



TOWN OF SOUTHAMPTON
Department of Community Preservation
24 W Montauk Hwy,
Hampton Bays, NY 11946 Ph: 631-287-5720
www.southamptontownny.gov/WQIPP

**COMMUNITY PRESERVATION FUND (CPF)
WATER QUALITY IMPROVEMENT PROGRAM**

2022



**Application for Southampton Town CPF WQIP Grant
For The Village of Southampton
Southampton, NY**

**By
New York Center for Clean Water Technology
and
CDM Smith**

4/18/22



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Department of Community Preservation
 24 W Montauk Hwy, Hampton Bays, NY 11946
 Ph: 631-287-5720 Fx: 631-728-1920
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COMMUNITY PRESERVATION FUND (CPF) WATER QUALITY IMPROVEMENT PROGRAM PROPOSAL SUMMARY

Project Applicant: Village of Southampton

Project Title: Installation of a pilot scale, injection well permeable reactive barrier on Lake Agawam to mitigate nitrogen loading

Project Manager Names:

1. New York State Center for Clean Water Technology at Stony Brook University ("CCWT")
2. CDM Smith, engineering and construction firm

Name	Chris Gobler
Title	Director
Organization	New York State Center for Clean Water Technology at Stony Brook University ("CCWT")
Address	239 Montauk HWY, Southampton, NY 11969
Phone	631-632-5043
Email	christopher.gobler@stonybrook.edu

Name	Dan O'Rouke
Title	Project Manager
Organization	CDM Smith
Address	110 Fieldcrest Avenue, #8, 6th Floor, Edison, New Jersey 07737
Phone	(732) 590-4699
Email	orourkede@cdmsmith.com

Property owner (if different from Project manager organization):

Name	Mayor Jesse Warren
Affiliation	Village of Southampton
Organization	Village of Southampton
Address	23 Main Street, Southampton NY 11968
Phone	631-283-0247
Email	jwarren@southamptonvillage.org

Project Address: Agawam Park, SCTM#: 0904015000200022002

Type of Project (Check all that apply):

- Reduction
 Remediation
 Restoration

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Project Summary: (Provide a brief narrative description of proposed WQIPP project)

The project is the installation of a pilot-scale injection permeable reactive barrier (PRB) that will remove nitrate from groundwater flowing to Lake Agawam. This project follows a three-phase assessment study by CDM Smith that identified a plume of high nitrate groundwater emanating from Main Street and flowing into Lake Agawam. The assessment study further identified the ideal approach for mitigating that nitrate being an injection well PRB which will specifically target deeper nitrate that is entering the lake. The use of an injection well rather than a deep-trenched woodchip barrier represents a significant cost savings and is significantly less disruptive. Excessive loading of nitrogen in Lake Agawam has been demonstrated to be promoting intense, toxic blue-green algae blooms that represent a serious threat to public health and pets. Mitigating nitrogen entering the Lake from groundwater was identified by the NYSDEC-led Harmful Algal Bloom Action Plan for Lake Agawam as the highest priority activity to mitigate toxic blue green algae blooms. This project has matching funds that are 50% of the project cost.



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If additional information is needed to describe the project; a project narrative can accompany the application. Please limit the narrative to approximately 3 pages of project description, provide a summary of water quality benefits/objectives of approximately 2 pages and provide a cost estimate of approximately 2 to 4 pages with supporting estimates. Any additional materials should be focused specifically on the proposed project with references to other studies that are pertinent

1. PROJECT TYPE (check all that apply)

Must meet at least one of the definitions of “Water Quality Improvement Project” per State Law Chapter 551 cited above. Check all that apply. **Note: Monitoring costs are only potentially eligible for CPF funding within Aquatic habitat restoration projects.**

- Wastewater Treatment Improvement Project
- Non-point source abatement and control
- Aquatic habitat restoration
- Pollution prevention
- Operation of Peconic Bay National Estuary Program (Grant Match)

2. PRIORITY AREA(S) (check all that apply)

Priority areas are defined in the [Water Quality Improvement Project Plan \(WQIPP\)](#).

- 303(d) Impaired
- Peconic Estuary Program - [PEP map](#)
- High
- Medium
- Outside High and Medium priority areas*

*If Outside High and Medium priority areas, explain how the project is relevant to WQIPP goals.

Lake Agawam is located within the South Shore Estuary Reserve and is included on the 2016 NYS Section 303(d) List of Impaired/TMDL waters. Nitrogen loading occurs predominately through groundwater contamination from sanitary/septic systems. See Attachment 1.

SECTION 3. PROJECT DESCRIPTION

3a. Existing conditions of applicable groundwater/sub-watershed/waterbody and most recent and relevant data available (provide sources).

Lake Agawam is located within the South Shore Estuary Reserve and is included on the 2016 NYS Section 303(d) List of Impaired/TMDL waters. The Lake Agawam Comprehensive Management Plan (2009) identified groundwater outflows as a key contributor of the excess nutrients that have led to hypereutrophic conditions and past fish kills. A 2017 report prepared by Dr. Christopher Gobler of the Stony Brook University Center for Clean Water Technology (CCWT), titled, “Quantifying Nitrogen Loading to from Southampton Village to Surrounding Water Bodies and their Mitigation by Creating a Sewer District,” (2017) indicates wastewater from sanitary/septic systems as the main source of nitrogen loading entering the Lake Agawam watershed.

The Lake Agawam Harmful Algal Bloom Action Plan, adopted April 2020, documents the historic frequency and severity of Harmful Algal Blooms (HABs) from 2013-2019:

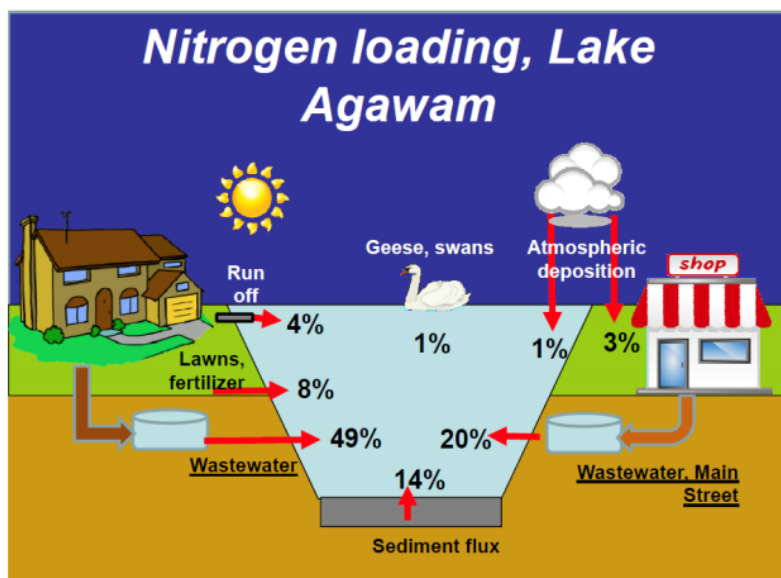
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Year	Earliest Sample Date	Latest Sample Date	Average of BGA Chlorophyll	Average of microcystin	Number of Confirmed	Number of Confirmed with High Toxins
2013	7/15/2013	10/8/2013	48	15	6	3
2014	5/28/2014	10/14/2014	52	14	15	3
2015	5/3/2015	10/22/2015	218	56	15	8
2016	4/27/2016	1/5/2017	1770	150	17	11
2017	5/8/2017	12/26/2017	270	70	15	17
2018	5/7/2018	10/16/2018	4492	316	7	17
2019	6/17/19	10/30/19	1086	1090	18	18

In September 2018, scientists from Stony Brook University reported that a toxic algae bloom in the lake was the densest growth ever recorded in a Long Island water body. Public health warnings have been issued by the Suffolk County Health Department to urge community members, especially children and pets, to avoid the contaminated water.

Intense and toxic blue-green algae blooms continued during 2020 and 2021. According to NYSDEC records, no lake in NYS has had more week of blue-green algae blooms than Lake Agawam.

A Nitrogen Loading Model prepared by Stony Brook University’s CCWT indicates that wastewater from sanitary onsite septic systems (groundwater) contribute the majority of nitrogen loading to the lake as shown in the following figure.



Dr. Gobler’s report further specifies external sources as the main source of nitrogen loading entering the Lake Agawam watershed, specifically:

- Wastewater from sanitary/septic systems = 70%
- Fertilizer = 8%
- Atmospheric deposition = 4%
- MS4 drain at the north-end of Lake Agawam = 4%

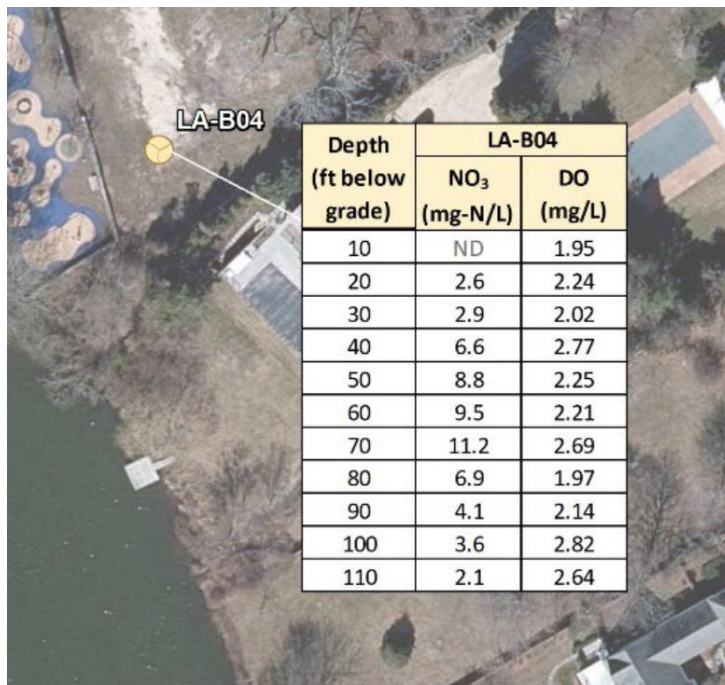
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The following photos depict existing conditions of the lake.



Lake Agawam. Source: Dr. Christopher Gobler.

In addition, surveying by CDM Smith during phase I and phase II investigations has revealed the presence of high concentrations of nitrate in the groundwater in the northeast corner of Lake Agawam. Within well LA-B04, nitrate levels exceeded 11mg/L and ranged from 3 – 11 mg/L in the zone of treatment. In addition, high levels of nitrate were also measured in pore water seeping into Lake Agawam along the shoreline with concentrations ranging from 4.4 – 6.7 mg/L nitrate. This represents the nitrate plume



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this project will mitigate with the pilot scale injection well PRB.

3b. How the proposed solution addresses the issue in the context of Reduction as per the CPF Water Quality Project Plan.

The proposed project is to install an injection well Permeable Reactive Barrier (PRB) at the north end of Lake Agawam. The purpose of the PRB is to reduce nitrogen inputs to the lake by denitrifying nitrate in groundwater before it reaches the lake. The technology works by injecting carbon-based liquid into the flow path of contaminated groundwater. The nitrate is denitrified by bacteria by using the injected carbon under the anoxia conditions that will dominate with the injection of the carbon providing passive bioremediation.

This project has been developed through a three-part feasibility study which can be summarized as follows:

Phase I (Funded by the Lake Agawam Conservancy) - Preliminary PRB Location Evaluation.

This phase confirmed the presence of high nitrogen concentrations in groundwater upgradient of the lake, and provided data needed to site locations of monitoring wells in Phase 2. Groundwater samples were collected to a depth of 110 feet. Geoprobes will be used at locations adjacent to north end of the lake, approximately as shown here. This effort identified high nitrogen in groundwater entering Lake Agawam, elevated nitrate specifically detected within the well closest to main street.

Phase II (Funded by CPF) - Collection and Evaluation of Design Considerations. This second phase of field investigation built on analyses performed under Phase I and developed the information needed to support the PRB design and was supported by a prior CPF request. This phase installed three well clusters (three well depths) of 2-inch diameter wells at the approximate center of the proposed PRB location. The wells provided water level measurements, water quality evaluation, and support slug testing and observation of hydrogeologic characteristics. The installation of a three well cluster (three well depths) of 1-inch diameter wells to either side of the 2-inch well cluster provided water level measurements, water quality evaluation and provide insight on variations in hydrogeologic characteristics. The installation of four additional one-inch piezometers upgradient of the site supported delineation of the water table upgradient of the proposed PRB and to provide calibration data for the groundwater model. A pressure transducer was installed in one of the wells to measure short term fluctuations in groundwater levels. The topographic survey helped established the configuration and depth of the PRB on the design documents. Slug testing of the two-inch well cluster defined hydraulic conductivity of the shallow upper glacial aquifer. Water quality samples were obtained to define variability in nitrate levels. All data was used to develop a local groundwater model that guided PRB geometry, including depth.

Phase III (Funded by a NYS grant to CCWT) - PRB Design: This portion of the study used the data collected in phase II to design the precise scale, scope, cost, and construction details of the injection well PRB. This is detailed at the end of this document.

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3c. Describe the proposed technology and its demonstrated efficacy in similar settings. May include published data.

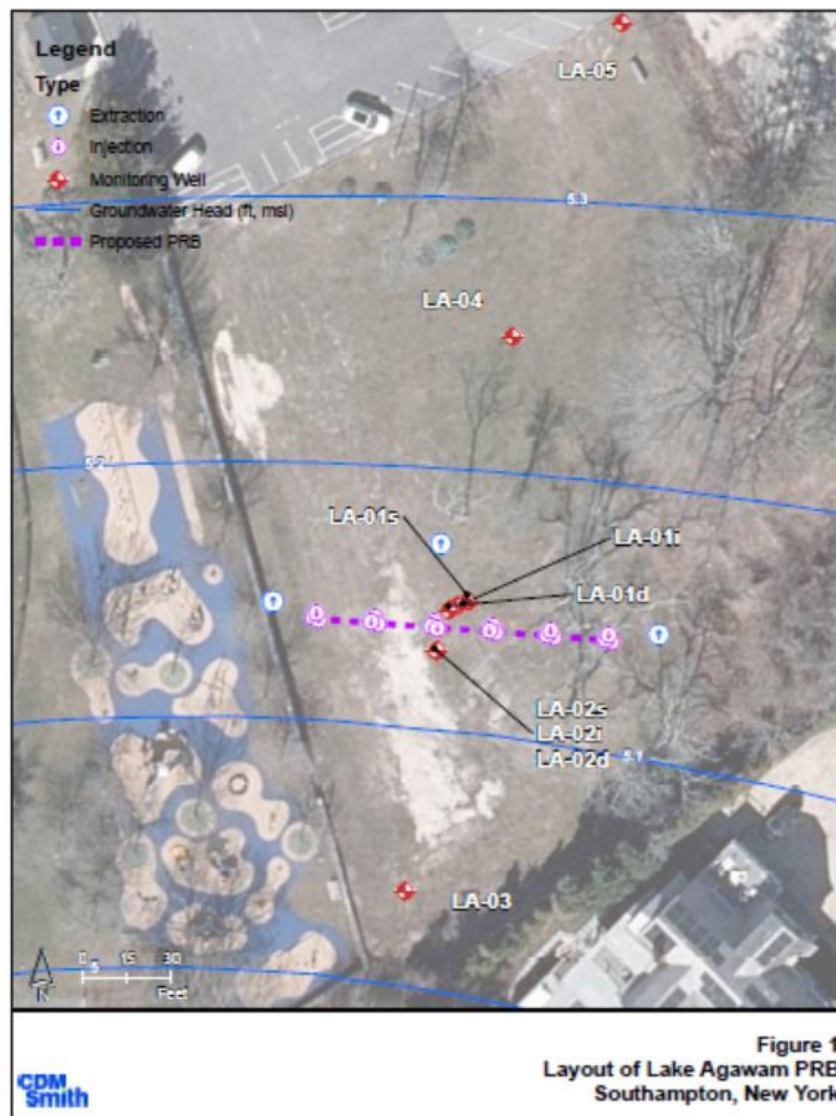
A PRB is described by the USEPA as a wall created below ground to clean up contaminated groundwater. While a traditional PRB is usually built by digging a long, narrow trench in the path of contaminated groundwater flow, an injection well PRB specifically injects a source of carbon (to the depth where denitrification of nitrate is needed. This represents a significantly more cost efficient and significantly less disruptive approach. The injection of a water-mixable biobased, organic substrate circumvents the need to dig a deep trench and the need for heavy equipment. This approach has been used for decades for the remediation of contaminants in groundwater.

Construction of a PRB approximately 100 feet in length consisting of 6 sets of 2-inch diameter wells, each set comprised of 3 wells screened from 50 to 60 feet below grade, 60 to 70 feet below grade and 70 to 80 feet below grade and three 4-inch extraction wells (30-foot screen) to supply water for the injection. One series of injections of EOS100 emulsified vegetable oil

EOS100 is food-grade and USDA certified vegetable oil that is 100% fermentable carbon

Once mixed the oil-in-water emulsion has a consistency similar to soy milk. Emulsion slowly releases dissolved organic carbon that binds to sands and provides a long-term carbon source for denitrifying bacteria. Emulsions are designed

to be immobile once injected into groundwater with travel of less than 20 feet anticipated.



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The consulting firm, CDM Smith has installed injection well PRBs across the country including the Iceland Coin Laundry Superfund Site in Vineland, NJ, which is a highly geologically similar to the Coastal Plain on which Lake Agawam sits. Cape Cod is also geologically similar in Long Island and an oil-based injection well PRB has been installed Waquoit Bay National Estuarine Research Reserve within the Town of Falmouth has been shown to remove more than 20 mg/L nitrate.

3d. How the project supports Town of Southamptton, Suffolk County, NYSDEC, Long Island Nitrogen Action Plan (LINAP) or other adopted goals/policies (provide references with pages numbers).

NYS DEC Lake Agawam Harmful Algal Bloom Action Plan (2020)

The project is directly responsive to the NYSDEC's HABS Action Plan for Lake Agawam. The plan identifies three primary factors that contribute to HABS in the lake:

- Nitrogen inputs associated with septic system discharge
- Internal loading of legacy nitrogen from in-lake sediments
- Nonpoint source nutrient inputs from the contributing watershed

Evaluation and installation of a PRB are recommended actions in the Lake Agawam HABS Action Plan. The plan was developed by an interagency team and local steering committee that worked cooperatively to identify, assess feasibility and costs, and prioritize both in-lake and watershed management strategies aimed at reducing HABS in Lake Agawam. The team consisted of representatives from the NYSDEC, Town of Southamptton, Southamptton Village, Lake Agawam Conservancy, consultants, residents and stakeholders. The team developed a list of priority actions intended to address watershed inputs that influence in-lake conditions that support HABS.

The plan offers three prioritized project lists. Priority List 1 indicates thirteen short-term projects. The proposed project is supported by item 2.b as follows:

2. Complete a full-scale groundwater study to assess the sources and levels of pollutants entering Lake Agawam via groundwater intrusion. This study would establish the flow to and from Lake Agawam to better define source nitrogen in groundwater that impacts the Lake. Hydraulic gradient and water quality monitoring wells would be placed in strategic locations at the head of and around the Lake, including multiple depth wells, to determine flow and water quality.
 - a. Coordinate with USGS, or other qualified private entity for implementation of study, including seasonality (i.e., 1 year of study).
 - b. Evaluate installation of permeable reactive barrier.

Installation of the PRB was recommended as the first priority medium-term action.

Town of Southamptton Water Quality Improvement Project Plan (WQIPP):



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ject will benefit Agawam Lake, which is located in a High Priority Area as defined in WQIPP maps (p. 53).

Suffolk County Subwatershed Plan

Lake Agawam is discussed as a water body that has experienced freshwater Harmful Algal Blooms (HABs) and is indicated as a Priority 1 subwatershed for nitrogen reduction via wastewater management (p. 2-74). While the Village is actively investigating wastewater management options relating to onsite septic systems, the PRB is a feasible near-term action that will improve water quality.

Suffolk County Water Resources Management Plan

The proposed project supports Nitrogen recommendation 1.15, Seek ways to remediate existing nitrogen pollution and its impacts. Recommendation 1.15.d. specifically calls for installation of PRBs.

YES	N/A	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	If stormwater system or drainage is proposed: The project must indicate compliance with the New York State Stormwater Design Manual (2015 and as updated).
<input type="checkbox"/>	<input checked="" type="checkbox"/>	If project is related to farmland: Describe any Agricultural Stewardship Plan or other long term strategy for Nitro- gen abatement.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	If the project is for habitat restoration: The narrative must address how underlying causes are being ameliorated and expected outcomes for local species populations or other ecological considerations are given.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	If project is a Sewage Treatment Plant (STP) or cluster treatment system: Fund allocation request is based on cost for reduction of pre-existing conditions and not for purpose of accommodating new density (describe pre-existing density and associated flow (gallons per day) and total projected nitrogen reduction in narrative). Include detailed information on how many homes the system would treat as well as potential for formation of Sewer District, if required by Suffolk County Health Department or Town Law.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	If the project is requesting grant match: Include information related to funding program source and purpose of application and any relevant items on this checklist. Note: A Town Board resolution will be required in order to encumber matching funds for grant applications.

4. WATER QUALITY BENEFIT

4a. Identify Nitrogen, Pathogen or Pollutant of Concern (POC) including Existing Condition and Target Reduction.

The key POC is Nitrogen in groundwater flows that have been contaminated by onsite septic systems.

The current Waterbody Inventory/Priority Waterbodies List (WI/PWL) assessment for Lake Agawam reflects monitoring data collected in 2015. Lake Agawam is assessed as an impaired waterbody for recreational uses, and stressed for aquatic life uses, due to HABs and nutrients. Nitrogen has repeatedly been shown to be the nutrient prompting toxic blue-green blooms in Lake Agawam. Beyond mitigating a serious public health and animal health threat, the mitigation of blue-green algal blooms will allow submerged aquatic vegetation to regrow which, in turn,

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will help mitigate blue-green blooms via competition for light and nutrients.

Groundwater studies performed during the phase II study demonstrated that the flux through the PRB is 1,120 ft³/day. The average nitrate concentrations in the Phase 2 report over the target treatment area is 7.5 mg/L-N. This approach, therefore, is expected to remove about 0.47 lbs-N/day assuming a literature-base denitrification efficiency of 90%. This equates to 172 lbs of N per year. This the same N removing ability of 16 onsite low N removing septic systems rated at 19mg/L-N (Suffolk County standard), yet this project will cost significantly less than upgrading 16 onsite septic systems in this region.

4b. Describe plans for collecting and reporting on water quality over time.

The CCWT, under the direction of Dr. Gobler, will perform monitoring of the injection well PRB and Lake Agawam for five years. This will be done using state funds, not CPF funds, and thus will be match for this project.

4c. Indicate useful life of proposed technology (must meet or exceed five years).

The projected useful life of the injection well PRB in this location is more than 5 years.

5. COST FACTORS

5a. Explain how you have confirmed that the proposed budget is reasonable, appropriate and necessary. If available, provide third party estimates or other documentation of how costs were determined.

The proposed budget was prepared by the firm CDM Smith. See attachments below.

5b. Describe any matching funds to be provided.

\$47,400 was invested by the Lake Agawam Conservancy for the Phase I PRB study.

\$66,300 was awarded to CCWT for the Phase III PRB study.

\$93,332 is committed by CCWT to monitor the Injection Well PRB for five years post-installation. Funds will cover staff as well as supplies, overhead, and fringe benefits for the purpose of sample collection and sample analyses (see budget below).

5c. Explain: i. Why project cannot proceed and intended benefits cannot be achieved without external funding. ii. if funds are awarded at a lower level than requested, or if there are cost overruns, explain how the project will proceed.

The Village has invested and continues to invest substantial funding to complete numerous water quality improvement initiatives throughout the Village over the past 10+ years. Because its funding needs far outweigh available local resources, the Village has attempted to leverage Suffolk County, Community Preservation Fund (CPF), NYS, local, and other sources whenever possible. If funds are not awarded by CPF, or are awarded at a lower level than requested, the project may be delayed due to the need to identify alternate sources of funding.

If cost overruns occur, these will be the responsibility of the Village.

6. MANAGEMENT, EXPERIENCE, ABILITY

6a. Describe applicant's experience in completing similar projects.

The project will be coordinated by New York State Center for Clean Water Technology (CCWT) the Stony Brook

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University, whose core mission is to harness science to engineer clean water for the protection of public health and the environment in New York and beyond. For the purpose of this project, CCWT will partner with the Village by acting as technical experts and will conduct all water quality monitoring. CCWT has designed and installed PRB's that remove more than 90% of nitrogen from groundwater before it discharges into surface waters and as such will work with the engineering consultant to bring similar solutions to Lake Agawam. Beyond Gobler serving as project lead, Director of Research, Dr. Stuart Waugh, and Dr. Nils Volkenborn who has been leading PRB efforts for CCWT will be engaged in the installation and sampling design of the PRB while Megan Oates, M.S., will be sampling the PRB and Caitlin Asato, M.S., will be performing analyses of samples.

Secondary project lead will come from Dan O'Rourke, P.G, project lead from CDM Smith engineering and construction firm. Mr. O'Rourke has 30 years of experience studying Long Island groundwater including constructing the groundwater model for the Suffolk County subwatersheds study. Mr. O'Rourke has experience in designing and constructing both traditional and injection well PRBs. He will contract and oversee the construction of the injection well PRB on Lake Agawam.

6b. Describe community support or opposition to project. If there is opposition, explain how this is to be addressed.

From 2019 – 2020, the NYSDEC led an effort that brought together Southampton Village, the Town of Southampton, the Town Trustees, CCWT, and the Lake Agawam Conservancy, and community stakeholders to develop a Harmful Algal Bloom HABs Action Plan for Lake Agawam. This process involved multiple public meetings with representatives of all organizations and continued opportunities for public engagement and feedback. HABs Action Plan for Lake Agawam was strongly supported by the community and was adopted by all organizations. The final adopted HABs Action Plan for Lake Agawam documented the Lake's ongoing water quality issues and provided evidence-based recommendations for corrective action and specifically made the installation of a PRB the highest priority action. No community opposition to this project has been recorded.

6c. Describe any permits needed and time frame/status of approvals. If permits are approved, indicate same.

The process for SEQRA determination is in progress with declaration expected in 2022.

7. MAINTENANCE, MONITORING, EVALUATION

Estimate ongoing maintenance costs and explain how these will be supported. Explain stewardship and monitoring activities planned for ensuring sustainability of the project.

There will be no ongoing maintenance costs. The New York State Center for Clean Water Technology (CCWT) will execute the monitoring and performance of the injection well PRB. The existence of monitoring wells upgradient and down gradient of the injection well will allow for assessment of the nitrogen removal by the well as well as quantification of any breakthrough of the organic carbon. Monitoring of the PRB by CCWT over at least five years will represent a highly significant match that will involve the effort of multiple staff members as well as supplies needed for sampling and analyses. A plan for data reporting will be established in cooperation with the Town should CPF funds be awarded.

8. DURATION OF PROJECT

8a. Provide a projected project timeline.

- SEQRA determination, Spring/Summer 2022
- Apply for and obtain necessary permits, Fall 2022 – Summer 2023
- Install Injection Well PRB, Fall/Winter 2023
- Monitoring of Injection Well PRB, 2024 - 2029

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8b. If project is multi-year or phased, provide a breakdown of budget and milestones for each year and phase.

See 8a.

