife	2.25	5.0	1:20
American Shad	4.00	20.0	1:30
American Eel ≤ 15 cm Total Length	1.25	3.0	1:20
American Eel > 15 cm Total Length	2.00	6.0	1:20
Sea Lamprey	2.00	10.0	1:30

Notes:
cm = Centimeters
ft = Foot (feet)

The limiting values for each category are associated with the American shad. As discussed in Section 3.2, the dimensions of the restored channel through the formerly impounded area are expected to be generally similar to the reach of Nashoba Brook upstream of Warner’s Pond and downstream of Fort Pond Brook. Based on field measurements of this reach of Nashoba Brook collected in September 2024, the average maximum channel depth within the wadeable portion of the stream was approximately 4.25 feet and the average bankfull width of the channel was estimated at approximately 47.4 feet. An analysis of existing conditions terrain within the impoundment results in a maximum channel slope through the project area of 1:178. It should be noted that conditions within the restored channel are expected to evolve over time following dam removal, which may alter the channel width, depth, and slope relative to the design thresholds for target anadromous fish species. However, this initial analysis indicates that the restored channel is expected to support the target species listed in Table 4.

4.4 WILDLIFE HABITAT

As discussed in Section 2.6, dam removal will lower average water surface elevations within the currently impounded area by approximately 4.2 feet, returning water surface elevations in the system to a condition more similar to what existed prior to the construction of the dam. Reduced water surface elevations will result in commensurate changes to the ecological communities within the currently impounded area. Existing ecological communities within the Warner’s Pond system are discussed in Section 2.4 and depicted on Figure 3. An analysis of modeled post-construction water depths during base flow conditions was completed to assist in predicting the approximate extents of ecological communities following dam removal. For this analysis, modeled water depth data for the impoundment was used as a proxy for ecological community occurrences. Table 5 identifies the post-construction ecological communities which may develop within the formerly impounded area and their approximate associated water depth ranges. Water depth ranges were derived from *Classification of the Natural Communities of Massachusetts* (Swain 2020) where available, and where unavailable, using the best professional judgement of EA ecologists.

Table 5. Post-Construction Ecological Communities and Approximate Associated Water Depth Ranges

Ecological Community	Approximate Associated Water Depth Range	
	Minimum (ft)	Maximum (ft)
Open Water	2.0	No maximum
Deep Emergent Marsh	0.5	3.0
Shallow Emergent Marsh	0.0	1.0
Shrub Swamp	0.0	0.5
Deciduous Forested Wetland	-1.5	0.0
Upland Forest	No minimum	-1.5

Notes:

Positive numbers indicate standing water, negative numbers indicate depth of water table below ground surface.

ft = Foot (feet)

Figure 4 depicts the approximate extents of post-construction ecological communities within the formerly impounded area based on the approximate water depth ranges provided in Table 5. Table 6 summarizes the approximate extents of the existing and potential post-construction ecological communities within the system.

Table 6. Approximate Extents of Existing and Potential Post-Construction Ecological Communities

Ecological Community	Current Extent (acres)	Current Extent (%)	Post-Construction Extent (acres)	Post-Construction Extent (%)
Open Water	42.2	64.4%	Up to 8.2	9.6%
Deep Emergent Marsh	8.9	13.6%	Up to 17.6	20.7%
Shallow Emergent Marsh	0.0	0.0%	Up to 15.9	18.7%
Shrub Swamp	2.6	4.0%	Up to 10.5	12.4%
Deciduous Forested Wetland	4.0	6.1%	Up to 11.2	13.2%
Upland Forest	7.8	11.9%	Up to 21.6	25.4%

It should be noted that the results of this analysis are approximate and presented for informational purposes only. The analysis relies on several inputs and assumptions, including existing pond bathymetry, the modeled effects of dam removal on water surface elevations, and the correlation between ecological communities and average water depth ranges. Predicting the exact type, extent, and location of ecological communities that may develop following dam removal may be infeasible, and changing site conditions (e.g., due to sediment mobilization, climate change, and other factors) may alter the results of this analysis. As discussed elsewhere in this report, an open channel is expected to develop within the formerly impounded area following dam removal as a result of changes to bottom elevations due to sediment mobilization. This effect is expected to increase the area of open water beyond what is presented in Table 6 and result in a continuous channel through the formerly impounded area.

4.5 RECREATION

Recreational opportunities and recreational use are dependent on and affected by vegetation, facilities and infrastructure, biodiversity, the hydraulic regime, and water quality, among other factors. Removal of the Warner’s Pond dam will change the nature and type of recreational

opportunities afforded by this resource. Of particular interest has been potential opportunities for paddle craft use in a post-dam removal scenario. As discussed in Section 3.2, the precise location and dimensions of the restored reach of Nashoba Brook are challenging to predict and will invariably evolve over time, as is the case in all natural riverine systems. In general, however, the restored channel is anticipated to be similar to the reach of Nashoba Brook located upstream of Warner's Pond and downstream of Fort Pond Brook. Section 3.2 discussed the existing channel dimensions within this area. Additionally, improvements to aquatic connectivity as a result of dam removal may improve the opportunities for paddle craft use between Nashoba Brook/Fort Pond Brook and the Assabet River by removing the need to portage around the existing dam.

It is EA's understanding that the Town of Concord is continuing to develop and evaluate options for recreational improvements in and around Warner's Pond. These options are partially dependent on the Town's evaluation of alternatives and strategies for managing the existing impoundment (e.g., dam removal, sediment dredging, etc.). As these alternatives are advanced, and recreational alternatives are evaluated, future recreational improvements can be incorporated into subsequent phases of the design.

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5. PROJECT PHASING

Further work will be required to advance the dam removal project beyond this 30% design phase as discussed in the following sections.

5.1 ADDITIONAL TECHNICAL STUDIES

Additional investigative work will be required to advance the engineering design and support future permitting and post-construction monitoring efforts. Sediment sampling within Warner's Pond will be required to determine presence or absence of contaminants that could be mobilized downstream following dam removal. The sediment samples collected in 2017 indicated that some of the sediment south of Scout's Island is impacted by arsenic; however, these samples are now too dated to support future permitting. This process should begin with a meeting with MassDEP 401 Dredging Program staff to discuss project-specific sampling and analysis requirements. A Sediment Sampling Plan should be prepared based on this discussion for review and approval by MassDEP prior to the start of field sampling. Once the Sediment Sampling Plan has been approved, sediment samples should be collected in accordance with the requirements of the plan. It is likely that MassDEP will require samples to be analyzed for the full suite of potential contaminants identified at 314 CMR 9.07(2)(b)(6), including volatile organic compounds, semi-volatile organic compounds, metals, mercury, pesticides, herbicides, and polychlorinated biphenyls. It should also be noted that under current regulations, MassDEP may require sampling for additional analytes – including but not limited to PFAS – beyond those identified at 314 CMR 9.07(2)(b)(6).

A delineation of jurisdictional wetland resource areas in the vicinity of the dam will also be required to support detailed design and permitting.

5.2 DETAILED DESIGN AND PERMITTING

Following completion of additional technical studies as described in Section 5.1, the preliminary design for the project should be advanced to detailed design. The detailed design phase will refine grading, including further cross-section and profile views of the work area and restoration areas. Technical construction specifications regarding construction and materials, project sequencing, planting plans (as needed), resource and infrastructure protection plans, etc. will be developed at this stage.

Dam removal will require multiple regulatory permits and approvals from federal, state, and local agencies as summarized in the following section. The 60% design set and specifications will be utilized for permit submittals and discussions.

Federal Clean Water Act (CWA): The project will entail a discharge of dredged or fill material to a jurisdictional Water of the United States and therefore will require authorization by the USACE under Section 404 of the federal CWA. The project is expected to be eligible for coverage under Massachusetts General Permit 23: Aquatic Habitat Restoration, Enhancement, and Establishment Activities. A Pre-Construction Notification would be required to seek coverage under the General Permit.

National Flood Insurance Program: The project will require a Letter of Map Revision issued by the Federal Emergency Management Agency because dam removal will alter the base flood elevation in the area around Nashoba Brook.

Massachusetts Environmental Policy Act (MEPA): The project will be subject to MEPA jurisdiction because it will require one or more permits from a state agency and will require MEPA review because it will trigger one or more MEPA review thresholds as listed in 301 CMR 11.03. If the project is eligible for a Restoration Order of Conditions as described below, the project would in turn be eligible for review under MEPA's streamlined process for ecological restoration projects. If the project is not eligible for a Restoration Order of Conditions, the project would require the filing of an Environmental Impact Report (EIR) because the project will exceed at least one mandatory EIR review threshold under MEPA (301 CMR 11.03(3)(a)(1)(b), alteration of ten or more acres of any other wetlands). Additionally, pursuant to 301 CMR 11.06(7)(b), the recently revised MEPA regulations require the submittal of an EIR for any project requiring MEPA review located within one mile of an Environmental Justice population. Warner's Pond is located within one mile of an Environmental Justice population (Block Group 3, Census Tract 3612).

Massachusetts Clean Waters Act: The project will require a 401 Water Quality Certification issued by Massachusetts Department of Environmental Protection pursuant to the Massachusetts CWA and the federal CWA because the project will result in more than 100 cubic yards of dredging and dredged material re-use or disposal (314 CMR 9.04(12)).

Massachusetts Public Waterfront Act (Chapter 91): The project is located within a geographic area subject to jurisdiction under Chapter 91 (310 CMR 9.04(1)(e)) and will involve an activity requiring a Chapter 91 license (310 CMR 9.05(1)(a)) and permit (310 CMR 9.05(2)(b) and (c)) issued by Massachusetts Department of Environmental Protection.

Massachusetts Dam Safety Statutes: The project will result in the removal of a dam which is regulated by the Office of Dam Safety and will therefore require a permit pursuant to Chapter 253 of the Massachusetts General Laws and 302 CMR 10.00.

Massachusetts Wetlands Protection Act and Concord Wetlands Protection Bylaw: The project will alter one or more areas subject to protection under the Wetlands Protection Act (310 CMR 10.02) and the Concord Wetlands Protection Bylaw and will therefore require an Order of Conditions issued by the Concord Natural Resources Commission. The project would be eligible for a Restoration Order of Conditions pursuant to 310 CMR 10.13 if the following criteria are met:

- The project will not involve the removal of a dam that was constructed or is managed for flood control by a municipal, state, or federal agency.
- The project will not adversely impact public water supply wells or water withdrawals permitted or registered under the Water Management Act, M.G.L. c. 21G, and 310 CMR 36.00: Massachusetts Water Resources Management Program within the reach of the stream impacted by the impoundment.

- The project will not adversely impact private water supply wells including agricultural or aquacultural wells or surface water withdrawal points.
- The project provides for the removal of the full vertical extent of the dam such that no remnant of the dam will remain at or below the streambed as determined prior to commencement of the dam removal project, or if such determination cannot be made at that time, as determined during construction of the project.
- The project provides for the removal of enough of the horizontal extent of the dam such that after removal no water will be impounded during the 500-year flood event.
- The project will not involve a hydroelectric facility requiring a Federal Energy Regulatory Commission license or an amendment to a Federal Energy Regulatory Commission license.
- A permit authorizing the dam removal in accordance with 302 CMR 10.00: Dam Safety has been issued by the Office of Dam Safety.
- If the project is exempt from the requirement to obtain a license or permit under 310 CMR 9.05(3)(n), the project will not have an adverse effect on navigation or on any docks, piers, or boat ramps authorized under 310 CMR 9.00: Waterways.

The project is anticipated to meet these criteria and therefore be eligible for a Restoration Order of Conditions. If the project is not eligible for a Restoration Order of Conditions, it is expected to be eligible for review as an Ecological Restoration Limited Project pursuant to 310 CMR 10.53(4)(e)(5). Resource areas expected to be directly affected by the proposed work include bank, land under waterbodies and waterways, and Riverfront Area, as well as the buffer zones associated with the bank resource area established by the Massachusetts Wetlands Protection Act and the Concord Wetlands Protection Bylaw. Resource areas anticipated to be indirectly affected by dam removal due to changing water levels include bank, land under waterbodies and waterways, bordering vegetated wetland, bordering land subject to flooding, and Riverfront Area, as well as the buffer zones associated with the bank and bordering vegetated wetland resource areas.

5.3 FINAL ENGINEERING DESIGN AND CONTRACTING

This project phase entails development of final engineering designs, technical specifications, and the final engineer's opinion of cost. The development of these documents will begin when the regulatory permitting process is substantially complete. The final design package will incorporate any revisions to the project design made during the permitting process and reflect any permit conditions, providing the contractor with the information necessary to complete the work in accordance with all project requirements. The final design package will be incorporated into the Town's bid documents to support the public bidding process for project implementation.

Table 7. Estimated Costs for Future Technical Studies, Design, and Permitting

Project Phase	Task	Low Estimate	High Estimate	Notes
Additional Technical Studies	MassDEP Coordination and Sediment Sampling Plan Preparation	\$5,000	\$8,000	
	Sediment Sample Collection	\$3,000	\$4,000	Cost is presented on a per-day basis
	Sediment Analysis	\$2,000	\$2,500	Cost is presented on a per-sample basis
	Sediment Sampling and Analysis Report	\$4,000	\$6,000	
	Wetland Delineation and Associated Documentation	\$5,000	\$7,000	Limited to the vicinity of the dam
Detailed Design and Permitting	Detailed (60%) Engineering Design Drawings and Associated Documentation	\$45,000	\$60,000	
	Regulatory Permitting	\$65,000	\$100,000	
Final Engineering Design and Contracting	Final Engineering Design and Contracting	\$35,000	\$55,000	

5.4 POST CONSTRUCTION MONITORING AND ADAPTIVE MANAGEMENT

Post-construction monitoring is a critical aspect of any restoration project and is likely to be a requirement of one or more permits issued for the work. Outside of permit conditions, project stakeholders should select a subset of the goals/objectives presented in Section 1.3 to monitor, evaluate, and assess post-construction. Monitoring confirms whether the project objectives have been achieved, identifies the need for adaptive management, and ensures that the restoration continues along the desired trajectory.

Routine monitoring assesses the physical, chemical, and biological condition of the areas affected by the project and should focus on documenting the response of Nashoba Brook, including any positive or negative ecological outcomes. The exact timing and duration of post-construction monitoring varies across projects, but a typical schedule is two rounds of monitoring per year for 5 to 10 years following the completion of construction. A year-end report would be prepared during each monitoring year that provides a summary of the monitoring results, identifies whether project objectives are being met, and provides recommendations for adaptive management measures to remedy any deficiencies.

Depending on the selected project objectives, monitoring can include an evaluation of wetland and vegetation establishment, invasive species presence and quantity, instream habitat, and channel stability (erosion and deposition). Wetland and vegetation monitoring is typically required under several of the permits identified in Section 5.2. If the stability and path of Nashoba Brook is important, monitoring might include mapping/survey of the channel. To assess stability, cross-sections could be selected and periodically monitored for changes, including after major flooding events. Changes to the stream channel geometry through the selected cross-sections can indicate channel instability (erosion or deposition). Successful channel stability would be defined by minimal changes in the cross-sectional area or channel geometry between monitoring events.

Adaptive management is an iterative process that includes evaluating the extent to which a project is achieving or is on a trajectory to achieve its goals and objectives, assessing the nature and extent of problems, designing or implementing solutions, continued monitoring, evaluating the effectiveness of the solution, and adjusting management actions as appropriate based on results. While not all problems/issues can be forecasted, it is highly recommended to develop a process for evaluating and responding to problems that may arise following the completion of a project to ensure its long-term success. A formal adaptive management plan and assessment matrix should be developed to define performance objectives and guide decision making to implement the needed corrections.

Stream restoration is an evolving field and the conditions within the Nashoba Brook watershed are expected to be dynamic. Adaptive management is implemented by project stakeholders using post-construction monitoring data if the project objectives or performance monitoring metrics appear not to be on a success trajectory. Adaptive management actions for addressing problems related to re-growth of native vegetation and invasive plant development could include:

- Supplemental planting and/or seeding focused on species that are well adapted to observed conditions within the target planting area
- Mechanical, biological, and/or chemical control of invasive species

It should be noted that dam removal projects completed at other locations in Massachusetts have documented rapid regrowth of native vegetation within the formerly impounded area.

Adaptive management actions for channel stability could include:

- Bank stabilization using nature-based solutions (live stakes, live fascines, coir logs, etc.)
- Installation of water control structures (e.g., vanes, barbs) to redirect flow
- Stabilization of in-stream structures (large wood, logs, etc.)
- Adaptive sediment management and re-grading

Implementation of adaptive management will likely require additional technical support, contracting, and disturbance of the original sites to carry out planned corrective actions.

6. REFERENCES

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Figures

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VICINITY MAP

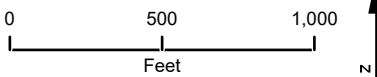
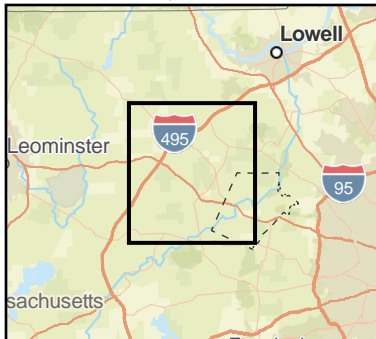
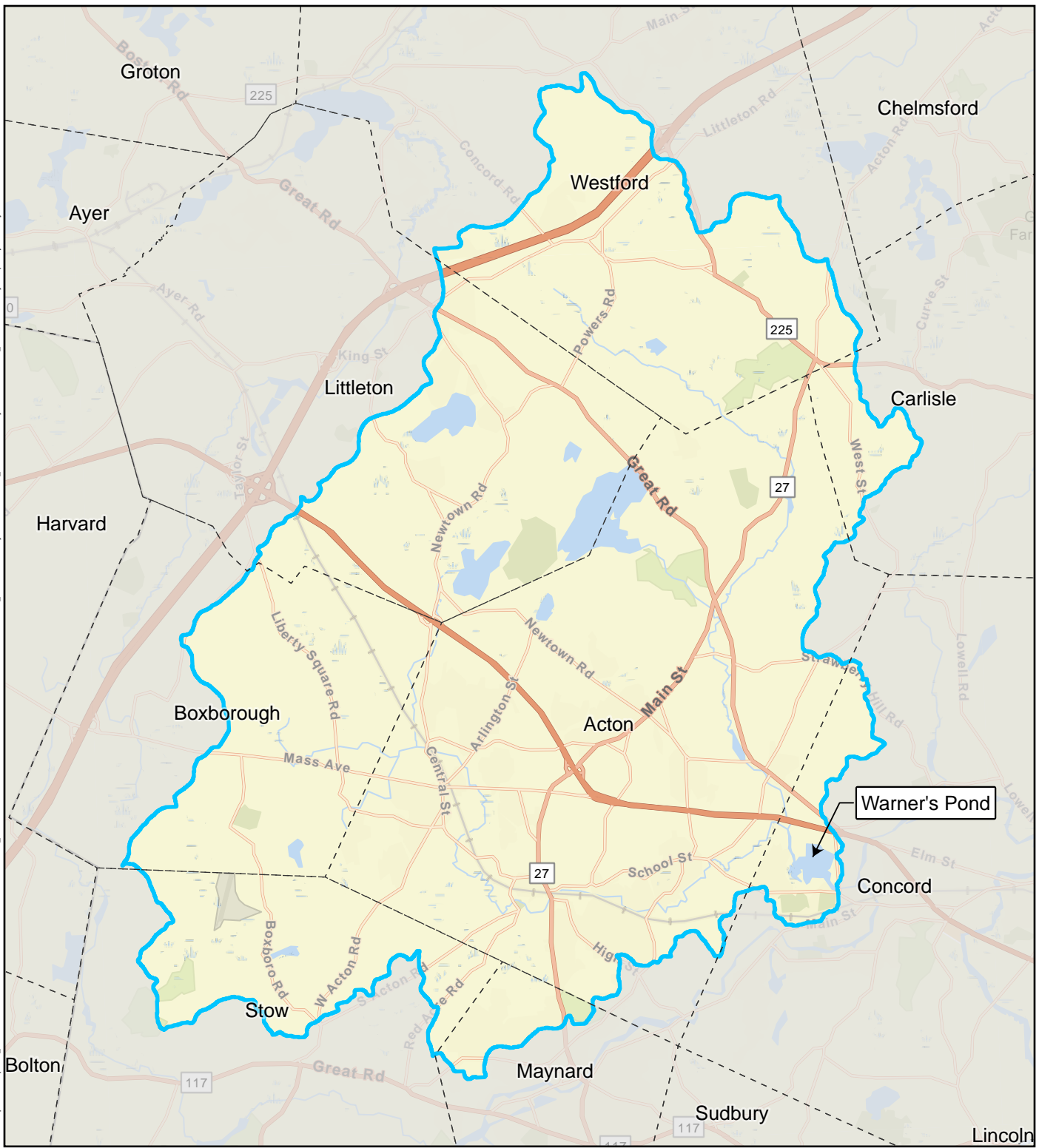


Figure 1
Site Locus
 Warner's Pond Basis of Design
 Concord, MA

Map Date: 5/4/2023
 Source: Census 2020
 Projection: NAD 1983 UTM Zone 19N





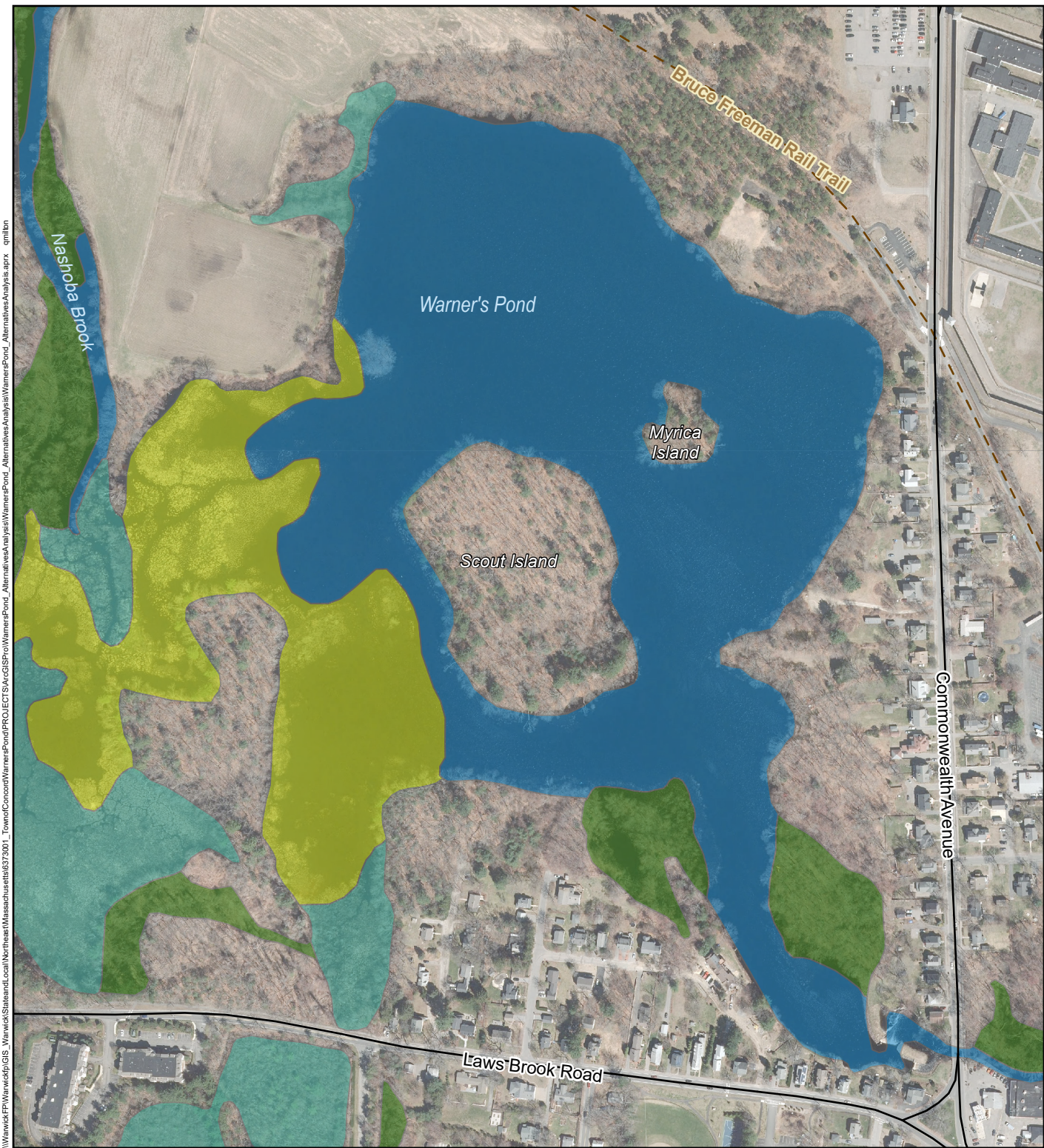
- Legend**
- Town Line
 - Warner's Pond Watershed



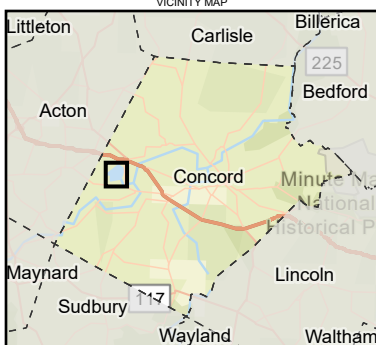
Figure 2
 Warner's Pond Watershed
 Warner's Pond Basis of Design
 Concord, MA

Map Date: 1/30/2023
 Source: ESRI 2022, MassGIS 2022; StreamStats 2023
 Projection: NAD 1983 UTM Zone 18N





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Legend

- Roads
- Wetland Type**
- Deep Marsh
- Open Water
- Shrub Swamp
- Wooded Swamp Deciduous

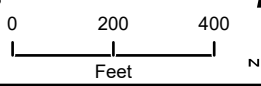
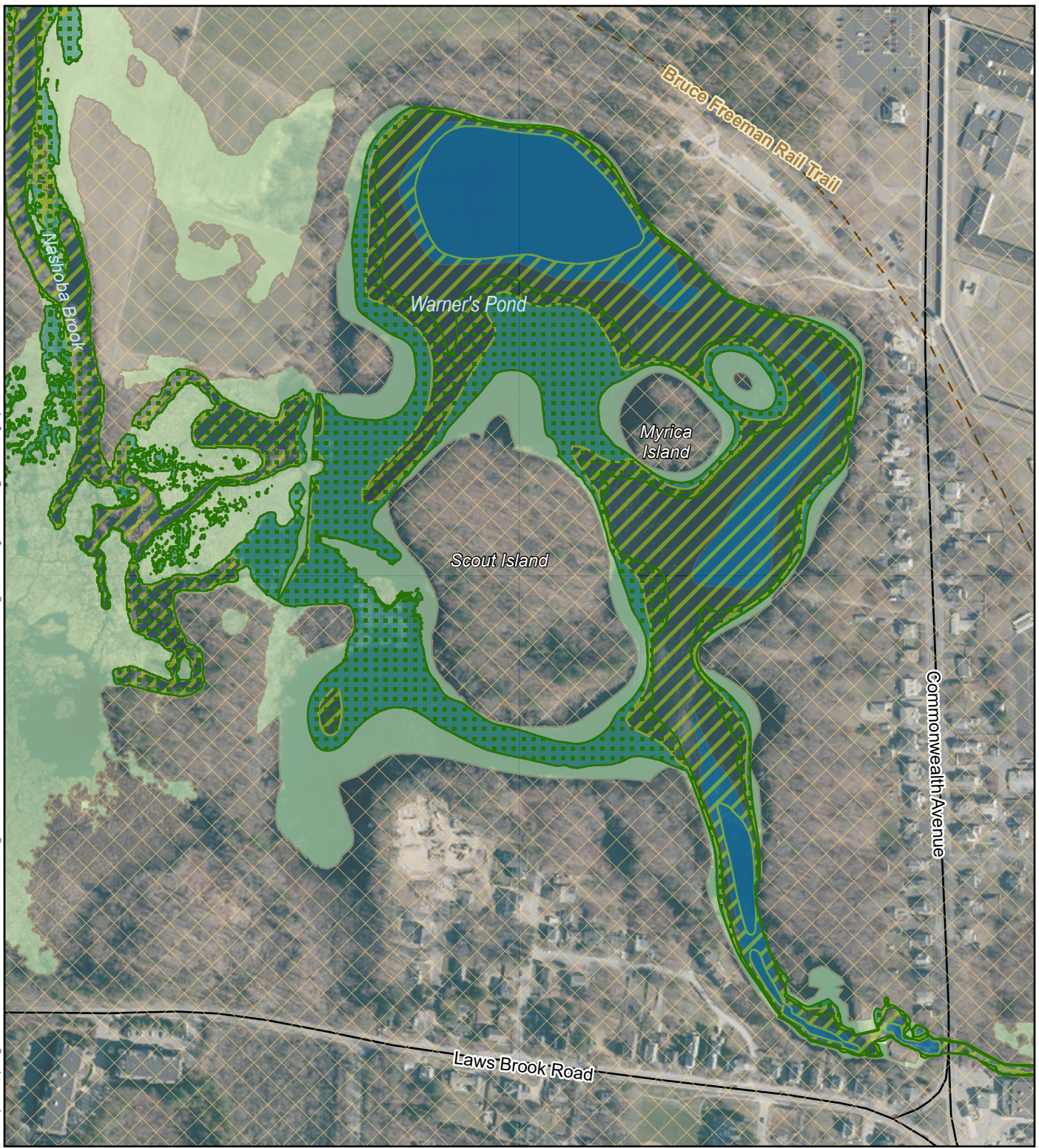


Figure 3
Existing Ecological Communities
 Warner's Pond Basis of Design
 Concord, MA

Map Date: 2/21/2023
 Source: MA DEP 2005
 Projection: NAD 1983 UTM Zone 19N





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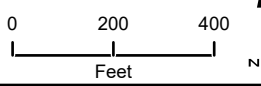
VICINITY MAP



- Legend**
- Roads
 - Shallow Emergent Marsh
 - ▨ Deep Marsh
 - Open Water
 - Shrub Swamp
 - Deciduous Forested Wetland
 - Upland Forest

Figure 4
Post Removal Ecological Communities
 Warner's Pond 30% Design
 Concord, MA

Map Date: 8/19/2024
 Source: MA DEP 2005
 Projection: NAD 1983 UTM Zone 19N



Appendix A:
30% Design Drawings

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WARNER'S POND DAM REMOVAL

CONCORD, MASSACHUSETTS

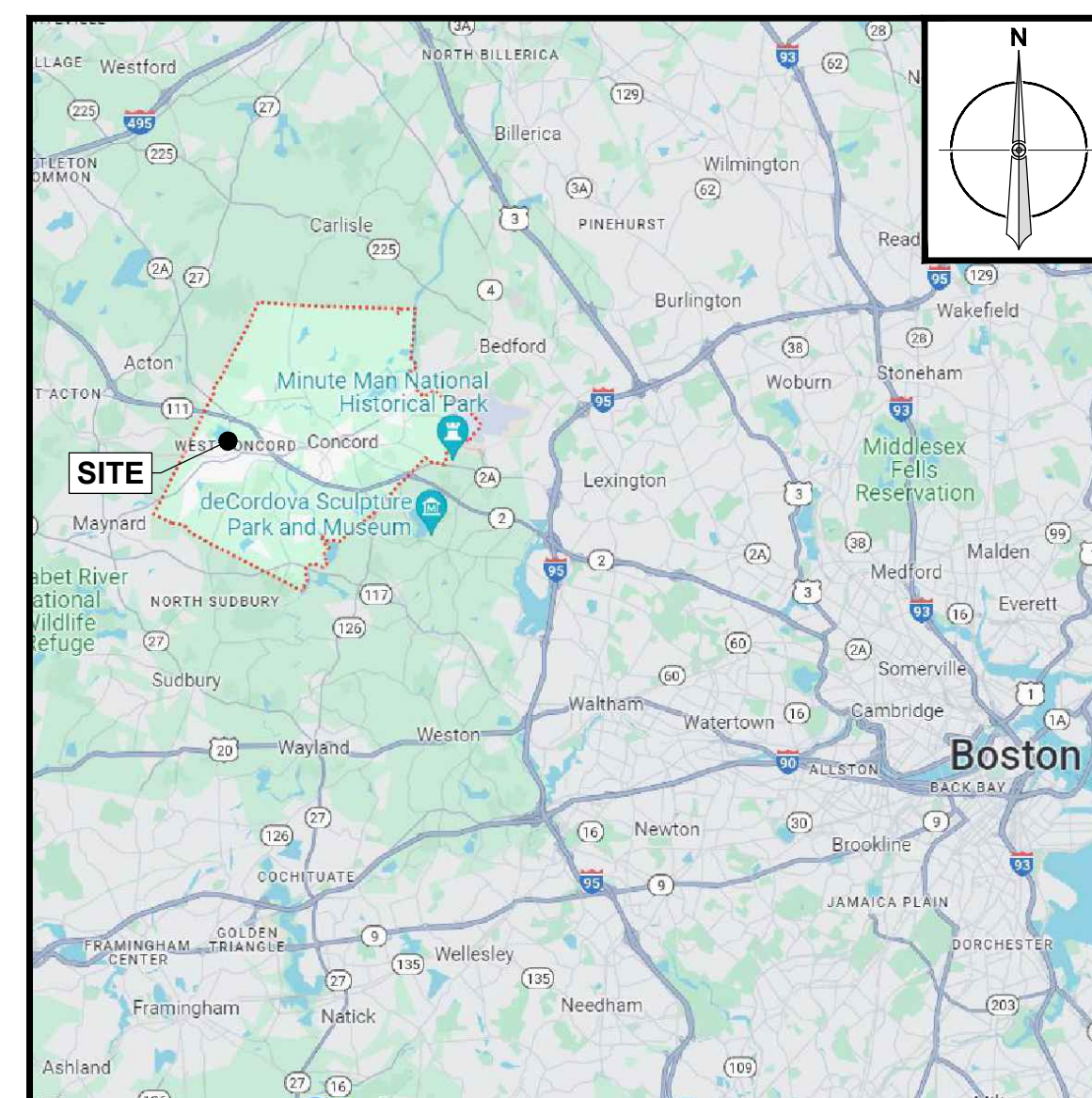
30% DESIGN



EA Engineering, Science, and
Technology, Inc., PBC

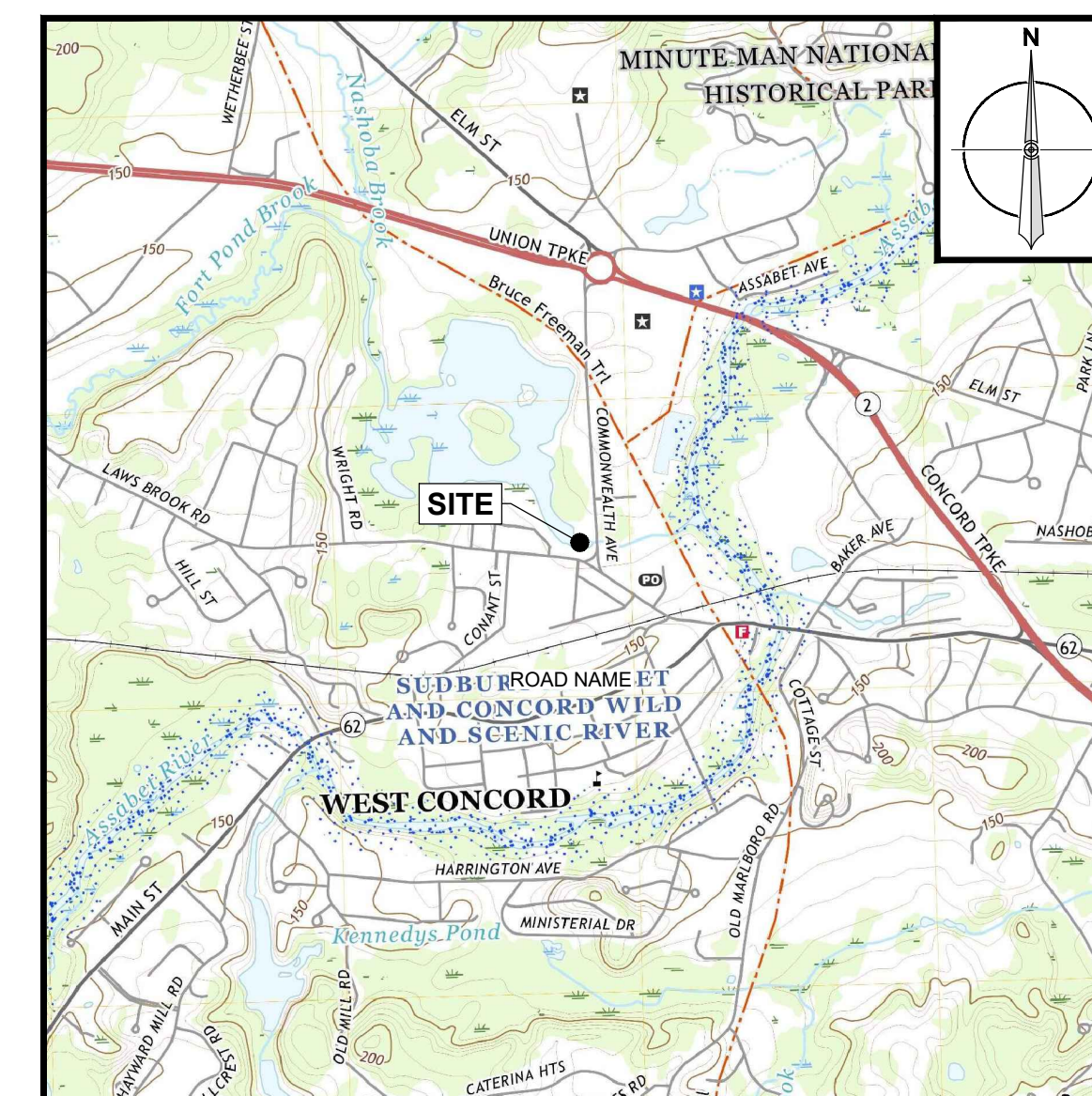
301 Metro Center Blvd, Suite 102
Warwick, Rhode Island 02886
(401) 736-3440

www.eaest.com



VICINITY MAP
SCALE: 1" = 4 MILES

PREPARED FOR:
TOWN OF CONCORD
DIVISION OF NATURAL RESOURCES
141 KEYS ROAD
CONCORD, MASSACHUSETTS



SITE LOCATION MAP
SCALE: 1" = 2,000'

PREPARED BY:



301 Metro Center Blvd, Suite 102
Warwick, Rhode Island 02886
(401) 736-3440

SHEET LIST

DRAWING NO.	SHEET NO.	DRAWING TITLE
G-001	1	TITLE SHEET
G-002	2	GENERAL NOTES AND LEGEND
C-101	3	EXISTING CONDITIONS PLAN
C-102	4	PROPOSED CONDITIONS PLAN
C-301	5	PROFILE AND CROSS SECTIONS
C-501	6	DETAILS

HORIZONTAL DATUM:
MASSACHUSETTS STATE
PLANE MAINLAND ZONE
NAD83

VERTICAL DATUM:
NAVD88

SCALE AS SHOWN

FULL SIZE PLOT: 24" x 36"

REVISIONS

NO.	DESCRIPTION

SEAL

PROJECT NAME
WARNER'S POND
DAM REMOVAL

PROJECT ADDRESS
COMMONWEALTH AVENUE
AT LAWS BROOK ROAD
CONCORD, MASSACHUSETTS

DRAWING TITLE
TITLE SHEET

DRAWING INFORMATION

DRAWN BY: DA DESIGNED BY: EC
CHECKED BY: AH PROJECT MANAGER: AP
PROJECT NUMBER: 6404001

DRAWING NO.

G-001

DATE: AUGUST 2024 SHEET: 1 OF 6

FILE PATH: \\HARVARD\PROJECTS\PROJECTS\64001 - WARNER'S POND DAM REMOVAL\CONSTRUCTION SET\DWG\DWG (G-001) ALLEN, DANIEL.DWG 17/08/24 5:39 PM

30% PLANS - NOT FOR CONSTRUCTION

PROJECT INFORMATION

SITE LOCATION:
COMMONWEALTH AVENUE AT LAWS BROOK ROAD
CONCORD, MASSACHUSETTS 01742
BOOK #: 9847; PAGE #: 0372
TAX ID #: 2017

CLIENT:
TOWN OF CONCORD
DIVISION OF NATURAL RESOURCES
141 KEYES ROAD
CONCORD, MASSACHUSETTS 01742

ENGINEER:
EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC
301 METRO CENTER BOULEVARD, SUITE 102
WARWICK, RHODE ISLAND 02886
401-736-3440

DATUM:
HORIZONTAL:
MASSACHUSETTS STATE PLANE, MAINLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD83)

VERTICAL:
NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

SITE DATA

- 1. TOPOGRAPHY AND EXISTING CONDITIONS ARE BASED ON FIELD RUN SURVEY PROVIDED BY SGC ENGINEERING, LLC., DATED 13 NOVEMBER 2023.
2. PROPERTY LINES ARE BASED ON THE TOWN OF CONCORD ELECTRONIC GIS MAPPING AND ARE NOT REFLECTIVE OF A BOUNDARY SURVEY.
3. THE SITE IS LOCATED WITHIN ZONE AE PER FEMA FIRM MAP 25017C0359F, FOR MIDDLESEX COUNTY, MASSACHUSETTS, MAP DATE 7 JULY 2014.

GENERAL NOTES

- 1. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR THE MEANS, METHODS, TECHNIQUES, AND PROCEDURES UTILIZED FOR THE CONSTRUCTION UNDER THE SCOPE OF WORK. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR CARRYING OUT THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND STANDARD CONSTRUCTION PRACTICES.
2. IT SHALL BE DISTINCTLY UNDERSTOOD THAT FAILURE TO MENTION SPECIFICALLY ANY WORK THAT WOULD NORMALLY BE REQUIRED TO COMPLETE THIS PROJECT SHALL NOT RELIEVE THE CONTRACTOR FROM PERFORMING SUCH WORK.
3. THE CONTRACTOR SHALL NOTIFY THE LOCAL 811 CENTER OR MISS UTILITY AT 800-257-7777 AT LEAST THREE (3) WORKING DAYS PRIOR TO CONSTRUCTION ACTIVITIES.
4. THE CONTRACTOR SHALL VERIFY THE PRESENCE, LOCATION, AND DEPTH OF ANY EXISTING UTILITIES AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO BEGINNING WORK. IF RELOCATION OF ANY UTILITIES IS REQUIRED, THE OWNER SHALL BE NOTIFIED AS TO THE RELOCATION REQUIRED.
5. THE CONTRACTOR SHALL TAKE THE NECESSARY PRECAUTIONS CONCERNING SAFETY AND PRESERVATION OF EXISTING UTILITIES ADJACENT TO ANY WORK AND SHALL BE RESPONSIBLE FOR THE PROTECTION OF EXISTING STRUCTURES BELOW AND ABOVE GRADE DURING THE COURSE OF DEMOLITION AND CONSTRUCTION. ANY DAMAGE CAUSED BY THE CONTRACTOR SHALL BE REPAIRED IMMEDIATELY AND THE COSTS OF SUCH REPAIR SHALL BE BORNE BY THE CONTRACTOR.
6. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, ELEVATIONS, SITE CONDITIONS, AND MATERIAL SPECIFICATIONS PRIOR TO PROCEEDING WITH CONSTRUCTION. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY ERROR, OMISSIONS, OR DISCREPANCIES BEFORE COMMENCING OR PROCEEDING WITH WORK ASSOCIATED WITH SUCH FINDINGS. THE CONTRACTOR SHALL NOTE THAT IN CASE OF DISCREPANCY BETWEEN THE SCALED AND FIGURED DIMENSIONS SHOWN ON THESE PLANS, THE FIGURED DIMENSIONS SHALL GOVERN.
7. ALL SAFETY MEASURES TO BE IMPLEMENTED DURING THE CONSTRUCTION OF THIS PROJECT ARE THE RESPONSIBILITY OF THE CONTRACTOR.
8. THE CONTRACTOR SHALL PERFORM ALL WORK IN ACCORDANCE WITH FEDERAL, STATE, AND LOCAL SAFETY REGULATIONS AS APPLICABLE, AND IN ACCORDANCE WITH CURRENT OSHA REGULATIONS.
9. THE CONTRACTOR SHALL PREPARE A TRAFFIC CONTROL PLAN FOR SUBMITTAL TO ALL APPROPRIATE STATE AND LOCAL JURISDICTIONS FOR REVIEW AND APPROVAL PRIOR TO MOBILIZATION. ROADWAYS SHALL REMAIN OPEN AT ALL TIMES THROUGHOUT CONSTRUCTION WITH ALL NECESSARY TRAFFIC CONTROL MEASURES. ANY ROAD OR LANE CLOSURES MUST BE COORDINATED AND APPROVED PRIOR TO THE START OF CONSTRUCTION.
10. IT IS NOT ANTICIPATED THAT BLASTING WILL BE REQUIRED FOR THIS PROJECT.
11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COLLECTING PHOTOGRAPHS, VIDEO, AND SKETCHES (AS NECESSARY) OF PROPERTIES, STRUCTURES, ROADWAYS, AND SITE IMPROVEMENTS WITHIN 100 FT OF EXCAVATION LIMITS ASSOCIATED WITH THE REMOVAL OF THE DAM PRIOR TO COMMENCING INTRUSIVE ACTIVITIES. PHOTOGRAPHS OR VIDEOS MUST INCLUDE BUT NOT LIMITED TO ADJUTMENT WALLS, BUILDINGS, PAVED SURFACES, WITHIN 100 FT OF EXCAVATION LIMITS.
12. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING CLEAN ROADWAYS, CONTROLLING DUST, AND TAKING NECESSARY MEASURES TO ENSURE PUBLIC ROADS ARE CLEAR OF ALL MUD/DUST/DEBRIS. WATER TRUCKS MUST BE AVAILABLE AN UTILIZED FOR DUST CONTROL DURING CONSTRUCTION.
13. MATERIALS WHICH COULD BE A POTENTIAL SOURCE OF STORMWATER POLLUTION SUCH AS GASOLINE, DIESEL FUEL, HYDRAULIC OIL, ETC. SHALL BE STORED IN STORAGE TRAILERS OR COVERED LOCATIONS AT THE END OF EACH WORK DAY. DISPOSAL OF ALL WASTE GENERATED AT THE SITE SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE DISPOSED OF IN A MANNER CONSISTENT WITH FEDERAL AND STATE LAWS/REGULATIONS.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR GOOD HOUSEKEEPING PRACTICES INCLUDING MINIMIZATION OF EXPOSED CONSTRUCTION DEBRIS TO PRECIPITATION.
15. VEHICLE STORAGE AND FUELING SHALL BE PERFORMED AT LEAST 50 FT OUTSIDE OF THE WATERCOURSE AND ONLY IN DESIGNATED AREAS SUCH THAT THERE WILL BE NO CONTAMINATION OF SOIL, GROUNDWATER, OR SURFACE WATER FROM SPILLS OR LEAKS.

EROSION CONTROL NOTES

- 1. DISTURBANCE OF SOIL SURFACES GREATER THAN ONE (1) ACRE IS REGULATED BY FEDERAL AND STATE LAW AND LOCAL ORDINANCES. ALL WORK SHALL COMPLY WITH THE 2022 USEPA CONSTRUCTION GENERAL PERMIT (CGP) AND THE TOWN OF CONCORD EROSION AND SEDIMENTATION CONTROL STANDARDS (TOWN OF CONCORD E&SC STANDARDS).
2. INSTALLATION AND MAINTENANCE OF EROSION CONTROL DEVICES IS THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE IMPLEMENTED PRIOR TO COMMENCEMENT OF LAND DISTURBING ACTIVITIES. THE CONTRACTOR SHALL INSTALL ALL EROSION AND SEDIMENTATION CONTROL DEVICES AS SHOWN ON THE PLANS AND AS DICTATED BY THE CGP AND TOWN OF CONCORD E&SC STANDARDS.
3. THE CONTRACTOR SHALL INSPECT E&SC DEVICES AT THE END OF EACH WORKING DAY, AFTER EACH STORM EVENT, AND DAILY DURING PROLONGED PERIODS OF PRECIPITATION. THE CONTRACTOR IS RESPONSIBLE FOR TIMELY INSTALLATION, INSPECTION, MAINTENANCE, AND REPLACEMENT OF ALL TEMPORARY AND PERMANENT E&SC DEVICES TO ENSURE PROPER OPERATION THROUGHOUT THE LIFE OF THE PROJECT. THE CONTRACTOR IS RESPONSIBLE FOR MAINTENANCE OF PERMANENT MEASURES UNTIL CONSTRUCTION OF THE PROJECT IS COMPLETED OR UNTIL IT IS ACCEPTED BY THE OWNER. THE OWNER IS RESPONSIBLE THEREAFTER.
4. TEMPORARY VEGETATIVE COVER, TEMPORARY MULCHING, OR TEMPORARY JUTE MATS SHALL BE APPLIED TO ANY DISTURBED AREAS THAT HAVE NOT REACHED FINAL GRADES AS SOON AS POSSIBLE, BUT NOT MORE THAN FOURTEEN (14) DAYS AFTER CONSTRUCTION ACTIVITIES HAVE CEASED, UNLESS THE ACTIVITY IS TO RESUME WITHIN TWENTY-ONE (21) DAYS.
5. TEMPORARY VEGETIVE COVER SHALL CONSIST OF 40% ANNUAL RYEGRASS AND 60% PERENNIAL RYEGRASS. ANNUAL COVER SHALL BE APPLIED AT A RATE OF 75 POUNDS PER ACRE (BY HAND) OR 85 POUNDS PER ACRE (BY HYDROSEED).
6. ACCEPTABLE TEMPORARY MULCHES INCLUDE STRAW/HAY MULCH, WOOD FIBER MULCH, AND HYDRO-MULCH. STRAW/HAY MULCHES SHOULD BE APPLIED AT A RATE OF 2 TONS PER ACRE. STRAW/HAY MULCH MUST BE ANCHORED IMMEDIATELY AFTER SPREADING TO PREVENT WIND BLOWING. WOOD FIBER MULCH SHOULD BE APPLIED AT A RATE OF 1,500 TO 2,000 POUNDS PER ACRE. WOOD FIBER MULCH SHOULD NOT BE USED ALONE IN THE WINTER OR DURING HOT AND DRY WEATHER. HYDRO-MULCH SHOULD BE APPLIED AT A RATE OF 1,500 POUNDS PER ACRE. MULCH ANCHORING SHALL BE USED ON SLOPES GREATER THAN THREE (3) PERCENT AND IN CONCENTRATED FLOW AREAS.
7. IF TEMPORARY MULCHES OR JUTE MATS ARE APPLIED, THEY SHALL BE INSPECTED PERIODICALLY AND AFTER PRECIPITATION TO CHECK FOR FAILURE INCLUDING EROSION, BREAKAGE, AND WASHOUT. IF FAILURE OCCURS, THE DAMAGED SLOPE SHALL BE REPAIRED, AND TEMPORARY MULCHES/MATS REPLACED.
8. INSTALL SEDIMENT CONTROL BARRIERS AROUND ANY SOIL STOCKPILE AREAS AND STAGING AREAS. STOCKPILES SHALL BE COVERED AT THE END OF EACH WORKDAY TO PREVENT FUGITIVE DUST GENERATION.

DAM REMOVAL AND WATER MANAGEMENT NOTES

- 1. PRIOR TO CONSTRUCTION, THE TOWN OF CONCORD WILL BE RESPONSIBLE FOR ACQUIRING ACCESS AND EASEMENTS TO PRIVATE PROPERTY WHERE ACCESS FOR CONSTRUCTION WILL BE REQUIRED.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY ACTIVITIES WITHIN THE LOD AS WELL AS PROPERLY STORING EQUIPMENT AND MATERIALS AWAY FROM THE WORK AREA IN PREPARATION OF STORMFLOW, AND FOR THE PROTECTION OF THE WORK AREA ONSITE DURING STORM FLOWS.
3. MATERIALS FROM THE DAM AND EMBANKMENTS MUST BE REMOVED AND DISPOSED OFFSITE. CUT STONE, ROCK, AND AGGREGATE MAY BE USED ONSITE IF IT COMPLIES WITH CONSTRUCTIONS SPECIFICATIONS AT THE DISCRETION OF THE ENGINEER.
4. TEMPORARY COFFERDAM AND BYPASS STRUCTURES MUST BE MAINTAINED TO ALLOW FOR DRY WORKING CONDITIONS IN AREAS OF EXCAVATION. SOIL DISTURBANCE WITHIN THE WATERCOURSE MUST TEMPORARILY CEASE IN THE EVENT OF ANY ABNORMALLY HIGH STORMWATER RUNOFF EVENT IF DRY WORKING CONDITIONS CANNOT BE MAINTAINED.
5. THERE SHALL BE NO DISCHARGES OF SEDIMENT OR TURBID WATERS TO THE WATERCOURSE, WETLANDS, OR WATERBODIES. DURING INSTREAM WORK, THE WATER BELOW THE WORK AREA SHALL REMAIN AS CLEAR AS FLOWING WATER ABOVE THE WORK SITE.
6. TEMPORARY COFFERDAM(S) AND WATER DIVERSION STRUCTURE(S) ARE TO BE CONSTRUCTED OF MATERIALS THAT CAN BE COMPLETELY REMOVED FROM THE WATERWAY FOLLOWING COMPLETION OF CONSTRUCTION.

ABBREVIATIONS

Table with 2 columns: Abbreviation and Description. Includes AC (ACRES), APPROX (APPROXIMATELY), BW (BOTTOM OF WALL), BGS (BELOW GROUND SURFACE), CL - C/L (CENTER LINE), CMP (CORRUGATED METAL PIPE), CY (CUBIC YARDS), CONC (CONCRETE), DA (DRAINAGE AREA), DIA (DIAMETER), E (EASTING), EL - ELEV (ELEVATION), EX - EXST (EXISTING), ESC (SOIL EROSION AND SEDIMENT CONTROL), FT (FEET), FEMA (FEDERAL EMERGENCY MANAGEMENT AGENCY), INV (INVERT), MHW (MEAN HIGH WATER), MLW (MEAN LOW WATER), N (NORTHING), NA (NOT APPLICABLE), NF (NOW OR FORMERLY), NO. (NUMBER), NAD 83 (NORTH AMERICAN DATUM OF 1983), NAVD 88 (NORTH AMERICAN VERTICAL DATUM OF 1988), OH - OVHD (OVERHEAD), PR - PROP (PROPOSED), RCP (REINFORCED CONCRETE PIPE), SF - SQ FT (SQUARE FEET), TW (TOP OF WALL), TYP (TYPICAL), W (WITH), WSEL (WATER SURFACE ELEVATION).

LEGEND

Legend table with columns: Description, Existing, Proposed. Includes symbols for PROPERTY BOUNDARY, SITE CONTROL POINT, SITE BENCHMARK, SITE SOIL BORING, SITE MONITORING WELL, SITE SIGN, SITE FENCE POST, SITE GATE POST, SITE BOLLARD, STORM DRAIN MANHOLE, STORM DRAIN CATCH BASIN, STORM DRAIN LINE, SANITARY SEWER MANHOLE, SITE TREE, SITE CONTOUR, SITE CONCRETE, SITE EDGE OF WATER, SITE FEMA FLOODPLAIN, SITE FENCE, SITE STONEWALL, SITE GUARD RAIL, SITE GRAVEL, SITE TREE/BRUSH LINE, AQUIFER LIMIT, SITE WETLAND, SITE WETLAND BUFFER, LIMIT OF DISTURBANCE, CONSTRUCTION ACCESS ROAD, COFFERDAM, EROSION CONTROLS, STAGING/STOCKPILE AREA, DEWATERING AREA, PLAN NORTH ARROW, PLAN NUMBER CALLOUT, PLAN KEYNOTE CALLOUT, PLAN REVISION CALLOUT, PLAN STRUCTURE NAME/NUMBER, PLAN SECTION CUT VIEW BEGIN, PLAN SECTION CUT VIEW END.



EA Engineering, Science, and Technology, Inc., PBC

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Warwick, Rhode Island 02886
(401) 736-3440

www.eaest.com

HORIZONTAL DATUM:
MASSACHUSETTS STATE
PLANE MAINLAND ZONE
NAD83

VERTICAL DATUM:
NAVD88

SCALE AS SHOWN

FULL SIZE PLOT: 24" x 36"

REVISIONS

Table with 4 columns: No., Description, Date, By. (Empty table for revisions)

SEAL

PROJECT NAME
WARNER'S POND
DAM REMOVAL

PROJECT ADDRESS
COMMONWEALTH AVENUE
AT LAWS BROOK ROAD
CONCORD, MASSACHUSETTS

DRAWING TITLE
GENERAL NOTES AND
LEGEND

DRAWING INFORMATION

DRAWN BY: DA DESIGNED BY: EC
CHECKED BY: AH PROJECT MANAGER: AP

PROJECT NUMBER: 6404001

DRAWING NO.

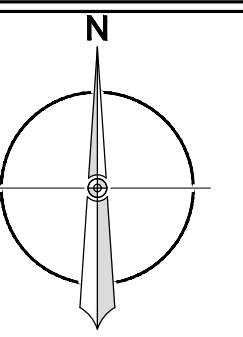
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DATE: AUGUST 2024 SHEET: 2 OF 6

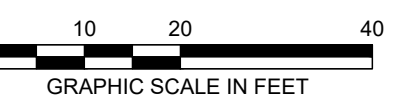


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PLANE MAINLAND ZONE
NAD83
VERTICAL DATUM:
NAVD88



FULL SIZE PLOT: 24" x 36"

REVISIONS

NO.	DESCRIPTION

SEAL

PROJECT NAME
**WARNER'S POND
DAM REMOVAL**

PROJECT ADDRESS
**COMMONWEALTH AVENUE
AT LAWS BROOK ROAD
CONCORD, MASSACHUSETTS**

DRAWING TITLE
EXISTING CONDITIONS PLAN

DRAWING INFORMATION
DRAWN BY: DA DESIGNED BY: EC
CHECKED BY: AH PROJECT MANAGER: AP
PROJECT NUMBER: 6404001

DRAWING NO.
C-101
DATE: AUGUST 2024 SHEET: 3 OF 6



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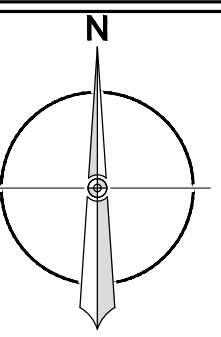
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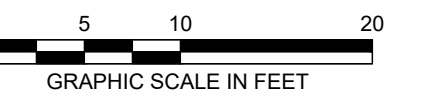
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MASSACHUSETTS STATE
PLANE MAINLAND ZONE
NAD83
VERTICAL DATUM:
NAVD88



0 5 10 20
GRAPHIC SCALE IN FEET

FULL SIZE PLOT: 24" x 36"

REVISIONS

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SEAL

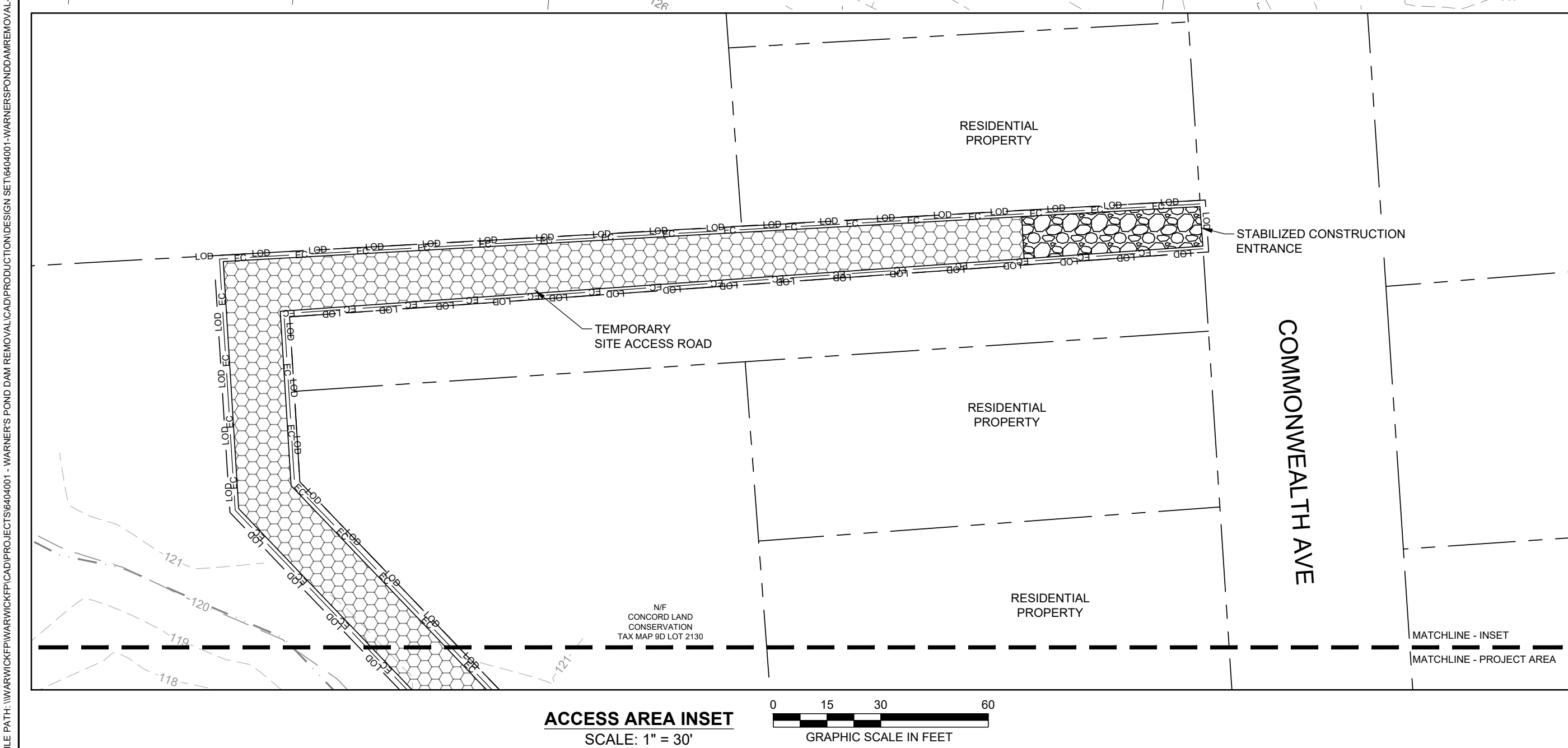
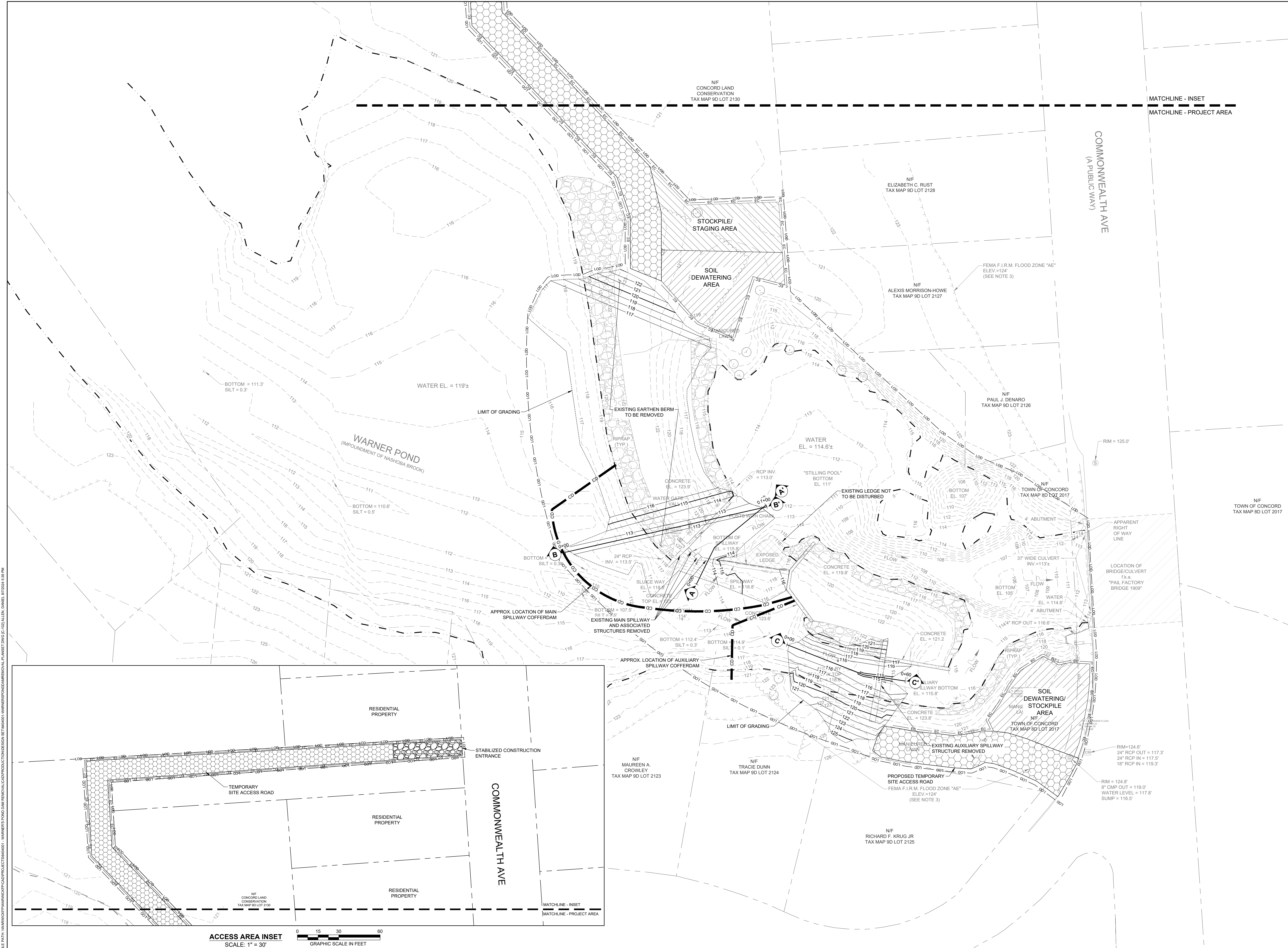
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DAM REMOVAL**

PROJECT ADDRESS
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AT LAWS BROOK ROAD
CONCORD, MASSACHUSETTS**

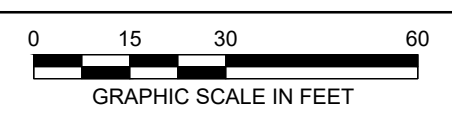
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PLAN**

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PROJECT NUMBER: 6404001

DRAWING NO.
C-102
DATE: AUGUST 2024 SHEET: 4 OF 6



ACCESS AREA INSET
SCALE: 1" = 30'



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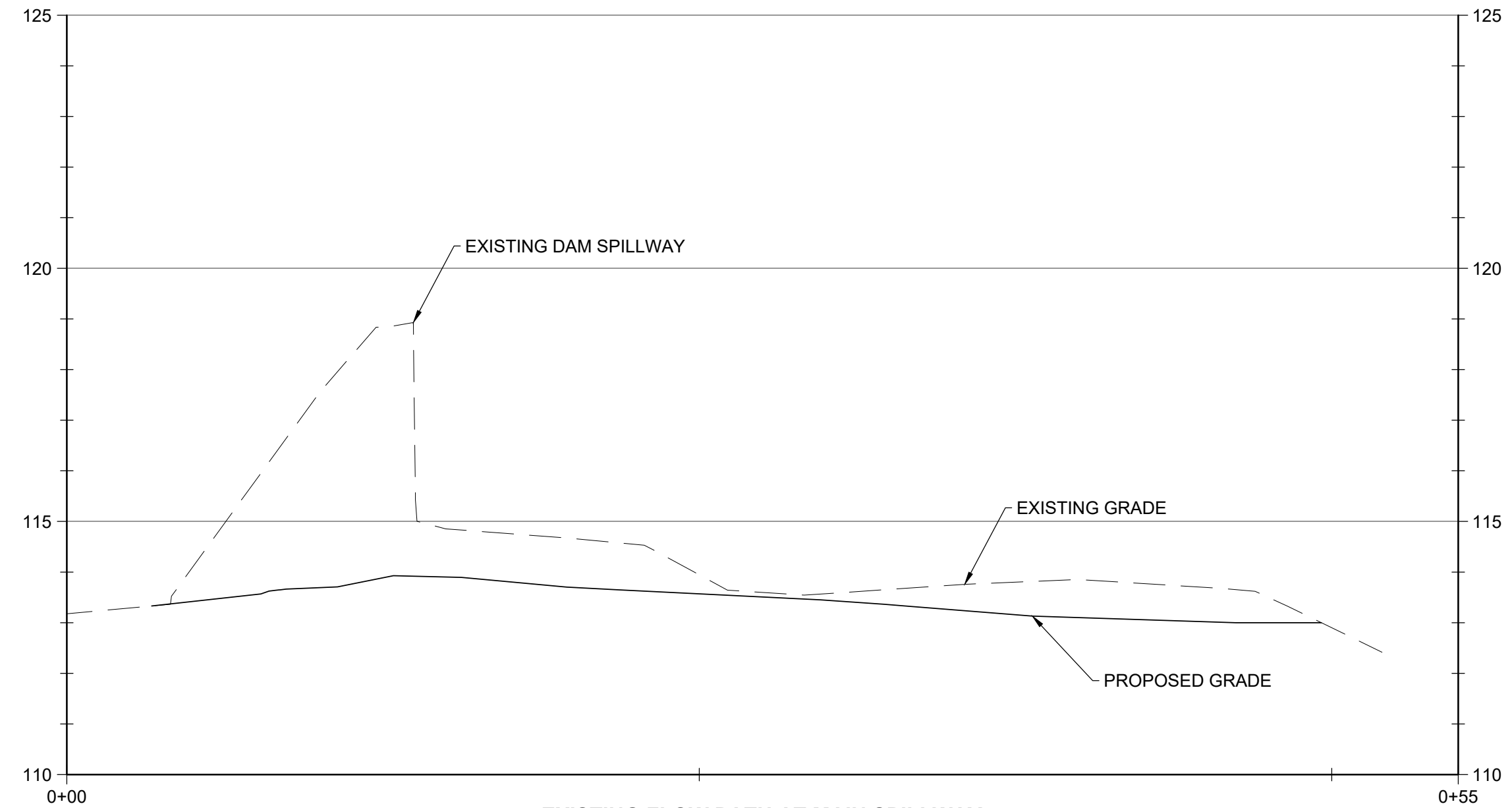
30% PLANS - NOT FOR CONSTRUCTION



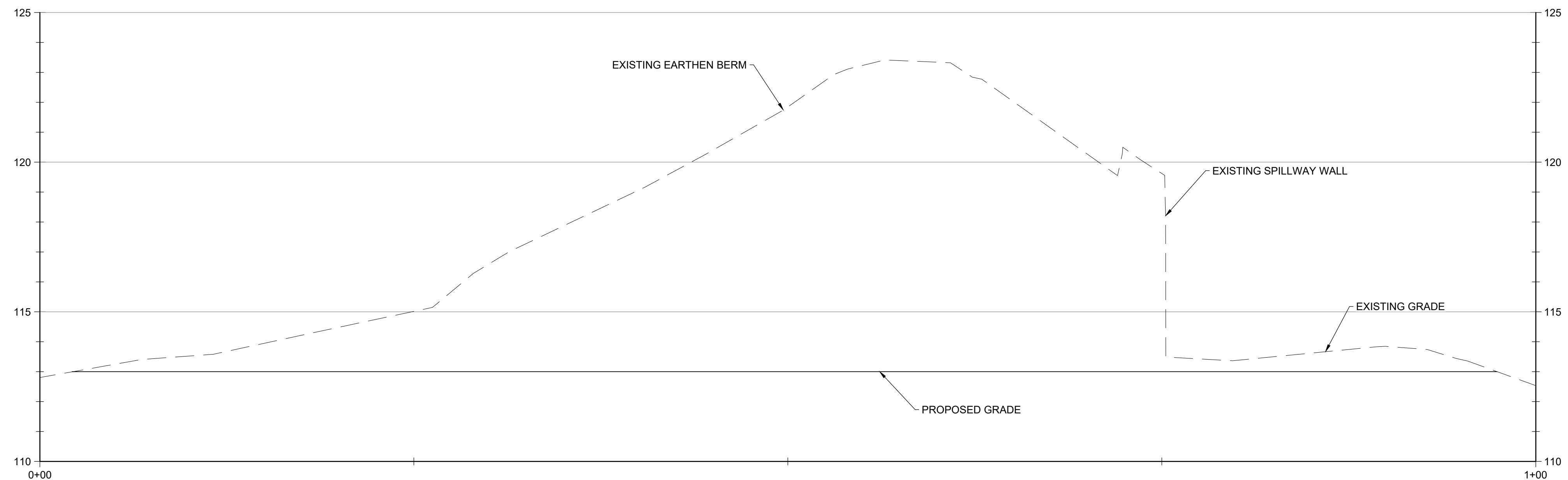
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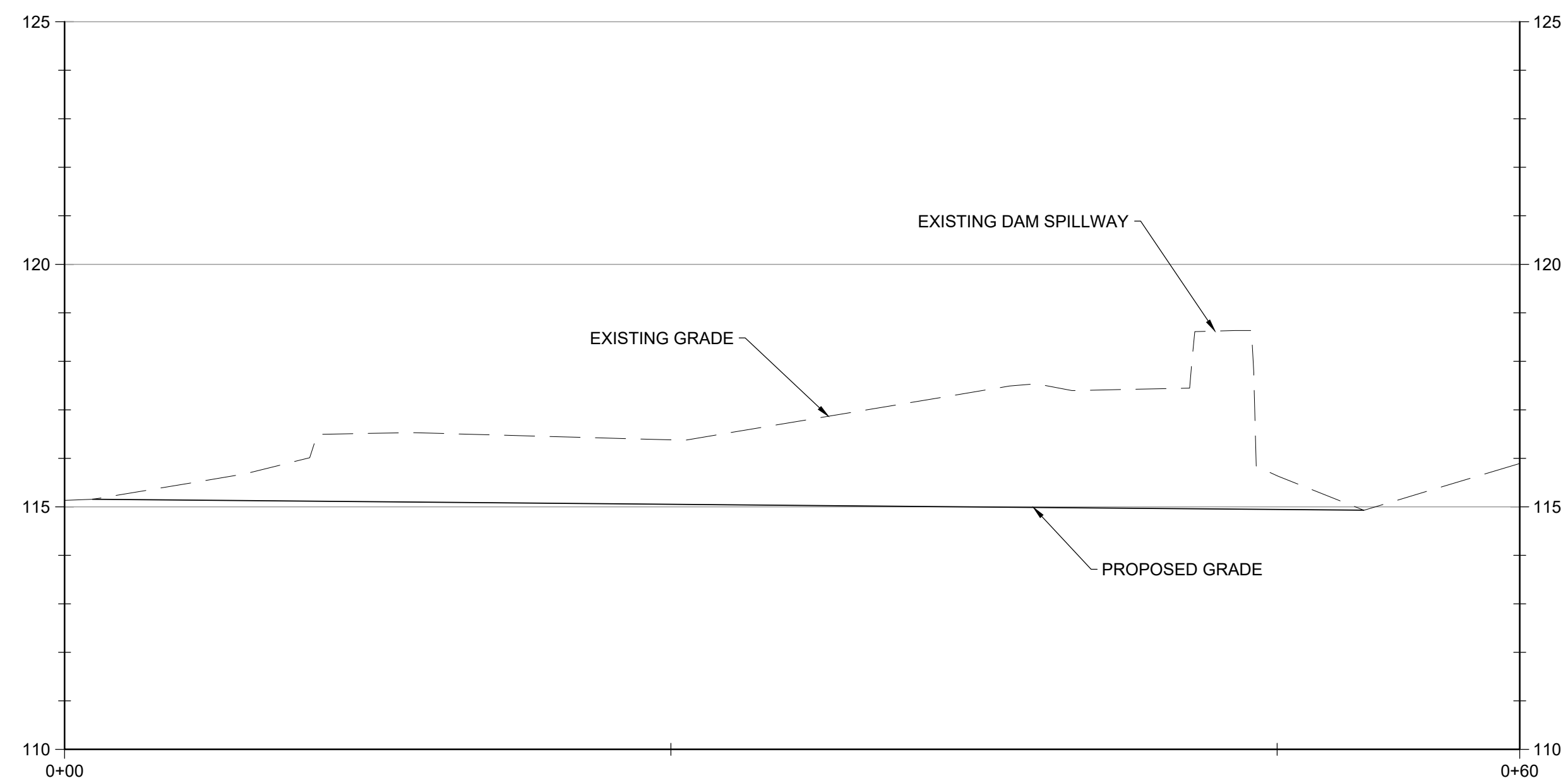
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EXISTING FLOW PATH AT MAIN SPILLWAY
PROFILE A-A'
HORIZONTAL SCALE: 1" = 5'
VERTICAL SCALE: 1" = 2.5'



PROPOSED FLOW PATH AT MAIN SPILLWAY
PROFILE B-B'
HORIZONTAL SCALE: 1" = 5'
VERTICAL SCALE: 1" = 2.5'



AUXILIARY SPILLWAY FLOW PATH
PROFILE C-C'
HORIZONTAL SCALE: 1" = 5'
VERTICAL SCALE: 1" = 2.5'

HORIZONTAL DATUM:
MASSACHUSETTS STATE
PLANE MAINLAND ZONE
NAD83

VERTICAL DATUM:
NAVD88

SCALE AS SHOWN

FULL SIZE PLOT: 24" x 36"

REVISIONS

NO.	DESCRIPTION

SEAL

PROJECT NAME
WARNER'S POND
DAM REMOVAL

PROJECT ADDRESS
COMMONWEALTH AVENUE
AT LAWS BROOK ROAD
CONCORD, MASSACHUSETTS

DRAWING TITLE
PROFILE AND CROSS
SECTIONS

DRAWING INFORMATION

DRAWN BY: DA DESIGNED BY: EC

CHECKED BY: AH PROJECT MANAGER: AP

PROJECT NUMBER: 6404001

DRAWING NO.