3. REQUIRED ATTACHMENTS Confirm that the following required documents are attached to this application:

- Photos of existing conditions Location Map
- State Environmental Quality Review Act (SEQRA) Long or Short Environmental Assessment Form (EAF) <https://www.dec.ny.gov/permits/6191.html>
- Completed EPA Spreadsheet Tool for Evaluating Pollutant Load (STEPL) <https://www.epa.gov/nps/spreadsheet-tool-estimating-pollutant-loads-step1> or *similar standardized methodology* (described above)
- Project budget (see attached template)
- Ownership commitment is provided via letter of intent (LOI) for non-municipal owners or municipal resolution for municipal owners
- Public agencies must complete SEQRA on the project and submit determination of significance and associated documentation.

4. OTHER ATTACHMENTS

List other attachments provided, including cost estimates, bids, plans, documentation of matching funds, and other as appropriate to demonstrate project readiness, quality, feasibility, and cost effectiveness



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Budget Proposal

Is the applicant a municipality group? Yes No

www.southamptontownny.gov/WQIPPLANNING/ENGINEERING/DESIGN	Town CPF Request	Matching Funds Committed	Matching Funds Pending	Estimated Total Project Costs
Phase I PRB Study (Lake Agawam Conservancy funded)	\$-	\$47,400	\$-	\$47,400
Phase III PRB Study (CCWT funded)	\$-	\$66,300	\$-	\$66,300
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
Phase I and Phase II PRB studies (Phase II funded by CPF; not counted as match)	\$-	\$113,700	\$-	\$113,700

Contractual Services				
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
	\$-	\$-	\$-	\$- 0.00
Contractual Services Cost Total	\$- 0.00	\$- 0.00	\$- 0.00	\$- 0.00

Construction & Site Improvements				
Well installation	\$154,950	\$-	\$-	\$154,950
Well installation oversight	\$16,200	\$-	\$-	\$16,200
Injection event	\$85,430	\$-	\$-	\$85,430
Amendment injection	\$88,500	\$-	\$-	\$88,500
Injection oversight	\$32,500	\$-	\$-	\$32,500
5% inflation adjustment	\$18,879	\$-	\$-	\$18,879
Construction & Site Improvements Cost Total	\$396,459	\$- 0.00	\$- 0.00	\$396,459



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Matching Funds from NYS Center for Clean Water Technology (per year; five-year sampling commitment)

In kind Contribution Schedule					
NYS Center for Clean Water Technology					
Analytical Services:		cost/sample	mo. samples	duration (mo)	
NH4+		\$20	3	12	\$720.00
NO3-/NO2-		\$12	2	12	\$288.00
NO2-		\$12	1	12	\$144.00
TkN		\$28	3	12	\$1,008.00
Alkalinity		\$15	3	12	\$540.00
BOD5		\$30	2	12	\$720.00
TOC		\$80	2	12	\$1,920.00
TSS		\$20	1	12	\$240.00
PO43-		\$20	0	0	\$0.00
1,4 dioxane		\$200	0	0	\$0.00
Sampling & Analytical Services per site					\$5,580.00
Sites per project					2
Subtotal Analytical costs/yr					\$11,160.00
			hours	hourly rate	
Wastewater Analyst	Analysis & Reporting		12	\$35.79	\$429.51
Field Technician			96	\$25.76	\$2,472.92
SubTotal Monitoring Labor/yr					\$2,902.43
Subtotal Monitoring Costs					\$14,062.43
			hours	hourly rate	
Project Manager	pre- installation select & coord		32	\$52.37	\$1,675.73
	installation (on-site inspection		32	\$52.37	\$1,675.73
	Analysis & reporting		12	\$52.37	\$628.40
Administrator	administrative		12	\$52.00	\$624.00
SubTotal Management and Admin Costs					\$4,603.87
Total NYS CCWT					\$18,666.30

CP-13107 (rev. 01/2022)



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 WATER QUALITY IMPROVEMENT PROGRAM**

APPLICANT'S INFORMATION

Owner: Village of Southampton
 Contact First and Last Name: Jesse Warren
 Contact Address: 23 Main Street, Southampton, NY 11968
 Contact Phone: 631-283-0247
 Contact Email: jwarren@southamptonvillage.org

CONTRACT RECIPIANT INFORMATION

Name/Organization: Village of Southampton
 Contact Person/Officer: Charlene Kagel-Betts, Village Administrator
 Contact Address: 23 Main Street, Southampton, NY 11968
 Contact Phone: 631-283-0247
 Contact Email: ckagel-betts@southamptonvillage.org

PROJECT INFORMATION

Project Title: Lake Agawam Injection Well Permeable Reactive Barrier
 Project Location: Agawam Park, Southampton Village
 Project Description (1-3 sentences):
 Village of Southampton will install an Injection Well Permeable Reactive Barrier to intercept nitrogen from groundwater flows prior discharge to Lake Agawam.

ANTICIPATED PROJECT TIMELINE

Begin: Winter 2022
 Complete: Winter 2023
 Notes:

ATTESTATION

Allocation of CPF funds will not be for the purpose of accommodating new growth, as this is prohibited by State law.
 Check all boxes & sign.
 We certify that funds will not be directed for projects for the purpose of accommodating new growth.
 We understand that progress reports will need to be generated as specified in our Water Quality Improvement Contract AND a final report showing qualitative and/or quantitative data will be generated upon project completion. .

Signature: *Jesse Warren* Date 4/15/2022

Attachments:

State Environmental Quality Review Act (SEQRA) Long or Short Environmental Assessment Form

CDM Smith PRB study, Phase 1 report

CDM Smith PRB study, Phase 2 report

CDM Smith PRB study, Phase 3 cost estimate

Short Environmental Assessment Form

Part 1 - Project Information

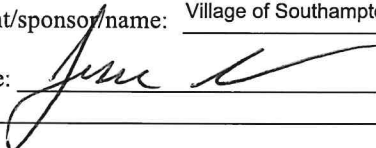
Instructions for Completing

Part 1 – Project Information. The applicant or project sponsor is responsible for the completion of Part 1. Responses become part of the application for approval or funding, are subject to public review, and may be subject to further verification. Complete Part 1 based on information currently available. If additional research or investigation would be needed to fully respond to any item, please answer as thoroughly as possible based on current information.

Complete all items in Part 1. You may also provide any additional information which you believe will be needed by or useful to the lead agency; attach additional pages as necessary to supplement any item.

Part 1 – Project and Sponsor Information			
Village of Southampton			
Name of Action or Project: Lake Agawam Permeable Reactive Barrier (PRB)			
Project Location (describe, and attach a location map): Agawam Park, Southampton, New York (See map; DSBL 0904 01500 0200 025000)			
Brief Description of Proposed Action: This application is for the construction of a permeable reactive barrier (PRB) to remove nitrate from groundwater prior to discharge into Lake Agawam. Lake Agawam has routinely experienced water quality problems that have triggered blooms of cyanobacteria. Previous studies have indicated that nutrient loading, particularly nitrogen, aids in triggering these blooms. This project proposes to construct a PRB to passively remove nitrate in groundwater prior to discharging into the lake. Due to the depth of elevated nitrate concentrations, the PRB needs to be constructed as an injection-type PRB that will involve injection of food grade amendment (emulsified vegetable oil) to promote biological denitrification. This will serve as a pilot study to determine the effectiveness of this type of PRB within a coarse unconsolidated aquifer. Field investigations have been completed and the project has been deemed feasible and is currently in design (expected to be completed in May 2022). To our knowledge, there are no other injection type PRBs for nitrate removal on Long Island. This project is consistent with the NYSDEC Harmful Algal Bloom Action Plan for Lake Agawam and is specifically identified as a mid-term priority project (April 2020).			
Name of Applicant or Sponsor: Jesse Warren		Telephone: 631.283.0247 ext. 222 E-Mail: jessewarren@southamptonvillage.org	
Address: 23 Main Street			
City/PO: Southampton		State: New York	Zip Code: 11968
1. Does the proposed action only involve the legislative adoption of a plan, local law, ordinance, administrative rule, or regulation? If Yes, attach a narrative description of the intent of the proposed action and the environmental resources that may be affected in the municipality and proceed to Part 2. If no, continue to question 2.			NO <input type="checkbox"/>
2. Does the proposed action require a permit, approval or funding from any other government Agency? If Yes, list agency(s) name and permit or approval: NYSDEC should be notified of the project, but a UIC permit is not required and wetlands will not be disturbed.			YES <input type="checkbox"/>
3. a. Total acreage of the site of the proposed action? _____ 1.61 acres b. Total acreage to be physically disturbed? _____ 0.2 acres c. Total acreage (project site and any contiguous properties) owned or controlled by the applicant or project sponsor? _____ 1.61 acres			
4. Check all land uses that occur on, are adjoining or near the proposed action: <input type="checkbox"/> Urban <input type="checkbox"/> Rural (non-agriculture) <input type="checkbox"/> Industrial <input type="checkbox"/> Commercial <input checked="" type="checkbox"/> Residential (suburban) <input type="checkbox"/> Forest <input type="checkbox"/> Agriculture <input type="checkbox"/> Aquatic <input type="checkbox"/> Other(Specify): <input checked="" type="checkbox"/> Parkland			

	NO	YES	N/A
5. Is the proposed action, a. A permitted use under the zoning regulations? b. Consistent with the adopted comprehensive plan?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. Is the proposed action consistent with the predominant character of the existing built or natural landscape?	NO	YES	
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
7. Is the site of the proposed action located in, or does it adjoin, a state listed Critical Environmental Area? If Yes, identify: _____	NO	YES	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
8. a. Will the proposed action result in a substantial increase in traffic above present levels? b. Are public transportation services available at or near the site of the proposed action? c. Are any pedestrian accommodations or bicycle routes available on or near the site of the proposed action?	NO	YES	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
9. Does the proposed action meet or exceed the state energy code requirements? If the proposed action will exceed requirements, describe design features and technologies: Not applicable. A building and energy needs are not required.	NO	YES	
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
10. Will the proposed action connect to an existing public/private water supply? If No, describe method for providing potable water: _____ Not applicable. Potable water not required.	NO	YES	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
11. Will the proposed action connect to existing wastewater utilities? If No, describe method for providing wastewater treatment: _____ Not applicable. Wastewater treatment not required (wastewater not generated from proposed project).	NO	YES	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
12. a. Does the project site contain, or is it substantially contiguous to, a building, archaeological site, or district which is listed on the National or State Register of Historic Places, or that has been determined by the Commissioner of the NYS Office of Parks, Recreation and Historic Preservation to be eligible for listing on the State Register of Historic Places? b. Is the project site, or any portion of it, located in or adjacent to an area designated as sensitive for archaeological sites on the NY State Historic Preservation Office (SHPO) archaeological site inventory?	NO	YES	
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
13. a. Does any portion of the site of the proposed action, or lands adjoining the proposed action, contain wetlands or other waterbodies regulated by a federal, state or local agency? b. Would the proposed action physically alter, or encroach into, any existing wetland or waterbody? If Yes, identify the wetland or waterbody and extent of alterations in square feet or acres: _____ Project site is > 100 feet from Lake Agawam and any associated freshwater wetland. The wetland and lake will not be disturbed.	NO	YES	
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

14. Identify the typical habitat types that occur on, or are likely to be found on the project site. Check all that apply: <input checked="" type="checkbox"/> Shoreline <input type="checkbox"/> Forest <input type="checkbox"/> Agricultural/grasslands <input type="checkbox"/> Early mid-successional <input checked="" type="checkbox"/> Wetland <input type="checkbox"/> Urban <input checked="" type="checkbox"/> Suburban		
15. Does the site of the proposed action contain any species of animal, or associated habitats, listed by the State or Federal government as threatened or endangered?	NO <input type="checkbox"/>	YES <input checked="" type="checkbox"/>
16. Is the project site located in the 100-year flood plan?	NO <input type="checkbox"/>	YES <input checked="" type="checkbox"/>
17. Will the proposed action create storm water discharge, either from point or non-point sources? If Yes, a. Will storm water discharges flow to adjacent properties? b. Will storm water discharges be directed to established conveyance systems (runoff and storm drains)? If Yes, briefly describe: _____ _____	NO <input checked="" type="checkbox"/>	YES <input type="checkbox"/>
18. Does the proposed action include construction or other activities that would result in the impoundment of water or other liquids (e.g., retention pond, waste lagoon, dam)? If Yes, explain the purpose and size of the impoundment: _____ _____	NO <input checked="" type="checkbox"/>	YES <input type="checkbox"/>
19. Has the site of the proposed action or an adjoining property been the location of an active or closed solid waste management facility? If Yes, describe: _____ _____	NO <input checked="" type="checkbox"/>	YES <input type="checkbox"/>
20. Has the site of the proposed action or an adjoining property been the subject of remediation (ongoing or completed) for hazardous waste? If Yes, describe: _____ _____	NO <input checked="" type="checkbox"/>	YES <input type="checkbox"/>
I CERTIFY THAT THE INFORMATION PROVIDED ABOVE IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE Applicant/sponsor/name: <u>Village of Southampton</u> Date: <u>4/18/2022</u> Signature: <u></u> Title: <u>Mayor</u>		

Project:

Date:

Short Environmental Assessment Form
Part 2 - Impact Assessment

Part 2 is to be completed by the Lead Agency.

Answer all of the following questions in Part 2 using the information contained in Part 1 and other materials submitted by the project sponsor or otherwise available to the reviewer. When answering the questions the reviewer should be guided by the concept “Have my responses been reasonable considering the scale and context of the proposed action?”

	No, or small impact may occur	Moderate to large impact may occur
1. Will the proposed action create a material conflict with an adopted land use plan or zoning regulations?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2. Will the proposed action result in a change in the use or intensity of use of land?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3. Will the proposed action impair the character or quality of the existing community?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4. Will the proposed action have an impact on the environmental characteristics that caused the establishment of a Critical Environmental Area (CEA)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5. Will the proposed action result in an adverse change in the existing level of traffic or affect existing infrastructure for mass transit, biking or walkway?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. Will the proposed action cause an increase in the use of energy and it fails to incorporate reasonably available energy conservation or renewable energy opportunities?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7. Will the proposed action impact existing:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
a. public / private water supplies?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b. public / private wastewater treatment utilities?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8. Will the proposed action impair the character or quality of important historic, archaeological, architectural or aesthetic resources?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9. Will the proposed action result in an adverse change to natural resources (e.g., wetlands, waterbodies, groundwater, air quality, flora and fauna)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10. Will the proposed action result in an increase in the potential for erosion, flooding or drainage problems?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
11. Will the proposed action create a hazard to environmental resources or human health?	<input checked="" type="checkbox"/>	<input type="checkbox"/>

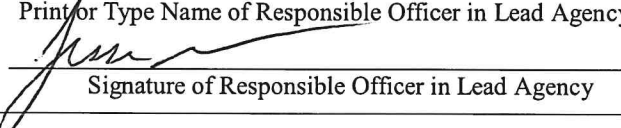
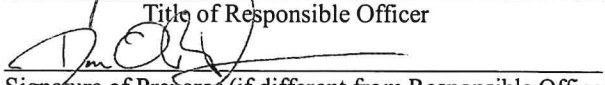
Project:

Date:

Short Environmental Assessment Form Part 3 Determination of Significance

For every question in Part 2 that was answered “moderate to large impact may occur”, or if there is a need to explain why a particular element of the proposed action may or will not result in a significant adverse environmental impact, please complete Part 3. Part 3 should, in sufficient detail, identify the impact, including any measures or design elements that have been included by the project sponsor to avoid or reduce impacts. Part 3 should also explain how the lead agency determined that the impact may or will not be significant. Each potential impact should be assessed considering its setting, probability of occurring, duration, irreversibility, geographic scope and magnitude. Also consider the potential for short-term, long-term and cumulative impacts.

Environmental impacts are not expected with the implementation of this project. Injected amendment will utilized food grade and USDA certified vegetable oil to promote anaerobic bioremediation of nitrate in groundwater to nitrogen gas. The points of injection is not anticipated to result in any amendment being directly discharged to the lake (but rather sorb onto the aquifer sediments within the immediate vicinity of the injection wells). Injection wells will be finished so that they are flush with the ground surface and will not degrade the natural character of the site.

<input type="checkbox"/>	Check this box if you have determined, based on the information and analysis above, and any supporting documentation, that the proposed action may result in one or more potentially large or significant adverse impacts and an environmental impact statement is required.
<input checked="" type="checkbox"/>	Check this box if you have determined, based on the information and analysis above, and any supporting documentation, that the proposed action will not result in any significant adverse environmental impacts.
<u>Southampton Village</u>	<u>4/18/2022</u>
Name of Lead Agency	Date
<u>Jesse Warren</u>	<u>Mayor</u>
Print or Type Name of Responsible Officer in Lead Agency	Title of Responsible Officer
	
Signature of Responsible Officer in Lead Agency	Signature of Preparer (if different from Responsible Officer)



Proposed PRB Location
0904 01500 0200 02500



Memorandum

To: Lake Agawam Conservancy

From: Dan O'Rourke, P.G., PMP and Mary Anne Taylor, P.E., PMP

Date: November 3, 2020

Subject: Lake Agawam Permeable Reactive Barrier: Phase 1

Harmful algal blooms (HABs) have been occurring in Lake Agawam triggered by excessive nitrogen loading to the lake (Suffolk County). Nitrogen loading from groundwater is primarily due to existing septic systems and fertilization, but legacy sources from historical agriculture within the area are also likely. The Lake Agawam Conservancy along with the Center for Clean Water Technology (Stony Brook University) and Southampton Village have partnered with CDM Smith to design a PRB at the northern portion of the lake, within Agawam Park, to reduce nitrogen load from groundwater to the lake.

Permeable reactive barriers (PRBs) have been receiving increased attention on Long Island as a means to reduce the nitrogen load to surface waters, as they have the potential to passively denitrify groundwater prior to discharge as baseflow. However, siting PRBs can be a challenge due to coupling available land for installation with elevated nitrate concentrations in groundwater. Because of this, the project has proceeded in a phased approach:

- Phase 1: PRB location evaluation – water quality profiling to confirm that elevated nitrate is present in the groundwater discharging to the Lake at Agawam Park and a PRB at that location would be effective.
- Phase 2: Collection and evaluation of design considerations – if the results from Phase 1 indicate that a PRB is appropriate, Phase 2 will commence involving data collection and additional testing.
- Phase 3: Full design

The results of Phase 1 are presented below.

Field Investigation

The proposed location for the PRB is within Agawam Park, between the World War II Memorial and the north shore of the lake. Field work commenced on Monday, October 12, 2020. Land, Air, Water Environmental Services, Inc. (driller) and representatives from Drew Bennett Engineering, Inc. (oversight) conducted the field effort. Three locations for water quality profiling were cleared of underground utilities using a ground penetrating radar (GPR) system. Boring and groundwater quality sampling locations are shown on **Figure 1**.



Figure 1 Boring and water quality profiling locations at Agawam Park.

Once the borehole locations were cleared, groundwater profiling commenced using a Geoprobe SP-16 groundwater sampling system. The sampling system consists of a stainless-steel screen and expandable steel drive points to collect groundwater samples (**Figure 2**). The screen is 45.5 inches in length with a slotted portion of 43.5 inches for sampling. The objective of the vertical groundwater profiling was to obtain groundwater samples to a depth of 160 feet, or to the saltwater interface, whichever was encountered first. Although the lake is fresh, the freshwater-saltwater interface within the aquifer is at some depth below the lake. Samples were collected in 10-foot intervals and analyzed for nitrate and nitrite.

Water quality profiling began at LA-1. The Geoprobe rig encountered significant resistance beyond a depth of 140 feet, likely due to the presence of a tight clay. Therefore, the maximum depth for sampling at this location was limited to 140 feet. Sampling commenced and the well screen was purged for approximately 2.5 hours without any significant reduction in turbidity as the screen was pumping from a silty-clay unit (the upper portion of the clay encountered at 140 feet; **Figure 3**). It is likely that this clay unit is an extension of a clay documented by the USGS in a nearby boring at a depth of approximately 110 feet (Nemickas and Koszalka, 1982; **Figure 4**). Turbidity did not readily clear (after excessive purging) at LA-1 until the SP-16 sampler was retracted and profiling performed at a depth of 110 feet. Because of the presence of this clay and excessive turbidity in water samples collected in LA-1 at those deeper depths, boring depths were subsequently limited to 120 feet in LA-2 and LA-3.

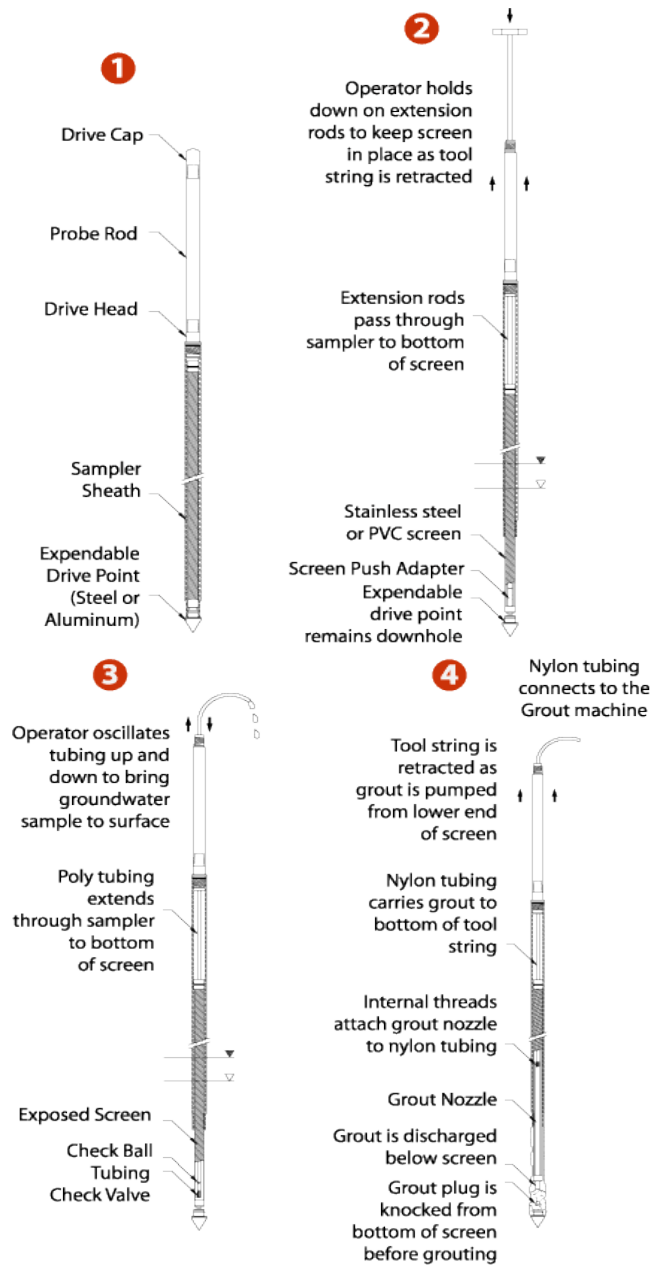


Figure 2 Geoprobe SP-16 Groundwater Sampling System (from <https://geoprobe.com/sp16-groundwater-sampler#parts>).



Figure 3 Sediment collected at depths beyond 120 feet below grade at LA-1 comprised of silty clay.

Groundwater samples were collected in 10-foot intervals as the SP-16 sampler was retracted. Samples were collected following a purge of 10 gallons and sent to Pace Analytical Laboratory for quantification of nitrate and nitrite. Field parameters of temperature, dissolved oxygen, oxidation/reduction potential (ORP), specific conductance and pH were collected for each sample. A duplicate set of samples was collected for analysis for ammonia and TKN by Stony Brook University.

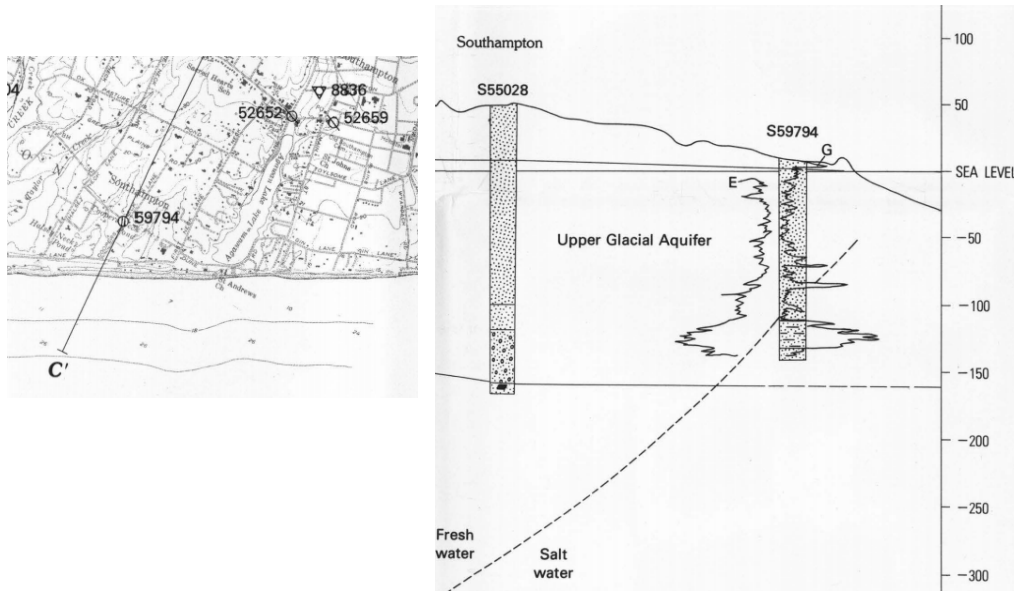


Figure 4 Boring log and position of saltwater/fresh water interface at S-59794, approximately 4,700 feet southwest of Agawam Park (from Nemickas and Koszalka, 1982).

Water Quality Results

Water quality results are summarized in **Table 1**. As shown on the table, nitrate is present at elevated concentrations, but at depth, likely reflecting sources well upgradient (north) of Lake Agawam. Elevated concentrations (7.6 mg/L) are present at LA-1 approximately 80 feet below grade, but nitrate was undetected at depths shallower than 70 feet below grade in LA-2 and 110 feet below grade in LA-3. It is likely that nitrogen is present in the form of ammonia in shallow groundwater at this location, which was not analyzed by Pace, as permeable reactive barriers are designed to denitrify nitrate. Dissolved oxygen is consistent throughout most of each profile, generally below 3 mg/L. Elevated oxygen at depth in LA-1 is likely attributed to the excessive sediment in the sample interfering with the measurement. Specific conductance is somewhat elevated (but still represents fresh water), and slightly more so in LA-1. Note the specific conductance values for LA-1 at depths greater than 100 feet are likely artifacts due to the excessive sediment representing air rather than porewater (consistent with elevated DO measurements at those depths).

Recommendation for Phase II

Permeable reactive barriers are typically either shallow systems constructed with trenching techniques or injection techniques used to treat elevated nitrogen in groundwater at depth. Due to the depth of the elevated nitrate concentrations at Agawam Park, injection is the only feasible alternative to reduce the nitrate discharging to the Lake via groundwater. Nitrate is distributed over a wider interval in the eastern portion of the site at LA-1, but exceeds 11 mg/L-N at 120 feet

below grade to the west at LA-2 and LA-3. Although this elevated nitrate is deep below grade, it is likely that it is discharging into the lake further south away from the shoreline.

Based on the data that was collected during Phase I, a PRB could be constructed to a depth between 70 and 120+ feet below grade to the top of the clay layer. The Phase II program should be implemented to collect the requisite data to support the PRB design. Due to the elevated nitrate present in LA-1, at least one additional profile using the SP-16 east of LA-1 (adjacent to the playground) is recommended, which may be conducted during installation of monitoring wells for Phase II and the design modified accordingly. Furthermore, the Phase 2 program should consider additional monitoring wells within the area to better understand the significant variation in the nitrate profiles between LA-1, LA-2 and LA-3.

References

B. Nemickas and E.J. Koszalka. 1982. Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York. United States Geological Survey (USGS) Water Supply Paper 2073.

Suffolk County Department of Health Services. 2020. Suffolk County Subwatersheds Wastewater Plan.

Lake Agawam Conservancy

November 3, 2020

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Table 1. Water quality data collected from Agawam Park: October 12-15, 2020.

Depth (ft below grade)	NO ₃ (mg/L-N)			Temp. at Collection (°C)			DO (mg/L)			Specific Conductance (uS/cm)			pH			ORP (mV)		
	LA-1	LA-2	LA-3	LA-1	LA-2	LA-3	LA-1	LA-2	LA-3	LA-1	LA-2	LA-3	LA-1	LA-2	LA-3	LA-1	LA-2	LA-3
10	ND	ND	ND	19	17.7	15.8	1.11	2.54	3.34	323	549	364	6.42	6.56	6.39	-73.2	-87.6	-38
20	ND	ND	ND	17.3	17	16	2.41	2.46	3	660	640	361	6.82	6.93	6.41	-72	-70	-49.8
30	ND	ND	ND	16.6	17	16.6	2.09	2.48	2.2	690	810	595	6.77	6.93	6.77	-132.9	-100.7	6.7
40	0.057	ND	ND	16.1	16.4	16.8	1.78	2.3	2.17	1040	840	830	6.64	6.91	6.91	-106.2	-112	-126.1
50	2.9	ND	ND	16	15.4	16.5	2.24	2.96	2.24	1040	850	800	6.59	6.96	6.85	-111.7	-52	-118.2
60	4.3	ND	ND	15.8	17.5	16.7	2.54	2.76	2.02	1140	770	1030	6.53	6.59	6.82	-48.5	-46.8	-111.6
70	2.3	0.17	ND	15.5	16.5	16.9	1.54	2.27	2.82	730	810	970	6.71	6.46	6.58	-252	-71.9	-75.2
80	7.6	1.1	ND	15.6	16.6	16.7	1.78	2.38	2.05	970	810	850	6.65	6.41	6.16	-165.7	-79.9	-72.3
90	0.39	1.8	ND	15.5	16.4	16.7	2.24	2.36	1.98	1140	588	780	6.6	6.31	6.08	-133.6	-24.7	-48.4
100	0.69	2.8	ND	15.3	15.8	16.7	1.73	1.8	5.16	1120	790	680	6.23	6.38	6.17	-140	-57.2	105.5
110	3.9	4.3	1.2	15.7	16.1	16.6	10.56	2.9	4.44	4	720	630	6.52	6.31	5.68	318	15.3	122
120	NS	11.4	13.6	14.1	16.2	16.9	10.14	2.16	3.28	1	336	305	6.55	6.38	6.01	390	50.2	110.9
130	NS	NS	NS	13.4	NS	NS	10.92	NS	NS	1	NS	NS	6.58	NS	NS	340	NS	NS
140	NS	NS	NS	14.6	NS	NS	10.67	NS	NS	1	NS	NS	6.33	NS	NS	406	NS	NS



Memorandum

To: Gary Goleski, Superintendent, Village of Southampton Department of Public Works

From: Dan O'Rourke, PG, PMP

Date: 4/13/2022

Subject: Lake Agawam Permeable Reactive Barrier: Phase II (DRAFT)

Lake Agawam has routinely experienced blooms of cyanobacteria. Studies have shown that nitrogen loading to the lake from groundwater discharge, benthic flux and stormwater have contributed to these cyanobacteria blooms (NYSDEC, 2020).

Nitrogen loading from groundwater is primarily due to on-site wastewater disposal systems (septic and cesspool systems). The recently completed Suffolk County Subwatersheds Wastewater Plan (CDM Smith, 2020) indicates that on-site wastewater systems account for 87 percent of the total nitrogen load to groundwater while fertilizer only accounts for 8.5 percent of the groundwater nitrogen load in the Lake Agawam subwatershed. However, legacy sources of nitrogen from historical agriculture activity within the area are also likely. While the Lake Agawam Plan (NP&V, 2009) noted the difficulty of groundwater remediation due to the nitrogen source largely being from onsite wastewater systems (requiring regional upgrades to advanced systems or sanitary sewerage), Southampton Village along with the Center for Clean Water Technology (Stony Brook University) have partnered with CDM Smith to design a permeable reactive barrier (PRB) at the northern portion of the lake, to reduce the nitrogen load from groundwater to the lake. The objective of the study is to pilot the effectiveness of PRBs to remove nitrate from groundwater prior to discharging into the lake.

PRBs have been receiving increased attention in Suffolk County as a means to reduce the nitrogen load to surface waters, as they have the potential to passively denitrify groundwater prior to discharge as baseflow. However, siting PRBs can be a challenge due to coupling available land for installation with elevated nitrate concentrations in groundwater. The objective of the PRB is to create an anaerobic environment so that bacteria utilize the oxygen from nitrate, thereby promoting denitrification and removing nitrate from groundwater. These permeable reactive barriers are not effective on nitrogen in the form of ammonium. Therefore, elevated concentrations of nitrate need to be present for the PRB to be effective. Because of this, the project has proceeded in a phased approach:

- Phase 1: PRB location evaluation – water quality profiling to confirm that elevated nitrate is present in the groundwater discharging to the Lake at Agawam Park and a PRB at that location would be effective in reducing the groundwater nitrogen load to the lake.
 - The results of this study have been documented in a technical memorandum submitted to the Lake Agawam Conservancy on November 3, 2020.
- Phase 2: Collection and evaluation of data supporting design considerations – if the results from Phase 1 indicate that a PRB is appropriate, Phase 2 will commence involving data collection and additional testing.
- Phase 3: Full design

The results of Phase 2 are presented below.

Water Quality Profile Boring

The results of the Phase 1 investigation indicated that groundwater along the northern shore of the lake has excessive nitrogen, however much of that nitrogen is in the form of ammonium and nitrate concentrations are generally low (**Figure 1**). Although elevated nitrate concentrations were detected at depth (> 100 feet) within the westernmost profiles (LA-B02 and LA-B03), the aquifer exhibited significant silt and clay at these depths and was not suitable for a permeable reactive barrier.

Water quality results collected from the eastern boring were more promising, showing elevated nitrate at 80 feet below grade and concentrations greater than 4 mg-N/L at a depth of 60 feet. Since nitrate was present in shallower samples, additional investigation to the east was warranted.

A fourth water quality profile boring was collected in October 2021 in the adjacent parcel to the east, owned by the Village of Southampton. Similar to the profiles collected during Phase 1, groundwater samples were collected in 10 foot intervals until the silty-clayey layer was



Figure 1 Nitrate and dissolved oxygen concentrations in vertical profile borings collected during Phase I.

reached below 100 feet below grade (Monmouth Greensand). Samples were processed by Pace Analytical Laboratory, an ELAP certified laboratory in Melville, NY. Results are shown on **Figure 2**.

Results from the eastern boring indicated that nitrate is present throughout the boring (at depths greater than 20 feet below grade) and concentrations were elevated between 40 and 80 feet below grade. These results support that a PRB at the eastern parcel could be viable at removing nitrate, thereby continuing the study.

Porewater Analysis

A porewater analysis was conducted by Cornell Cooperative Extension in early January 2022 to evaluate nitrogen concentrations within groundwater discharging into Lake Agawam. The objective was to verify results from the four vertical profile borings that the majority of nitrate is discharging within the northeastern portion of the lake and that the porewater nitrogen signature was similar to that identified with the vertical profile borings. The CCE report is included here as **Attachment 1** and portions of the report and conclusions are discussed below.

This survey was conducted using proprietary equipment and techniques including an instrument called the Trident Probe which was deployed from two tethered 14-foot Jon boats. The Trident Probe (**Figure 3**) is a direct-push, integrated temperature sensor, conductivity sensor, and porewater sampler, developed to screen sites for areas where groundwater may be discharging to a surface water body and collect porewater samples from potential discharge zones. Specifically, the Trident Probe measures temperature and bulk conductivity contrast

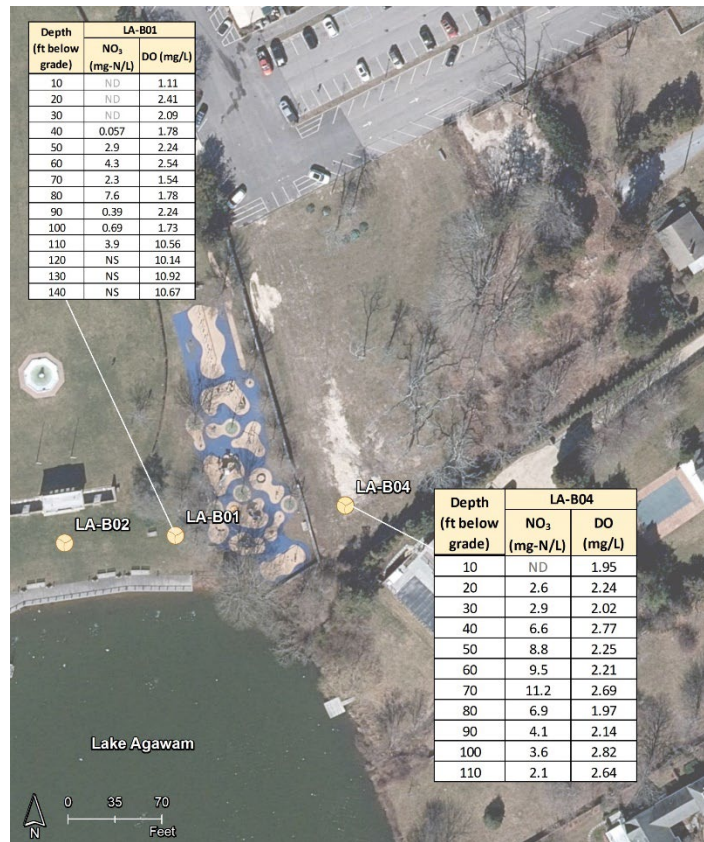


Figure 2 Nitrate concentrations in LA-B04

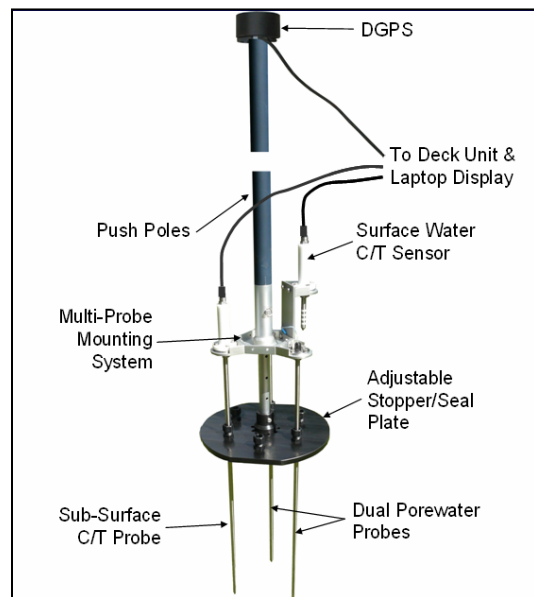


Figure 3 Trident probe (CCE) used to survey groundwater discharge and collect porewater.

between porewater 1 foot below the sediment-water interface and surface water 1 foot above the sediment-water interface. The probe sensors are calibrated for both temperature and conductivity before deployment. Typically, groundwater temperatures in the winter months are in the range of 10 to 13 °C. During winter months, high contrast areas with high temperature and low conductivity values in the porewater are conditions indicating groundwater discharge. When the temperature and conductivity signal indicated there was fresh groundwater present, porewater and surface water samples were collected for further analysis. Porewater samples were collected from the probe through 1/8-inch Teflon tubing using a low-flow peristaltic pump. A minimum of 200 mL was purged prior to collection of a porewater sample.

Porewater and surface water within Agawam Lake were surveyed using nine transects with multiple stations along each transect. In total, the survey included twenty-two porewater and surface water stations, with eighteen samples collected for porewater and two for surface water. Samples were stored on ice and analyzed for nitrogen by Long Island Analytical Laboratory, a NYS ELAP certified laboratory.

A map of bulk sediment and porewater temperatures measured 1 foot below the sediment/water interface is shown on **Figure 4**. As mentioned above, during winter months, groundwater is generally warmer than surface water. That is the case here, as the surface water temperature averaged 5.24 °C. Areas with higher temperatures on **Figure 4** are indicative of a higher flux of groundwater discharge. In general, higher temperatures are observed close to the shoreline and primarily within the northeast portion of the study area. It's important to note that as all porewater samples have a higher temperature than the surface water, groundwater is discharging within those zones, but that a higher flux is apparent in the northeast portion of the shoreline.

Nitrate and ammonium concentrations collected from porewater samples 1 foot and 5 feet below the sediment water interface are shown on **Figures 5** and **6**, respectively. Consistent with Phase 1 results, ammonium in porewater is the dominant form of nitrogen in the north and northwestern portion of the lake. Nitrate is low throughout, however, with elevated concentrations being detected in the eastern most sample, exceeding 4 mg/L-N in shallow (1 foot) and deeper samples. These porewater results provide confirmation that nitrate is found at higher concentrations to the east and support the development of a PRB in the eastern parcel of the study area.

Although ammonium remains the dominant form of nitrogen within groundwater throughout much of the study area, water quality results support that a PRB located in the parcel immediately east of Agawam Park would be beneficial to reducing nitrogen to Lake Agawam. Although beyond the scope of this study, in order to remove the ammonium in situ, it must first be nitrified, perhaps with some sort of air sparging system and then could potentially be removed by a PRB. This could potentially be done by upgrading the existing system that provides compressed air to the several bubblers installed throughout the lake.



Figure 4 Porewater and sediment temperature 1 foot below the sediment water interface.



Figure 5 Nitrate (white text) and ammonium (green text) collected from porewater 1 foot below the sediment/water interface. Concentrations are in mg/L as N.



Figure 6 Nitrate (white text) and ammonium (green text) collected from porewater 4-6 feet below the sediment/water interface. Concentrations are in mg/L as N.

Monitoring Well Installation

Several groundwater monitoring wells were installed during late February 2022 to support the design of the PRB. Monitoring wells were installed by Land, Air, Water Environmental Services (LAWES). Monitoring wells were installed using a hollow-stem auger drill rig and a Geoprobe unit with auger and direct push capabilities. A map of monitoring wells and construction specifics is shown on **Figure 7**. Wells were sited so that the potential location of the PRB was at least 100 feet from potential wetlands along the northeast corner of the lake, and to allow for adequate spacing for an injection event so that amendment does not directly discharge into the lake.

Monitoring well nests were installed to correspond with elevated nitrate concentrations that were detected in vertical profile boring LA-B04. LA-01s, LA-01i and LA-01d were installed as 2-inch diameter wells so that slug tests could be conducted. All other wells are 1-inch diameter. A second nest installed as LA-02s, LA-02i and LA-02d will serve as downgradient monitoring wells for a conceptual PRB sited between LA-01 and LA-02. LA-04 was installed 60 feet below grade. All other wells were constructed as water table wells for groundwater flow model calibration. All wells are constructed of Schedule 40 PVC pipe and 10-slot well screen.

Survey

A topographic survey was conducted in March 2022, following the installation of the monitoring wells. The top of casing of each well, the lake level and the top of the valve box (concrete portion) at the southern end of the lake were also surveyed. The elevation of the valve box will allow for previous measured lake levels to be converted to elevations, which can be used during the design. The top of the valve box was surveyed at 7.43 ft, NAVD88.

The elevation of the water table from March 3, 2022 and March 10, 2022 is shown on **Figure 7** as well as the elevation of the lake level (surveyed on March 7, 2022). A staff gauge was also installed on one of the pilings of the floating dock on the northwestern area of the lake.



Figure 7 Monitoring wells constructed at the Lake Agawam PRB site.

Grain Size & Slug Testing

During construction of LA-01d, split spoon samples were collected in 5 foot intervals between 30 and 85 feet below grade and sent to CDM Smith’s geotechnical laboratory for grain size analysis (sieve analysis using ASTM D6913 and ASTM D1140) and classification using USCS (D487). Grain size results are included as **Attachment 2**.

The sediments are described as brown poorly graded (or well sorted) sand containing silt and/or gravel through the depth of the sampling. Samples are representative of the Unified Soil Classification System (USCS) classification of “SP” (poorly graded sand). One sample (45 to 47 feet below grade) is classified as SP-SM (poorly graded sand with silt).

Grain size results are summarized on **Table 1**. Grain size distribution curves are shown on **Figure 8**. The finest sediments are found at depth (>80 feet) which is consistent with Phase 1 data, fining downwards to the silt and clay layer observed at depth (presumably the Monmouth Greensand). Sediments are generally coarser between 50 and 70 feet below grade. Note that the sample

Table 1. Summary of grain size data collected from LA-01d at Lake Agawam.

Depth (ft below grade)	30 to 32	35 to 37	40 to 42	45 to 47	50 to 52	55 to 57	60 to 62	65 to 67	75 to 77	80 to 82	85 to 87
Boring	LA01 (well)	LA01 (well)	LA01 (well)	LA01 (well)	LA01 (well)	LA01 (well)	LA01 (well)	LA01 (well)	LA01 (well)	LA01 (well)	LA01 (well)
USCS (D2487)	SP-SM	SP-SM	SP-SM	SP-SM	SP	SP	SP	SP	SP	SP	SP
% Gravel	9.7	11.8	4.9	2.7	14.4	18.9	9.4	12.1	4.4	1.5	2.4
Coarse	0.0	0.0	0.0	0.0	4.5	0.0	0.0	4.6	3.0	0.0	0.0
Fine	9.7	11.8	4.9	2.7	9.9	18.9	9.4	7.5	1.4	1.5	2.4
% Sand	82.6	83.0	89.9	91.8	83.5	79.6	87.5	87.3	94.1	96.3	95.1
Coarse	7.1	7.5	6.1	3.7	5.5	4.9	6.8	5.2	3.4	2.5	2.9
Medium	51.5	49.2	51.1	53.5	49.8	46.9	57.6	54.6	59.5	44.7	56.6
Fine	24.0	26.3	32.7	34.6	28.2	27.8	23.1	27.5	31.2	49.1	35.6
% Fines (Silt & Clay)	7.7	5.2	5.2	5.5	2.1	1.5	3.1	0.6	1.5	2.2	2.5
K (ft/d): Hazen	83	121	80	107	188	198	179	232	203	61	154
K (ft/d): Kozeny-Carmen	16	27	15	21	86	91	83	75	39	12	34
K (ft/d): Beyer	191	290	189	268	475	498	445	598	529	148	400
K (ft/d): Wang	56	82	58	81	130	134	120	159	147	49	116
Hydraulic conductivity approximations using Aqtesolv Calculator (http://www.aqtesolv.com/aquifer-tests/a)											

collected from 70-72 feet below grade was lost in shipping due to package damage sustained during transport to the geotechnical laboratory.

An estimate of hydraulic conductivity using various analytical approximations is also listed. Analytical calculations of hydraulic conductivity using grain size data are meant only as an approximation and comparison to slug test data. As shown in **Table 1**, depending on the method used, hydraulic conductivity estimates calculated based on grain size data can vary widely.

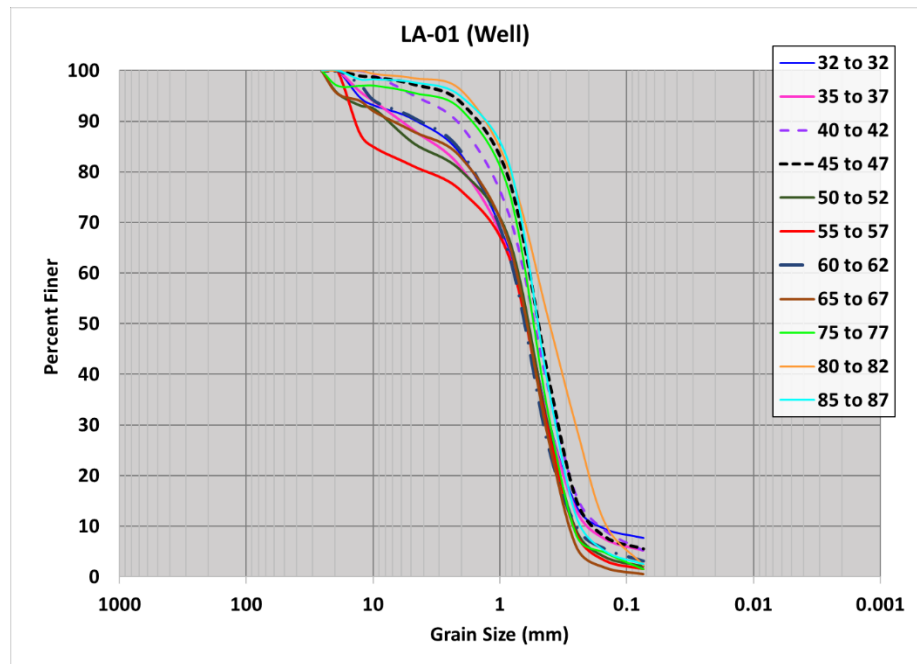


Figure 8 Grain Size Distribution Curves

Slug Testing

Slug tests were conducted on March 10, 2022 from the LA-01 monitoring well cluster to better estimate local hydraulic conductivity. Slug testing was conducted using a 12-inch solid PVC slug and

Table 2. Calculated hydraulic conductivity from slug tests at the LA-01 cluster

Well ID	Screen Interval (ft, below grade)	Static Depth to Water (ft, below top of casing)	Horizontal Hydraulic Conductivity (ft/d) ¹
LA-01s (avg)	40 to 45	2.64	315.7
<i>Kz/Kh = 0.01</i>			344
<i>Kz/Kh = 0.05</i>			303.2
<i>Kz/Kh = 0.10</i>			299.9
LA-01i (avg)	55 to 60	2.65	314.3
<i>Kz/Kh = 0.01</i>			357.5
<i>Kz/Kh = 0.05</i>			289.2
<i>Kz/Kh = 0.10</i>			296.2
LA-01d (avg)	70 to 75	2.68	237.0
<i>Kz/Kh = 0.01</i>			254.5
<i>Kz/Kh = 0.05</i>			230.9
<i>Kz/Kh = 0.10</i>			225.5

1. Calculated using the Bouwer-Rice analytical solution.
2. Represents average between rising and falling head tests.

a Solinst pressure transducer which recorded water levels in 1/8 second intervals. This incredibly high sampling frequency was necessary due to prior experience in very transmissive glacial outwash sediments of the upper glacial aquifer. Barometric pressure was also collected at the time of the test and water level data were corrected accordingly. Rising and falling head tests were conducted for each of the wells. Manual water level measurements were collected before and after testing using an electronic water level meter.

Slug test data were analyzed using the AQTESOLV Pro aquifer testing analysis software and utilized the Bouwer-Rice solution for unconfined aquifers. Slug test results are presented in **Table 2**. As shown in the table, the sediments are very transmissive, having calculated horizontal hydraulic conductivity between approximately 237 and 316 feet per day, generally consistent with the Beyer solution in **Table 1**. Vertical hydraulic conductivity of the upper glacial aquifer is generally 10 to 100 times less that of horizontal hydraulic conductivity (known as anisotropy). As this anisotropy ratio can vary across Long Island, horizontal conductivity was calculated using a range of anisotropy ratios.

Water Quality Sampling

Groundwater samples were collected at the LA-01 and LA-02 cluster on March 3, 2022 for water quality analysis. Samples were collected after initially purging three well volumes from the wells and switching to a peristaltic pump for actual sample collection. Samples were then sent to Pace Analytical Laboratories for processing. Field parameters are listed in **Table 3** and laboratory analytical results in **Table 4**. Water quality results are consistent with the water quality profile boring, LA-B04, although elevated nitrate concentrations are slightly deeper.

Table 3. Field parameters from LA-01 and LA-02 sampling event.

Station ID	Screen Interval (ft below grade)	DTW (ft)	Cond. (µS/cm)	TDS (ppm)	ORP (mV)	pH	Temp. (°C)	DO (mg/L)
LA-01s	40-45	2.66	701.5	339.8	172	6.27	11.5	2.80
LA-01i	55-60	2.69	578.4	263.8	190	6.14	11.3	2.86
LA-01d	70-75	2.80	765.9	372.7	242	6.23	11.6	2.15
LA-02s	40-45	2.62	1044	516.5	172	6.13	11.7	1.47
LA-02i	55-60	2.52	561.8	253.7	205	5.98	11.7	1.49
LA-02d	70-75	2.50	762.1	370.2	200	5.86	12.1	3.18

Table 4. Water quality results from LA-01 and LA-02 sampling event.

Parameter	Well						
	LA-01s	LA-01i	LA-01d	LA-02s	LA-02i	LA-02i ^d	LA-02d
Chloride (mg/L)	178	133	188	302	110	110	195
Ammonia (mg/L)	1.0	0.22	< 0.10	4.2	< 0.10	< 0.10	< 0.10
Total Kjeldhal Nitrogen (mg/L)	0.34	< 0.10	< 0.10	4.1	< 0.10	< 0.10	< 0.10
Nitrate (mg/L as N)	2.7	5.6	8.7	0.066	6.7	6.6	9.0
Nitrate-Nitrite (mg/L as N)	2.8	5.6	8.8	0.083	6.7	6.7	9.1
Nitrite (mg/L as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.079	< 0.05
Sulfate (mg/L)	27.7	30.1	32.5	38.7	50.7	50.7	32.1
Total Organic Carbon (mg/L)	< 1.0	< 1.0	< 1.0	1.5	< 1.0	< 1.0	< 1.0
Total Phosphorus (mg/L)	< 0.05	< 0.05	< 0.05	0.059	1.0	0.97	< 0.05

d = duplicate sample

Chlorides are elevated, which is consistent with elevated specific conductance. While the source of the chlorides is not certain, it is likely due to road salting within the parking area and surrounding roadways resulting in salt deposition to the aquifer from winter storm events and melt water.

Water quality data collected from both vertical profile boring LA-B04 and the two well clusters support the construction of a PRB within this area. However, due to the depth where elevated nitrate is present, the PRB should be an injection type PRB, targeting an area of 50-80+ feet below grade. The results and water quality report from Pace Analytical are included as **Attachment 3**.

Groundwater Flow Model

The Lake Agawam groundwater model was developed based on the fresh-water version of the Suffolk County South Fork Groundwater Model (South Fork Model). The South Fork Model was developed as a dual-density salt-water/fresh-water model to evaluate regional management alternatives and potential impact from salt-water intrusion (CDM Smith, 2003). The South Fork Model was converted to a fresh-water model as part of the Source Water Assessment Program

(SWAP) conducted in 2003 and has been used for a number of regional planning projects since that time (Suffolk County Comprehensive Water Resources Management Plan (2015), Suffolk County Subwatersheds Wastewater Plan (2020)).

Model Refinements

The South Fork Model was refined in the vicinity of Lake Agawam to represent in greater detail the direction and rate of groundwater flow near the lake, groundwater discharge into the lake, and the estimated impact of the PRB on local groundwater flow and solute transport. Model revisions include:

- **Computational grid (horizontal):** Computational finite element sizes and node spacing were significantly reduced in the study area (**Figure 9**). The number of elements representing the lake and surrounding area was increased from 181 to 3832, i.e., average element size in this 6 square mile area was reduced by approximately 95 percent. Within the lake area, node spacing averages approximately 100 feet. Typical node spacing is 40 feet in the area near the north shoreline of the lake where the PRB pilot is proposed. Node spacing at the location of proposed pilot wells is as fine as 0.2 feet.
- **Stratigraphy and layering:** Stratigraphic logs for borings LA-B01 – LA-B04 in the proposed pilot area just north and northeast of the lake indicate that fine-grained soil (silt followed by clay) was encountered at depths of 90 feet and greater, corresponding to an elevation of approximately -73 feet MSL. Overlying soils were sandy, typical of Long Island’s upper glacial aquifer. Logs for USGS monitoring well S-59794, located approximately 4,700 feet southwest of Agawam Park, indicate a similar fine-grained layer from 110 feet to 130 feet depth (Nemickas and Koszalka, 1982). This is illustrated in Figure 4 of the technical memorandum “Lake Agawam Permeable Reactive Barrier: Phase 1” (CDM Smith, 2020), but also shown as **Figure 10** for reference.