C-301

DATE: AUGUST 2024 SHEET: 5 OF 6

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30% PLANS - NOT FOR CONSTRUCTION



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PLANE MAINLAND ZONE
NAD83
VERTICAL DATUM:
NAVD88

SCALE AS SHOWN

FULL SIZE PLOT: 24" x 36"

REVISIONS

NO.	DATE	DESCRIPTION

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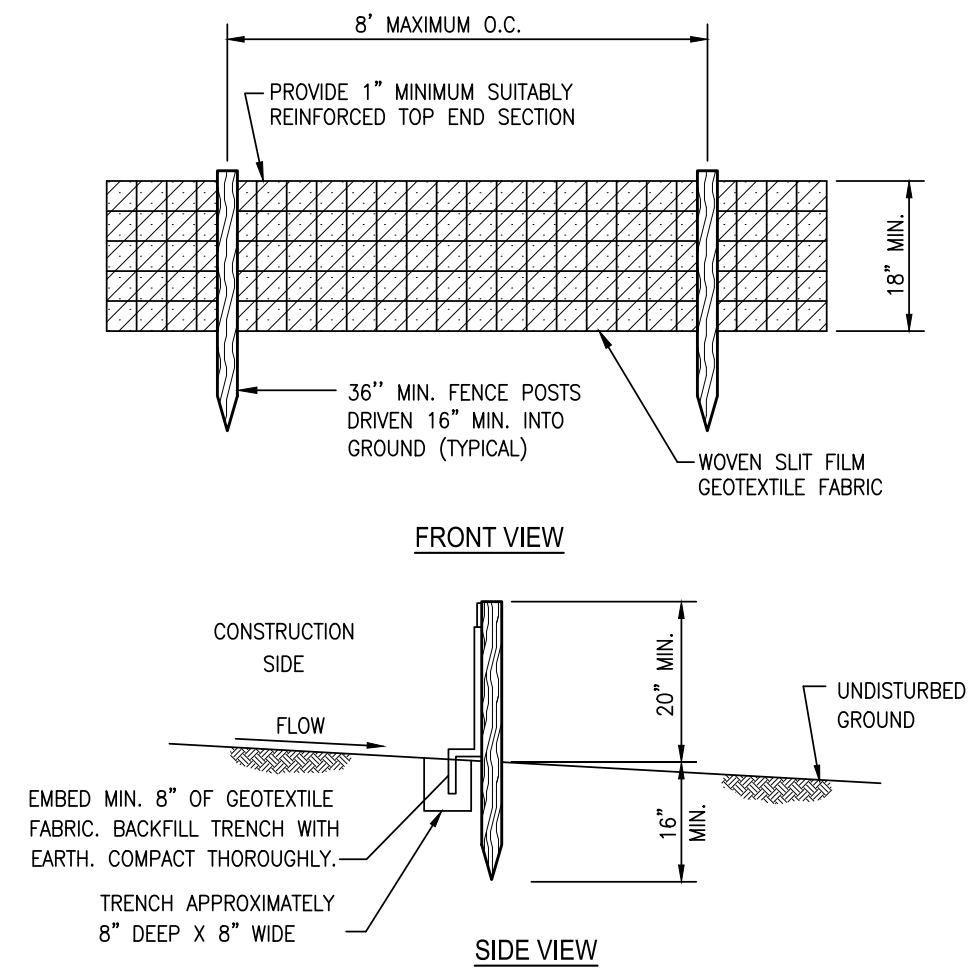
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DAM REMOVAL**

PROJECT ADDRESS
**COMMONWEALTH AVENUE
AT LAWS BROOK ROAD
CONCORD, MASSACHUSETTS**

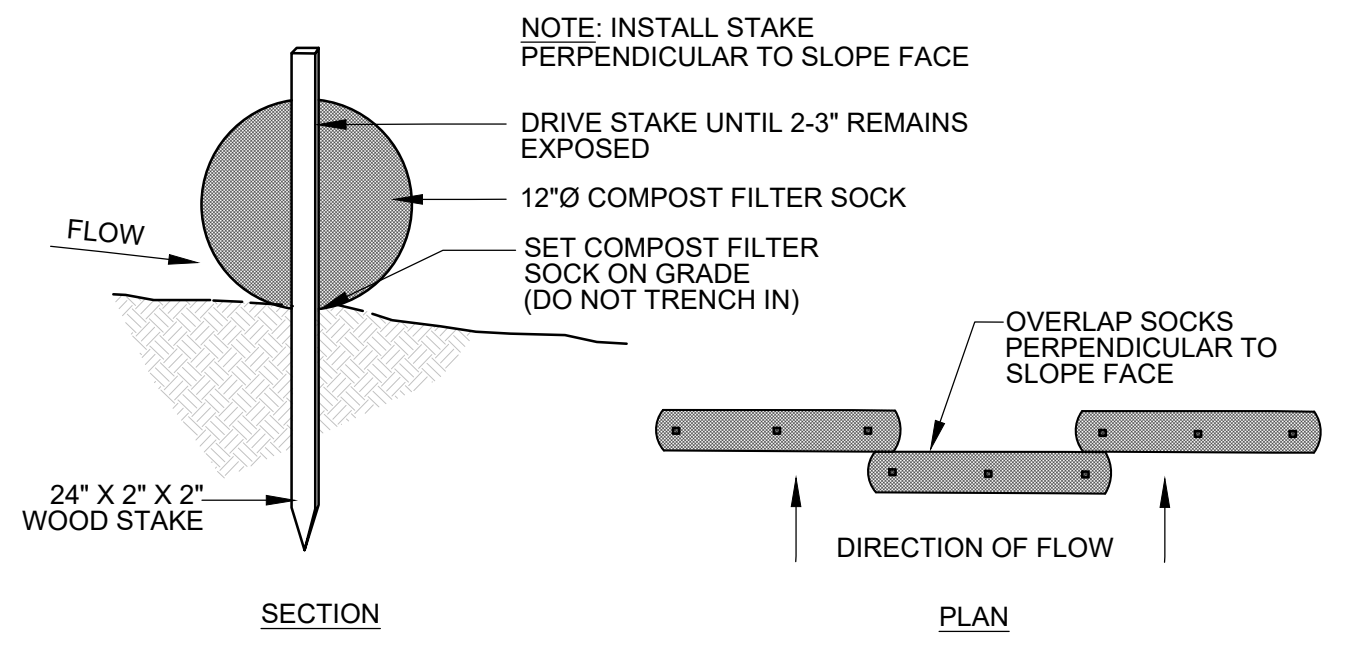
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C-501
DATE: AUGUST 2024 SHEET: 6 OF 6

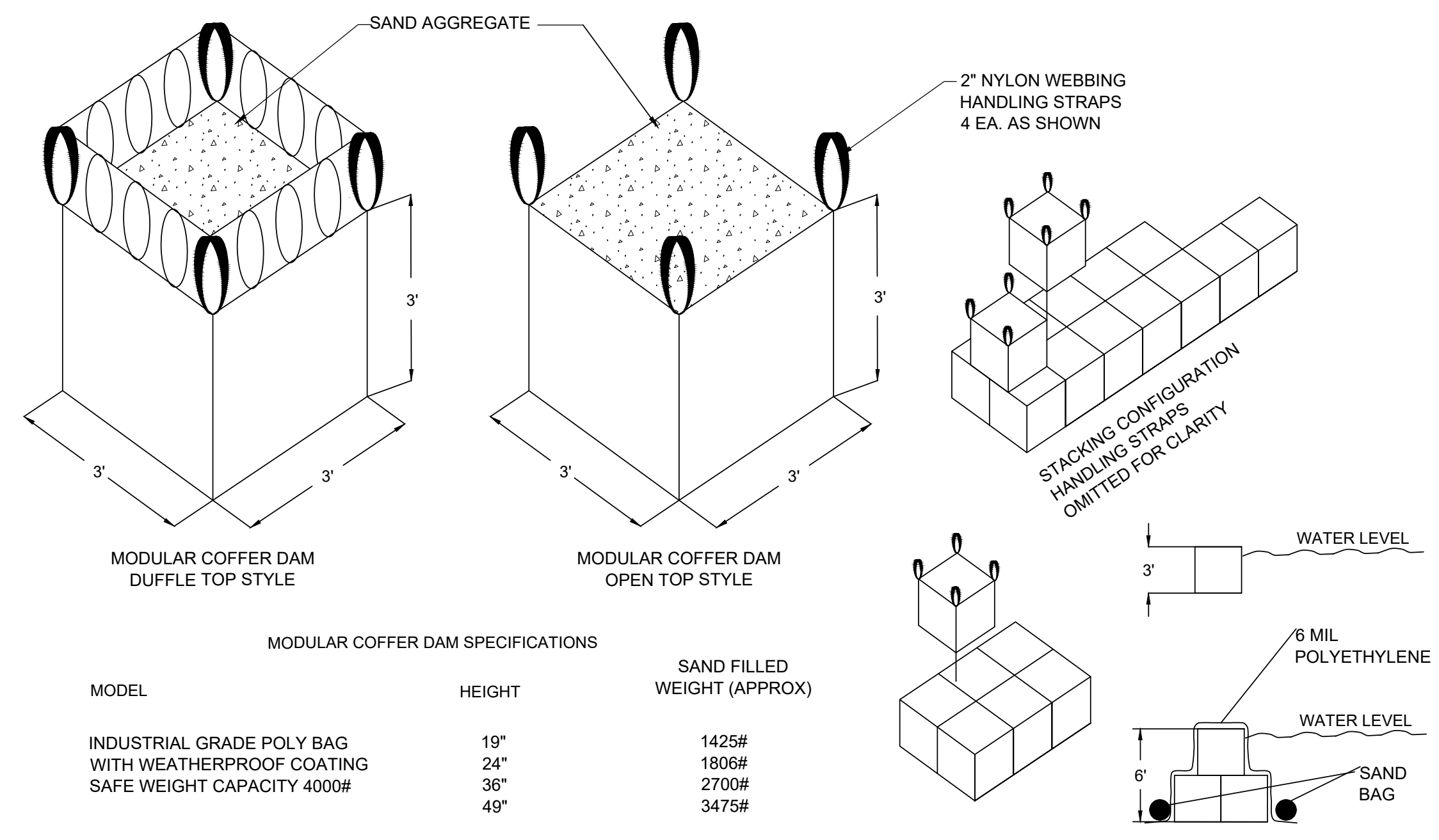
30% PLANS - NOT FOR CONSTRUCTION



1 SILT FENCE
C-102 SCALE: NOT TO SCALE



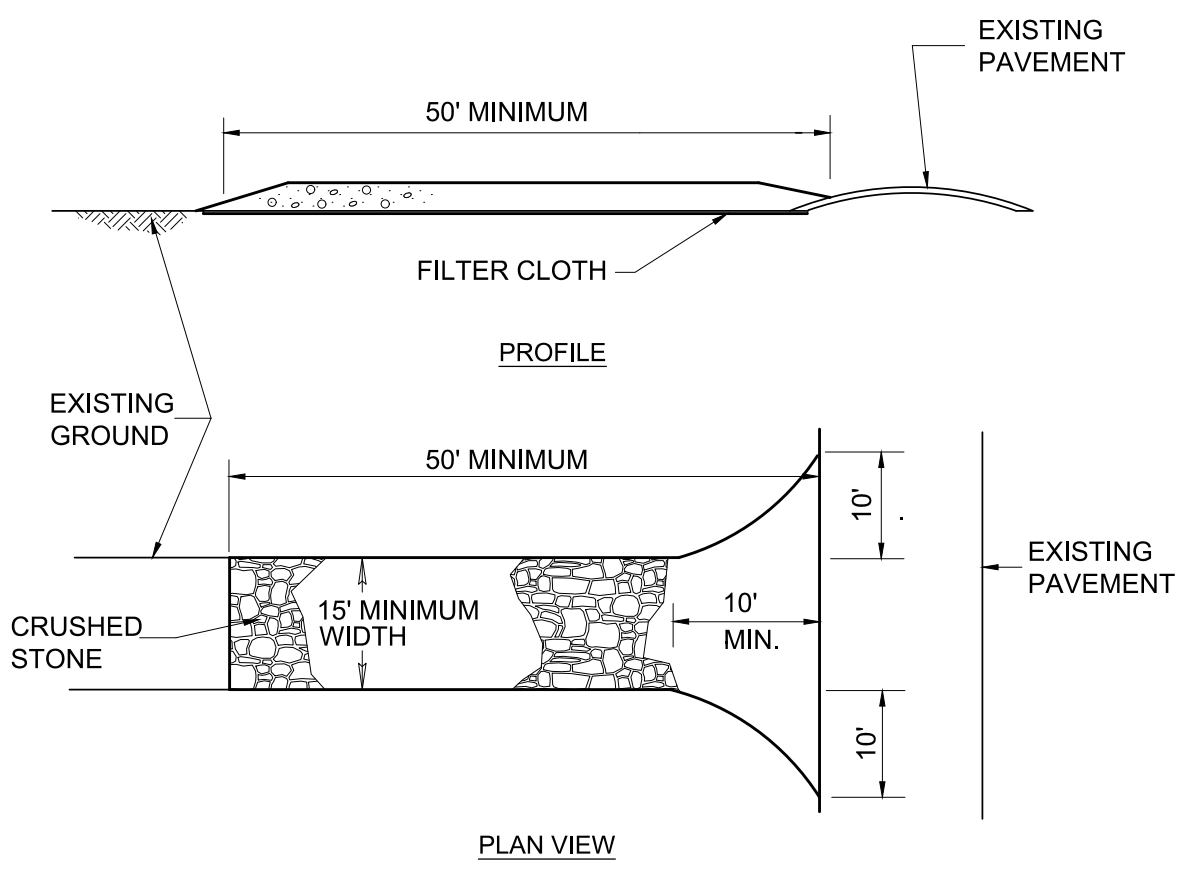
2 COMPOST FILTER SOCK
C-102 SCALE: NOT TO SCALE



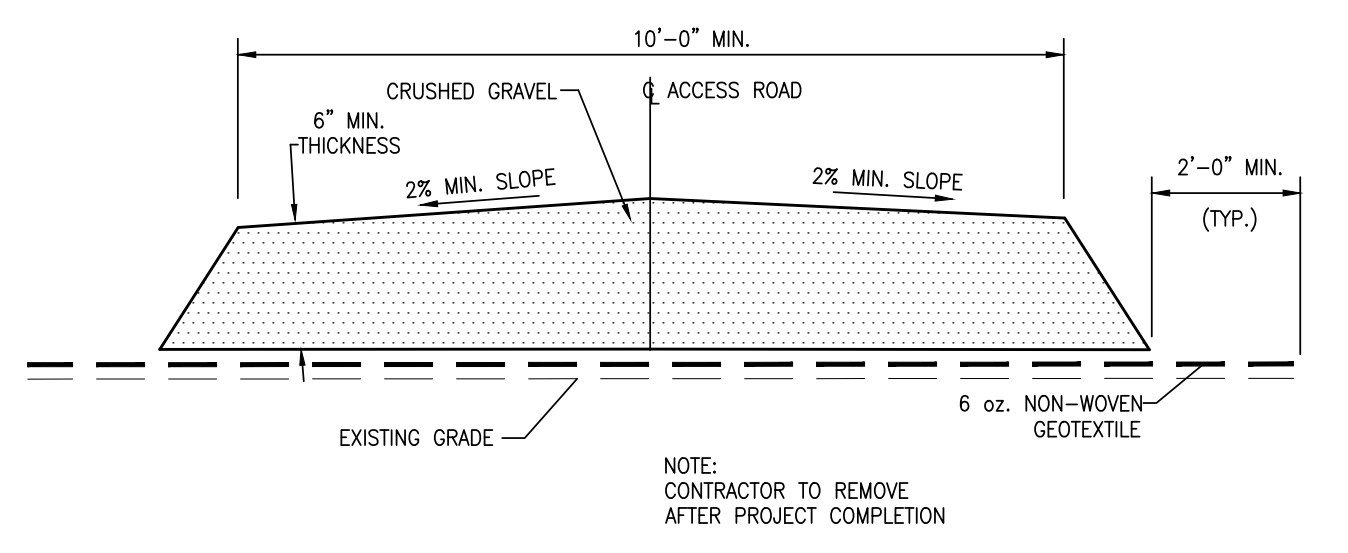
MODULAR COFFER DAM SPECIFICATIONS

MODEL	HEIGHT	SAND FILLED WEIGHT (APPROX)
INDUSTRIAL GRADE POLY BAG WITH WEATHERPROOF COATING SAFE WEIGHT CAPACITY 4000#	19"	1425#
	24"	1806#
	36"	2700#
	49"	3475#

3 SANDBAG COFFERDAM
C-102 SCALE: NOT TO SCALE



4 STABILIZED CONSTRUCTION ENTRANCE
C-102 SCALE: NOT TO SCALE



5 TEMPORARY CONSTRUCTION ACCESS ROAD
C-102 SCALE: NOT TO SCALE

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Appendix B:

Sediment Sampling Technical Memorandum

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April 5, 2024

Delia Kaye, Natural Resources Director
Town of Concord
141 Keyes Road
Concord, Massachusetts 01742

*RE: Sediment Sampling Technical Memorandum
Warner's Pond Dam Removal Preliminary Design
Concord, Massachusetts
EA Project No. 6404001*

Dear Ms. Kaye,

EA Engineering, Science, and Technology, Inc., PBC (EA) is pleased to provide you with this technical memorandum for the sediment characterization within Warner's Pond, Nashoba Brook, and the Assabet River in Concord, Massachusetts (the site). EA collected three sediment grab samples from both Nashoba Brook and the Assabet River, and two sediment core samples from Nashoba Brook on October 25, 2023. Additionally, EA collected five sediment core samples from within Warner's Pond on November 8, 2023.

INTRODUCTION

Warner's Pond is an approximately 59-acre impoundment of Nashoba Brook – a perennial tributary to the Assabet River – located in West Concord, Massachusetts. Nashoba Brook continues approximately 1,300-feet downstream of the dam to its confluence with the Assabet River. Warner's Pond generally contains water depths that are 5 feet or less, and a few deep holes where water depths reach a maximum of approximately 12 feet. Sediment depth ranges between 0 and 9 feet. Sediment samples were collected to examine the sediment characteristics within Warner's Pond, Nashoba Brook, and the Assabet River to determine how dam removal would influence the physical and chemical sediment characteristics within and downstream of the pond.

METHODS

In-pond Sediment Sampling

Five sediment cores were collected from within Warner's Pond. Cores were collected from a 14-foot catamaran-style coring platform using a Vibracore system on a sampling winch and A-frame. Cores were collected using 2-5/8 inch polycarbonate core tubes. Core tubes were driven into the sediment until the tube reached the target depth at each location, at which point the tube was pulled to the surface, split open, and visually examined for the core's sediment characteristics. Samples were collected from each distinctive sediment horizon. In the event that a hard bottom was encountered at a depth shallower than the target depth, a retry was attempted. Samples were analyzed for physical analysis (bulk density, moisture content, and dry density) and grain size analysis using sieve testing. Results from the analysis are presented in the results section of this technical memorandum.

Downstream Sediment Sampling

EA collected sediment grab samples to support the development of recommendations for sediment management as part of the potential Warner's Pond Dam removal. Sediment grabs were collected at three points within Nashoba Brook downstream of the dam between the Commonwealth Avenue bridge and Nashoba Brook's confluence with the Assabet River (see Figure 1). Three grabs were also collected from the Assabet River between Nashoba Brook and Route 2. Each group of sediment grabs was composited into one sample for each respective stream reach for a total of two samples. Sediment grabs were collected using an Ekman dredge in the upper twelve inches of the sediment profile to classify the zone with the highest likelihood of human and ecological interaction.

In conjunction with sediment grab samples, EA collected two sediment cores from within Nashoba Brook between the Pail Factory (Commonwealth Avenue) Bridge and the Bruce Freeman Rail Trail. Sediment cores were collected using a hand corer fitted with a core sleeve. The corer was driven into the sediment and pulled straight up as friction/suction held the core in place within the sleeve. Upon removal from the water, the core sleeve was split open to allow examination of the core's sediment characteristics. At the conclusion of visual observations, each distinct horizon of each core was removed and sampled for analysis.

Sediment samples were analyzed for all required parameters identified in the Massachusetts Department of Environmental Protection (MassDEP) 401 Water Quality Criteria (WQC) regulations. The sediment analysis included heavy metals, polycyclic aromatic hydrocarbons, organochlorine pesticides, polychlorinated biphenyls, extractable and total petroleum hydrocarbons, volatile organic compounds, total organic carbon, physical analysis (bulk density, moisture content, and dry density), and grain size analysis using sieve testing. Results from the analysis are presented in the results section of this technical memorandum.

RESULTS

In-Pond Sediment Sampling Results

Observations of sediment samples within Warner's Pond indicated that the majority of the sediment collected is dark brown to gray. Grain size analysis of sediment samples indicated that in most samples, the upper 3 to 4 feet primarily contained fine silt and clay while fine sand was primarily observed at sediment depths greater than 3 to 4 feet. However, sample SED-05, which was collected approximately 800 feet upstream of the dam, contained a substantial amount of gravel in the upper 4 feet of the sample. Physical analysis results of in-pond sediment samples are presented in Table 1.

Downstream Sediment Sampling Results

Observations and grain size analysis of sediment core samples collected within Nashoba Brook indicated that the majority of sediment collected is a silty sand with small amounts of organic material. Gravel was more prevalent in Nashoba Brook than in Warner's Pond. Physical analysis results of downstream sediment samples are present in Table 2.

No chemical or petroleum odors were noted during sediment grab sampling in either Nashoba Brook or the Assabet River. Chemical analysis of sediment grab samples indicated that none of the analytes included as part of this study exceeded the S-1/GW-1 Method 1 Risk Values found in Table 2 of the Massachusetts Contingency Plan (MCP). However, the reporting limits and method detection limits of bromoform, Dibromochloromethane, and Methyl tert butyl ether



exceed the S-1/GW-1 Risk Values. Laboratory reporting limit is defined as the lowest concentration of an analyte that can be reported reliably under normal laboratory conditions. Method detection limit is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results. As such, despite laboratory analysis results indicating non-detections for the aforementioned analytes, it is possible that their actual concentrations in the samples exceed the S-1/GW-1 Risk Values. Chemical analysis results of downstream sediment samples are present in Table 3 attached.

COMPARISON OF RESULTS TO PREVIOUSLY COLLECTED IN-POND DATA

The results of the downstream investigation were compared to previous in-pond sediment sampling results collected in 2018. The 2018 sampling indicated that arsenic was in exceedance of the MCP S-1/GW-1 standard in one sample located approximately 1,200-feet upstream of the dam immediately south of Scout Island. Additionally, several analytes that were not detected by laboratory analysis also had a method detection limit that exceeded the MCP standard and confirmation of their compliance with the MCP could not be achieved.

None of the analytes included as part of this study of downstream waters exceeded the MCP standard. However, since the reporting limits and method detection limits of bromoform, Dibromochloromethane, and Methyl tert butyl ether exceed the S-1/GW-1 Risk Values, these analytes could not be confirmed to be in compliance with the risk values.

SUMMARY

EA completed sampling and analysis of sediment within the Nashoba Brook and Assabet River downstream of the Warner's Pond dam, and within the pond itself. The sediment sample analysis revealed the majority of sediment collected within Nashoba Brook is composed of silty sand or organic matter at various depths in the sediment. Additionally, chemical analysis of the downstream sediment samples indicated that there are no exceedances of regulatory criteria for the chemicals analyzed. Sediment samples collected from within Warner's Pond indicated that the sediment collected at the sampling locations is a fine silt or clay near the sediment surface, and a fine sand at depth.

The results of this study, in conjunction with previously collected in-pond data, suggest that management of sediment containing arsenic in Warner's Pond may be required by MassDEP as part of the design of a dam removal project at Warner's Pond to avoid potential downstream impacts. As such, the 30% design prepared by EA will take into account the need for sediment management in the context of the results of this study.

EA appreciates the opportunity to provide the Town of Concord with professional environmental consulting services. Should you have any questions or require additional information, please do not hesitate to contact me at qmilton@eaest.com or (401) 352-5740.

Sincerely,

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC

A handwritten signature in black ink that reads "Quincy Milton III". The signature is written in a cursive style.

Quincy Milton III, CE
Ecologist



Attachments:

Figure

Photographic Log

Sediment Core Log Sheets

Laboratory Analysis Results

**Table 1. Physical Analysis Results of Sediment Coring within Warner's Pond**

Sample ID	Depth (in.)	Visual Description	Bulk Density pcf	Moisture Content (%)	Dry Density pcf
SED-01-2.5	2.5	Moist, very dark brown silt with sand and organics	93.87	70.38	55.09
SED-01-7	7	Moist, grayish brown sand	105.4	26.92	83.08
SED-01-10.25	10.25	Moist, very dark brown silty sand with organics	84.94	91.04	44.46
SED-01-12.5	12.5	Moist, gray sandy clay with organics	115.3	31.49	87.7
SED-01-14.75	14.75	Moist, gray sand with silt	115.7	15.54	100.2
SED-02-3	3	Moist, very dark brown silt with organics	69.11	195.9	23.36
SED-02-11	11	Moist, very dark brown silt with organics	63.4	389.6	12.95
SED-02-18	18	Moist, dark grayish brown silty sand with organics	101	36.29	74.12
SED-03-6.5	6.5	Moist, very dark brown sandy silt with organics	63.8	353.6	14.07
SED-03-15	15	Moist, grayish brown sand with silt	107.9	23.03	87.67
SED-03-18.5	18.5	Moist, very dark brown clay with organics	65.36	263.2	17.99
SED-04-2.5	2.5	Moist, very dark brown clay with organics	59.02	359.3	12.85
SED-04-5.5	5.5	Moist, dark brown clay with sand	89.56	62.11	55.25
SED-04-10	10	Moist, grayish brown sand	117.1	23.08	95.17
SED-05-1	1	Moist, very dark brown silt	67.61	367.5	14.46
SED-05-5.5	5.5	Moist, grayish brown sand with gravel	110.2	13.44	97.11
SED-05-12	12	Moist, yellowish-brown sand	119.7	18.03	101.4

pcf = pounds/cubic foot

**Table 2. Physical Analysis Results of Sediment Coring within Nashoba Brook**

Sample ID	Depth (in.)	Visual Description	Bulk Density pcf	Moisture Content (%)	Dry Density pcf
NB-CA-2-4	2-4	Moist, dark brown sand with silt and organics	99.49	75.61	56.66
NB- PB-0-2.5	0-2.5	Moist, dark brown silt	69.12	359.6	15.04
NB- PB-2.5-6	2.5-6	Moist, dark brown sandy silt with organics	95.13	99.45	47.69

pcf = pounds/cubic foot

Table 3. Chemical Analysis Results of Sediment Grab Samples

Analyte	RL	MDL	NB-102523	AR-102523	MCP S-1 & GW-1 Standard
			Result	Result	
Volatiles ug/kg					
1,1,1,2-Tetrachloroethane	43	11	ND	ND	100
1,1,1-Trichloroethane	43	14	ND	ND	30000
1,1,2,2-Tetrachloroethane	43	14	ND	ND	100
1,1,2-Trichloroethane	86	23	ND	ND	100
1,1-Dichloroethane	86	12	ND	ND	3000
1,1-Dichloroethene	86	20	ND	ND	400
1,1-Dichloropropene	43	14	ND	ND	NL
1,2,3-Trichlorobenzene	170	28	ND	ND	NL
1,2,3-Trichloropropane	170	11	ND	ND	NL
1,2,4-Trichlorobenzene	170	24	ND	ND	2000
1,2,4-Trimethylbenzene	170	29	ND	ND	NL
1,2-Dibromo-3-chloropropane	260	86	ND	ND	NL
1,2-Dibromoethane	86	24	ND	ND	100
1,2-Dichlorobenzene	170	12	ND	ND	9000
1,2-Dichloroethane	86	22	ND	ND	100
1,2-Dichloroethene, Total	86	12	ND	ND	NL
1,2-Dichloropropane	86	11	ND	ND	100
1,3,5-Trimethylbenzene	170	17	ND	ND	NL
1,3-Dichlorobenzene	170	13	ND	ND	3000
1,3-Dichloropropane	170	14	ND	ND	NL
1,3-Dichloropropene, Total	43	14	ND	ND	10
1,4-Dichlorobenzene	170	15	ND	ND	700
1,4-Dichlorobutane	860	20	ND	ND	NL
2,2-Dichloropropane	170	17	ND	ND	NL
2-Butanone	860	190	ND	ND	NL
2-Hexanone	860	100	ND	ND	NL
4-Methyl-2-pentanone	860	110	ND	ND	NL
Acetone	860	420	ND	ND	6000
Acrylonitrile	350	100	ND	ND	NL
Benzene	43	14	ND	ND	2000
Bromobenzene	170	12	ND	ND	NL
Bromochloromethane	170	18	ND	ND	NL
Bromodichloromethane	43	9.4	ND	ND	100
Bromoform	350	21	ND	ND	100
Bromomethane	170	50	ND	ND	500
Carbon disulfide	860	390	ND	ND	NL
Carbon tetrachloride	86	20	ND	ND	10000



Analyte	RL	MDL	NB-102523	AR-102523	MCP S-1 & GW-1 Standard
			Result	Result	
Volatiles ug/kg					
Chlorobenzene	43	11	ND	ND	1000
Chloroethane	170	39	ND	ND	NL
Chloroform	130	12	ND	ND	400
Chloromethane	350	81	ND	ND	NL
cis-1,2-Dichloroethene	86	15	ND	ND	300
cis-1,3-Dichloropropene	43	14	ND	ND	NL
Dibromochloromethane	86	12	ND	ND	5
Dibromomethane	170	20	ND	ND	NL
Dichlorodifluoromethane	860	79	ND	ND	NL
Ethyl ether	170	30	ND	ND	NL
Ethyl methacrylate	860	140	ND	ND	NL
Ethylbenzene	86	12	ND	ND	40000
Hexachlorobutadiene	350	15	ND	ND	30000
Isopropylbenzene	86	9.4	ND	ND	NL
Methyl tert butyl ether	170	17	ND	ND	100
Methylene chloride	430	200	ND	ND	NL
Naphthalene	350	56	ND	ND	4000
n-Butylbenzene	86	14	ND	ND	NL
n-Propylbenzene	86	15	ND	ND	NL
o-Chlorotoluene	170	16	ND	ND	NL
o-Xylene	86	25	ND	ND	NL
p/m-Xylene	170	48	ND	ND	NL
p-Chlorotoluene	170	9.3	ND	ND	NL
p-Isopropyltoluene	86	9.4	ND	ND	NL
sec-Butylbenzene	86	13	ND	ND	NL
Styrene	86	17	ND	ND	3000
tert-Butylbenzene	170	10	ND	ND	NL
Tetrachloroethene	43	17	ND	ND	1000
Tetrahydrofuran	350	140	ND	ND	NL
Toluene	86	47	ND	ND	30000
trans-1,2-Dichloroethene	130	12	ND	ND	1000
trans-1,3-Dichloropropene	86	24	ND	ND	NL
trans-1,4-Dichloro-2-butene	430	120	ND	ND	NL
Trichloroethene	43	12	ND	ND	300
Trichlorofluoromethane	350	60	ND	ND	NL
Vinyl acetate	860	190	ND	ND	NL
Vinyl chloride	86	29	ND	ND	900
Xylenes, Total	86	25	ND	ND	400000



Analyte	RL	MDL	NB-102523	AR-102523	MCP S-1 & GW-1 Standard
			Result	Result	
Semi Volatiles ug/kg					
Acenaphthene	5.34	2.67	18	18	4000
Acenaphthylene	5.34	2.67	35.4	10.5	1000
Anthracene	5.34	2.67	74.4	49.5	1000000
Benz(a)anthracene	5.34	2.67	252	215	7000
Benzo(a)pyrene	5.34	2.67	249	236	2000
Benzo(b)fluoranthene	5.34	2.67	225	187	7000
Benzo(ghi)perylene	5.34	2.67	189	176	1000000
Benzo(k)fluoranthene	5.34	2.67	214	152	70000
Chrysene	5.34	2.67	258	203	70000
Cl10-BZ#209	0.534	0.267	0.514	4.75	NL
Cl2-BZ#8	0.534	0.267	ND	ND	NL
Cl3-BZ#18	0.534	0.267	ND	ND	NL
Cl3-BZ#28	0.534	0.267	ND	ND	NL
Cl4-BZ#44	0.534	0.267	ND	ND	NL
Cl4-BZ#49	0.534	0.267	ND	ND	NL
Cl4-BZ#52	0.534	0.267	ND	0.722	NL
Cl4-BZ#66	0.534	0.267	ND	ND	NL
Cl5-BZ#101	0.534	0.267	ND	0.964	NL
Cl5-BZ#105	0.534	0.267	ND	ND	NL
Cl5-BZ#118	0.534	0.267	ND	0.956	NL
Cl5-BZ#87	0.534	0.267	ND	0.326	NL
Cl6-BZ#128	0.534	0.267	ND	ND	NL
Cl6-BZ#138	0.534	0.267	ND	2.12	NL
Cl6-BZ#153	0.534	0.267	ND	1.26	NL
Cl7-BZ#170	0.534	0.267	ND	ND	NL
Cl7-BZ#180	0.534	0.267	ND	0.671	NL
Cl7-BZ#183	0.534	0.267	ND	ND	NL
Cl7-BZ#184	0.534	0.267	ND	ND	NL
Cl7-BZ#187	0.534	0.267	ND	0.396	NL
Cl8-BZ#195	0.534	0.267	ND	ND	NL
Cl9-BZ#206	0.534	0.267	ND	4.19	NL
Dibenz(a,h)anthracene	5.34	2.67	43.1	37.2	700
Fluoranthene	5.34	2.67	540	365	1000000
Fluorene	5.34	2.67	26.3	15.7	1000000
Indeno(1,2,3-cd)Pyrene	5.34	2.67	191	174	7000
Naphthalene	5.34	2.67	18.8	36	4000
Phenanthrene	5.34	2.67	290	212	10000
Pyrene	5.34	2.67	430	318	1000000



Analyte	RL	MDL	NB-102523	AR-102523	MCP S-1 & GW-1 Standard
			Result	Result	
PH mg/kg					
C9-C18 Aliphatics	9.58	9.58	ND	ND	1000
C19-C36 Aliphatics	9.58	9.58	29	21.4	3000
C11-C22 Aromatics	9.58	9.58	23.5	29.9	1000
C11-C22 Aromatics, Adjusted	9.58	9.58	23.5	25.6	NL
Pesticides ug/kg					
2,4'-DDD	0.146	0.146	ND	ND	NL
2,4'-DDE	0.146	0.146	ND	ND	NL
2,4'-DDT	0.146	0.146	ND	ND	NL
4,4'-DDD	0.146	0.146	0.314	0.487	NL
4,4'-DDE	0.146	0.146	1.84	1.62	NL
4,4'-DDT	0.146	0.146	0.465	0.41	NL
Aldrin	0.146	0.146	ND	ND	6000
alpha-BHC	0.146	0.146	ND	ND	NL
alpha-Chlordane	0.146	0.146	ND	0.175	NL
beta-BHC	0.146	0.146	ND	ND	NL
Chlordane	7.32	7.32	ND	ND	5000
cis-Nonachlor	0.146	0.146	ND	ND	NL
delta-BHC	0.146	0.146	ND	ND	NL
Dieldrin	0.146	0.146	ND	ND	80
Endosulfan I	0.146	0.146	ND	ND	500
Endosulfan II	0.146	0.146	ND	ND	500
Endosulfan sulfate	0.146	0.146	ND	ND	500
Endrin	0.146	0.146	ND	ND	10000
Endrin aldehyde	0.437	0.437	ND	ND	NL
Endrin ketone	0.146	0.146	ND	ND	NL
gamma-BHC	0.146	0.146	ND	ND	3
gamma-Chlordane	0.146	0.146	ND	0.237	NL
Heptachlor	0.146	0.146	ND	ND	300
Heptachlor epoxide (B)	0.292	0.292	ND	ND	100
Hexachlorobenzene	0.292	0.292	ND	ND	700
Methoxychlor	1.46	1.46	ND	ND	200000
Mirex	0.146	0.146	ND	ND	NL
Oxychlordane	0.292	0.292	ND	ND	NL
Toxaphene	7.32	7.32	ND	ND	NL
trans-Nonachlor	0.146	0.146	0.52	0.386	NL
Metals mg/kg					
Arsenic, Total	0.726	0.096	5.14	5.75	20
Cadmium, Total	0.29	0.038	0.064	0.112	70



Analyte	RL	MDL	NB-102523	AR-102523	MCP S-1 & GW-1 Standard
			Result	Result	
Metals mg/kg					
Chromium, Total	2.9	0.679	21	38.7	100
Copper, Total	2.9	0.281	121	14.6	NL
Lead, Total	0.871	0.212	14.9	24.6	200
Mercury, Total	0.018	0.002	0.005	0.122	20
Nickel, Total	1.45	0.388	12.4	9.04	600
Zinc, Total	14.5	3.77	24.1	41.7	1000
Inorganic/Miscellaneous					
Total Organic Carbon (Rep1)	0.01	0.01	0.832	0.817	NA
Total Organic Carbon (Rep2)	0.01	0.01	0.819	0.735	
Total Organic Carbon (Average)	0.01	0.01	0.826	0.776	
% Total Gravel	0.1	NA	28.2	4.2	
% Coarse Sand	0.1	NA	13.1	5.7	
% Medium Sand	0.1	NA	41.1	19.3	
% Fine Sand	0.1	NA	16.2	63.2	
% Total Fines	0.1	NA	1.4	7.6	
Solids, Total	0.1	0.1	68.1	64.1	

mg/kg = milligrams/kilogram

ug/kg = micrograms/kilogram

PH = Petroleum Hydrocarbons

ND = Non-detect

S-1/GW-1 Risk Values found in Table 2 of the MCP

RL = Reporting Limit

MDL = Method Detection Limit

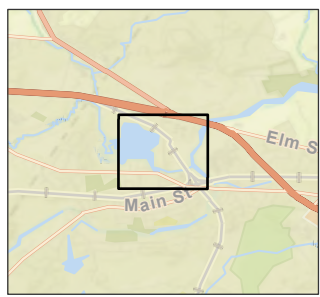
RED values indicate RL or MDL that exceed the S-1/GW-1 Risk Values

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Figure

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Path: \\Warwick\FP\Warwick\p\GIS - Warwick\StateandLocal\Northeast\Massachusetts\6373001 - TownofConcord\Warmer'sPond\PROJECTS\ArcGIS\Pro\Warmer'sPond - SedimentAnalysis\Warmer'sPond - SedimentAnalysis.aprx | 3/7/2024 | qmilton



- Legend**
- Grab Sample Location
 - Core Sample Location
 - Vibracore Sample Location

Figure 1
Sediment Sample Locations
 Warner's Pond Dam
 Removal Feasibility
 Concord, Massachusetts

Source: MassMapper2021
 Date: 3/7/2024
 Projection: NAD 1983 StatePlane Massachusetts
 FIPS 2001



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Photographic Log

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1: SED-01 sediment core sample.



2: SED-01 sediment core sample.



3: SED-01 sediment core sample.



4: SED-01 sediment core sample.



5: SED-01 sediment core sample.



6: SED-02 sediment core sample.



7: SED-02 sediment core sample.



8: SED-02 sediment core sample.



9: SED-02 sediment core sample.



10: SED-02 sediment core sample.



11: SED-02 sediment core sample.



12: SED-02 sediment core sample.



13: SED-03 sediment core sample.



14: SED-03 sediment core sample.



15: SED-03 sediment core sample.



16: SED-03 sediment core sample.



17: SED-03 sediment core sample.



18: SED-03 sediment core sample.



19: SED-04 sediment core sample.



20: SED-04 sediment core sample.



21: SED-04 sediment core sample.



22: SED-04 sediment core sample.



23: SED-04 sediment core sample.



24: SED-05 sediment core sample.



25: SED-05 sediment core sample.



26: SED-05 sediment core sample.



27: SED-05 sediment core sample.



28: SED-05 sediment core sample.



29: SED-05 sediment core sample.

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Sediment Core Log Sheets

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EA Engineering, Science,
and Technology, Inc., PBC

Job No. _____ Client: Town of Concord
Project: 6404021

Location: Warner's Pond

Drilling Method: _____

Soil Boring/Well Number: SED-01

LOG OF SOIL BORING

Sampling Method: Vibracore

Sheet 1 of _____

Coordinates: Northing _____ Easting: _____

TOC Elevation: _____

Surface Elevation: _____

Water Level: _____

Start _____ Finish _____

Reference Elevation: _____

Time: _____

DATE 11/8/23 DATE _____

Reference Description: _____

Date: _____

TIME 9:30 TIME _____

Blow Counts (140-lb)	In. Recvd/ In. Driven	Boring Diagram	PID (ppm) 10.6 eV with Isobutylene as reference gas	Depth		Surface Conditions: <u>Pond surface</u>
				in	Feet	
				0		
				1		
				2		<u>0-2.5': decomposed organics, muck, dark grey, soft, fine grained, visible roots near end. silt</u>
				3		
				4		<u>2.5-4': grey medium grained sandy</u>
				5		
				6		<u>4.5-5.75': dark grey/brown, fine grain, some roots, medium stiff, sandy silt</u>
				7		
				8		<u>5.75-6.75': light olive grey, fine grained stiff clay</u>
				9		
				10		<u>6.75-8': light olive grey, coarse grained sand</u>
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Monitoring Well Construction Information	
Monitoring Well Diameter: _____	in
Bottom of Monitoring Well: _____	ft bgs
Stick Up or Flush Mount: _____	
Screen Interval: _____ To _____	ft bgs
Riser Interval: _____ To _____	ft bgs
Sand Pack Interval: _____ To _____	ft bgs
Bentonite Seal: _____ To _____	ft bgs
Grout Interval: _____ To _____	ft bgs

Soil Vapor Point Installation Information	
Depth of Soil Vapor Point: _____	ft
Bottom of Tubing: _____	ft
Top of Sand Pack: _____	ft
Top of Bentonite Seal: _____	ft

Logged by: DM
Drilling Contractor: TGB

Date: 11/8/23
Driller: _____



EA Engineering, Science,
and Technology, Inc., PBC

Job No. _____ Client: Town of Concord
Project: WAGNER

Location: Wagner's Pond
Soil Boring/Well Number: SED-02

LOG OF SOIL BORING

Coordinates: Northing _____ Easting: _____
TOC Elevation: _____
Surface Elevation: _____
Reference Elevation: _____
Reference Description: _____

Drilling Method: _____
Sampling Method: Vibracore
Water Level: _____
Time: _____
Date: _____
Start DATE 11/8/23 TIME 10:30
Finish DATE _____ TIME _____

Blow Counts (140-16)	In. Recvd/ In. Driven	Boring Diagram	PID (ppm) 10.6 eV with isobutylene as reference gas	Depth	Surface Conditions:
				in	
				Feet	Temperature: <u>38°</u>
				0	<u>0-3': decomposed organics, muck, visible roots, dark grey, fine grain silt</u>
				1	
				2	
				3	
				4	<u>3-8': dark greenish grey, visible roots, fine grained, clayey silt</u>
				5	
				6	
				7	
				8	<u>8-10': dark grey, coarse grained sandy, some organic matter packets</u>
				9	
				10	
				11	
				12	
				13	
				14	
				15	
				16	
				17	
				18	
				19	
				20	

Monitoring Well Construction Information

Monitoring Well Diameter: _____ in
Bottom of Monitoring Well: _____ ft bgs
Stick Up or Flush Mount: _____
Screen Interval: _____ To _____ ft bgs
Riser Interval: _____ To _____ ft bgs
Sand Pack Interval: _____ To _____ ft bgs
Bentonite Seal: _____ To _____ ft bgs
Grout Interval: _____ To _____ ft bgs

Soil Vapor Point Installation Information

Depth of Soil Vapor Point: _____ ft
Bottom of Tubing: _____ ft
Top of Sand Pack: _____ ft
Top of Bentonite Seal: _____ ft

Logged by: DM Date: 11/8/23
Drilling Contractor: TGBB Driller: _____



EA Engineering, Science,
and Technology, Inc., PBC

Job No. _____ Client: Town of Concord
Project: 6404001

Location: Warner's Pond

Drilling Method: _____

Soil Boring/Well Number:
SED-03

LOG OF SOIL BORING

Sampling Method: Vibracore

Sheet 1 of 1

Coordinates: Northing _____ Easting: _____

TOC Elevation: _____

Surface Elevation: _____

Reference Elevation: _____

Reference Description: _____

Water Level: _____

Time: _____

Date: _____

Start _____ Finish _____

DATE 11/8/23 DATE _____

TIME 11:30 TIME _____

Blow Counts (140-lb)	In. Recvd/ In. Driven	Boring Diagram	PID (ppm) 10.6 eV with isobutylene as reference gas	Depth		Surface Conditions:
				in	Feet	
				0		Weather: <u>sun</u> Temperature: <u>40°</u>
				1		
				2		
				3		0-6.5': dark grey, decomposed organ. cs very soft silt
				4		
				5		
				6		
				7		
				8		6.5-8.5': light olive grey, medium and coarse grained sand
				9		
				10		8.5-10': dark grey, medium stiff, fine grain, silty clay
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Monitoring Well Construction Information			Soil Vapor Point Installation Information		
Monitoring Well Diameter:	_____	in	Depth of Soil Vapor Point:	_____	ft
Bottom of Monitoring Well:	_____	ft bgs	Bottom of Tubing:	_____	ft
Stick Up or Flush Mount:	_____		Top of Sand Pack:	_____	ft
Screen Interval:	_____ To _____	ft bgs	Top of Bentonite Seal:	_____	ft
Riser Interval:	_____ To _____	ft bgs			
Sand Pack Interval:	_____ To _____	ft bgs			
Bentonite Seal:	_____ To _____	ft bgs			
Grout Interval:	_____ To _____	ft bgs			

Logged by: DM Date: 11/8/23
Drilling Contractor: TGB Driller: _____



EA Engineering, Science,
and Technology, Inc., PBC

Job No. _____ Client: Town of Concord
Project: GH01001

Location: Warner's Pond
Soil Boring/Well Number: SED-04

LOG OF SOIL BORING

Coordinates: Northing _____ Easting: _____
TOC Elevation: _____
Surface Elevation: _____
Reference Elevation: _____
Reference Description: _____

Drilling Method: _____
Sampling Method: _____
Woracore
Water Level: _____
Time: _____
Date: _____

Sheet 1 of 1
Drilling
Start _____ Finish _____
DATE 11/8/23 DATE _____
TIME 11:58 TIME _____

Blow Counts (140-lb)	In. Recvrd/ In. Driven	Boring Diagram	PID (ppm) 10.6 eV with isobutylene as reference gas	Depth		Surface Conditions:
				in	Feet	
				0		Weather: <u>Sun</u> Temperature: <u>40°</u>
				1		0-2.5': decomposed organic, dark grey, soft, fine grain silt
				2		
				3		
				4		2.5-3': dark grey, fine grained silty clay, medium stiff
				5		
				6		3-7': light olive grey, medium / coarse grained sand, some roots
				7		
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Monitoring Well Construction Information

Monitoring Well Diameter: _____ in
Bottom of Monitoring Well: _____ ft bgs
Stick Up or Flush Mount: _____
Screen Interval: _____ To _____ ft bgs
Riser Interval: _____ To _____ ft bgs
Sand Pack Interval: _____ To _____ ft bgs
Bentonite Seal: _____ To _____ ft bgs
Grout Interval: _____ To _____ ft bgs

Soil Vapor Point Installation Information

Depth of Soil Vapor Point: _____ ft
Bottom of Tubing: _____ ft
Top of Sand Pack: _____ ft
Top of Bentonite Seal: _____ ft

Logged by: DK
Drilling Contractor: TGBB

Date: 11/8/23
Driller: _____



EA Engineering, Science,
and Technology, Inc., PBC

Job No. _____ Client: Town of Concord
Project: (1104001)

Location: Warner's Pond

Drilling Method: _____

Soil Boring/Well Number: SED-00

LOG OF SOIL BORING

Sampling Method: Vibracore

Sheet 1 of 1

Coordinates: Northing _____ Easting _____

TOC Elevation: _____

Surface Elevation: _____

Reference Elevation: _____

Reference Description: _____

Water Level: _____
Time: _____
Date: _____

Drilling
Start _____ Finish _____
DATE 11/8/23 DATE _____
TIME 12:15 TIME _____

Blow Counts (140-lb)	In. Recvrd/ In. Driven	Boring Diagram	PID (ppm) 10.6 eV with isobutylene as reference gas	Depth		Surface Conditions:
				in	Feet	
				0		Weather: <u>SUN</u> Temperature: <u>40°</u>
				1		<u>0-1': decomposed organics, muck, dark grey, soft, fine grained silt</u>
				2		
				3		
				4		<u>1-4.5': greenish grey, coarse grained sand</u>
				5		
				6		<u>4.5-7.5': light tan grey, medium grained sand, some redox features near bottom, larger rocks mixed in</u>
				7		
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Monitoring Well Construction Information

Monitoring Well Diameter: _____ in
Bottom of Monitoring Well: _____ ft bgs
Stick Up or Flush Monnt: _____
Screen Interval: _____ To _____ ft bgs
Riser Interval: _____ To _____ ft bgs
Sand Pack Interval: _____ To _____ ft bgs
Bentonite Seal: _____ To _____ ft bgs
Grout Interval: _____ To _____ ft bgs

Soil Vapor Point Installation Information

Depth of Soil Vapor Point: _____ ft
Bottom of Tubing: _____ ft
Top of Sand Pack: _____ ft
Top of Bentonite Seal: _____ ft

Logged by: [Signature] Date: 11/8/23
Drilling Contractor: TGB Driller: _____



EA Engineering, Science, and Technology, Inc., PBC

Job No.	Client: <u>Town of Concord</u> Project: <u>6404201</u>	Location: <u>Nashoba Brook</u>
Drilling Method:		Soil Boring/Well Number: <u>WB-CA</u>
Sampling Method: <u>Wildco Sed Corer</u>		Sheet <u>1</u> of <u>1</u>
Coordinates: Northing _____ Easting: _____		Drilling
TOC Elevation: _____	Water Level: _____	Start _____ Finish _____
Surface Elevation: _____	Time: _____	DATE <u>10/15/23</u> DATE _____
Reference Elevation: _____	Date: _____	TIME <u>1600</u> TIME _____
Reference Description: _____		

Blow Counts (140-lb)	In. Recvrd/ In. Driven	Boring Diagram	PID (ppm) 10.6 eV with isobutylene as reference gas	Depth in feet <u>m</u>	Surface Conditions: <u>~ 1ft of water, cobbles, gravel</u> Weather: <u>Sun</u> Temperature: <u>68°</u>
				0	
				1	0-2' : brown organics suspended in water column
				2	
				3	2-4' : brown-gray fine to medium sand w some roots
				4	
				5	
				6	
				7	
				8	
				9	
				10	
				11	
				12	
				13	
				14	
				15	
				16	
				17	
				18	
				19	
				20	

Monitoring Well Construction Information		Soil Vapor Point Installation Information	
Monitoring Well Diameter: _____ in		Depth of Soil Vapor Point: _____ ft	
Bottom of Monitoring Well: _____ ft bgs		Bottom of Tubing: _____ ft	
Stick Up or Flush Mount: _____		Top of Sand Pack: _____ ft	
Screen Interval: _____ To _____ ft bgs		Top of Bentonite Seal: _____ ft	
Riser Interval: _____ To _____ ft bgs			
Sand Pack Interval: _____ To _____ ft bgs			
Bentonite Seal: _____ To _____ ft bgs			
Grout Interval: _____ To _____ ft bgs			

Logged by: GA/AM Date: 10-15-23
 Drilling Contractor: _____ Driller: _____



EA Engineering, Science, and Technology, Inc., PBC

Job No. _____ Client: Town of Concord
Project: 604001

Location: Nashua Brook

Drilling Method: _____

Soil Boring/Well Number: _____

LOG OF SOIL BORING

Sampling Method: _____

NB-PB

Coordinates: Northing _____ Easting: _____

Sheet 1 of 1

TOC Elevation: _____

Wildco seal cover

Surface Elevation: _____

Water Level: _____

Drilling

Reference Elevation: _____

Time: _____

Start

Finish

Reference Description: _____

Date: _____

DATE 10/25/23

TIME 1520

Blow Counts (140-lb)	In. Recvrd/ In. Driven	Boring Diagram	PID (ppm) 10.6 eV with isobutylene as reference gas	Depth	Surface Conditions: <u>~1 ft of water, sediment</u>
				in	
				0	Temperature: <u>68°</u>
				1	<u>0-2.5" : brown organic muck, wet</u>
				2	
				3	
				4	<u>2.5-6" : brown loamy fine sand</u>
				5	
				6	
				7	
				8	
				9	
				10	
				11	
				12	
				13	
				14	
				15	
				16	
				17	
				18	
				19	
				20	

Monitoring Well Construction Information		Soil Vapor Point Installation Information	
Monitoring Well Diameter: _____	in	Depth of Soil Vapor Point: _____	ft
Bottom of Monitoring Well: _____	ft bgs	Bottom of Tubing: _____	ft
Stick Up or Flush Mount: _____		Top of Sand Pack: _____	ft
Screen Interval: _____ To _____	ft bgs	Top of Bentonite Seal: _____	ft
Riser Interval: _____ To _____	ft bgs		
Sand Pack Interval: _____ To _____	ft bgs		
Bentonite Seal: _____ To _____	ft bgs		
Grout Interval: _____ To _____	ft bgs		

Logged by: GJ/KM Date: 10/25/23
Drilling Contractor: _____ Driller: _____

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Laboratory Reports

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Client:	EA Engineering, Science, & Technology		
Project:	Warner's Pond		
Location:	Concord, MA	Project No:	GTX-318057
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	11/27/23
Depth :	---	Test Id:	745089

Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
---	SED- 01 -0-2.5	---	Moist, very dark brown silt with sand and organics	93.87	70.38	55.09	(1)
---	SED- 01 -2.5-4.5	---	Moist, grayish brown sand	105.4	26.92	83.08	(2)
---	SED- 01 -4.5-5.75	---	Moist, very dark brown silty sand with organics	84.94	91.04	44.46	(3)
---	SED- 01 -5.75-6.75	---	Moist, gray sandy clay with organics	115.3	31.49	87.70	(4)
---	SED- 01 -6.75-8	---	Moist, gray sand with silt	115.7	15.54	100.2	(5)

* Sample Comments

- (1): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (2): Method B-Volumetric, Reconstituted (compacted)
- (3): Sample contains organics
Method B-Volumetric,
- (4): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (5): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.



Client:	EA Engineering, Science, & Technology		
Project:	Warner's Pond		
Location:	Concord, MA	Project No:	GTX-318057
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	11/27/23
Depth :	---	Test Id:	745111

Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
---	SED- 02 -0-3	---	Moist, very dark brown silt with organics	69.11	195.9	23.36	(1)
---	SED- 02 -3-8	---	Moist, very dark brown silt with organics	63.40	389.6	12.95	(2)
---	SED- 02 -8-10	---	Moist, dark grayish brown silty sand with organics	101.0	36.29	74.12	(3)
---	SED- 03 -0-6.5	---	Moist, very dark brown sandy silt with organics	63.80	353.6	14.07	(4)
---	SED- 03 -6.5-8.5	---	Moist, grayish brown sand with silt	107.9	23.03	87.67	(5)

* Sample Comments

- (1): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (2): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (3): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (4): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (5): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.



Client:	EA Engineering, Science, & Technology		
Project:	Warner's Pond		
Location:	Concord, MA	Project No:	GTX-318057
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	11/28/23
Depth :	---	Test Id:	745116

Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
---	SED- 03 -8.5-10	---	Moist, very dark brown clay with organics	65.36	263.2	17.99	(1)
---	SED- 04 -0-2.5	---	Moist, very dark brown clay with organics	59.02	359.3	12.85	(2)
---	SED- 04 -2.5-3	---	Moist, dark brown clay with sand	89.56	62.11	55.25	(3)
---	SED- 04 -3-7	---	Moist, grayish brown sand	117.1	23.08	95.17	(4)
---	SED- 05 -0-1	---	Moist, very dark brown silt	67.61	367.5	14.46	(5)

* Sample Comments

- (1): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (2): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (3): Method B-Volumetric, Reconstituted (compacted)
- (4): Method B-Volumetric, Reconstituted (compacted)
- (5): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.



Client:	EA Engineering, Science, & Technology				
Project:	Warner's Pond				
Location:	Concord, MA	Project No:	GTX-318057		
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	11/27/23	Checked By:	jsc
Depth :	---	Test Id:	745118		

**Laboratory Determination of Density (Unit Weight)
of Soil Specimens by ASTM D7263**

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
---	SED- 05 -1-4.5	---	Moist, grayish brown sand with gravel	110.2	13.44	97.11	(1)
---	SED- 05 -4.5-7.5	---	Moist, yellowish brown sand	119.7	18.03	101.4	(2)

* Sample Comments

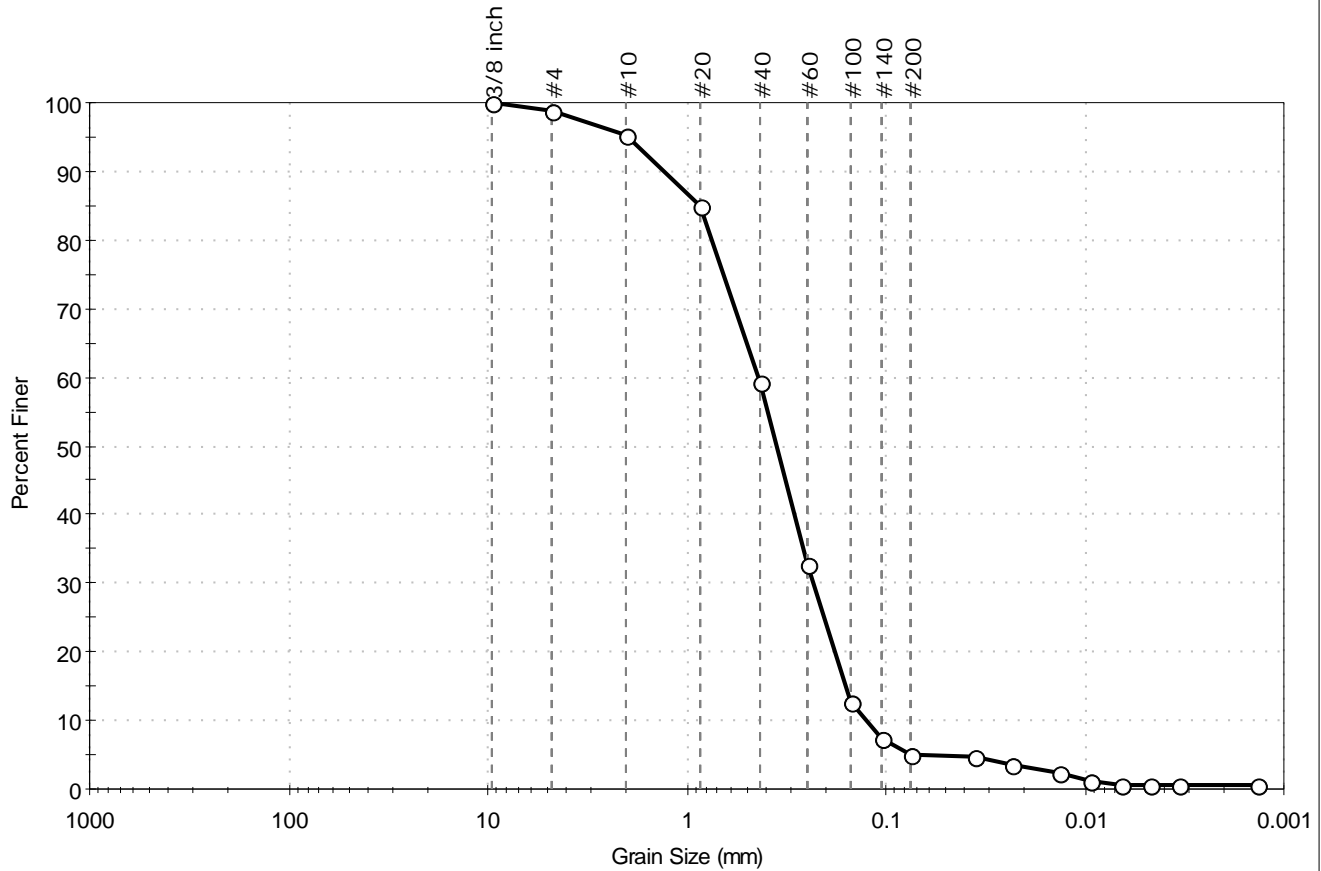
- (1): Method B-Volumetric, Reconstituted (compacted)
- (2): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-03-6.5-8.5	Test Date: 11/28/23
Depth: ---	Test Id: 745103
Tested By: ckg	Checked By: jsc
Test Comment: ---	
Visual Description: Moist, grayish brown sand with silt	
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	1.0	93.9	5.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	99		
#10	2.00	95		
#20	0.85	85		
#40	0.42	59		
#60	0.25	33		
#100	0.15	13		
#140	0.11	7		
#200	0.075	5.1		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0362	5		
---	0.0232	4		
---	0.0134	2		
---	0.0095	1		
---	0.0066	0		
---	0.0047	0		
---	0.0033	0		
---	0.0014	0		

Coefficients	
D ₈₅ = 0.8478 mm	D ₃₀ = 0.2334 mm
D ₆₀ = 0.4329 mm	D ₁₅ = 0.1591 mm
D ₅₀ = 0.3530 mm	D ₁₀ = 0.1257 mm
C _u = 3.444	C _c = 1.001

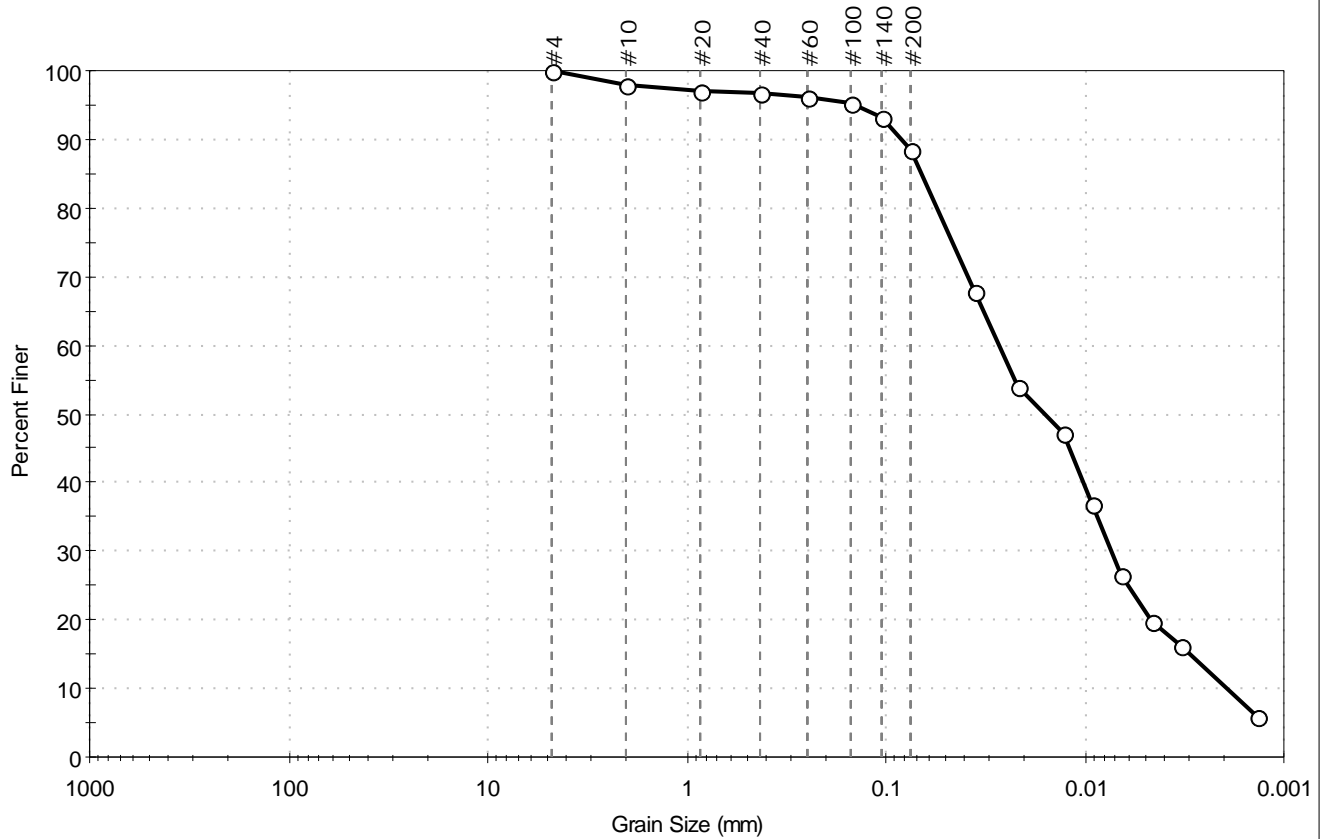
Classification	
ASTM	N/A
AASHTO	Fine Sand (A-3 (1))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-03-8.5-10	Test Date: 11/28/23
Depth: ---	Test Id: 745104
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown clay with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	11.5	88.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	98		
#20	0.85	97		
#40	0.42	97		
#60	0.25	96		
#100	0.15	95		
#140	0.11	93		
#200	0.075	88		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0360	68		
---	0.0220	54		
---	0.0130	47		
---	0.0092	37		
---	0.0066	27		
---	0.0047	20		
---	0.0033	16		
---	0.0014	6		

<u>Coefficients</u>	
D ₈₅ = 0.0663 mm	D ₃₀ = 0.0074 mm
D ₆₀ = 0.0272 mm	D ₁₅ = 0.0030 mm
D ₅₀ = 0.0161 mm	D ₁₀ = 0.0019 mm
C _u = 14.316	C _c = 1.060

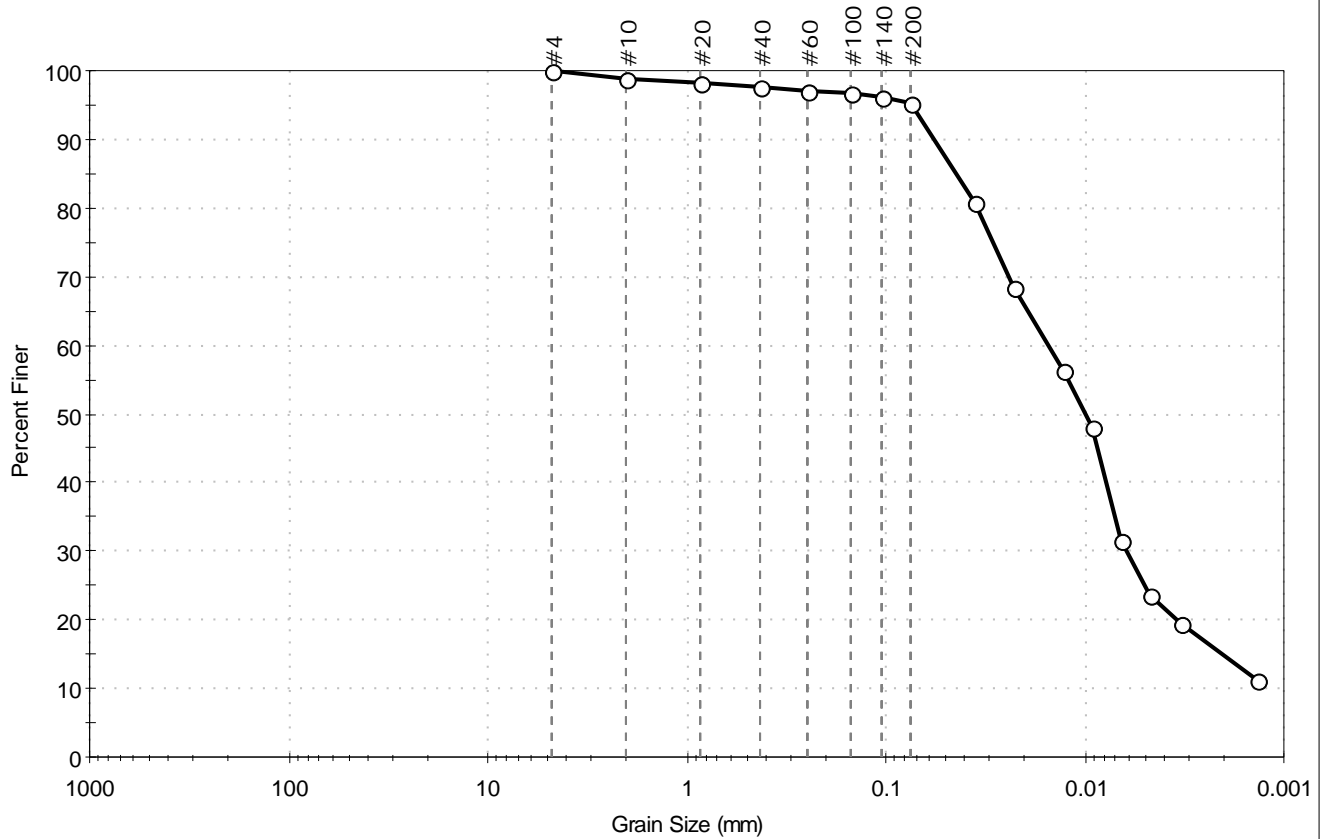
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-04-0-2.5	Test Date: 11/28/23
Depth: ---	Test Id: 745105
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown clay with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	4.6	95.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	98		
#40	0.42	98		
#60	0.25	97		
#100	0.15	97		
#140	0.11	96		
#200	0.075	95		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0359	81		
---	0.0225	69		
---	0.0130	56		
---	0.0092	48		
---	0.0066	32		
---	0.0047	23		
---	0.0033	19		
---	0.0014	11		

<u>Coefficients</u>	
D ₈₅ = 0.0444 mm	D ₃₀ = 0.0061 mm
D ₆₀ = 0.0154 mm	D ₁₅ = 0.0021 mm
D ₅₀ = 0.0100 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

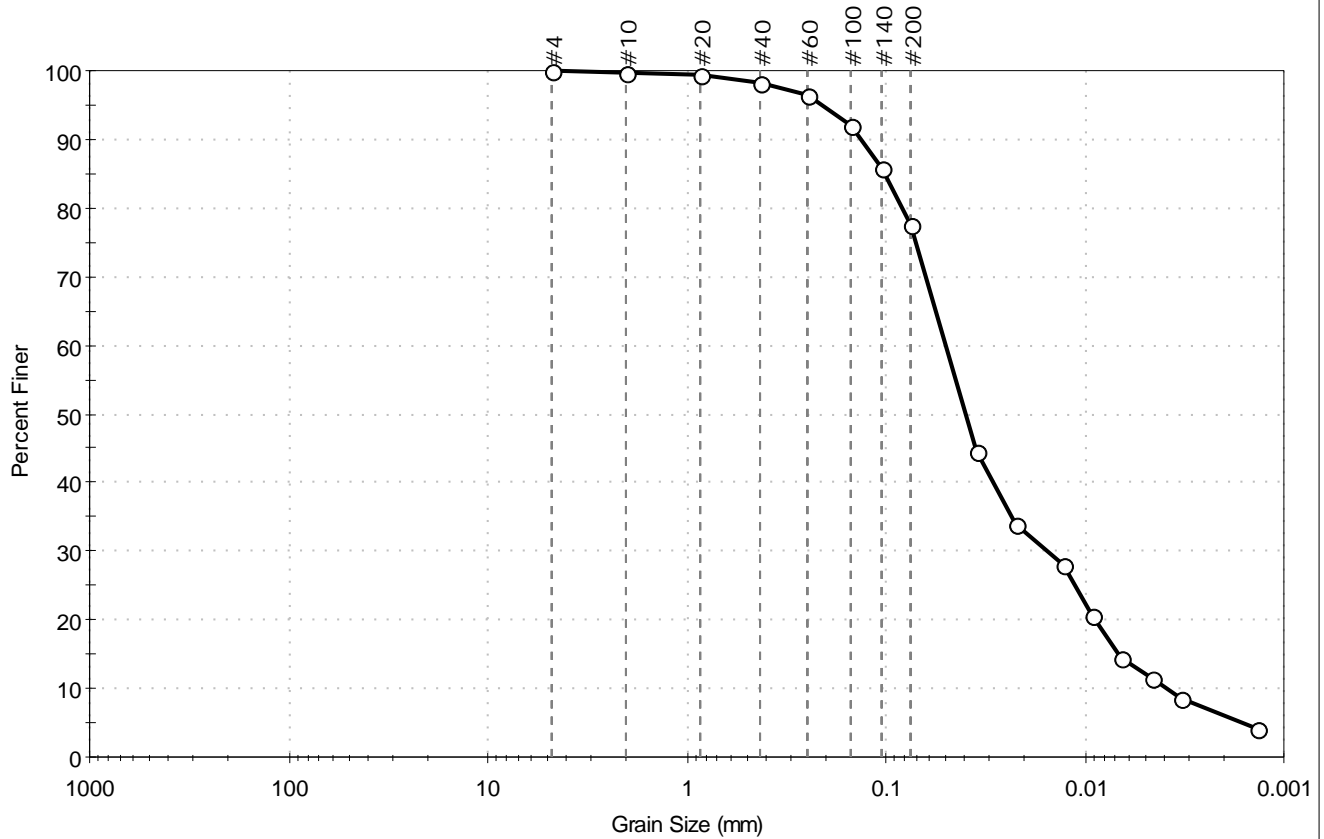
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-04-2.5-3	Test Date: 11/28/23
Depth: ---	Test Id: 745106
Tested By: ckg	Checked By: jsc
Test Comment: ---	
Visual Description: Moist, dark brown clay with sand	
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	22.5	77.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	98		
#60	0.25	97		
#100	0.15	92		
#140	0.11	86		
#200	0.075	78		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0351	45		
---	0.0222	34		
---	0.0128	28		
---	0.0091	21		
---	0.0065	15		
---	0.0047	12		
---	0.0033	9		
---	0.0014	4		

<u>Coefficients</u>	
D ₈₅ = 0.1027 mm	D ₃₀ = 0.0153 mm
D ₆₀ = 0.0501 mm	D ₁₅ = 0.0067 mm
D ₅₀ = 0.0398 mm	D ₁₀ = 0.0039 mm
C _u = 12.846	C _c = 1.198

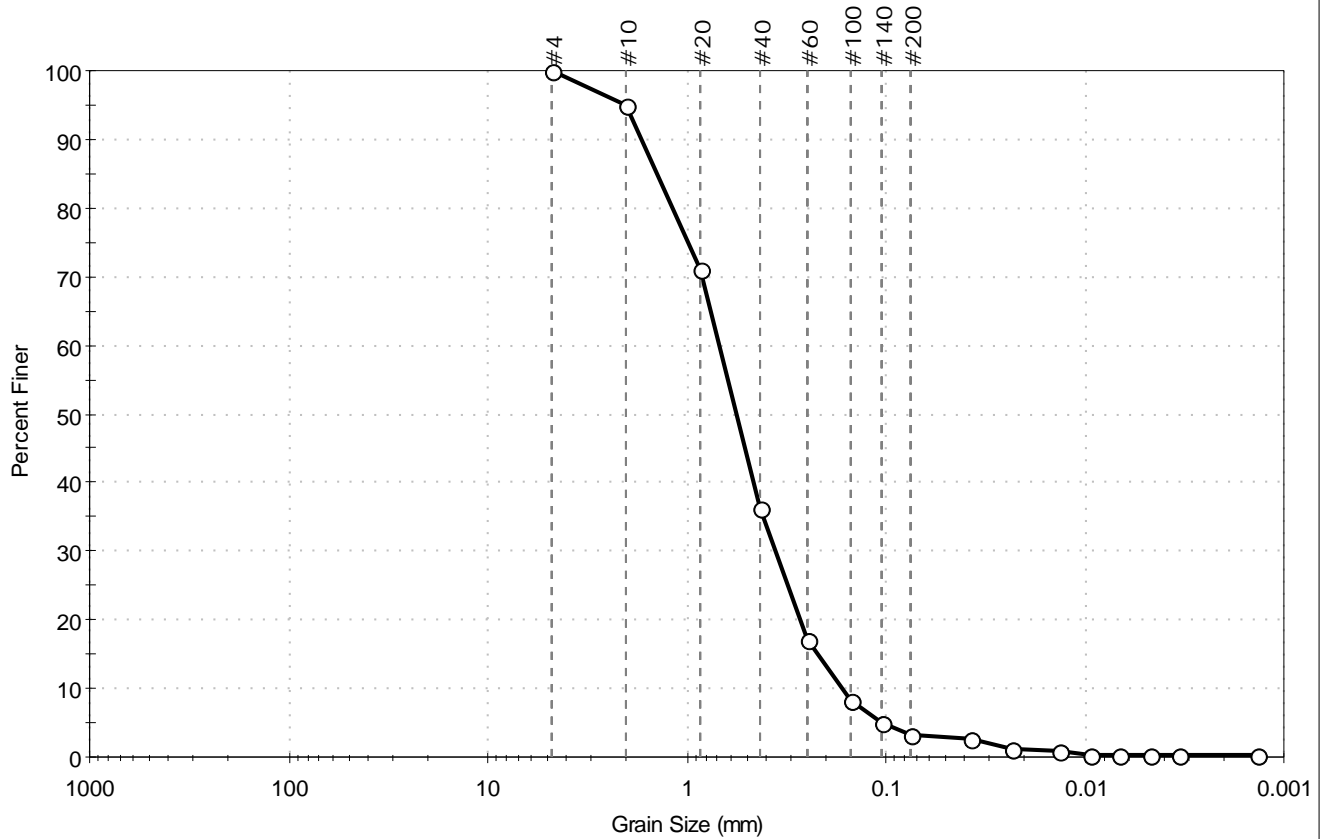
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client:	EA Engineering, Science, & Technology		
Project:	Warner's Pond		
Location:	Concord, MA	Project No:	GTX-318057
Boring ID:	---	Sample Type:	tube
Sample ID:	SED-04-3-7	Test Date:	11/28/23
Depth:	---	Test Id:	745107
Test Comment:	---		
Visual Description:	Moist, grayish brown sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	96.9	3.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	95		
#20	0.85	71		
#40	0.42	36		
#60	0.25	17		
#100	0.15	8		
#140	0.11	5		
#200	0.075	3.1		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0374	3		
---	0.0235	1		
---	0.0134	1		
---	0.0095	0		
---	0.0067	0		
---	0.0047	0		
---	0.0034	0		
---	0.0014	0		

<u>Coefficients</u>	
D ₈₅ = 1.3974 mm	D ₃₀ = 0.3573 mm
D ₆₀ = 0.6813 mm	D ₁₅ = 0.2231 mm
D ₅₀ = 0.5582 mm	D ₁₀ = 0.1672 mm
C _u = 4.075	C _c = 1.121

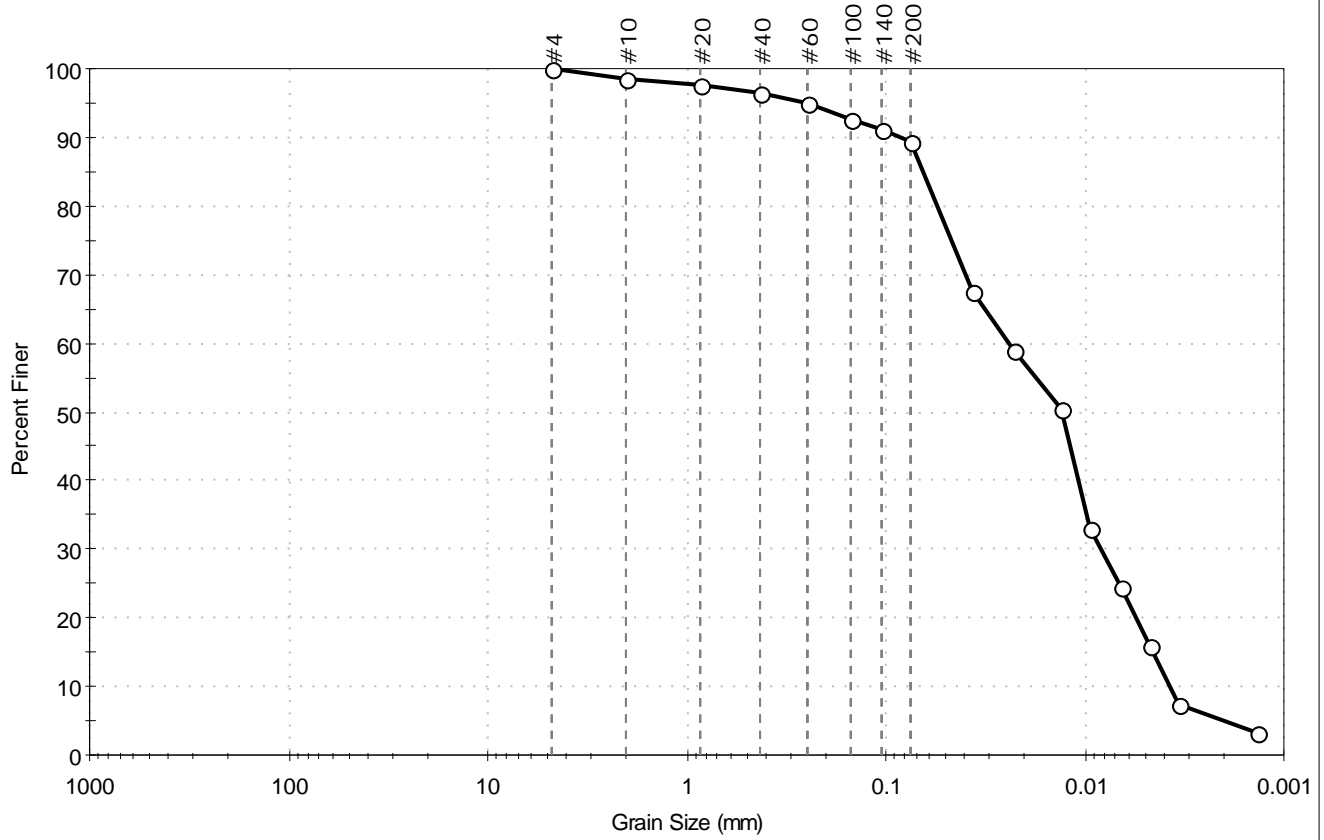
<u>Classification</u>	
<u>ASTM</u>	Poorly graded SAND (SP)
<u>AASHTO</u>	Stone Fragments, Gravel and Sand (A-1-b (1))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape : ---	
Sand/Gravel Hardness : ---	
Dispersion Device : Apparatus A - Mech Mixer	
Dispersion Period : 1 minute	
Est. Specific Gravity : 2.65	
Separation of Sample: #200 Sieve	



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-05-0-1	Test Date: 11/28/23
Depth: ---	Test Id: 745108
Tested By: ckg	Checked By: jsc
Test Comment: ---	
Visual Description: Moist, very dark brown silt	
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	10.5	89.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	98		
#40	0.42	97		
#60	0.25	95		
#100	0.15	93		
#140	0.11	91		
#200	0.075	89		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0364	67		
---	0.0228	59		
---	0.0131	50		
---	0.0093	33		
---	0.0066	25		
---	0.0047	16		
---	0.0033	7		
---	0.0014	3		

<u>Coefficients</u>	
D ₈₅ = 0.0648 mm	D ₃₀ = 0.0082 mm
D ₆₀ = 0.0242 mm	D ₁₅ = 0.0045 mm
D ₅₀ = 0.0130 mm	D ₁₀ = 0.0037 mm
C _u = 6.541	C _c = 0.751

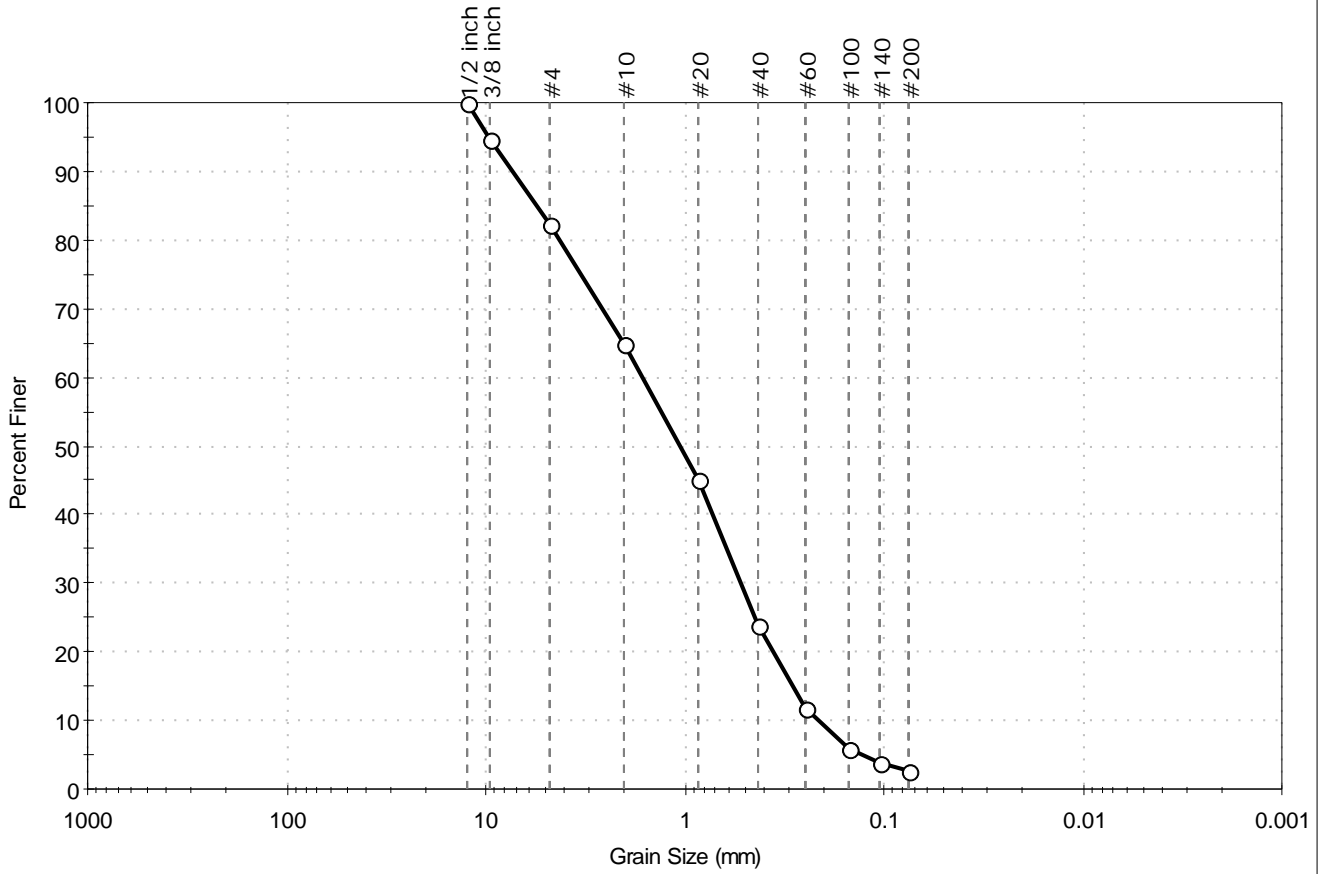
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-05-1-4.5	Test Date: 11/28/23
Depth: ---	Test Id: 745109
Test Comment: ---	Tested By: ckg
Visual Description: Moist, grayish brown sand with gravel	Checked By: jsc
Sample Comment: ---	

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	17.7	79.5	2.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1/2 inch	12.50	100		
3/8 inch	9.50	95		
#4	4.75	82		
#10	2.00	65		
#20	0.85	45		
#40	0.42	24		
#60	0.25	12		
#100	0.15	6		
#140	0.11	4		
#200	0.075	2.8		

<u>Coefficients</u>	
D ₈₅ = 5.5373 mm	D ₃₀ = 0.5181 mm
D ₆₀ = 1.6174 mm	D ₁₅ = 0.2877 mm
D ₅₀ = 1.0512 mm	D ₁₀ = 0.2151 mm
C _u = 7.519	C _c = 0.772

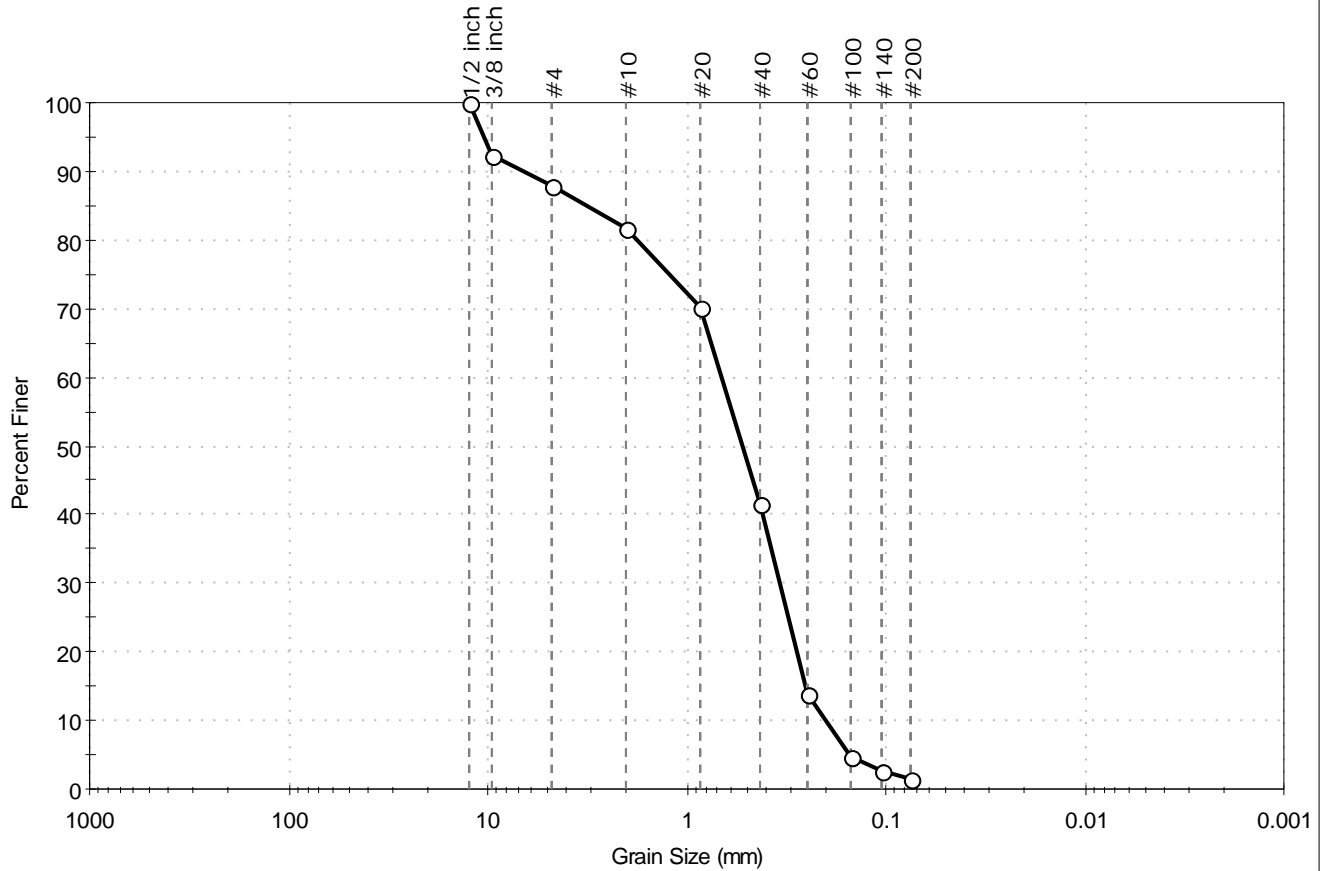
<u>Classification</u>	
<u>ASTM</u>	Poorly graded SAND with Gravel (SP)
<u>AASHTO</u>	Stone Fragments, Gravel and Sand (A-1-b (1))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape : ANGULAR	
Sand/Gravel Hardness : HARD	



Client: EA Engineering, Science, & Technology	Project No: GTX-318057	
Project: Warner's Pond	Tested By: ckg	
Location: Concord, MA	Sample Type: tube	Checked By: jsc
Boring ID: ---	Test Date: 11/28/23	Test Id: 745110
Sample ID: SED-05-4.5-7.5	Visual Description: Moist, yellowish brown sand	
Depth: ---	Sample Comment: ---	

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	12.0	86.6	1.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1/2 inch	12.50	100		
3/8 inch	9.50	92		
#4	4.75	88		
#10	2.00	82		
#20	0.85	70		
#40	0.42	42		
#60	0.25	14		
#100	0.15	5		
#140	0.11	3		
#200	0.075	1.4		

<u>Coefficients</u>	
D ₈₅ = 3.1395 mm	D ₃₀ = 0.3409 mm
D ₆₀ = 0.6644 mm	D ₁₅ = 0.2558 mm
D ₅₀ = 0.5218 mm	D ₁₀ = 0.2017 mm
C _u = 3.294	C _c = 0.867

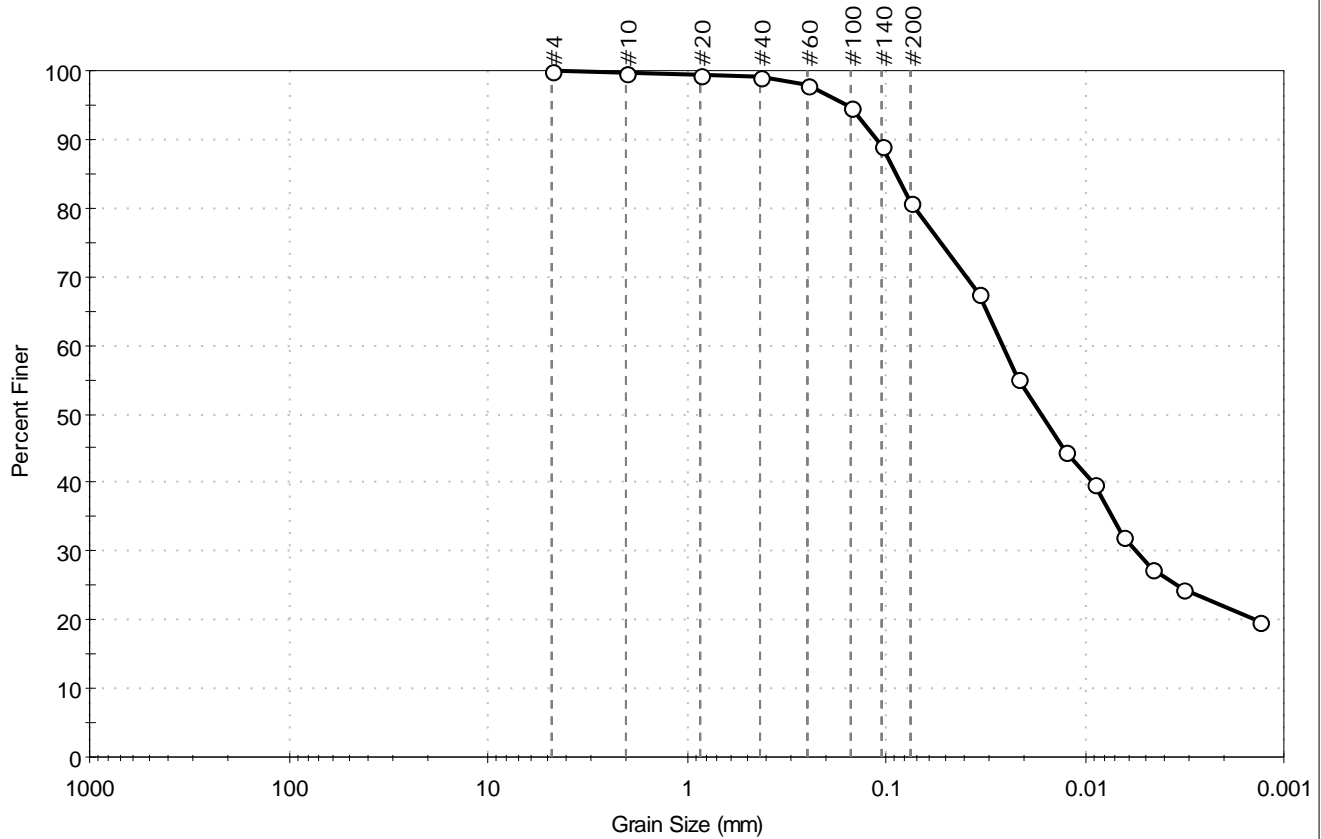
<u>Classification</u>	
<u>ASTM</u>	Poorly graded SAND (SP)
<u>AASHTO</u>	Stone Fragments, Gravel and Sand (A-1-b (1))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape : ANGULAR	
Sand/Gravel Hardness : HARD	



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-01-0-2.5	Test Date: 11/28/23
Depth: ---	Test Id: 745076
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown silt with sand and organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	19.1	80.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	98		
#100	0.15	95		
#140	0.11	89		
#200	0.075	81		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0338	68		
---	0.0215	55		
---	0.0126	44		
---	0.0090	40		
---	0.0064	32		
---	0.0046	27		
---	0.0032	24		
---	0.0013	20		

<u>Coefficients</u>	
D ₈₅ = 0.0890 mm	D ₃₀ = 0.0055 mm
D ₆₀ = 0.0256 mm	D ₁₅ = N/A
D ₅₀ = 0.0166 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

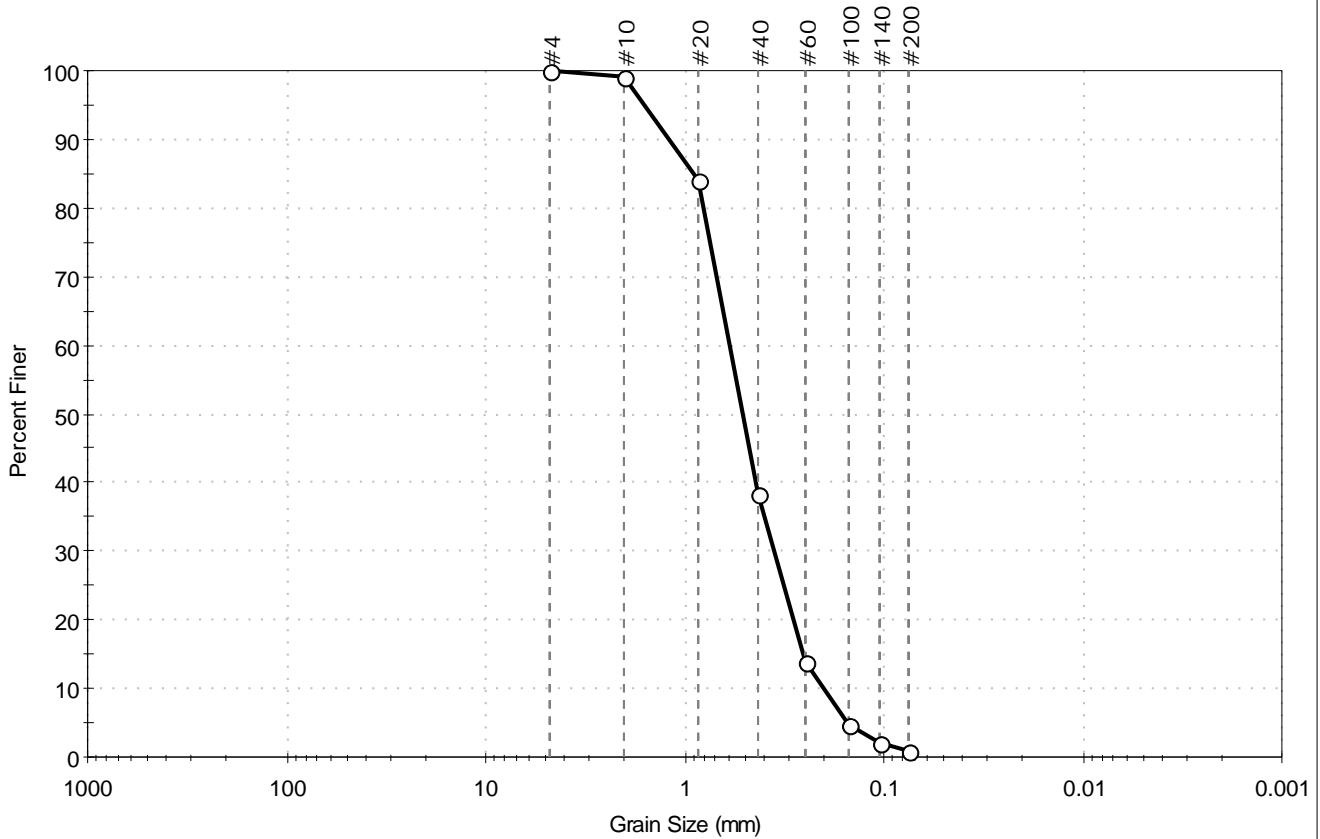
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057	
Project: Warner's Pond	Tested By: ckg	
Location: Concord, MA	Sample Type: tube	Checked By: jsc
Boring ID: ---	Test Date: 11/28/23	Test Id: 745077
Sample ID: SED-01-2.5-4.5	Visual Description: Moist, grayish brown sand	
Depth: ---	Sample Comment: ---	

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	99.2	0.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	84		
#40	0.42	38		
#60	0.25	14		
#100	0.15	5		
#140	0.11	2		
#200	0.075	0.8		

<u>Coefficients</u>	
D ₈₅ = 0.9014 mm	D ₃₀ = 0.3545 mm
D ₆₀ = 0.5907 mm	D ₁₅ = 0.2559 mm
D ₅₀ = 0.5074 mm	D ₁₀ = 0.2005 mm
C _u = 2.946	C _c = 1.061

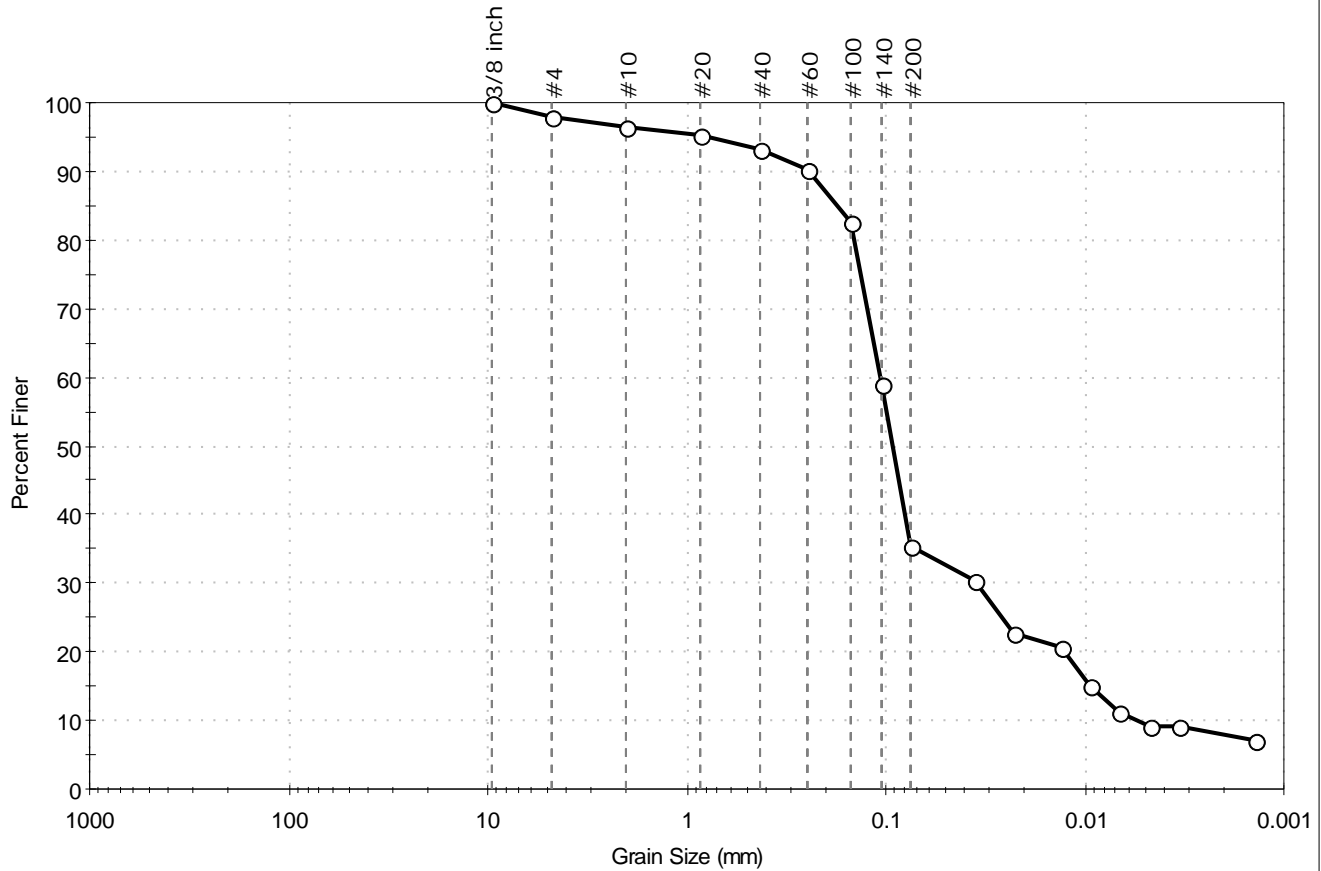
<u>Classification</u>	
<u>ASTM</u>	Poorly graded SAND (SP)
<u>AASHTO</u>	Stone Fragments, Gravel and Sand (A-1-b (1))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape	: ---
Sand/Gravel Hardness	: ---



Client: EA Engineering, Science, & Technology	Project No: GTX-318057	
Project: Warner's Pond	Tested By: ckg	
Location: Concord, MA	Sample Type: tube	Checked By: jsc
Boring ID: ---	Test Date: 11/28/23	Test Id: 745078
Sample ID: SED-01-4.5-5.75	Visual Description: Moist, very dark brown silty sand with organics	
Depth: ---	Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	2.1	62.6	35.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	98		
#10	2.00	97		
#20	0.85	95		
#40	0.42	93		
#60	0.25	90		
#100	0.15	82		
#140	0.11	59		
#200	0.075	35		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0361	30		
---	0.0230	23		
---	0.0133	21		
---	0.0094	15		
---	0.0067	11		
---	0.0047	9		
---	0.0034	9		
---	0.0014	7		

Coefficients	
D ₈₅ = 0.1773 mm	D ₃₀ = 0.0356 mm
D ₆₀ = 0.1074 mm	D ₁₅ = 0.0094 mm
D ₅₀ = 0.0929 mm	D ₁₀ = 0.0054 mm
C _u = 19.889	C _c = 2.185

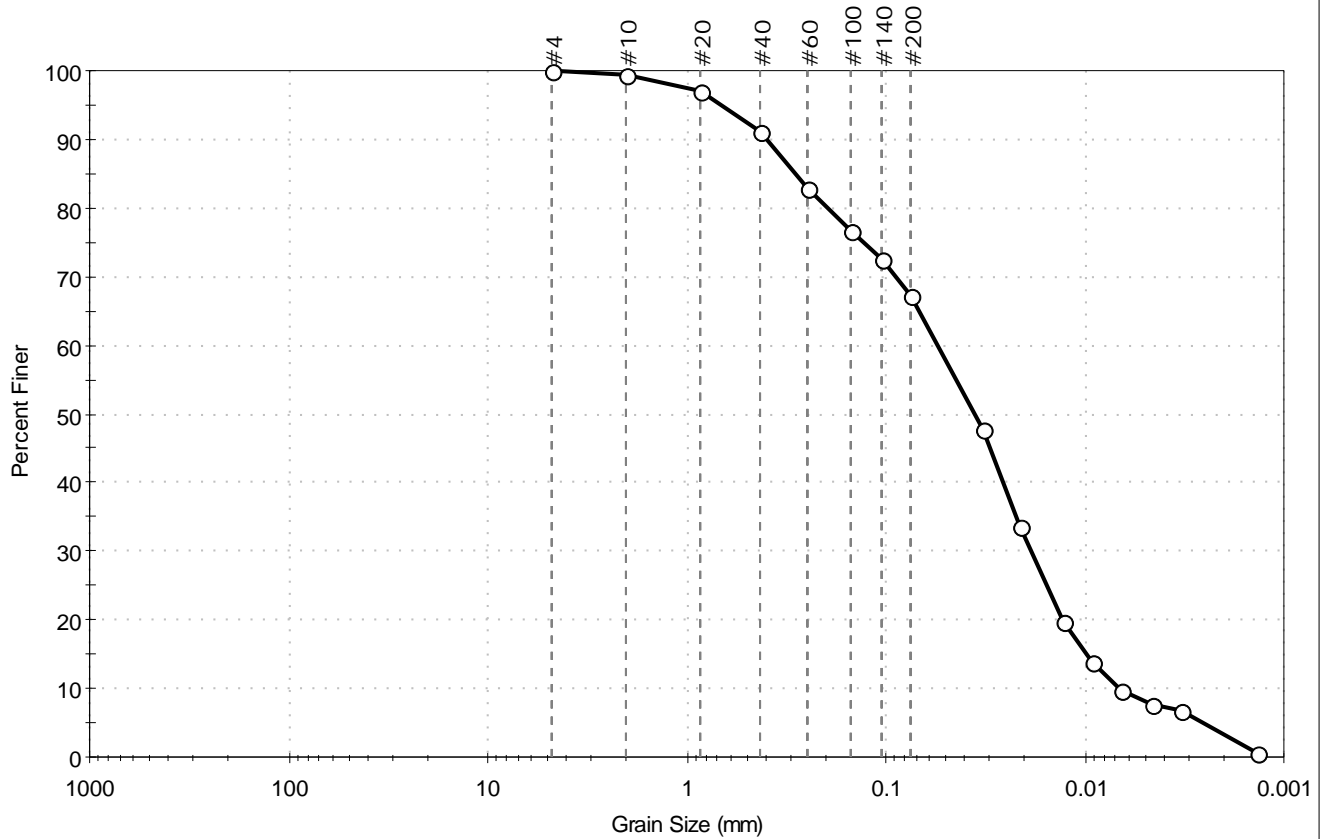
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057	
Project: Warner's Pond	Tested By: ckg	
Location: Concord, MA	Sample Type: tube	Checked By: jsc
Boring ID: ---	Test Date: 11/28/23	Test Id: 745079
Sample ID: SED-01-5.75-6.75	Test Comment: ---	
Depth: ---	Visual Description: Moist, gray sandy clay with organics	
Sample Comment: Sample contains organics		

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	32.7	67.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	97		
#40	0.42	91		
#60	0.25	83		
#100	0.15	77		
#140	0.11	72		
#200	0.075	67		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0328	48		
---	0.0214	34		
---	0.0127	20		
---	0.0092	14		
---	0.0065	10		
---	0.0046	8		
---	0.0033	7		
---	0.0014	1		

<u>Coefficients</u>	
D ₈₅ = 0.2860 mm	D ₃₀ = 0.0186 mm
D ₆₀ = 0.0550 mm	D ₁₅ = 0.0098 mm
D ₅₀ = 0.0360 mm	D ₁₀ = 0.0067 mm
C _u = 8.209	C _c = 0.939

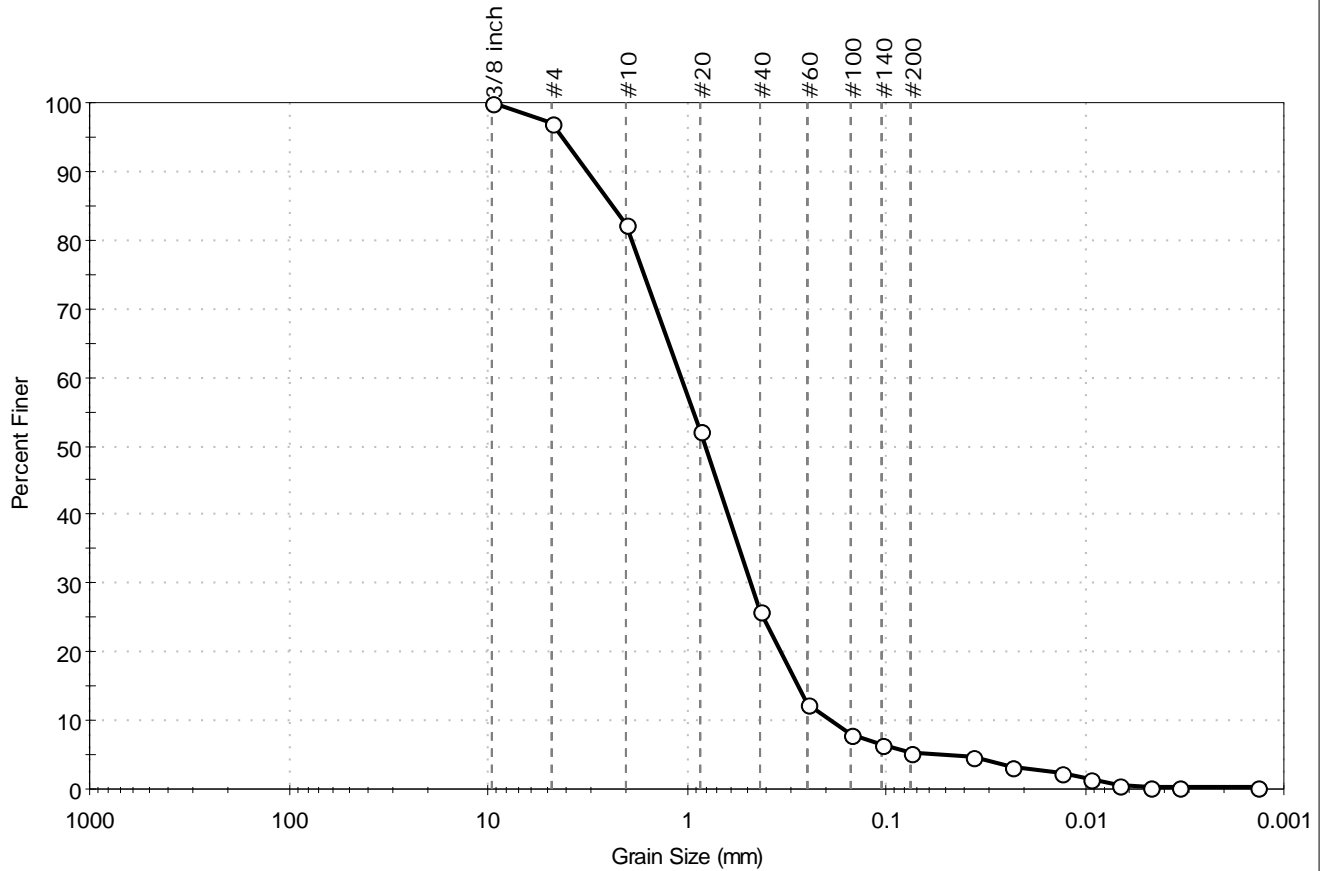
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-01-6.75-8	Test Date: 11/28/23
Depth: ---	Test Id: 745080
Tested By: ckg	Checked By: jsc
Test Comment: ---	
Visual Description: Moist, gray sand with silt	
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	3.0	91.6	5.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	97		
#10	2.00	82		
#20	0.85	52		
#40	0.42	26		
#60	0.25	12		
#100	0.15	8		
#140	0.11	7		
#200	0.075	5.4		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0364	5		
---	0.0231	3		
---	0.0133	2		
---	0.0094	1		
---	0.0067	1		
---	0.0047	0		
---	0.0034	0		
---	0.0014	0		

Coefficients	
D ₈₅ = 2.3437 mm	D ₃₀ = 0.4724 mm
D ₆₀ = 1.0592 mm	D ₁₅ = 0.2767 mm
D ₅₀ = 0.8005 mm	D ₁₀ = 0.1878 mm
C _u = 5.640	C _c = 1.122

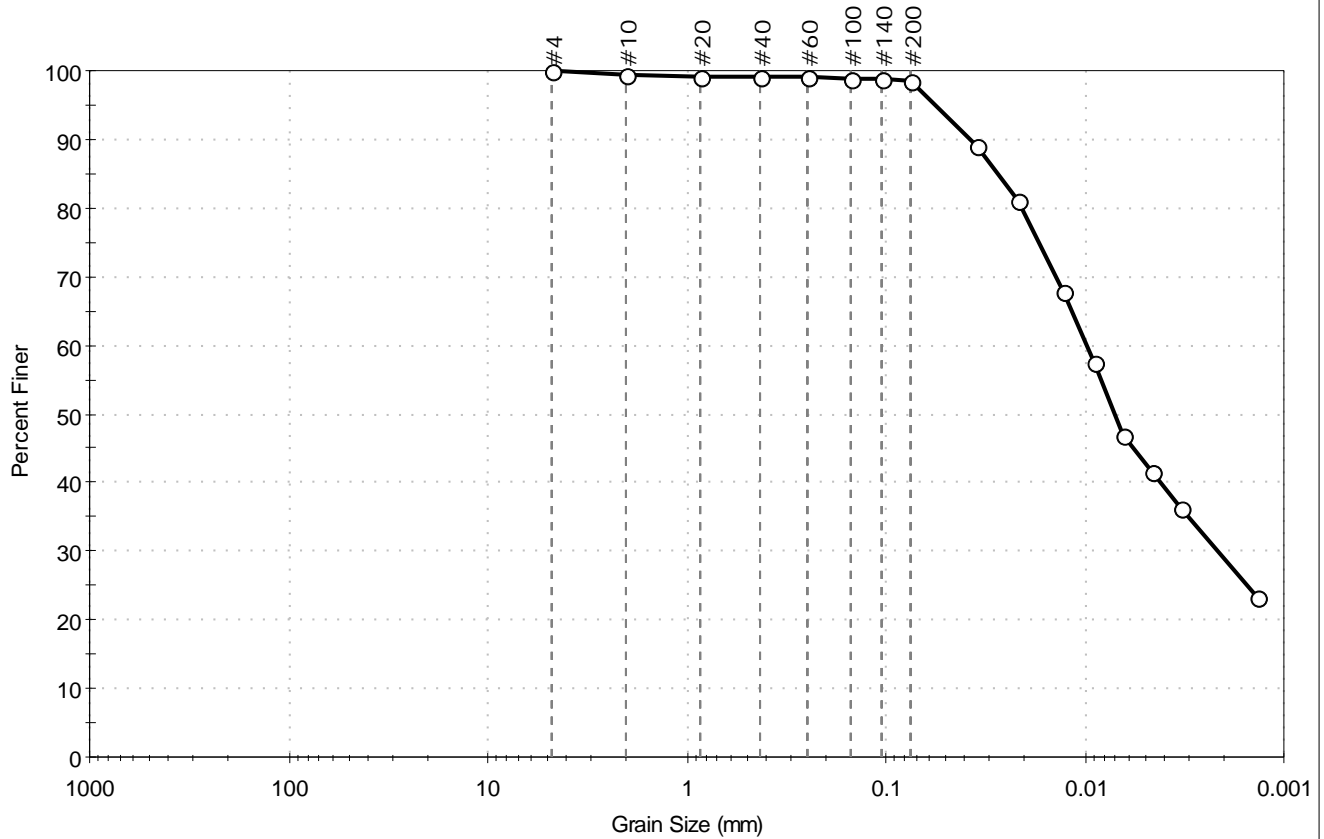
Classification	
ASTM	N/A
AASHTO	Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description
Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-02-0-3	Test Date: 11/28/23
Depth: ---	Test Id: 745081
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown silt with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	1.5	98.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	99		
#60	0.25	99		
#100	0.15	99		
#140	0.11	99		
#200	0.075	99		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0351	89		
---	0.0219	81		
---	0.0127	68		
---	0.0091	57		
---	0.0065	47		
---	0.0046	42		
---	0.0033	36		
---	0.0014	23		

<u>Coefficients</u>	
D ₈₅ = 0.0276 mm	D ₃₀ = 0.0021 mm
D ₆₀ = 0.0098 mm	D ₁₅ = N/A
D ₅₀ = 0.0071 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

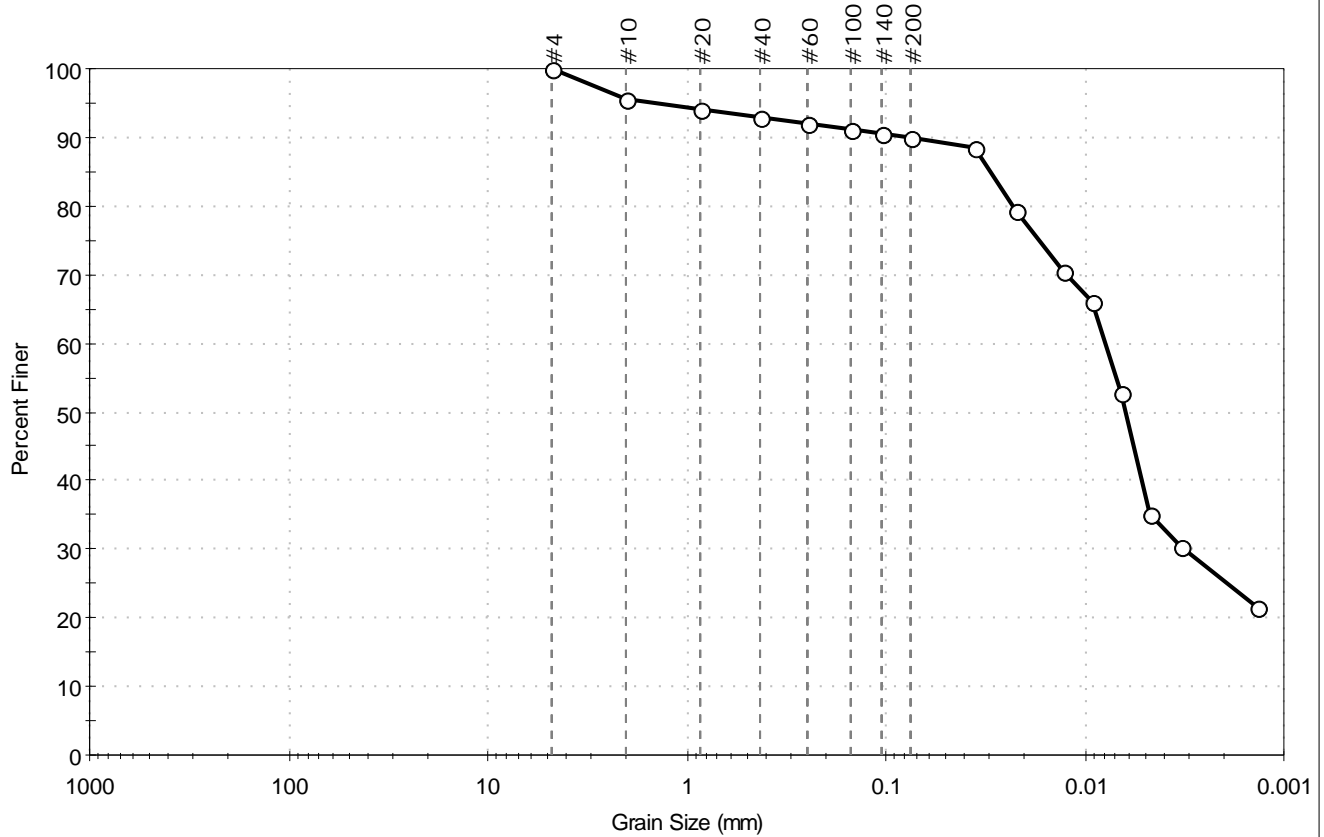
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-02-3-8	Test Date: 11/28/23
Depth: ---	Test Id: 745082
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown silt with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	10.0	90.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	96		
#20	0.85	94		
#40	0.42	93		
#60	0.25	92		
#100	0.15	91		
#140	0.11	91		
#200	0.075	90		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0360	88		
---	0.0225	79		
---	0.0129	71		
---	0.0092	66		
---	0.0065	53		
---	0.0047	35		
---	0.0033	31		
---	0.0014	22		

<u>Coefficients</u>	
D ₈₅ = 0.0301 mm	D ₃₀ = 0.0031 mm
D ₆₀ = 0.0079 mm	D ₁₅ = N/A
D ₅₀ = 0.0062 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

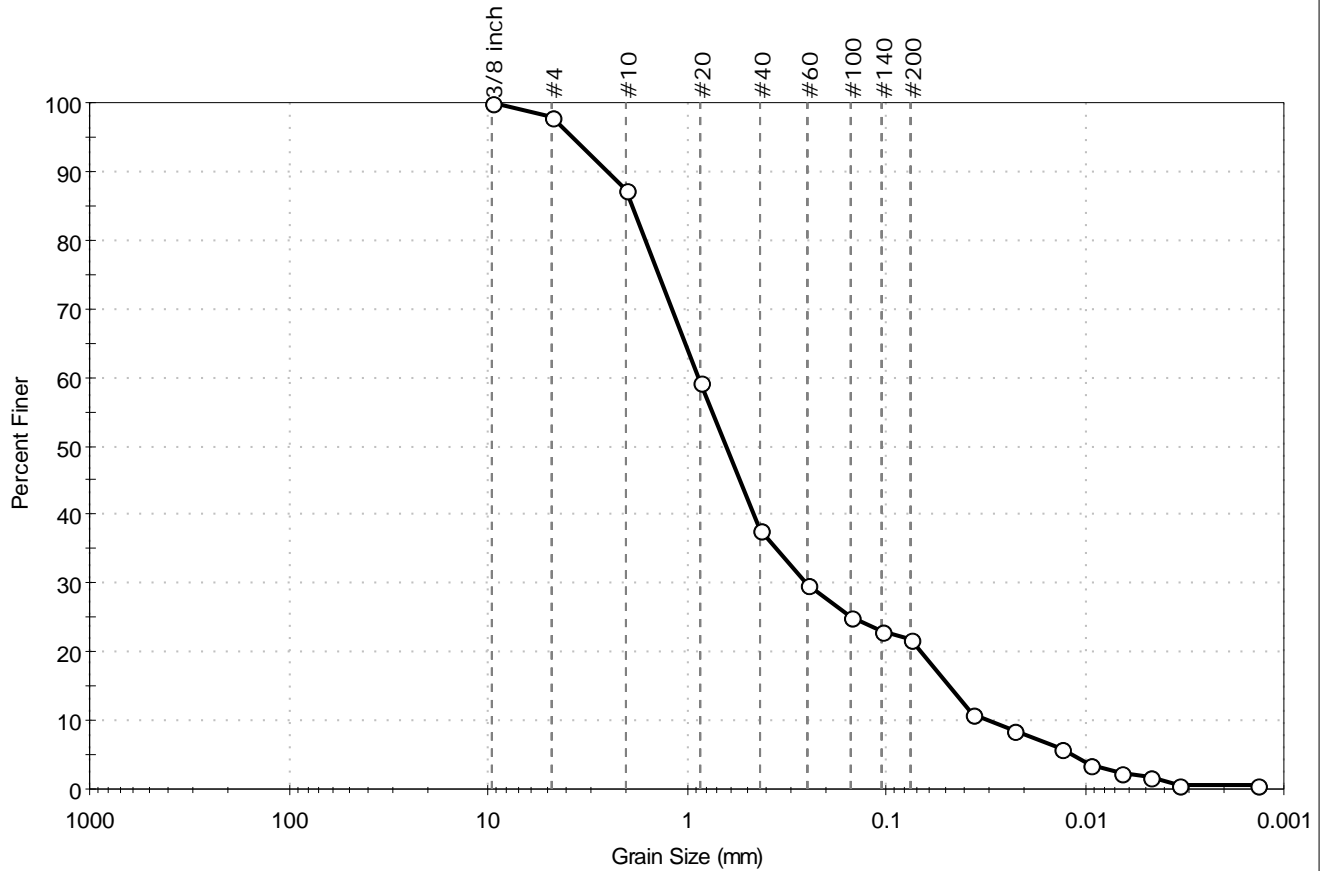
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-02-8-10	Test Date: 11/28/23
Depth: ---	Test Id: 745083
Test Comment: ---	Tested By: ckg
Visual Description: Moist, dark grayish brown silty sand with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	2.1	76.2	21.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	98		
#10	2.00	87		
#20	0.85	59		
#40	0.42	38		
#60	0.25	30		
#100	0.15	25		
#140	0.11	23		
#200	0.075	22		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0364	11		
---	0.0228	9		
---	0.0131	6		
---	0.0094	4		
---	0.0066	2		
---	0.0047	2		
---	0.0033	0		
---	0.0014	0		

Coefficients	
D ₈₅ = 1.8664 mm	D ₃₀ = 0.2544 mm
D ₆₀ = 0.8692 mm	D ₁₅ = 0.0477 mm
D ₅₀ = 0.6317 mm	D ₁₀ = 0.0301 mm
C _u = 28.877	C _c = 2.474

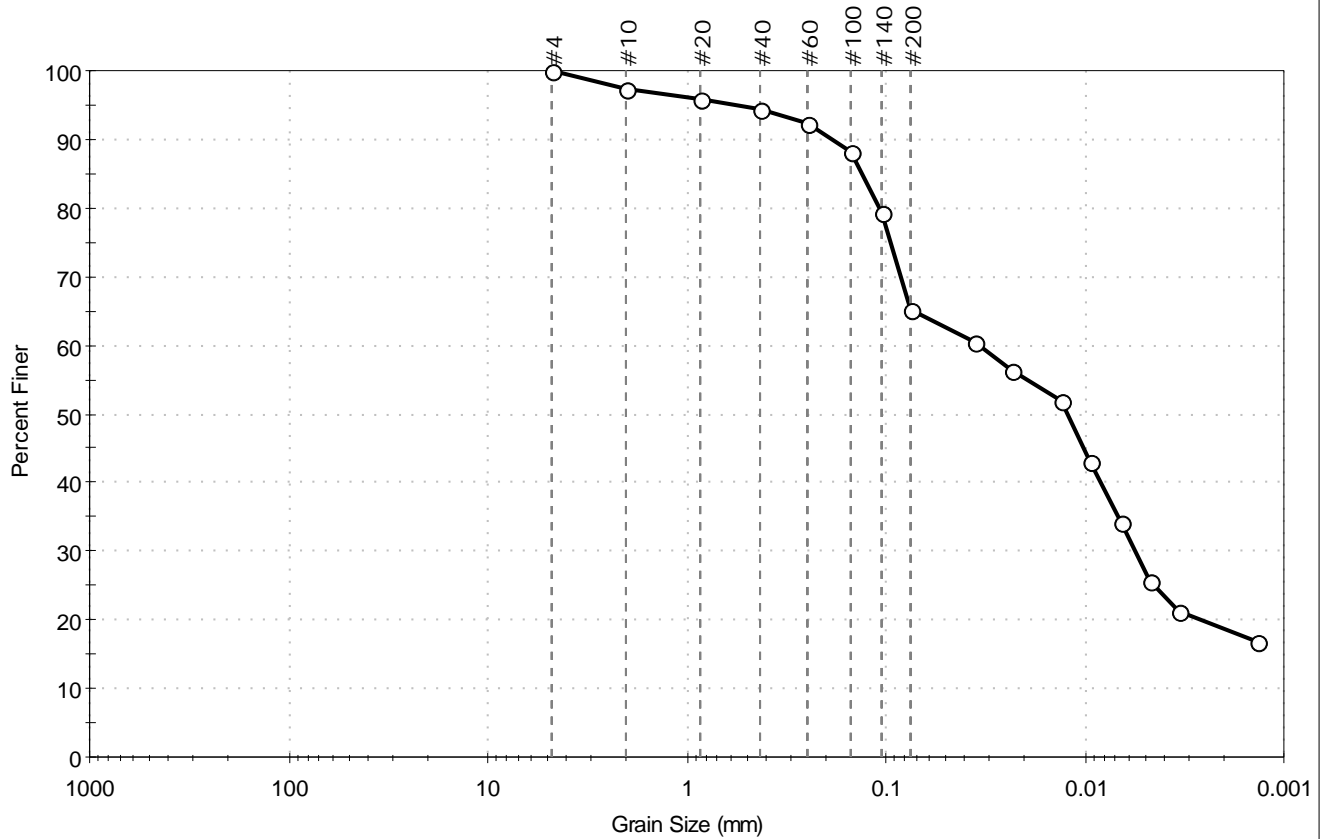
Classification	
ASTM	N/A
AASHTO	Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description	
Sand/Gravel Particle Shape	: ANGULAR
Sand/Gravel Hardness	: HARD
Dispersion Device	: Apparatus A - Mech Mixer
Dispersion Period	: 1 minute
Est. Specific Gravity	: 2.65
Separation of Sample	: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-03-0-6.5	Test Date: 11/28/23
Depth: ---	Test Id: 745084
Tested By: ckg	Checked By: jsc
Test Comment: ---	
Visual Description: Moist, very dark brown sandy silt with organics	
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	34.7	65.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	97		
#20	0.85	96		
#40	0.42	94		
#60	0.25	92		
#100	0.15	88		
#140	0.11	79		
#200	0.075	65		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0361	61		
---	0.0231	56		
---	0.0132	52		
---	0.0093	43		
---	0.0067	34		
---	0.0047	26		
---	0.0034	21		
---	0.0014	17		

<u>Coefficients</u>	
D ₈₅ = 0.1325 mm	D ₃₀ = 0.0056 mm
D ₆₀ = 0.0340 mm	D ₁₅ = N/A
D ₅₀ = 0.0123 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client:	EA Engineering, Science, & Technology		
Project:	Warner's Pond		
Location:	Concord, MA	Project No:	GTX-318057
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	11/10/23
Depth :	---	Test Id:	742660
		Tested By:	ckg
		Checked By:	ank

Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
---	NB- CA-2-4	2-4	Moist, dark brown sand with silt and organics	99.49	75.61	56.66	(1)
---	NB- PB-0-2.5	0-2.5	Moist, dark brown silt	69.12	359.6	15.04	(2)
---	NB- PB-2.5-6	2.5-6	Moist, dark brown sandy silt with organics	95.13	99.45	47.69	(3)

* Sample Comments

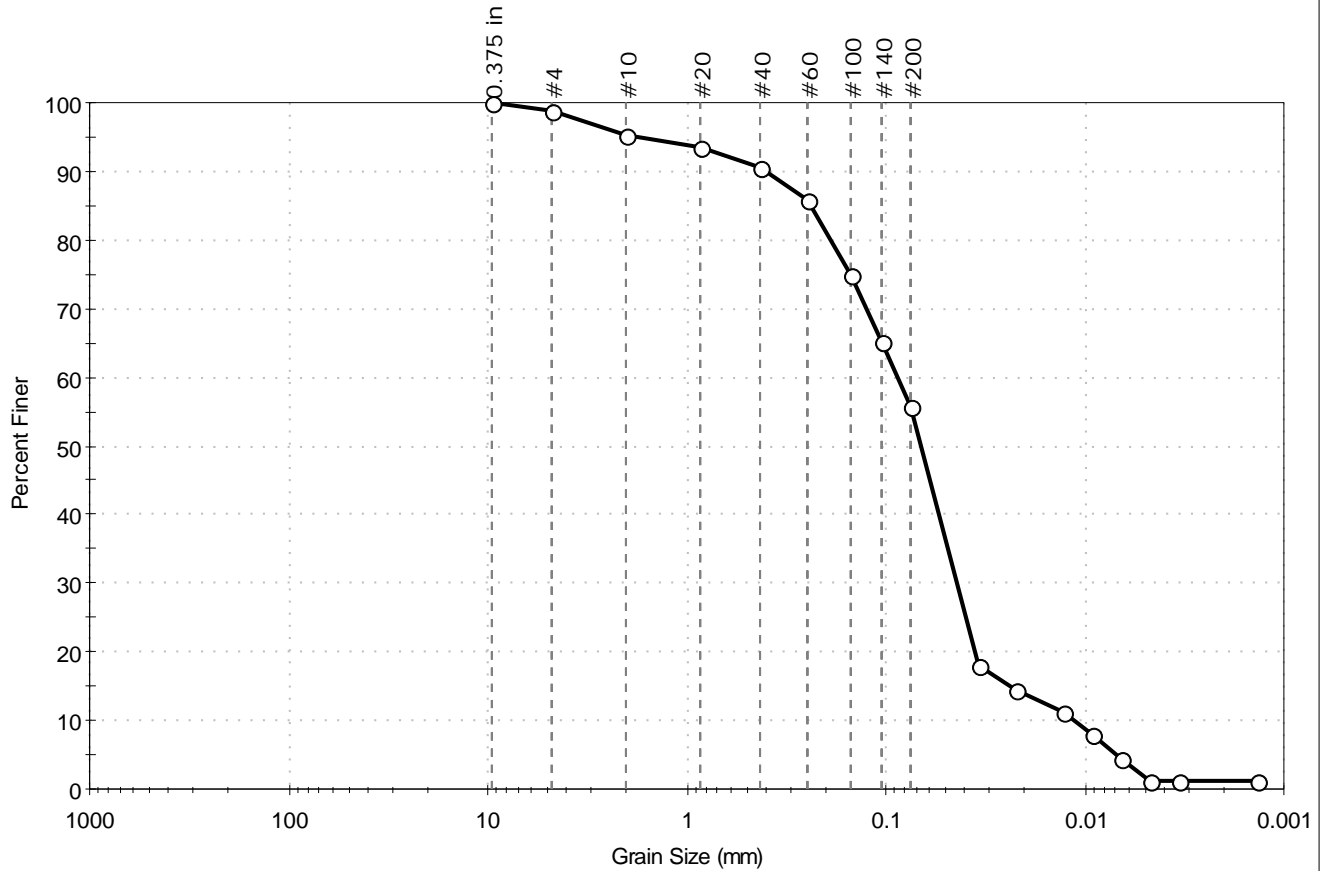
- (1): Method B-Volumetric, Reconstituted (compacted)
- (2): Method B-Volumetric, Reconstituted (compacted)
- (3): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: NB-PB-2.5-6	Test Date: 11/10/23
Depth: 2.5-6	Test Id: 742656
Tested By: ckg	Checked By: ank
Test Comment: ---	
Visual Description: Moist, dark brown sandy silt with organics	
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	1.1	43.1	55.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	95		
#20	0.85	94		
#40	0.42	90		
#60	0.25	86		
#100	0.15	75		
#140	0.11	65		
#200	0.075	56		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0338	18		
---	0.0223	15		
---	0.0130	11		
---	0.0091	8		
---	0.0066	5		
---	0.0047	1		
---	0.0034	1		
---	0.0014	1		

Coefficients	
D ₈₅ = 0.2399 mm	D ₃₀ = 0.0437 mm
D ₆₀ = 0.0875 mm	D ₁₅ = 0.0236 mm
D ₅₀ = 0.0664 mm	D ₁₀ = 0.0114 mm
C _u = 7.675	C _c = 1.914

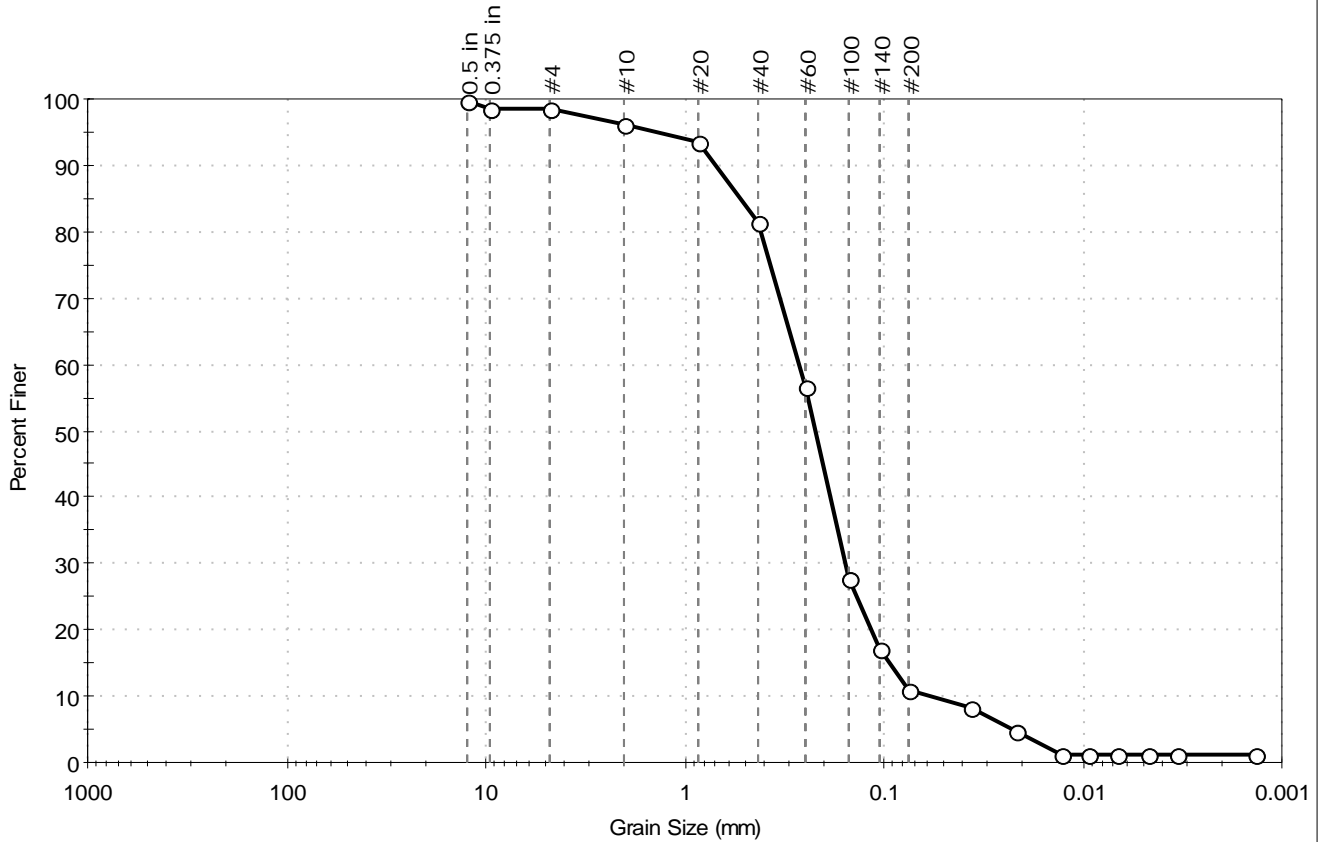
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: NB-CA-2-4	Test Date: 11/10/23
Depth: 2-4	Test Id: 742658
Test Comment: ---	Tested By: ckg
Visual Description: Moist, dark brown sand with silt and organics	Checked By: ank
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	1.6	87.6	10.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	98		
#4	4.75	98		
#10	2.00	96		
#20	0.85	93		
#40	0.42	82		
#60	0.25	57		
#100	0.15	28		
#140	0.11	17		
#200	0.075	11		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0363	8		
---	0.0218	5		
---	0.0130	1		
---	0.0094	1		
---	0.0067	1		
---	0.0047	1		
---	0.0034	1		
---	0.0014	1		

<u>Coefficients</u>	
D ₈₅ = 0.5200 mm	D ₃₀ = 0.1565 mm
D ₆₀ = 0.2689 mm	D ₁₅ = 0.0940 mm
D ₅₀ = 0.2227 mm	D ₁₀ = 0.0592 mm
C _u = 4.542	C _c = 1.539

<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Gravel and Sand (A-2-4 (0))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape : ---	
Sand/Gravel Hardness : ---	
Dispersion Device : Apparatus A - Mech Mixer	
Dispersion Period : 1 minute	
Est. Specific Gravity : 2.65	
Separation of Sample: #200 Sieve	



ANALYTICAL REPORT

Lab Number:	L2363511
Client:	EA Engineering, Science and Technology 301 Metro Center Blvd. Suite 102 Warwick, RI 02886
ATTN:	Alexander Patterson
Phone:	(401) 736-3440
Project Name:	WARNER'S POND
Project Number:	6404001
Report Date:	12/19/23

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Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com



Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2363511-01	NB-102523	SEDIMENT	CONCORD, MA	10/25/23 12:00	10/25/23
L2363511-02	AR-102523	SEDIMENT	CONCORD, MA	10/25/23 13:00	10/25/23

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

HOLD POLICY - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Case Narrative (continued)

Report Submission

December 19, 2023: This final report includes the results of all requested analyses.