The South Fork model includes an interval of relatively low permeability, identified as Monmouth Greensand, within the upper glacial aquifer, consistent with the fine-grained soil encountered at depth in the LA-B01 – LA-B04 profiles. In the Lake Agawam model, the elevation of this low-K model interval was adjusted within the Lake Agawam study area to be consistent with the observations at profiles LA-B01 – LA-B04 and well S-08836.

In both the South Fork and Lake Agawam models, the relatively low-hydraulic conductivity model interval is subdivided into two computational layers, each with the same hydraulic properties. The upper glacial aquifer above the low permeability material is subdivided into four computational layers, with the same hydraulic properties assigned to each, in both models. The elevations of the upper computational layers were adjusted in the Lake Agawam model in conjunction with the elevation adjustments made to the low permeability interval.

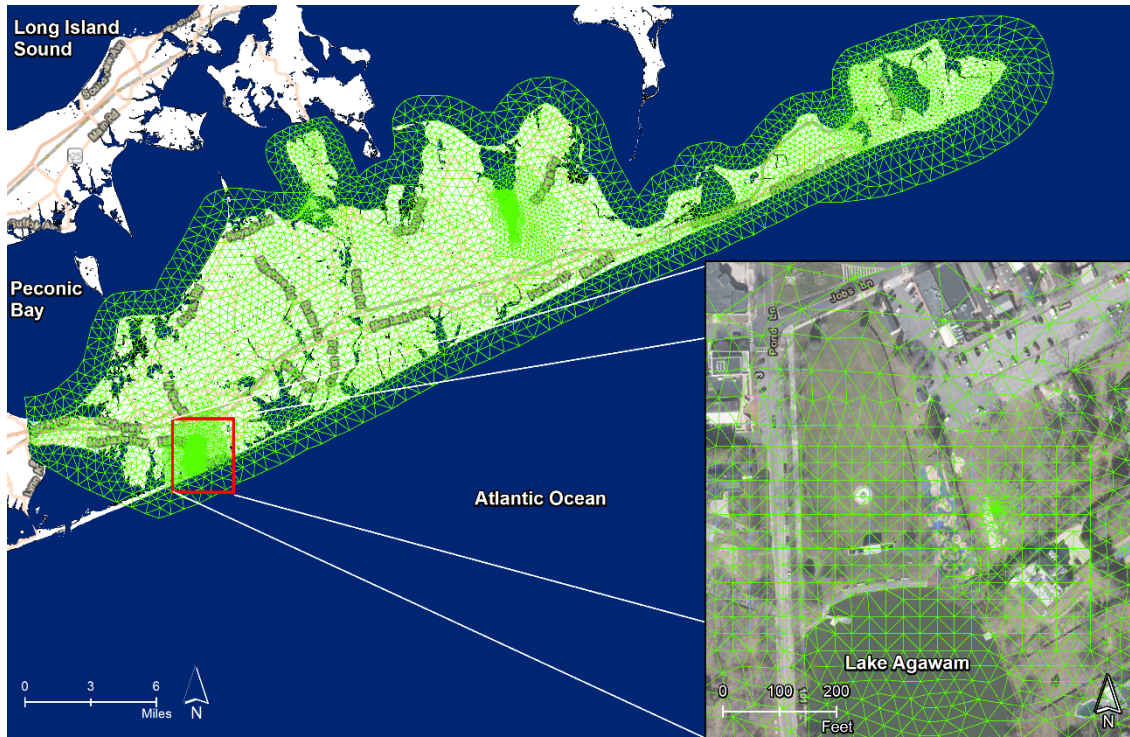


Figure 9 Finite element grid.

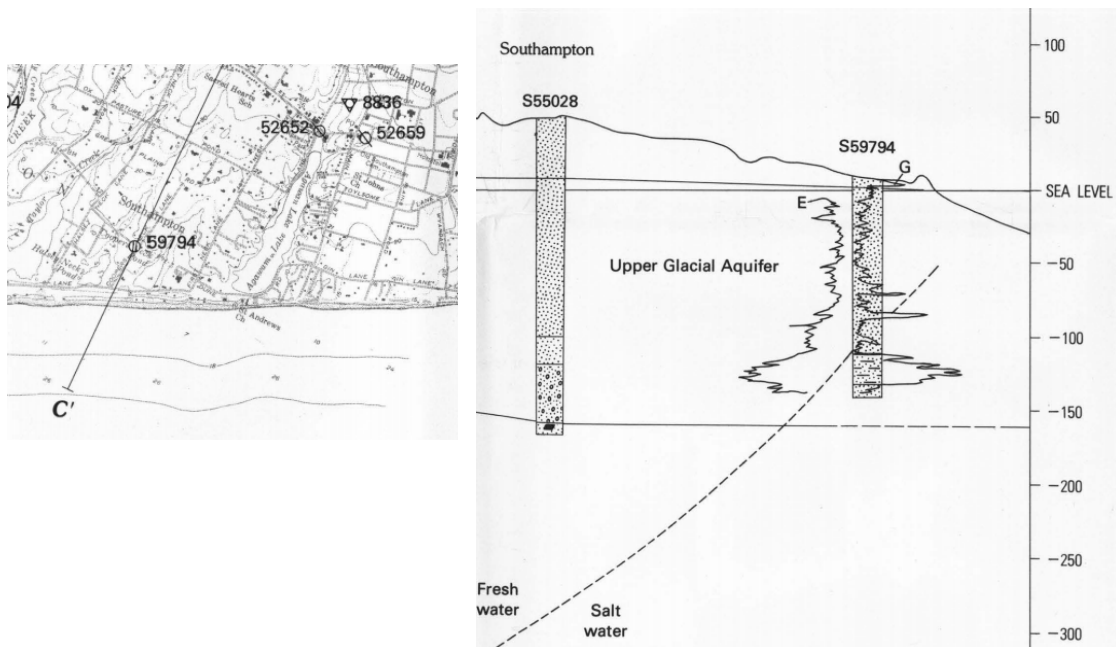


Figure 10 Boring log and position of saltwater/freshwater interface at S-59794, approximately 4,700 feet southwest of Agawam Park (from Nemickas and Koszalka, 1982).

Model stratigraphy and layering is shown on a northeast-southwest cross-section on **Figure 11**.

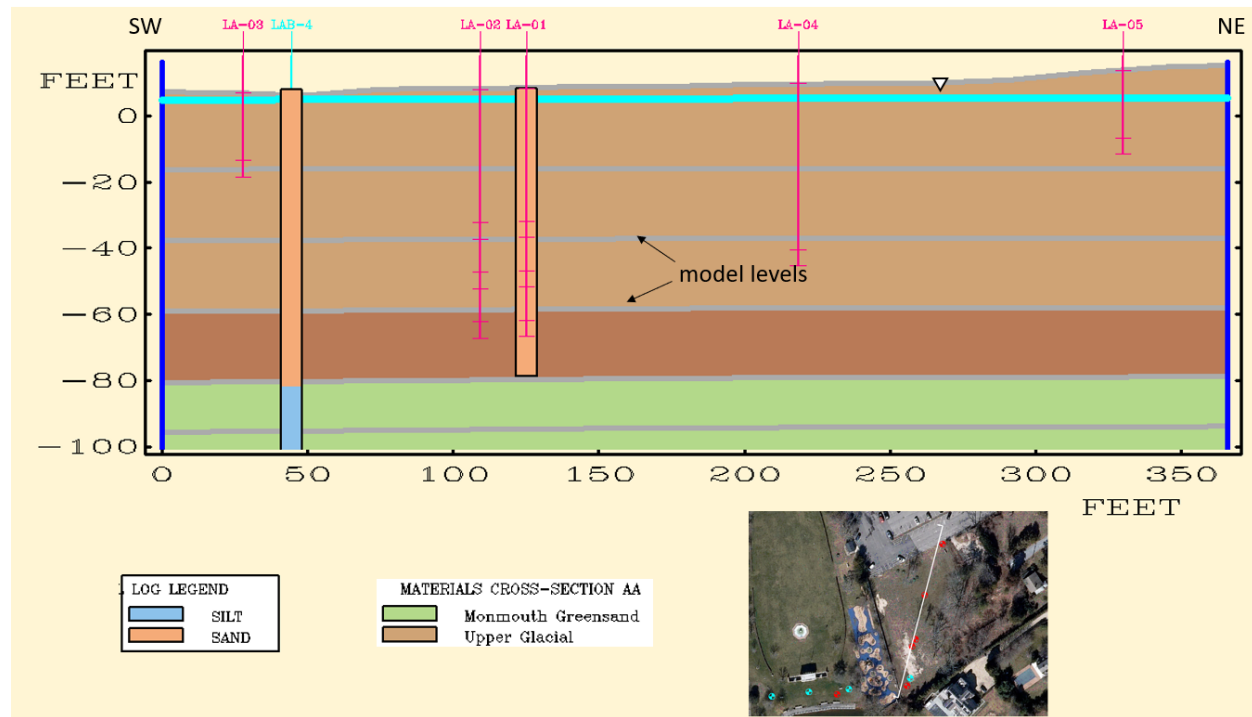


Figure 11 Cross-section through proposed PRB area. PRB proposed between LA-01 and LA-02

- **Model bottom:** The bottom of the model is set at the elevation of the saltwater interface as calculated according to the Ghyben-Hertzberg relationship between freshwater head and saltwater interface for coastal areas. Model computed heads at the bottom of the model (level 1) and an assumed saltwater density 1.025 times the density of fresh water were used to compute the interface elevation at each node location. The bottom elevation was recalculated within the Lake Agawam study area for each model simulation based on the model calculated heads.
- **Model Surface:** Within the Lake Agawam study area, except for the lake itself, the top of the model represents the ground surface and was modified by interpolation from LiDAR data (received from SCDHS in 2016 for the Subwatersheds Wastewater Plan). Within the area of the lake, the top of the model was set at the estimated top of the aquifer below the lake bottom sediments, as described below.
- **Aquifer Hydraulic Properties:** Hydraulic properties assigned to the upper glacial aquifer and the silt-clay layer encountered at the site at a depth of approximately 90 feet were adjusted within the study area. The revised hydraulic conductivity values are:

- Upper glacial: 290 ft/day horizontal, 15 ft/day vertical
- Upper glacial (lower; dark brown on **Figure 11**): 240 ft/day horizontal, 12.5 ft/day vertical
- Silt-clay (Monmouth Greensand): 0.5 ft/day horizontal, 0.05 ft/day vertical

The adjustments were made to improve the agreement between model simulated and measured water levels at site monitoring wells (see Model Validation below). The assigned values are consistent with site boring logs, grain size analyses and slug test results.

- Lake representation {boundary conditions}: Interaction between groundwater and the lake is represented by assigning a general head boundary condition (GHB) to each lake node at the top model level. This is a conditional boundary condition that calculates groundwater discharge to the lake where the groundwater head is greater than the lake level and groundwater inflow from the lake where the lake level is greater than the groundwater head. The GHB incorporates the hydraulic effect of a sediment layer at the lake bottom through which groundwater discharge and inflow pass. Lake bathymetry, as incorporated into the groundwater model from NP&V (2009), is shown on **Figure 12**.

At each model node, GHB flow is computed as follows:

$$Q = (Hl - Hgw) * Cond$$

Where:

Q is calculated flow at the node. A positive value of Q indicates inflow from the lake to groundwater and a negative value indicates groundwater discharge to the lake.

Hl is lake water level assigned at each lake node

Hgw is the model-computed groundwater head at the lake bottom below the sediment layer.

Cond is hydraulic conductance that is assigned at each model node.

Conductance is calculated as:

$$Cond = Kv * Area / Thick$$

Where,

Kv is vertical hydraulic conductivity of sediment

Area is the area associated with each node, which is calculated based on the spacing of adjacent nodes

Thick is the sediment thickness at the node location

A lake level of 4.1 feet MSL was measured 3/7/2022, during the time period when the groundwater levels were measured at site monitoring wells. This lake level was assigned to simulations of that time period. Since the lake level varies during the year, lake levels ranging from 3 to 5 feet MSL could be assigned in design test simulations (actual range will be determined from historic lake levels measured by the Village).

Sediment thickness was measured at sampling points at the north end of Lake Agawam by NP&V (2019). The results are summarized in contour maps attached to the NP&V report. The sediment thickness contour data were interpolated to model nodes. Sediment thickness ranged from 0 to 8.2 feet. For lake nodes south of the sediment study area an assumed thickness of 2.5 feet was assigned uniformly, based on the average thickness estimated within the sediment study area. The “depth to hard bottom” as measured by NP&V and the subsequent sediment thickness, as incorporated into the model, are shown on **Figure 13**.

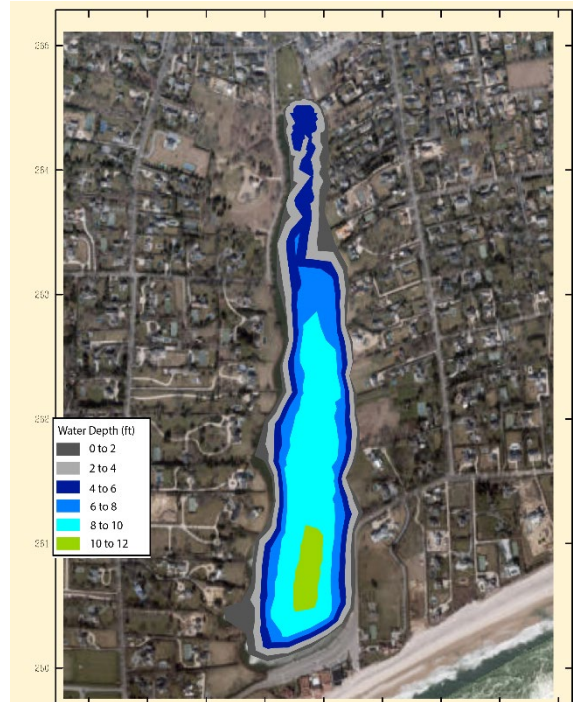


Figure 12 Lake bathymetry

A uniform lake sediment vertical hydraulic conductivity of 0.9 feet/day was used to calculate and assign conductance values to lake nodes. Using these conductance values, model-simulated heads at monitoring wells near the lake were reasonably consistent with the 3/3/2022 and 3/10/2022 measured values.

The elevation of the sediment bottom was calculated by subtracting the sediment thickness used to calculate conductance from the sediment top elevations (bathymetry). The top of the aquifer (and hence the computational top of the model) was set at the sediment bottom elevations (**Figure 14**).

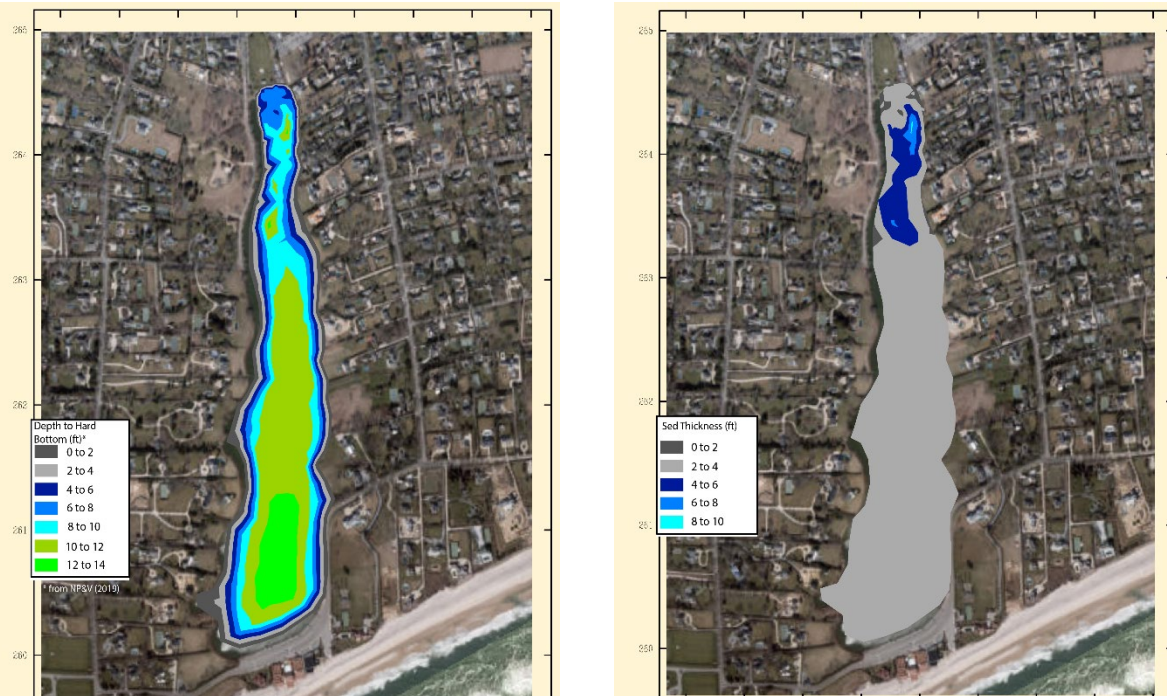


Figure 13 Depth to “hard bottom” sediments (top of upper glacial aquifer) and resulting lake sediment thickness (interpreted from NP&V (2009, 2019).

Model Validation

The regional South Fork model was originally calibrated to water levels measured by the Suffolk County Department of Health Services (SCDHS) and the USGS (CDM Smith, 2003). The calibrated model was used over the past 19 years for a variety of projects, most recently the Suffolk County Subwatersheds Wastewater Plan. To verify that the Lake Agawam model is representative of detailed local conditions near the proposed PRB injection site, a model validation simulation was made to compare simulated water levels at site monitoring wells (LA-01 – LA-06) with water levels measured 3/3/2022 and 3/10/2022. An offsite USGS monitoring well, S-08836, was also used to verify simulated groundwater head. That well is located on Nugent Street and is 37 feet deep. Water quality samples haven’t been collected in this well since 1976 and only three samples have been collected since 1974.

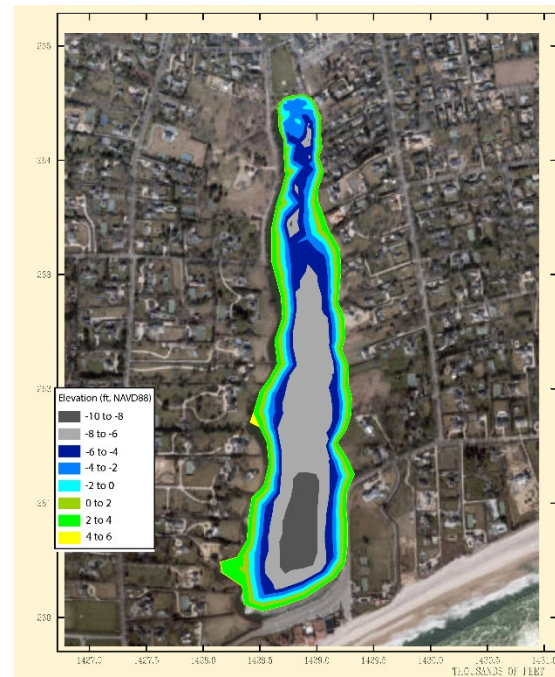


Figure 14 Elevation of the top of the upper glacial aquifer within Lake Agawam.

At the time, nitrate concentrations ranged between 1.2 and 3.2 mg/L as N.

Monthly pumping for each SCWA well within the South Fork from 2010 through 2020 was incorporated. Pumping data in 2021 and 2022 was approximated based on 2018 conditions (similar precipitation) as pumping data were not available during the time the model was developed.

Monthly precipitation data from the NOAA weather station at Bridgehampton (NOAA Station USC00300889) from January 2010 through March 2022 was utilized for rainfall recharge assignments. Average return flow from septic systems from the Subwatersheds Wastewater Plan was utilized (non-consumptive use returned based on 85 percent of winter pumping). Average discharge from eight sewage treatment facilities was also added throughout the South Fork, although none of these facilities is within the immediate vicinity of the study area.

A water level of 4.1 feet MSL was assigned to Lake Agawam, based on the site survey conducted on 3/7/2022.

To account for seasonal hydrologic variability, the model was run in transient mode for the period from 11/1/2021 to 3/7/2022, starting with average conditions represented by a steady state simulation incorporating 2010-2020 average pumping and recharge.

Target water levels were the average of the 3/3/2022 and 3/10/2022 measured values. Differences between the 3/3/2022 and 3/10/2022 readings were less than 0.05 feet at all locations. The target head from the USGS monitoring well is the average of the water levels collected on 2/28/2022 and 3/18/2022. Simulated head within the upper glacial aquifer is shown on **Figure 15**.

Table 5 lists the targeted measured head, simulated head and difference between target measured and simulated head (residual) for each of the site monitoring wells and the offsite USGS monitoring well. The average of the residuals is 0.03 feet, with a standard deviation of 0.06 feet, indicating very good agreement between the simulated and measured water levels.

The model is sensitive to changes in lake level. A detailed record of lake surface elevation should be kept and compared with measured groundwater head moving forward to understand the aquifer's responsiveness due to changes in lake level, particularly when the lake is being drained. The model will be used to support the design of the PRB in Phase 3 of this project and evaluate how changes in historic lake levels may be impacting head at the site. Gradient changes can increase groundwater velocity and as the PRB requires appropriate contact time with the nitrate in groundwater, this needs to be understood so that the PRB is designed appropriately.

Summary and Conclusions

Water quality data indicate that the parcel immediately east of Agawam Park is suitable for the installation of a permeable reactive barrier. Elevated nitrate is present at depths below 45 feet. Due to the depth of the elevated nitrate, the PRB cannot be installed with trenching and backfilling with media (wood chips, mulch, etc.). It is recommended that the PRB utilize a series of injection wells to inject a carbon amendment (emulsified vegetable oil, or similar) across screened intervals between 50 and 80 feet below grade. The proposed location of the PRB is shown on **Figure 16**. The location shown is 100 feet long, but the ultimate length of the PRB will depend on available funding. As this project is a pilot to evaluate the effectiveness of the PRB, the length of the PRB can vary.

The groundwater model has been validated against measured head at the site and an upgradient USGS monitoring well and has shown very good agreement with field data. It will be utilized to evaluate radius of influence of the injection wells and travel time to the lake to determine how many wells are required and verify that the PRB will be far enough upgradient to not discharge amendment directly into the lake. Groundwater head data will continue to be collected throughout the design, both manually and using a pressure transducer to monitor fluctuations in groundwater head.

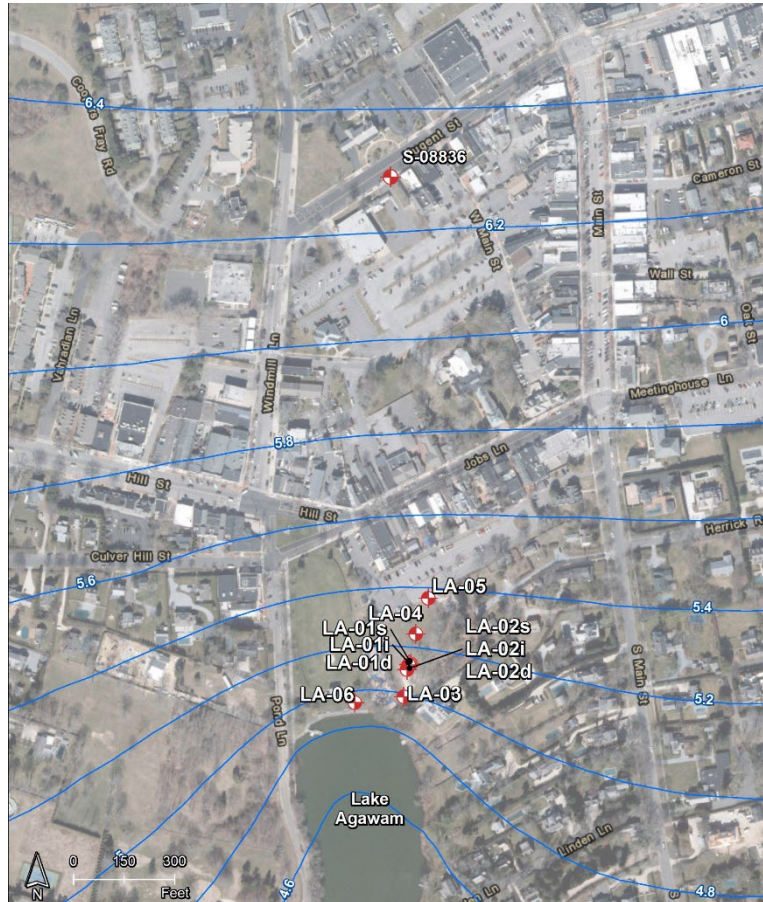


Figure 15 Simulated groundwater head: model level 10

Table 5. Simulated and Observed Head, March 2022

Well	Simulated Head (ft, msl)	Observed Head (ft, msl)	Residual (ft)
LA-01s	5.14	5.14	0.00
LA-01i	5.15	5.14	0.01
LA-01d	5.15	5.10	0.05
LA-02s	5.12	5.13	0.00
LA-02i	5.13	5.10	0.03
LA-02d	5.13	5.11	0.02
LA-03	4.99	4.99	0.00
LA-04	5.25	5.22	0.03
LA-05	5.37	5.30	0.07
LA-06	4.93	4.98	-0.04
S-08836	6.29	6.10	0.19
Mean Difference (ft)			0.034
Standard Deviation (ft)			0.062

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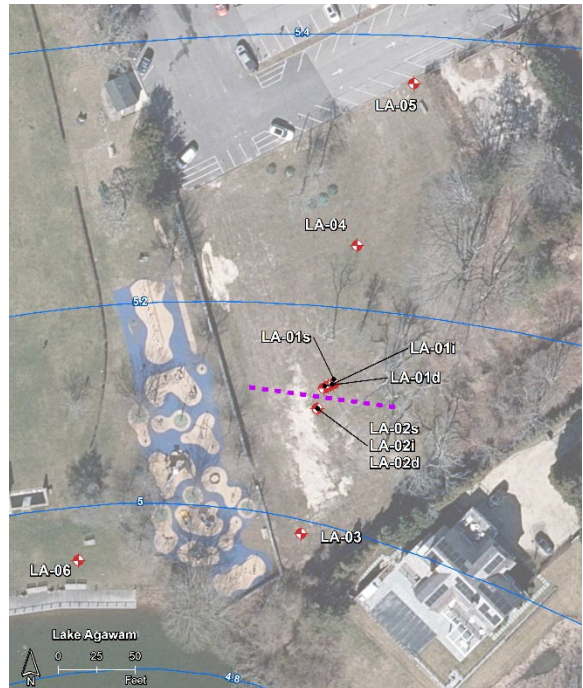


Figure 16 Proposed location of PRB (purple dashed line).

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Action Plan – Lake Agawam. April 2020.

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Attachment 1: CCE Porewater Report



AGAWAM LAKE REPORT

Locating Groundwater Derived Nitrogen Entering into Agawam Lake

Data Findings and Recommendations

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1/2022

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Introduction

This report presents the results of water sample analysis from water samples collected from sites around Agawam Lake: trident data, porewater field data, porewater lab data, surface water field data, and surface water lab data. Figures are presented showing locations where samples were collected from.