December 14, 2023: This is a preliminary report.

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

Sample Receipt

The samples were received at the laboratory above the required temperature range. The samples were transported to the laboratory in a cooler with ice and delivered directly from the sampling site. This is considered acceptable since the samples were in the process of cooling.

PAHs/PCB Congeners

L2363511-01 and -02: The sample was frozen upon receipt in order to arrest the holding time.

The WG1859138-1 Method Blank, associated with L2363511-01 and -02, has a concentration above the reporting limit for Naphthalene. The results of the original analysis are reported and are qualified with a "B" for any associated sample concentrations that are less than 10x the blank concentration for this analyte.

Pesticides

L2363511-01 and -02: The sample was frozen upon receipt in order to arrest the holding time.

Total Metals

L2363511-01 and -02: The samples were frozen upon receipt in order to arrest the holding time for Total Mercury.

The WG1857705-3 MS recovery, performed on L2363511-01, is outside the acceptance criteria for chromium (49%). A post digestion spike was performed and was within acceptance criteria.

The WG1857705-3 MS recovery for copper (0%), performed on L2363511-01, does not apply because the

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Case Narrative (continued)

sample concentration is greater than four times the spike amount added.

The WG1857705-4 Laboratory Duplicate RPDs for arsenic (21%), chromium (62%), copper (175%), lead (33%) and nickel (33%), performed on L2363511-01, are outside the acceptance criteria. The elevated RPDs have been attributed to the non-homogeneous nature of the native sample.

Total Organic Carbon

L2363511-01 and -02: The sample was frozen upon receipt in order to arrest the holding time.

Grain Size Analysis

The WG1860514-1 Laboratory Duplicate RPDs for % gravel (24%), % coarse sand (62%) and fines (24%), performed on L2363511-02, are outside the acceptance criteria. The elevated RPDs have been attributed to the non-homogeneous nature of the native sample.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:  Melissa Sturgis

Title: Technical Director/Representative

Date: 12/19/23

ORGANICS

VOLATILES

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-01
 Client ID: NB-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 12:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:

Matrix: Sediment
 Analytical Method: 1,8260D
 Analytical Date: 11/06/23 21:00
 Analyst: JIC
 Percent Solids: 68%

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by EPA 5035 High - Westborough Lab						
Methylene chloride	ND		ug/kg	430	200	1
1,1-Dichloroethane	ND		ug/kg	86	12.	1
Chloroform	ND		ug/kg	130	12.	1
Carbon tetrachloride	ND		ug/kg	86	20.	1
1,2-Dichloropropane	ND		ug/kg	86	11.	1
Dibromochloromethane	ND		ug/kg	86	12.	1
1,1,2-Trichloroethane	ND		ug/kg	86	23.	1
Tetrachloroethene	ND		ug/kg	43	17.	1
Chlorobenzene	ND		ug/kg	43	11.	1
Trichlorofluoromethane	ND		ug/kg	350	60.	1
1,2-Dichloroethane	ND		ug/kg	86	22.	1
1,1,1-Trichloroethane	ND		ug/kg	43	14.	1
Bromodichloromethane	ND		ug/kg	43	9.4	1
trans-1,3-Dichloropropene	ND		ug/kg	86	24.	1
cis-1,3-Dichloropropene	ND		ug/kg	43	14.	1
1,3-Dichloropropene, Total	ND		ug/kg	43	14.	1
1,1-Dichloropropene	ND		ug/kg	43	14.	1
Bromoform	ND		ug/kg	350	21.	1
1,1,2,2-Tetrachloroethane	ND		ug/kg	43	14.	1
Benzene	ND		ug/kg	43	14.	1
Toluene	ND		ug/kg	86	47.	1
Ethylbenzene	ND		ug/kg	86	12.	1
Chloromethane	ND		ug/kg	350	81.	1
Bromomethane	ND		ug/kg	170	50.	1
Vinyl chloride	ND		ug/kg	86	29.	1
Chloroethane	ND		ug/kg	170	39.	1
1,1-Dichloroethene	ND		ug/kg	86	20.	1
trans-1,2-Dichloroethene	ND		ug/kg	130	12.	1

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-01
Client ID: NB-102523
Sample Location: CONCORD, MA

Date Collected: 10/25/23 12:00
Date Received: 10/25/23
Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatiles Organics by EPA 5035 High - Westborough Lab						
Trichloroethene	ND		ug/kg	43	12.	1
1,2-Dichlorobenzene	ND		ug/kg	170	12.	1
1,3-Dichlorobenzene	ND		ug/kg	170	13.	1
1,4-Dichlorobenzene	ND		ug/kg	170	15.	1
Methyl tert butyl ether	ND		ug/kg	170	17.	1
p/m-Xylene	ND		ug/kg	170	48.	1
o-Xylene	ND		ug/kg	86	25.	1
Xylenes, Total	ND		ug/kg	86	25.	1
cis-1,2-Dichloroethene	ND		ug/kg	86	15.	1
1,2-Dichloroethene, Total	ND		ug/kg	86	12.	1
Dibromomethane	ND		ug/kg	170	20.	1
1,4-Dichlorobutane	ND		ug/kg	860	20.	1
1,2,3-Trichloropropane	ND		ug/kg	170	11.	1
Styrene	ND		ug/kg	86	17.	1
Dichlorodifluoromethane	ND		ug/kg	860	79.	1
Acetone	ND		ug/kg	860	420	1
Carbon disulfide	ND		ug/kg	860	390	1
2-Butanone	ND		ug/kg	860	190	1
Vinyl acetate	ND		ug/kg	860	190	1
4-Methyl-2-pentanone	ND		ug/kg	860	110	1
2-Hexanone	ND		ug/kg	860	100	1
Ethyl methacrylate	ND		ug/kg	860	140	1
Acrylonitrile	ND		ug/kg	350	100	1
Bromochloromethane	ND		ug/kg	170	18.	1
Tetrahydrofuran	ND		ug/kg	350	140	1
2,2-Dichloropropane	ND		ug/kg	170	17.	1
1,2-Dibromoethane	ND		ug/kg	86	24.	1
1,3-Dichloropropane	ND		ug/kg	170	14.	1
1,1,1,2-Tetrachloroethane	ND		ug/kg	43	11.	1
Bromobenzene	ND		ug/kg	170	12.	1
n-Butylbenzene	ND		ug/kg	86	14.	1
sec-Butylbenzene	ND		ug/kg	86	13.	1
tert-Butylbenzene	ND		ug/kg	170	10.	1
o-Chlorotoluene	ND		ug/kg	170	16.	1
p-Chlorotoluene	ND		ug/kg	170	9.3	1
1,2-Dibromo-3-chloropropane	ND		ug/kg	260	86.	1
Hexachlorobutadiene	ND		ug/kg	350	15.	1

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-01
Client ID: NB-102523
Sample Location: CONCORD, MA

Date Collected: 10/25/23 12:00
Date Received: 10/25/23
Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by EPA 5035 High - Westborough Lab						
Isopropylbenzene	ND		ug/kg	86	9.4	1
p-Isopropyltoluene	ND		ug/kg	86	9.4	1
Naphthalene	ND		ug/kg	350	56.	1
n-Propylbenzene	ND		ug/kg	86	15.	1
1,2,3-Trichlorobenzene	ND		ug/kg	170	28.	1
1,2,4-Trichlorobenzene	ND		ug/kg	170	24.	1
1,3,5-Trimethylbenzene	ND		ug/kg	170	17.	1
1,2,4-Trimethylbenzene	ND		ug/kg	170	29.	1
trans-1,4-Dichloro-2-butene	ND		ug/kg	430	120	1
Ethyl ether	ND		ug/kg	170	30.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	105		70-130
Toluene-d8	101		70-130
4-Bromofluorobenzene	108		70-130
Dibromofluoromethane	89		70-130

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-02
 Client ID: AR-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 13:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:

Matrix: Sediment
 Analytical Method: 1,8260D
 Analytical Date: 11/06/23 21:26
 Analyst: JIC
 Percent Solids: 64%

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by EPA 5035 High - Westborough Lab						
Methylene chloride	ND		ug/kg	370	170	1
1,1-Dichloroethane	ND		ug/kg	75	11.	1
Chloroform	ND		ug/kg	110	10.	1
Carbon tetrachloride	ND		ug/kg	75	17.	1
1,2-Dichloropropane	ND		ug/kg	75	9.4	1
Dibromochloromethane	ND		ug/kg	75	10.	1
1,1,2-Trichloroethane	ND		ug/kg	75	20.	1
Tetrachloroethene	ND		ug/kg	37	15.	1
Chlorobenzene	ND		ug/kg	37	9.5	1
Trichlorofluoromethane	ND		ug/kg	300	52.	1
1,2-Dichloroethane	ND		ug/kg	75	19.	1
1,1,1-Trichloroethane	ND		ug/kg	37	12.	1
Bromodichloromethane	ND		ug/kg	37	8.2	1
trans-1,3-Dichloropropene	ND		ug/kg	75	20.	1
cis-1,3-Dichloropropene	ND		ug/kg	37	12.	1
1,3-Dichloropropene, Total	ND		ug/kg	37	12.	1
1,1-Dichloropropene	ND		ug/kg	37	12.	1
Bromoform	ND		ug/kg	300	18.	1
1,1,2,2-Tetrachloroethane	ND		ug/kg	37	12.	1
Benzene	ND		ug/kg	37	12.	1
Toluene	ND		ug/kg	75	41.	1
Ethylbenzene	ND		ug/kg	75	10.	1
Chloromethane	ND		ug/kg	300	70.	1
Bromomethane	ND		ug/kg	150	44.	1
Vinyl chloride	ND		ug/kg	75	25.	1
Chloroethane	ND		ug/kg	150	34.	1
1,1-Dichloroethene	ND		ug/kg	75	18.	1
trans-1,2-Dichloroethene	ND		ug/kg	110	10.	1

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-02
Client ID: AR-102523
Sample Location: CONCORD, MA

Date Collected: 10/25/23 13:00
Date Received: 10/25/23
Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatiles Organics by EPA 5035 High - Westborough Lab						
Trichloroethene	ND		ug/kg	37	10.	1
1,2-Dichlorobenzene	ND		ug/kg	150	11.	1
1,3-Dichlorobenzene	ND		ug/kg	150	11.	1
1,4-Dichlorobenzene	ND		ug/kg	150	13.	1
Methyl tert butyl ether	ND		ug/kg	150	15.	1
p/m-Xylene	ND		ug/kg	150	42.	1
o-Xylene	ND		ug/kg	75	22.	1
Xylenes, Total	ND		ug/kg	75	22.	1
cis-1,2-Dichloroethene	ND		ug/kg	75	13.	1
1,2-Dichloroethene, Total	ND		ug/kg	75	10.	1
Dibromomethane	ND		ug/kg	150	18.	1
1,4-Dichlorobutane	ND		ug/kg	750	17.	1
1,2,3-Trichloropropane	ND		ug/kg	150	9.5	1
Styrene	ND		ug/kg	75	15.	1
Dichlorodifluoromethane	ND		ug/kg	750	68.	1
Acetone	ND		ug/kg	750	360	1
Carbon disulfide	ND		ug/kg	750	340	1
2-Butanone	ND		ug/kg	750	170	1
Vinyl acetate	ND		ug/kg	750	160	1
4-Methyl-2-pentanone	ND		ug/kg	750	96.	1
2-Hexanone	ND		ug/kg	750	88.	1
Ethyl methacrylate	ND		ug/kg	750	120	1
Acrylonitrile	ND		ug/kg	300	86.	1
Bromochloromethane	ND		ug/kg	150	15.	1
Tetrahydrofuran	ND		ug/kg	300	120	1
2,2-Dichloropropane	ND		ug/kg	150	15.	1
1,2-Dibromoethane	ND		ug/kg	75	21.	1
1,3-Dichloropropane	ND		ug/kg	150	12.	1
1,1,1,2-Tetrachloroethane	ND		ug/kg	37	9.9	1
Bromobenzene	ND		ug/kg	150	11.	1
n-Butylbenzene	ND		ug/kg	75	12.	1
sec-Butylbenzene	ND		ug/kg	75	11.	1
tert-Butylbenzene	ND		ug/kg	150	8.8	1
o-Chlorotoluene	ND		ug/kg	150	14.	1
p-Chlorotoluene	ND		ug/kg	150	8.1	1
1,2-Dibromo-3-chloropropane	ND		ug/kg	220	75.	1
Hexachlorobutadiene	ND		ug/kg	300	13.	1

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-02
Client ID: AR-102523
Sample Location: CONCORD, MA

Date Collected: 10/25/23 13:00
Date Received: 10/25/23
Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by EPA 5035 High - Westborough Lab						
Isopropylbenzene	ND		ug/kg	75	8.2	1
p-Isopropyltoluene	ND		ug/kg	75	8.2	1
Naphthalene	ND		ug/kg	300	49.	1
n-Propylbenzene	ND		ug/kg	75	13.	1
1,2,3-Trichlorobenzene	ND		ug/kg	150	24.	1
1,2,4-Trichlorobenzene	ND		ug/kg	150	20.	1
1,3,5-Trimethylbenzene	ND		ug/kg	150	14.	1
1,2,4-Trimethylbenzene	ND		ug/kg	150	25.	1
trans-1,4-Dichloro-2-butene	ND		ug/kg	370	110	1
Ethyl ether	ND		ug/kg	150	26.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	103		70-130
Toluene-d8	101		70-130
4-Bromofluorobenzene	108		70-130
Dibromofluoromethane	87		70-130

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260D
Analytical Date: 11/06/23 13:12
Analyst: AJK

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by EPA 5035 High - Westborough Lab for sample(s): 01-02 Batch: WG1849235-5					
Methylene chloride	ND		ug/kg	250	110
1,1-Dichloroethane	ND		ug/kg	50	7.2
Chloroform	ND		ug/kg	75	7.0
Carbon tetrachloride	ND		ug/kg	50	12.
1,2-Dichloropropane	ND		ug/kg	50	6.2
Dibromochloromethane	ND		ug/kg	50	7.0
1,1,2-Trichloroethane	ND		ug/kg	50	13.
Tetrachloroethene	ND		ug/kg	25	9.8
Chlorobenzene	ND		ug/kg	25	6.4
Trichlorofluoromethane	ND		ug/kg	200	35.
1,2-Dichloroethane	ND		ug/kg	50	13.
1,1,1-Trichloroethane	ND		ug/kg	25	8.4
Bromodichloromethane	ND		ug/kg	25	5.4
trans-1,3-Dichloropropene	ND		ug/kg	50	14.
cis-1,3-Dichloropropene	ND		ug/kg	25	7.9
1,3-Dichloropropene, Total	ND		ug/kg	25	7.9
1,1-Dichloropropene	ND		ug/kg	25	8.0
Bromoform	ND		ug/kg	200	12.
1,1,2,2-Tetrachloroethane	ND		ug/kg	25	8.3
Benzene	ND		ug/kg	25	8.3
Toluene	ND		ug/kg	50	27.
Ethylbenzene	ND		ug/kg	50	7.0
Chloromethane	ND		ug/kg	200	47.
Bromomethane	ND		ug/kg	100	29.
Vinyl chloride	ND		ug/kg	50	17.
Chloroethane	ND		ug/kg	100	23.
1,1-Dichloroethene	ND		ug/kg	50	12.
trans-1,2-Dichloroethene	ND		ug/kg	75	6.8
Trichloroethene	ND		ug/kg	25	6.8

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260D
Analytical Date: 11/06/23 13:12
Analyst: AJK

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by EPA 5035 High - Westborough Lab for sample(s): 01-02 Batch: WG1849235-5					
1,2-Dichlorobenzene	ND		ug/kg	100	7.2
1,3-Dichlorobenzene	ND		ug/kg	100	7.4
1,4-Dichlorobenzene	ND		ug/kg	100	8.6
Methyl tert butyl ether	ND		ug/kg	100	10.
p/m-Xylene	ND		ug/kg	100	28.
o-Xylene	ND		ug/kg	50	14.
Xylenes, Total	ND		ug/kg	50	14.
cis-1,2-Dichloroethene	ND		ug/kg	50	8.8
1,2-Dichloroethene, Total	ND		ug/kg	50	6.8
Dibromomethane	ND		ug/kg	100	12.
1,4-Dichlorobutane	ND		ug/kg	500	11.
1,2,3-Trichloropropane	ND		ug/kg	100	6.4
Styrene	ND		ug/kg	50	9.8
Dichlorodifluoromethane	ND		ug/kg	500	46.
Acetone	ND		ug/kg	500	240
Carbon disulfide	ND		ug/kg	500	230
2-Butanone	ND		ug/kg	500	110
Vinyl acetate	ND		ug/kg	500	110
4-Methyl-2-pentanone	ND		ug/kg	500	64.
2-Hexanone	ND		ug/kg	500	59.
Ethyl methacrylate	ND		ug/kg	500	79.
Acrylonitrile	ND		ug/kg	200	58.
Bromochloromethane	ND		ug/kg	100	10.
Tetrahydrofuran	ND		ug/kg	200	80.
2,2-Dichloropropane	ND		ug/kg	100	10.
1,2-Dibromoethane	ND		ug/kg	50	14.
1,3-Dichloropropane	ND		ug/kg	100	8.4
1,1,1,2-Tetrachloroethane	ND		ug/kg	25	6.6
Bromobenzene	ND		ug/kg	100	7.2

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

**Method Blank Analysis
Batch Quality Control**

Analytical Method: 1,8260D
Analytical Date: 11/06/23 13:12
Analyst: AJK

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by EPA 5035 High - Westborough Lab for sample(s): 01-02 Batch: WG1849235-5					
n-Butylbenzene	ND		ug/kg	50	8.4
sec-Butylbenzene	ND		ug/kg	50	7.3
tert-Butylbenzene	ND		ug/kg	100	5.9
o-Chlorotoluene	ND		ug/kg	100	9.6
p-Chlorotoluene	ND		ug/kg	100	5.4
1,2-Dibromo-3-chloropropane	ND		ug/kg	150	50.
Hexachlorobutadiene	ND		ug/kg	200	8.4
Isopropylbenzene	ND		ug/kg	50	5.4
p-Isopropyltoluene	ND		ug/kg	50	5.4
Naphthalene	ND		ug/kg	200	32.
n-Propylbenzene	ND		ug/kg	50	8.6
1,2,3-Trichlorobenzene	ND		ug/kg	100	16.
1,2,4-Trichlorobenzene	ND		ug/kg	100	14.
1,3,5-Trimethylbenzene	ND		ug/kg	100	9.6
1,2,4-Trimethylbenzene	ND		ug/kg	100	17.
trans-1,4-Dichloro-2-butene	ND		ug/kg	250	71.
Ethyl ether	ND		ug/kg	100	17.

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	96		70-130
Toluene-d8	102		70-130
4-Bromofluorobenzene	109		70-130
Dibromofluoromethane	82		70-130

Lab Control Sample Analysis

Batch Quality Control

Project Name: WARNER'S POND

Lab Number: L2363511

Project Number: 6404001

Report Date: 12/19/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by EPA 5035 High - Westborough Lab Associated sample(s): 01-02 Batch: WG1849235-3 WG1849235-4								
Methylene chloride	75		74		70-130	1		30
1,1-Dichloroethane	91		89		70-130	2		30
Chloroform	84		81		70-130	4		30
Carbon tetrachloride	92		90		70-130	2		30
1,2-Dichloropropane	92		90		70-130	2		30
Dibromochloromethane	105		100		70-130	5		30
1,1,2-Trichloroethane	93		89		70-130	4		30
Tetrachloroethene	98		95		70-130	3		30
Chlorobenzene	100		96		70-130	4		30
Trichlorofluoromethane	80		79		70-139	1		30
1,2-Dichloroethane	97		95		70-130	2		30
1,1,1-Trichloroethane	88		88		70-130	0		30
Bromodichloromethane	86		86		70-130	0		30
trans-1,3-Dichloropropene	105		100		70-130	5		30
cis-1,3-Dichloropropene	87		86		70-130	1		30
1,1-Dichloropropene	89		87		70-130	2		30
Bromoform	96		95		70-130	1		30
1,1,2,2-Tetrachloroethane	91		86		70-130	6		30
Benzene	84		82		70-130	2		30
Toluene	96		92		70-130	4		30
Ethylbenzene	100		96		70-130	4		30
Chloromethane	94		88		52-130	7		30
Bromomethane	69		67		57-147	3		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: WARNER'S POND

Lab Number: L2363511

Project Number: 6404001

Report Date: 12/19/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by EPA 5035 High - Westborough Lab Associated sample(s): 01-02 Batch: WG1849235-3 WG1849235-4								
Vinyl chloride	78		75		67-130	4		30
Chloroethane	77		74		50-151	4		30
1,1-Dichloroethene	79		75		65-135	5		30
trans-1,2-Dichloroethene	80		78		70-130	3		30
Trichloroethene	87		88		70-130	1		30
1,2-Dichlorobenzene	104		101		70-130	3		30
1,3-Dichlorobenzene	101		100		70-130	1		30
1,4-Dichlorobenzene	101		100		70-130	1		30
Methyl tert butyl ether	85		83		66-130	2		30
p/m-Xylene	100		96		70-130	4		30
o-Xylene	100		96		70-130	4		30
cis-1,2-Dichloroethene	81		80		70-130	1		30
Dibromomethane	80		78		70-130	3		30
1,4-Dichlorobutane	120		118		70-130	2		30
1,2,3-Trichloropropane	100		98		68-130	2		30
Styrene	98		93		70-130	5		30
Dichlorodifluoromethane	71		70		30-146	1		30
Acetone	82		76		54-140	8		30
Carbon disulfide	77		75		59-130	3		30
2-Butanone	91		84		70-130	8		30
Vinyl acetate	83		71		70-130	16		30
4-Methyl-2-pentanone	108		97		70-130	11		30
2-Hexanone	98		94		70-130	4		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: WARNER'S POND

Lab Number: L2363511

Project Number: 6404001

Report Date: 12/19/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by EPA 5035 High - Westborough Lab Associated sample(s): 01-02 Batch: WG1849235-3 WG1849235-4								
Ethyl methacrylate	95		90		70-130	5		30
Acrylonitrile	93		92		70-130	1		30
Bromochloromethane	86		81		70-130	6		30
Tetrahydrofuran	83		80		66-130	4		30
2,2-Dichloropropane	87		84		70-130	4		30
1,2-Dibromoethane	104		98		70-130	6		30
1,3-Dichloropropane	102		96		69-130	6		30
1,1,1,2-Tetrachloroethane	105		103		70-130	2		30
Bromobenzene	100		100		70-130	0		30
n-Butylbenzene	104		103		70-130	1		30
sec-Butylbenzene	106		104		70-130	2		30
tert-Butylbenzene	109		107		70-130	2		30
o-Chlorotoluene	122		120		70-130	2		30
p-Chlorotoluene	106		105		70-130	1		30
1,2-Dibromo-3-chloropropane	92		90		68-130	2		30
Hexachlorobutadiene	93		95		67-130	2		30
Isopropylbenzene	108		106		70-130	2		30
p-Isopropyltoluene	108		106		70-130	2		30
Naphthalene	102		100		70-130	2		30
n-Propylbenzene	105		103		70-130	2		30
1,2,3-Trichlorobenzene	97		97		70-130	0		30
1,2,4-Trichlorobenzene	96		96		70-130	0		30
1,3,5-Trimethylbenzene	107		107		70-130	0		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: WARNER'S POND

Lab Number: L2363511

Project Number: 6404001

Report Date: 12/19/23

Parameter	LCS		LCSD		%Recovery Limits	RPD	RPD	
	%Recovery	Qual	%Recovery	Qual			Qual	Limits
Volatile Organics by EPA 5035 High - Westborough Lab Associated sample(s): 01-02 Batch: WG1849235-3 WG1849235-4								
1,2,4-Trimethylbenzene	107		106		70-130	1		30
trans-1,4-Dichloro-2-butene	119		113		70-130	5		30
Ethyl ether	79		75		67-130	5		30

Surrogate	LCS		LCSD		Acceptance Criteria
	%Recovery	Qual	%Recovery	Qual	
1,2-Dichloroethane-d4	94		95		70-130
Toluene-d8	101		100		70-130
4-Bromofluorobenzene	110		110		70-130
Dibromofluoromethane	85		85		70-130

SEMIVOLATILES

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-01
 Client ID: NB-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 12:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:

Matrix: Sediment
 Analytical Method: 105,8270E-SIM/680(M)
 Analytical Date: 12/16/23 21:58
 Analyst: DB
 Percent Solids: 68%

Extraction Method: EPA 3570
 Extraction Date: 12/03/23 13:17
 Cleanup Method: EPA 3630
 Cleanup Date: 12/05/23

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
PAHs/PCB Congeners by GC/MS - Mansfield Lab						
Naphthalene	18.8	B	ug/kg	5.34	2.67	1
2-Methylnaphthalene	7.46		ug/kg	5.34	2.67	1
Acenaphthylene	35.4		ug/kg	5.34	2.67	1
Acenaphthene	18.0		ug/kg	5.34	2.67	1
Fluorene	26.3		ug/kg	5.34	2.67	1
Phenanthrene	290		ug/kg	5.34	2.67	1
Anthracene	74.4		ug/kg	5.34	2.67	1
Fluoranthene	540		ug/kg	5.34	2.67	1
Pyrene	430		ug/kg	5.34	2.67	1
Benz(a)anthracene	252		ug/kg	5.34	2.67	1
Chrysene	258		ug/kg	5.34	2.67	1
Benzo(b)fluoranthene	225		ug/kg	5.34	2.67	1
Benzo(k)fluoranthene	214		ug/kg	5.34	2.67	1
Benzo(a)pyrene	249		ug/kg	5.34	2.67	1
Indeno(1,2,3-cd)Pyrene	191		ug/kg	5.34	2.67	1
Dibenz(a,h)anthracene	43.1		ug/kg	5.34	2.67	1
Benzo(ghi)perylene	189		ug/kg	5.34	2.67	1
Cl2-BZ#8	ND		ug/kg	0.534	0.267	1
Cl3-BZ#18	ND		ug/kg	0.534	0.267	1
Cl3-BZ#28	ND		ug/kg	0.534	0.267	1
Cl4-BZ#44	ND		ug/kg	0.534	0.267	1
Cl4-BZ#49	ND		ug/kg	0.534	0.267	1
Cl4-BZ#52	ND		ug/kg	0.534	0.267	1
Cl4-BZ#66	ND		ug/kg	0.534	0.267	1
Cl5-BZ#87	ND		ug/kg	0.534	0.267	1
Cl5-BZ#101	ND		ug/kg	0.534	0.267	1
Cl5-BZ#105	ND		ug/kg	0.534	0.267	1
Cl5-BZ#118	ND		ug/kg	0.534	0.267	1

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-01
Client ID: NB-102523
Sample Location: CONCORD, MA

Date Collected: 10/25/23 12:00
Date Received: 10/25/23
Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
PAHs/PCB Congeners by GC/MS - Mansfield Lab						
Cl6-BZ#128	ND		ug/kg	0.534	0.267	1
Cl6-BZ#138	ND		ug/kg	0.534	0.267	1
Cl6-BZ#153	ND		ug/kg	0.534	0.267	1
Cl7-BZ#170	ND		ug/kg	0.534	0.267	1
Cl7-BZ#180	ND		ug/kg	0.534	0.267	1
Cl7-BZ#183	ND		ug/kg	0.534	0.267	1
Cl7-BZ#184	ND		ug/kg	0.534	0.267	1
Cl7-BZ#187	ND		ug/kg	0.534	0.267	1
Cl8-BZ#195	ND		ug/kg	0.534	0.267	1
Cl9-BZ#206	ND		ug/kg	0.534	0.267	1
Cl10-BZ#209	0.514	J	ug/kg	0.534	0.267	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
2-Methylnaphthalene-d10	83		30-150
Pyrene-d10	92		30-150
Benzo(b)fluoranthene-d12	95		30-150
DBOB	62		50-125
BZ 198	115		50-125

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-02
 Client ID: AR-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 13:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:

Matrix: Sediment
 Analytical Method: 105,8270E-SIM/680(M)
 Analytical Date: 12/16/23 22:31
 Analyst: DB
 Percent Solids: 64%

Extraction Method: EPA 3570
 Extraction Date: 12/03/23 13:17
 Cleanup Method: EPA 3630
 Cleanup Date: 12/05/23

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
PAHs/PCB Congeners by GC/MS - Mansfield Lab						
Naphthalene	36.0	B	ug/kg	6.12	3.06	1
2-Methylnaphthalene	12.9		ug/kg	6.12	3.06	1
Acenaphthylene	10.5		ug/kg	6.12	3.06	1
Acenaphthene	18.0		ug/kg	6.12	3.06	1
Fluorene	15.7		ug/kg	6.12	3.06	1
Phenanthrene	212		ug/kg	6.12	3.06	1
Anthracene	49.5		ug/kg	6.12	3.06	1
Fluoranthene	365		ug/kg	6.12	3.06	1
Pyrene	318		ug/kg	6.12	3.06	1
Benz(a)anthracene	215		ug/kg	6.12	3.06	1
Chrysene	203		ug/kg	6.12	3.06	1
Benzo(b)fluoranthene	187		ug/kg	6.12	3.06	1
Benzo(k)fluoranthene	152		ug/kg	6.12	3.06	1
Benzo(a)pyrene	236		ug/kg	6.12	3.06	1
Indeno(1,2,3-cd)Pyrene	174		ug/kg	6.12	3.06	1
Dibenz(a,h)anthracene	37.2		ug/kg	6.12	3.06	1
Benzo(ghi)perylene	176		ug/kg	6.12	3.06	1
Cl2-BZ#8	ND		ug/kg	0.612	0.306	1
Cl3-BZ#18	ND		ug/kg	0.612	0.306	1
Cl3-BZ#28	ND		ug/kg	0.612	0.306	1
Cl4-BZ#44	ND		ug/kg	0.612	0.306	1
Cl4-BZ#49	ND		ug/kg	0.612	0.306	1
Cl4-BZ#52	0.722		ug/kg	0.612	0.306	1
Cl4-BZ#66	ND		ug/kg	0.612	0.306	1
Cl5-BZ#87	0.326	J	ug/kg	0.612	0.306	1
Cl5-BZ#101	0.964		ug/kg	0.612	0.306	1
Cl5-BZ#105	ND		ug/kg	0.612	0.306	1
Cl5-BZ#118	0.956		ug/kg	0.612	0.306	1

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-02
Client ID: AR-102523
Sample Location: CONCORD, MA

Date Collected: 10/25/23 13:00
Date Received: 10/25/23
Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
PAHs/PCB Congeners by GC/MS - Mansfield Lab						
Cl6-BZ#128	ND		ug/kg	0.612	0.306	1
Cl6-BZ#138	2.12		ug/kg	0.612	0.306	1
Cl6-BZ#153	1.26		ug/kg	0.612	0.306	1
Cl7-BZ#170	ND		ug/kg	0.612	0.306	1
Cl7-BZ#180	0.671		ug/kg	0.612	0.306	1
Cl7-BZ#183	ND		ug/kg	0.612	0.306	1
Cl7-BZ#184	ND		ug/kg	0.612	0.306	1
Cl7-BZ#187	0.396	J	ug/kg	0.612	0.306	1
Cl8-BZ#195	ND		ug/kg	0.612	0.306	1
Cl9-BZ#206	4.19		ug/kg	0.612	0.306	1
Cl10-BZ#209	4.75		ug/kg	0.612	0.306	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
2-Methylnaphthalene-d10	75		30-150
Pyrene-d10	86		30-150
Benzo(b)fluoranthene-d12	89		30-150
DBOB	63		50-125
BZ 198	112		50-125

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 105,8270E-SIM/680(M)
Analytical Date: 12/16/23 14:26
Analyst: DB

Extraction Method: EPA 3570
Extraction Date: 12/03/23 13:17
Cleanup Method: EPA 3630
Cleanup Date: 12/05/23

Parameter	Result	Qualifier	Units	RL	MDL
PAHs/PCB Congeners by GC/MS - Mansfield Lab for sample(s): 01-02 Batch: WG1859138-1					
Naphthalene	4.56		ug/kg	4.00	2.00
2-Methylnaphthalene	ND		ug/kg	4.00	2.00
Acenaphthylene	ND		ug/kg	4.00	2.00
Acenaphthene	ND		ug/kg	4.00	2.00
Fluorene	ND		ug/kg	4.00	2.00
Phenanthrene	ND		ug/kg	4.00	2.00
Anthracene	ND		ug/kg	4.00	2.00
Fluoranthene	ND		ug/kg	4.00	2.00
Pyrene	ND		ug/kg	4.00	2.00
Benz(a)anthracene	ND		ug/kg	4.00	2.00
Chrysene	ND		ug/kg	4.00	2.00
Benzo(b)fluoranthene	ND		ug/kg	4.00	2.00
Benzo(k)fluoranthene	ND		ug/kg	4.00	2.00
Benzo(a)pyrene	ND		ug/kg	4.00	2.00
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	4.00	2.00
Dibenz(a,h)anthracene	ND		ug/kg	4.00	2.00
Benzo(ghi)perylene	ND		ug/kg	4.00	2.00
Cl2-BZ#8	ND		ug/kg	0.400	0.200
Cl3-BZ#18	ND		ug/kg	0.400	0.200
Cl3-BZ#28	ND		ug/kg	0.400	0.200
Cl4-BZ#44	ND		ug/kg	0.400	0.200
Cl4-BZ#49	ND		ug/kg	0.400	0.200
Cl4-BZ#52	ND		ug/kg	0.400	0.200
Cl4-BZ#66	ND		ug/kg	0.400	0.200
Cl5-BZ#87	ND		ug/kg	0.400	0.200
Cl5-BZ#101	ND		ug/kg	0.400	0.200
Cl5-BZ#105	ND		ug/kg	0.400	0.200
Cl5-BZ#118	ND		ug/kg	0.400	0.200
Cl6-BZ#128	ND		ug/kg	0.400	0.200

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 105,8270E-SIM/680(M)
Analytical Date: 12/16/23 14:26
Analyst: DB

Extraction Method: EPA 3570
Extraction Date: 12/03/23 13:17
Cleanup Method: EPA 3630
Cleanup Date: 12/05/23

Parameter	Result	Qualifier	Units	RL	MDL
PAHs/PCB Congeners by GC/MS - Mansfield Lab for sample(s): 01-02 Batch: WG1859138-1					
CI6-BZ#138	ND		ug/kg	0.400	0.200
CI6-BZ#153	ND		ug/kg	0.400	0.200
CI7-BZ#170	ND		ug/kg	0.400	0.200
CI7-BZ#180	ND		ug/kg	0.400	0.200
CI7-BZ#183	ND		ug/kg	0.400	0.200
CI7-BZ#184	ND		ug/kg	0.400	0.200
CI7-BZ#187	ND		ug/kg	0.400	0.200
CI8-BZ#195	ND		ug/kg	0.400	0.200
CI9-BZ#206	ND		ug/kg	0.400	0.200
CI10-BZ#209	ND		ug/kg	0.400	0.200

Surrogate	%Recovery	Qualifier	Acceptance Criteria
2-Methylnaphthalene-d10	78		30-150
Pyrene-d10	100		30-150
Benzo(b)fluoranthene-d12	101		30-150
DBOB	68		50-125
BZ 198	109		50-125

Lab Control Sample Analysis

Batch Quality Control

Project Name: WARNER'S POND

Lab Number: L2363511

Project Number: 6404001

Report Date: 12/19/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
PAHs/PCB Congeners by GC/MS - Mansfield Lab Associated sample(s): 01-02 Batch: WG1859138-2 WG1859138-3								
Naphthalene	75		82		40-140	9		30
Acenaphthylene	85		93		40-140	9		30
Acenaphthene	76		81		40-140	6		30
Fluorene	84		88		40-140	5		30
Phenanthrene	79		82		40-140	4		30
Anthracene	90		95		40-140	5		30
Fluoranthene	82		85		40-140	4		30
Pyrene	81		87		40-140	7		30
Benz(a)anthracene	104		108		40-140	4		30
Chrysene	77		82		40-140	6		30
Benzo(b)fluoranthene	91		99		40-140	8		30
Benzo(k)fluoranthene	81		90		40-140	11		30
Benzo(a)pyrene	86		94		40-140	9		30
Indeno(1,2,3-cd)Pyrene	103		109		40-140	6		30
Dibenz(a,h)anthracene	92		99		40-140	7		30
Benzo(ghi)perylene	100		107		40-140	7		30
Cl2-BZ#8	94		96		40-140	2		50
Cl3-BZ#18	89		92		40-140	3		50
Cl3-BZ#28	92		95		40-140	3		50
Cl4-BZ#44	100		103		40-140	3		50
Cl4-BZ#49	95		99		40-140	4		50
Cl4-BZ#52	93		96		40-140	3		50
Cl4-BZ#66	99		103		40-140	4		50

Lab Control Sample Analysis Batch Quality Control

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Parameter	LCS %Recovery	Qual	LCS %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
PAHs/PCB Congeners by GC/MS - Mansfield Lab Associated sample(s): 01-02 Batch: WG1859138-2 WG1859138-3								
Cl5-BZ#87	99		103		40-140	4		50
Cl5-BZ#101	102		105		40-140	3		50
Cl5-BZ#105	108		114		40-140	5		50
Cl5-BZ#118	95		99		40-140	4		50
Cl6-BZ#128	107		108		40-140	1		50
Cl6-BZ#138	105		108		40-140	3		50
Cl6-BZ#153	102		105		40-140	3		50
Cl7-BZ#170	112		116		40-140	4		50
Cl7-BZ#180	93		95		40-140	2		50
Cl7-BZ#183	103		106		40-140	3		50
Cl7-BZ#184	101		103		40-140	2		50
Cl7-BZ#187	107		107		40-140	0		50
Cl8-BZ#195	126		130		40-140	3		50
Cl9-BZ#206	119		125		40-140	5		50
Cl10-BZ#209	111		119		40-140	7		50

Surrogate	LCS %Recovery	Qual	LCS %Recovery	Qual	Acceptance Criteria
2-Methylnaphthalene-d10	81		84		30-150
Pyrene-d10	94		98		30-150
Benzo(b)fluoranthene-d12	99		104		30-150
DBOB	80		75		50-125
BZ 198	112		113		50-125



PETROLEUM HYDROCARBONS

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-01
 Client ID: NB-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 12:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Sediment
 Analytical Method: 135,EPH-19-2.1
 Analytical Date: 10/28/23 16:52
 Analyst: CRE
 Percent Solids: 68%

Extraction Method: EPA 3546
 Extraction Date: 10/27/23 08:36
 Cleanup Method1: EPH-19-2.1
 Cleanup Date1: 10/27/23

Quality Control Information

Condition of sample received: Satisfactory
 Sample Temperature upon receipt: Received on Ice
 Sample Extraction method: Extracted Per the Method

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Extractable Petroleum Hydrocarbons - Westborough Lab						
C9-C18 Aliphatics	ND		mg/kg	9.58	9.58	1
C19-C36 Aliphatics	29.0		mg/kg	9.58	9.58	1
C11-C22 Aromatics	23.5		mg/kg	9.58	9.58	1
C11-C22 Aromatics, Adjusted	23.5		mg/kg	9.58	9.58	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Chloro-Octadecane	61		40-140
o-Terphenyl	65		40-140
2-Fluorobiphenyl	74		40-140
2-Bromonaphthalene	75		40-140

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-02
 Client ID: AR-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 13:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Sediment
 Analytical Method: 135,EPH-19-2.1
 Analytical Date: 10/28/23 17:17
 Analyst: CRE
 Percent Solids: 64%

Extraction Method: EPA 3546
 Extraction Date: 10/27/23 08:36
 Cleanup Method1: EPH-19-2.1
 Cleanup Date1: 10/27/23

Quality Control Information

Condition of sample received: Satisfactory
 Sample Temperature upon receipt: Received on Ice
 Sample Extraction method: Extracted Per the Method

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Extractable Petroleum Hydrocarbons - Westborough Lab						
C9-C18 Aliphatics	ND		mg/kg	10.0	10.0	1
C19-C36 Aliphatics	21.4		mg/kg	10.0	10.0	1
C11-C22 Aromatics	29.9		mg/kg	10.0	10.0	1
C11-C22 Aromatics, Adjusted	25.6		mg/kg	10.0	10.0	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Chloro-Octadecane	60		40-140
o-Terphenyl	76		40-140
2-Fluorobiphenyl	83		40-140
2-Bromonaphthalene	86		40-140

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 135,EPH-19-2.1
Analytical Date: 10/28/23 10:21
Analyst: MTC

Extraction Method: EPA 3546
Extraction Date: 10/27/23 08:36
Cleanup Method: EPH-19-2.1
Cleanup Date: 10/27/23

Parameter	Result	Qualifier	Units	RL	MDL
Extractable Petroleum Hydrocarbons - Westborough Lab for sample(s): 01-02 Batch: WG1845020-1					
C9-C18 Aliphatics	ND		mg/kg	6.31	6.31
C19-C36 Aliphatics	ND		mg/kg	6.31	6.31
C11-C22 Aromatics	ND		mg/kg	6.31	6.31
C11-C22 Aromatics, Adjusted	ND		mg/kg	6.31	6.31

Surrogate	%Recovery	Qualifier	Acceptance Criteria
Chloro-Octadecane	72		40-140
o-Terphenyl	63		40-140
2-Fluorobiphenyl	70		40-140
2-Bromonaphthalene	72		40-140

Lab Control Sample Analysis

Batch Quality Control

Project Name: WARNER'S POND

Lab Number: L2363511

Project Number: 6404001

Report Date: 12/19/23

Parameter	LCS %Recovery	Qual	LCS %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Extractable Petroleum Hydrocarbons - Westborough Lab Associated sample(s): 01-02 Batch: WG1845020-2 WG1845020-3								
C9-C18 Aliphatics	67		65		40-140	3		25
C19-C36 Aliphatics	80		75		40-140	6		25
C11-C22 Aromatics	73		73		40-140	0		25
Naphthalene	67		68		40-140	1		25
2-Methylnaphthalene	70		71		40-140	1		25
Acenaphthylene	65		65		40-140	0		25
Acenaphthene	69		69		40-140	0		25
Fluorene	72		72		40-140	0		25
Phenanthrene	72		72		40-140	0		25
Anthracene	73		73		40-140	0		25
Fluoranthene	71		71		40-140	0		25
Pyrene	72		72		40-140	0		25
Benzo(a)anthracene	72		72		40-140	0		25
Chrysene	74		74		40-140	0		25
Benzo(b)fluoranthene	69		68		40-140	1		25
Benzo(k)fluoranthene	66		65		40-140	2		25
Benzo(a)pyrene	72		72		40-140	0		25
Indeno(1,2,3-cd)Pyrene	68		66		40-140	3		25
Dibenzo(a,h)anthracene	69		67		40-140	3		25
Benzo(ghi)perylene	65		62		40-140	5		25

Lab Control Sample Analysis

Batch Quality Control

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Parameter	<i>LCS</i> %Recovery	<i>Qual</i>	<i>LCSD</i> %Recovery	<i>Qual</i>	<i>%Recovery</i> Limits	<i>RPD</i>	<i>Qual</i>	<i>RPD</i> Limits
Extractable Petroleum Hydrocarbons - Westborough Lab Associated sample(s): 01-02 Batch: WG1845020-2 WG1845020-3								

<i>Surrogate</i>	<i>LCS</i> %Recovery	<i>Qual</i>	<i>LCSD</i> %Recovery	<i>Qual</i>	<i>Acceptance</i> Criteria
Chloro-Octadecane	71		67		40-140
o-Terphenyl	66		66		40-140
2-Fluorobiphenyl	75		76		40-140
2-Bromonaphthalene	75		77		40-140
% Naphthalene Breakthrough	0		0		
% 2-Methylnaphthalene Breakthrough	0		0		

PESTICIDES

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-01
 Client ID: NB-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 12:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:

Matrix: Sediment
 Analytical Method: 1,8081B
 Analytical Date: 12/07/23 19:37
 Analyst: DP
 Percent Solids: 68%

Extraction Method: EPA 3570
 Extraction Date: 12/05/23 18:52
 Cleanup Method: EPA 3630
 Cleanup Date: 12/07/23

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Organochlorine Pesticides by GC - Mansfield Lab							
alpha-BHC	ND		ug/kg	0.146	0.146	1	A
Hexachlorobenzene	ND		ug/kg	0.292	0.292	1	A
beta-BHC	ND		ug/kg	0.146	0.146	1	A
gamma-BHC	ND		ug/kg	0.146	0.146	1	A
delta-BHC	ND		ug/kg	0.146	0.146	1	A
Heptachlor	ND		ug/kg	0.146	0.146	1	A
Aldrin	ND		ug/kg	0.146	0.146	1	A
Heptachlor epoxide (B)	ND		ug/kg	0.292	0.292	1	B
Oxychlordane	ND		ug/kg	0.292	0.292	1	B
gamma-Chlordane	ND		ug/kg	0.146	0.146	1	A
2,4'-DDE	ND		ug/kg	0.146	0.146	1	A
Endosulfan I	ND		ug/kg	0.146	0.146	1	A
alpha-Chlordane	ND		ug/kg	0.146	0.146	1	A
trans-Nonachlor	0.520		ug/kg	0.146	0.146	1	B
4,4'-DDE	1.84		ug/kg	0.146	0.146	1	B
Dieldrin	ND		ug/kg	0.146	0.146	1	A
2,4'-DDD	ND		ug/kg	0.146	0.146	1	A
Endrin	ND		ug/kg	0.146	0.146	1	A
Endosulfan II	ND		ug/kg	0.146	0.146	1	A
4,4'-DDD	0.314		ug/kg	0.146	0.146	1	A
2,4'-DDT	ND		ug/kg	0.146	0.146	1	A
cis-Nonachlor	ND		ug/kg	0.146	0.146	1	A
Endrin aldehyde	ND		ug/kg	0.437	0.437	1	A
Endosulfan sulfate	ND		ug/kg	0.146	0.146	1	A
4,4'-DDT	0.465		ug/kg	0.146	0.146	1	A
Endrin ketone	ND		ug/kg	0.146	0.146	1	A
Methoxychlor	ND		ug/kg	1.46	1.46	1	A
Mirex	ND		ug/kg	0.146	0.146	1	A

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-01
 Client ID: NB-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 12:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Organochlorine Pesticides by GC - Mansfield Lab							
Toxaphene	ND		ug/kg	7.32	7.32	1	A
Chlordane	ND		ug/kg	7.32	7.32	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
TMX - Surrogate	59		30-150	A
DCB - Surrogate	58		30-150	A
TMX - Surrogate	59		30-150	B
DCB - Surrogate	66		30-150	B

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-02
 Client ID: AR-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 13:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:

Matrix: Sediment
 Analytical Method: 1,8081B
 Analytical Date: 12/07/23 20:10
 Analyst: DP
 Percent Solids: 64%

Extraction Method: EPA 3570
 Extraction Date: 12/05/23 18:52
 Cleanup Method: EPA 3630
 Cleanup Date: 12/07/23

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Organochlorine Pesticides by GC - Mansfield Lab							
alpha-BHC	ND		ug/kg	0.155	0.155	1	A
Hexachlorobenzene	ND		ug/kg	0.310	0.310	1	A
beta-BHC	ND		ug/kg	0.155	0.155	1	A
gamma-BHC	ND		ug/kg	0.155	0.155	1	A
delta-BHC	ND		ug/kg	0.155	0.155	1	A
Heptachlor	ND		ug/kg	0.155	0.155	1	A
Aldrin	ND		ug/kg	0.155	0.155	1	A
Heptachlor epoxide (B)	ND		ug/kg	0.310	0.310	1	B
Oxychlordane	ND		ug/kg	0.310	0.310	1	B
gamma-Chlordane	0.237		ug/kg	0.155	0.155	1	B
2,4'-DDE	ND		ug/kg	0.155	0.155	1	A
Endosulfan I	ND		ug/kg	0.155	0.155	1	A
alpha-Chlordane	0.175		ug/kg	0.155	0.155	1	A
trans-Nonachlor	0.386		ug/kg	0.155	0.155	1	A
4,4'-DDE	1.62		ug/kg	0.155	0.155	1	A
Dieldrin	ND		ug/kg	0.155	0.155	1	A
2,4'-DDD	ND		ug/kg	0.155	0.155	1	A
Endrin	ND		ug/kg	0.155	0.155	1	A
Endosulfan II	ND		ug/kg	0.155	0.155	1	A
4,4'-DDD	0.487		ug/kg	0.155	0.155	1	B
2,4'-DDT	ND		ug/kg	0.155	0.155	1	A
cis-Nonachlor	ND		ug/kg	0.155	0.155	1	A
Endrin aldehyde	ND		ug/kg	0.465	0.465	1	A
Endosulfan sulfate	ND		ug/kg	0.155	0.155	1	A
4,4'-DDT	0.410	IP	ug/kg	0.155	0.155	1	A
Endrin ketone	ND		ug/kg	0.155	0.155	1	A
Methoxychlor	ND		ug/kg	1.55	1.55	1	A
Mirex	ND		ug/kg	0.155	0.155	1	A

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-02
 Client ID: AR-102523
 Sample Location: CONCORD, MA

Date Collected: 10/25/23 13:00
 Date Received: 10/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Organochlorine Pesticides by GC - Mansfield Lab							
Toxaphene	ND		ug/kg	7.78	7.78	1	A
Chlordane	ND		ug/kg	7.78	7.78	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
TMX - Surrogate	56		30-150	A
DCB - Surrogate	60		30-150	A
TMX - Surrogate	57		30-150	B
DCB - Surrogate	68		30-150	B

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8081B
Analytical Date: 12/07/23 14:34
Analyst: DP

Extraction Method: EPA 3570
Extraction Date: 12/05/23 18:52
Cleanup Method: EPA 3630
Cleanup Date: 12/07/23

Parameter	Result	Qualifier	Units	RL	MDL	Column
Organochlorine Pesticides by GC - Mansfield Lab for sample(s): 01-02 Batch: WG1860053-1						
alpha-BHC	ND		ug/kg	0.100	0.100	A
Hexachlorobenzene	ND		ug/kg	0.200	0.200	A
beta-BHC	ND		ug/kg	0.100	0.100	A
gamma-BHC	ND		ug/kg	0.100	0.100	A
delta-BHC	ND		ug/kg	0.100	0.100	A
Heptachlor	ND		ug/kg	0.100	0.100	A
Aldrin	ND		ug/kg	0.100	0.100	A
gamma-Chlordane	ND		ug/kg	0.100	0.100	A
2,4'-DDE	ND		ug/kg	0.100	0.100	A
Endosulfan I	ND		ug/kg	0.100	0.100	A
alpha-Chlordane	ND		ug/kg	0.100	0.100	A
trans-Nonachlor	ND		ug/kg	0.100	0.100	A
4,4'-DDE	ND		ug/kg	0.100	0.100	A
Dieldrin	ND		ug/kg	0.100	0.100	A
2,4'-DDD	ND		ug/kg	0.100	0.100	A
Endrin	ND		ug/kg	0.100	0.100	A
Endosulfan II	ND		ug/kg	0.100	0.100	A
4,4'-DDD	ND		ug/kg	0.100	0.100	A
2,4'-DDT	ND		ug/kg	0.100	0.100	A
cis-Nonachlor	ND		ug/kg	0.100	0.100	A
Endrin aldehyde	ND		ug/kg	0.300	0.300	A
Endosulfan sulfate	ND		ug/kg	0.100	0.100	A
4,4'-DDT	ND		ug/kg	0.100	0.100	A
Endrin ketone	ND		ug/kg	0.100	0.100	A
Methoxychlor	ND		ug/kg	1.00	1.00	A
Mirex	ND		ug/kg	0.100	0.100	A
Toxaphene	ND		ug/kg	5.02	5.02	A
Chlordane	ND		ug/kg	5.02	5.02	A
Heptachlor epoxide (B)	ND		ug/kg	0.200	0.200	B

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8081B
Analytical Date: 12/07/23 14:34
Analyst: DP

Extraction Method: EPA 3570
Extraction Date: 12/05/23 18:52
Cleanup Method: EPA 3630
Cleanup Date: 12/07/23

Parameter	Result	Qualifier	Units	RL	MDL	Column
Organochlorine Pesticides by GC - Mansfield Lab for sample(s): 01-02 Batch: WG1860053-1						
Oxychlorane	ND		ug/kg	0.200	0.200	B

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
TMX - Surrogate	73		30-150	A
DCB - Surrogate	87		30-150	A
TMX - Surrogate	72		30-150	B
DCB - Surrogate	90		30-150	B

Lab Control Sample Analysis

Batch Quality Control

Project Name: WARNER'S POND

Lab Number: L2363511

Project Number: 6404001

Report Date: 12/19/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Organochlorine Pesticides by GC - Mansfield Lab Associated sample(s): 01-02 Batch: WG1860053-2 WG1860053-3									
alpha-BHC	97		99		40-140	2		50	A
Hexachlorobenzene	79		80		40-140	1		50	A
beta-BHC	80		82		40-140	2		50	A
gamma-BHC	93		95		40-140	2		50	A
delta-BHC	74		75		40-140	1		50	A
Heptachlor	88		90		40-140	2		50	A
Aldrin	92		94		40-140	2		50	A
gamma-Chlordane	94		97		40-140	3		50	A
2,4'-DDE	89		91		40-140	2		50	A
Endosulfan I	94		96		40-140	2		50	A
alpha-Chlordane	92		94		40-140	2		50	A
trans-Nonachlor	96		98		40-140	2		50	A
4,4'-DDE	102		105		40-140	3		50	A
Dieldrin	103		106		40-140	3		50	A
2,4'-DDD	99		102		40-140	3		50	A
Endrin	86		88		40-140	2		50	A
Endosulfan II	92		96		40-140	4		50	A
4,4'-DDD	102		106		40-140	4		50	A
2,4'-DDT	106		108		40-140	2		50	A
cis-Nonachlor	88		91		40-140	3		50	A
Endrin aldehyde	68		74		40-140	8		50	A
Endosulfan sulfate	96		100		40-140	4		50	A
4,4'-DDT	98		102		40-140	4		50	A

Lab Control Sample Analysis Batch Quality Control

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Parameter	LCS		LCSD		%Recovery Limits	RPD	RPD	
	%Recovery	Qual	%Recovery	Qual			Qual	Limits
Organochlorine Pesticides by GC - Mansfield Lab Associated sample(s): 01-02 Batch: WG1860053-2 WG1860053-3								
Endrin ketone	114		118		40-140	3	50	A
Methoxychlor	92		94		40-140	2	50	A
Mirex	79		83		40-140	5	50	A

Surrogate	LCS		LCSD		Acceptance Criteria	Column
	%Recovery	Qual	%Recovery	Qual		
TMX - Surrogate	74		75		30-150	A
DCB - Surrogate	86		87		30-150	A
TMX - Surrogate	72		74		30-150	B
DCB - Surrogate	91		92		30-150	B



Lab Control Sample Analysis Batch Quality Control

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Organochlorine Pesticides by GC - Mansfield Lab Associated sample(s): 01-02 Batch: WG1860053-2 WG1860053-3									
Heptachlor epoxide (B)	91		93		40-140	2		50	B
Oxychlorane	99		102		40-140	3		50	B

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
TMX - Surrogate	74		75		30-150	A
DCB - Surrogate	86		87		30-150	A
TMX - Surrogate	72		74		30-150	B
DCB - Surrogate	91		92		30-150	B



METALS

Project Name: WARNER'S POND**Lab Number:** L2363511**Project Number:** 6404001**Report Date:** 12/19/23**SAMPLE RESULTS**

Lab ID: L2363511-01

Date Collected: 10/25/23 12:00

Client ID: NB-102523

Date Received: 10/25/23

Sample Location: CONCORD, MA

Field Prep: Not Specified

Sample Depth:

Matrix: Sediment

Percent Solids: 68%

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Mansfield Lab											
Arsenic, Total	5.14		mg/kg	0.726	0.096	10	12/07/23 15:37	12/07/23 19:32	EPA 3050B	1,6020B	NTB
Cadmium, Total	0.064	J	mg/kg	0.290	0.038	10	12/07/23 15:37	12/07/23 19:32	EPA 3050B	1,6020B	NTB
Chromium, Total	21.0		mg/kg	2.90	0.679	10	12/07/23 15:37	12/07/23 19:32	EPA 3050B	1,6020B	NTB
Copper, Total	121		mg/kg	2.90	0.281	10	12/07/23 15:37	12/07/23 19:32	EPA 3050B	1,6020B	NTB
Lead, Total	14.9		mg/kg	0.871	0.212	10	12/07/23 15:37	12/07/23 19:32	EPA 3050B	1,6020B	NTB
Mercury, Total	0.005	J	mg/kg	0.018	0.002	5	12/07/23 14:10	12/08/23 09:19	EPA 7474	1,7474	RJP
Nickel, Total	12.4		mg/kg	1.45	0.388	10	12/07/23 15:37	12/07/23 19:32	EPA 3050B	1,6020B	NTB
Zinc, Total	24.1		mg/kg	14.5	3.77	10	12/07/23 15:37	12/07/23 19:32	EPA 3050B	1,6020B	NTB

Project Name: WARNER'S POND**Lab Number:** L2363511**Project Number:** 6404001**Report Date:** 12/19/23**SAMPLE RESULTS**

Lab ID: L2363511-02

Date Collected: 10/25/23 13:00

Client ID: AR-102523

Date Received: 10/25/23

Sample Location: CONCORD, MA

Field Prep: Not Specified

Sample Depth:

Matrix: Sediment

Percent Solids: 64%

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Mansfield Lab											
Arsenic, Total	5.75		mg/kg	0.745	0.098	10	12/07/23 15:37	12/07/23 19:46	EPA 3050B	1,6020B	NTB
Cadmium, Total	0.112	J	mg/kg	0.298	0.039	10	12/07/23 15:37	12/07/23 19:46	EPA 3050B	1,6020B	NTB
Chromium, Total	38.7		mg/kg	2.98	0.697	10	12/07/23 15:37	12/07/23 19:46	EPA 3050B	1,6020B	NTB
Copper, Total	14.6		mg/kg	2.98	0.289	10	12/07/23 15:37	12/07/23 19:46	EPA 3050B	1,6020B	NTB
Lead, Total	24.6		mg/kg	0.894	0.218	10	12/07/23 15:37	12/07/23 19:46	EPA 3050B	1,6020B	NTB
Mercury, Total	0.122		mg/kg	0.020	0.003	5	12/07/23 14:10	12/08/23 09:28	EPA 7474	1,7474	RJP
Nickel, Total	9.04		mg/kg	1.49	0.398	10	12/07/23 15:37	12/07/23 19:46	EPA 3050B	1,6020B	NTB
Zinc, Total	41.7		mg/kg	14.9	3.87	10	12/07/23 15:37	12/07/23 19:46	EPA 3050B	1,6020B	NTB

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Method Blank Analysis Batch Quality Control

Parameter	Result Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Mansfield Lab for sample(s): 01-02 Batch: WG1857705-1									
Arsenic, Total	ND	mg/kg	0.500	0.066	10	12/07/23 15:37	12/07/23 19:09	1,6020B	NTB
Cadmium, Total	ND	mg/kg	0.200	0.026	10	12/07/23 15:37	12/07/23 19:09	1,6020B	NTB
Chromium, Total	ND	mg/kg	2.00	0.468	10	12/07/23 15:37	12/07/23 19:09	1,6020B	NTB
Copper, Total	ND	mg/kg	2.00	0.194	10	12/07/23 15:37	12/07/23 19:09	1,6020B	NTB
Lead, Total	ND	mg/kg	0.600	0.146	10	12/07/23 15:37	12/07/23 19:09	1,6020B	NTB
Nickel, Total	ND	mg/kg	1.00	0.267	10	12/07/23 15:37	12/07/23 19:09	1,6020B	NTB
Zinc, Total	ND	mg/kg	10.0	2.60	10	12/07/23 15:37	12/07/23 19:09	1,6020B	NTB

Prep Information

Digestion Method: EPA 3050B

Parameter	Result Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Mansfield Lab for sample(s): 01-02 Batch: WG1857709-1									
Mercury, Total	ND	mg/kg	0.013	0.002	5	12/07/23 14:10	12/08/23 09:14	1,7474	RJP

Prep Information

Digestion Method: EPA 7474



Lab Control Sample Analysis Batch Quality Control

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Parameter	LCS		LCSD		%Recovery Limits	RPD	Qual	RPD Limits
	%Recovery	Qual	%Recovery	Qual				
Total Metals - Mansfield Lab Associated sample(s): 01-02 Batch: WG1857705-2 SRM Lot Number: D122-540								
Arsenic, Total	95		-		81-119	-		20
Cadmium, Total	102		-		83-117	-		20
Chromium, Total	93		-		82-118	-		20
Copper, Total	93		-		84-116	-		20
Lead, Total	94		-		83-117	-		20
Nickel, Total	97		-		83-117	-		20
Zinc, Total	94		-		82-119	-		20
Total Metals - Mansfield Lab Associated sample(s): 01-02 Batch: WG1857709-2 SRM Lot Number: D122-540								
Mercury, Total	100		-		73-127	-		20



Matrix Spike Analysis Batch Quality Control

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Total Metals - Mansfield Lab Associated sample(s): 01-02 QC Batch ID: WG1857705-3 QC Sample: L2363511-01 Client ID: NB-102523												
Arsenic, Total	5.14	13.6	21.1	117		-	-		75-125	-		20
Cadmium, Total	0.064J	6.02	5.98	99		-	-		75-125	-		20
Chromium, Total	21.0	22.7	32.2	49	Q	-	-		75-125	-		20
Copper, Total	121	28.4	33.6	0	Q	-	-		75-125	-		20
Lead, Total	14.9	60.2	79.4	107		-	-		75-125	-		20
Nickel, Total	12.4	56.8	61.9	87		-	-		75-125	-		20
Zinc, Total	24.1	56.8	75.8	91		-	-		75-125	-		20
Total Metals - Mansfield Lab Associated sample(s): 01-02 QC Batch ID: WG1857709-3 QC Sample: L2363511-01 Client ID: NB-102523												
Mercury, Total	0.005J	0.838	0.830	99		-	-		80-120	-		20

Lab Duplicate Analysis

Batch Quality Control

Project Name: WARNER'S POND

Project Number: 6404001

Lab Number: L2363511

Report Date: 12/19/23

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Total Metals - Mansfield Lab Associated sample(s): 01-02 QC Batch ID: WG1857705-4 QC Sample: L2363511-01 Client ID: NB-102523						
Arsenic, Total	5.14	6.37	mg/kg	21	Q	20
Cadmium, Total	0.064J	0.061J	mg/kg	NC		20
Chromium, Total	21.0	11.1	mg/kg	62	Q	20
Copper, Total	121	8.04	mg/kg	175	Q	20
Lead, Total	14.9	20.8	mg/kg	33	Q	20
Nickel, Total	12.4	8.90	mg/kg	33	Q	20
Zinc, Total	24.1	26.4	mg/kg	9		20
Total Metals - Mansfield Lab Associated sample(s): 01-02 QC Batch ID: WG1857709-4 QC Sample: L2363511-01 Client ID: NB-102523						
Mercury, Total	0.005J	0.013J	mg/kg	NC		20

INORGANICS & MISCELLANEOUS

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-01
Client ID: NB-102523
Sample Location: CONCORD, MA

Date Collected: 10/25/23 12:00
Date Received: 10/25/23
Field Prep: Not Specified

Sample Depth:
Matrix: Sediment

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Organic Carbon - Mansfield Lab										
Total Organic Carbon (Rep1)	0.832		%	0.010	0.010	1	-	12/14/23 08:38	1,9060A	SPP
Total Organic Carbon (Rep2)	0.819		%	0.010	0.010	1	-	12/14/23 08:38	1,9060A	SPP
Total Organic Carbon (Average)	0.826		%	0.010	0.010	1	-	12/14/23 08:38	1,9060A	SPP
Grain Size Analysis - Mansfield Lab										
% Total Gravel	28.2		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
% Coarse Sand	13.1		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
% Medium Sand	41.1		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
% Fine Sand	16.2		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
% Total Fines	1.40		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
General Chemistry - Mansfield Lab										
Solids, Total	68.1		%	0.100	0.100	1	-	10/26/23 19:19	121,2540G	CLF



Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

SAMPLE RESULTS

Lab ID: L2363511-02
Client ID: AR-102523
Sample Location: CONCORD, MA

Date Collected: 10/25/23 13:00
Date Received: 10/25/23
Field Prep: Not Specified

Sample Depth:
Matrix: Sediment

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Organic Carbon - Mansfield Lab										
Total Organic Carbon (Rep1)	0.817		%	0.010	0.010	1	-	12/14/23 08:38	1,9060A	SPP
Total Organic Carbon (Rep2)	0.735		%	0.010	0.010	1	-	12/14/23 08:38	1,9060A	SPP
Total Organic Carbon (Average)	0.776		%	0.010	0.010	1	-	12/14/23 08:38	1,9060A	SPP
Grain Size Analysis - Mansfield Lab										
% Total Gravel	4.20		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
% Coarse Sand	5.70		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
% Medium Sand	19.3		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
% Fine Sand	63.2		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
% Total Fines	7.60		%	0.100	NA	1	-	12/06/23 12:36	12,D6913/D7928	SJK
General Chemistry - Mansfield Lab										
Solids, Total	64.1		%	0.100	0.100	1	-	10/26/23 19:19	121,2540G	CLF



Project Name: WARNER'S POND

Lab Number: L2363511

Project Number: 6404001

Report Date: 12/19/23

Method Blank Analysis
Batch Quality Control

Parameter	Result Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Organic Carbon - Mansfield Lab for sample(s): 01-02 Batch: WG1864065-1									
Total Organic Carbon (Rep1)	ND	%	0.010	0.010	1	-	12/14/23 08:38	1,9060A	SPP
Total Organic Carbon (Rep2)	ND	%	0.010	0.010	1	-	12/14/23 08:38	1,9060A	SPP
Total Organic Carbon (Average)	ND	%	0.010	0.010	1	-	12/14/23 08:38	1,9060A	SPP

Lab Control Sample Analysis

Batch Quality Control

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Total Organic Carbon - Mansfield Lab Associated sample(s): 01-02 Batch: WG1864065-2								
Total Organic Carbon (Rep1)	103		-		75-125	-		25
Total Organic Carbon (Rep2)	104		-		75-125	-		25
Total Organic Carbon (Average)	103		-		75-125	-		25

Matrix Spike Analysis Batch Quality Control

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	MSD Qual	MSD Found	MSD %Recovery	MSD Qual	Recovery Limits	RPD	RPD Qual	RPD Limits
Total Organic Carbon - Mansfield Lab Associated sample(s): 01-02 QC Batch ID: WG1864065-4 WG1864065-5 QC Sample: L2363403-04 Client ID: MS Sample												
Total Organic Carbon (Rep1)	2.06	1.84	3.99	105		3.44	105		75-125	15		25
Total Organic Carbon (Rep2)	2.04	1.54	3.71	109		3.70	109		75-125	0		25

Lab Duplicate Analysis

Batch Quality Control

Project Name: WARNER'S POND

Project Number: 6404001

Lab Number: L2363511

Report Date: 12/19/23

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Mansfield Lab Associated sample(s): 01-02 QC Batch ID: WG1844741-1 QC Sample: L2359195-04 Client ID: DUP Sample						
Solids, Total	96.8	96.9	%	0		10
Grain Size Analysis - Mansfield Lab Associated sample(s): 01-02 QC Batch ID: WG1860514-1 QC Sample: L2363511-02 Client ID: AR-102523						
% Total Gravel	4.20	3.30	%	24	Q	20
% Coarse Sand	5.70	3.00	%	62	Q	20
% Medium Sand	19.3	19.5	%	1		20
% Fine Sand	63.2	68.2	%	8		20
% Total Fines	7.60	6.00	%	24	Q	20
Total Organic Carbon - Mansfield Lab Associated sample(s): 01-02 QC Batch ID: WG1864065-3 QC Sample: L2363403-04 Client ID: DUP Sample						
Total Organic Carbon (Rep1)	2.06	2.04	%	1		25
Total Organic Carbon (Rep2)	2.04	1.96	%	4		25
Total Organic Carbon (Average)	2.05	2.00	%	2		25

Project Name: WARNER'S POND
Project Number: 6404001

Serial_No:12192316:40
Lab Number: L2363511
Report Date: 12/19/23

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler **Custody Seal**
A Absent

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2363511-01A	Vial MeOH preserved	A	NA		12.7	Y	Absent		8260H(14)
L2363511-01B	Vial water preserved	A	NA		12.7	Y	Absent	25-OCT-23 19:30	ARCHIVE()
L2363511-01C	Vial water preserved	A	NA		12.7	Y	Absent	25-OCT-23 19:30	ARCHIVE()
L2363511-01D	Plastic 2oz unpreserved for TS	A	NA		12.7	Y	Absent		A2-TS(7)
L2363511-01E	Plastic 2oz unpreserved for TS	A	NA		12.7	Y	Absent		A2-TS(7)
L2363511-01F	Glass 120ml/4oz unpreserved	A	NA		12.7	Y	Absent		EPH-20(14)
L2363511-01G	Plastic 8oz unpreserved for Grain Size	A	NA		12.7	Y	Absent		A2-HYDRO-TFINE(),A2-HYDRO-FSAND(),A2-HYDRO-MSAND(),A2-HYDRO-TGRAVEL(),A2-HYDRO-CSAND()
L2363511-01H	Glass 250ml/8oz unpreserved	A	NA		12.7	Y	Absent		A2-PB-6020T(180),A2-ZN-6020T(180),A2-NI-6020T(180),A2-HG-7474T(28),A2-CR-6020T(180),A2-AS-6020T(180),A2-CD-6020T(180),A2-HGPREP-AF(28),A2-PREP-3050:2T(180),A2-CU-6020T(180)
L2363511-01I	Glass 250ml/8oz unpreserved	A	NA		12.7	Y	Absent		A2-PEST-8081(14),A2-TOC-9060-2REPS(28),A2-PAH/PCBCONG(14)
L2363511-02A	Vial MeOH preserved	A	NA		12.7	Y	Absent		8260H(14)
L2363511-02B	Vial water preserved	A	NA		12.7	Y	Absent	25-OCT-23 19:30	ARCHIVE()
L2363511-02C	Vial water preserved	A	NA		12.7	Y	Absent	25-OCT-23 19:30	ARCHIVE()
L2363511-02D	Plastic 2oz unpreserved for TS	A	NA		12.7	Y	Absent		A2-TS(7)
L2363511-02E	Plastic 2oz unpreserved for TS	A	NA		12.7	Y	Absent		A2-TS(7)
L2363511-02F	Glass 120ml/4oz unpreserved	A	NA		12.7	Y	Absent		EPH-20(14)
L2363511-02G	Plastic 8oz unpreserved for Grain Size	A	NA		12.7	Y	Absent		A2-HYDRO-TFINE(),A2-HYDRO-FSAND(),A2-HYDRO-MSAND(),A2-HYDRO-TGRAVEL(),A2-HYDRO-CSAND()
L2363511-02H	Glass 250ml/8oz unpreserved	A	NA		12.7	Y	Absent		A2-PB-6020T(180),A2-NI-6020T(180),A2-ZN-6020T(180),A2-HG-7474T(28),A2-CR-6020T(180),A2-AS-6020T(180),A2-HGPREP-AF(28),A2-CD-6020T(180),A2-PREP-3050:2T(180),A2-CU-6020T(180)

*Values in parentheses indicate holding time in days



Project Name: WARNER'S POND
Project Number: 6404001

Serial_No:12192316:40
Lab Number: L2363511
Report Date: 12/19/23

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2363511-02I	Glass 250ml/8oz unpreserved	A	NA		12.7	Y	Absent		A2-PEST-8081(14),A2-TOC-9060-2REPS(28),A2-PAH/PCBCONG(14)

Container Comments

L2363511-01I

L2363511-02I

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

GLOSSARY

Acronyms

DL	- Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LOD	- Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
LOQ	- Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.) Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
NR	- No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: DU Report with 'J' Qualifiers



Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA, this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

- A** - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).
- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- F** - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.
- G** - The concentration may be biased high due to matrix interferences (i.e. co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The lower value for the two columns has been reported due to obvious interference.
- J** - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively

Report Format: DU Report with 'J' Qualifiers



Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

Data Qualifiers

Identified Compounds (TICs). For calculated parameters, this represents that one or more values used in the calculation were estimated.

- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
- ND** - Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.
- NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- R** - Analytical results are from sample re-analysis.
- RE** - Analytical results are from sample re-extraction.
- S** - Analytical results are from modified screening analysis.
- V** - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)
- Z** - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Project Name: WARNER'S POND
Project Number: 6404001

Lab Number: L2363511
Report Date: 12/19/23

REFERENCES

- 1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - VI, 2018.
- 12 Annual Book of ASTM Standards. (American Society for Testing and Materials) ASTM International.
- 105 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IIIA, 1997 in conjunction with NOAA Technical Memorandum NMFS-NWFSC-59: Extraction, Cleanup and GC/MS Analysis of Sediments and Tissues for Organic Contaminants, March 2004 and the Determination of Pesticides and PCBs in Water and Oil/Sediment by GC/MS: Method 680, EPA 01A0005295, November 1985.
- 121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.
- 135 Method for the Determination of Extractable Petroleum Hydrocarbons (EPH), MassDEP, December 2019, Revision 2.1 with QC Requirements & Performance Standards for the Analysis of EPH under the Massachusetts Contingency Plan, WSC-CAM-IVB, March 1, 2020.

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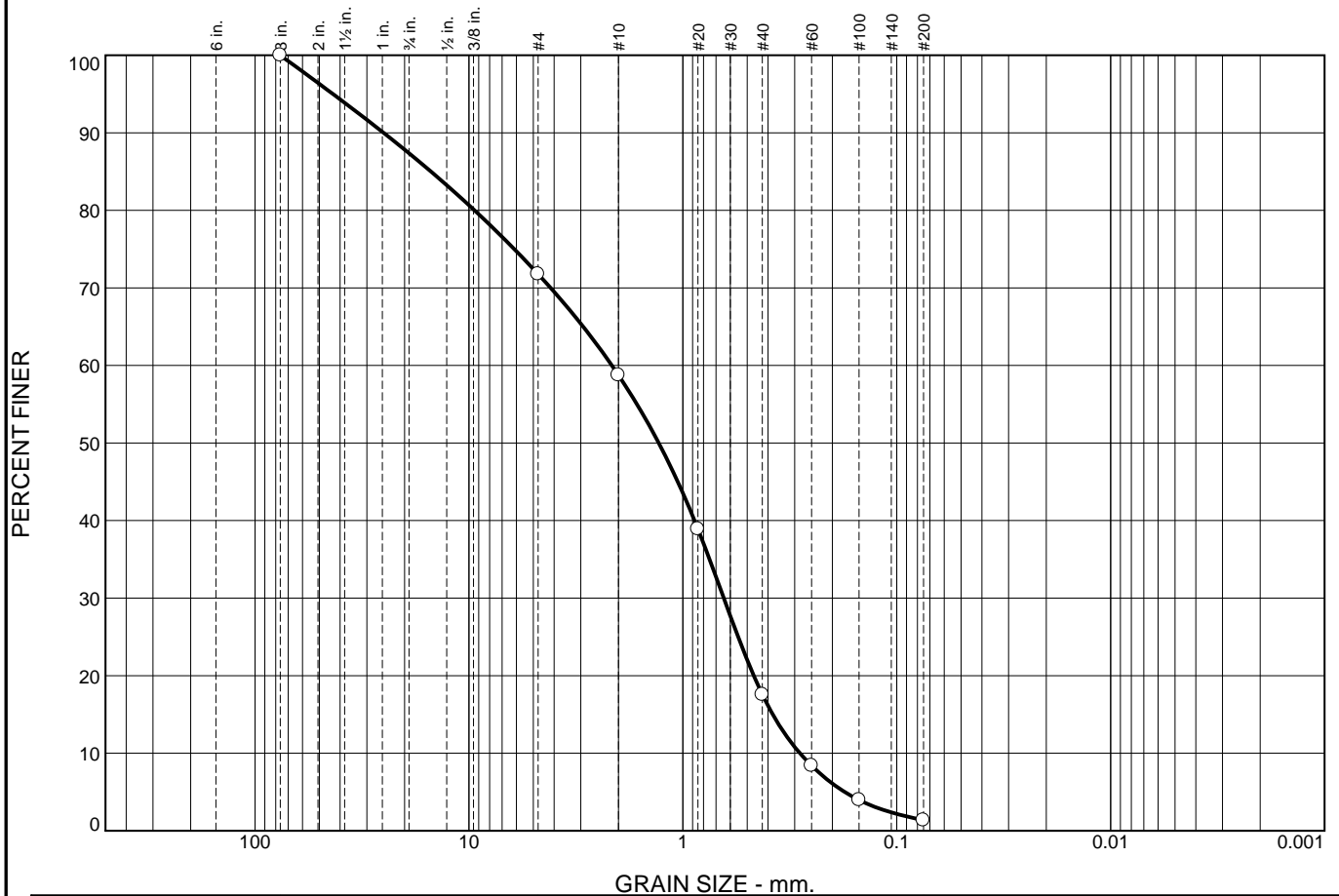
We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.



ASTM D6913/D7928

GRAIN SIZE ANALYSIS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.6	15.6	13.1	41.1	16.2	1.4	

LL	PL	D85	D60	D50	D30	D15	D10	Cc	Cu
		15.0483	2.1471	1.2957	0.6437	0.3800	0.2837	0.68	7.57

Material Description	USCS	AASHTO
	SP	

Project No. Project:	Client: Source of Sample: NB-102523 Sample Number: L2363511-01	Remarks: <div style="text-align: right; margin-top: 20px;">Figure</div>
Alpha Analytical Mansfield, MA		

GRAIN SIZE DISTRIBUTION TEST DATA

12/11/2023

Location: NB-102523

Sample Number: L2363511-01

USCS Classification: SP

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 130.23
 Tare Wt. = 0.00
 Minus #200 from wash = 0.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
130.23	0.00	3	0.00	0.00	100.0
		#4	36.76	0.00	71.8
		#10	16.96	0.00	58.7
		#20	25.85	0.00	38.9
		#40	27.79	0.00	17.6
		#60	11.94	0.00	8.4
		#100	5.77	0.00	4.0
		#200	3.40	0.00	1.4

Fractional Components

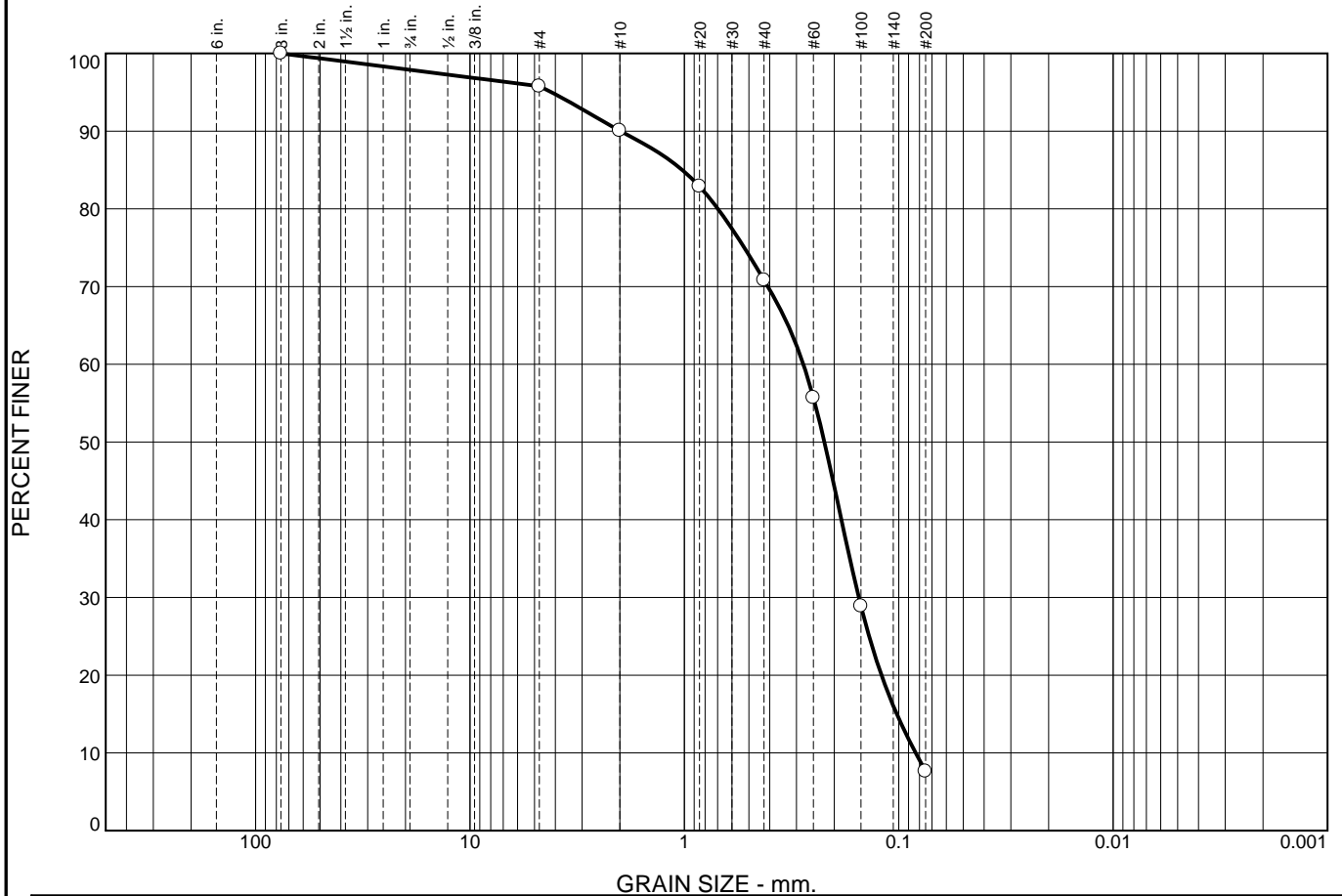
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	12.6	15.6	28.2	13.1	41.1	16.2	70.4			1.4

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
0.1751	0.2837	0.3800	0.4662	0.6437	0.8819	1.2957	2.1471	9.4150	15.0483	25.0633	43.2448

Fineness Modulus	C _u	C _c
4.15	7.57	0.68

Alpha Analytical

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.1	2.1	5.7	19.3	63.2	7.6	

LL	PL	D85	D60	D50	D30	D15	D10	Cc	Cu
		1.0224	0.2786	0.2222	0.1536	0.1021	0.0834	1.02	3.34

Material Description	USCS	AASHTO

Project No. Project:	Client: Source of Sample: AR-102523 Sample Number: L2363511-02	Remarks:
Alpha Analytical Mansfield, MA		Figure

GRAIN SIZE DISTRIBUTION TEST DATA

12/11/2023

Location: AR-102523

Sample Number: L2363511-02

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 99.62

Tare Wt. = 0.00

Minus #200 from wash = 0.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
99.62	0.00	3	0.00	0.00	100.0
		#4	4.21	0.00	95.8
		#10	5.70	0.00	90.1
		#20	7.15	0.00	82.9
		#40	12.00	0.00	70.8
		#60	15.07	0.00	55.7
		#100	26.73	0.00	28.9
		#200	21.16	0.00	7.6

Fractional Components

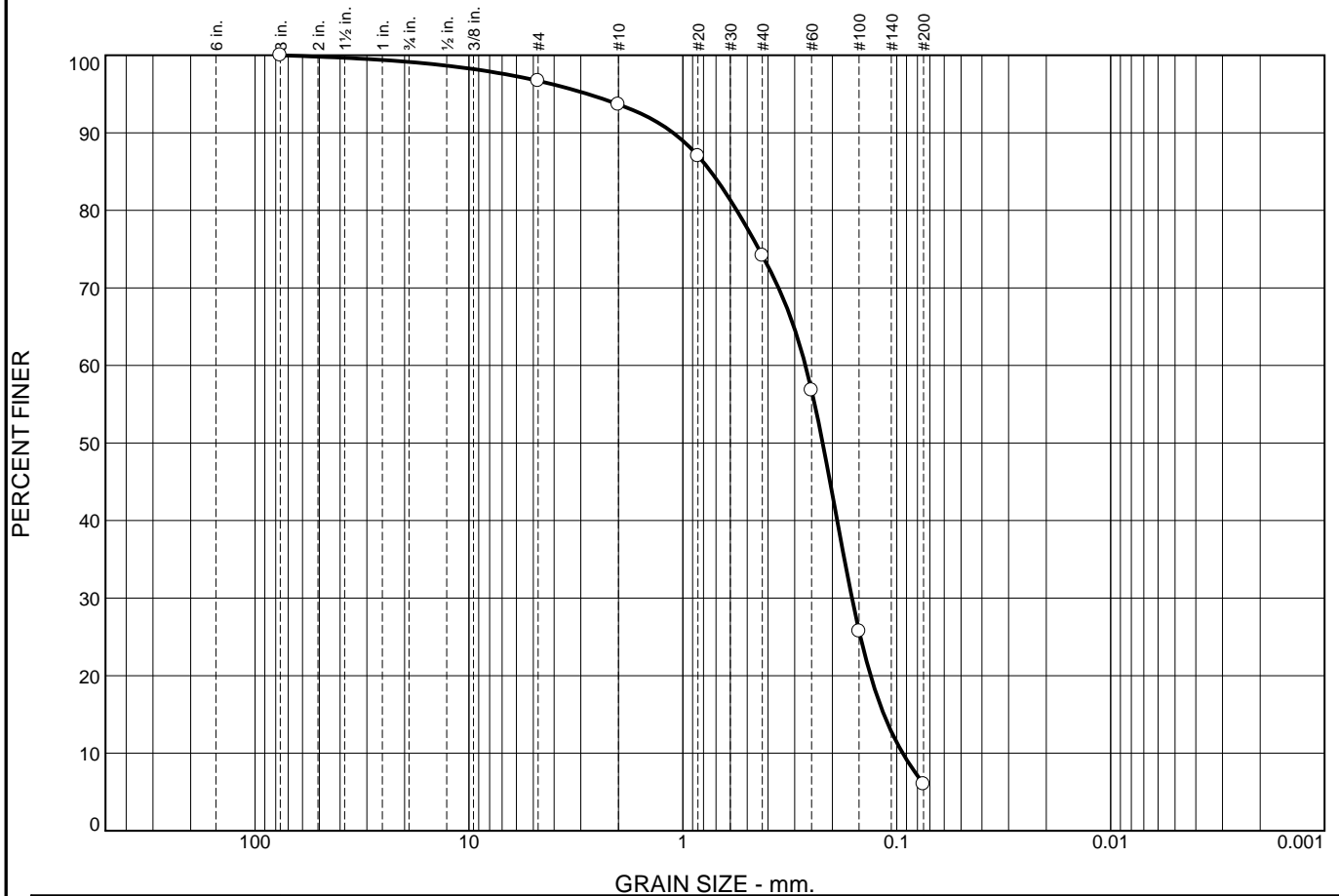
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	2.1	2.1	4.2	5.7	19.3	63.2	88.2			7.6

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
	0.0834	0.1021	0.1204	0.1536	0.1852	0.2222	0.2786	0.6975	1.0224	1.9842	4.1687

Fineness Modulus	C _u	C _c
1.64	3.34	1.02

Alpha Analytical

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.9	2.4	3.0	19.5	68.2	6.0	

LL	PL	D85	D60	D50	D30	D15	D10	Cc	Cu
		0.7405	0.2671	0.2219	0.1619	0.1149	0.0938	1.05	2.85

Material Description	USCS	AASHTO

Project No. Project:	Client: Source of Sample: AR-102523 Sample Number: WG1860514-1	Remarks:
Alpha Analytical Mansfield, MA		Figure

GRAIN SIZE DISTRIBUTION TEST DATA

12/11/2023

Location: AR-102523

Sample Number: WG1860514-1

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 111.64

Tare Wt. = 0.00

Minus #200 from wash = 0.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
111.64	0.00	3	0.00	0.00	100.0
		#4	3.69	0.00	96.7
		#10	3.39	0.00	93.7
		#20	7.41	0.00	87.0
		#40	14.35	0.00	74.2
		#60	19.40	0.00	56.8
		#100	34.67	0.00	25.7
		#200	22.01	0.00	6.0

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.9	2.4	3.3	3.0	19.5	68.2	90.7			6.0

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
	0.0938	0.1149	0.1325	0.1619	0.1899	0.2219	0.2671	0.5601	0.7405	1.1102	2.7859

Fineness Modulus	C _u	C _c
1.50	2.85	1.05

Alpha Analytical

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility

EPA 624.1: m/p-xylene, o-xylene, Naphthalene

EPA 625.1: alpha-Terpineol

EPA 8260D: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.

EPA 8270E: NPW: Dimethylnaphthalene, 1,4-Diphenylhydrazine, alpha-Terpineol; SCM: Dimethylnaphthalene, 1,4-Diphenylhydrazine.

SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO₂, NO₃.

Mansfield Facility

SM 2540D: TSS.

EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene,

3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water

EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2:** Nitrate-N, Nitrite-N; **SM4500NO3-F:** Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE,**

EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B

EPA 524.2: THMs and VOCs; **EPA 504.1:** EDB, DBCP.

Microbiology: SM9215B; SM9223-P/A, SM9223B-Colilert-QT, SM9222D.

Non-Potable Water

SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1:**

Ammonia-N, **LACHAT 10-107-06-1-B:** Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2:** Nitrate-N, **SM4500P-E, SM4500P-B, E, SM4500SO4-E,**

SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.

EPA 624.1: Volatile Halocarbons & Aromatics,

EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II,

Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs

EPA 625.1: SVOC (Acid/Base/Neutral Extractables).

Microbiology: SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603, SM9222D.

Mansfield Facility:

Drinking Water

EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1 Hg.**

EPA 522, EPA 537.1.

Non-Potable Water

EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.

EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.

EPA 245.1 Hg.

SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

Appendix C:

Warner's Pond Dam Inspection Report

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Appendix D:

Warner's Pond Dam Removal Hydrologic, Hydraulic, and Sediment Transport Analysis

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WARNER'S POND DAM REMOVAL HYDROLOGIC, HYDRAULIC, AND SEDIMENT TRANSPORT ANALYSES

**Warner's Pond Dam
Town of Concord, Middlesex County, Massachusetts**

July 31, 2024

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Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

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APPENDICES

- Appendix A. Supporting Data and Calculations
- Appendix B. Inundation Maps
- Appendix C. HEC-RAS Results
- Appendix D. Sediment Core Analysis

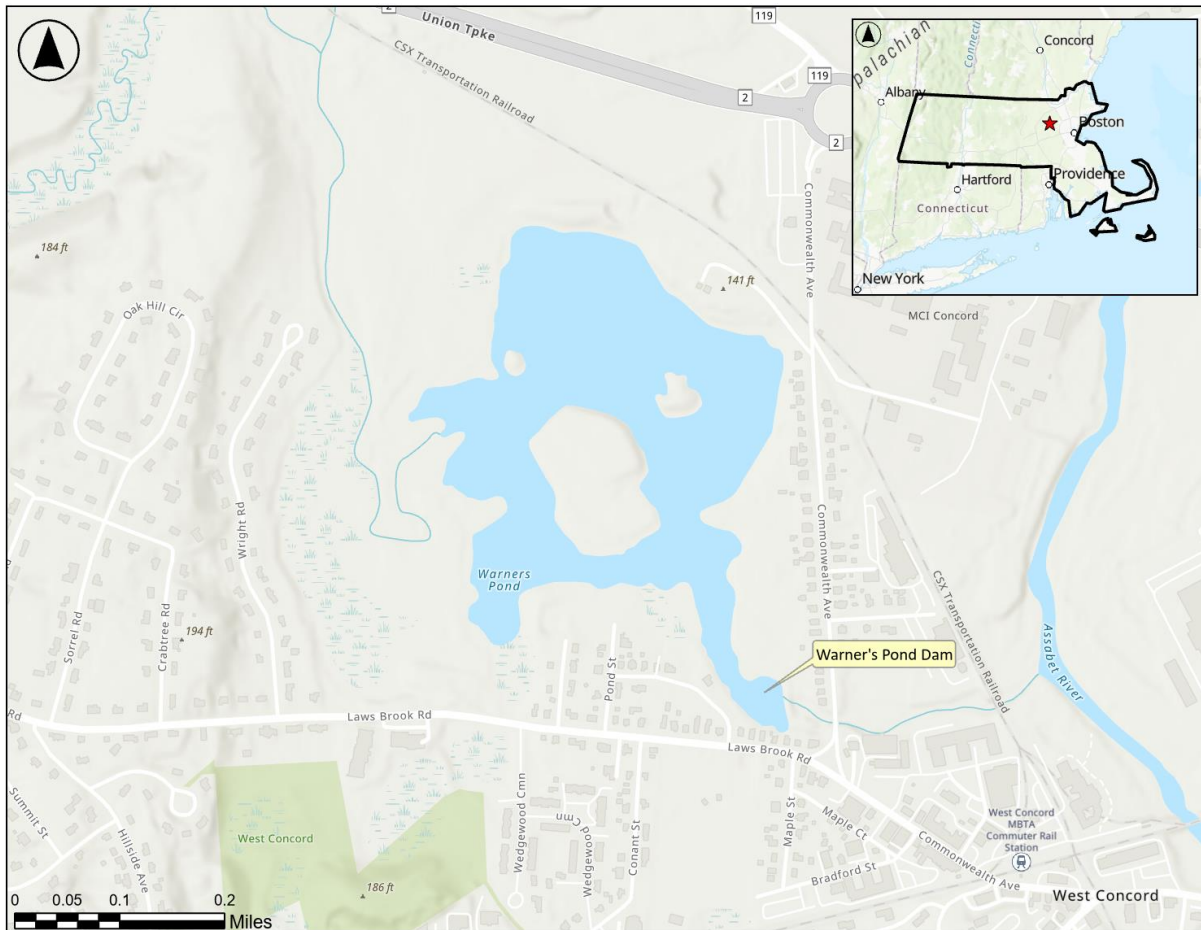
Warner's Pond Dam Removal Hydrologic, Hydraulic, and Sediment Transport Analyses

1.0 BACKGROUND

Aterra Solutions, LLC (Aterra) entered into contract with EA Engineering, Science, and Technology, Inc., PBC (EA) to provide support with Task 3: Hydrologic and Hydraulic (H&H) Modeling and Task 4a: Sediment Transport Modeling for the Warner's Pond Dam Removal Preliminary Design. The evaluation was performed for existing and post-removal conditions of Warner's Pond Dam to characterize potential downstream changes resulting from the dam removal. This report summarizes the methods, assumptions, results, and findings from the analyses.

Warner's Pond, located in Concord Township, Middlesex County, MA (42.458935, -71.397464), is impounded by a 9-foot high and 320-foot long earthen dam across Nashoba Brook, which is a tributary to the Assabet River. See Figure 1 and Figure 2. The dam's spillway system consists of a 40.2-foot long stone masonry weir that serves as the primary spillway, a concrete auxiliary (secondary) spillway with a rectangular section (18-foot bottom width), a 5-foot wide stop log controlled rectangular sluiceway channel located to the left of the primary spillway, and a gate valve controlled 24-inch diameter low level outlet pipe.

Figure 1: Topographic Location Map



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure 2: Aerial Imagery Location Map



The contributing drainage area is approximately 47 square miles. The dam impounds approximately 195 acre-feet at normal pool and approximately 483 acre-feet at the top of dam, estimated from a stage-storage curve generated using terrain data comprised of a 2022 bathymetric survey (EA Engineering, Science, and Technology, Inc., PBC, 2023), 2023 dam survey (SGC ENGINEERING, LLC, 2023), and LiDAR. The stage-storage curve is shown in Figure 3.

Additional project information, including elevations and reservoir storage, is shown in Table 1. The features and elevations presented herein are based upon a 2023 survey conducted by SGC Engineering, LLC.

Figure 3: Warner’s Pond Stage-Storage Curve

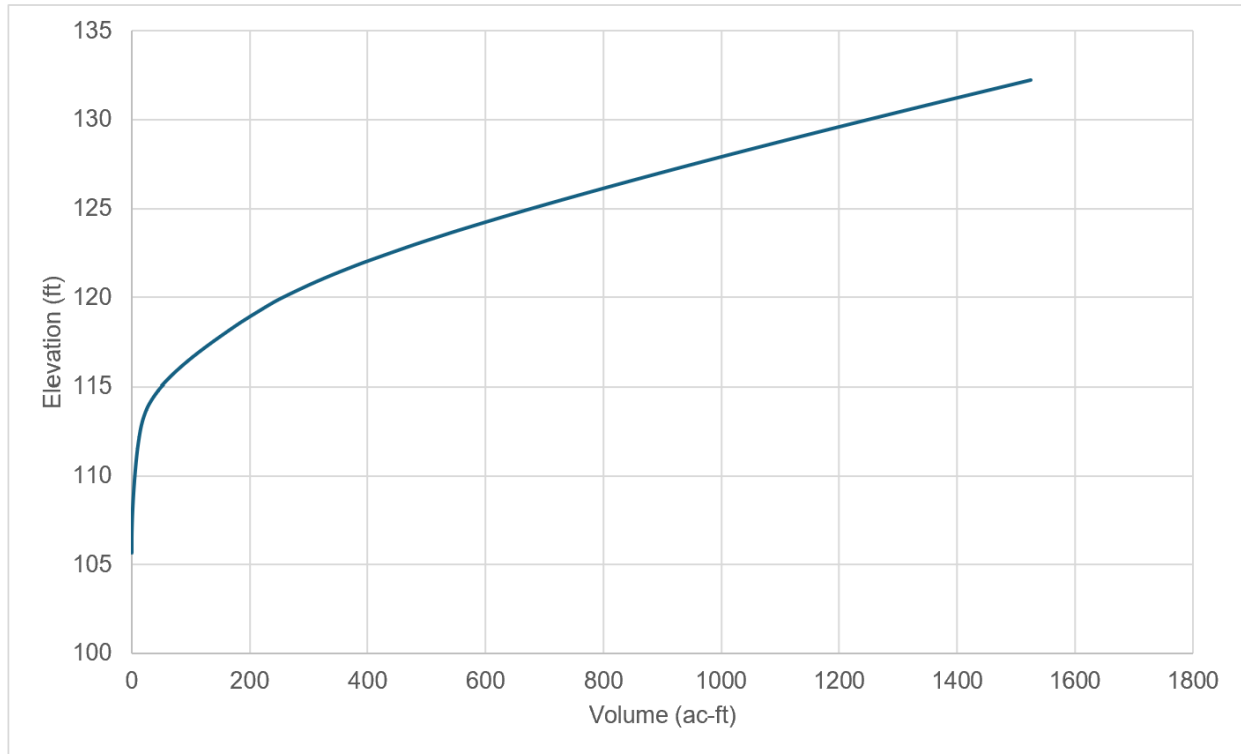


Table 1: Existing Project Information

Parameter	Value
Total Drainage Area (mi ²)	47
Dam Height (ft)	9
Dam Length (ft)	320
Normal Pool Elevation (ft)	118.8
Primary Spillway Crest Elevation (ft)	118.8
Auxiliary Spillway Crest Elevation (ft)	118.6
Top of Dam Elevation (ft)	123
Normal Pool Storage (ac-ft)	195
Top of Dam Storage (ac-ft)	483

Descriptive nomenclature for dams is based upon one looking downstream in the direction of flow. The terms “right” and “left” are used herein accordingly. The reservoir side of the embankment is known as the upstream side with the opposite side referred to as the downstream side. Unless otherwise noted, the elevation (EL) values presented in this report are in the units of feet and reference the North American Vertical Datum of 1988 (NAVD88).

2.0 HYDROLOGIC MODELING

The initial step in completing the evaluation of the effects of Warner’s Pond Dam removal is the development of the hydrologic model to simulate watershed runoff and flow response (i.e., flood hydrographs) for several flood frequency storms. The U.S. Army Corps of Engineers (USACE) HEC-HMS

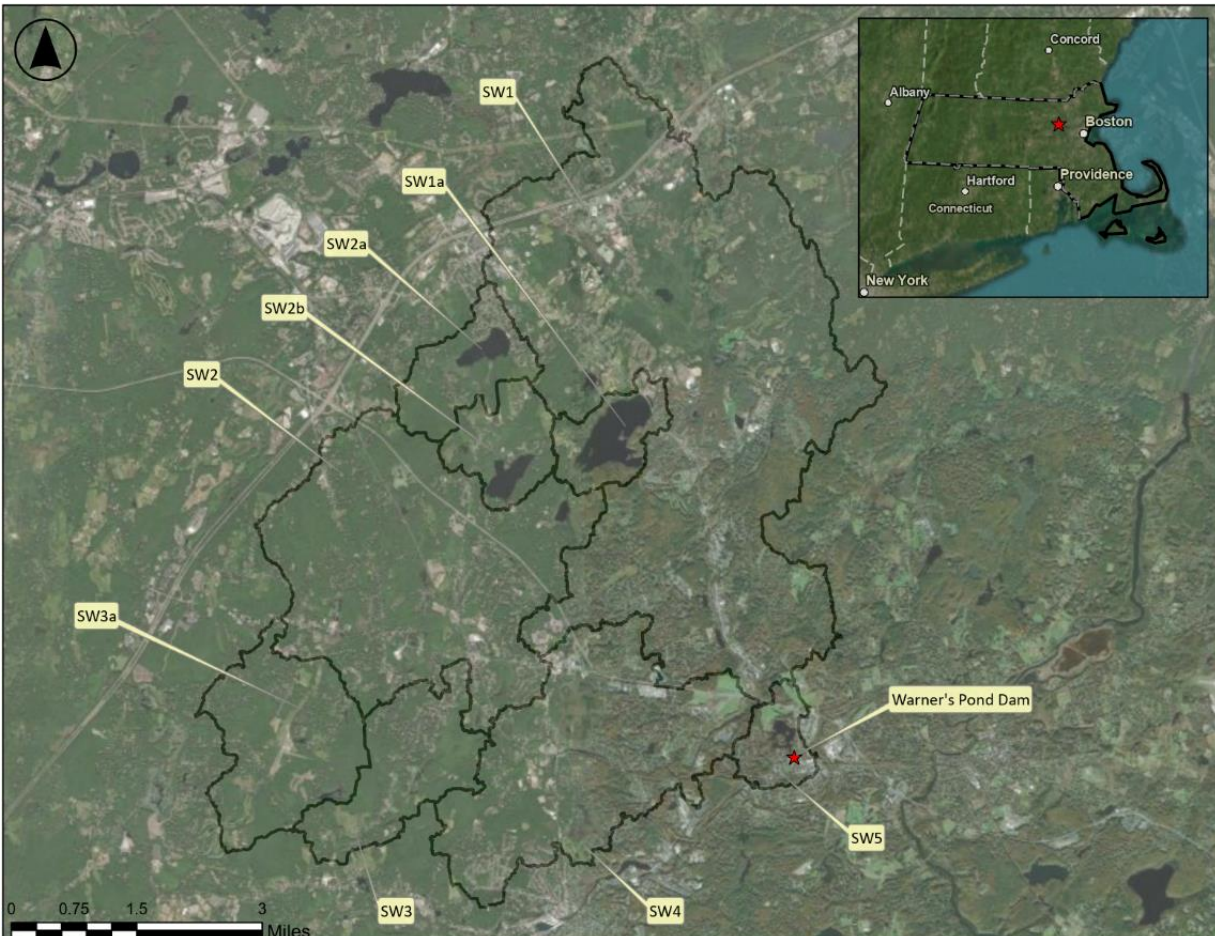
Warner's Pond Dam Removal Hydrologic, Hydraulic, and Sediment Transport Analyses

hydrologic modeling computer software (USACE, 2022) was used to complete the hydrologic analysis of the watershed. The HEC-HMS model domain covers the Fort Pond Brook and Nashoba Brook watersheds up to the confluence with Assabet River; a combined watershed area of approximately 47 square miles. The main components of the HEC-HMS model are described in the following sub-sections.

2.1 Overall Model Description

The 47-square-mile watershed was divided into nine sub-watersheds in the HEC-HMS model, as shown in Figure 4. The watershed boundaries were delineated using a DEM constructed from a combination of data from a 2022 bathymetric survey collected by EA, a topographic survey conducted by SGC Engineering, LLC (2023), and 1-meter resolution LiDAR obtained from the USGS National Map Viewer (USGS, 2020). Sub-dividing the watershed provides a semi-distributed approach to the simulation, accounting for variability in soil types and lag times, and hydrographs at distinct inflow points for the hydraulic model (discussed further below). Dynamic routing through the Warner's Pond Dam is performed in the hydraulic model for improved accuracy, with the HEC-HMS model providing the inflow hydrographs. See Appendix A for additional information for the development of the hydrologic parameters (land cover map, soils map, etc.).

Figure 4: Sub-watershed Map



2.2 Rainfall

Precipitation scenarios include the frequency-based flood routings for the 2-, 5-, 25-, 100-, and 500-year 24-hour flood events for the existing and post-removal conditions. The frequency storms were also

**Warner’s Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses**

evaluated in the HEC-HMS model, entered as a “frequency-storm” distribution. The associated rainfall values obtained using NOAA Atlas 14 (NOAA, 2017), are provided in Table 2.

Table 2. 24-hour Frequency Storm Rainfall Depths

Parameter	Warner’s Pond Watershed
2-year	3.23
5-year	4.21
25-year	6.14
100-year	7.87
500-year	10.7

2.3 Runoff

The SCS curve number (CN) method was used to estimate the runoff volume (rainfall minus losses due to infiltration and retention) in the HEC-HMS model. CNs were derived from National Engineering Handbook (NEH), Part 630, Chapter 10 (USDA-NRCS, 2004) based on cover type, hydrologic conditions, and hydrologic soil groups (HSGs), obtained from the following sources.

- National Land Cover Database (MRLC Consortium, 2019)
- Soil Survey Geographic database (SSURGO) using the NRCS Web Soil Survey (USDA-NRCS, 2021).

Land cover in the watershed is primarily forested with open water and developed spaces. The sub-watershed characteristics, including drainage area and CN values, are presented in Table 3. The CN values represent average soil moisture conditions, defined as Antecedent Runoff Condition (ARC) I in NEH, Part 630, Chapter 10 (USDA-NRCS, 2004). ARC I was used in this analysis to capture retention in ponds and reservoirs upstream of Warner’s Pond, which were not modeled individually, resulting in average sub-basin CNs between 57 and 72. In addition, sub-basins with larger reservoirs were sub-divided further with the reservoirs located at outlet from the sub-basin (SW1a, SW2a, SW2b, SW3a). Stage-storage and stage-discharge curves for the reservoirs were estimated using HEC-RAS 2D storage tools in RAS Mapper. The stage-storage for each reservoir was estimated by using a combination of online resources (such as the National Inventory of Dams) and LiDAR. In addition, a supplementary HEC-RAS geometry was created to include the domain of the 47-mi² watershed to evaluate how water enters and exits the reservoirs. Constant inflow was assigned to boundary conditions placed across the watershed to fill the domain with water. After estimating the stage and location at which water will exit or overtop each reservoir, a stage-discharge curve was obtained from HEC-RAS. The curves were then added in the HEC-HMS model to capture potential water retention. Note that these curves were developed based on estimates and only for larger reservoirs.

Table 3. Sub-Watershed Characteristics

Sub-Watershed ID	Drainage Area (mi ²)	ARC I Curve Number (rounded to nearest integer)
SW1	19.7	59
SW1a	1.2	72
SW2	9.3	61
SW2a	1.6	68
SW2b	1.4	69
SW3	2.5	61
SW3a	3.4	61

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Sub-Watershed ID	Drainage Area (mi ²)	ARC I Curve Number (rounded to nearest integer)
SW4	6.7	61
SW5	0.8	57
	Total = 46.6	Weighted Average = 61

2.4 Runoff Transformation

The SCS Dimensionless Unit Hydrograph method (USDA-NRCS, 2007) was used to transform runoff volumes to flow hydrographs. This method consists of parameters such as rainfall duration (D), time-to-peak (T_p), time-of-recede (T_r) and peak flow (q_p). The dimensionless hydrograph is scaled by Lag Time (L) and the Peak Flow (q_p) to produce the basic shape of the unit hydrograph. As described in NEH, Part 630, Chapter 15 (USDA-NRCS, 2010), lag time is the delay between the peak rainfall (that generates runoff) and the resulting peak flow rate at the watershed outlet. Lag time can be calculated using various approaches, including the SCS lag time equation described in Section 630.1502, Equation 15-4a, NEH, Part 630, Chapter 15 (USDA-NRCS, 2010) or 0.6 times the time of concentration (Equation 15-3 NEH-630 Chapter 15). The SCS lag time equation is applicable for watersheds ranging in size from 1.3 acres up to 16,000 acres (25 square miles). The SCS lag time equation was applied to each sub-watershed. The resulting lag times range between 60 and 345 minutes. See Table 4.

Table 4. SCS Dimensionless Unite Hydrograph Parameters

Sub-Watershed ID	Longest Flow Length (mi)	Average Slope (%)	ARC I Lag Time (minutes)
SW1	12.4	7.8	344.6
SW1a	2.1	5.7	68.2
SW2	7.8	7.6	230.2
SW2a	2.8	7.4	84.7
SW2b	1.9	7.7	59.7
SW3	3.7	7.3	122.0
SW3a	3.6	7.6	128.6
SW4	7.3	7.3	220.3
SW5	2.2	6.2	102.7

3.0 HYDRAULIC MODELING

3.1 Model Development

The USACE HEC-RAS computer program (USACE, 2023) was used to complete the hydraulic analysis of the dam, spillway system, and downstream area., The model was developed as a two-dimensional (2D) unsteady-flow model to better account for spatial variability in the terrain and surface roughness, along with improved stability.

The DEM developed for the hydrologic model in Section 2.0 was used as the terrain for the HEC-RAS model. The model domain includes Warner's Pond and Nashoba Brook to below the confluence with the Assabet River. The downstream boundary of model domain occurs where the Assabet River passes under the Concord Turnpike. The 2D flow area mesh consists of 100-ft by 100-ft grids with 50-ft by 50-ft refinement areas along the Assabet River and 25-ft by 25-ft refinement areas in Warner's Pond and

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Nashoba Brook. The internal SA/2D connections have refinement regions of 5-ft by 5-ft cells. Internal connections incorporated into the model include Warner's Pond Dam, its principal and auxiliary spillways, 1 upstream culvert, and 3 downstream bridges. The culvert upstream of Warner's Pond is located under the Union Turnpike and its dimensions were estimated from LiDAR. Bridge dimensions were obtained from a field visit conducted by EA in 2023, supplemented with LiDAR.

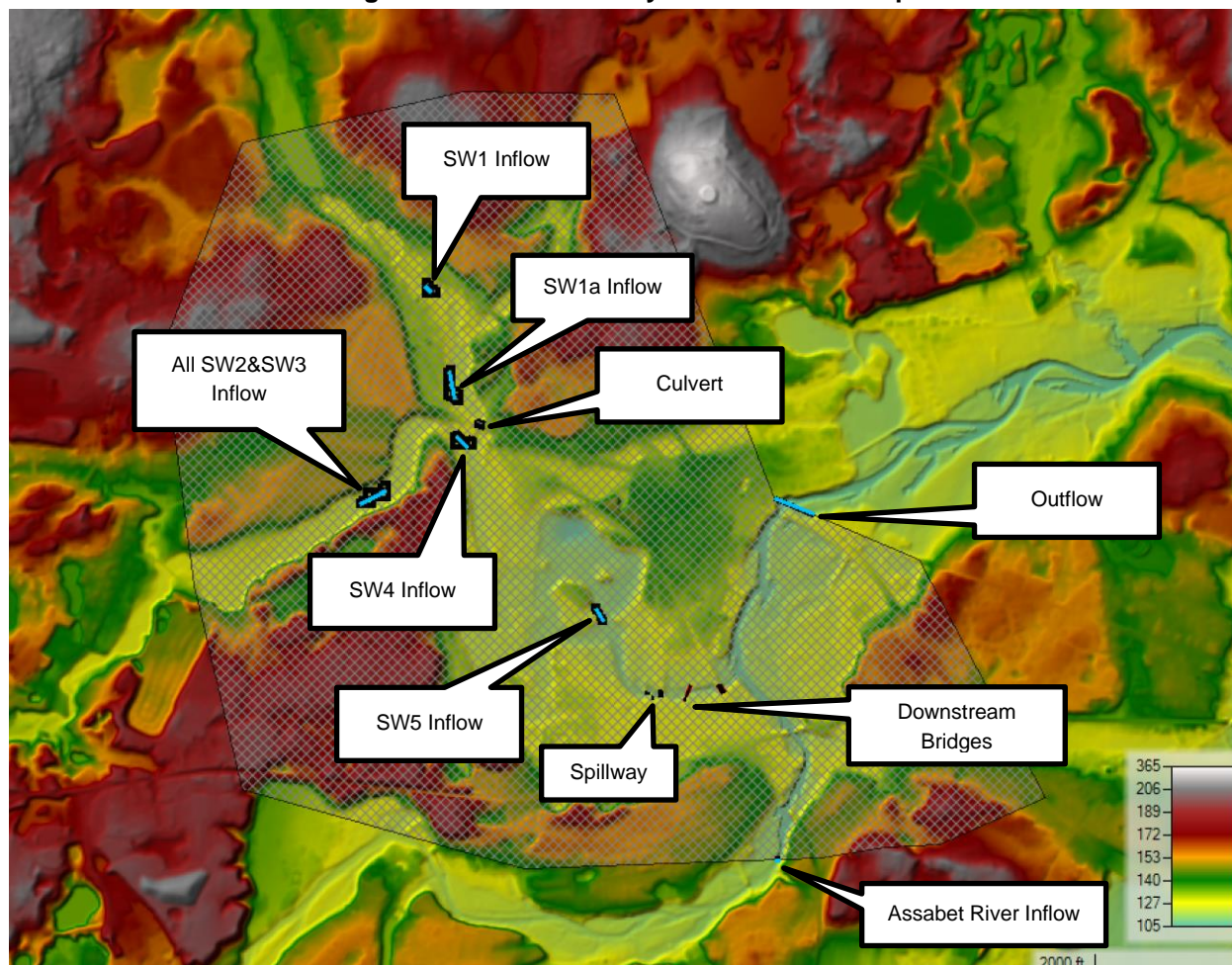
Manning's n-values for the 2D model were derived using guidance developed by NRCS (NRCS-Kansas, 2016) and estimates based on site photos obtained during the survey. The land cover data used as the basis for n-value estimation was a high resolution (1-meter resolution data) data set obtained from NOAA (NOAA, 2024). Additionally, Manning's n-value modifications were assigned to Warner's Pond and stream channels using data from Chow's hydraulics textbook (Chow, 1959) and comparison photos from verified roughness characteristics of natural channels (USGS, n.d.). Table 5 provides Manning's n-values for the corresponding land cover types.

Table 5: Land Cover and Assigned Manning's n-values

Land Cover Type	Manning's n-value
Developed - High Intensity	0.15
Palustrine Forested Wetland	0.12
Deciduous Forest	0.16
Developed - Open Space	0.04
Palustrine Emergent Wetland	0.07
Open Water	0.04
Evergreen Forest	0.16
Palustrine Aquatic Bed	0.45
Grassland-Herbaceous	0.035
Scrub-Shrub	0.1
Barren Land	0.025
Palustrine Scrub-Shrub Wetland	0.1
Pasture-Hay	0.03
Cultivated Crops	0.035
Estuarine Emergent Wetland	0.07
Refinement Regions	0.04 – 0.045

For each flood frequency scenario, the controlling inflow hydrographs to Warner's Pond were dynamically linked with the HEC-HMS model. For the Assabet River, the 2-year flow (which approximately represents bank-full conditions), obtained from the StreamStats web-based application tool (USGS, n.d.), was added upstream of the confluence of Nashoba Brook to account for additional downstream tributary inflow. A channel modification was added to the LiDAR for the Assabet River since bathymetry data was not available. The model time step was controlled by a courant condition and run with a variable computational interval ranging from 2 seconds to 0.5 seconds using the full momentum (St. Venant) equations. See Figure 5 for the HEC-RAS 2D hydraulic model setup.

Figure 5: HEC-RAS 2D Hydraulic Model Setup



3.2 Model Validation

A rain event that occurred between 5:00 PM EST on December 17th, 2023, and 5:00 PM EST on December 18th, 2023, was used to validate the hydraulic model. Precipitation data recorded at stations throughout each sub-watershed was obtained from Weather Underground (Wunderground.com, 2024). Note that rainfall data for this region with the same temporal resolution was not available from other sources. The average cumulative rainfall recorded from each station in the watershed is shown in Figure 6. EA also provided a field photo of the reservoir levels at the spillway (timestamped December 19th, 2023, at 10:45 AM EST), which was used as a rough reference point for model validation (Figure 7). The initial model runs indicated that the inflow hydrograph was peaking early, and the runoff volume was higher than expected. Therefore, the peaking factor in was adjusted from 484 (default) to 200 (rural, with slight slopes). The peaking factor essentially controls the volume of water on the rising and recession limbs and a lower peaking factor can account for a delayed, lowered peak in the hydrograph (NOHRSC, 2024). Additional sub-watersheds were also modeled to consider retention taking place in ponds and reservoirs in the sub-watersheds upstream of Warner's Pond (SW1a, SW2a, SW2b, and SW3a).

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Figure 6: Cumulative Rainfall in each sub-watershed for December 17th, 2023, to December 18th, 2023

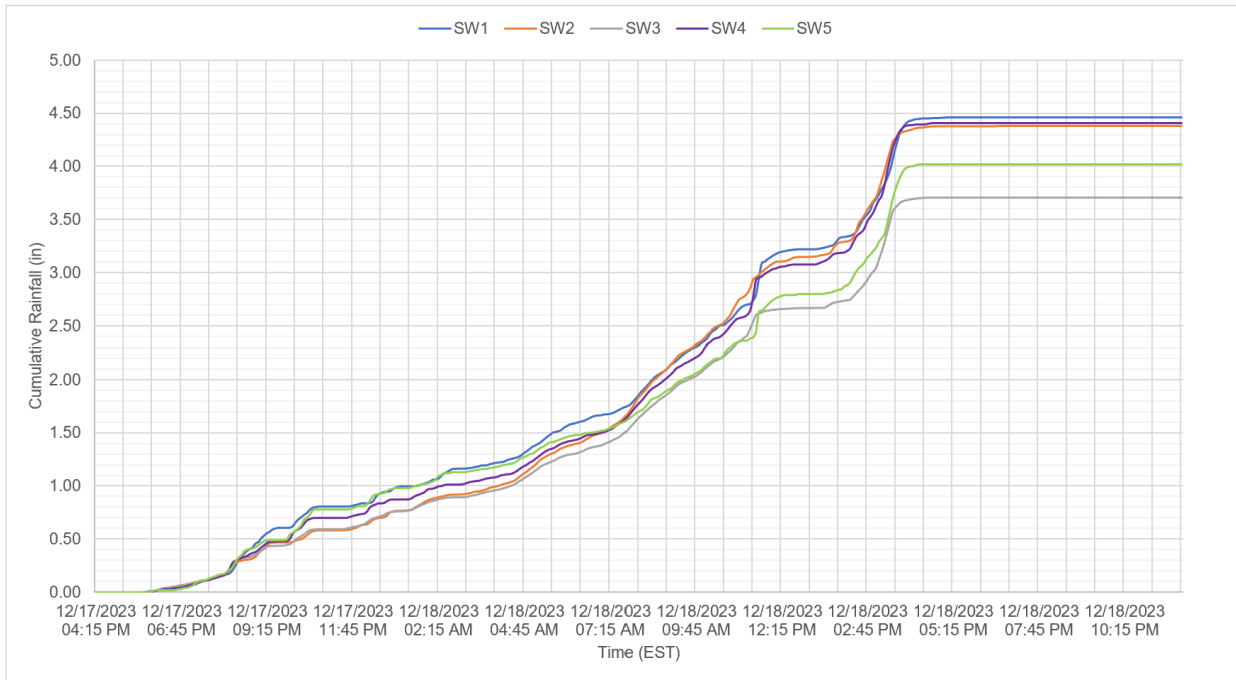


Figure 7: Warner's Pond Stage (Photo time-stamped December 19th, 2023, 10:45 AM EST)



Warner's Pond Dam Removal Hydrologic, Hydraulic, and Sediment Transport Analyses

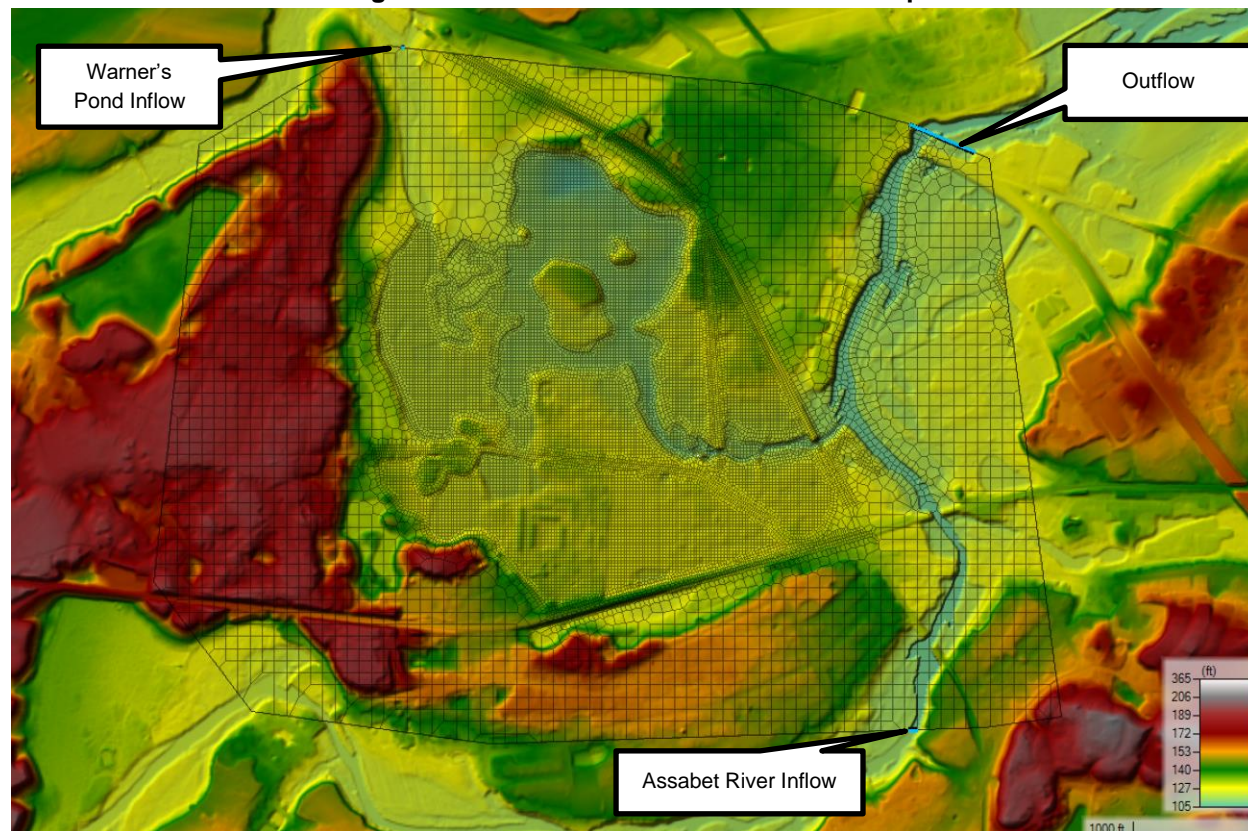
The auxiliary spillway concrete elevation is EL 121.2 and was used as a reference point in Figure 7 since the water surface elevation at the time of the photo is unknown. During the validation simulation, the WSE downstream of the auxiliary spillway ranged from EL 119.6 to EL 117.5 .

4.0 SEDIMENT TRANSPORT MODELING

The evaluation of the effects of Warner's Pond Dam removal on sediment was conducted using sediment transport modeling techniques built into HEC-RAS. The HEC-RAS hydraulic model, discussed in Section 3.0, was modified slightly to simulate sediment transport through the project reach. Flow scenarios included the bank-full discharge (obtained from USGS StreamStats), 10% of the bank-full discharge (to represent an estimated baseflow), and the 2-year and 5-year 24-hour frequency storms. See Figure 8 for the HEC-RAS sediment model setup. The main modifications of the HEC-RAS model are described below:

- The SA/2D connections were removed.
- For existing conditions, a non-erodible surface was added at the location of the primary and auxiliary spillway.
- The internal inflow boundary conditions were removed and inflow into Warner's Pond was represented with a singular external inflow boundary condition.
- The upstream mesh domain was adjusted to coincide with the start of Warner's Pond sub-watershed (SW5).

Figure 8: HEC-RAS 2D Sediment Model Setup



Sediment core samples from Warner's Pond were collected by EA in November 2023 and lab tested by Geotesting Express. See Figure 9 for the core sample locations and Appendix D for the lab test results, including grain size distributions. The grain size distributions are used to define the bed material in the

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model. Assumptions were made to define the bed material where sediment samples were not available. The channel upstream of Warner's Pond was grouped with Sediment Core 4 and the channel downstream of the spillway was grouped with Sediment Core 5. The Assabet river was assumed to comprise primarily of silt sediment. See Figure 10 for sediment bed material groupings.

Two methods were used to qualitative analyze the effects of dam removal on sediment transport patterns. A capacity only method which utilizes a fixed bed in the sediment model. During the capacity only analysis, only the sediment transport capacity is calculated for all grain classes and does not solve the transport, bed sorting, and bed layering equations (USACE, 2021). A capacity only analysis was conducted for the existing and post removal conditions and compared to identify areas potentially susceptible to erosion or deposition. A mobile bed analysis was also conducted for the post removal scenario. The mobile bed analysis does solve the transport, bed sorting, and bed layering equations and can estimate changes in the bed elevation. An equilibrium load sediment boundary condition was assigned to both the Warner's Pond and Assabet River external flow boundary locations for the capacity only scenarios. The equilibrium load boundary condition assumes the inflow sediment load equals sediment transport capacity and a zero-gradient concentration normal to the boundary. An inflow sediment load rating curve was used as the boundary conditions for the mobile bed scenarios. The rating curve specifies the sediment load in tons/day entering through the boundary as a function of discharge. The rating curve was estimated using the Rating Curve Calculator in the Hydraulic Desing Functions tool in HEC-RAS. The tool imports data from USGS gauges and The Assabet at Maynard, MA gauge (#01097000) was used to estimate the sediment inflow rating curve for the mobile bed analysis. See Figure 11. Given the uncertainties associated with using equilibrium load and a rating curve at the upstream boundary condition, the boundary was established upstream of the reservoir pool to limit its effect on the reach of interest.

Figure 9: Sediment Core Sample Locations

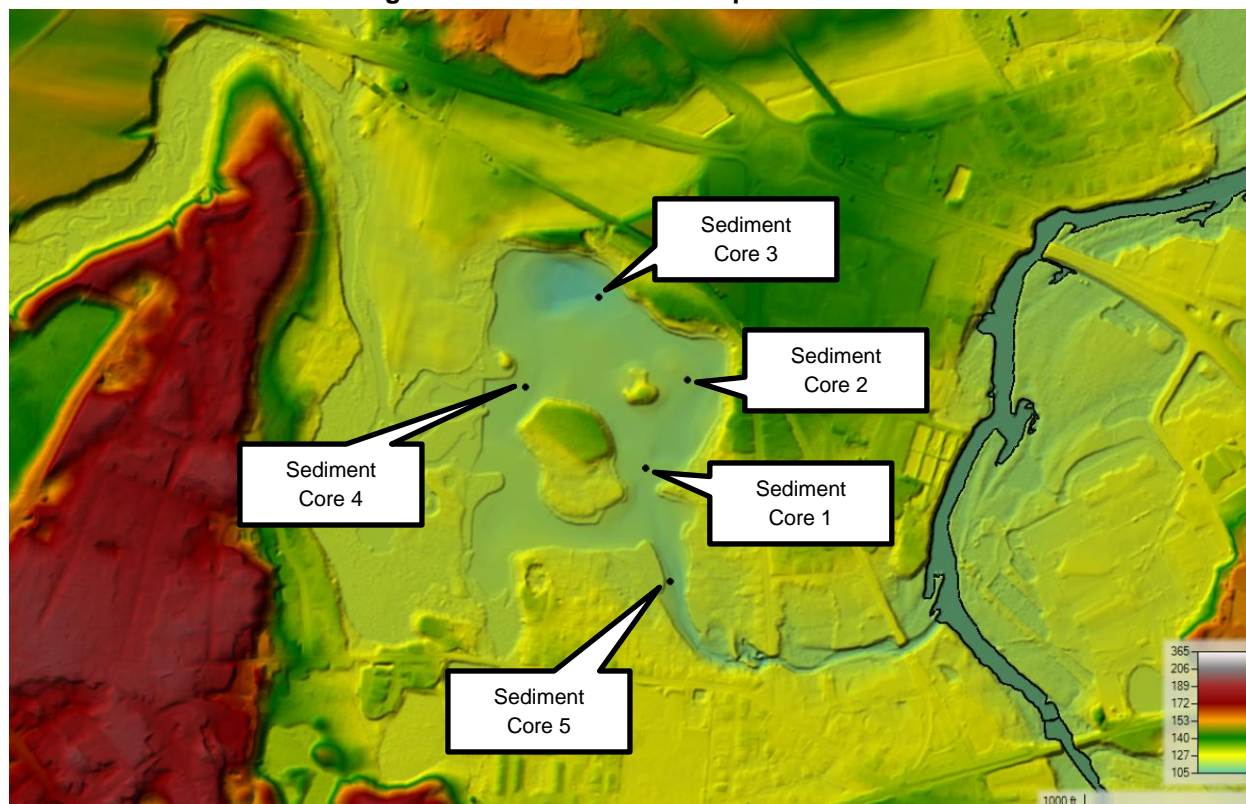


Figure 10: Sediment Bed Material Layer Groupings

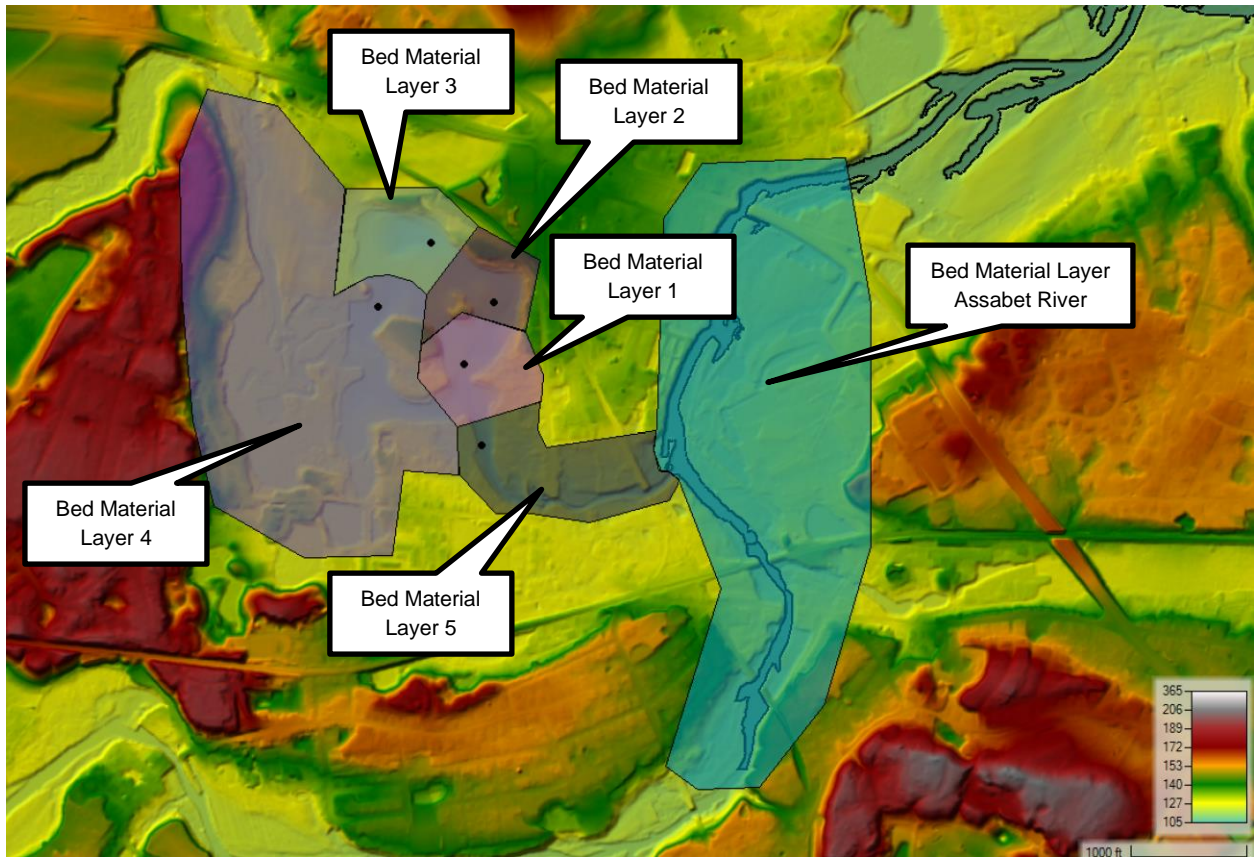
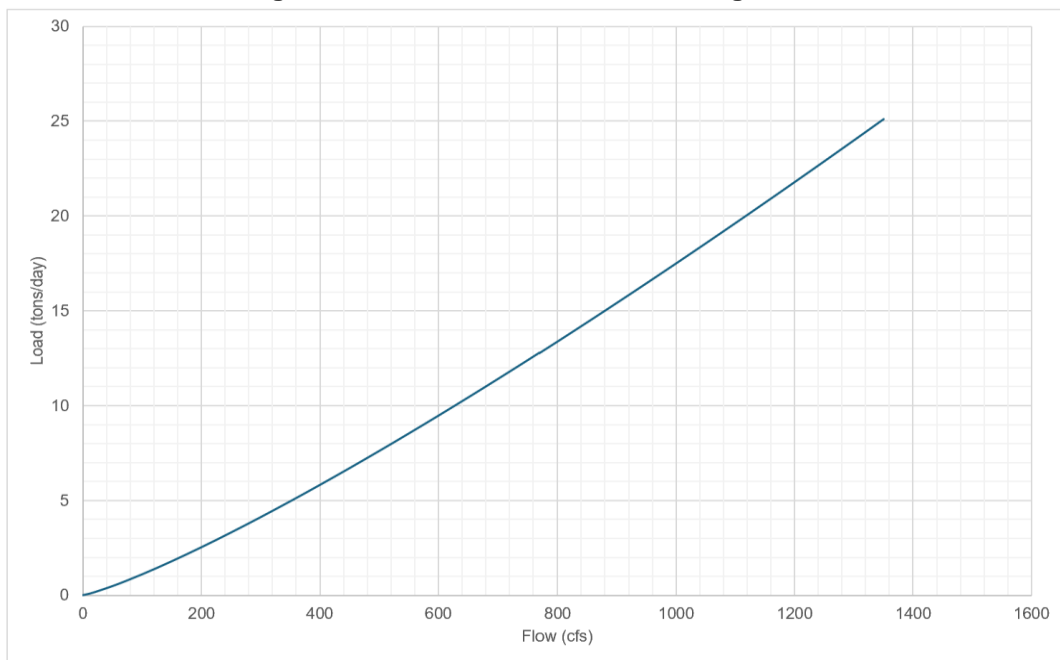


Figure 11. Inflow Sediment Load Rating Curve



5.0 DAM REMOVAL ANALYSIS RESULTS

Two georeferenced raster files of the proposed post dam removal grading for Warner's Pond were provided by EA. One file included the proposed surface of the berm and the main spillway and the other file included the proposed surface of the auxiliary spillway. These raster files were combined with the existing conditions DEM to develop a post dam removal DEM. Water Surface Elevations (WSEL) at selected locations for the existing and post removal conditions for each flood recurrence interval are presented in Table 6 and Table 7, respectively. The results show that the removal of the dam has a minimal effect on downstream WSEL. Inundation maps for each flood recurrence interval are provided in Appendix B. WSEL at a profile through the principal spillway and various cross sections near the dam location (for the post removal scenario) are provided in Appendix C.

Table 6. Inundation Analysis WSEL Results for Existing Conditions

Structure	Approximate Top Elevation (ft NAVD88)	Peak WSEL (ft NAVD88) for selected flood recurrence intervals					
		53 cfs	2-yr	5-yr	25-yr	100-yr	500-yr
Reservoir	N/A	119.2	120.8	122.2	125.4	127.4	129.5
Commonwealth Avenue Bridge	129.2	114.6	118.3	120.6	124.7	126.7	129.2
Arched Timber Pedestrian Bridge	127.9	113.6	116.7	118.8	121.8	124.3	128.3
Bruce Freeman Rail Trail Bridge	127.0	112.9	115.0	116.6	118.8	120.7	125.6

Table 7. Inundation Analysis WSEL Results for Post Removal Conditions

Structure	Approximate Top Elevation (ft NAVD88)	Peak WSEL (ft NAVD88) for selected flood recurrence intervals					
		53 cfs	2-yr	5-yr	25-yr	100-yr	500-yr
Reservoir	N/A	115.0	118.5	120.8	125.0	127.3	129.5
Commonwealth Avenue Bridge	129.2	114.9	118.3	120.4	124.4	126.6	129.2
Arched Timber Pedestrian Bridge	127.9	113.9	116.7	118.6	121.6	124.3	128.3
Bruce Freeman Rail Trail Bridge	127.0	113.0	115.1	116.6	118.8	121.1	125.8

6.0 SEDIMENT TRANSPORT ANALYSIS RESULTS

The sediment transport model results were evaluated to understand two issues related to the dam removal: 1) the stream bed's initial response to removing the dam under normal or sunny day conditions, and 2) a comparison of sediment transport patterns during a hypothetical high flow event (pre- and post-removal). For the initial sunny day response, steady-state baseflow (53 cfs) and bank-full flow (533 cfs) values were modeled for existing and post dam removal conditions using the capacity only and mobile bed methods. The capacity only method provides a total transport capacity flux for existing and post dam removal conditions. Figure 12 and Figure 13 show comparison maps directly upstream and downstream of the spillway for baseflow and bank-full flow conditions, respectively. The difference between existing and post dam removal conditions were calculated, with blue areas indicating a decrease in transport capacity and red areas indicating an increase in transport capacity with the dam removed. Transport

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capacity represents the hydraulic capacity of the stream system, given the grain size distribution, to transport sediment, which was used to identify areas of potential erosion and deposition shortly after the dam is removed. An increase in transport capacity indicates a potential for erosion, while a decrease in transport capacity indicates a potential for deposition. Figure 14 and Figure 15 also show the potential change in bed elevation from the mobile bed simulation for the baseflow and bank-full flow conditions, respectively. The red areas indicate a lower bed elevation (erosion) while the blue areas indicate a higher bed elevation (deposition).

The capacity only and mobile bed analysis for the baseflow and bank-full conditions show that an incised channel is expected to start forming approximately 500 to over 800 feet upstream of the dam, respectively. Downstream of the dam, simulations for both conditions show that sediment will be transported through the downstream channel and past its confluence with the Assabet River, with isolated areas of deposition. The mobile bed simulation shows an estimated drop in bed elevation upstream of the dam, post dam removal, of between 0 to 2 feet, with higher drops at the dam and near the Commonwealth Avenue Bridge.

Figure 12. Total Load Transport Capacity Difference During Baseflow



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Figure 13. Total Load Transport Capacity Difference During Bank-full Flow



Figure 14. Bed Change for Post Removal Conditions During Baseflow



Figure 15. Bed Change for Post Removal Conditions During Bank-full Flow



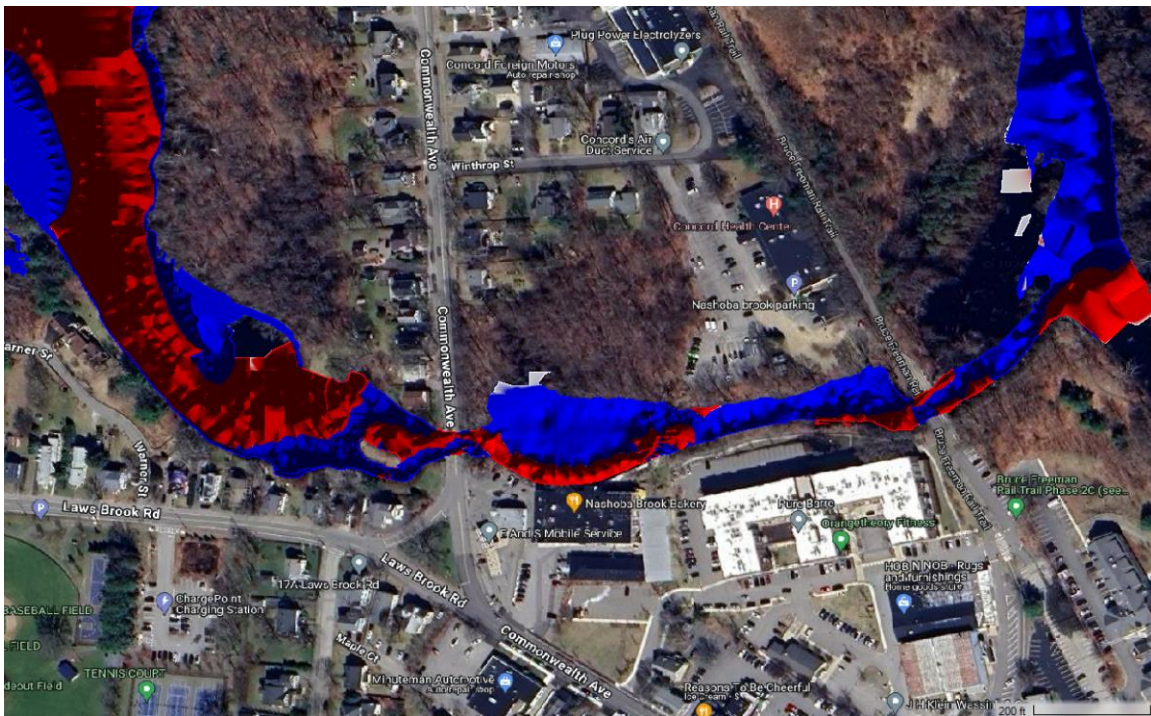
A capacity only analysis and mobile bed analysis was also conducted for the 2-yr and 5-yr 24-hr flood frequencies to observe the sediment response to removing the dam for hypothetical flood events. Figure 16 to Figure 18 show the total load transport capacity for the 2-yr 24-hr frequency flood during the rising limb, peak, and falling limb, respectively. While Figure 19 shows the potential change in bed elevation from the mobile bed simulation after the 2-yr 24-hr frequency flood. Figure 20 to Figure 22 show the total load transport capacity for the 5-yr 24-hr frequency flood during the rising limb, peak, and falling limb, respectively. While Figure 23 shows the potential change in bed elevation from the mobile bed simulation after the 5-yr 24-hr frequency flood. Both flood scenarios show sediment being transported through the main channel upstream and downstream of the dam until the peak of the storm passes, after which, sediment is expected to deposit downstream of the dam. The mobile bed simulations show an estimated drop in bed elevation upstream of the dam, post dam removal, of between 0 to 4 feet, with higher drops at the dam and near the Commonwealth Avenue Bridge. This pattern is also shown with the velocity and stream power maps for each scenario in Appendix C. The flood scenarios are intended to qualitatively show the effects of dam removal for hypothetical single storm events. The long-term net change in bed configuration cannot be defined since the real-time meteorological conditions cannot be predicted.

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Figure 16. Total Load Capacity Difference During 2yr-24hr Flood Frequency Rising Limb



Figure 17. Total Load Capacity Difference During 2yr-24hr Flood Frequency Peak



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Figure 18. Total Load Capacity Difference During 2-yr 24-hr Flood Frequency Falling Limb



Figure 19. Bed Change for Post Removal Conditions After 2-yr 24-hr Flood Frequency



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure 20. Total Load Capacity Difference During 5-yr 24-hr Flood Frequency Rising Limb



Figure 21. Total Load Capacity Difference During 5-yr 24-hr Flood Frequency Peak



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Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure 22. Total Load Capacity Difference During 5-yr 24-hr Flood Frequency Falling Limb



Figure 23. Bed Change for Post Removal Conditions After 5-yr 24-hr Flood Frequency



7.0 CONCLUSIONS

In the post dam removal conditions, the WSE in the reservoir can be expected to decrease from EL 119.2 to approximately EL 115.0 while the WSE downstream of spillway is not expected to change. The upstream effects of removing the dam are less noticeable as the flow increases. The difference in results upstream and downstream of the spillway during the 25yr, 100yr, and 500yr flood frequencies for the existing and post dam removal conditions are negligible. However, there is expected to be an effect on the sediment transport downstream of the spillway in the post dam removal conditions. By removing the dam embankment, a new path will form for water to flow through and can result in erosion occurring to form that path down to the confluence of the Assabet River.

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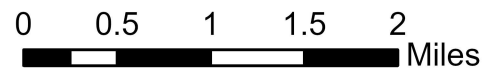
APPENDIX A

SUPPORTING DATA, CALCULATIONS, AND MAPS

Warner's Pond Dam
Concord, Middlesex County
Massachusetts

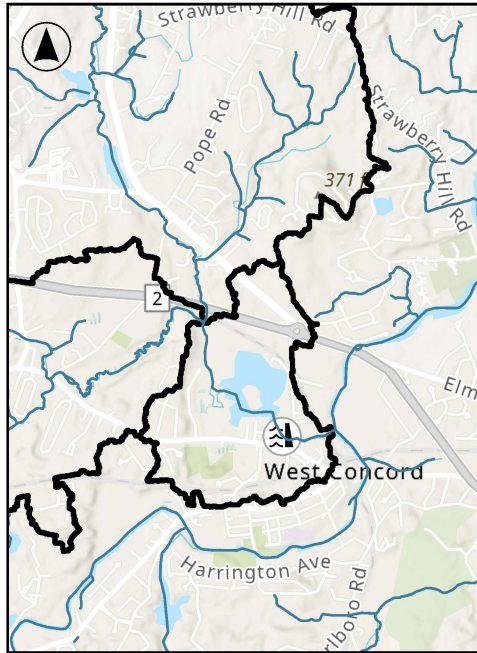
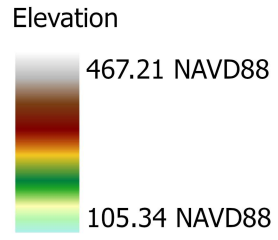


Elevation Map

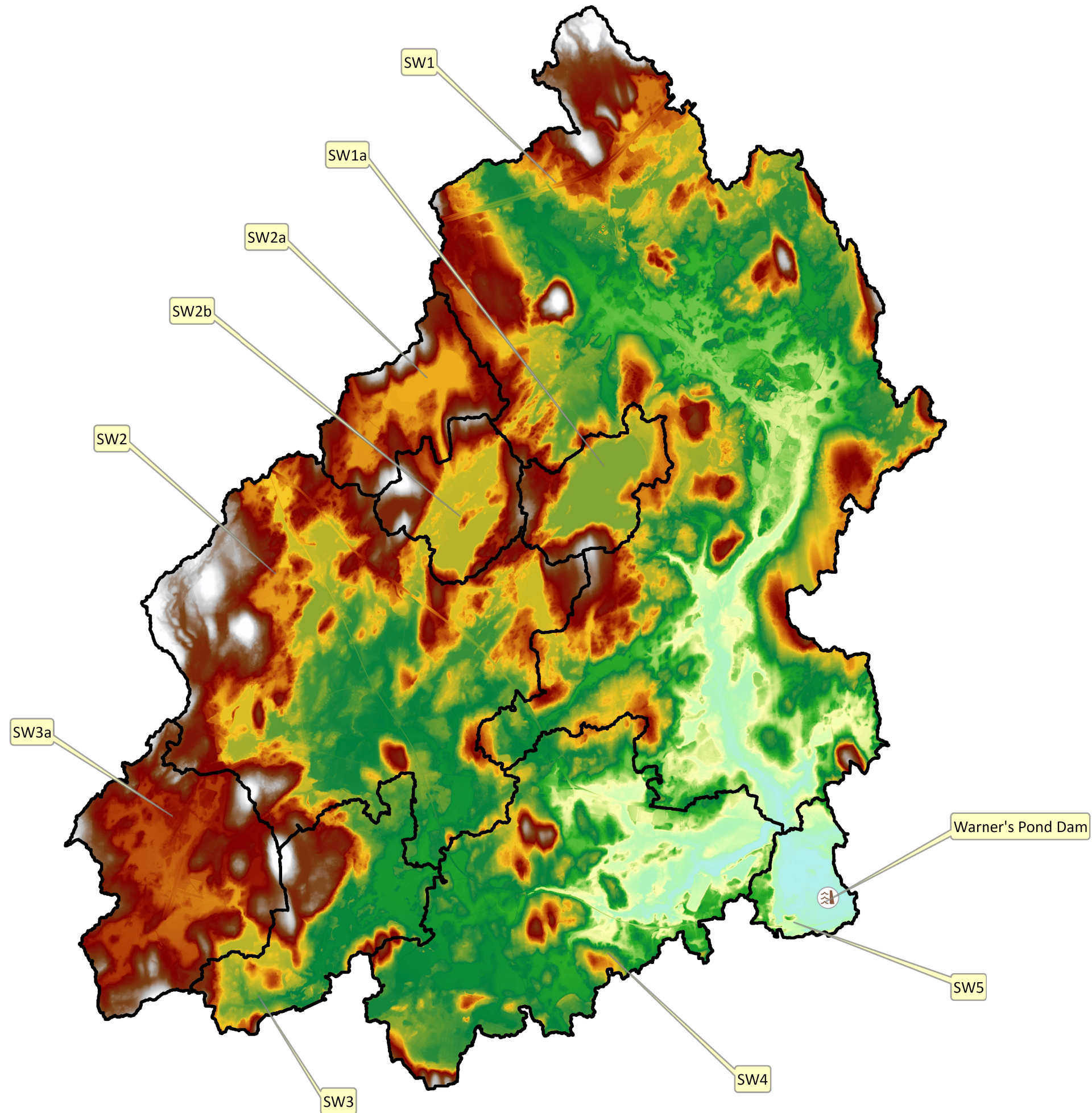


Legend

- Subwatershed
- Warner's Pond Dam



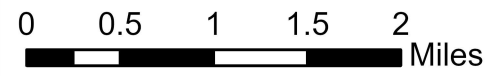
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Warner's Pond Dam
Concord, Middlesex County
Massachusetts



Hydrologic Soil Group Map



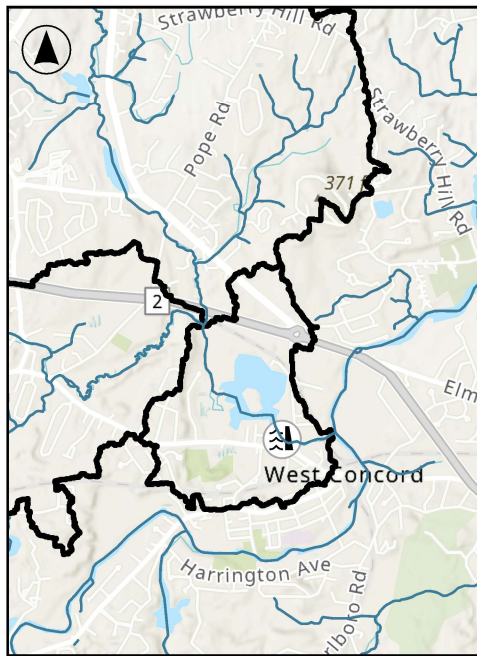
Legend

Subwatershed

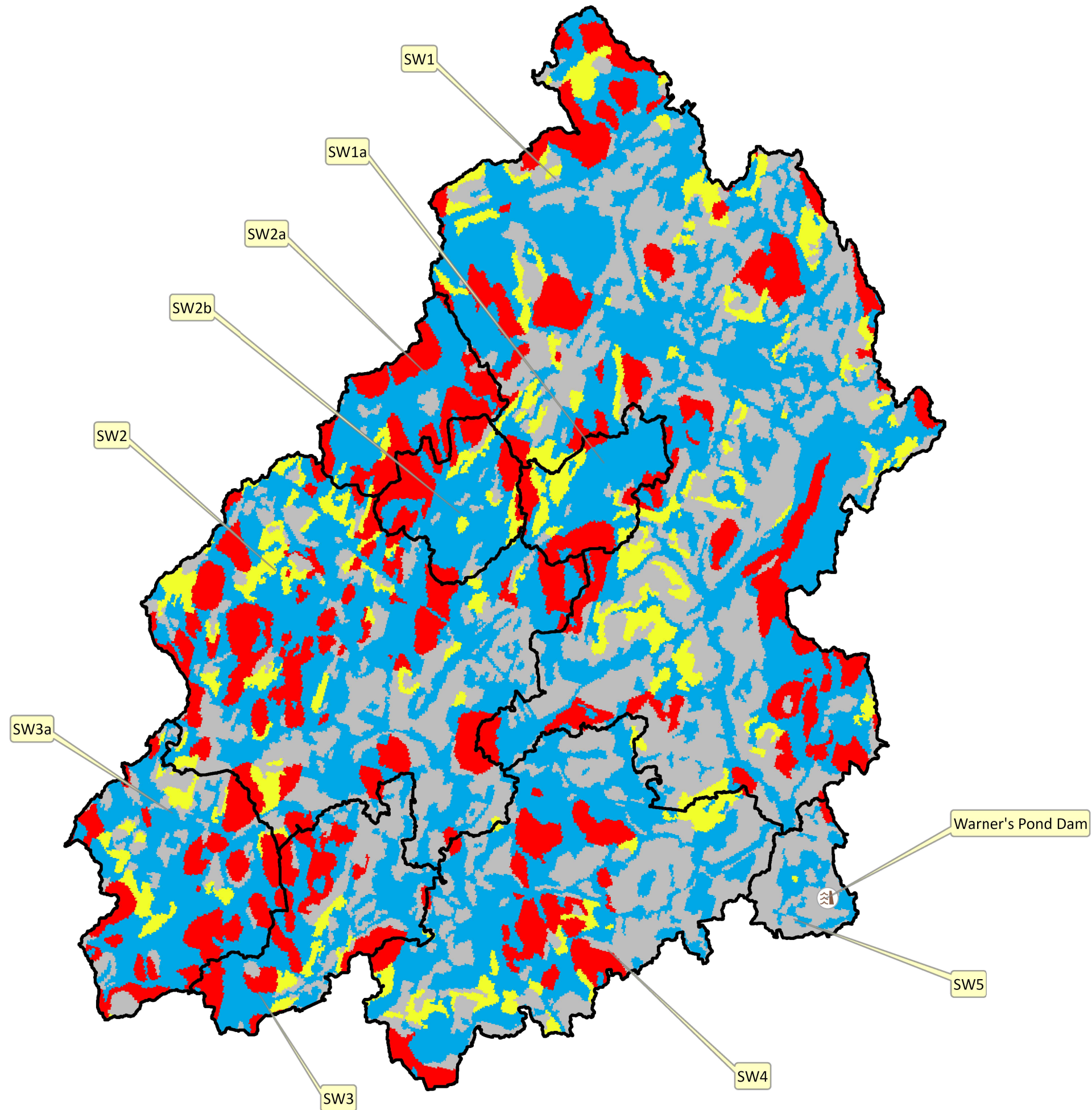
Warner's Pond Dam

HSG

- A
- B
- C
- D



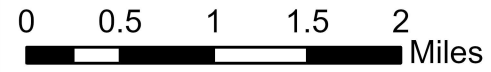
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Warner's Pond Dam
Concord, Middlesex County
Massachusetts

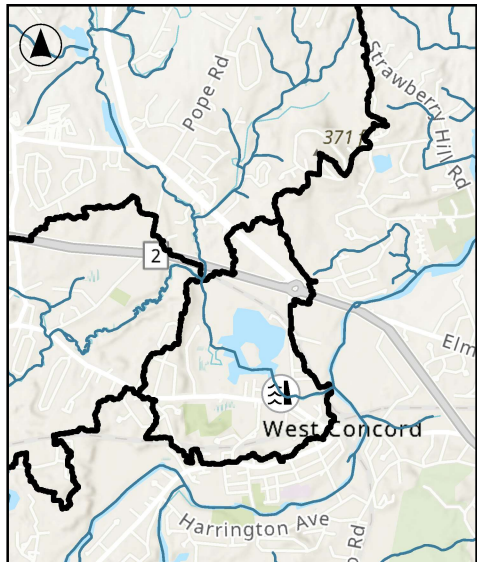


Land Cover Map

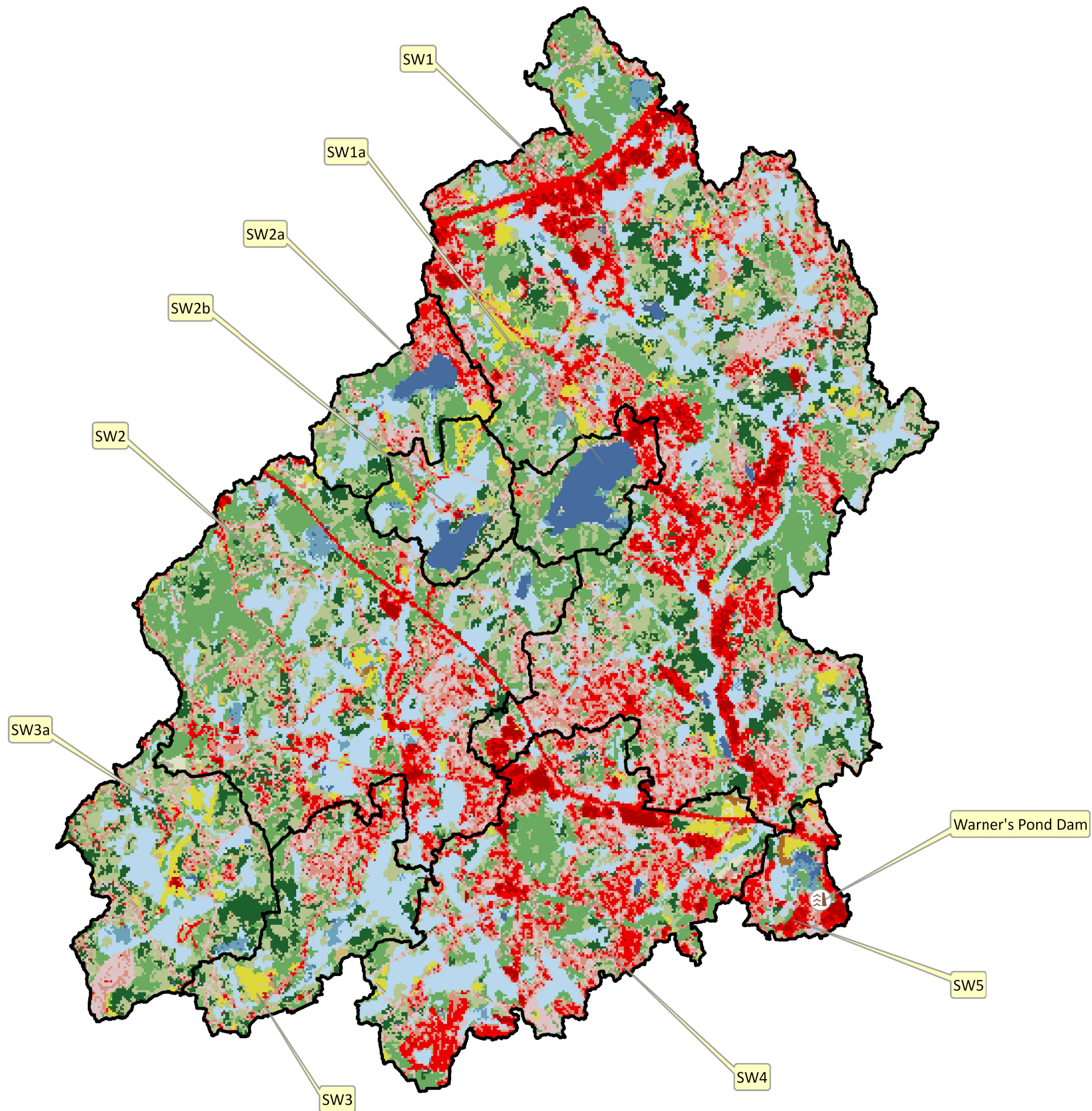


Legend

- Subwatershed
- Warner's Pond Dam
- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Herbaceous
- Hay/Pasture
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands



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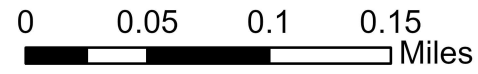


APPENDIX B INUNDATION MAPS

Warner's Pond Dam
Concord, Middlesex County
Massachusetts

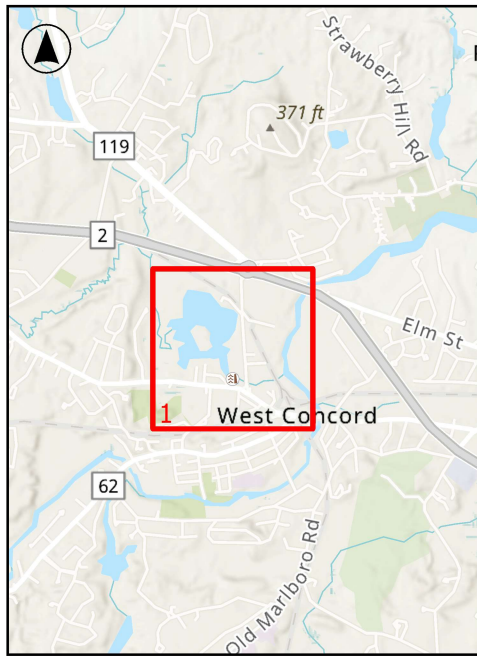


2-YR Flood Frequency
Inundation Map



Legend

- Warner's Pond Dam
- Commonwealth Avenue Bridge
- Timber Arch Pedestrian Bridge
- Bruce Freeman Rail Trail Bridge
- 2-YR Existing Conditions
- 2-YR Post Removal Conditions



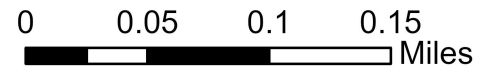
Date Printed: 8/1/2024 8:09 AM



Warner's Pond Dam
Concord, Middlesex County
Massachusetts

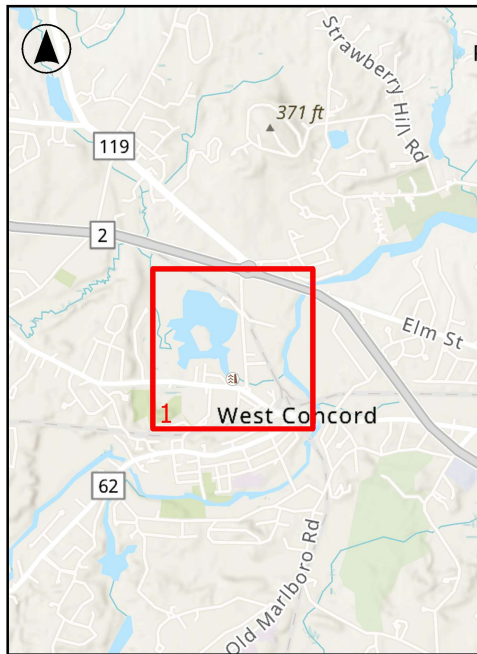


5-YR Flood Frequency
Inundation Map

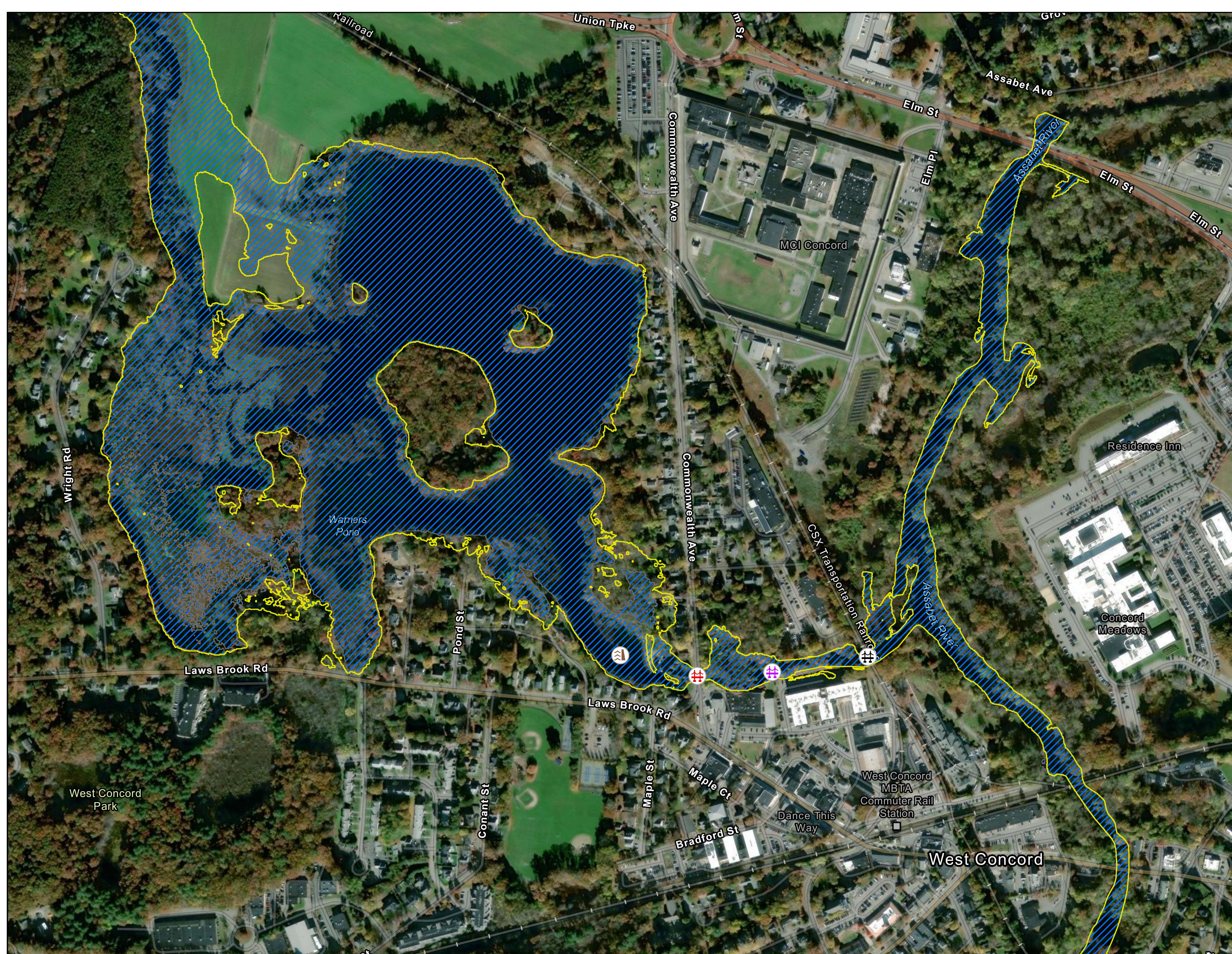


Legend

- Warner's Pond Dam
- Commonwealth Avenue Bridge
- Timber Arch Pedestrian Bridge
- Bruce Freeman Rail Trail Bridge
- 5-YR Existing Conditions
- 5-YR Post Removal Conditions



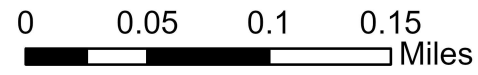
Date Printed: 8/1/2024 8:13 AM



Warner's Pond Dam
Concord, Middlesex County
Massachusetts

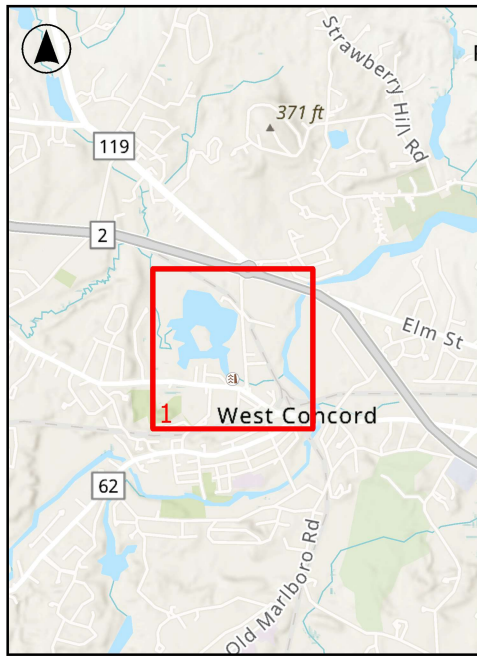


25-YR Flood Frequency
Inundation Map

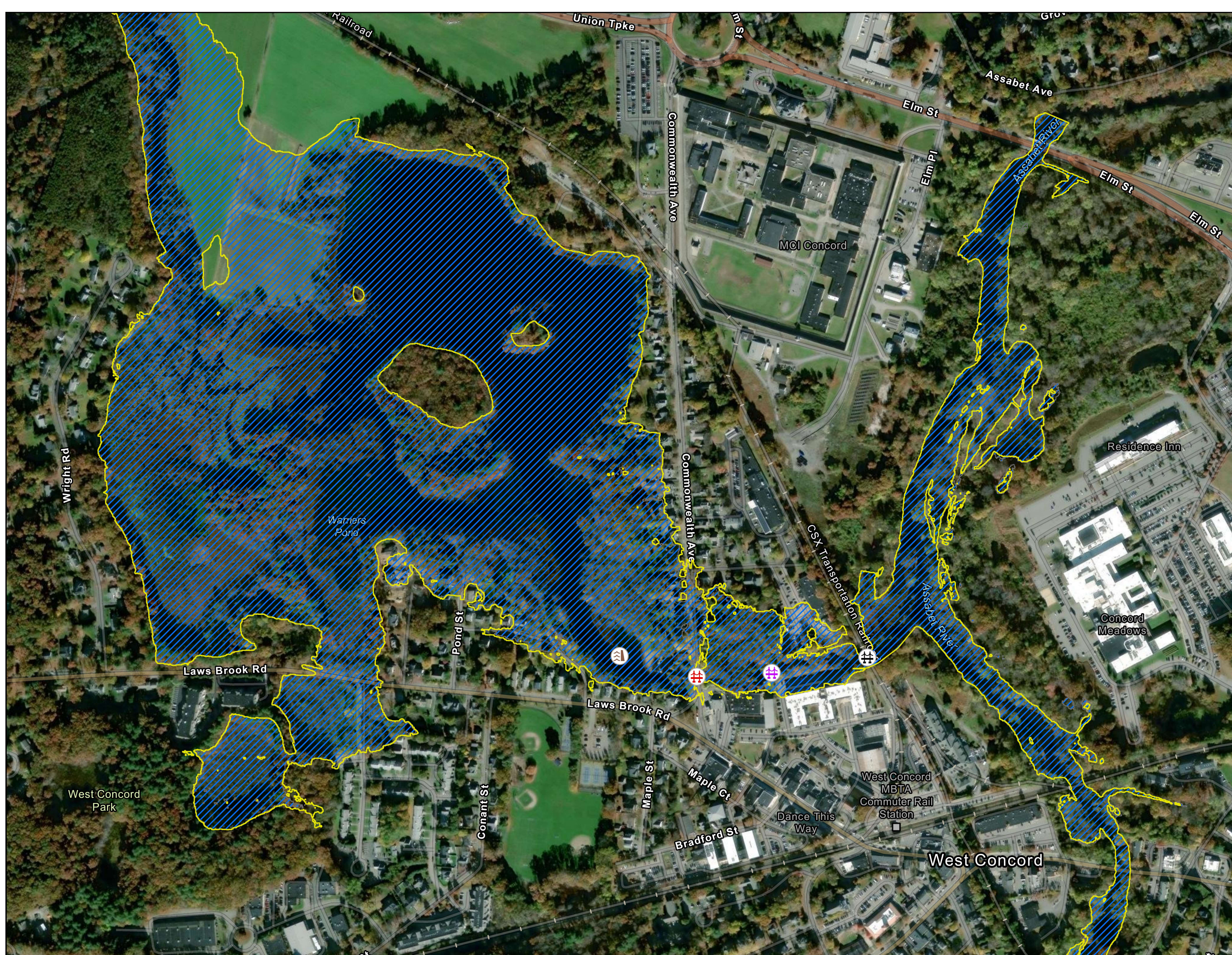


Legend

- Warner's Pond Dam
- Commonwealth Avenue Bridge
- Timber Arch Pedestrian Bridge
- Bruce Freeman Rail Trail Bridge
- 25-YR Existing Conditions
- 25-YR Post Removal Conditions



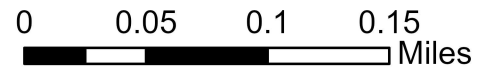
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Warner's Pond Dam
Concord, Middlesex County
Massachusetts

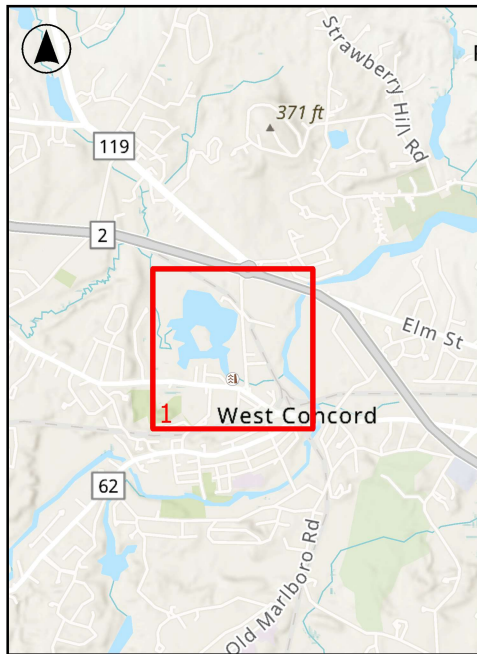


100-YR Flood Frequency
Inundation Map

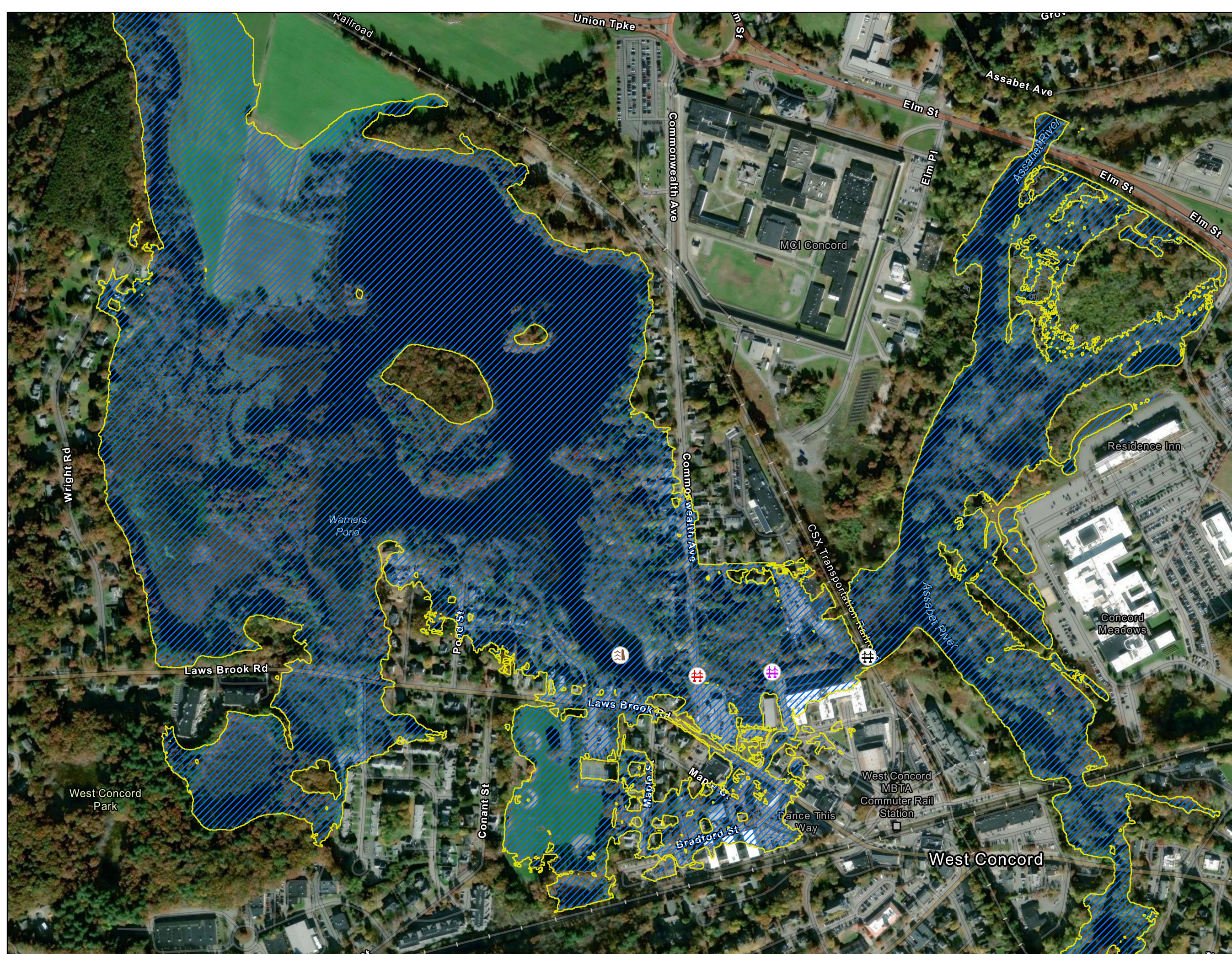


Legend

- Warner's Pond Dam
- Commonwealth Avenue Bridge
- Timber Arch Pedestrian Bridge
- Bruce Freeman Rail Trail Bridge
- 100-YR Existing Conditions
- 100-YR Post Removal Conditions



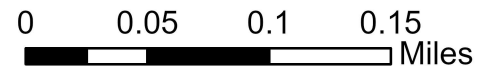
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Warner's Pond Dam
Concord, Middlesex County
Massachusetts

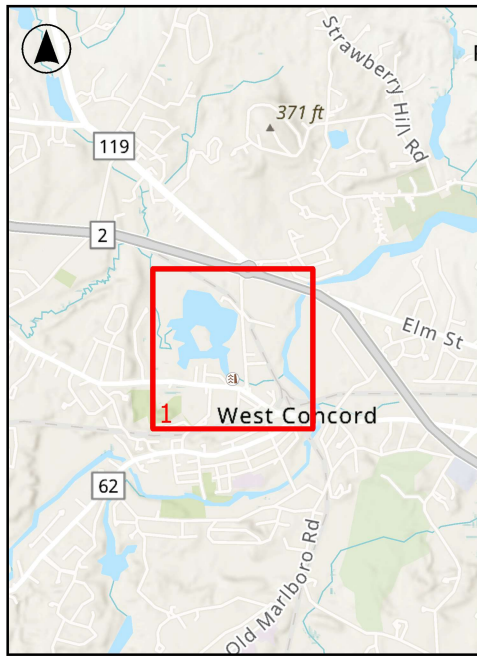


500-YR Flood Frequency
Inundation Map

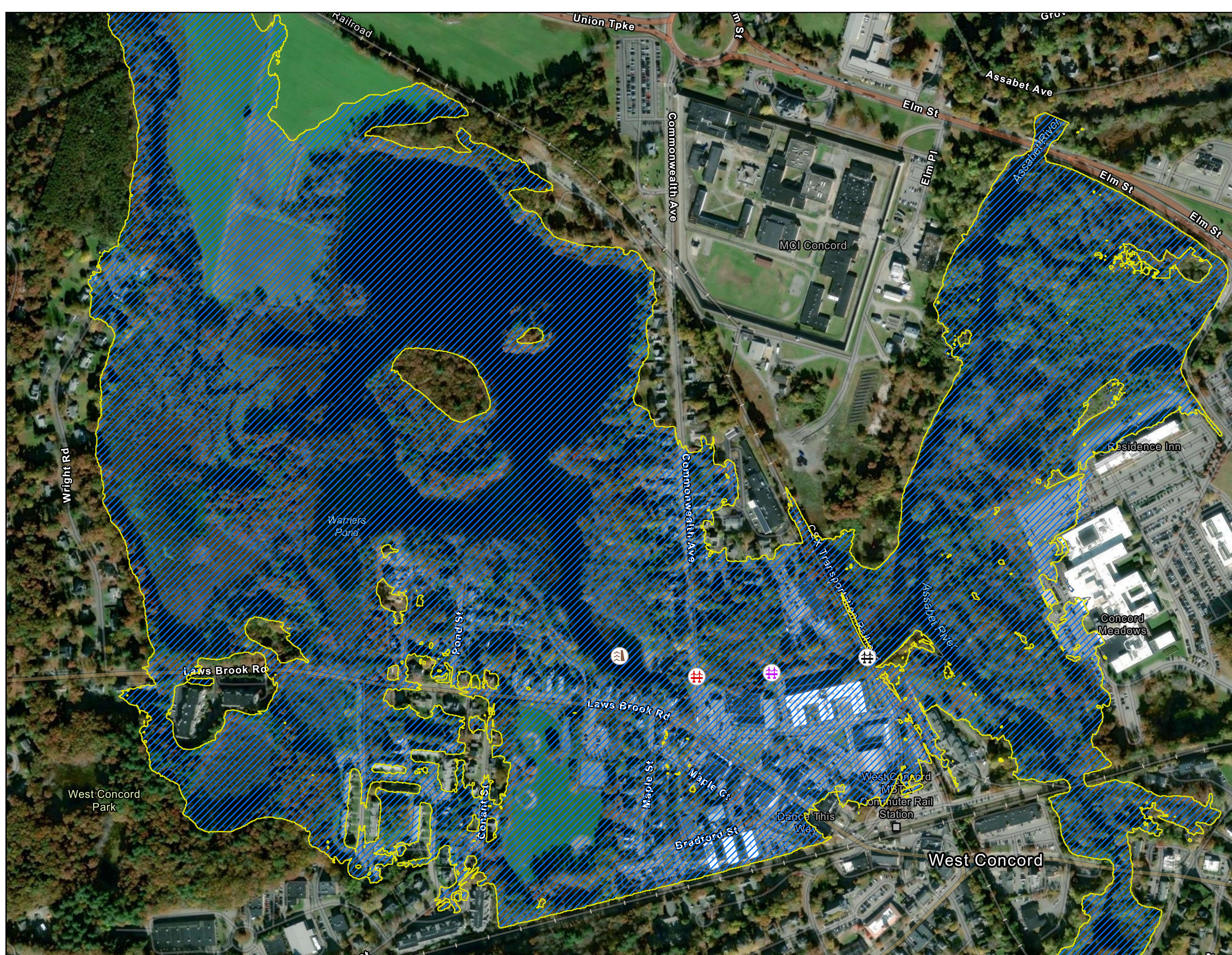


Legend

- Warner's Pond Dam
- Commonwealth Avenue Bridge
- Timber Arch Pedestrian Bridge
- Bruce Freeman Rail Trail Bridge
- 500-YR Existing Conditions
- 500-YR Post Removal Conditions



Date Printed: 8/1/2024 8:24 AM



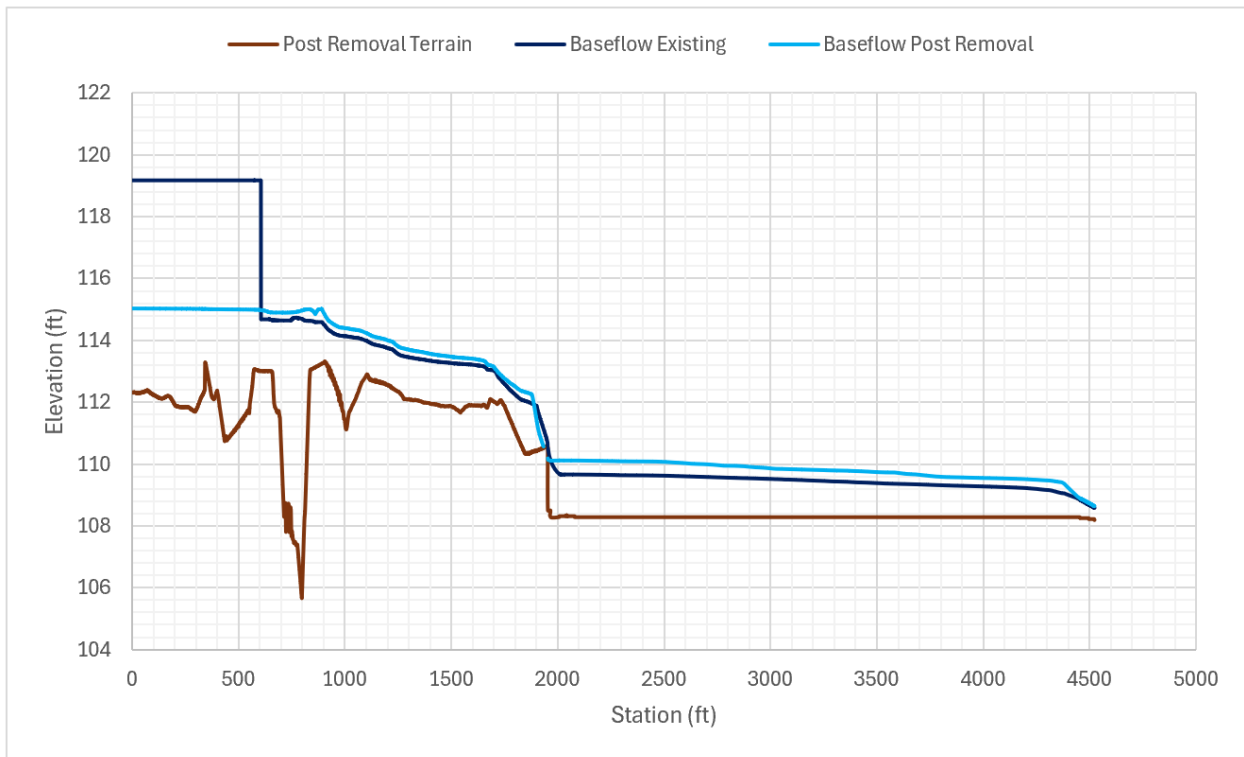
APPENDIX C HEC-RAS RESULTS

**Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses**

Figure C1. Profile Line Location



Figure C2. WSE Profile During Baseflow Conditions



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C3. WSE Profile During 2-yr 24-hr Flood Frequency

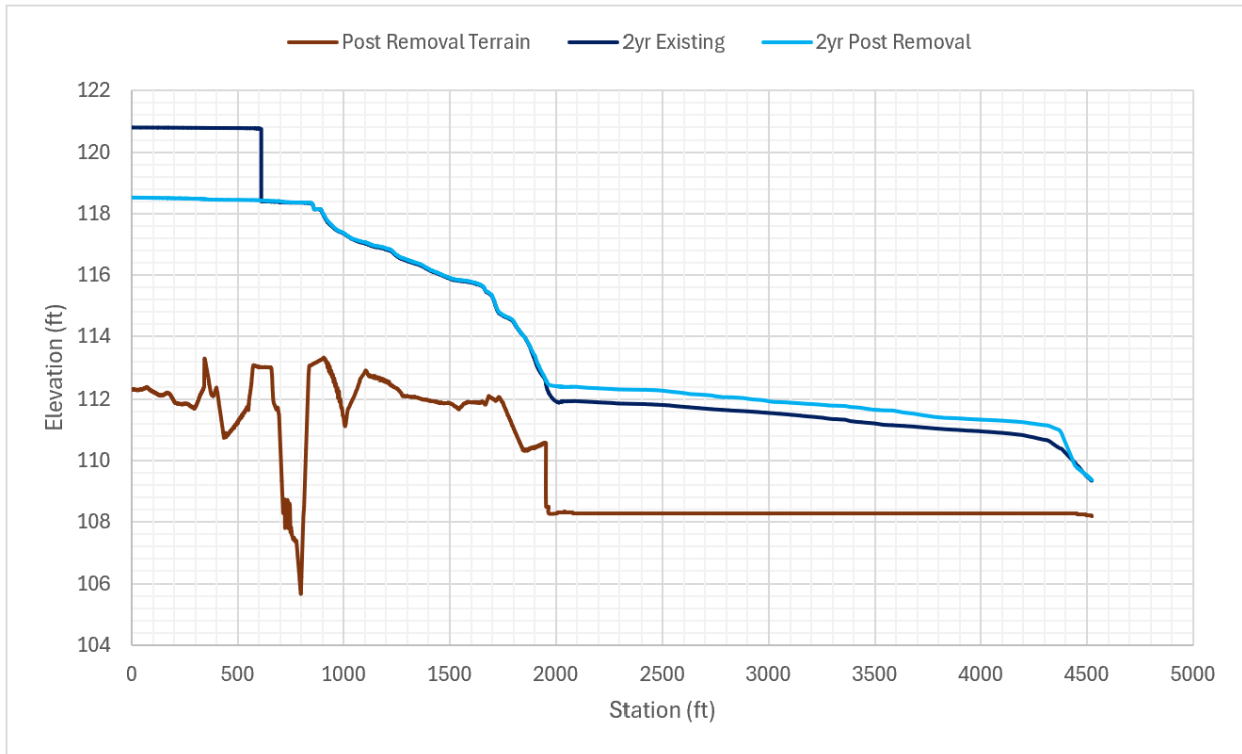
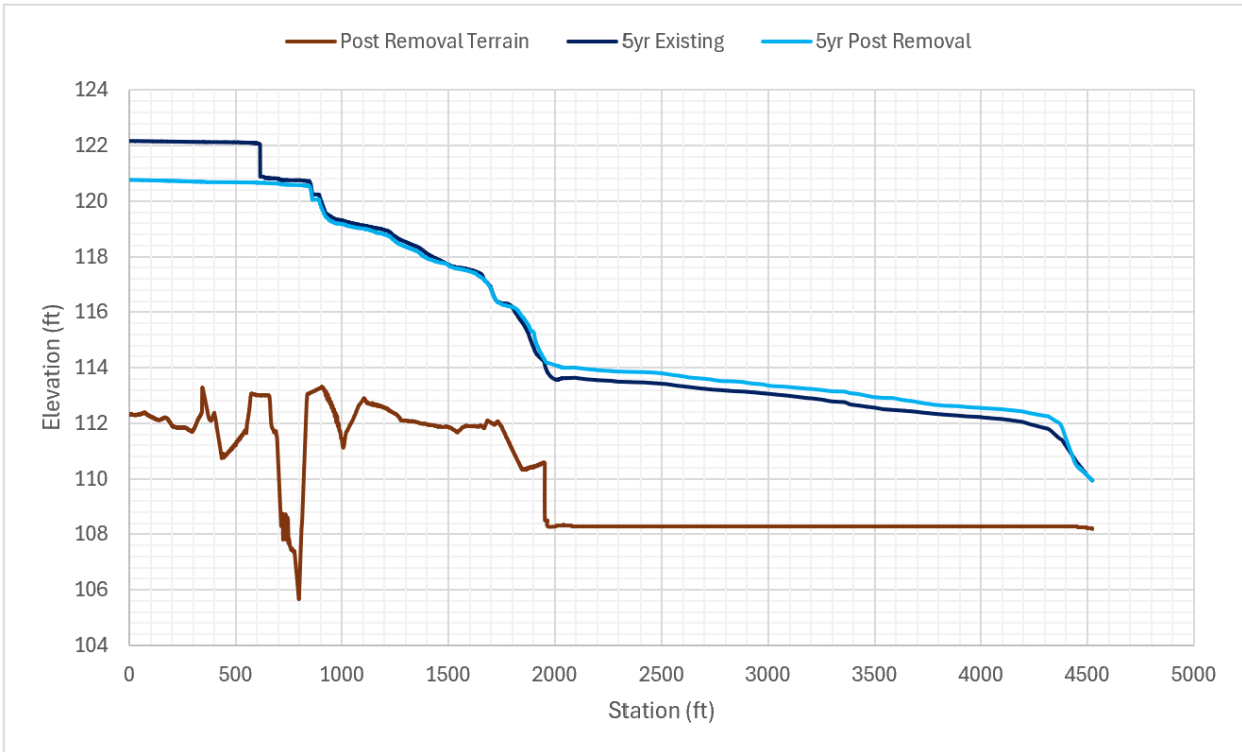


Figure C4. WSE Profile During 5-yr 24-hr Flood Frequency



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C5. WSE Profile During 25-yr 24-hr Flood Frequency

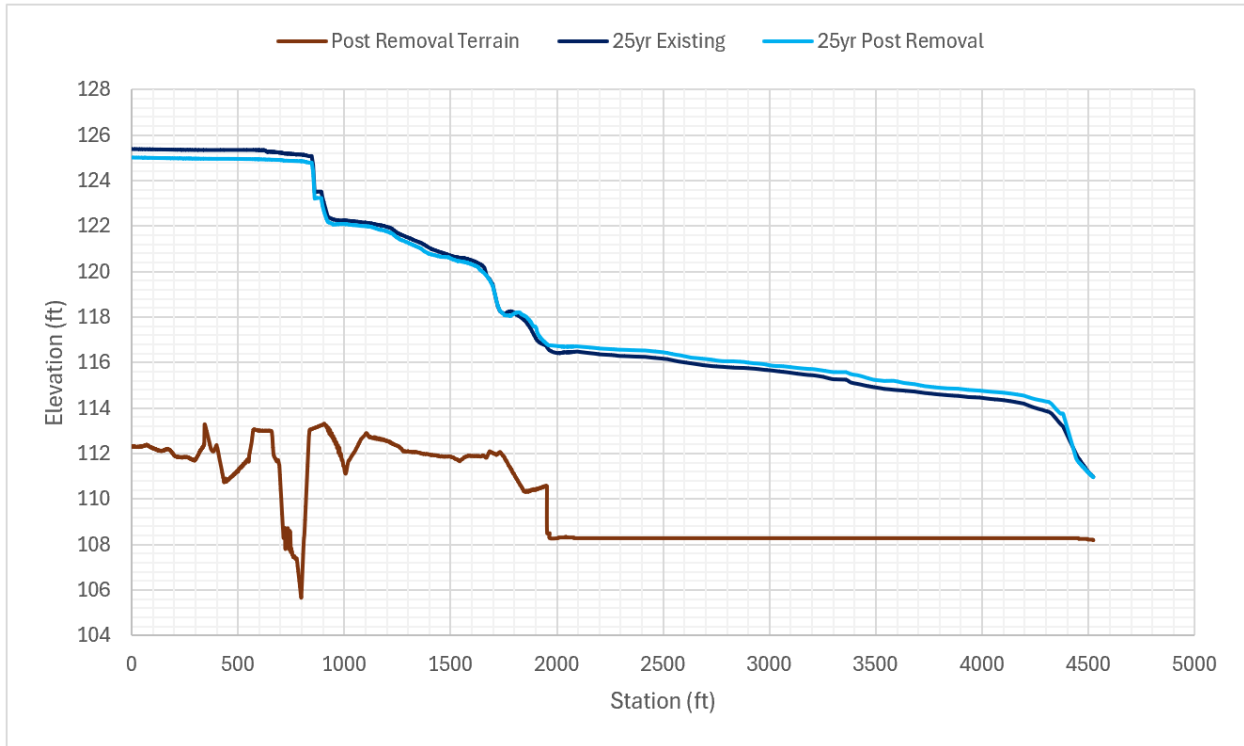
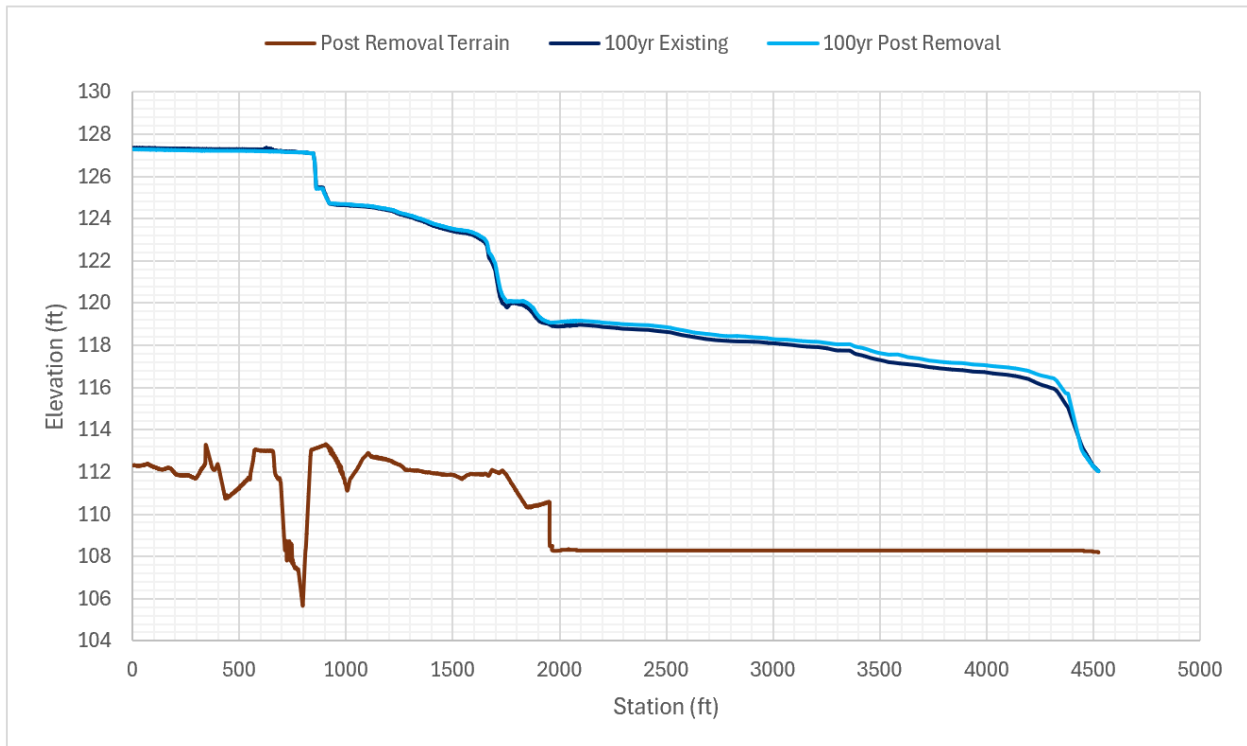


Figure C6. WSE Profile During 100-yr 24-hr Flood Frequency



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C7. WSE Profile During 500-yr 24-hr Flood Frequency

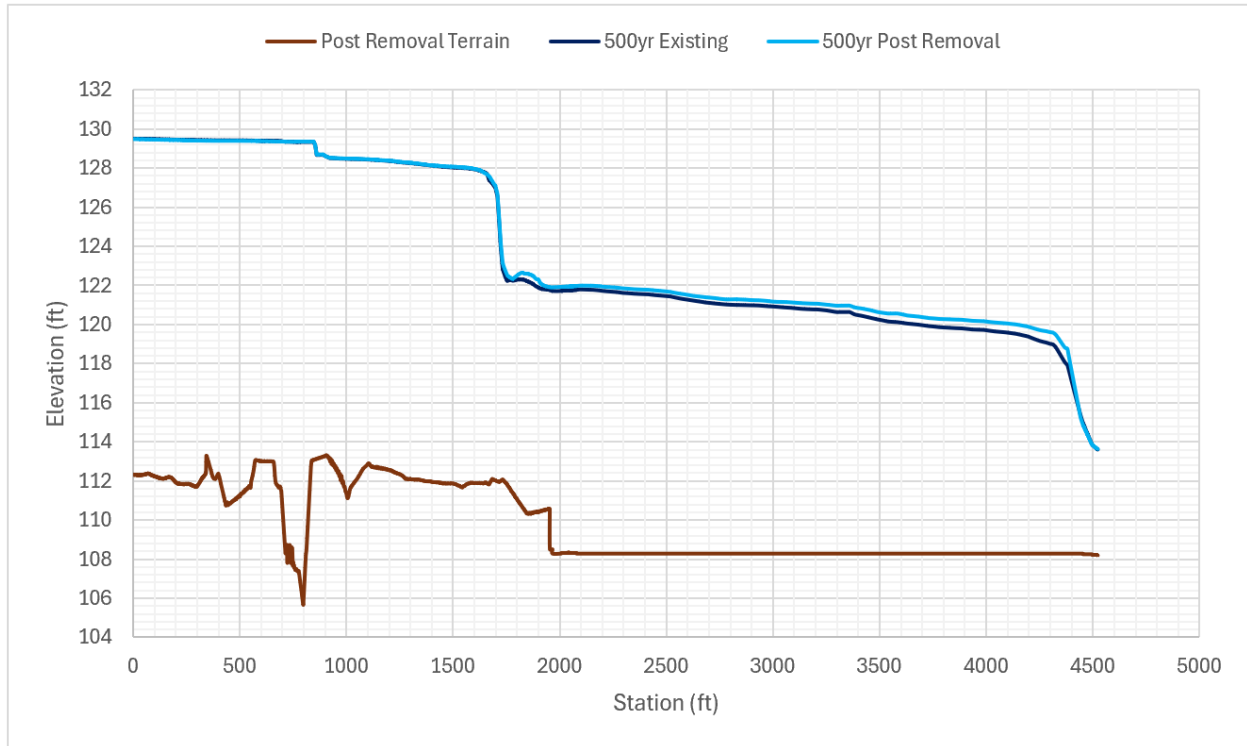
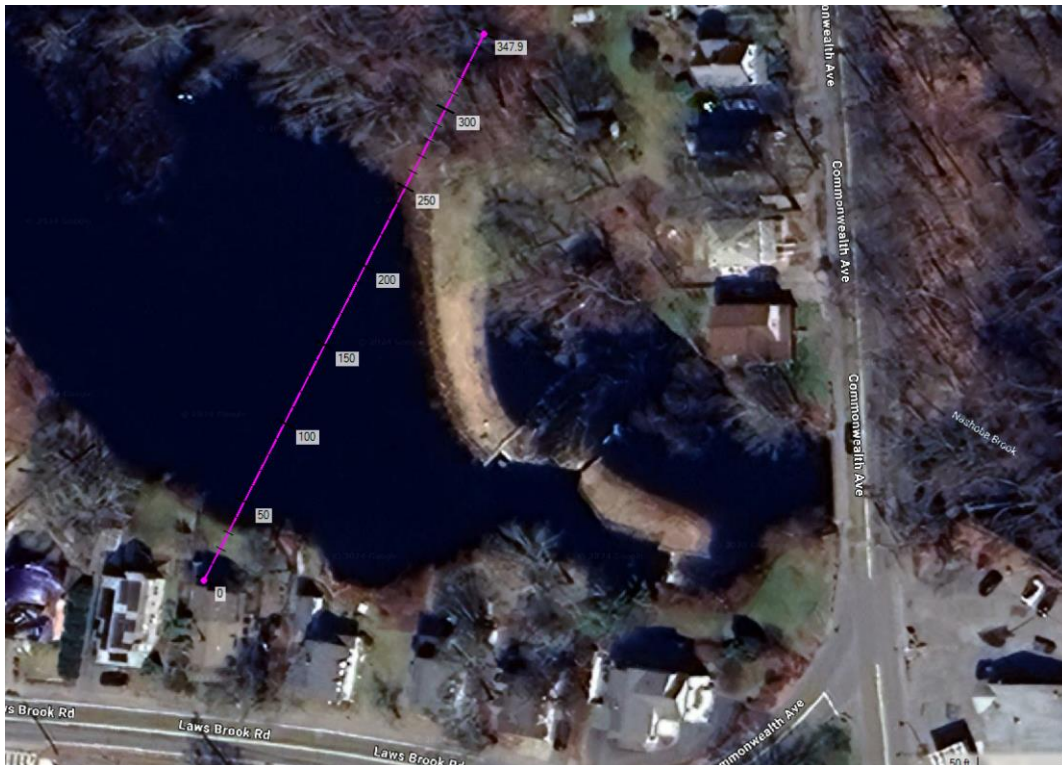


Figure C8. Cross Section Location 1

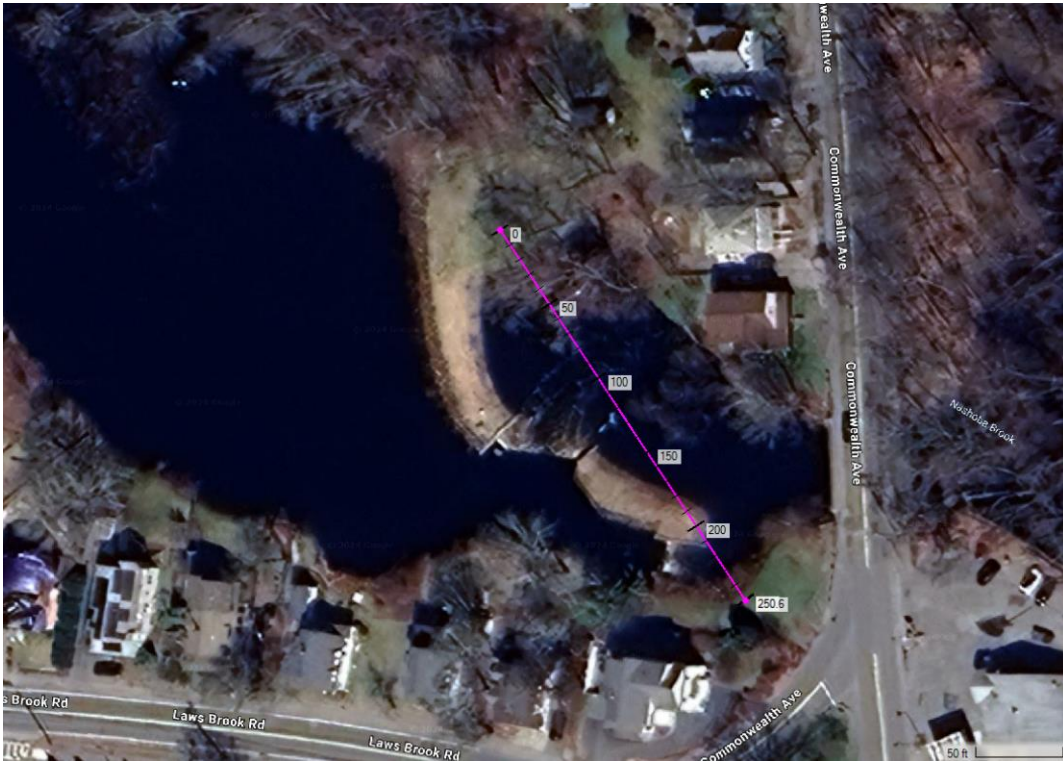


Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C9. Cross Section Location 2



Figure C10. Cross Section Location 3



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C11. Post Removal WSE at Cross Section 1