Objectives

The following are the objectives of the water analysis in Agawam Lake:

- Evaluate nitrogen which enters Agawam Lake via SGD and use this information to guide installation of shoreline groundwater wells related to installation of future PRB
- Identify and prioritize shoreline areas in terms of groundwater nitrogen inputs
- Compile the information gained during this survey in a series of maps and final report to be used as a guide for the strategic placement of future water quality remediation projects
- Provide recommendations and conceptual remedies

Methods

The project was accomplished by surveying the porewater and surface water within Agawam Lake in nine transects with multiple stations within each transect on January 4, 5, and 6, 2022. In total, the survey included twenty-two porewater and surface water stations, with eighteen samples collected for porewater and two for surface water.

This survey was accomplished using proprietary equipment and techniques including an instrument called the Trident Probe which was deployed from two tethered 14-foot Jon boats (see figure 12). The Trident Probe (figure 15) is a direct-push, integrated temperature sensor, conductivity sensor, and porewater sampler, developed to screen sites for areas where groundwater may be discharging to a surface water body and collect porewater samples from potential discharge zones (Chadwick et al., 2003). Specifically, the Trident Probe measures

temperature and bulk conductivity contrast between porewater 1 ft below the sediment-water interface and surface water 1 ft above the sediment-water interface. The probe sensors are calibrated for both temperature and conductivity before deployment. During winter months, high contrast areas with high temperature and low conductivity values in the porewater are conditions indicating groundwater discharge. Typically, groundwater temperatures in the winter months are in the range of 10 to 13 °C. When the temperature and conductivity signal indicated there was fresh groundwater present, porewater and surface water samples were collected for further analysis. Porewater samples were collected from the probe through 1/8-inch Teflon tubing using a low-flow peristaltic pump. A minimum of 200 mL was purged prior to collection of a porewater sample. Samples were stored on ice and analyzed for nitrogen by a NYS ELAP certified laboratory.

In addition to temperature and conductivity measured by the Trident Probe, porewater field parameters including oxidation reduction potential (ORP), total dissolved solids (TDS), pH, and dissolved oxygen (DO) were measured with a Myron ultrameter and YSI DO meter. The ultrameter was calibrated using NIST standards prior to the survey, and the calibration was checked daily. The DO meter was calibrated according to instructions using water-saturated air and was checked daily. Additionally, the surface water column height, measured by hand-held acoustic sounder, and a qualitative description of the sediment bottom type were recorded at each sampling station. This ancillary information is relevant for future remediation strategies. Coordinates for each station were recorded using a Wide Area Augmentation System locked GPS, an instrument capable of sub-meter accuracy.

Station and Sample Identification

Station and sample identification (ID) includes the transect number and the approximate distance from the northern shoreline of Agawam Lake. Stations were numbered T0 to T8 moving east to west. Station T0 was fifty feet from T1 due to tree limbs and roots, but all the other stations were twenty-five feet apart. The ID further indicates the distance from shore and the depth (in feet) below sediment-water interface that the probe obtained the sample. No depth indicated the standard Trident depth of one foot. AGP_T0_3 indicates Agawam Lake station T0 which is three feet from shore at the standard one-foot trident depth. AGP_T0_5_5 indicates

further that the sample was taken five feet from shore at a depth of five feet below the sediment-water interface.

Trident Data

Figure 1 shows the locations of the porewater stations established for Agawam Lake in 2022.



Figure 1: Agawam Porewater Stations 2022

Table 1 shows the sample IDs corresponding with the stations shown in Figure 1, their latitudes, longitudes, water column heights, bottom characteristics, trident probe bulk (sediment/porewater) conductivity, trident probe bulk (sediment/porewater) temperatures, trident surface water reference probe conductivity, and trident reference probe temperatures, and the temperature differences.

Sample ID	Latitude	Longitude	Water Column Height (inches)	Bottom Characteristics	Trident Probe Bulk (Sediment/Porewater) Cond uS/cm	Trident Probe Bulk (Sediment/Porewater) Temp (C)	Trident Surface Water Reference Probe Cond uS/cm	Trident surface water Reference Probe Temp (C)	Temp Difference (C)
AGP T0 3	40.881512	72.391707	14.0	gravel sandy bottom	106	8.407	1357	5.193	3.214
AGP T0 30	40.881461	72.391785	49.0	silty sand-6 inches of muck	183	7.254	1381	5.177	2.077
AGP T1 3	40.881624	72.391809	8.0	silty sand, branches debris	100	11.772	1379	5.619	6.153
AGP T2 3	40.881651	72.391897	10.0	silty sand and debris	400	9.092	1311	6.233	2.859
AGP T3 3	40.881664	72.391988	8.0	silty sand	133	11.083	1391	4.951	6.133
AGP T3 30	40.881597	72.391977	40.0	Silty	201	6.731	1396	4.837	1.894
AGP T4 3	40.881666	72.392095	9.0	sandy	120	10.659	1398	4.777	5.882
AGP T4 30	40.881631	72.392077	40.0	silty	200	6.735	1410	4.676	2.06
AGP T5 3	40.881600	72.392256	8.0	silty sand	136	6.281	1377	5.405	0.877
AGP T6 3	40.881657	72.392344	7.0	sand with gravel	150	10.588	1370	5.525	5.063
AGP T6 60	40.881460	72.392282	55.0	silty, mucky	547	9.866	1384	5.098	4.768
AGP T7 3	40.881635	72.392478	8.5	sandy gravel, no drive point sample	191	6.015	1386	5.252	0.763
AGP T7 30	40.881547	72.392440	44.4	silty muck	441	8.574	1400	5.071	3.503
AGP T8 3	40.881589	72.392613	12.0	sandy gravel rock	117	6.897	1383	5.514	1.383

Table 1: Agawam Lake Trident Data

Discussion for Table 1, Trident Data:

Groundwater temperature falls within a narrower range of values compared to surface water. Porewater measurements were performed in January when surface water temperatures were relatively low compared to groundwater temperatures, thus a greater positive contrast between porewater and surface water indicated the presence of groundwater seepage under these circumstances. Bulk (sediment/porewater) temperature measurements with the Trident Probe showed a minimum value of 6.015°C and a maximum value of 11.772°C with an average value

of 8.568°C. This average value, as compared with an average of 5.3°C from the reference probe in the surface water column, indicated an inflow of groundwater. This indication is particularly true in areas such as T1, T3, T4, and T6 having bulk temperatures closest to the maximum porewater temperature value.

Porewater Field Data

Figure 2 shows the trident porewater temp for each of the porewater stations.



Figure 2: Trident Porewater Temp C

Table 2 shows the latitude, longitude, field conductivity, field TDS, field pH, field temp, field ORP, and field DO data results for each of the sample IDs listed in the first column.

Sample ID	Latitude	Longitude	Field Conductivity (us/cm)	Field TDS (ppm)	Field pH	Field Temp (C)	Field ORP (mV)	Field DO (mg/L)
AGP T0 3	40.881512	72.391707	305.6	147.3	6.05	6.2	186	4.18
AGP T0 30	40.881461	72.391785	502.4	216.1	6.71	5.5	13	4.42
AGP T0 5 5	40.881512	72.391707	278.9	134.5	6.01	11.7	165	1.30
AGP T1 3	40.881624	72.391809	407.4	196.9	6.61	9.8	59	2.02
AGP T1 3 5	40.881624	72.391809	717.9	348.2	6.45	10.8	25	
AGP T2 3	40.881651	72.391897	673.0	320.1	6.82	4.6	7	3.86
AGP T2 3 6	40.881651	72.391897	576.0	263.0	6.60	11.4	194	1.70
AGP T3 3	40.881664	72.391988	879.6	430.9	6.51	6.3	-48	2.20
AGP T3 3 6	40.881664	72.391988	770.1	376.1	6.34	12.8	-14	2.00
AGP T3 30	40.881597	72.391977	947.8	467.1	6.61	3.7	-41	3.13
AGP T4 3	40.881666	72.392095	536.7	237.3	6.94	4.5	-42	3.92
AGP T4 3 4	40.881666	72.392095	523.6	229.9	6.61	12.5	-14	1.80
AGP T4 30	40.881631	72.392077	585.0	267.4	6.80	2.8	-27	5.23
AGP T5 3	40.881600	72.392256	738.5	357.5	6.74	10.2	-11	4.30
AGP T5 3 4	40.881600	72.392256	527.5	232.8	6.51	10.0	9	4.80
AGP T6 3	40.881657	72.392344	599.5	277.0	6.77	10.7	-42	4.37
AGP T6 3 5.5	40.881657	72.392344	536.4	237.5	6.34	10.3	-12	1.00
AGP T6 60	40.881460	72.392282	880.1	430.9	6.77	5.3	34	10.41
AGP T7 3	40.881635	72.392478	739.9	389.3	6.52	8.4	17	4.16
AGP T7 30	40.881547	72.392440	805.2	391.9	6.79	5.9	-4	2.62
AGP T8 3	40.881589	72.392613	437.3	211.3	6.48	8.6	12	4.23
AGP T8 3 5.5	40.881589	72.392613	386.4	186.5	6.94	11.6	-33	

Table 2: Agawam Lake Porewater Field Data

Discussion for Table 2, Porewater Field Data:

Conductivity measurements in the porewater showed a minimum value of 278.9 $\mu\text{S}/\text{ml}$ and a maximum value of 947.0 $\mu\text{S}/\text{ml}$, with an average of 607.0 $\mu\text{S}/\text{ml}$. Compared to the surface water average of 1211.8 $\mu\text{S}/\text{ml}$, these values further indicated an inflow of groundwater.

Dissolved oxygen measurements ranged from a minimum of 1.0 mg/L to a maximum of 10.41 mg/L with an average of 3.58 mg/L. The inconsistent value of 10.41 mg/L was taken right next to an aerator whose effect was apparently significant, as the next highest value was only 5.23 mg/L.

Figure 3 shows the porewater conductivity levels ($\mu\text{S}/\text{ml}$) for each of the sample locations in Agawam Lake.



Figure 3: Agawam Porewater Conductivity $\mu\text{S}/\text{ml}$

Figure 4 shows the porewater dissolved oxygen levels (mg/L) for each of the sample locations in Agawam Lake.



Figure 4: Agawam Porewater Dissolved Oxygen mg/L

Porewater Lab Data

Table 3 shows the latitude, longitude, date and time samples were collected, and lab results (nitrate, ammonia, nitrite, TKN, and total nitrogen) for each of the surface water samples listed in the first column. The Long Island Analytical Laboratories Inc. analyzed water samples

Sample ID	Latitude	Longitude	Date	Time	Lab Nitrate NO3 (mg/L)	Lab Ammonia NH4 (mg/L)	Lab Nitrite NO2 (mg/L)	Lab TKN (mg/L)	Lab Total Nitrogen (mg/L)
AGP T0 3	40.881512	72.391707	1/6/2022	10:15	4.37	<1.0	<0.4	1.30	5.67
AGP T0 5 5	40.881512	72.391707	1/6/2022	10:18	6.27	4.80	<0.040	4.10	10.40
AGP T1 3	40.881624	72.391809	1/5/2022	12:22	0.14	<0.0406	<0.01	1.10	1.24
AGP T1 3 5	40.881624	72.391809	1/5/2022	13:30	0.26	2.10	<0.01	2.90	3.16
AGP T2 3	40.881651	72.391897	1/4/2022	14:20	0.09	1.40	<0.01	1.70	1.79
AGP T2 3 6	40.881651	72.391897	1/4/2022	14:13	0.09	0.60	<0.01	<0.863	<1.06
AGP T3 3	40.881664	72.391988	1/4/2022	14:50	0.09	22.60	<0.01	18.90	19.00
AGP T3 3 6	40.881664	72.391988	1/4/2022	14:58	<0.02	17.00	<0.01	14.30	14.30
AGP T4 3	40.881666	72.392095	1/6/2022	13:35	<0.02	2.00	<0.01	1.90	1.90
AGP T4 3 4	40.881666	72.392095	1/6/2022	15:18	<0.02	1.80	<0.01	2.10	2.10
AGP T5 3	40.881600	72.392256	1/5/2022	10:35	0.18	7.00	<0.01	6.30	6.48
AGP T5 3 4	40.881600	72.392256	1/5/2022	10:30	0.10	4.60	<0.01	5.90	6.00
AGP T6 3	40.881657	72.392344	1/5/2022	11:30	0.12	9.40	<0.01	7.70	7.82
AGP T6 3 5.5	40.881657	72.392344	1/5/2022	11:21	0.11	11.20	<0.01	8.90	9.01
AGP T7 3	40.881635	72.392478	1/6/2022	11:35	<0.40				
AGP T8 3	40.881589	72.392613	1/6/2022	12:30	<0.40	3.08	<0.40	3.70	3.70
AGP T8 3 5.5	40.881589	72.392613	1/6/2022	12:33	<0.40	1.40	<0.40	2.90	2.90

Table 3: Agawam Lake Porewater Lab Data

Discussion for Table 3, Porewater Lab Data:

Nitrate measurements ranged from a minimum value of <0.02 mg/L to a maximum value of 6.27 mg/L with a detectable average of 1.07 mg/L. Station T0, which is in the Northeast corner of the lake, showed the highest values. Station T1 is closer to T2 than it is to T0. Specifically, the distance between T1 and T2 is 25 feet, whereas the distance from T1 to T0 is 50 feet. This was the result of obstacles, namely large trees in the way. As a result, the nitrate and ammonia levels in T1 are more similar to T2 than they are to T0.

Ammonia measurements ranged from a minimum value of <0.0406 mg/L to a maximum value of 22.60 mg/L with an average value of 6.36 mg/L. Ammonia was found inconsistently around the lake but tended to be highest in the middle stations, with the highest values at T3 and T6.

Figure 5 shows the porewater nitrate levels (mg/L) for each of the sample locations in Agawam Lake.



Figure 5: Agawam Porewater Nitrate mg/L

Figure 6 shows the porewater ammonia levels (mg/L) for each of the sample locations in Agawam Lake.



Figure 6: Agawam Porewater Ammonia mg/L

Figure 7 shows the porewater pH levels for each of the sample locations in Agawam Lake.



Figure 7: Agawam Porewater pH

Figure 8 shows the porewater ORP levels (mV) for each of the sample locations in Agawam Lake.



Figure 8: Agawam Porewater ORP (mV)

Figure 9 shows the porewater TKN levels (mg/L) for each of the sample locations in Agawam Lake.



Figure 9: Porewater TKN mg/L

Figure 10 shows the porewater total nitrogen levels (mg/L) for each of the sample locations in Agawam Lake.



Figure 10: Agawam Porewater Total N mg/L

Surface Water Field and Lab Data

Table 4 shows the latitude, longitude, field conductivity, field TTS, field pH, field temperature, field ORP, and field DO for each of the surface water samples listed in the first column.

Sample ID	Latitude	Longitude	Field Conductivity (us/cm)	Field TDS (ppm)	Field pH	Field Temp (C)	Field ORP (mV)	Field DO (mg/L)
AGP T0 3	40.881512	72.391707	1213.0	608.8	5.63	5.4	209	11.91
AGP T1 3	40.881624	72.391809	1228.0	615.0	6.36	7.0	80	12.33
AGP T2 3	40.881651	72.391897	1186.0	593.7	6.60	5.7	63	10.00
AGP T3 3	40.881664	72.391988	1235.0	620.6	6.65	4.9	0	12.47
AGP T3 30	40.881597	72.391977	1245.0	626.2	6.73	4.6	3	
AGP T4 3	40.881666	72.392095	1251.0	629.5	6.59	4.4	0	12.49
AGP T4 30	40.881631	72.392077	1248.0	627.9	6.08	4.2	9	
AGP T5 3	40.881600	72.392256	1224.0	612.1	6.80	6.1	5	12.37
AGP T6 3	40.881657	72.392344	1221.0	611.3	6.78	6.7	-18	
AGP T6 60	40.881460	72.392282	1155.0	576.4	6.28	5.2	194	14.00
AGP T7 3	40.881635	72.392478	1172.0	553.6	6.68	5.6	111	
AGP T7 30	40.881547	72.392440	1159.0	578.6	6.70	5.0	155	14.00
AGP T8 3	40.881589	72.392613	1217.0	610.3	6.39	6.8	37	12.71

Table 4: Agawam Surface Water Field Data

Table 5 shows the latitude, longitude, and lab results (nitrate, ammonia, nitrite, TKN, and total nitrogen) for each of the surface water samples listed in the first column. The Long Island Analytical Laboratories Inc. analyzed water samples

Sample ID	Latitude	Longitude	Lab Nitrate NO3 (mg/L)	Lab Ammonia NH4 (mg/L)	Lab Nitrite NO2 (mg/L)	Lab TKN (mg/L)	Lab Total Nitrogen (mg/L)
AGP T3 3	40.881664	72.391988	0.70	0.80	<0.01	2.30	3.00
AGP T6 3	40.881657	72.392344	0.69	0.80	<0.01	1.9	2.59

Table 5: Agawam Surface Water Lab Data

Discussion for Tables 4 and 5, Surface Water Field and Lab Data

Two surface water samples collected from T3 and T6 had an average of 0.7 and 0.8 mg N/L nitrate and ammonia, respectively. The average total nitrogen was 2.65 mg N/L. The SCSWP used 0.32 mg N/L as a reference threshold for surface water of undrained fresh waterbodies (SCSWP pg. 2-103) and the Long Island Nitrogen Action Plan considers surface water with >0.5 mg N/L dissolved inorganic nitrogen as poor water quality, thus surface water concentrations within the lake were above acceptable levels even in the winter season when fertilizer-derived nitrogen was likely at a minimum. Conductivity ranged from a minimum value of 1155.0 $\mu\text{S}/\text{ml}$ to a maximum value of 1251.0 $\mu\text{S}/\text{ml}$ with an average value of 1211.8 $\mu\text{S}/\text{ml}$.

Temperature values ranged from a minimum of 4.2°C to a maximum of 7.0°C with an average of 5.5°C.

Dissolved oxygen ranged from a minimum value of 10.0 mg/L to a maximum value of 14.0 mg/L with an average value of 12.48 mg/L.

Recommendations

Finding significant nitrate, elevated temperature, and lowered conductivity in the porewater entering in the northeast corner of Agawam Lake suggests a suitable site for a PRB in the property just to the east of the playground. Finding high ammonia in the area west of the playground and near the oxygen pump house does not support the installation of a PRB there at this time.

The combination of ammonia and the logistics of having suitable infrastructure nearby does suggest the possibility of setting up an air injection system to convert ammonia to nitrate. Installing a PRB to remove that nitrate could then be a future project.

Appendix

The following pictures show under the dock, boat setup, and views of the dock looking east and west on Agawam Lake.



Figure 11: Underneath Dock



Figure 12: Boat Setup



Figure 13: Dock Looking East



Figure 14: Dock Looking West

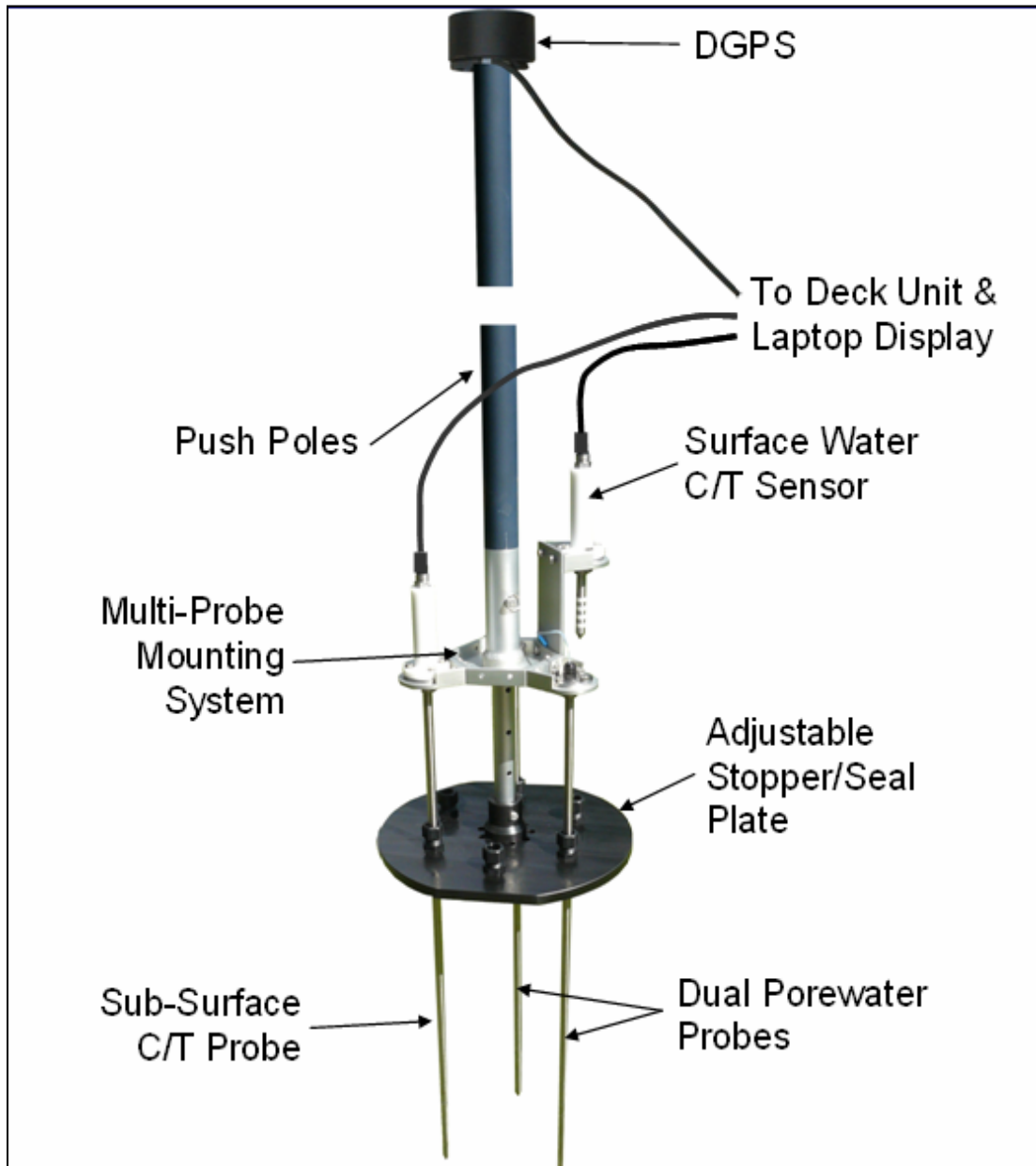


Figure 15: Photo of Trident Probe which was used to directly measure bulk conductivity and temperature as well as collect porewater samples

Gary Goleski
April 13, 2022
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Attachment 2: Grain Size Analysis



CDM Smith Geotechnical Laboratory Testing Summary Sheet

Client: Village of Southampton, NY

Project Number: 265416-267019

Reviewed By: M. Polsky - Lab Manager

Project Name: Lake Agawam Phase II

Task: 03.CORE

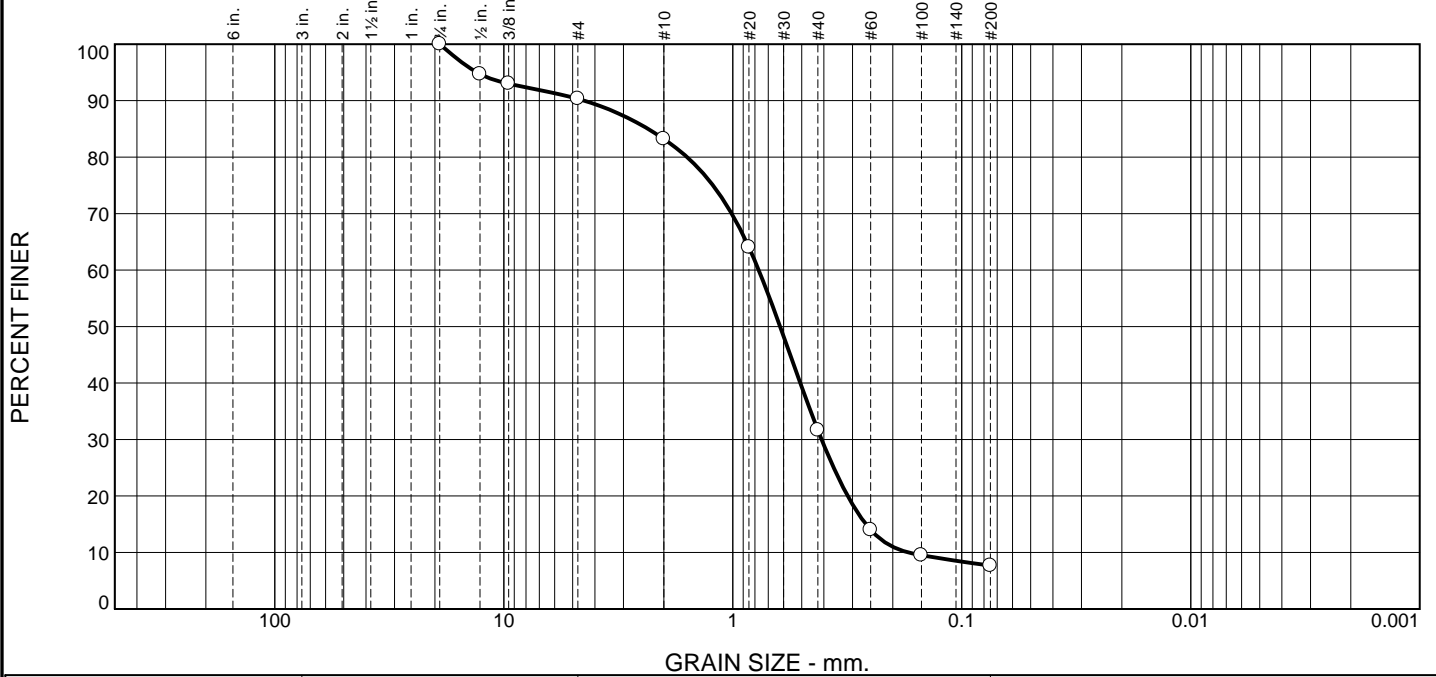
Project Location: Southampton, NY

Assigned By: D. O'Rourke

Date Reviewed: 3/7/2022

Sample Date	Boring Number	Sample	Depth (ft)	Identification Tests								Strength Tests			Soil Description
				Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	Dry unit wt. pcf	σ_c psi	Failure Criteria (CIU)	Compr. Ratio	
2/21/22	Lake Agawam	2	30-32	14.3			9.7	82.6	7.7						Brown poorly graded sand with silt
2/21/22	Lake Agawam	3	35-37	14.7			11.8	83.0	5.2						Brown poorly graded sand with silt
2/21/22	Lake Agawam	4	40-42	15.8			4.9	89.9	5.2						Light brown poorly graded sand with silt
2/21/22	Lake Agawam	5	45-47	17.2			2.7	91.8	5.5						Brown poorly graded sand with silt
2/21/22	Lake Agawam	6	50-52	15.5			14.4	83.5	2.1						Light brown poorly graded sand
2/21/22	Lake Agawam	7	55-57	18.2			18.9	79.6	1.5						Light brown poorly graded sand with gravel
2/21/22	Lake Agawam	8	60-62	14.7			9.4	87.5	3.1						Light brown poorly graded sand
2/21/22	Lake Agawam	9	65-67	17.8			12.1	87.3	0.6						Light brown poorly graded sand
2/21/22	Lake Agawam	10	70-72												
2/21/22	Lake Agawam	11	75-77	16.9			4.4	94.1	1.5						Light brown poorly graded sand
2/21/22	Lake Agawam	12	80-82	18.3			1.5	96.3	2.2						Light brown poorly graded sand
2/21/22	Lake Agawam	13	85-87	17.6			2.4	95.1	2.5						Light brown poorly graded sand