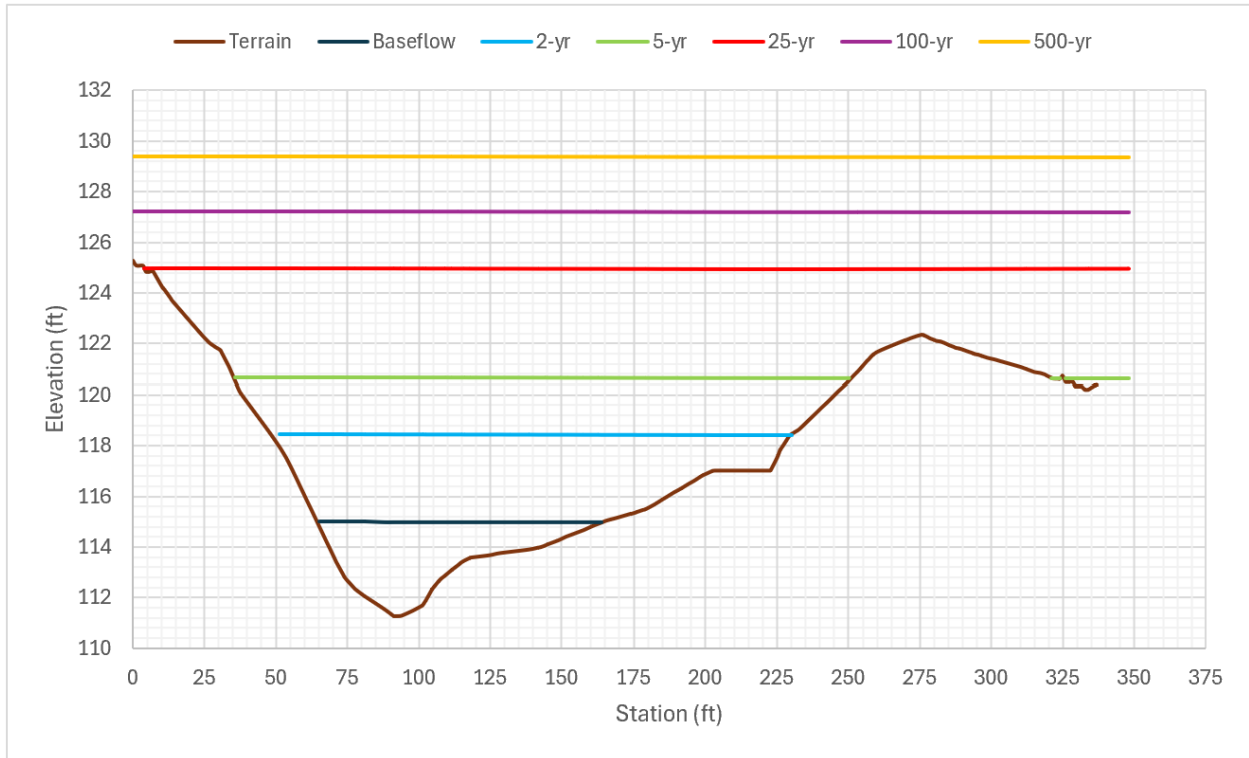
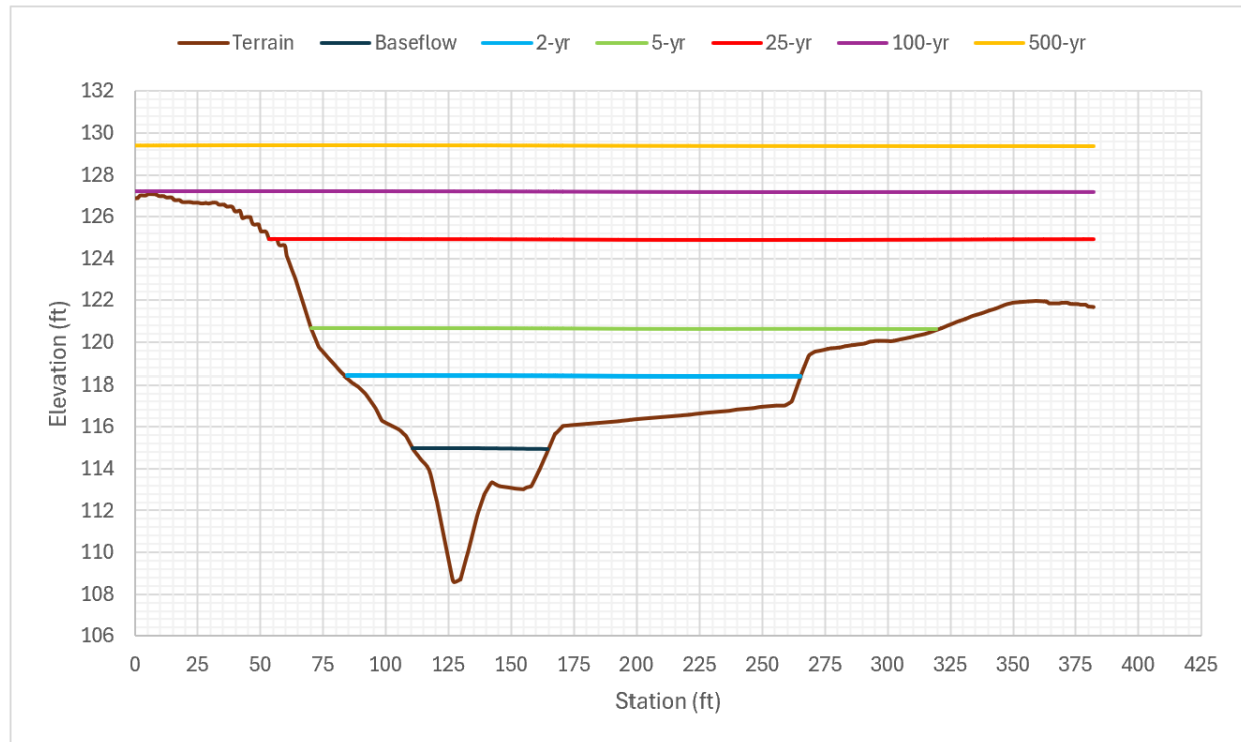
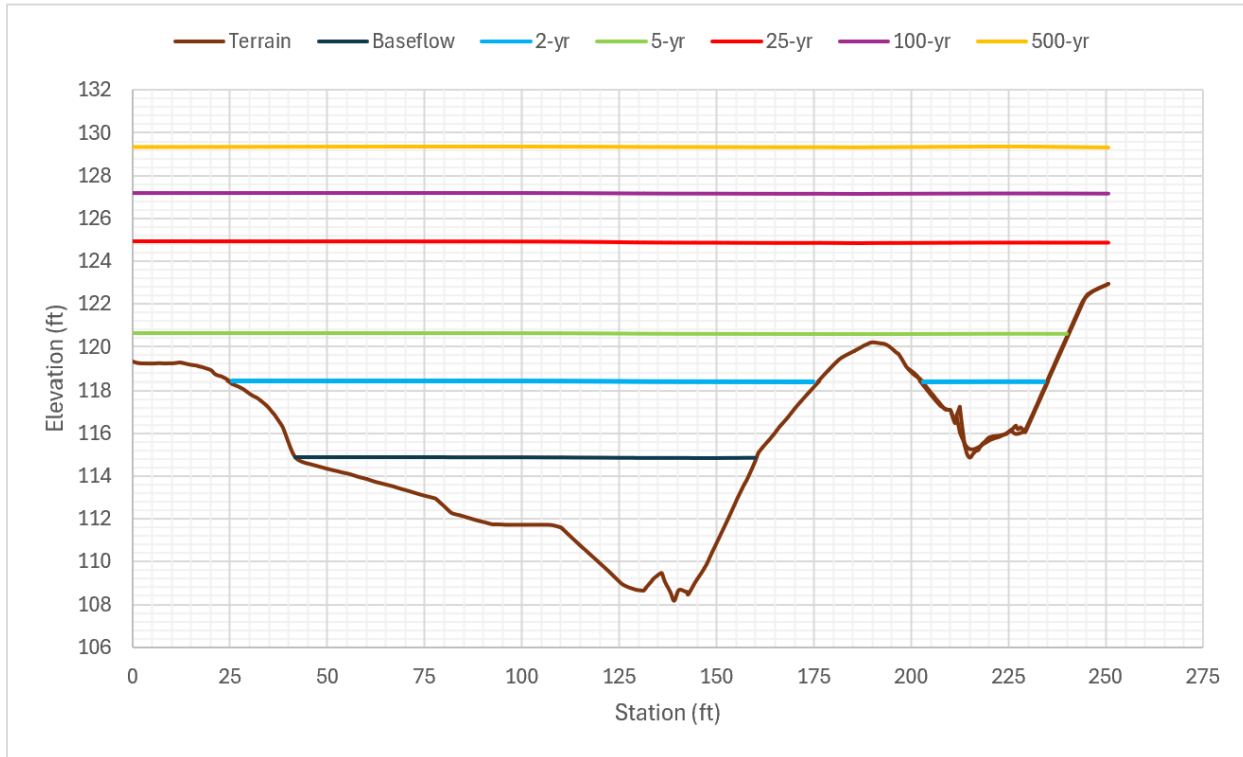


Figure C12. Post Removal WSE at Cross Section 2



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C13. Post Removal WSE at Cross Section 3

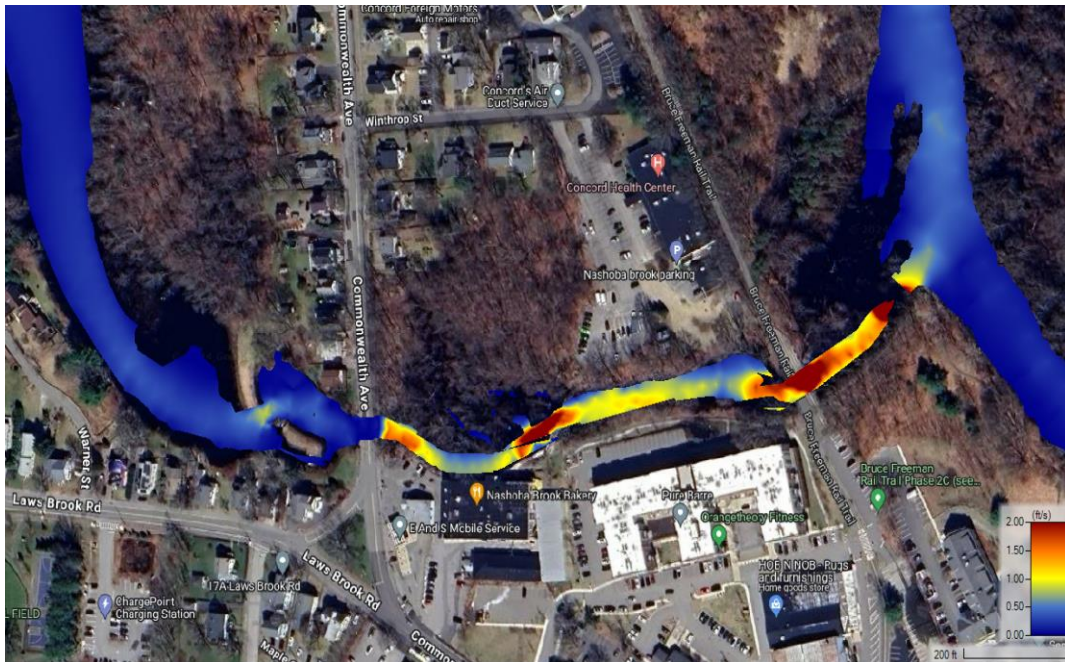


Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C14. Velocity Map (ft/s) for Existing Conditions During Baseflow



Figure C15. Velocity Map (ft/s) for Post Removal Conditions During Baseflow



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C16. Velocity Map (ft/s) for Existing Conditions During Bank-full Flow

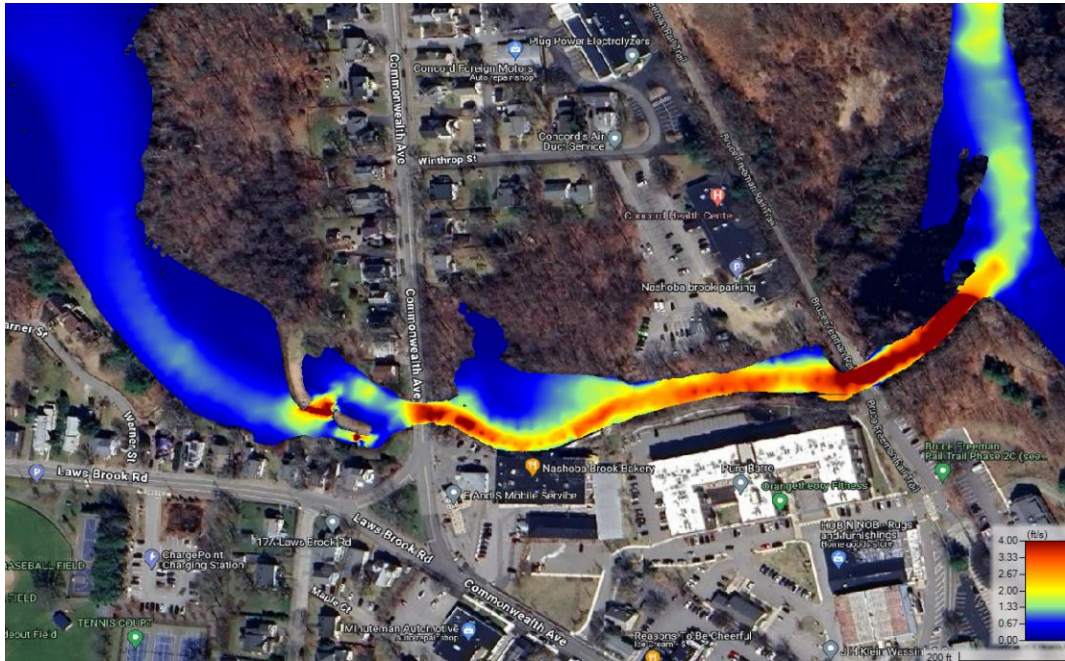
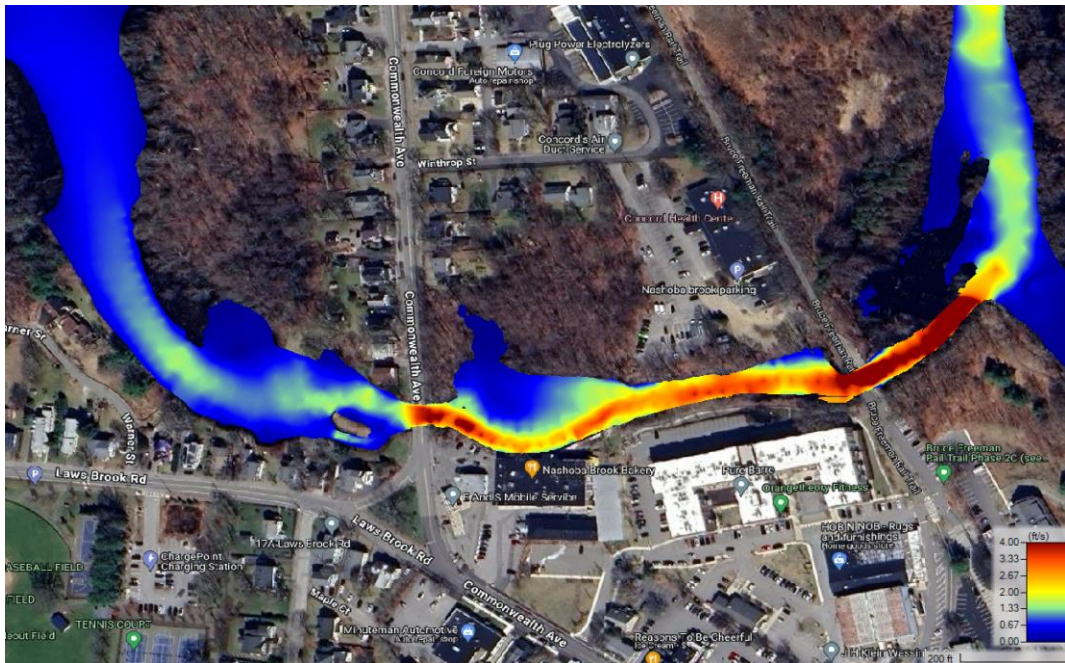


Figure C17. Velocity Map (ft/s) for Post Removal Conditions During Bank-full Flow



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C18. Velocity Map (ft/s) for Existing Conditions During 2yr-24hr Flood Frequency

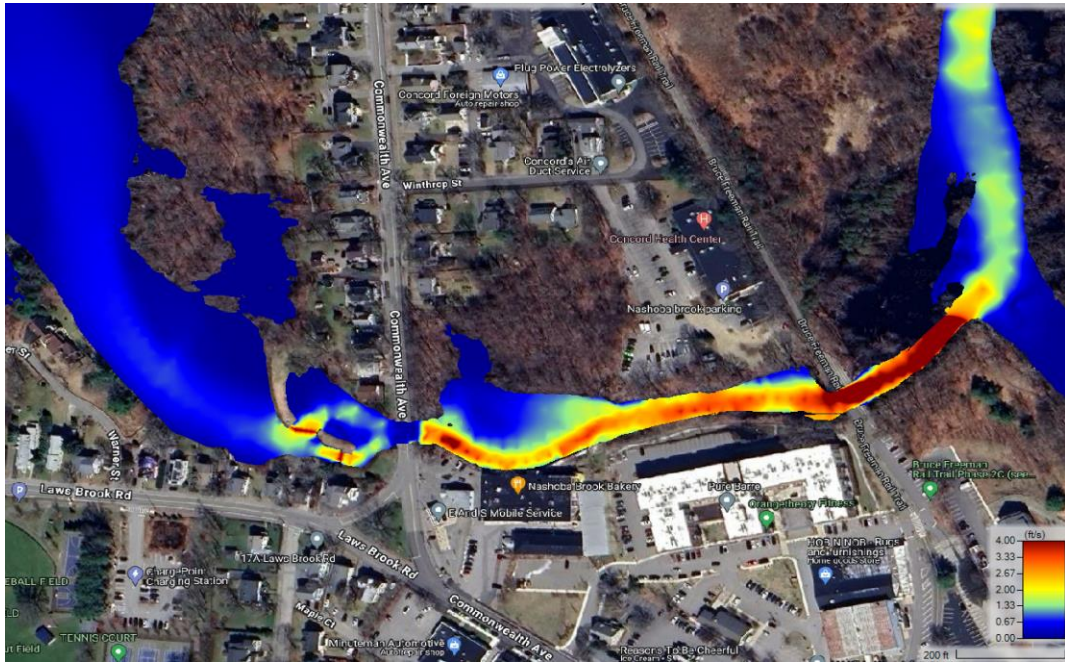
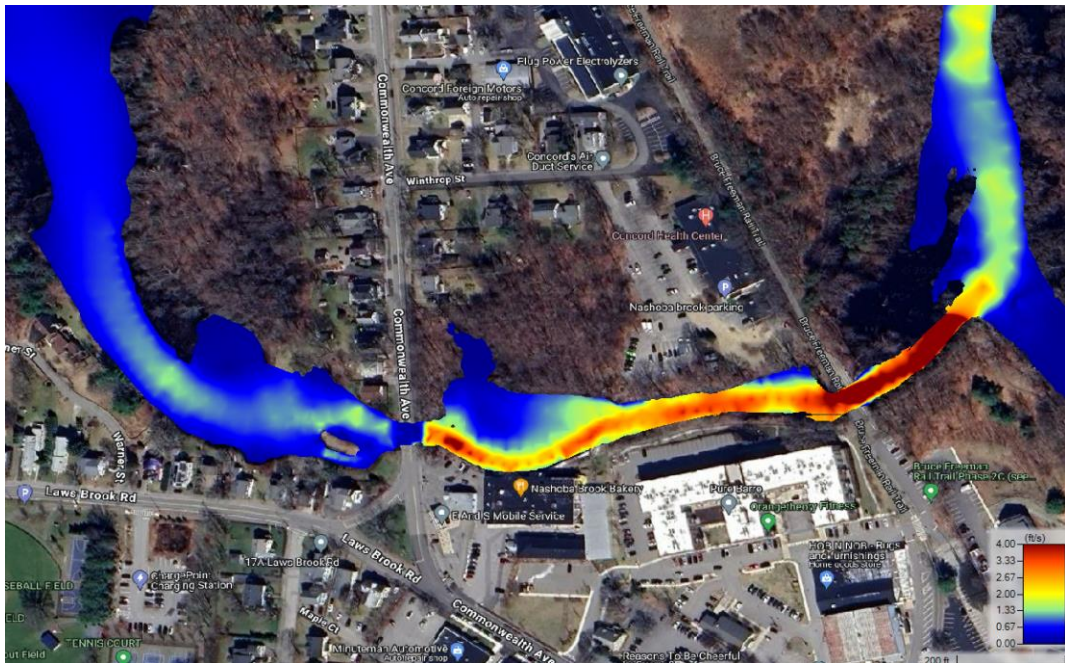


Figure C19. Velocity Map (ft/s) for Post Removal Conditions During 2yr-24hr Flood Frequency



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C20. Velocity Map (ft/s) for Existing Conditions During 5yr-24hr Flood Frequency

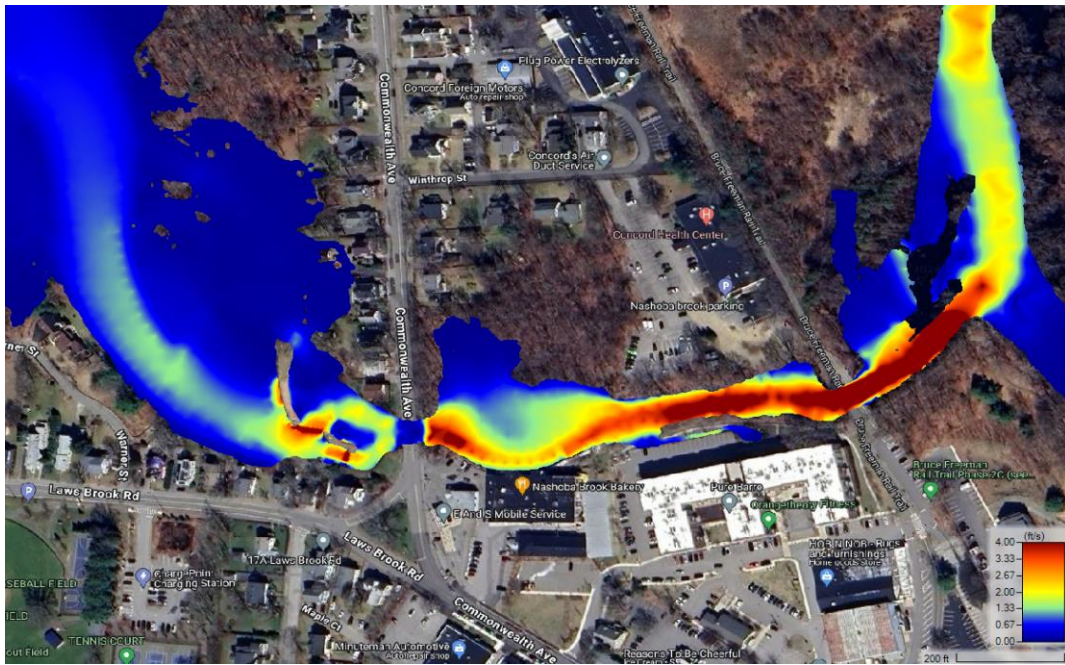
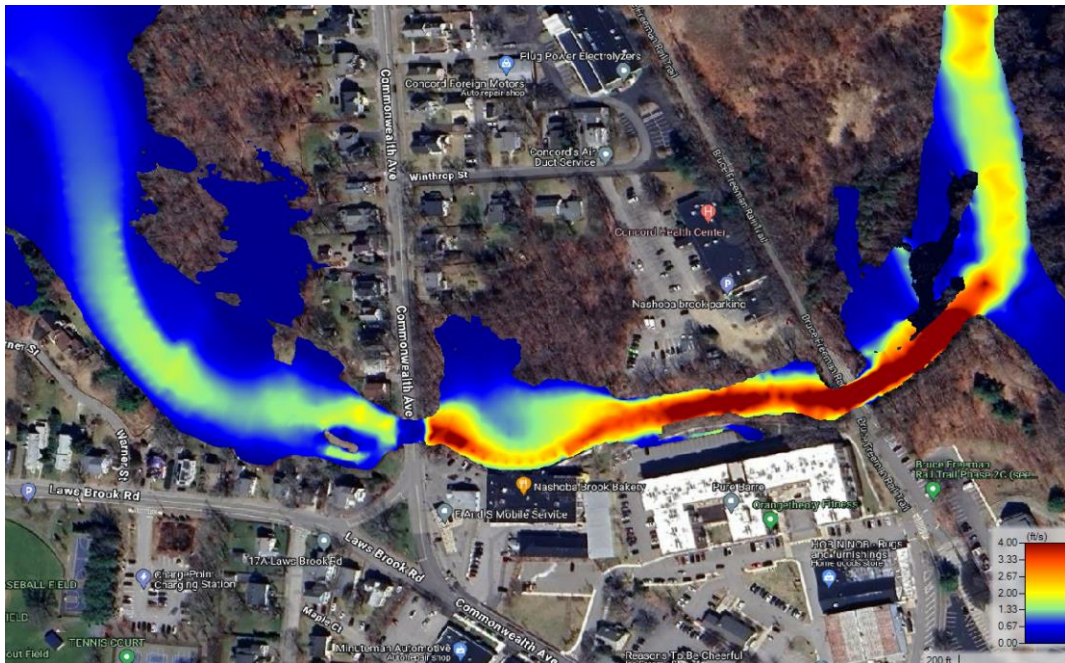


Figure C21. Velocity Map (ft/s) for Post Removal Conditions During 5yr-24hr Flood Frequency



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C22. Stream Power Map ($\text{kg m}^2 \text{s}^{-3}$) for Existing Conditions During Baseflow



Figure C23. Stream Power Map ($\text{kg m}^2 \text{s}^{-3}$) for Post Removal Conditions During Baseflow



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C24. Stream Power Map ($\text{kg m}^2 \text{s}^{-3}$) for Existing Conditions During Bank-full Flow



Figure C25. Stream Power Map ($\text{kg m}^2 \text{s}^{-3}$) for Post Removal Conditions During Bank-full Flow



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C26. Stream Power map ($\text{kg m}^2 \text{s}^{-3}$) for Existing Conditions During 2yr-24hr Flood Frequency

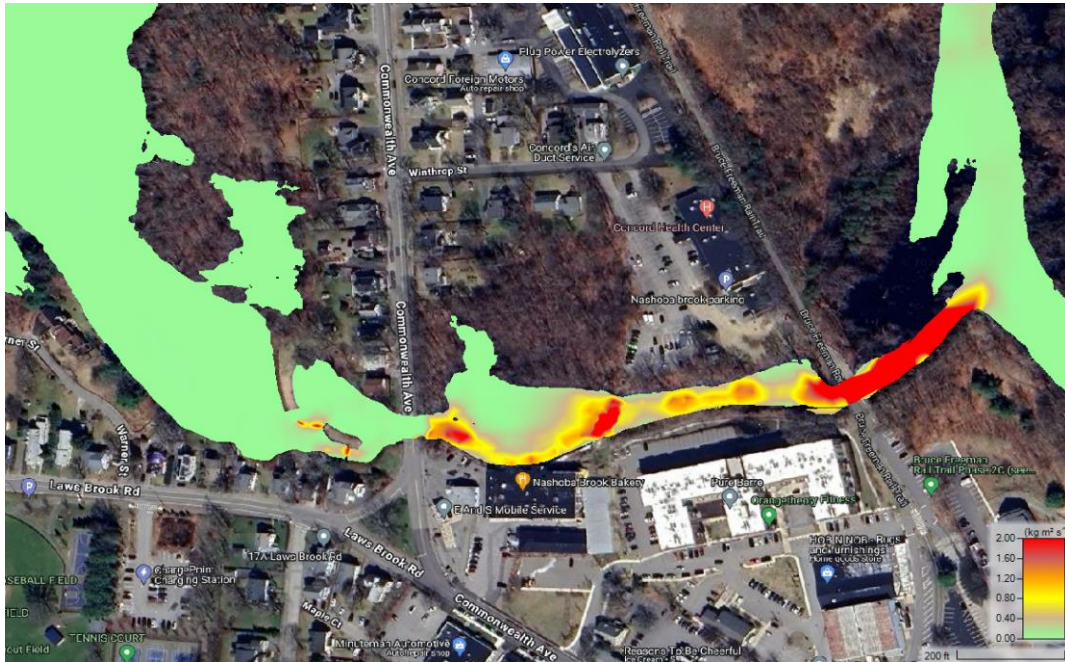


Figure C27. Stream Power Map ($\text{kg m}^2 \text{s}^{-3}$) for Post Removal Conditions During 2yr-24hr Flood Frequency



Warner's Pond Dam Removal
Hydrologic, Hydraulic, and Sediment Transport Analyses

Figure C28. Stream Power Map ($\text{kg m}^2 \text{s}^{-3}$) for Existing Conditions During 5yr-24hr Flood Frequency

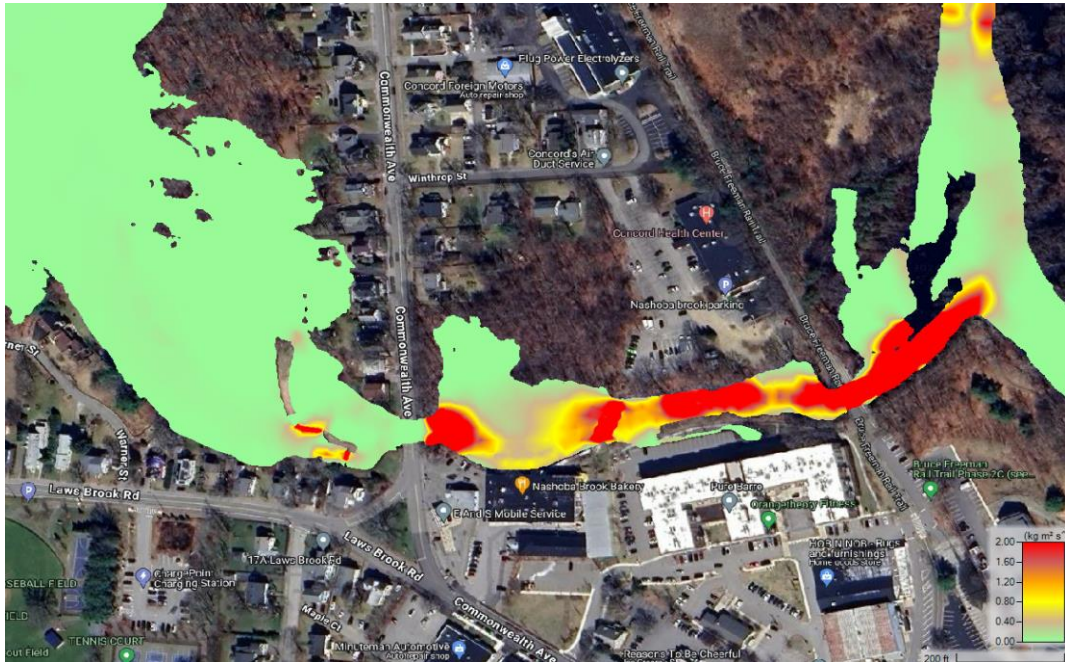
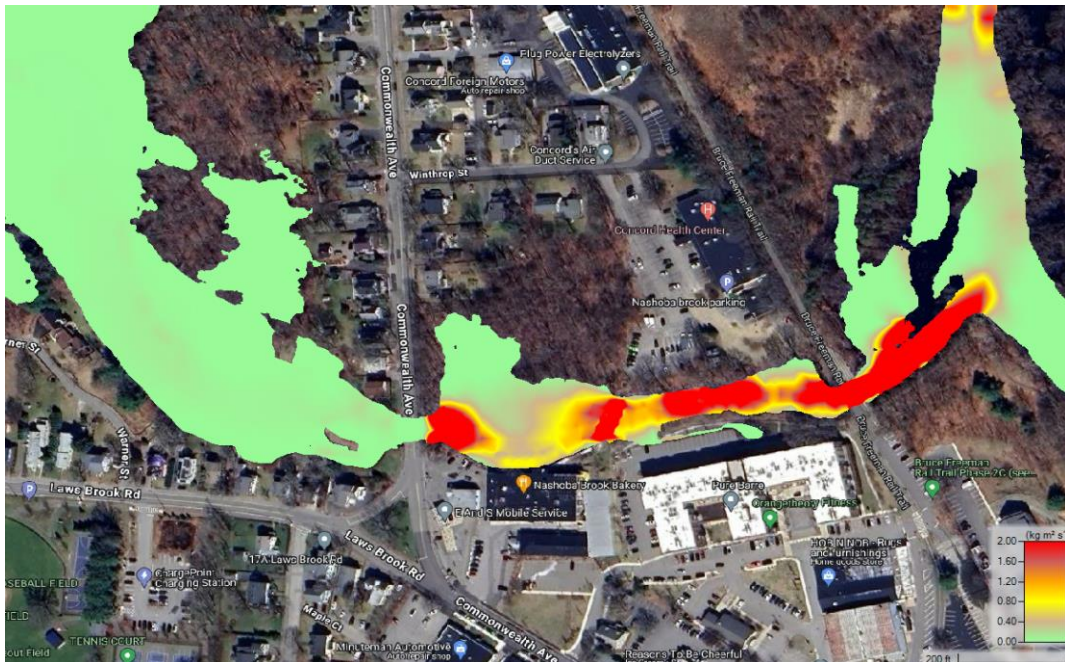


Figure C29. Stream Power Map ($\text{kg m}^2 \text{s}^{-3}$) for Post Removal Conditions During 5yr-24hr Flood Frequency



APPENDIX D SEDIMENT CORE ANALYSIS



Client:	EA Engineering, Science, & Technology		
Project:	Warner's Pond		
Location:	Concord, MA	Project No:	GTX-318057
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	11/27/23
Depth :	---	Test Id:	745089

Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
---	SED- 01 -0-2.5	---	Moist, very dark brown silt with sand and organics	93.87	70.38	55.09	(1)
---	SED- 01 -2.5-4.5	---	Moist, grayish brown sand	105.4	26.92	83.08	(2)
---	SED- 01 -4.5-5.75	---	Moist, very dark brown silty sand with organics	84.94	91.04	44.46	(3)
---	SED- 01 -5.75-6.75	---	Moist, gray sandy clay with organics	115.3	31.49	87.70	(4)
---	SED- 01 -6.75-8	---	Moist, gray sand with silt	115.7	15.54	100.2	(5)

* Sample Comments

- (1): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (2): Method B-Volumetric, Reconstituted (compacted)
- (3): Sample contains organics
Method B-Volumetric,
- (4): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (5): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.



Client:	EA Engineering, Science, & Technology		
Project:	Warner's Pond		
Location:	Concord, MA	Project No:	GTX-318057
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	11/27/23
Depth :	---	Test Id:	745111
		Tested By:	ckg
		Checked By:	jsc

Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
---	SED- 02 -0-3	---	Moist, very dark brown silt with organics	69.11	195.9	23.36	(1)
---	SED- 02 -3-8	---	Moist, very dark brown silt with organics	63.40	389.6	12.95	(2)
---	SED- 02 -8-10	---	Moist, dark grayish brown silty sand with organics	101.0	36.29	74.12	(3)
---	SED- 03 -0-6.5	---	Moist, very dark brown sandy silt with organics	63.80	353.6	14.07	(4)
---	SED- 03 -6.5-8.5	---	Moist, grayish brown sand with silt	107.9	23.03	87.67	(5)

* Sample Comments

- (1): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (2): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (3): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (4): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (5): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.



Client:	EA Engineering, Science, & Technology		
Project:	Warner's Pond		
Location:	Concord, MA	Project No:	GTX-318057
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	11/28/23
Depth :	---	Test Id:	745116
		Tested By:	ckg
		Checked By:	jsc

Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
---	SED- 03 -8.5-10	---	Moist, very dark brown clay with organics	65.36	263.2	17.99	(1)
---	SED- 04 -0-2.5	---	Moist, very dark brown clay with organics	59.02	359.3	12.85	(2)
---	SED- 04 -2.5-3	---	Moist, dark brown clay with sand	89.56	62.11	55.25	(3)
---	SED- 04 -3-7	---	Moist, grayish brown sand	117.1	23.08	95.17	(4)
---	SED- 05 -0-1	---	Moist, very dark brown silt	67.61	367.5	14.46	(5)

* Sample Comments

- (1): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (2): Sample contains organics
Method B-Volumetric, Reconstituted (compacted)
- (3): Method B-Volumetric, Reconstituted (compacted)
- (4): Method B-Volumetric, Reconstituted (compacted)
- (5): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.



Client:	EA Engineering, Science, & Technology		
Project:	Warner's Pond		
Location:	Concord, MA	Project No:	GTX-318057
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	11/27/23
Depth :	---	Test Id:	745118

**Laboratory Determination of Density (Unit Weight)
of Soil Specimens by ASTM D7263**

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
---	SED- 05 -1-4.5	---	Moist, grayish brown sand with gravel	110.2	13.44	97.11	(1)
---	SED- 05 -4.5-7.5	---	Moist, yellowish brown sand	119.7	18.03	101.4	(2)

* Sample Comments

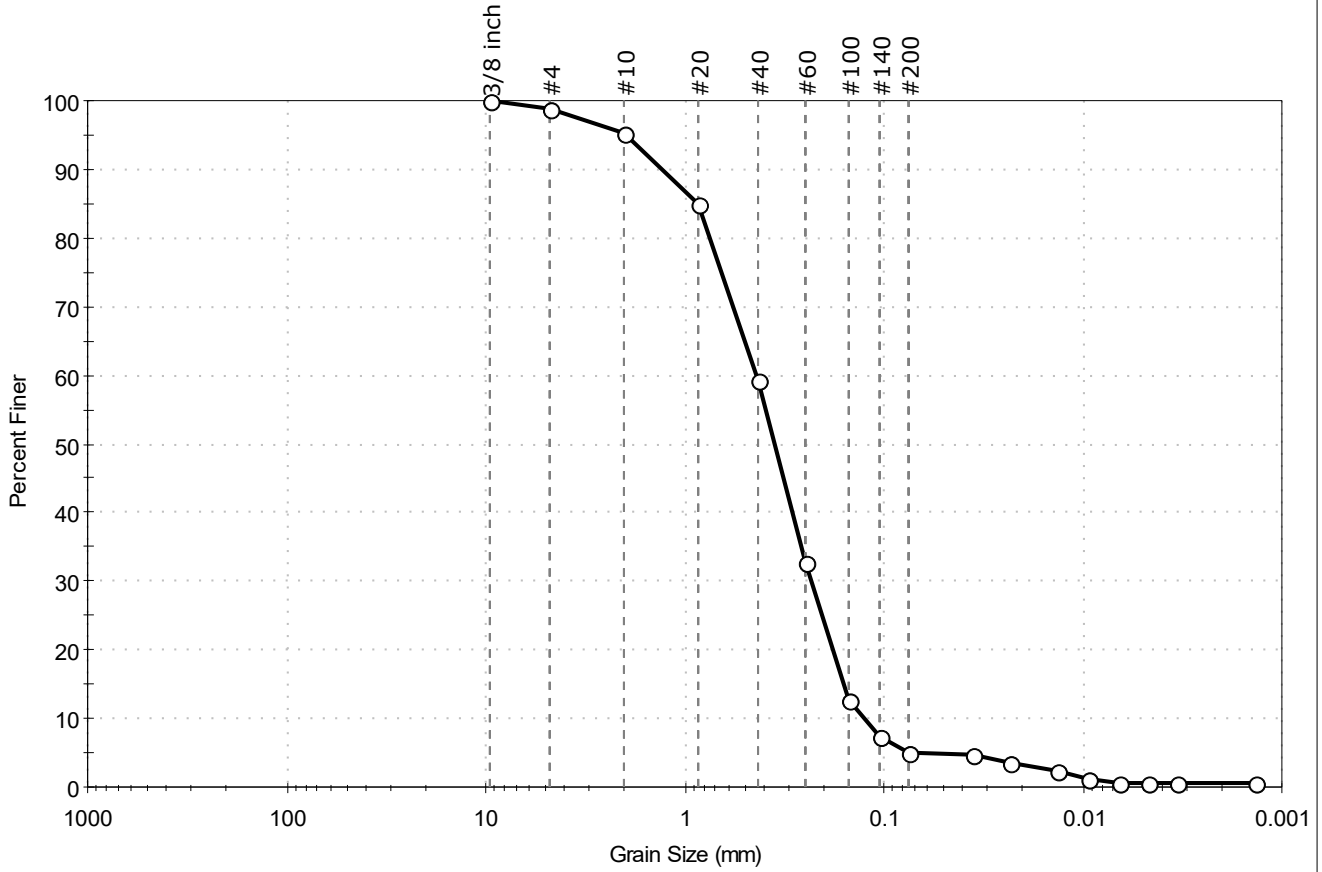
- (1): Method B-Volumetric, Reconstituted (compacted)
- (2): Method B-Volumetric, Reconstituted (compacted)

Notes: Moisture Content determined by ASTM D2216.



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-03-6.5-8.5	Test Date: 11/28/23
Depth: ---	Test Id: 745103
Test Comment: ---	Tested By: ckg
Visual Description: Moist, grayish brown sand with silt	Checked By: jsc
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	1.0	93.9	5.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	99		
#10	2.00	95		
#20	0.85	85		
#40	0.42	59		
#60	0.25	33		
#100	0.15	13		
#140	0.11	7		
#200	0.075	5.1		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0362	5		
---	0.0232	4		
---	0.0134	2		
---	0.0095	1		
---	0.0066	0		
---	0.0047	0		
---	0.0033	0		
---	0.0014	0		

Coefficients	
D ₈₅ = 0.8478 mm	D ₃₀ = 0.2334 mm
D ₆₀ = 0.4329 mm	D ₁₅ = 0.1591 mm
D ₅₀ = 0.3530 mm	D ₁₀ = 0.1257 mm
C _u = 3.444	C _c = 1.001

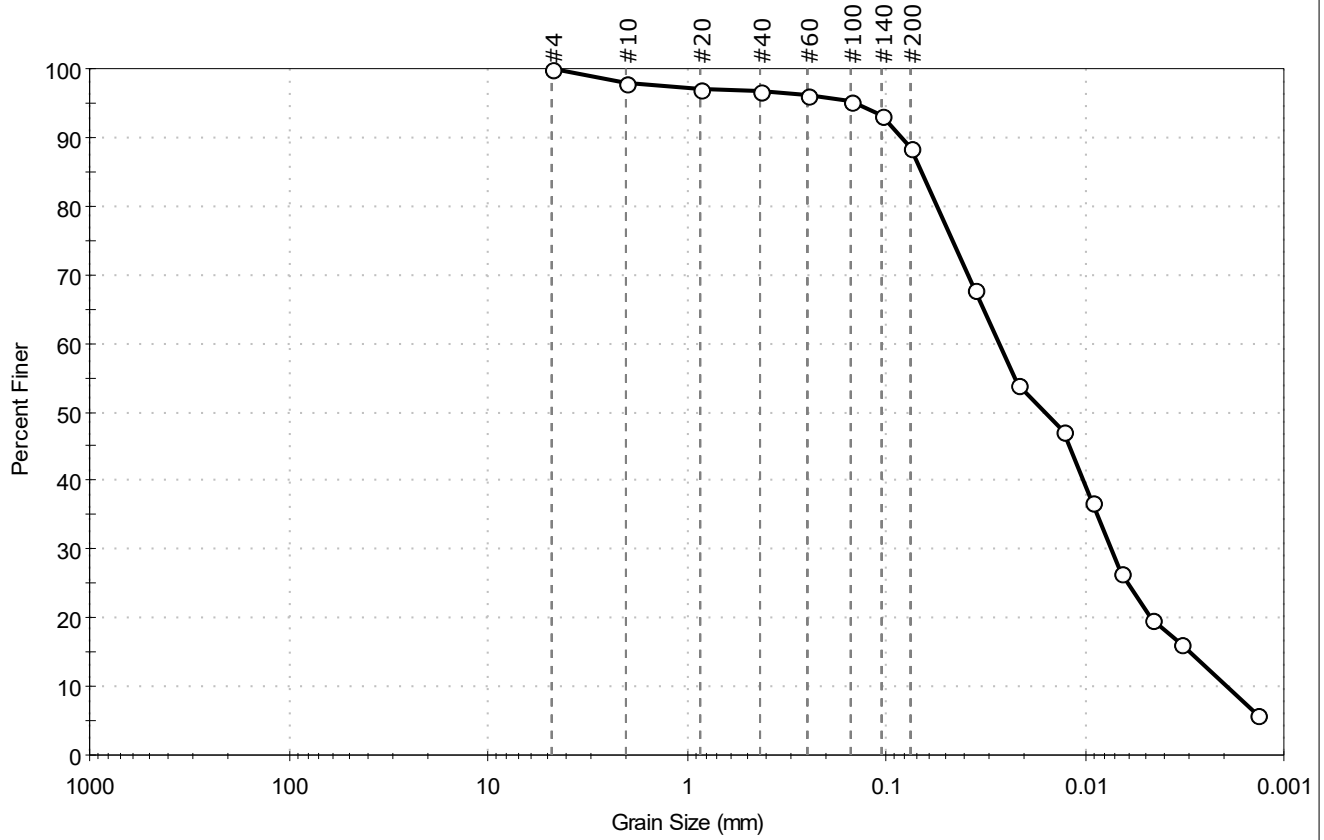
Classification	
ASTM	N/A
AASHTO	Fine Sand (A-3 (1))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-03-8.5-10	Test Date: 11/28/23
Depth: ---	Test Id: 745104
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown clay with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	11.5	88.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	98		
#20	0.85	97		
#40	0.42	97		
#60	0.25	96		
#100	0.15	95		
#140	0.11	93		
#200	0.075	88		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0360	68		
---	0.0220	54		
---	0.0130	47		
---	0.0092	37		
---	0.0066	27		
---	0.0047	20		
---	0.0033	16		
---	0.0014	6		

Coefficients	
D ₈₅ = 0.0663 mm	D ₃₀ = 0.0074 mm
D ₆₀ = 0.0272 mm	D ₁₅ = 0.0030 mm
D ₅₀ = 0.0161 mm	D ₁₀ = 0.0019 mm
C _u = 14.316	C _c = 1.060

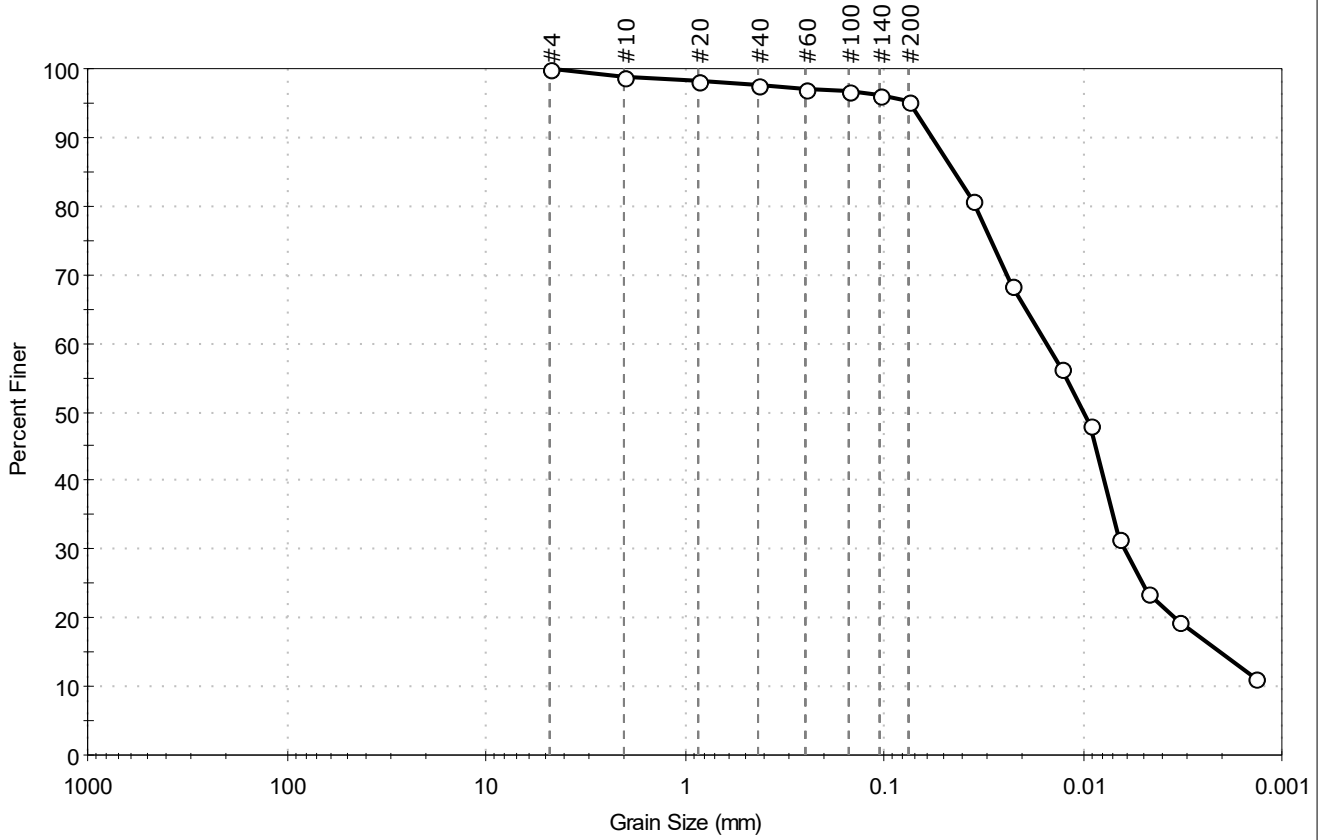
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-04-0-2.5	Test Date: 11/28/23
Depth: ---	Test Id: 745105
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown clay with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	4.6	95.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	98		
#40	0.42	98		
#60	0.25	97		
#100	0.15	97		
#140	0.11	96		
#200	0.075	95		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0359	81		
---	0.0225	69		
---	0.0130	56		
---	0.0092	48		
---	0.0066	32		
---	0.0047	23		
---	0.0033	19		
---	0.0014	11		

Coefficients	
D ₈₅ = 0.0444 mm	D ₃₀ = 0.0061 mm
D ₆₀ = 0.0154 mm	D ₁₅ = 0.0021 mm
D ₅₀ = 0.0100 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

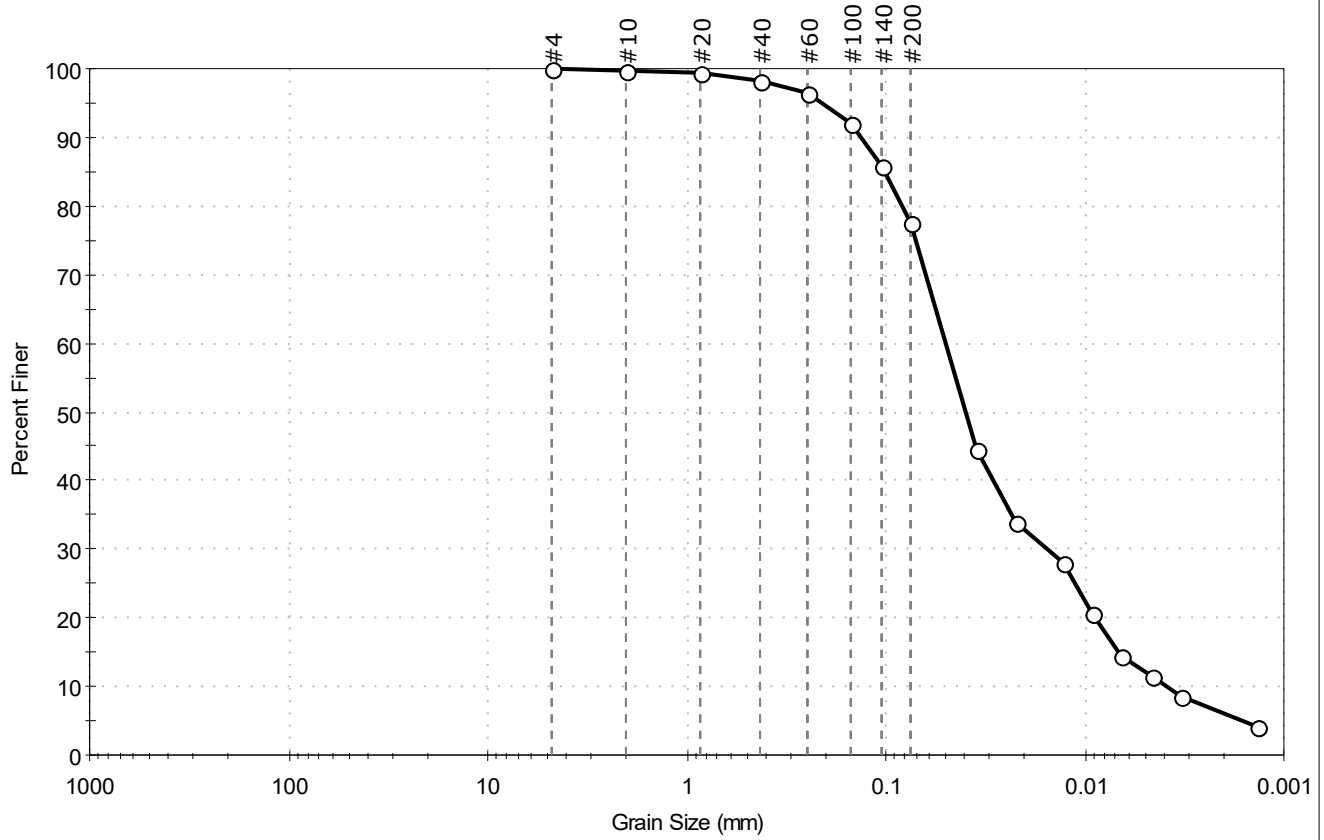
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-04-2.5-3	Test Date: 11/28/23
Depth: ---	Test Id: 745106
Tested By: ckg	Checked By: jsc
Test Comment: ---	
Visual Description: Moist, dark brown clay with sand	
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	22.5	77.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	98		
#60	0.25	97		
#100	0.15	92		
#140	0.11	86		
#200	0.075	78		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0351	45		
---	0.0222	34		
---	0.0128	28		
---	0.0091	21		
---	0.0065	15		
---	0.0047	12		
---	0.0033	9		
---	0.0014	4		

Coefficients	
D ₈₅ = 0.1027 mm	D ₃₀ = 0.0153 mm
D ₆₀ = 0.0501 mm	D ₁₅ = 0.0067 mm
D ₅₀ = 0.0398 mm	D ₁₀ = 0.0039 mm
C _u = 12.846	C _c = 1.198

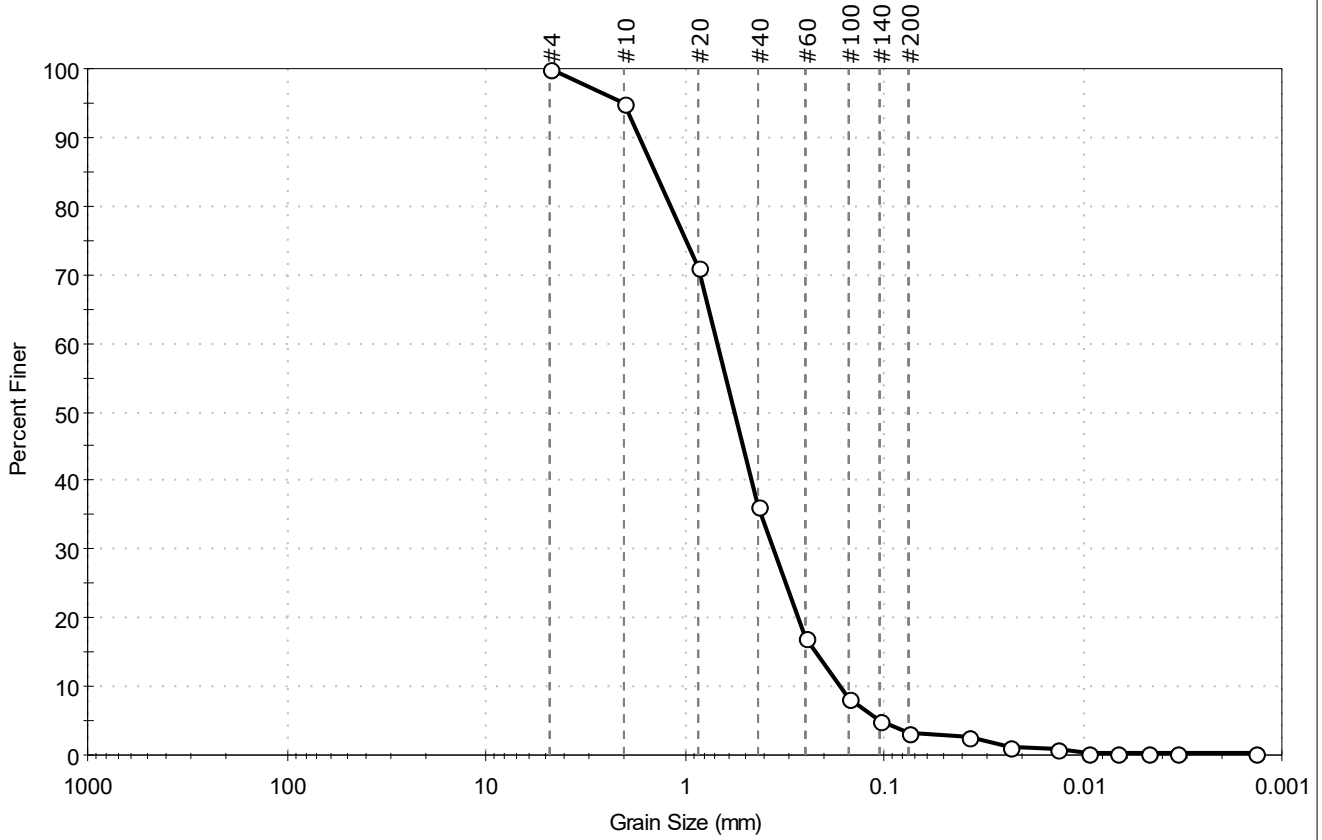
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-04-3-7	Test Date: 11/28/23
Depth: ---	Test Id: 745107
Test Comment: ---	Tested By: ckg
Visual Description: Moist, grayish brown sand	Checked By: jsc
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	96.9	3.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	95		
#20	0.85	71		
#40	0.42	36		
#60	0.25	17		
#100	0.15	8		
#140	0.11	5		
#200	0.075	3.1		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0374	3		
---	0.0235	1		
---	0.0134	1		
---	0.0095	0		
---	0.0067	0		
---	0.0047	0		
---	0.0034	0		
---	0.0014	0		

Coefficients	
D ₈₅ = 1.3974 mm	D ₃₀ = 0.3573 mm
D ₆₀ = 0.6813 mm	D ₁₅ = 0.2231 mm
D ₅₀ = 0.5582 mm	D ₁₀ = 0.1672 mm
C _u = 4.075	C _c = 1.121

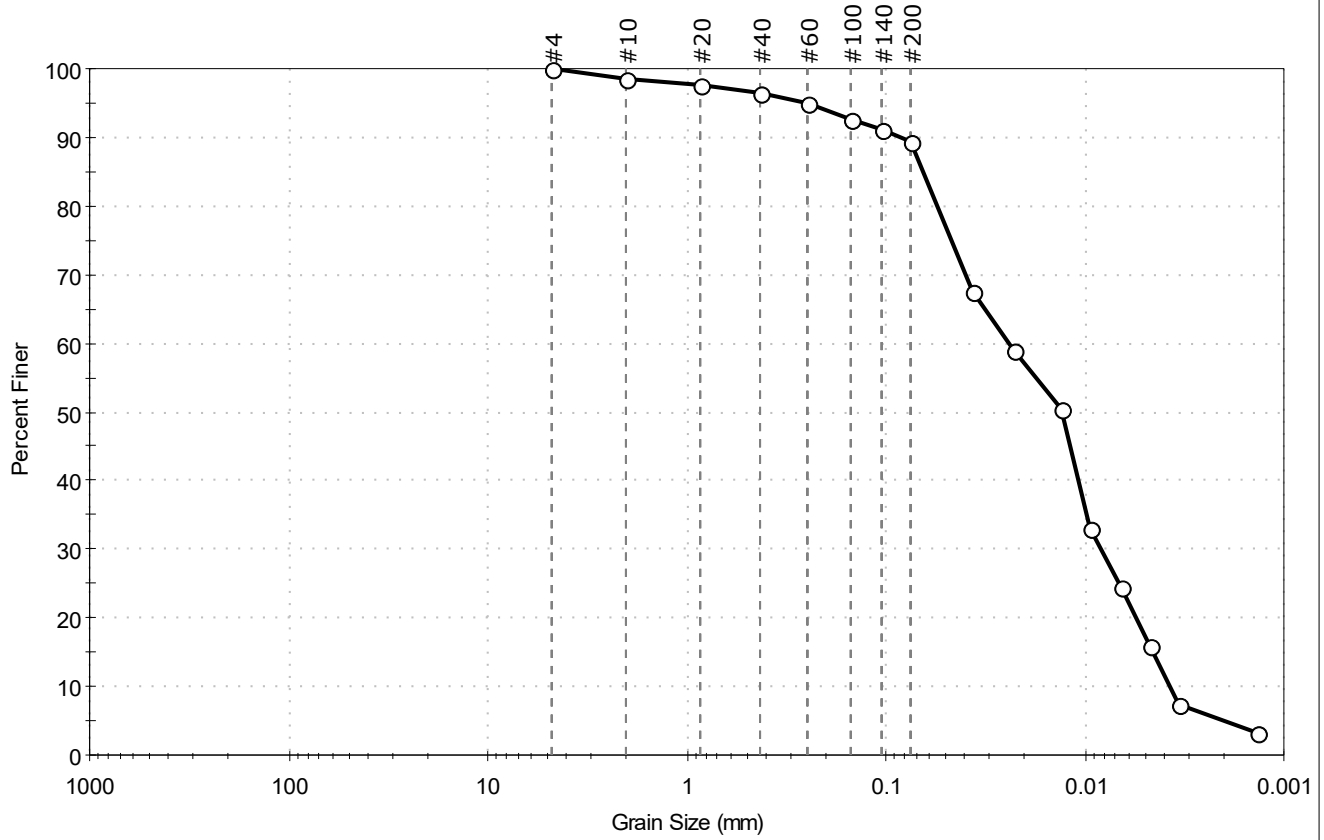
Classification	
ASTM	Poorly graded SAND (SP)
AASHTO	Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description	
Sand/Gravel Particle Shape	: ---
Sand/Gravel Hardness	: ---
Dispersion Device	: Apparatus A - Mech Mixer
Dispersion Period	: 1 minute
Est. Specific Gravity	: 2.65
Separation of Sample	: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-05-0-1	Test Date: 11/28/23
Depth: ---	Test Id: 745108
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown silt	Checked By: jsc
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	10.5	89.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	98		
#40	0.42	97		
#60	0.25	95		
#100	0.15	93		
#140	0.11	91		
#200	0.075	89		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0364	67		
---	0.0228	59		
---	0.0131	50		
---	0.0093	33		
---	0.0066	25		
---	0.0047	16		
---	0.0033	7		
---	0.0014	3		

<u>Coefficients</u>	
D ₈₅ = 0.0648 mm	D ₃₀ = 0.0082 mm
D ₆₀ = 0.0242 mm	D ₁₅ = 0.0045 mm
D ₅₀ = 0.0130 mm	D ₁₀ = 0.0037 mm
C _u = 6.541	C _c = 0.751

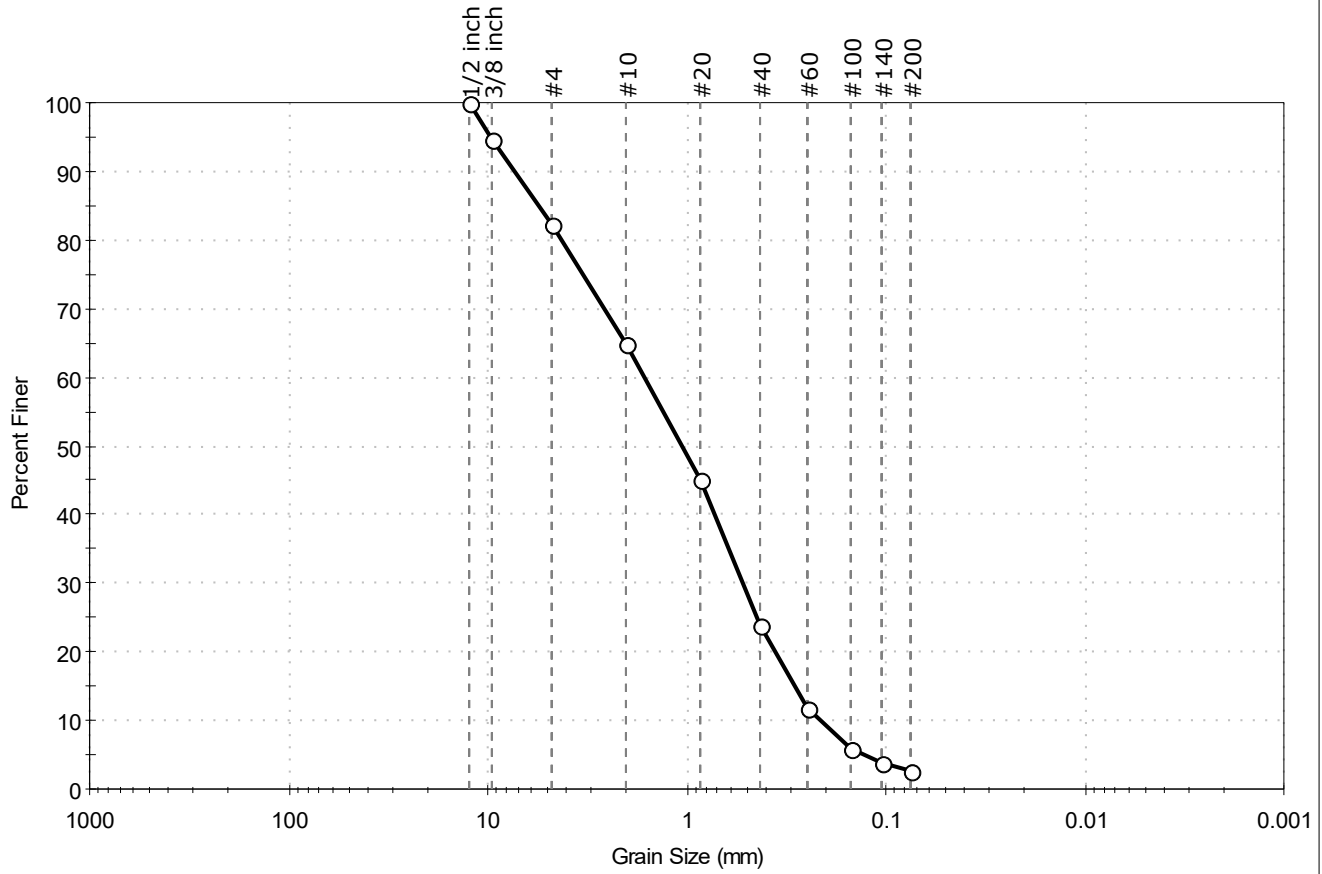
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-05-1-4.5	Test Date: 11/28/23
Depth: ---	Test Id: 745109
Test Comment: ---	Tested By: ckg
Visual Description: Moist, grayish brown sand with gravel	Checked By: jsc
Sample Comment: ---	

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	17.7	79.5	2.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1/2 inch	12.50	100		
3/8 inch	9.50	95		
#4	4.75	82		
#10	2.00	65		
#20	0.85	45		
#40	0.42	24		
#60	0.25	12		
#100	0.15	6		
#140	0.11	4		
#200	0.075	2.8		

<u>Coefficients</u>	
D ₈₅ = 5.5373 mm	D ₃₀ = 0.5181 mm
D ₆₀ = 1.6174 mm	D ₁₅ = 0.2877 mm
D ₅₀ = 1.0512 mm	D ₁₀ = 0.2151 mm
C _u = 7.519	C _c = 0.772

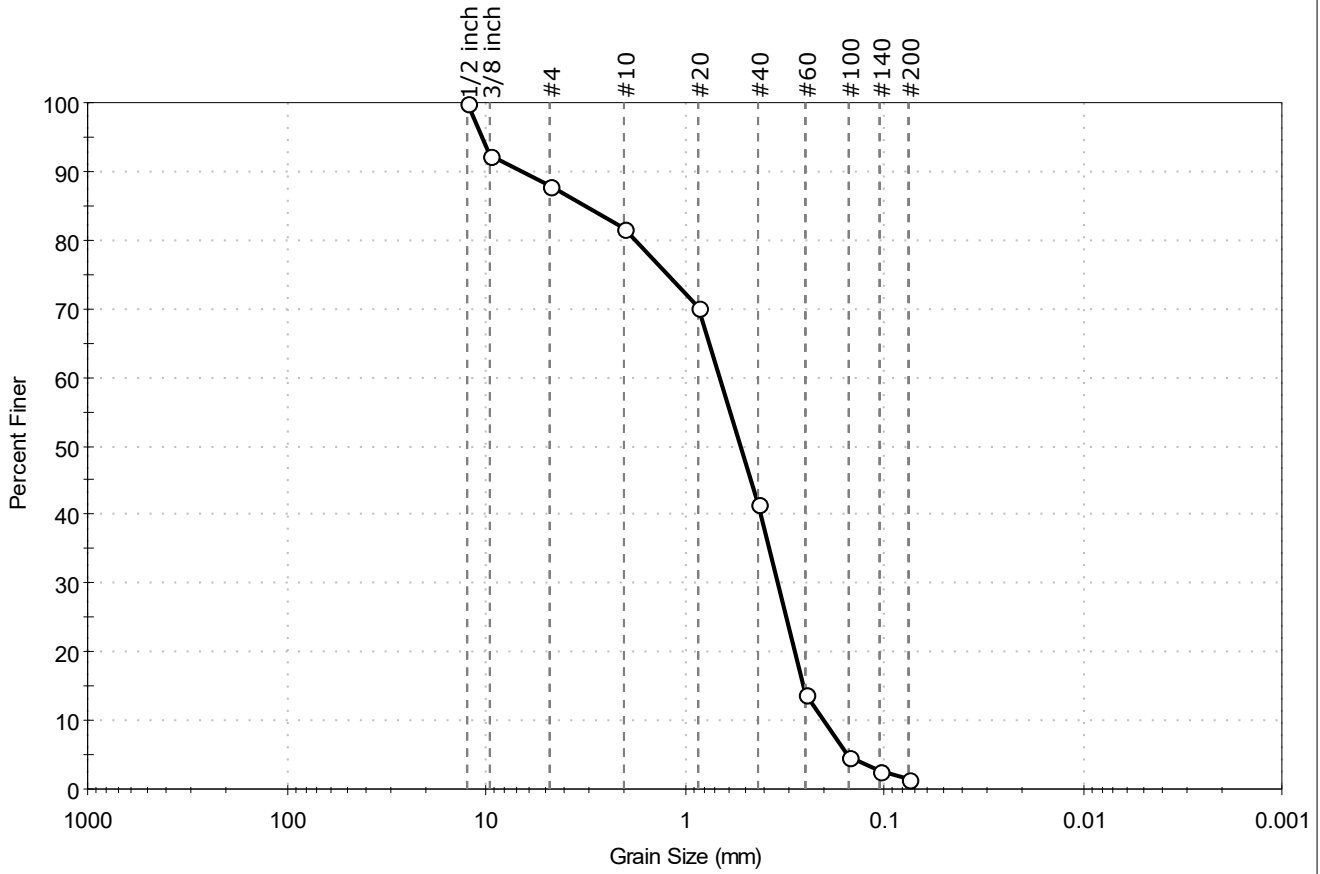
<u>Classification</u>	
<u>ASTM</u>	Poorly graded SAND with Gravel (SP)
<u>AASHTO</u>	Stone Fragments, Gravel and Sand (A-1-b (1))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape : ANGULAR	
Sand/Gravel Hardness : HARD	



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-05-4.5-7.5	Test Date: 11/28/23
Depth: ---	Test Id: 745110
Test Comment: ---	Tested By: ckg
Visual Description: Moist, yellowish brown sand	Checked By: jsc
Sample Comment: ---	

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	12.0	86.6	1.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1/2 inch	12.50	100		
3/8 inch	9.50	92		
#4	4.75	88		
#10	2.00	82		
#20	0.85	70		
#40	0.42	42		
#60	0.25	14		
#100	0.15	5		
#140	0.11	3		
#200	0.075	1.4		

Coefficients

D ₈₅ = 3.1395 mm	D ₃₀ = 0.3409 mm
D ₆₀ = 0.6644 mm	D ₁₅ = 0.2558 mm
D ₅₀ = 0.5218 mm	D ₁₀ = 0.2017 mm
C _u = 3.294	C _c = 0.867

Classification

ASTM	Poorly graded SAND (SP)
AASHTO	Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description

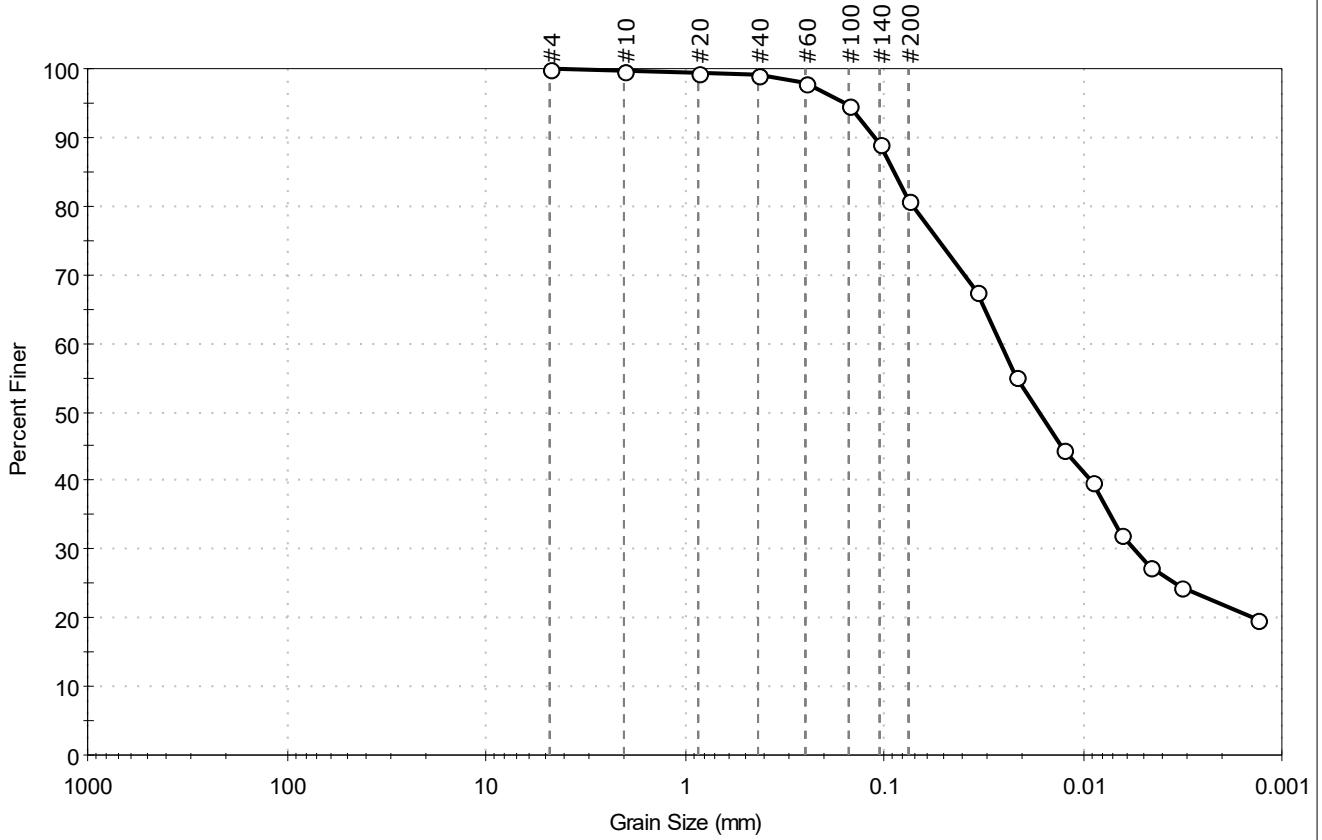
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD



Client: EA Engineering, Science, & Technology
 Project: Warner's Pond
 Location: Concord, MA
 Project No: GTX-318057
 Boring ID: --- Sample Type: tube Tested By: ckg
 Sample ID: SED-01-0-2.5 Test Date: 11/28/23 Checked By: jsc
 Depth: --- Test Id: 745076
 Test Comment: ---
 Visual Description: Moist, very dark brown silt with sand and organics
 Sample Comment: Sample contains organics

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	19.1	80.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	98		
#100	0.15	95		
#140	0.11	89		
#200	0.075	81		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0338	68		
---	0.0215	55		
---	0.0126	44		
---	0.0090	40		
---	0.0064	32		
---	0.0046	27		
---	0.0032	24		
---	0.0013	20		

Coefficients	
D ₈₅ = 0.0890 mm	D ₃₀ = 0.0055 mm
D ₆₀ = 0.0256 mm	D ₁₅ = N/A
D ₅₀ = 0.0166 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

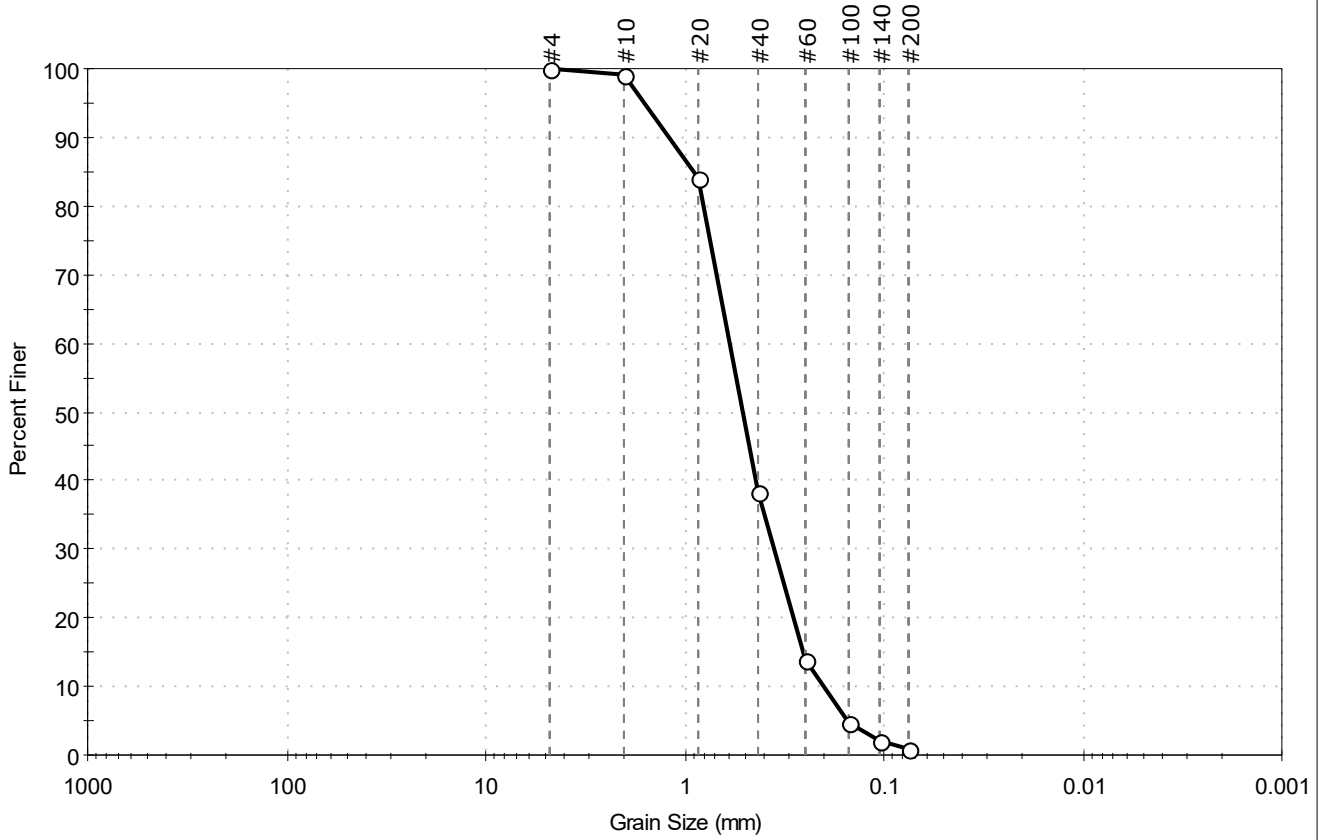
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-01-2.5-4.5	Test Date: 11/28/23
Depth: ---	Test Id: 745077
Test Comment: ---	Tested By: ckg
Visual Description: Moist, grayish brown sand	Checked By: jsc
Sample Comment: ---	

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	99.2	0.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	84		
#40	0.42	38		
#60	0.25	14		
#100	0.15	5		
#140	0.11	2		
#200	0.075	0.8		

Coefficients	
D ₈₅ = 0.9014 mm	D ₃₀ = 0.3545 mm
D ₆₀ = 0.5907 mm	D ₁₅ = 0.2559 mm
D ₅₀ = 0.5074 mm	D ₁₀ = 0.2005 mm
C _u = 2.946	C _c = 1.061

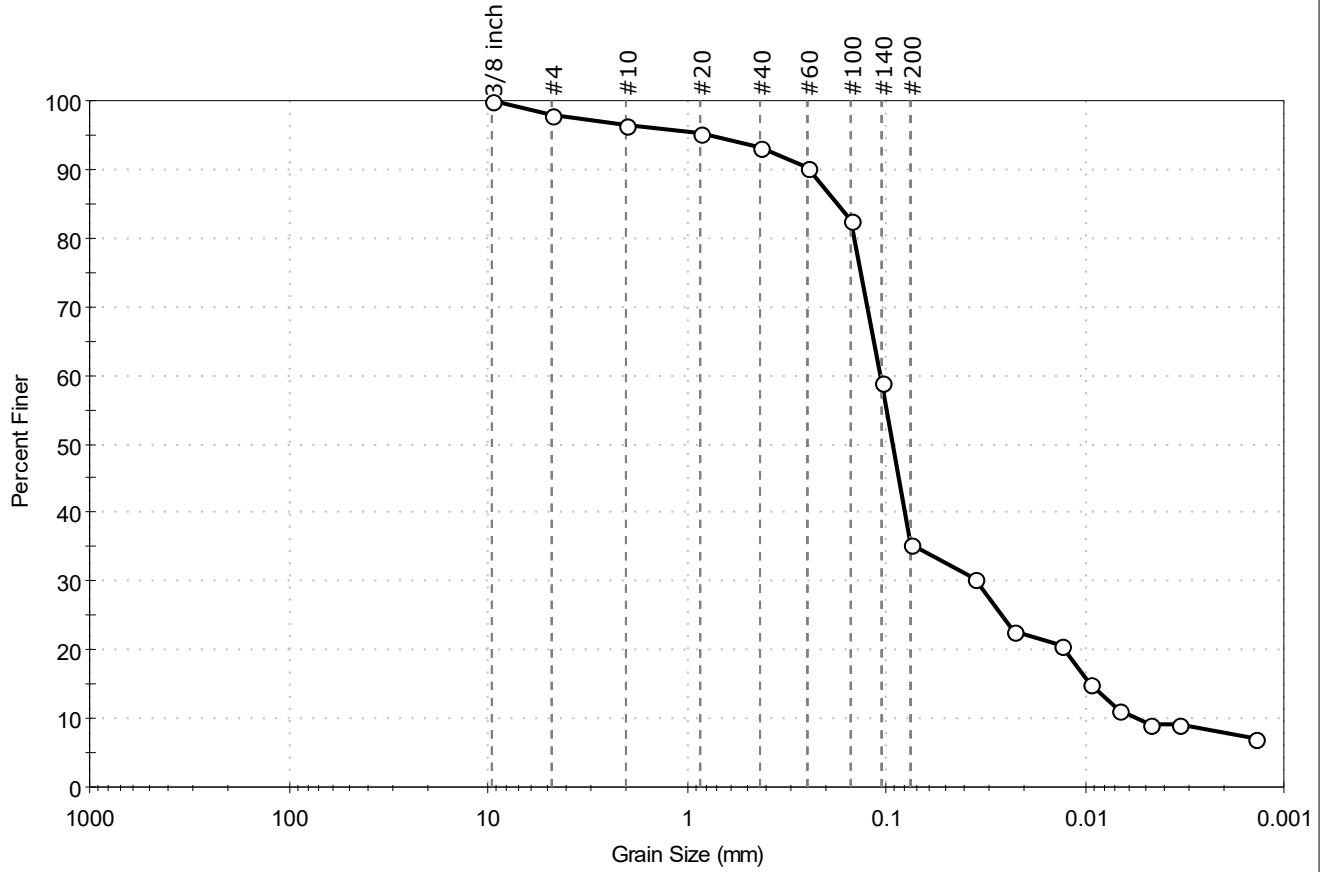
Classification	
ASTM	Poorly graded SAND (SP)
AASHTO	Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description	
Sand/Gravel Particle Shape	: ---
Sand/Gravel Hardness	: ---



Client: EA Engineering, Science, & Technology	Project: Warner's Pond	Location: Concord, MA	Project No: GTX-318057
Boring ID: ---	Sample Type: tube	Tested By: ckg	Checked By: jsc
Sample ID: SED-01-4.5-5.75	Test Date: 11/28/23	Test Id: 745078	
Depth: ---	Test Comment: ---	Visual Description: Moist, very dark brown silty sand with organics	Sample Comment: Sample contains organics

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	2.1	62.6	35.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	98		
#10	2.00	97		
#20	0.85	95		
#40	0.42	93		
#60	0.25	90		
#100	0.15	82		
#140	0.11	59		
#200	0.075	35		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0361	30		
---	0.0230	23		
---	0.0133	21		
---	0.0094	15		
---	0.0067	11		
---	0.0047	9		
---	0.0034	9		
---	0.0014	7		

Coefficients	
D ₈₅ = 0.1773 mm	D ₃₀ = 0.0356 mm
D ₆₀ = 0.1074 mm	D ₁₅ = 0.0094 mm
D ₅₀ = 0.0929 mm	D ₁₀ = 0.0054 mm
C _u = 19.889	C _c = 2.185

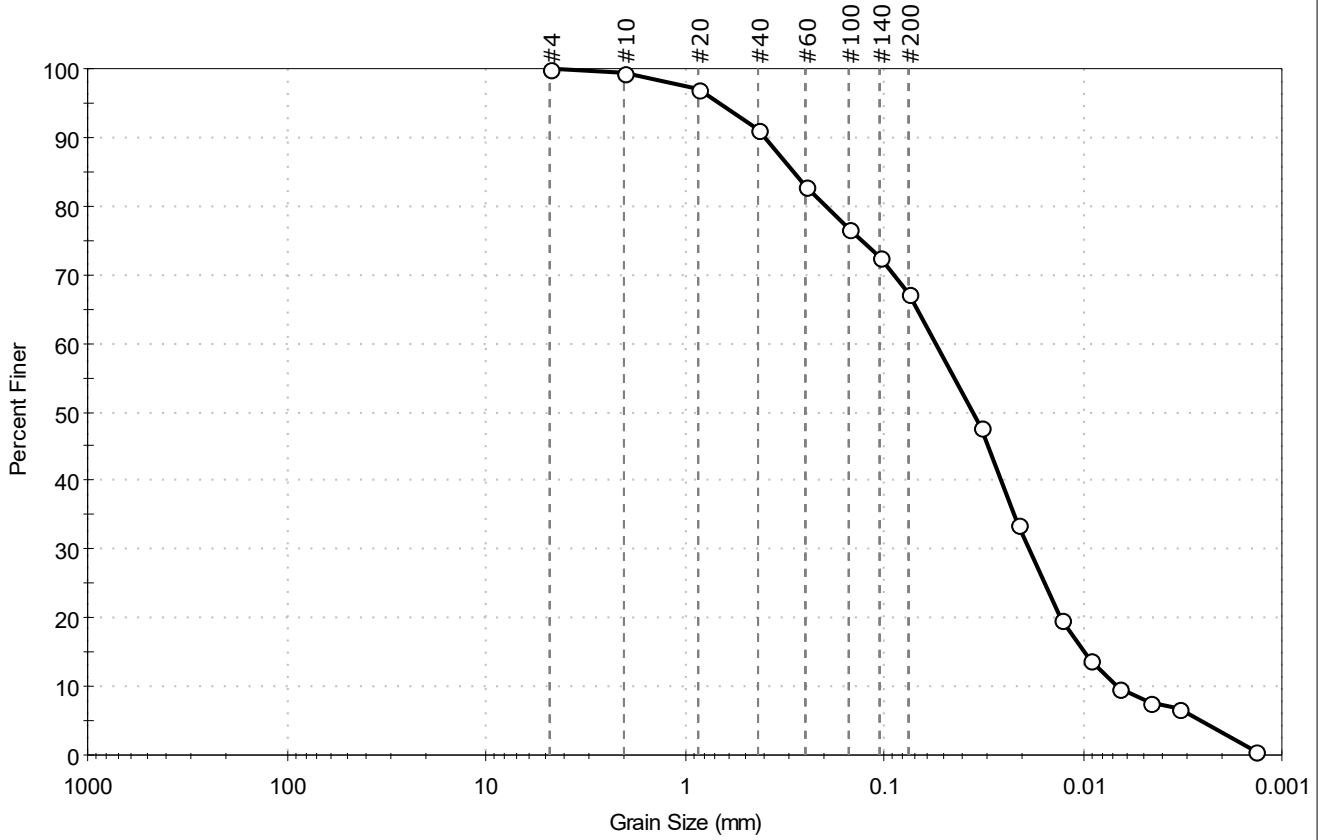
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-01-5.75-6.75	Test Date: 11/28/23
Depth: ---	Test Id: 745079
Test Comment: ---	Tested By: ckg
Visual Description: Moist, gray sandy clay with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	32.7	67.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	97		
#40	0.42	91		
#60	0.25	83		
#100	0.15	77		
#140	0.11	72		
#200	0.075	67		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0328	48		
---	0.0214	34		
---	0.0127	20		
---	0.0092	14		
---	0.0065	10		
---	0.0046	8		
---	0.0033	7		
---	0.0014	1		

<u>Coefficients</u>	
D ₈₅ = 0.2860 mm	D ₃₀ = 0.0186 mm
D ₆₀ = 0.0550 mm	D ₁₅ = 0.0098 mm
D ₅₀ = 0.0360 mm	D ₁₀ = 0.0067 mm
C _u = 8.209	C _c = 0.939

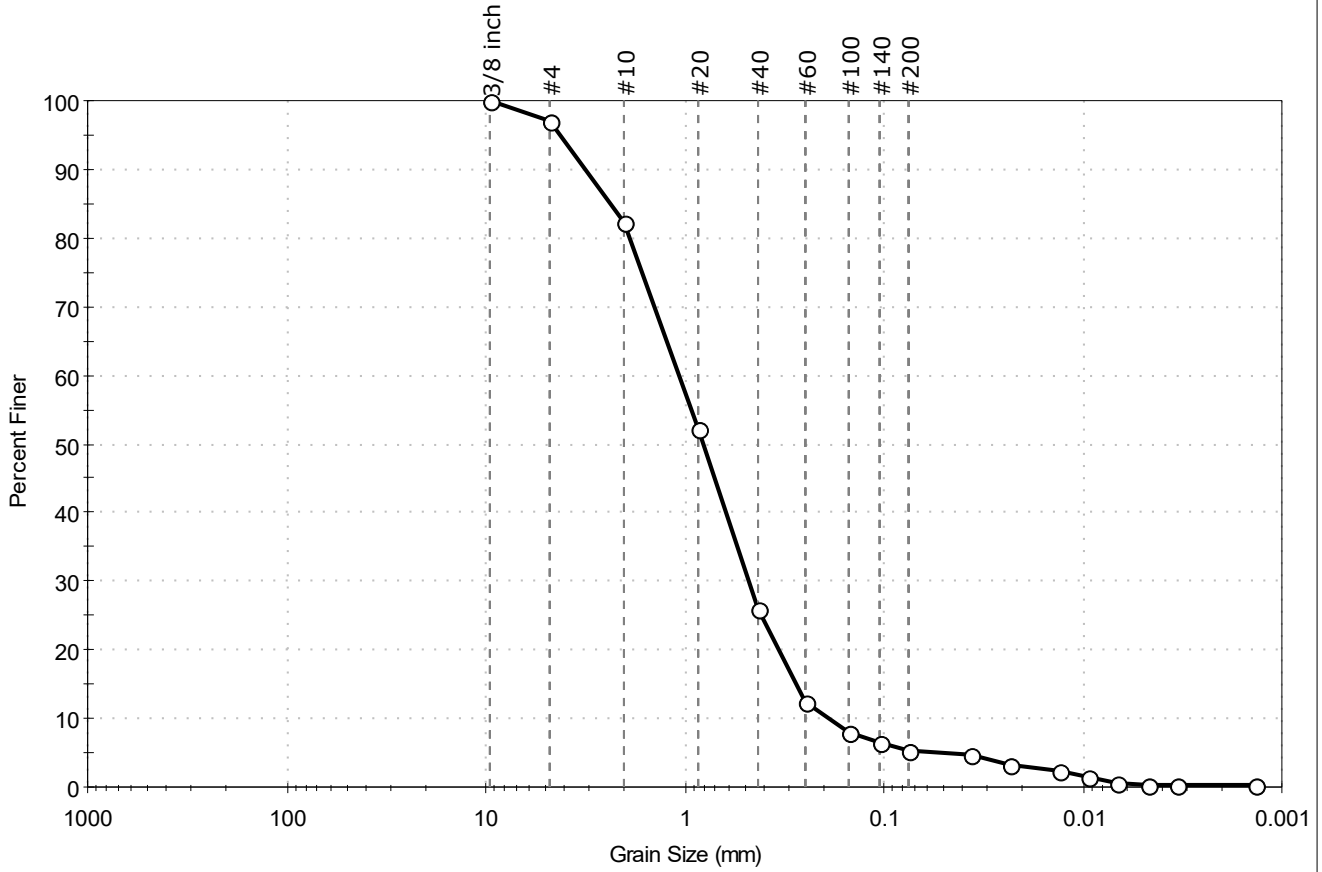
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-01-6.75-8	Test Date: 11/28/23
Depth: ---	Test Id: 745080
Tested By: ckg	Checked By: jsc
Test Comment: ---	
Visual Description: Moist, gray sand with silt	
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	3.0	91.6	5.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	97		
#10	2.00	82		
#20	0.85	52		
#40	0.42	26		
#60	0.25	12		
#100	0.15	8		
#140	0.11	7		
#200	0.075	5.4		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0364	5		
---	0.0231	3		
---	0.0133	2		
---	0.0094	1		
---	0.0067	1		
---	0.0047	0		
---	0.0034	0		
---	0.0014	0		

<u>Coefficients</u>	
D ₈₅ = 2.3437 mm	D ₃₀ = 0.4724 mm
D ₆₀ = 1.0592 mm	D ₁₅ = 0.2767 mm
D ₅₀ = 0.8005 mm	D ₁₀ = 0.1878 mm
C _u = 5.640	C _c = 1.122

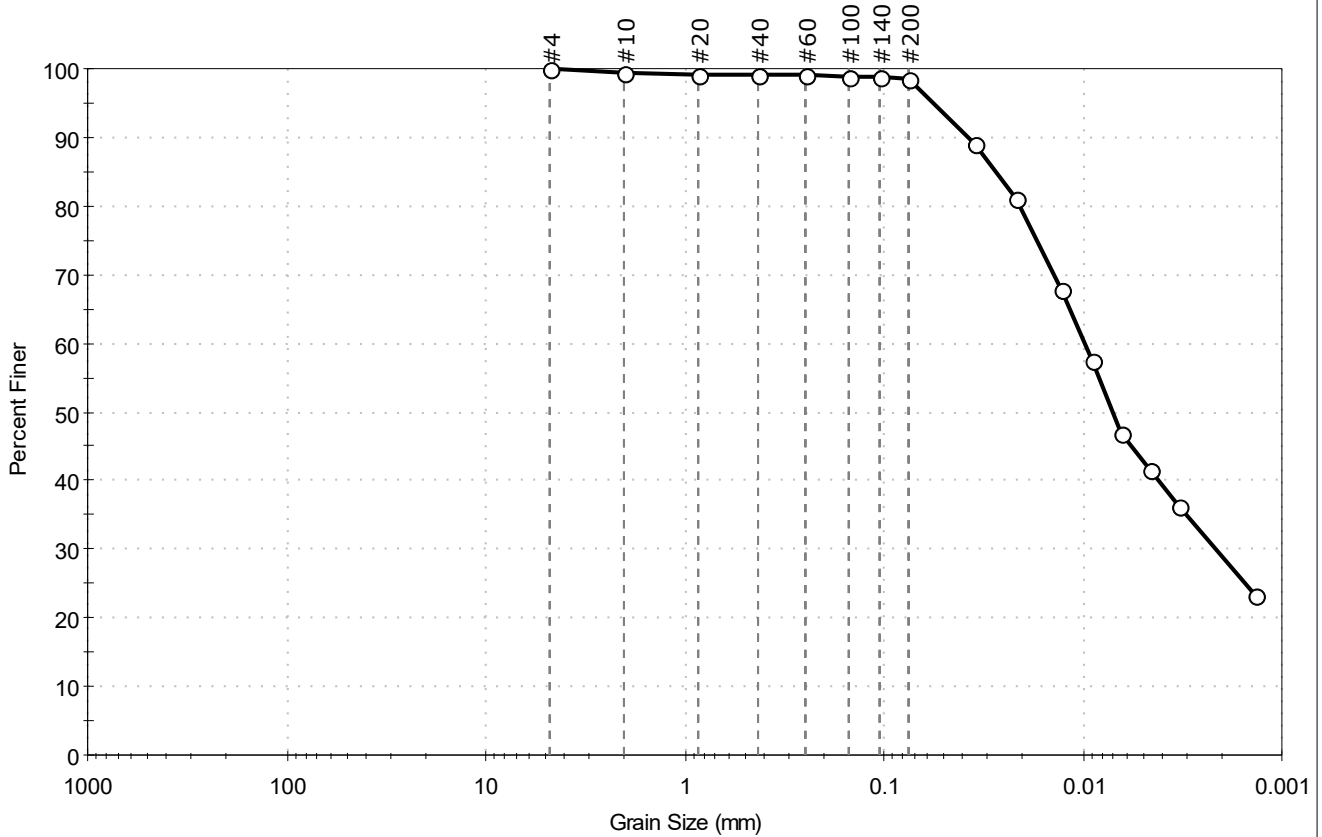
<u>Classification</u>	
ASTM	N/A
AASHTO	Stone Fragments, Gravel and Sand (A-1-b (1))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-02-0-3	Test Date: 11/28/23
Depth: ---	Test Id: 745081
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown silt with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	1.5	98.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	99		
#60	0.25	99		
#100	0.15	99		
#140	0.11	99		
#200	0.075	99		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0351	89		
---	0.0219	81		
---	0.0127	68		
---	0.0091	57		
---	0.0065	47		
---	0.0046	42		
---	0.0033	36		
---	0.0014	23		

Coefficients	
D ₈₅ = 0.0276 mm	D ₃₀ = 0.0021 mm
D ₆₀ = 0.0098 mm	D ₁₅ = N/A
D ₅₀ = 0.0071 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

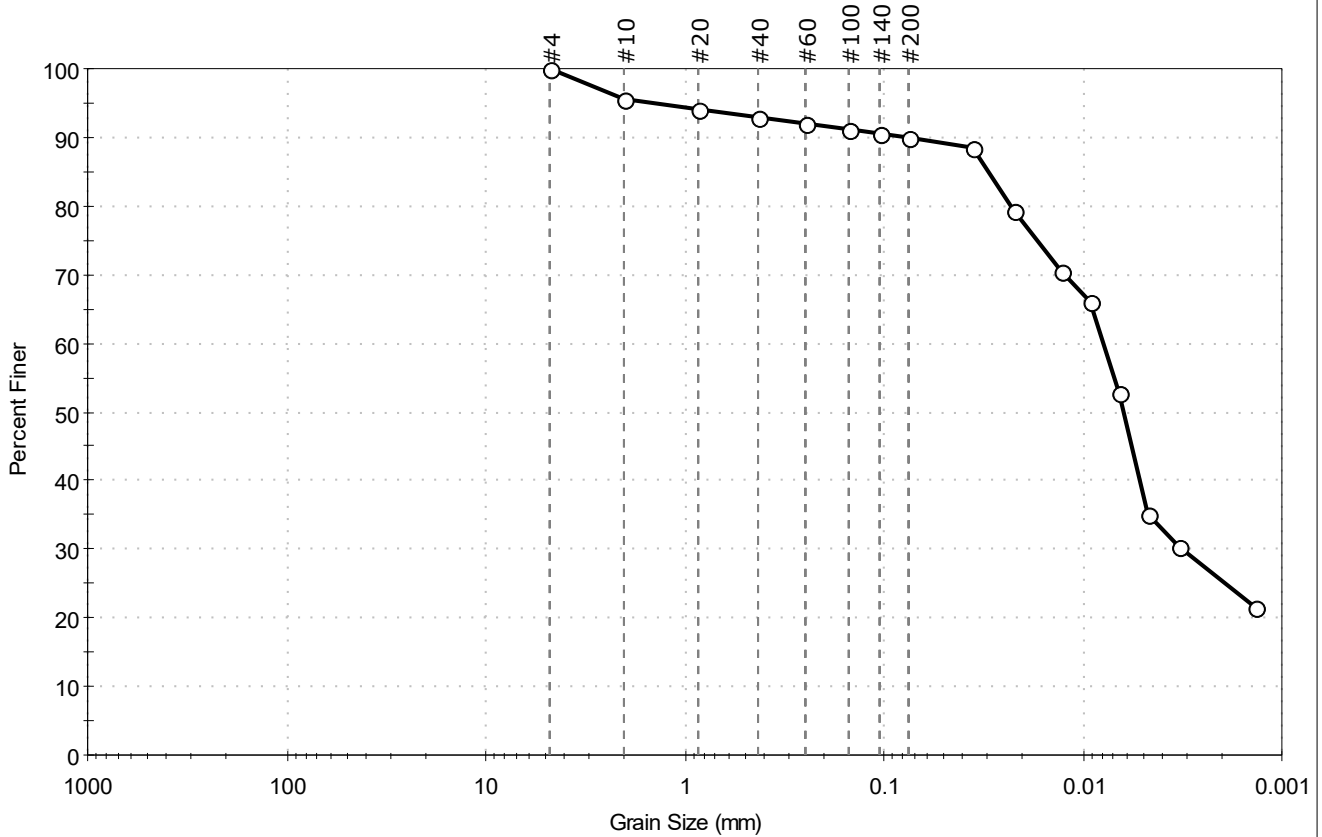
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-02-3-8	Test Date: 11/28/23
Depth: ---	Test Id: 745082
Test Comment: ---	Tested By: ckg
Visual Description: Moist, very dark brown silt with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	10.0	90.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	96		
#20	0.85	94		
#40	0.42	93		
#60	0.25	92		
#100	0.15	91		
#140	0.11	91		
#200	0.075	90		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0360	88		
---	0.0225	79		
---	0.0129	71		
---	0.0092	66		
---	0.0065	53		
---	0.0047	35		
---	0.0033	31		
---	0.0014	22		

Coefficients	
D ₈₅ = 0.0301 mm	D ₃₀ = 0.0031 mm
D ₆₀ = 0.0079 mm	D ₁₅ = N/A
D ₅₀ = 0.0062 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

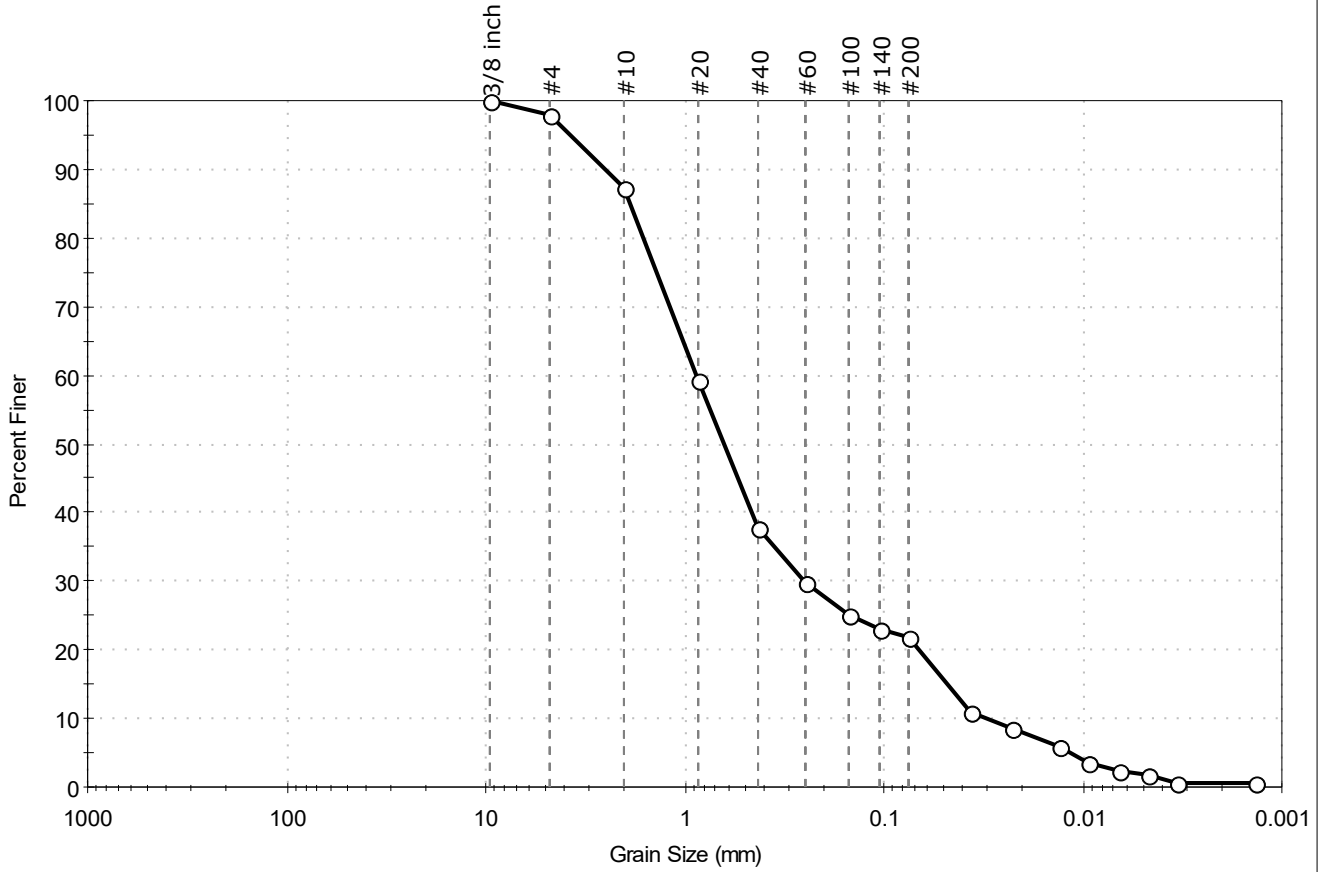
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-02-8-10	Test Date: 11/28/23
Depth: ---	Test Id: 745083
Test Comment: ---	Tested By: ckg
Visual Description: Moist, dark grayish brown silty sand with organics	Checked By: jsc
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	2.1	76.2	21.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	98		
#10	2.00	87		
#20	0.85	59		
#40	0.42	38		
#60	0.25	30		
#100	0.15	25		
#140	0.11	23		
#200	0.075	22		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0364	11		
---	0.0228	9		
---	0.0131	6		
---	0.0094	4		
---	0.0066	2		
---	0.0047	2		
---	0.0033	0		
---	0.0014	0		

Coefficients	
D ₈₅ = 1.8664 mm	D ₃₀ = 0.2544 mm
D ₆₀ = 0.8692 mm	D ₁₅ = 0.0477 mm
D ₅₀ = 0.6317 mm	D ₁₀ = 0.0301 mm
C _u = 28.877	C _c = 2.474

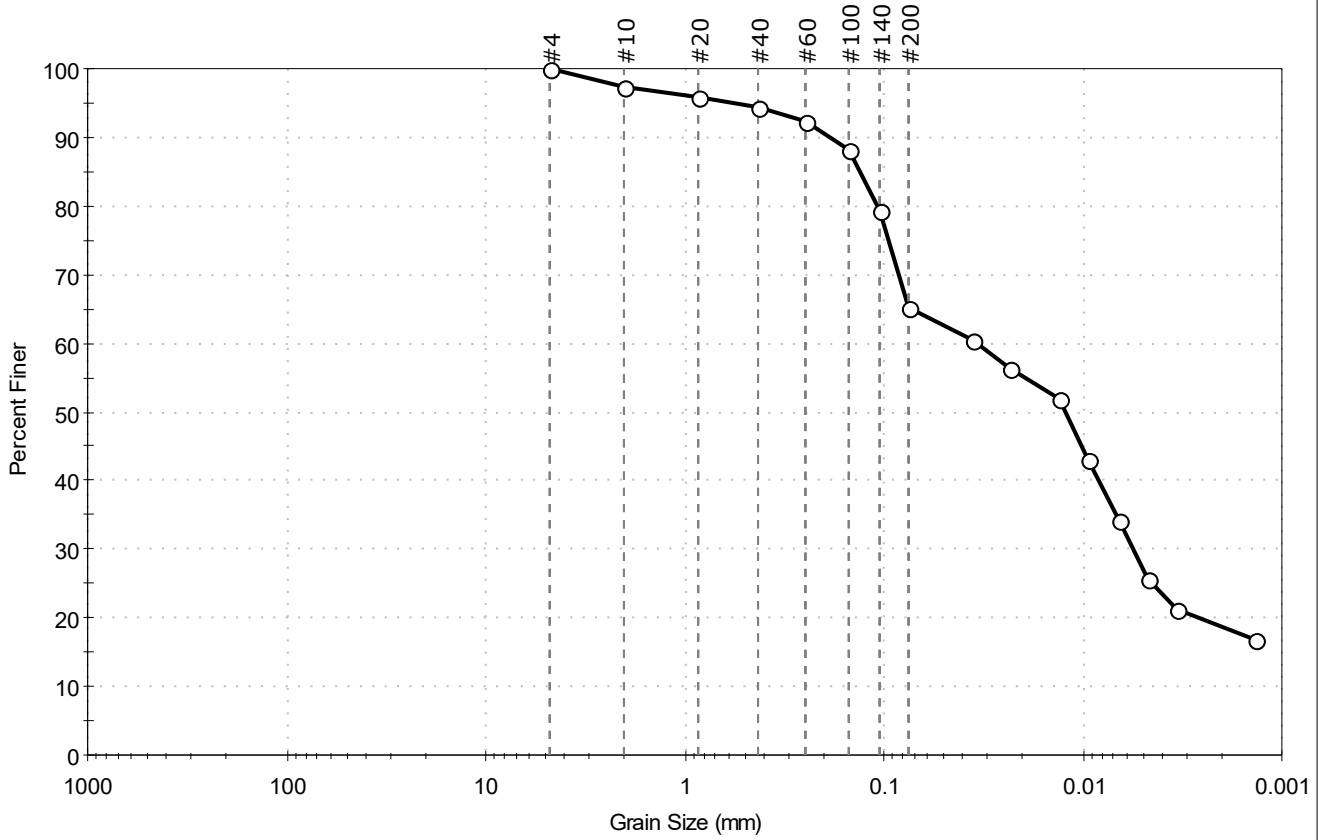
Classification	
ASTM	N/A
AASHTO	Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description
Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve



Client: EA Engineering, Science, & Technology	Project No: GTX-318057
Project: Warner's Pond	
Location: Concord, MA	
Boring ID: ---	Sample Type: tube
Sample ID: SED-03-0-6.5	Tested By: ckg
Depth: ---	Test Date: 11/28/23
Test Comment: ---	Checked By: jsc
Visual Description: Moist, very dark brown sandy silt with organics	Test Id: 745084
Sample Comment: Sample contains organics	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	34.7	65.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	97		
#20	0.85	96		
#40	0.42	94		
#60	0.25	92		
#100	0.15	88		
#140	0.11	79		
#200	0.075	65		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0361	61		
---	0.0231	56		
---	0.0132	52		
---	0.0093	43		
---	0.0067	34		
---	0.0047	26		
---	0.0034	21		
---	0.0014	17		

<u>Coefficients</u>	
D ₈₅ = 0.1325 mm	D ₃₀ = 0.0056 mm
D ₆₀ = 0.0340 mm	D ₁₅ = N/A
D ₅₀ = 0.0123 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

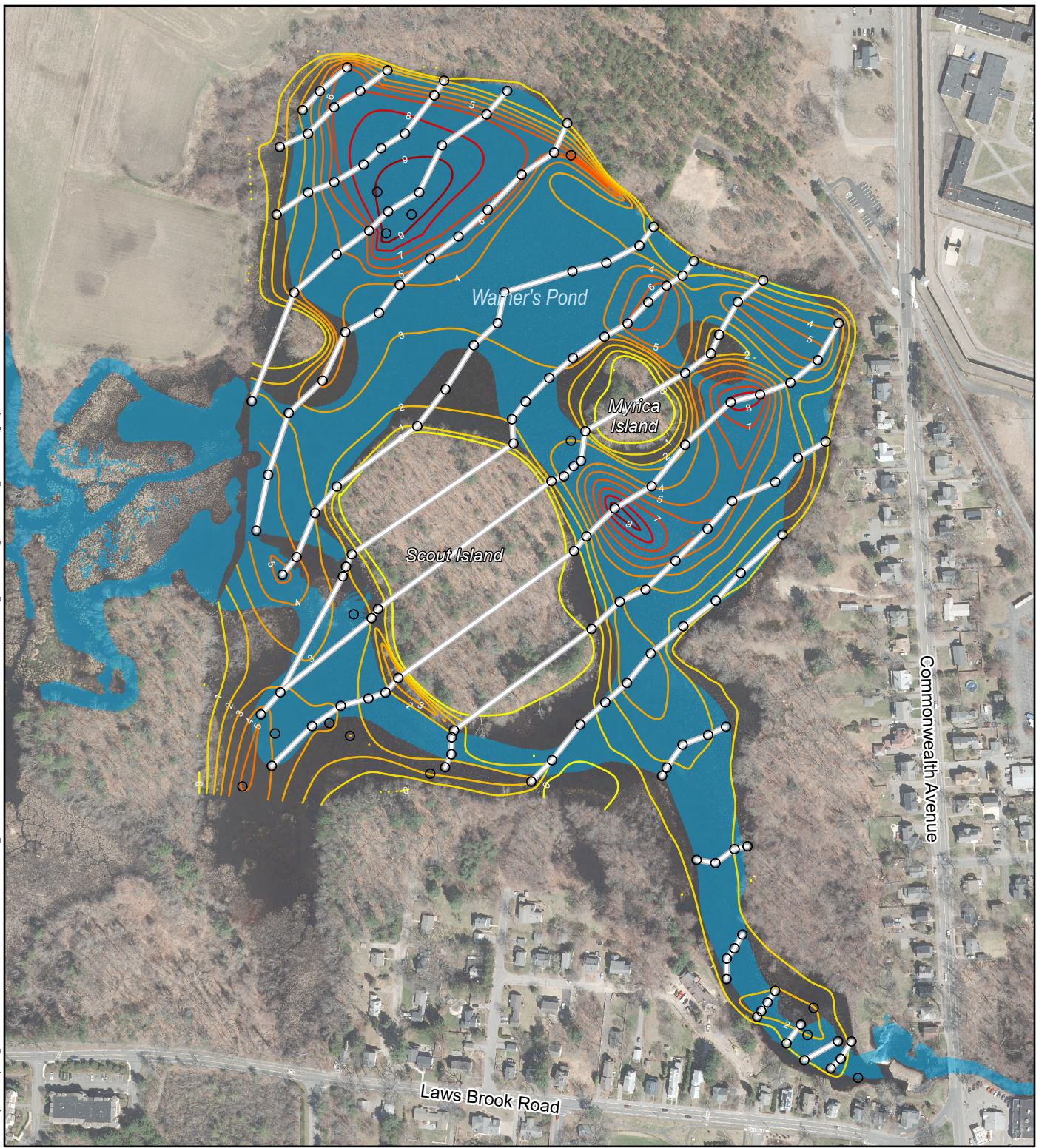
<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Appendix E:

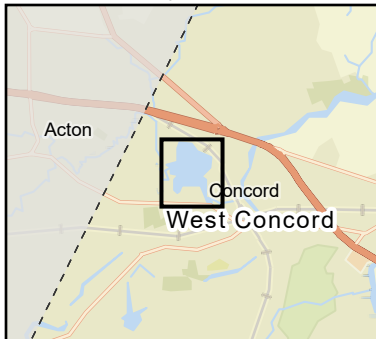
Mobile Sediment Volume Calculation

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I:\warwick\GIS\Warwick\StateandLocal\NorthEast\Massachusetts\6373001_Town\Concord\Warner'sPond\PROJECT\BIA\GIS\Warner'sPond_30PercentDesign\Warner'sPond_30PercentDesign.aprx etowne

VICINITY MAP



Legend

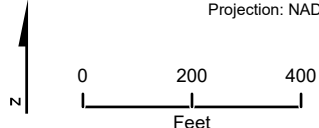
- Bathymetric / Sediment Depth Sample Point
- Cross-Section
- Post-Dam Removal Baseflow Inundation

Sediment Depth Contour (feet)

0	3	6	9
1	4	7	
2	5	8	

Appendix E
Mobile Sediment Volume Calculation
 Warner's Pond 30% Design
 Concord, MA

Map Date: 8/20/2024
 Source: MassGIS 2022
 Projection: NAD 1983 UTM Zone 19N



Appendix F:

Nashoba Brook Field Photos

**Photo Log:
Upstream Reach of Nashoba Brook
September 25, 2004**



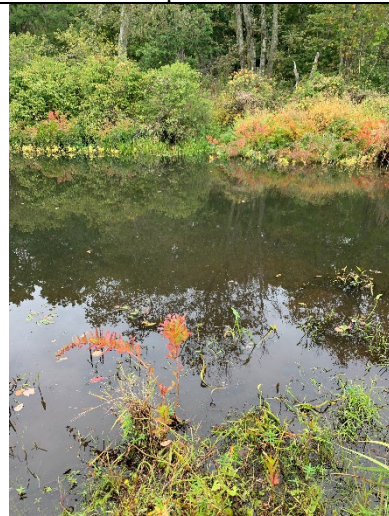
Transect 1 Location; Standing on east bank, looking upstream



Transect 2 Location; Standing on east bank, looking upstream



Transect 3 Location; Standing on east bank, looking downstream



Transect 4 location; standing on east bank looking west.



Transect 6 location; standing on east bank, looking downstream



Transect 7 location; standing on east bank, looking downstream

**Photo Log:
Upstream Reach of Nashoba Brook
September 25, 2004**



Field north of Warner's Pond



Field north of Warner's Pond

Location: Warner's Pond Date: 9/25/04
Project/Client: BARNETT TRANSECTS - DIVERSITY OF POND

RET

Transect 1
 • Walked in from the east bank, got 32.7' into the channel before needing to stop due to depth of channel.
 • Estimate 10 more feet to west bank.

Station (ft)	Depth (ft)
0	4.5
5	3
10	3
15	2.75
20	2.25
25	2.75
30	2.5

Transect 2
 • Walked in from the east bank, got 13.4' into the channel before needing to stop due to depth of channel.
 • Estimate that Alex went 50% of the way across the channel.

Station (ft)	Depth (ft)
0	4.25
3	3
6	3.25
9	2.25
12	1.75
15	0.5
22	0.25
25	

Transect 3
 • Walked in from the east bank, got 25.8' into the channel before needing to stop due to depth of channel.
 • Estimate that Alex went 50% of the way across the channel.

Station (ft)	Depth (ft)
0	4.25
3	3
6	3.25
9	2.25
12	1.75
15	0.5
22	0.25
25	

emergent wetland sheet begins
emergent wetland soil ends

Field Measurements

Location: Warner's Pond Date: 9/25/04
Project/Client: BARNETT TRANSECTS - DIVERSITY OF POND

Transect 4
 • Walked in from the east bank, got 24.0' into the channel before needing to stop due to channel depth.
 • Estimate Alex went 50% of the way across the channel.

Station (ft)	Depth (ft)
0	4.5
3	4
6	3.5
9	3.25
12	2.5
15	1.25
18	0

Transect 5
 • Walked in from the bank.
 • Got about 19.2' in (1/2 of way across) before stopping due to water depth.

Station (ft)	Depth (ft)
0	3.75
2	3.75
4	3.5
6	3.25
8	3.0
10	2.25
12	1.5
14	1.0
16	1.0

Field Measurements



Concord Municipal Light Plant
Concord Information Technology

N

Fort Pond Brook

T2

T3

T1

T4

T5

T6

T7

Gulf Gas & Quick Shop

MCI Concord Parking

Bruce Freeman Rail Trail Parking

Warners Pond

Warners Pond

Commonwealth Ave

Wright Rd

more information

Appendix G:
HEC-RAS Alternate Flow Conditions

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HEC-RAS Flow Condition Exports

EA used StreamStats and the historic USGS gauge record to develop flows for the below evaluation. A summary of the flow data is presented in the tables below. A full record of the gauge data is also included under a separate section.

Average flow in August

41 cfs	all years
21 cfs	2006
6 cfs	2007
84 cfs	2008
52 cfs	2009

Row Labels	Average of Discharge (ft ³ /s)	Max of Discharge (ft ³ /s)	Min of Discharge (ft ³ /s)
January	102	210	31.1
February	161	536	27.4
March	206	626	36.3
April	199	789	38.4
May	96	397	23
June	49	211	9.49
July	64	290	6.66
August	41	234	3.33
September	40	453	1.39
October	39	182	1.1
November	81	298	6.38
December	101	463	11.2
Grand Total	94	789	1.1

Figure A. Location of channel through Warner's Pond. The approximate channel width and depth were estimated using a profile line drawn in Aterra's HEC-RAS model that follows the deepest sections of terrain.



Figure B. Water surface depth contours (1-ft contours) during baseflow (53 CFS) post-dam removal

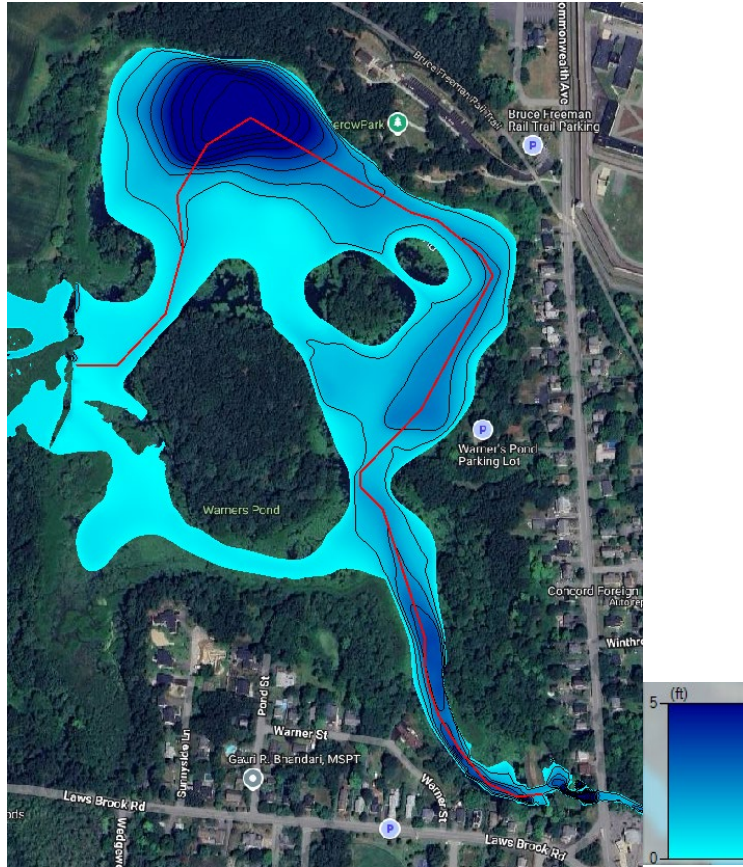


Figure C. Profile view of water surface elevation modeled during the baseflow (53 CFS) post-dam removal.

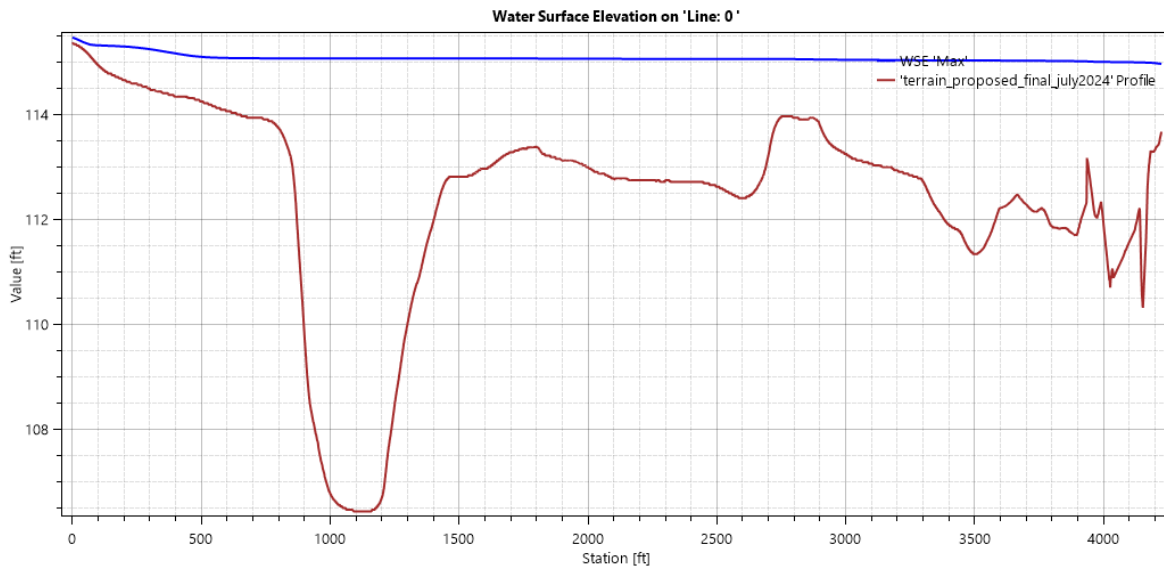


Figure D. Water surface depth contours (1-ft contours) during average flow during August (41 CFS) post-dam removal

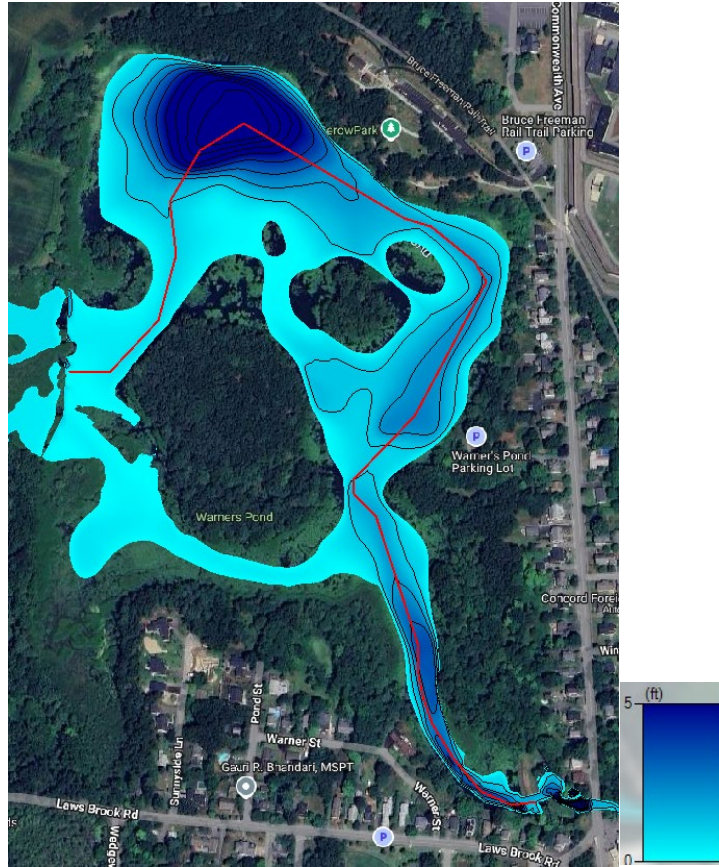


Figure E. Profile view of water surface elevation modeled for average August flow (41 CFS) post-dam removal.

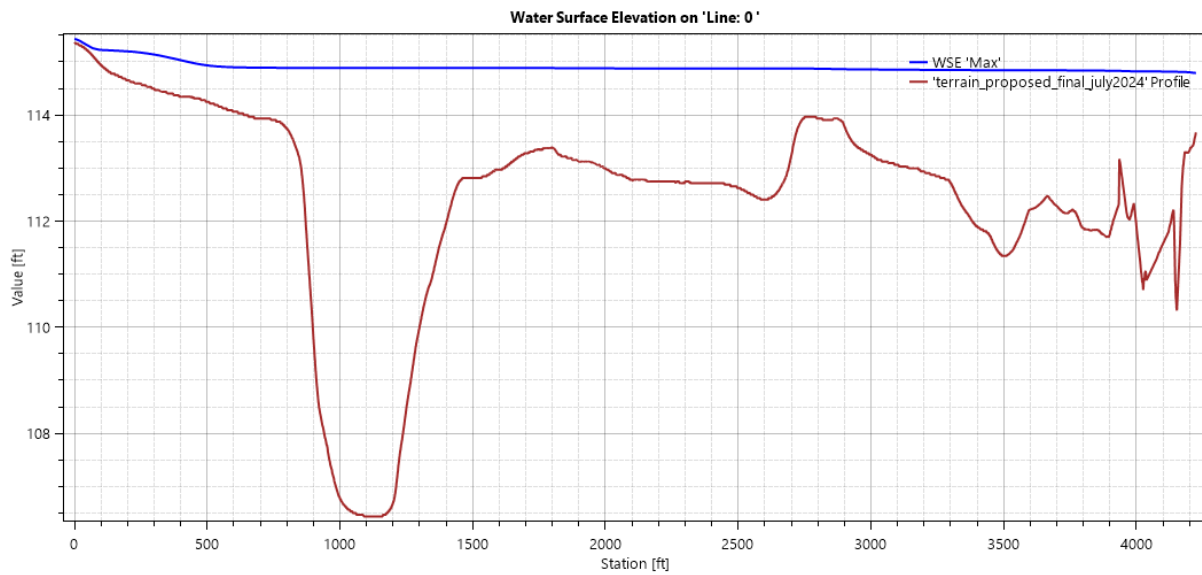


Figure F. Water surface depth contours (1-ft contours) during the August 50% exceedance flow (11 CFS) post-dam removal.

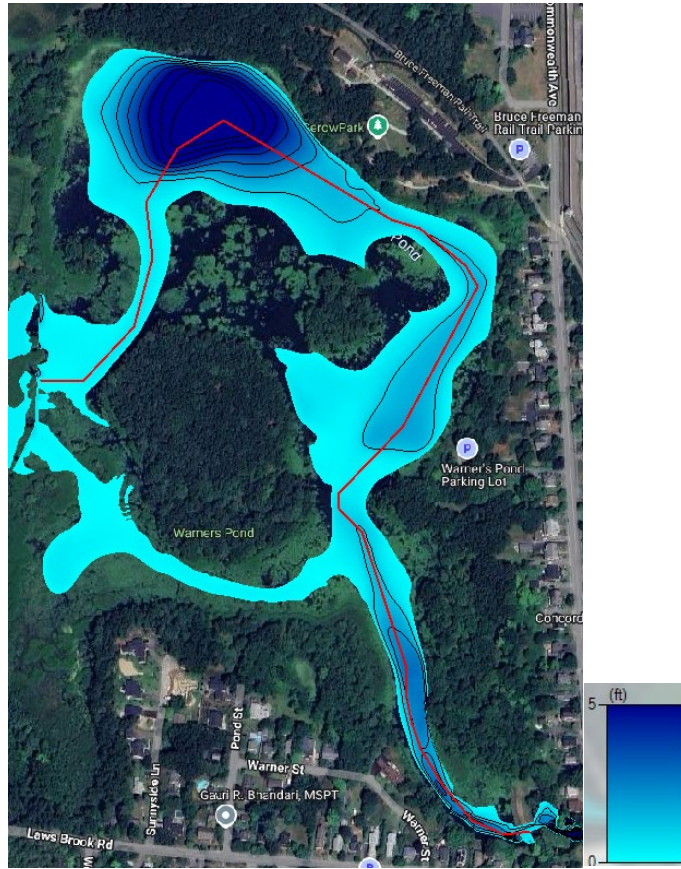
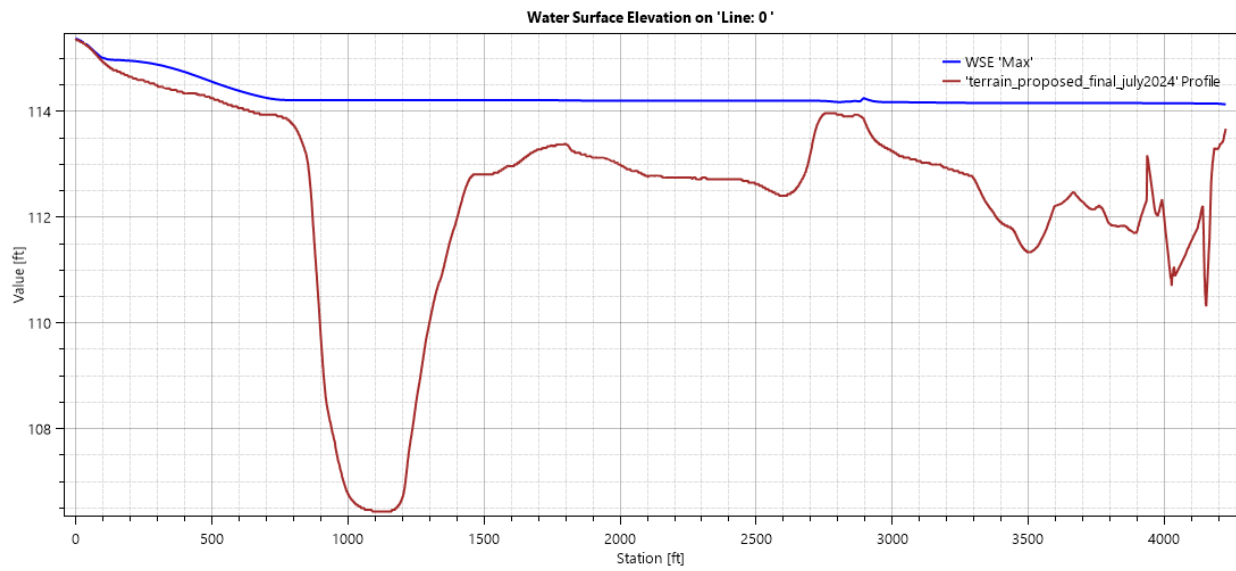
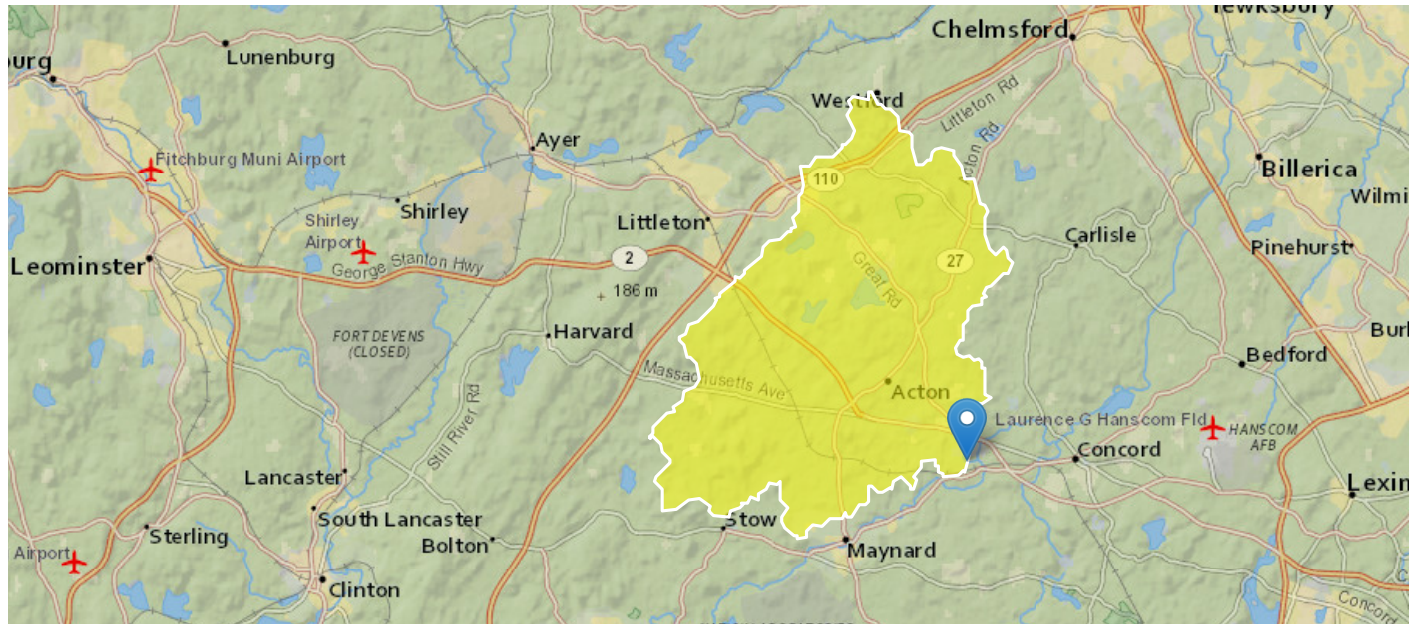


Figure G. Profile view of water surface elevation modeled for the August 50% exceedance flow (11 CFS) post-dam removal.



Warner's Pond StreamStats Report

Region ID: MA
Workspace ID: MA20240913130920681000
Clicked Point (Latitude, Longitude): 42.45892, -71.39795
Time: 2024-09-13 09:09:44 -0400



[+ Collapse All](#)

➤ Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
ACRSDFT	Area underlain by stratified drift	18	square miles
BSLDEM10M	Mean basin slope computed from 10 m DEM	5.244	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	2.286	percent
CAT1ROADS	Length of interstates lmt'd access highways and ramps for lmt'd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	15.8	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmt'd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	4.78	miles
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	27.2	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	270	miles
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	203795.8	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	916448.6	meters
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	21	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	6	dimensionless

Parameter Code	Parameter Description	Value	Unit
CROSCOUNT3	Number of intersections between streams and roads, where roads are local connecting roads (CAT3ROADS)	29	dimensionless
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	173	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	38.58	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	11.1	feet per mi
DRFTPERSTR	Area of stratified drift per unit of stream length	0.16	square mile per mile
DRNAREA	Area that drains to a point on a stream	46.6	square miles
ELEV	Mean Basin Elevation	237	feet
FOREST	Percentage of area covered by forest	59	percent
LAKEAREA	Percentage of Lakes and Ponds	2.36	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	14.88	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	33.1	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	11.5	percent
LFPLENGTH	Length of longest flow path	14.8	miles
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
MAXTEMPC	Mean annual maximum air temperature over basin area, in degrees Centigrade	15.1	degrees C
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	208395	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	912045	feet
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	38.58	percent
PRECPRI00	Basin average mean annual precipitation for 1971 to 2000 from PRISM	46.6	inches
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	115	miles
WETLAND	Percentage of Wetlands	14.29	percent

➤ Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	0.16	512
ELEV	Mean Basin Elevation	237	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	14.88	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	693	ft ³ /s	356	1350	42.3
20-percent AEP flood	1110	ft ³ /s	563	2190	43.4
10-percent AEP flood	1430	ft ³ /s	709	2880	44.7
4-percent AEP flood	1890	ft ³ /s	906	3940	47.1
2-percent AEP flood	2260	ft ³ /s	1050	4860	49.4
1-percent AEP flood	2650	ft ³ /s	1190	5880	51.8
0.5-percent AEP flood	3070	ft ³ /s	1340	7010	54.1
0.2-percent AEP flood	3670	ft ³ /s	1540	8770	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (<https://dx.doi.org/10.3133/sir20165156>)

➤ Low-Flow Statistics

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.286	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.16	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct (other -- see report)

Statistic	Value	Unit	PIL	PIU	SE	ASEp
7 Day 2 Year Low Flow	5.24	ft ³ /s	1.63	16.3	49.5	49.5
7 Day 10 Year Low Flow	2.24	ft ³ /s	0.566	8.26	70.8	70.8

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (<http://pubs.usgs.gov/wri/wri004135/>)

➤ Flow-Duration Statistics

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0.16	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	2.286	percent	0.32	24.6

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct (other -- see report)

Statistic	Value	Unit	PIL	PIU	SE	ASEp
50 Percent Duration	48.1	ft ³ /s	27.1	84.8	17.6	17.6
60 Percent Duration	36.5	ft ³ /s	18.3	72.5	19.8	19.8
70 Percent Duration	22.9	ft ³ /s	9.56	54.3	23.5	23.5
75 Percent Duration	18	ft ³ /s	7.47	42.8	25.8	25.8
80 Percent Duration	13.7	ft ³ /s	5.41	34.2	28.4	28.4
85 Percent Duration	10.5	ft ³ /s	4.11	26.4	31.9	31.9
90 Percent Duration	7.67	ft ³ /s	2.83	20.3	36.6	36.6
95 Percent Duration	4.8	ft ³ /s	1.58	14.1	45.6	45.6
98 Percent Duration	3.13	ft ³ /s	0.892	10.4	60.3	60.3
99 Percent Duration	2.44	ft ³ /s	0.654	8.57	65.1	65.1

Flow-Duration Statistics Citations

Ries, K.G., III, 2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (<http://pubs.usgs.gov/wri/wri004135/>)

➤ August Flow-Duration Statistics

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.286	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.16	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct (other -- see report)

Statistic	Value	Unit	PIL	PIU	SE	ASEp
August 50 Percent Duration	11.2	ft ³ /s	4.37	28.2	33.2	33.2

August Flow-Duration Statistics Citations

Ries, K.G., III, 2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (<http://pubs.usgs.gov/wri/wri004135/>)

➤ Bankfull Statistics

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	5.244	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	64.6	ft	21.3
Bankfull Depth	2.76	ft	19.8
Bankfull Area	178	ft ²	29
Bankfull Streamflow	533	ft ³ /s	55

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	74.8	ft
Bieger_D_channel_depth	3.38	ft
Bieger_D_channel_cross_sectional_area	258	ft ²

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	74.1	ft
Bieger_P_channel_depth	3.2	ft
Bieger_P_channel_cross_sectional_area	246	ft ²

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	47.9	ft
Bieger_USA_channel_depth	2.73	ft
Bieger_USA_channel_cross_sectional_area	136	ft ²

Bankfull Statistics Flow Report [Area-Averaged]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	64.6	ft	21.3
Bankfull Depth	2.76	ft	19.8
Bankfull Area	178	ft ²	29
Bankfull Streamflow	533	ft ³ /s	55
Bieger_D_channel_width	74.8	ft	
Bieger_D_channel_depth	3.38	ft	
Bieger_D_channel_cross_sectional_area	258	ft ²	
Bieger_P_channel_width	74.1	ft	
Bieger_P_channel_depth	3.2	ft	
Bieger_P_channel_cross_sectional_area	246	ft ²	
Bieger_USA_channel_width	47.9	ft	
Bieger_USA_channel_depth	2.73	ft	
Bieger_USA_channel_cross_sectional_area	136	ft ²	

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M., 2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013-5155, 62 p., (<http://pubs.usgs.gov/sir/2013/5155/>)

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G., 2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFCoverPages)

➤ Probability Statistics

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	0.01	1.99
PCTSDNGRV	Percent Underlain By Sand And Gravel	38.58	percent	0	100
FOREST	Percent Forest	59	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Disclaimers [Perennial Flow Probability]

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

Probability Statistics Flow Report [Perennial Flow Probability]

Statistic	Value	Unit
Probability Stream Flowing Perennially	0.997	dim

Probability Statistics Citations

Bent, G.C., and Steeves, P.A., 2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006-5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

➤ Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [Crippen Bue Region 2]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	46.6	square miles	0.1	3000

Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 2]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	58800	ft ³ /s

Maximum Probable Flood Statistics Citations

Crippen, J.R. and Bue, Conrad D. 1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (<https://pubs.usgs.gov/wsp/1887/report.pdf>)

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Application Version: 4.23.0

StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1