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.7	7.1	51.5	24.0	7.7	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	94.7		
0.375"	93.0		
#4	90.3		
#10	83.2		
#20	64.0		
#40	31.7		
#60	14.0		
#100	9.5		
#200	7.7		

Material Description

Brown poorly graded sand with silt

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-b

Coefficients

D ₉₀ = 4.4614	D ₈₅ = 2.3444	D ₆₀ = 0.7706
D ₅₀ = 0.6214	D ₃₀ = 0.4093	D ₁₅ = 0.2622
D ₁₀ = 0.1708	C _u = 4.51	C _c = 1.27

Remarks

As Received Moisture Content = 14.3%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

Checked By: MP

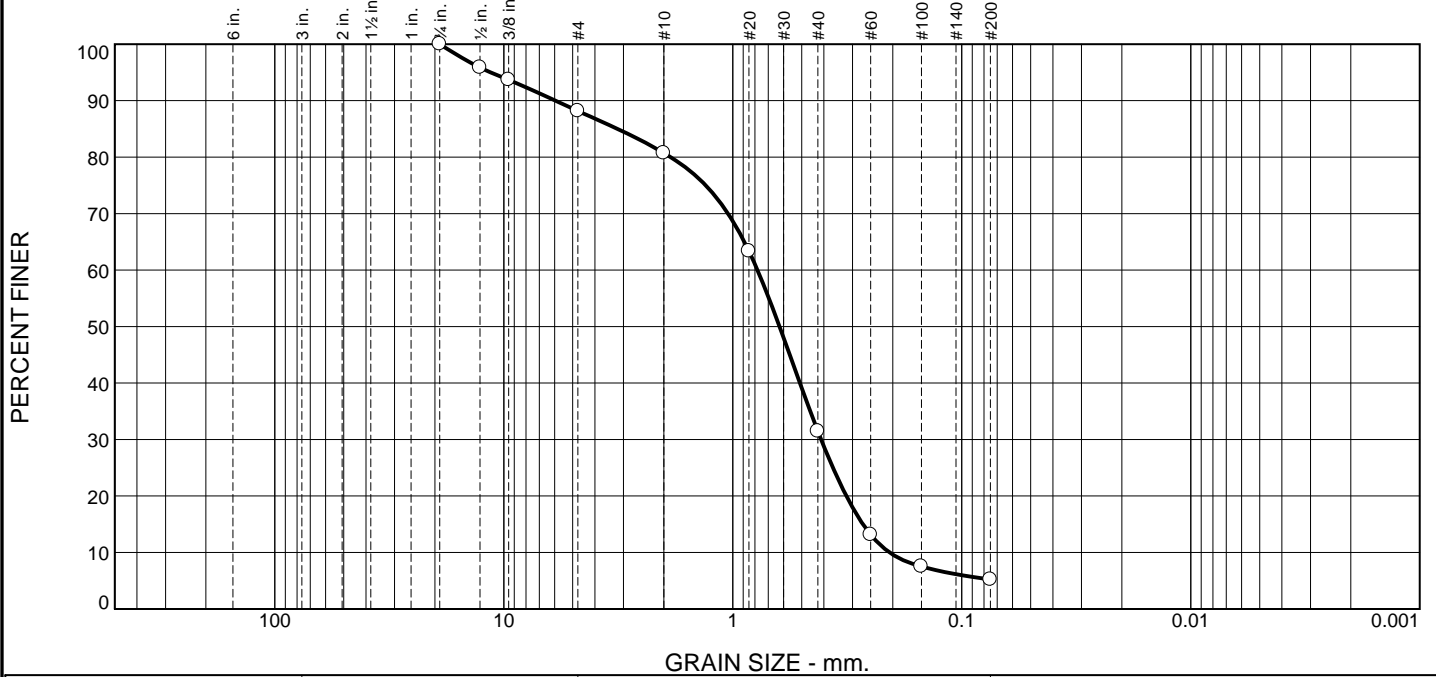
Title: Laboratory Manager

* (no specification provided)

Source of Sample: Lake Agawam Depth: 30-32' Date Sampled: 2/21/22
 Sample Number: 2

CDM Smith Boston, Massachusetts	Client: Village of Southampton, NY Project: Lake Agawam Phase II Southampton, NY Project No: 265416.267019
--	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	11.8	7.5	49.2	26.3	5.2	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	95.9		
0.375"	93.7		
#4	88.2		
#10	80.7		
#20	63.4		
#40	31.5		
#60	13.2		
#100	7.5		
#200	5.2		

Material Description

Brown poorly graded sand with silt

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-b

Coefficients

D ₉₀ = 5.9547	D ₈₅ = 3.1896	D ₆₀ = 0.7802
D ₅₀ = 0.6250	D ₃₀ = 0.4113	D ₁₅ = 0.2702
D ₁₀ = 0.2066	C _u = 3.78	C _c = 1.05

Remarks

As Received Moisture Content = 14.7%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

Checked By: MP

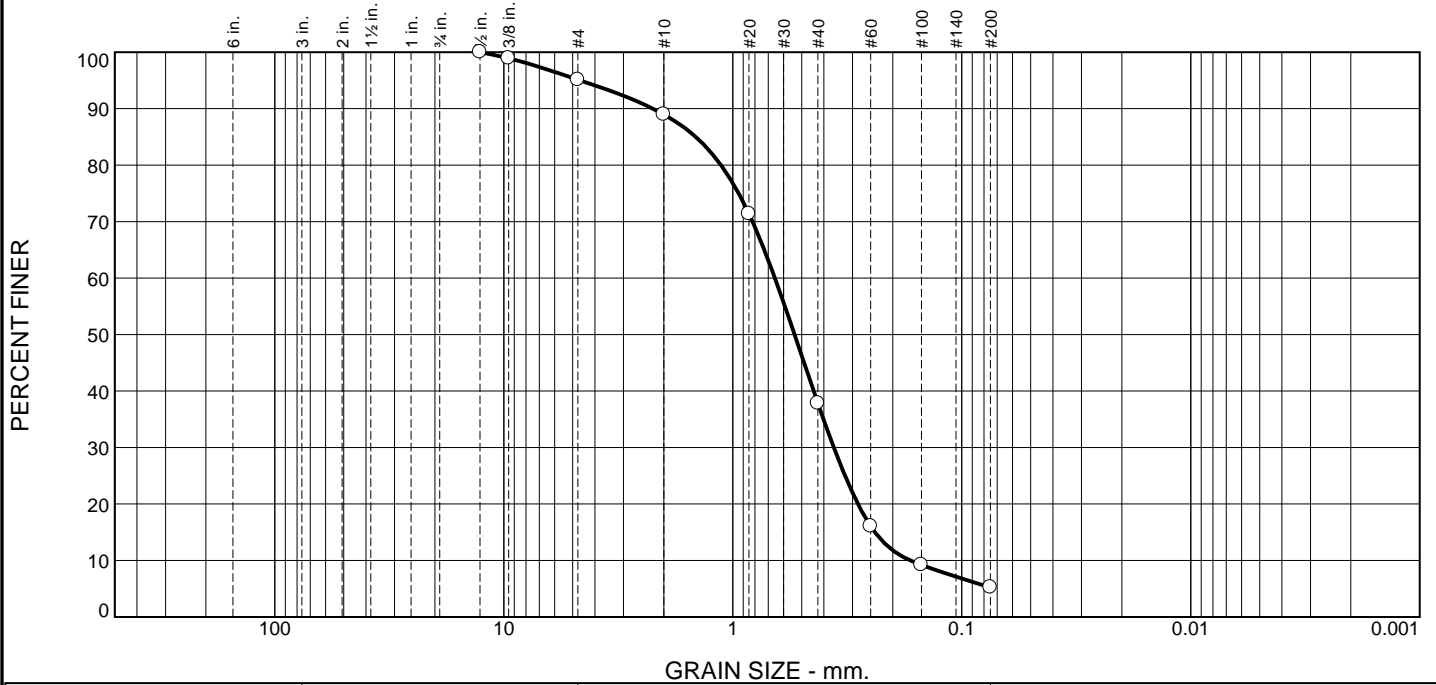
Title: Laboratory Manager

* (no specification provided)

Source of Sample: Lake Agawam Depth: 35-37' Date Sampled: 2/21/22
 Sample Number: 3

CDM Smith Boston, Massachusetts	Client: Village of Southampton, NY Project: Lake Agawam Phase II Southampton, NY Project No: 265416.267019
--	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.9	6.1	51.1	32.7	5.2	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5"	100.0		
0.375"	98.9		
#4	95.1		
#10	89.0		
#20	71.4		
#40	37.9		
#60	16.1		
#100	9.2		
#200	5.2		

* (no specification provided)

Material Description

Light brown poorly graded sand with silt

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-b

Coefficients

D ₉₀ = 2.2357	D ₈₅ = 1.4516	D ₆₀ = 0.6549
D ₅₀ = 0.5373	D ₃₀ = 0.3619	D ₁₅ = 0.2394
D ₁₀ = 0.1676	C _u = 3.91	C _c = 1.19

Remarks

As Received Moisture Content = 15.8%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

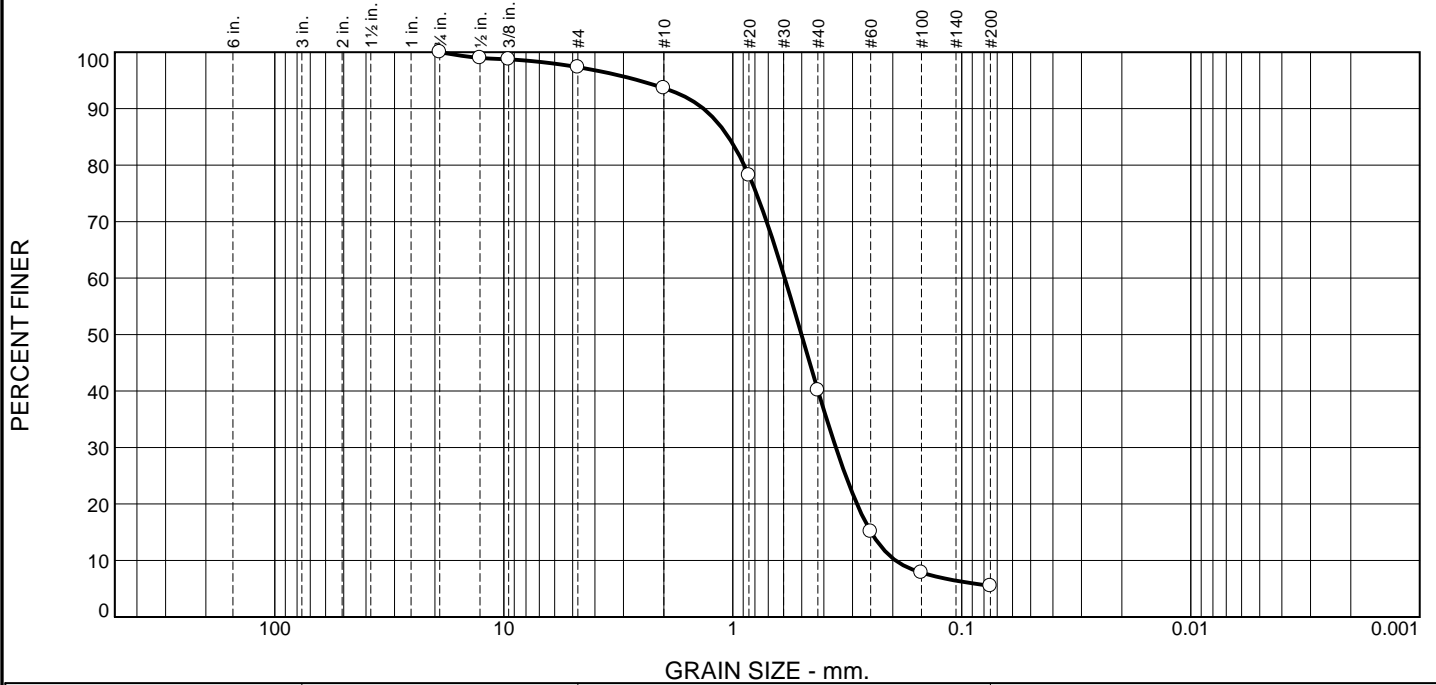
Checked By: MP

Title: Laboratory Manager

Source of Sample: Lake Agawam Depth: 40-42' Date Sampled: 2/21/22
 Sample Number: 4

CDM Smith Boston, Massachusetts	Client: Village of Southampton, NY Project: Lake Agawam Phase II Southampton, NY Project No: 265416.267019
--	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.7	3.7	53.5	34.6	5.5	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	99.0		
0.375"	98.7		
#4	97.3		
#10	93.6		
#20	78.2		
#40	40.1		
#60	15.1		
#100	7.9		
#200	5.5		

* (no specification provided)

Material Description

Brown poorly graded sand with silt

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-b

Coefficients

D ₉₀ = 1.3433	D ₈₅ = 1.0453	D ₆₀ = 0.5931
D ₅₀ = 0.5013	D ₃₀ = 0.3546	D ₁₅ = 0.2489
D ₁₀ = 0.1946	C _u = 3.05	C _c = 1.09

Remarks

As Received Moisture Content = 17.2%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

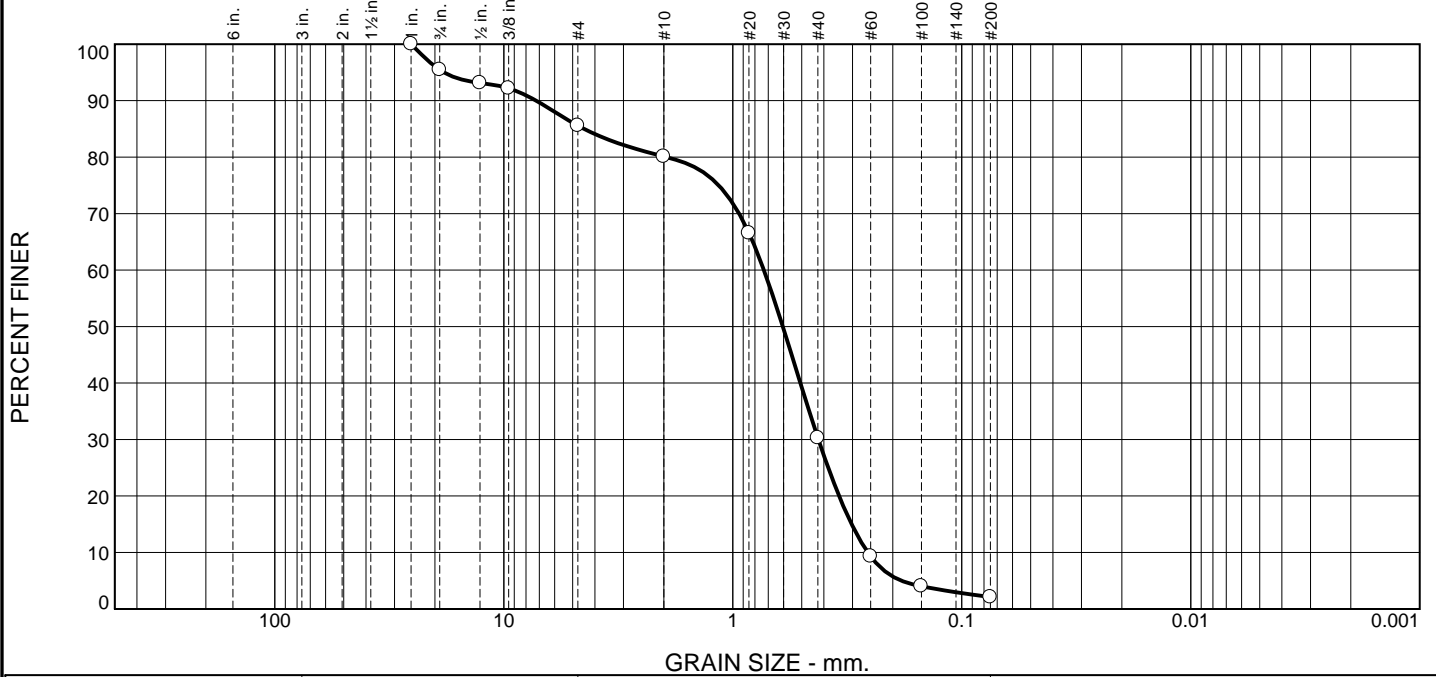
Checked By: MP

Title: Laboratory Manager

Source of Sample: Lake Agawam Depth: 45-47' Date Sampled: 2/21/22
 Sample Number: 5

CDM Smith Boston, Massachusetts	Client: Village of Southampton, NY Project: Lake Agawam Phase II Southampton, NY Project No: 265416.267019
--	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.5	9.9	5.5	49.8	28.2	2.1	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	95.5		
0.5"	93.1		
0.375"	92.2		
#4	85.6		
#10	80.1		
#20	66.6		
#40	30.3		
#60	9.3		
#100	4.0		
#200	2.1		

Material Description

Light brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

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

Coefficients

D₉₀= 7.2342 D₈₅= 4.4643 D₆₀= 0.7316
D₅₀= 0.6047 D₃₀= 0.4228 D₁₅= 0.3026
D₁₀= 0.2572 C_u= 2.84 C_c= 0.95

Remarks

As Received Moisture Content = 15.5%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

Checked By: MP

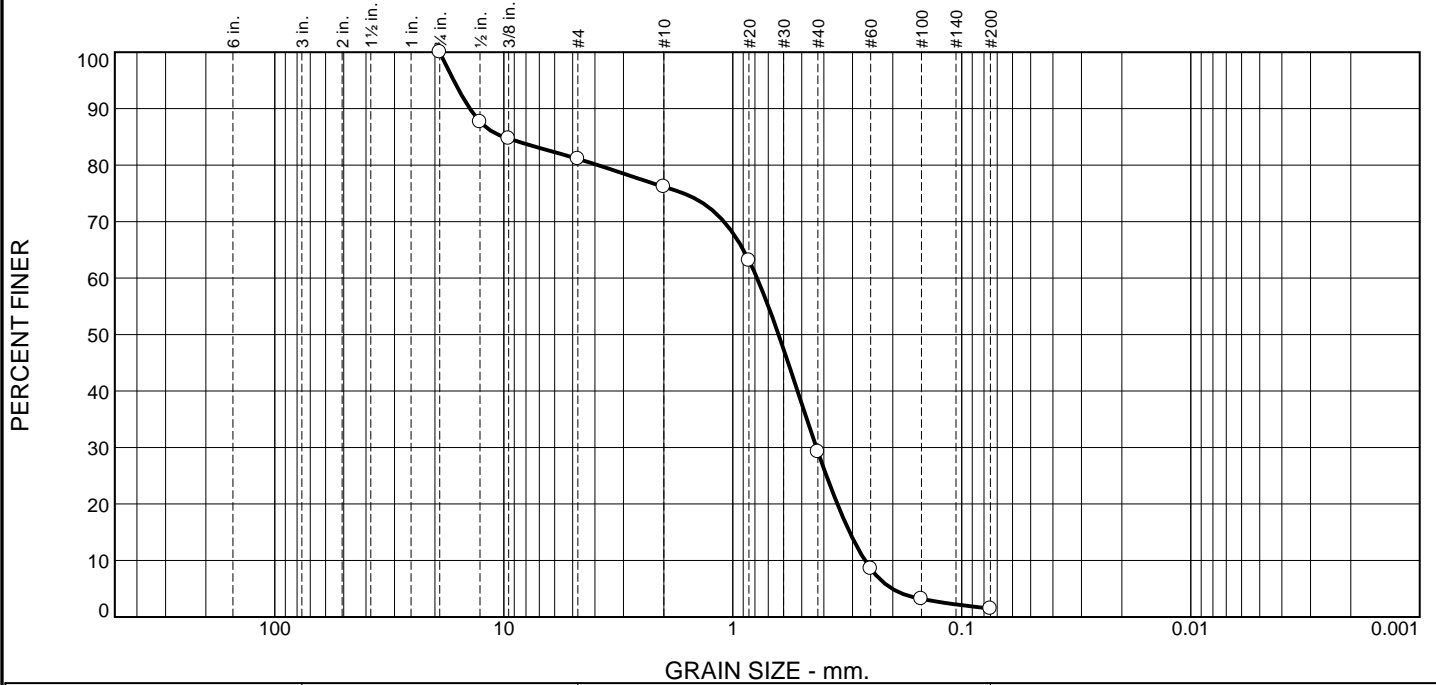
Title: Laboratory Manager

* (no specification provided)

Source of Sample: Lake Agawam Depth: 50-52' Date Sampled: 2/21/22
Sample Number: 6

CDM Smith Boston, Massachusetts	Client: Village of Southampton, NY Project: Lake Agawam Phase II Southampton, NY Project No: 265416.267019
--	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	18.9	4.9	46.9	27.8	1.5	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	87.7		
0.375"	84.7		
#4	81.1		
#10	76.2		
#20	63.1		
#40	29.3		
#60	8.6		
#100	3.2		
#200	1.5		

* (no specification provided)

Material Description

Light brown poorly graded sand with gravel

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

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

Coefficients

D ₉₀ = 14.0703	D ₈₅ = 10.0066	D ₆₀ = 0.7835
D ₅₀ = 0.6312	D ₃₀ = 0.4313	D ₁₅ = 0.3086
D ₁₀ = 0.2645	C _u = 2.96	C _c = 0.90

Remarks

As Received Moisture Content = 18.2%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

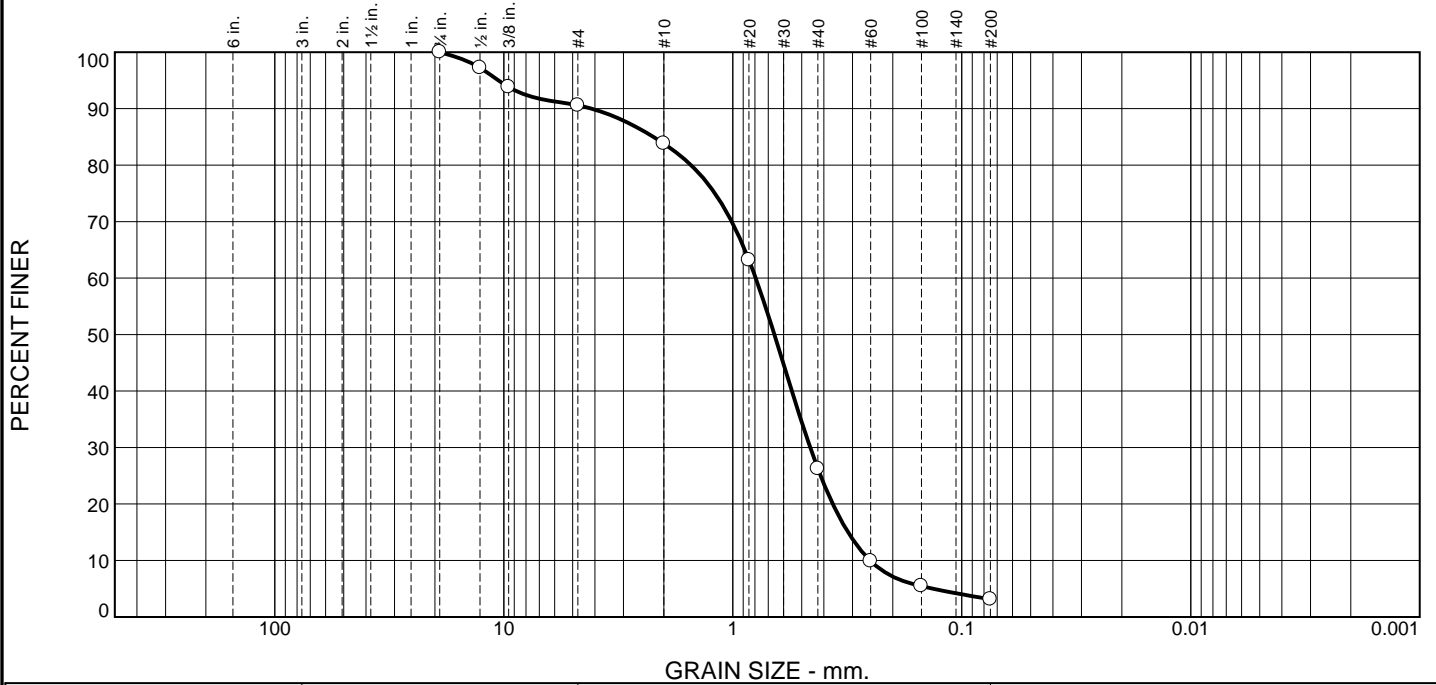
Checked By: MP

Title: Laboratory Manager

Source of Sample: Lake Agawam Depth: 55-57' Date Sampled: 2/21/22
 Sample Number: 7

CDM Smith Boston, Massachusetts	Client: Village of Southampton, NY Project: Lake Agawam Phase II Southampton, NY Project No: 265416.267019
--	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.4	6.8	57.6	23.1	3.1	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	97.2		
0.375"	93.8		
#4	90.6		
#10	83.8		
#20	63.2		
#40	26.2		
#60	9.9		
#100	5.5		
#200	3.1		

Material Description

Light brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

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

Coefficients

D₉₀= 4.1381 D₈₅= 2.2219 D₆₀= 0.7942
D₅₀= 0.6582 D₃₀= 0.4591 D₁₅= 0.3138
D₁₀= 0.2515 C_u= 3.16 C_c= 1.06

Remarks

As Received Moisture Content = 14.7%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

Checked By: MP

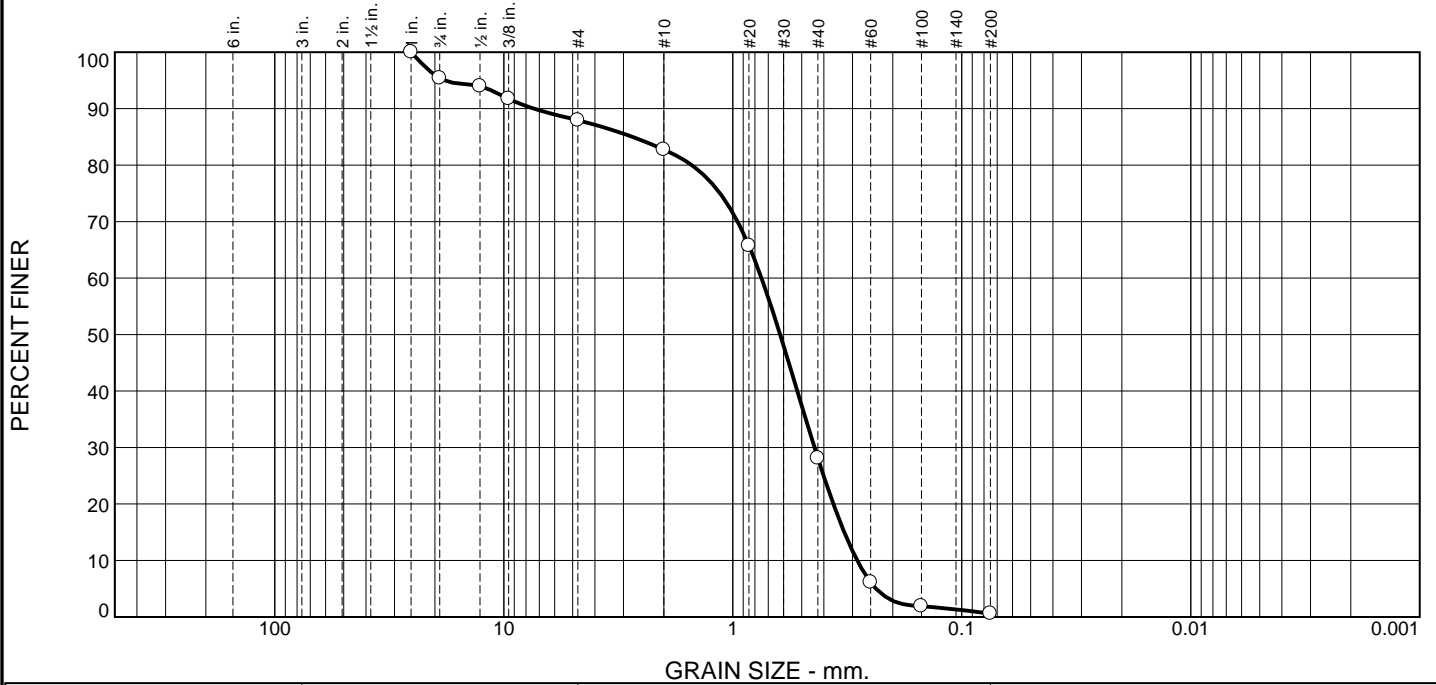
Title: Laboratory Manager

* (no specification provided)

Source of Sample: Lake Agawam Depth: 60-62' Date Sampled: 2/21/22
Sample Number: 8

CDM Smith Boston, Massachusetts	Client: Village of Southampton, NY Project: Lake Agawam Phase II Southampton, NY Project No: 265416.267019
--	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.6	7.5	5.2	54.6	27.5	0.6	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	95.4		
0.5"	94.0		
0.375"	91.7		
#4	87.9		
#10	82.7		
#20	65.7		
#40	28.1		
#60	6.1		
#100	1.9		
#200	0.6		

* (no specification provided)

Material Description

Light brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

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

Coefficients

D ₉₀ = 7.3911	D ₈₅ = 2.7411	D ₆₀ = 0.7493
D ₅₀ = 0.6212	D ₃₀ = 0.4396	D ₁₅ = 0.3259
D ₁₀ = 0.2862	C _u = 2.62	C _c = 0.90

Remarks

As Received Moisture Content = 17.8%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

Checked By: MP

Title: Laboratory Manager

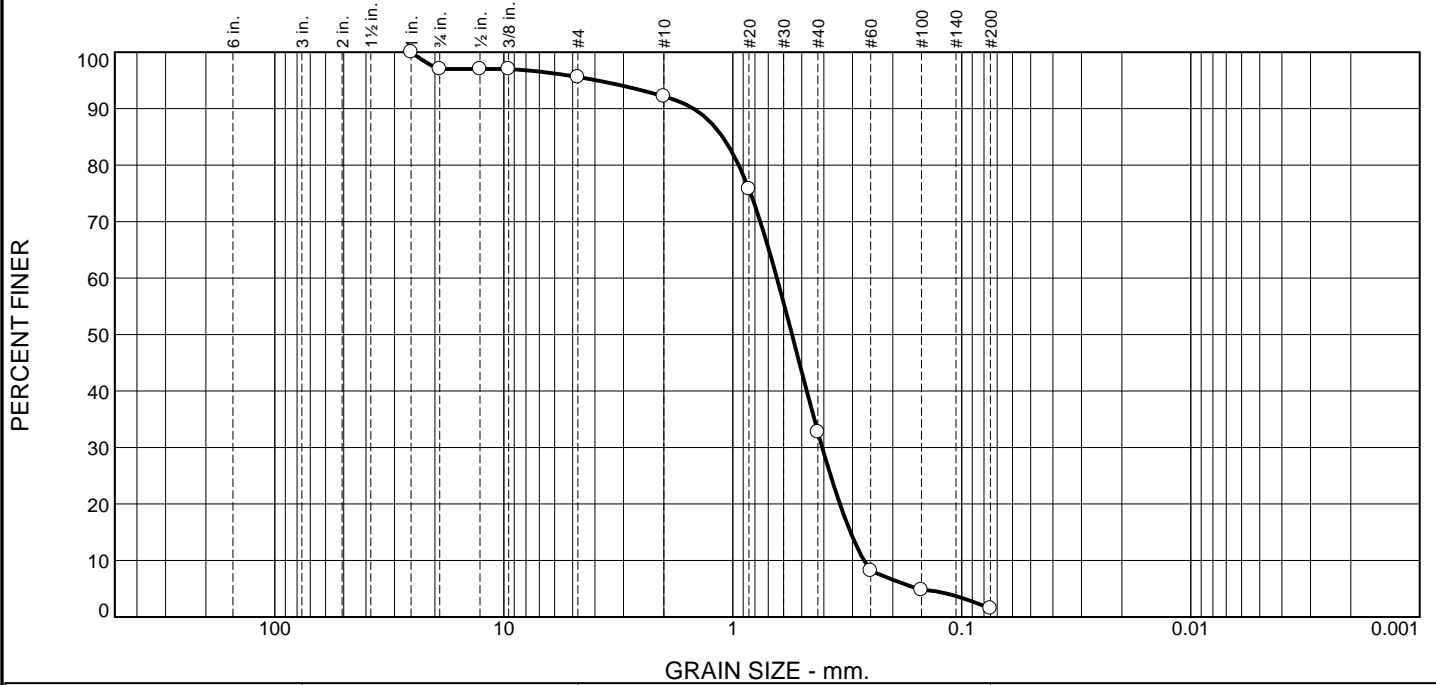
Source of Sample: Lake Agawam
Sample Number: 9

Depth: 65-67'

Date Sampled: 2/21/22

<p>CDM Smith</p> <p>Boston, Massachusetts</p>	<p>Client: Village of Southampton, NY</p> <p>Project: Lake Agawam Phase II Southampton, NY</p> <p>Project No: 265416.267019</p>
---	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.0	1.4	3.4	59.5	31.2	1.5	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	97.0		
0.5"	97.0		
0.375"	97.0		
#4	95.6		
#10	92.2		
#20	75.8		
#40	32.7		
#60	8.2		
#100	4.8		
#200	1.5		

* (no specification provided)

Material Description

Light brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

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

Coefficients

D₉₀= 1.4817 D₈₅= 1.1081 D₆₀= 0.6415
D₅₀= 0.5513 D₃₀= 0.4067 D₁₅= 0.3062
D₁₀= 0.2674 C_u= 2.40 C_c= 0.96

Remarks

As Received Moisture Content = 16.9%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

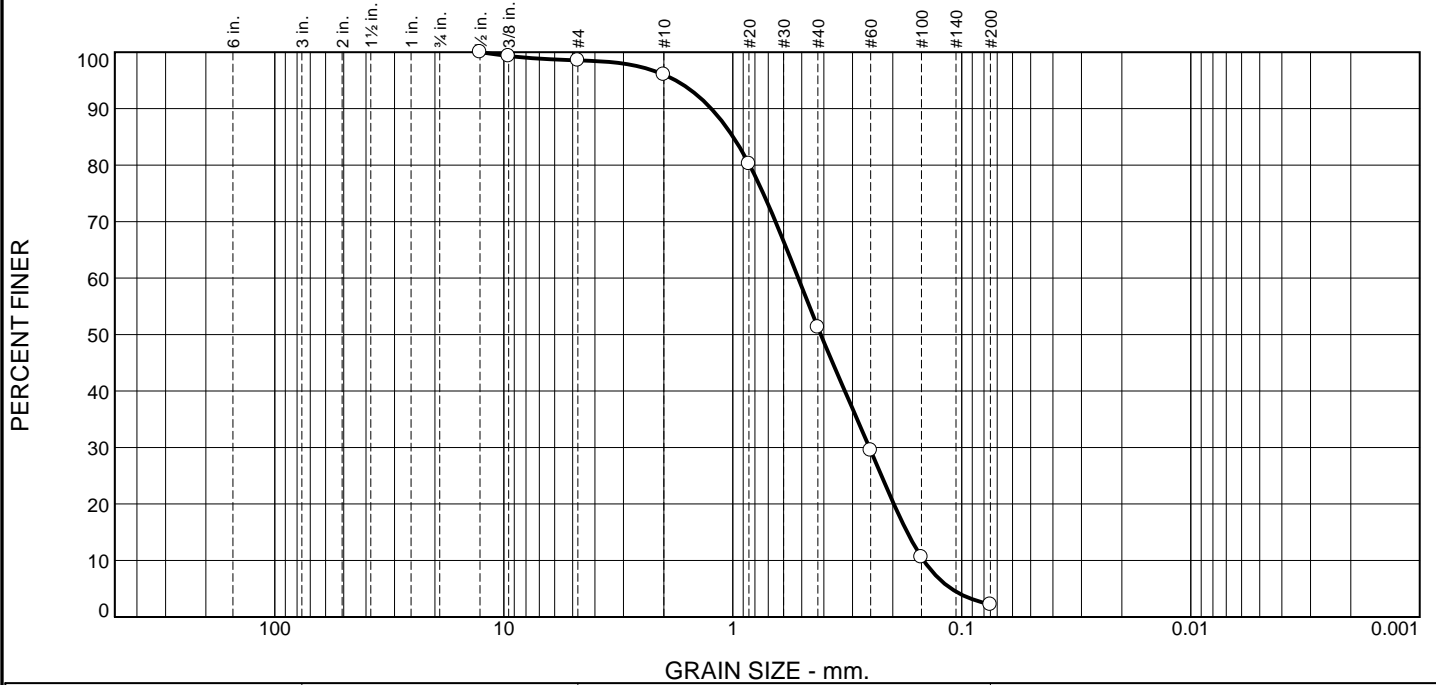
Checked By: MP

Title: Laboratory Manager

Source of Sample: Lake Agawam Depth: 75-77' Date Sampled: 2/21/22
Sample Number: 11

CDM Smith Boston, Massachusetts	Client: Village of Southampton, NY Project: Lake Agawam Phase II Southampton, NY Project No: 265416.267019
--	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.5	2.5	44.7	49.1	2.2	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5"	100.0		
0.375"	99.3		
#4	98.5		
#10	96.0		
#20	80.2		
#40	51.3		
#60	29.5		
#100	10.6		
#200	2.2		

* (no specification provided)

Material Description

Light brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

USCS (D 2487)= SP AASHTO (M 145)= A-3

Coefficients

D ₉₀ = 1.2417	D ₈₅ = 0.9966	D ₆₀ = 0.5178
D ₅₀ = 0.4126	D ₃₀ = 0.2531	D ₁₅ = 0.1730
D ₁₀ = 0.1466	C _u = 3.53	C _c = 0.84

Remarks

As Received Moisture Content = 18.3%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

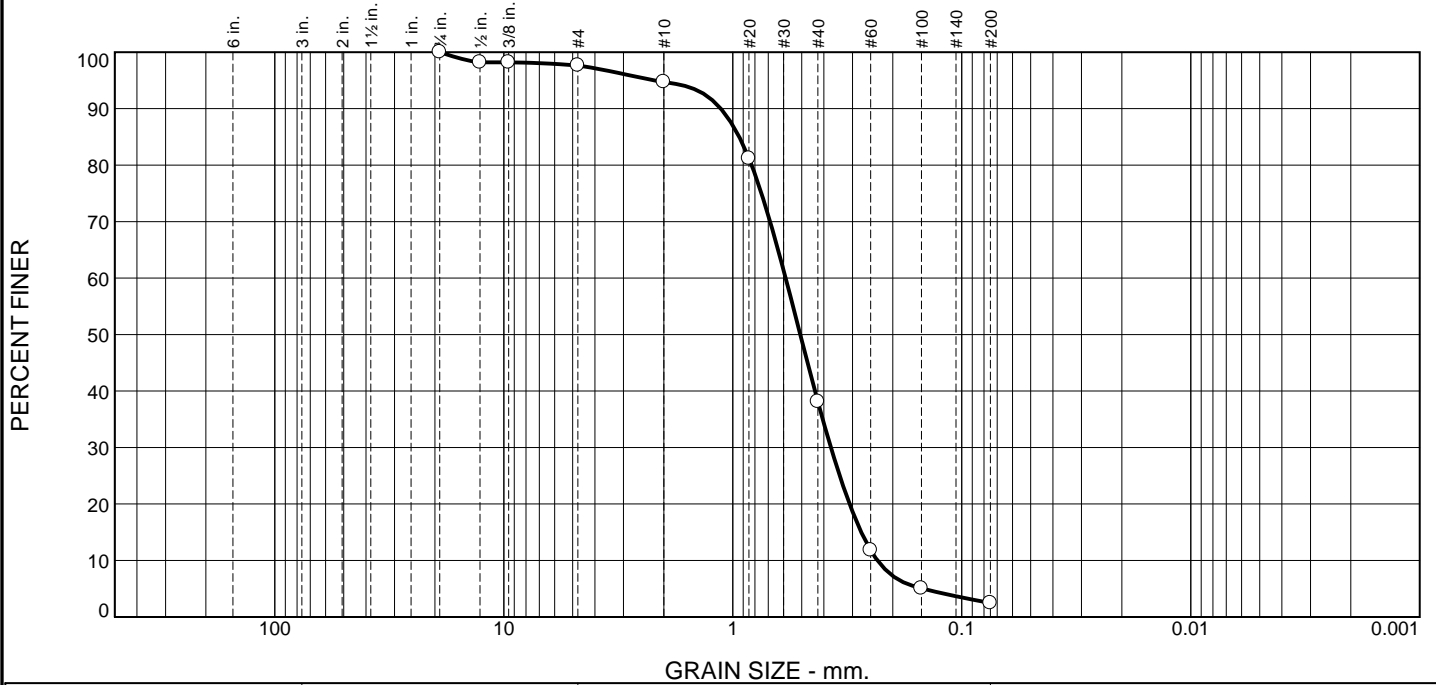
Checked By: MP

Title: Laboratory Manager

Source of Sample: Lake Agawam Depth: 80-82' Date Sampled: 2/21/22
 Sample Number: 12

CDM Smith Boston, Massachusetts	Client: Village of Southampton, NY Project: Lake Agawam Phase II Southampton, NY Project No: 265416.267019
--	--

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.4	2.9	56.6	35.6	2.5	

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	98.2		
0.375"	98.2		
#4	97.6		
#10	94.7		
#20	81.2		
#40	38.1		
#60	11.8		
#100	5.1		
#200	2.5		

* (no specification provided)

Material Description

Light brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

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

Coefficients

D₉₀= 1.1282 D₈₅= 0.9374 D₆₀= 0.5877
D₅₀= 0.5073 D₃₀= 0.3727 D₁₅= 0.2747
D₁₀= 0.2334 C_u= 2.52 C_c= 1.01

Remarks

As Received Moisture Content = 17.6%

Date Received: 3/1/22 Date Tested: 3/5/22

Tested By: MP

Checked By: MP

Title: Laboratory Manager

Source of Sample: Lake Agawam Depth: 85-87' Date Sampled: 2/21/22

<p>CDM Smith</p> <p>Boston, Massachusetts</p>	<p>Client: Village of Southampton, NY</p> <p>Project: Lake Agawam Phase II Southampton, NY</p> <p>Project No: 265416.267019</p>
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Gary Goleski
April 13, 2022
Page 60

Attachment 3: Water Quality Analytical Results

March 13, 2022

Dan O'Rourke
CDM Smith
110 Fieldcrest Avenue #8
Edison, NJ 08837

RE: Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

Dear Dan O'Rourke:

Enclosed are the analytical results for sample(s) received by the laboratory on March 03, 2022. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - Melville

If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Catherine M. Gierbolini
catherine.gierbolini@pacelabs.com
(631)694-3040
Project Manager

Enclosures



REPORT OF LABORATORY ANALYSIS

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CERTIFICATIONS

Project: HAMPTONS EVENT 3/3

Pace Project No.: 70206216

Pace Analytical Services Long Island

575 Broad Hollow Rd, Melville, NY 11747

Connecticut Certification #: PH-0435

Delaware Certification # NY 10478

Maryland Certification #: 208

Massachusetts Certification #: M-NY026

New Hampshire Certification #: 2987

New Jersey Certification #: NY158

New York Certification #: 10478 Primary Accrediting Body

Pennsylvania Certification #: 68-00350

Rhode Island Certification #: LAO00340

Virginia Certification # 460302

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

Sample: AL-01S	Lab ID: 70206216001	Collected: 03/03/22 12:41	Received: 03/03/22 16:41	Matrix: Water				
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500PE Total Phosphorus	Analytical Method: SM22 4500-P E Preparation Method: SM22 4500-P B Pace Analytical Services - Melville							
Phosphorus	<0.050	mg/L	0.050	1	03/07/22 11:00	03/07/22 18:35	7723-14-0	
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0 Pace Analytical Services - Melville							
Chloride	178	mg/L	10.0	5		03/10/22 17:09	16887-00-6	
Sulfate	27.7	mg/L	5.0	1		03/09/22 23:30	14808-79-8	
350.1 Ammonia	Analytical Method: EPA 350.1 Pace Analytical Services - Melville							
Nitrogen, Ammonia	1.0	mg/L	0.10	1		03/10/22 14:07	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Melville							
Nitrogen, Kjeldahl, Total	0.34	mg/L	0.10	1	03/10/22 05:27	03/10/22 18:51	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrate as N	2.7	mg/L	0.25	5		03/05/22 17:48	14797-55-8	
Nitrate-Nitrite (as N)	2.8	mg/L	0.25	5		03/05/22 17:48	7727-37-9	
353.2 Nitrogen, NO2	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrite as N	<0.050	mg/L	0.050	1		03/04/22 01:12	14797-65-0	
5310B TOC as NPOC	Analytical Method: SM22 5310B Pace Analytical Services - Melville							
Total Organic Carbon	<1.0	mg/L	1.0	1		03/08/22 19:16	7440-44-0	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

Sample: AL-011	Lab ID: 70206216002	Collected: 03/03/22 12:15	Received: 03/03/22 16:41	Matrix: Water				
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500PE Total Phosphorus	Analytical Method: SM22 4500-P E Preparation Method: SM22 4500-P B Pace Analytical Services - Melville							
Phosphorus	<0.050	mg/L	0.050	1	03/07/22 11:00	03/07/22 18:35	7723-14-0	
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0 Pace Analytical Services - Melville							
Chloride	133	mg/L	10.0	5		03/10/22 17:22	16887-00-6	
Sulfate	30.1	mg/L	5.0	1		03/09/22 23:44	14808-79-8	
350.1 Ammonia	Analytical Method: EPA 350.1 Pace Analytical Services - Melville							
Nitrogen, Ammonia	0.22	mg/L	0.10	1		03/10/22 14:08	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Melville							
Nitrogen, Kjeldahl, Total	<0.10	mg/L	0.10	1	03/10/22 05:27	03/10/22 18:54	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrate as N	5.6	mg/L	0.25	5		03/05/22 17:50	14797-55-8	
Nitrate-Nitrite (as N)	5.6	mg/L	0.25	5		03/05/22 17:50	7727-37-9	
353.2 Nitrogen, NO2	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrite as N	<0.050	mg/L	0.050	1		03/04/22 00:59	14797-65-0	
5310B TOC as NPOC	Analytical Method: SM22 5310B Pace Analytical Services - Melville							
Total Organic Carbon	<1.0	mg/L	1.0	1		03/08/22 19:39	7440-44-0	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

Sample: AL-01D	Lab ID: 70206216003	Collected: 03/03/22 11:50	Received: 03/03/22 16:41	Matrix: Water				
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500PE Total Phosphorus	Analytical Method: SM22 4500-P E Preparation Method: SM22 4500-P B Pace Analytical Services - Melville							
Phosphorus	<0.050	mg/L	0.050	1	03/07/22 11:00	03/07/22 18:36	7723-14-0	
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0 Pace Analytical Services - Melville							
Chloride	188	mg/L	10.0	5		03/10/22 17:36	16887-00-6	
Sulfate	32.5	mg/L	5.0	1		03/09/22 23:58	14808-79-8	
350.1 Ammonia	Analytical Method: EPA 350.1 Pace Analytical Services - Melville							
Nitrogen, Ammonia	<0.10	mg/L	0.10	1		03/10/22 14:09	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Melville							
Nitrogen, Kjeldahl, Total	<0.10	mg/L	0.10	1	03/10/22 05:27	03/10/22 18:55	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrate as N	8.7	mg/L	0.25	5		03/05/22 17:51	14797-55-8	
Nitrate-Nitrite (as N)	8.8	mg/L	0.25	5		03/05/22 17:51	7727-37-9	
353.2 Nitrogen, NO2	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrite as N	<0.050	mg/L	0.050	1		03/04/22 00:56	14797-65-0	
5310B TOC as NPOC	Analytical Method: SM22 5310B Pace Analytical Services - Melville							
Total Organic Carbon	<1.0	mg/L	1.0	1		03/08/22 20:14	7440-44-0	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

Sample: AL-02S	Lab ID: 70206216004	Collected: 03/03/22 14:10	Received: 03/03/22 16:41	Matrix: Water				
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500PE Total Phosphorus	Analytical Method: SM22 4500-P E Preparation Method: SM22 4500-P B Pace Analytical Services - Melville							
Phosphorus	0.059	mg/L	0.050	1	03/07/22 11:00	03/07/22 18:36	7723-14-0	
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0 Pace Analytical Services - Melville							
Chloride	302	mg/L	20.0	10		03/10/22 17:49	16887-00-6	
Sulfate	38.7	mg/L	5.0	1		03/10/22 00:11	14808-79-8	
350.1 Ammonia	Analytical Method: EPA 350.1 Pace Analytical Services - Melville							
Nitrogen, Ammonia	4.2	mg/L	0.10	1		03/10/22 14:10	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Melville							
Nitrogen, Kjeldahl, Total	4.1	mg/L	0.10	1	03/10/22 05:27	03/10/22 18:57	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrate as N	0.066	mg/L	0.050	1		03/05/22 20:04	14797-55-8	
Nitrate-Nitrite (as N)	0.083	mg/L	0.050	1		03/05/22 20:04	7727-37-9	
353.2 Nitrogen, NO2	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrite as N	<0.050	mg/L	0.050	1		03/04/22 01:18	14797-65-0	
5310B TOC as NPOC	Analytical Method: SM22 5310B Pace Analytical Services - Melville							
Total Organic Carbon	1.5	mg/L	1.0	1		03/08/22 21:15	7440-44-0	

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ANALYTICAL RESULTS

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

Sample: AL-02I	Lab ID: 70206216005	Collected: 03/03/22 14:50	Received: 03/03/22 16:41	Matrix: Water				
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500PE Total Phosphorus	Analytical Method: SM22 4500-P E Preparation Method: SM22 4500-P B Pace Analytical Services - Melville							
Phosphorus	1.0	mg/L	0.050	1	03/07/22 11:00	03/07/22 18:39	7723-14-0	
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0 Pace Analytical Services - Melville							
Chloride	110	mg/L	10.0	5		03/10/22 18:03	16887-00-6	
Sulfate	50.7	mg/L	5.0	1		03/10/22 00:25	14808-79-8	
350.1 Ammonia	Analytical Method: EPA 350.1 Pace Analytical Services - Melville							
Nitrogen, Ammonia	<0.10	mg/L	0.10	1		03/10/22 14:11	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Melville							
Nitrogen, Kjeldahl, Total	<0.10	mg/L	0.10	1	03/10/22 05:27	03/10/22 18:58	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrate as N	6.7	mg/L	0.25	5		03/05/22 17:57	14797-55-8	
Nitrate-Nitrite (as N)	6.7	mg/L	0.25	5		03/05/22 17:57	7727-37-9	
353.2 Nitrogen, NO2	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrite as N	0.080	mg/L	0.050	1		03/04/22 01:20	14797-65-0	
5310B TOC as NPOC	Analytical Method: SM22 5310B Pace Analytical Services - Melville							
Total Organic Carbon	<1.0	mg/L	1.0	1		03/08/22 21:26	7440-44-0	

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ANALYTICAL RESULTS

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

Sample: AL-02I DUP	Lab ID: 70206216006	Collected: 03/03/22 14:50	Received: 03/03/22 16:41	Matrix: Water				
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500PE Total Phosphorus	Analytical Method: SM22 4500-P E Preparation Method: SM22 4500-P B Pace Analytical Services - Melville							
Phosphorus	0.97	mg/L	0.050	1	03/07/22 11:00	03/07/22 18:40	7723-14-0	
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0 Pace Analytical Services - Melville							
Chloride	110	mg/L	10.0	5		03/10/22 18:17	16887-00-6	
Sulfate	50.7	mg/L	5.0	1		03/10/22 01:05	14808-79-8	
350.1 Ammonia	Analytical Method: EPA 350.1 Pace Analytical Services - Melville							
Nitrogen, Ammonia	<0.10	mg/L	0.10	1		03/10/22 14:13	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Melville							
Nitrogen, Kjeldahl, Total	<0.10	mg/L	0.10	1	03/10/22 05:27	03/10/22 18:59	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrate as N	6.6	mg/L	0.25	5		03/05/22 17:58	14797-55-8	
Nitrate-Nitrite (as N)	6.7	mg/L	0.25	5		03/05/22 17:58	7727-37-9	
353.2 Nitrogen, NO2	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrite as N	0.079	mg/L	0.050	1		03/04/22 01:21	14797-65-0	
5310B TOC as NPOC	Analytical Method: SM22 5310B Pace Analytical Services - Melville							
Total Organic Carbon	<1.0	mg/L	1.0	1		03/08/22 21:38	7440-44-0	

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ANALYTICAL RESULTS

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

Sample: AL-02D	Lab ID: 70206216007	Collected: 03/03/22 14:32	Received: 03/03/22 16:41	Matrix: Water				
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500PE Total Phosphorus	Analytical Method: SM22 4500-P E Preparation Method: SM22 4500-P B Pace Analytical Services - Melville							
Phosphorus	<0.050	mg/L	0.050	1	03/07/22 11:00	03/07/22 18:41	7723-14-0	
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0 Pace Analytical Services - Melville							
Chloride	195	mg/L	10.0	5		03/10/22 18:30	16887-00-6	
Sulfate	32.1	mg/L	5.0	1		03/10/22 01:19	14808-79-8	
350.1 Ammonia	Analytical Method: EPA 350.1 Pace Analytical Services - Melville							
Nitrogen, Ammonia	<0.10	mg/L	0.10	1		03/10/22 14:14	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Melville							
Nitrogen, Kjeldahl, Total	<0.10	mg/L	0.10	1	03/10/22 05:27	03/10/22 19:00	7727-37-9	
353.2 Nitrogen, NO2/NO3 pres.	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrate as N	9.0	mg/L	0.50	10		03/05/22 18:02	14797-55-8	
Nitrate-Nitrite (as N)	9.1	mg/L	0.50	10		03/05/22 18:02	7727-37-9	
353.2 Nitrogen, NO2	Analytical Method: EPA 353.2 Pace Analytical Services - Melville							
Nitrite as N	<0.050	mg/L	0.050	1		03/04/22 01:19	14797-65-0	
5310B TOC as NPOC	Analytical Method: SM22 5310B Pace Analytical Services - Melville							
Total Organic Carbon	<1.0	mg/L	1.0	1		03/08/22 22:13	7440-44-0	

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3

Pace Project No.: 70206216

QC Batch:	247129	Analysis Method:	SM22 4500-P E
QC Batch Method:	SM22 4500-P B	Analysis Description:	4500PE Total Phosphorus
		Laboratory:	Pace Analytical Services - Melville

Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

METHOD BLANK: 1248680 Matrix: Water
Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Phosphorus	mg/L	ND	0.050	03/07/22 18:23	

LABORATORY CONTROL SAMPLE: 1248681

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Phosphorus	mg/L	0.5	0.55	110	85-115	

MATRIX SPIKE SAMPLE: 1248683

Parameter	Units	70206141001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Phosphorus	mg/L	2.8	2.5	5.3	102	75-125	

SAMPLE DUPLICATE: 1248682

Parameter	Units	70206141001 Result	Dup Result	RPD	Qualifiers
Phosphorus	mg/L	2.8	2.8	1	

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

QC Batch:	247609	Analysis Method:	EPA 300.0
QC Batch Method:	EPA 300.0	Analysis Description:	300.0 IC Anions
		Laboratory:	Pace Analytical Services - Melville

Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

METHOD BLANK: 1250816 Matrix: Water
Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Chloride	mg/L	<2.0	2.0	03/09/22 18:59	
Sulfate	mg/L	<5.0	5.0	03/09/22 18:59	

LABORATORY CONTROL SAMPLE: 1250817

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	10	10.7	107	90-110	
Sulfate	mg/L	10	10.7	107	90-110	

MATRIX SPIKE SAMPLE: 1250818

Parameter	Units	70205428001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	23.8	10	33.2	94	90-110	
Sulfate	mg/L	32.8	10	42.4	96	90-110	

MATRIX SPIKE SAMPLE: 1250820

Parameter	Units	70205460003 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	14.1	10	23.7	95	90-110	
Sulfate	mg/L	20.2	10	30.9	107	90-110	

SAMPLE DUPLICATE: 1250819

Parameter	Units	70205428001 Result	Dup Result	RPD	Qualifiers
Chloride	mg/L	23.8	23.6	1	
Sulfate	mg/L	32.8	32.6	1	

SAMPLE DUPLICATE: 1250821

Parameter	Units	70205460003 Result	Dup Result	RPD	Qualifiers
Chloride	mg/L	14.1	14.1	0	
Sulfate	mg/L	20.2	20.3	0	

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

QC Batch: 247724 Analysis Method: EPA 350.1
QC Batch Method: EPA 350.1 Analysis Description: 350.1 Ammonia
Laboratory: Pace Analytical Services - Melville
Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

METHOD BLANK: 1251480 Matrix: Water
Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Ammonia	mg/L	ND	0.10	03/10/22 14:04	

LABORATORY CONTROL SAMPLE: 1251481

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/L	1	1.0	100	90-110	

MATRIX SPIKE SAMPLE: 1251482

Parameter	Units	70205999005 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/L	12.6	10	22.9	102	90-110	

MATRIX SPIKE SAMPLE: 1251484

Parameter	Units	70206127001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/L	21.6	10	31.0	94	90-110	

SAMPLE DUPLICATE: 1251483

Parameter	Units	70205999005 Result	Dup Result	RPD	Qualifiers
Nitrogen, Ammonia	mg/L	12.6	12.3	3	

SAMPLE DUPLICATE: 1251485

Parameter	Units	70206127001 Result	Dup Result	RPD	Qualifiers
Nitrogen, Ammonia	mg/L	21.6	20.2	7	

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

QC Batch: 247654 Analysis Method: EPA 351.2
QC Batch Method: EPA 351.2 Analysis Description: 351.2 TKN
Laboratory: Pace Analytical Services - Melville
Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

METHOD BLANK: 1251281 Matrix: Water
Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	ND	0.10	03/10/22 18:45	

LABORATORY CONTROL SAMPLE: 1251282

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	4	4.3	107	90-110	

MATRIX SPIKE SAMPLE: 1251283

Parameter	Units	70206216001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	0.34	4	4.7	109	90-110	

MATRIX SPIKE SAMPLE: 1251285

Parameter	Units	70206221001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	0.93	20	19.3	92	90-110	

SAMPLE DUPLICATE: 1251284

Parameter	Units	70206216001 Result	Dup Result	RPD	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	0.34	0.39	16	

SAMPLE DUPLICATE: 1251286

Parameter	Units	70206221001 Result	Dup Result	RPD	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	0.93	0.88	6	

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

QC Batch: 246870 Analysis Method: EPA 353.2
QC Batch Method: EPA 353.2 Analysis Description: 353.2 Nitrite, Unpres.
Laboratory: Pace Analytical Services - Melville

Associated Lab Samples: 70206216002, 70206216003

METHOD BLANK: 1247417 Matrix: Water
Associated Lab Samples: 70206216002, 70206216003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrite as N	mg/L	ND	0.050	03/04/22 00:24	

LABORATORY CONTROL SAMPLE: 1247418

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrite as N	mg/L	1	0.97	97	90-110	

MATRIX SPIKE SAMPLE: 1247419

Parameter	Units	70206190004 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrite as N	mg/L	<0.050	0.5	0.49	95	90-110	

MATRIX SPIKE SAMPLE: 1247421

Parameter	Units	70206223001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrite as N	mg/L	<0.050	0.5	0.49	96	90-110	

SAMPLE DUPLICATE: 1247420

Parameter	Units	70206190004 Result	Dup Result	RPD	Qualifiers
Nitrite as N	mg/L	<0.050	<0.050		

SAMPLE DUPLICATE: 1247422

Parameter	Units	70206223001 Result	Dup Result	RPD	Qualifiers
Nitrite as N	mg/L	<0.050	<0.050		

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

QC Batch: 246871 Analysis Method: EPA 353.2
QC Batch Method: EPA 353.2 Analysis Description: 353.2 Nitrite, Unpres.
Laboratory: Pace Analytical Services - Melville
Associated Lab Samples: 70206216001, 70206216004, 70206216005, 70206216006, 70206216007

METHOD BLANK: 1247423 Matrix: Water
Associated Lab Samples: 70206216001, 70206216004, 70206216005, 70206216006, 70206216007

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrite as N	mg/L	ND	0.050	03/04/22 01:02	

LABORATORY CONTROL SAMPLE: 1247424

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrite as N	mg/L	1	0.97	97	90-110	

MATRIX SPIKE SAMPLE: 1247425

Parameter	Units	70206230002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrite as N	mg/L	<0.050	0.5	0.47	91	90-110	

MATRIX SPIKE SAMPLE: 1247427

Parameter	Units	70206216006 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrite as N	mg/L	0.079	0.5	0.57	98	90-110	

SAMPLE DUPLICATE: 1247426

Parameter	Units	70206230002 Result	Dup Result	RPD	Qualifiers
Nitrite as N	mg/L	<0.050	<0.050		

SAMPLE DUPLICATE: 1247428

Parameter	Units	70206216006 Result	Dup Result	RPD	Qualifiers
Nitrite as N	mg/L	0.079	0.080	1	

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3

Pace Project No.: 70206216

QC Batch: 247067 Analysis Method: EPA 353.2
 QC Batch Method: EPA 353.2 Analysis Description: 353.2 Nitrate + Nitrite, preserved
 Laboratory: Pace Analytical Services - Melville

Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006

METHOD BLANK: 1248413 Matrix: Water
 Associated Lab Samples: 70206216001, 70206216002, 70206216003, 70206216004, 70206216005, 70206216006

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrate-Nitrite (as N)	mg/L	ND	0.050	03/05/22 17:19	

LABORATORY CONTROL SAMPLE: 1248414

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrate-Nitrite (as N)	mg/L	1	1.1	105	90-110	

MATRIX SPIKE SAMPLE: 1248415

Parameter	Units	70205994001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrate-Nitrite (as N)	mg/L	0.36	0.5	0.91	110	90-110	

MATRIX SPIKE SAMPLE: 1248417

Parameter	Units	70205995009 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrate-Nitrite (as N)	mg/L	2.0	0.5	2.4	80	90-110	M1

SAMPLE DUPLICATE: 1248416

Parameter	Units	70205994001 Result	Dup Result	RPD	Qualifiers
Nitrate-Nitrite (as N)	mg/L	0.36	0.36	0	

SAMPLE DUPLICATE: 1248418

Parameter	Units	70205995009 Result	Dup Result	RPD	Qualifiers
Nitrate-Nitrite (as N)	mg/L	2.0	2.0	1	

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REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

QC Batch: 247068 Analysis Method: EPA 353.2
QC Batch Method: EPA 353.2 Analysis Description: 353.2 Nitrate + Nitrite, preserved
Laboratory: Pace Analytical Services - Melville

Associated Lab Samples: 70206216007

METHOD BLANK: 1248419 Matrix: Water
Associated Lab Samples: 70206216007

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrate-Nitrite (as N)	mg/L	ND	0.050	03/05/22 17:59	

LABORATORY CONTROL SAMPLE: 1248420

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrate-Nitrite (as N)	mg/L	1	1.1	106	90-110	

MATRIX SPIKE SAMPLE: 1248421

Parameter	Units	70206216007 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrate-Nitrite (as N)	mg/L	9.1	5	14.0	98	90-110	

MATRIX SPIKE SAMPLE: 1248423

Parameter	Units	70205957002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrate-Nitrite (as N)	mg/L	6.1	2.5	8.6	100	90-110	

SAMPLE DUPLICATE: 1248422

Parameter	Units	70206216007 Result	Dup Result	RPD	Qualifiers
Nitrate-Nitrite (as N)	mg/L	9.1	8.7	4	

SAMPLE DUPLICATE: 1248424

Parameter	Units	70205957002 Result	Dup Result	RPD	Qualifiers
Nitrate-Nitrite (as N)	mg/L	6.1	5.8	4	

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REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3

Pace Project No.: 70206216

QC Batch: 247325

Analysis Method: SM22 5310B

QC Batch Method: SM22 5310B

Analysis Description: 5310B TOC

Laboratory: Pace Analytical Services - Melville

Associated Lab Samples: 70206216001, 70206216002

METHOD BLANK: 1249556

Matrix: Water

Associated Lab Samples: 70206216001, 70206216002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Organic Carbon	mg/L	ND	1.0	03/08/22 14:06	

LABORATORY CONTROL SAMPLE: 1249557

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Organic Carbon	mg/L	10	9.6	96	85-115	

MATRIX SPIKE SAMPLE: 1249559

Parameter	Units	70206067004 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Total Organic Carbon	mg/L	<1.0	10	10.4	102	75-125	

SAMPLE DUPLICATE: 1249558

Parameter	Units	70206067004 Result	Dup Result	RPD	Qualifiers
Total Organic Carbon	mg/L	<1.0	<1.0		

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: HAMPTONS EVENT 3/3
Pace Project No.: 70206216

QC Batch: 247327 Analysis Method: SM22 5310B
QC Batch Method: SM22 5310B Analysis Description: 5310B TOC
Laboratory: Pace Analytical Services - Melville
Associated Lab Samples: 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

METHOD BLANK: 1249560 Matrix: Water
Associated Lab Samples: 70206216003, 70206216004, 70206216005, 70206216006, 70206216007

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Organic Carbon	mg/L	ND	1.0	03/08/22 19:50	

LABORATORY CONTROL SAMPLE: 1249561

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Organic Carbon	mg/L	10	9.5	95	85-115	

MATRIX SPIKE SAMPLE: 1249563

Parameter	Units	70206216003 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Total Organic Carbon	mg/L	<1.0	10	10.9	102	75-125	

SAMPLE DUPLICATE: 1249562

Parameter	Units	70206216003 Result	Dup Result	RPD	Qualifiers
Total Organic Carbon	mg/L	<1.0	<1.0		

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

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QUALIFIERS

Project: HAMPTONS EVENT 3/3

Pace Project No.: 70206216

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Reported results are not rounded until the final step prior to reporting. Therefore, calculated parameters that are typically reported as "Total" may vary slightly from the sum of the reported component parameters.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

M1 Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: HAMPTONS EVENT 3/3

Pace Project No.: 70206216

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
70206216001	AL-01S	SM22 4500-P B	247129	SM22 4500-P E	247226
70206216002	AL-01I	SM22 4500-P B	247129	SM22 4500-P E	247226
70206216003	AL-01D	SM22 4500-P B	247129	SM22 4500-P E	247226
70206216004	AL-02S	SM22 4500-P B	247129	SM22 4500-P E	247226
70206216005	AL-02I	SM22 4500-P B	247129	SM22 4500-P E	247226
70206216006	AL-02I DUP	SM22 4500-P B	247129	SM22 4500-P E	247226
70206216007	AL-02D	SM22 4500-P B	247129	SM22 4500-P E	247226
70206216001	AL-01S	EPA 300.0	247609		
70206216002	AL-01I	EPA 300.0	247609		
70206216003	AL-01D	EPA 300.0	247609		
70206216004	AL-02S	EPA 300.0	247609		
70206216005	AL-02I	EPA 300.0	247609		
70206216006	AL-02I DUP	EPA 300.0	247609		
70206216007	AL-02D	EPA 300.0	247609		
70206216001	AL-01S	EPA 350.1	247724		
70206216002	AL-01I	EPA 350.1	247724		
70206216003	AL-01D	EPA 350.1	247724		
70206216004	AL-02S	EPA 350.1	247724		
70206216005	AL-02I	EPA 350.1	247724		
70206216006	AL-02I DUP	EPA 350.1	247724		
70206216007	AL-02D	EPA 350.1	247724		
70206216001	AL-01S	EPA 351.2	247654	EPA 351.2	247657
70206216002	AL-01I	EPA 351.2	247654	EPA 351.2	247657
70206216003	AL-01D	EPA 351.2	247654	EPA 351.2	247657
70206216004	AL-02S	EPA 351.2	247654	EPA 351.2	247657
70206216005	AL-02I	EPA 351.2	247654	EPA 351.2	247657
70206216006	AL-02I DUP	EPA 351.2	247654	EPA 351.2	247657
70206216007	AL-02D	EPA 351.2	247654	EPA 351.2	247657
70206216001	AL-01S	EPA 353.2	247067		
70206216002	AL-01I	EPA 353.2	247067		
70206216003	AL-01D	EPA 353.2	247067		
70206216004	AL-02S	EPA 353.2	247067		
70206216005	AL-02I	EPA 353.2	247067		
70206216006	AL-02I DUP	EPA 353.2	247067		
70206216007	AL-02D	EPA 353.2	247068		
70206216001	AL-01S	EPA 353.2	246871		
70206216002	AL-01I	EPA 353.2	246870		
70206216003	AL-01D	EPA 353.2	246870		
70206216004	AL-02S	EPA 353.2	246871		
70206216005	AL-02I	EPA 353.2	246871		
70206216006	AL-02I DUP	EPA 353.2	246871		
70206216007	AL-02D	EPA 353.2	246871		
70206216001	AL-01S	SM22 5310B	247325		
70206216002	AL-01I	SM22 5310B	247325		

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: HAMPTONS EVENT 3/3

Pace Project No.: 70206216

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
70206216003	AL-01D	SM22 5310B	247327		
70206216004	AL-02S	SM22 5310B	247327		
70206216005	AL-02I	SM22 5310B	247327		
70206216006	AL-02I DUP	SM22 5310B	247327		
70206216007	AL-02D	SM22 5310B	247327		

REPORT OF LABORATORY ANALYSIS

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Sample Condition Upon Receipt

WO#: 70206216

PM: CMG

Due Date: 03/10/22

CLIENT: CDM-NJ

Client Name: CDM

Project: _____

Courier: Fed Ex UPS USPS Client Commercial Pace Other

Tracking #: _____

Custody Seal on Cooler/Box Present: Yes No Seals intact: Yes No N/A

Packing Material: Bubble Wrap Bubble Bags Ziploc None Other

Thermometer Used: TH091

Correction Factor: + 0.1

Cooler Temperature(°C): 5.6

Cooler Temperature Corrected(°C): 5.7

Temp should be above freezing to 6.0°C

USDA Regulated Soil N/A, water sample

Date and Initials of person examining contents: KW 3/1/22

Did samples originate in a quarantine zone within the United States: AL, AR, CA, FL, GA, ID, LA, MS, NC, NM, NY, OK, OR, SC, TN, TX, or VA (check map)? Yes No

Did samples originate from a foreign source including Hawaii and Puerto Rico)? Yes No

If Yes to either question, fill out a Regulated Soil Checklist (F-LI-C-010) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		1.
Chain of Custody Filled Out:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		2.
Chain of Custody Relinquished:	<input type="checkbox"/> Yes	<input type="checkbox"/> No		3.
Sampler Name & Signature on COC:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	4.
Samples Arrived within Hold Time:	<input type="checkbox"/> Yes	<input type="checkbox"/> No		5.
Short Hold Time Analysis (<72hr):	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		6.
Rush Turn Around Time Requested:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No		7.
Sufficient Volume: (Triple volume provided for I):	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		8.
Correct Containers Used:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		9.
-Pace Containers Used:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		10.
Containers Intact:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		11.
Filtered volume received for Dissolved tests	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A	Note if sediment is visible in the dissolved container.
Sample Labels match COC:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No		12.
-Includes date/time/ID, Matrix: <u>SL, WT, OIL</u>				
All containers needing preservation have been checked?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	13.
pH paper Lot # <u>HCL160347</u>				
All containers needing preservation are found to be in compliance with method recommendation? (HNO ₃ , H ₂ SO ₄ , HCl, NaOH>9 Sulfide, NaOH>12 Cyanide)	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	Sample #
Exceptions: VOA, Coliform, TOC/DOC, Oil and Grease, DRO/8015 (water). Per Method, VOA pH is checked after analysis				Initial when completed: _____ Lot # of added preservative: _____ Date/Time preservative added: _____
Samples checked for dechlorination:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A	14.
KI starch test strips Lot # _____				Positive for Res. Chlorine? Y N
Residual chlorine strips Lot # _____				
SM 4500 CN samples checked for sulfide?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A	15.
Lead Acetate Strips Lot # _____				Positive for Sulfide? Y N
Headspace in VOA Vials (>6mm):	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A	16.
Trip Blank Present:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A	17.
Trip Blank Custody Seals Present	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A	
Pace Trip Blank Lot # (if applicable): _____				

Client Notification/ Resolution: _____

Field Data Required? Y / N

Person Contacted: _____

Date/Time: _____

Comments/ Resolution: _____



Memorandum

To: Dr. Christopher Gobler

From: Dan O'Rourke, P.G., PMP

Date: 4/15/2022

Subject: *Engineer's Probable Cost Estimate for Construction of a Permeable Reactive Barrier at Lake Agawam*

CDM Smith is pleased to present this probable cost estimate for construction of a permeable reactive barrier (PRB) adjacent to Agawam Park in Southampton, New York. The cost estimate is based on a thorough field investigation conducted at the site between October 2021 and March 2022 as well as a partial design which is underway.

The components of this cost estimate include the following:

- Construction of a PRB approximately 100 feet in length
- The PRB will consist of 6 sets of 2-inch diameter wells, each set comprised of 3 wells screened from 50 to 60 feet below grade, 60 to 70 feet below grade and 70 to 80 feet below grade.
- The PRB will also include include three 4-inch extraction wells (30 foot screen) to supply water for the injection. The extraction wells will be screened 50 to 80 feet below grade.
- One series of injections of EOS100 emulsified vegetable oil amendment.

Significant Assumptions

- Costs are based on estimates obtained as of April 2022. Escalation of 5% has been added, but depending on the schedule of construction, costs could be exceeded.
- **Well Installation:** Well installation will involve a CDM Smith geologist onsite for up to 4 days throughout the duration of well installation to train/oversee Gobler Laboratory staff. That geologist will be also be available offsite for questions. A plan view of wells is shown on **Figure 1**. It is assumed 20 gallons per minute (gpm) can be withdrawn from each extraction well.

- **Injection:** One injection event has been included in the cost estimate. It is assumed that this event will occur over a 12 day period. CDM Smith will provide oversight of the injection activities through the entire duration of the event. A fact sheet of the amendment, EOS100, has been attached for reference.
- The cost does not include any sampling or performance monitoring. It is assumed Gobler Laboratory will conduct all sampling and analysis through their laboratory.

Opinion of Probable Cost

CDM Smith's opinion of probable cost is shown in **Table 1**. The total cost for construction with CDM Smith oversight is approximately \$378,000.

Table 1. Estimate of Probable Construction Cost: Lake Agawam PRB

Work Activity	Estimate of Probable Cost
Well Installation	\$154,950
Oversight	\$16,200
Injection Event	\$85,430
Amendment for Injection	\$88,500
Oversight for Injection	\$32,500
Total	\$377,580
<i>With 5% Escalation</i>	<i>\$396,459</i>

cc: file.

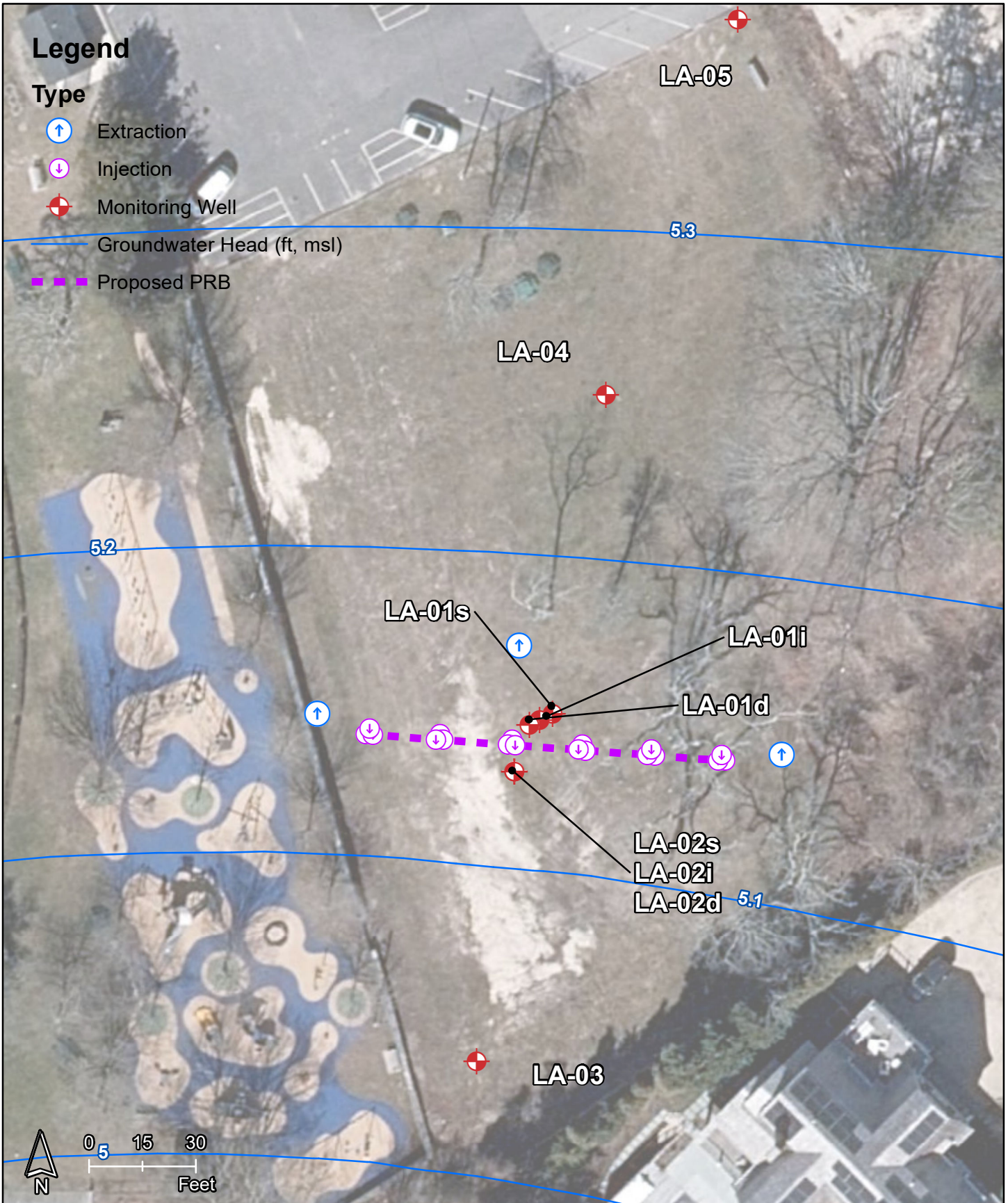


Figure 1
Layout of Lake Agawam PRB
Southampton, New York

EOS₁₀₀

Water-mixable organic substrate
excellent for barrier applications and
high velocity aquifers



Water-mixable vegetable oil based organic
substrate which provides a long-lasting source
of carbon for enhanced *in situ* anaerobic
bioremediation



Product Advantages

- Ideal for fractured rock
- Extended shelf life
- Food-grade and USDA certified
- 100% fermentable carbon
- Increased oil retention - longer life in biobarriers

EOS
EOS Remediation



**Experience you can rely on,
Products you can trust™**

Description



EOS₁₀₀ is a water-mixable vegetable oil based organic substrate which provides a long-lasting source of carbon for enhanced *in situ* anaerobic bioremediation. EOS₁₀₀ is shipped as a concentrate; simply mix with water to instantly create an injection-ready oil solution.

EOS₁₀₀ benefits:

- 100% fermentable
- Employs the proven EOS[®] technology
- Larger droplet size for greater oil retention
- Excellent for barrier and fractured rock applications

Domestic supply made in the USA with US farmed soybeans.

Chemical & Physical Properties

<u>Oil Concentrate: EOS₁₀₀</u>	<u>Typical</u>
Organic Carbon (% by wt.)	100
Refined and Bleached US Soybean Oil (% by wt.)	85
Slow Release Organics (% by wt.)	15
Specific Gravity	0.92 - 0.93
Mass of Hydrogen Produced (lbs. H ₂ per lb. EOS ₁₀₀)	0.40

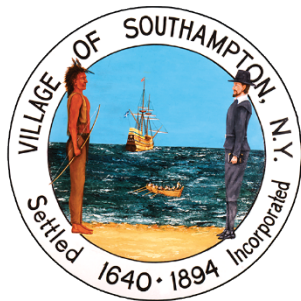
Packaging

Shipped in 55-gallon drums, 275-gallon IBC totes or bulk tankers (40,000 lbs.)

Handling & Storage

EOS₁₀₀ is shipped as concentrated oil that is diluted with water in the field to prepare a solution for easy injection. EOS₁₀₀ has a low viscosity and can be distributed with commonly available pumps or by continuous metering with a diluter (e.g., Dosatron™). Dilution ratios for EOS₁₀₀ typically range from 4:1 to 20:1 (water: EOS₁₀₀) depending on site conditions. EOS₁₀₀ injections should be followed with additional chase water to maximize distribution of EOS₁₀₀ into the formation.

EOS₁₀₀ as shipped, has a shelf-life of ≥ 2 years depending on storage conditions.



Village of Southampton

23 MAIN STREET
SOUTHAMPTON, NEW YORK 11968-4899

Phone: (631) 283-0247

Fax: (631) 283-4990

Website: www.southamptonvillage.org

Resolution

2022-919

5/24/2022

Information: WHEREAS, the Village of Southampton has submitted a grant application to the 2022 Town of Southampton Community Preservation Fund Water Quality Improvement Program to support estimated project costs associated with installation of a pilot-scale Injection Well Permeable Reactive Barrier at the north end of Lake Agawam; and

WHEREAS, the application was submitted in partnership with the New York State Center for Clean Water Technology (CCWT) at Stony Brook University; and

Whereas, the grant request of \$396,459 will support capital costs for installation of the permeable reactive barrier for the purposes of intercepting nitrogen from groundwater flows prior to discharge to Lake Agawam;

NOW THEREFORE BE IT RESOLVED that the Village of Southampton Board of Trustees ratifies the submission of the proposal requesting funding from the Town of Southampton Community Preservation Fund Water Quality Improvement Program in the amount of \$396,459.

Department:

Village Hall

Sponsors:

Category:

Resolutions

Functions:

Financial Impact

Body

Voting

Motioned: Jesse Warren

Seconded: Joseph McLoughlin

Y: Jesse Warren, Gina Arresta, Joseph McLoughlin, Robin Brown, Roy Stevenson

N: None

A: None

N/A:

Certified By:

Cathy M. Sweeney
Village Clerk
Incorporated Village of Southampton