Accabonac Harbor Phase 1 Report

Submitted to:

Accabonac Protection Committee

Submitted by:

Molly Graffam, PhD
Cornell Cooperative Extension of Suffolk County

Ron Paulsen, PG
Coastline Evaluation Corp.

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Cornell Cooperative Extension | Marine Program

Background:

Accabonac Harbor is within the Peconic Estuary and is an impaired waterbody due to pathogen inputs. About half of the harbor is either permanently or seasonally closed to shellfishing. Avian derived fecal coliforms is a known source of pathogens to the waterbody (Gobler 2022). Additionally, there is no sewer system in the Accabonac subwatershed, and areas surrounding the harbor have been identified in the Suffolk County Subwatershed Wastewater Plan (SCSWP) as needing septic upgrades. Outdated septic systems have been identified as a major contributor to excessive groundwater nutrients and surface water quality impairments according to the SCSWP. The northermost portion of Accabonac Harbor has relatively dense residential land use within the subwatershed as well as tributaries and mosquito ditches which extend through the wetland up to Springs Fireplace Rd. A previous study of other mosquito ditches in Accabonac Harbor indicated they are a source of nutrients and pathogenic bacteria to the estuary (Koch and Gobler 2010). In 2021 there were 16.50 acres uncertified and 14.62 acres seasonally uncertified for shellfishing due to pathogen contamination. NYS DEC updated the map in 2022 to reflect current conditions, increasing the uncertified area in northwest Accabonac to 17.08 acres and seasonally uncertified to 31.71 acres (Fig. 1). Greater area of uncertified and seasonally uncertified regions for shellfishing suggests areas significant for pathogen loading to the harbor changed or increased in recent years.

Despite the prominence of the issue in this region there is currently a lack of information about whether the tributaries, mosquito ditches, or shoreline regions downgradient of residential properties facilitate nitrogen-rich and/or pathogen-rich groundwater seepage into the harbor. While there is evidence that these areas have elevated concentrations of pollutants, more information is needed to determine whether groundwater seepage is contributing to the conditions. We hypothesize that groundwater derived fecal coliforms, additional pollutants such as excess nutrients, and co-occurring factors such as increased temperature or decreased dissolved oxygen, are contributing to water quality declines in the northwest Accabonac Harbor. A multi-phase surface water and submarine groundwater discharge (SGD) investigation can provide insight into water quality impairments and help quantify the pollutant load associated with shoreline regions. Additionally, a surface water and SGD survey can provide data to justify remediation and will inform the potential location for various mitigation strategies. Data collected from this project can also potentially help focus the stormwater management initiatives intended to decrease pathogen loading and will provide additional background water quality information in the uncertified and seasonally certified waters.

Remediation technologies will be most useful where the contaminant flux into the harbor is elevated. Thus, the identification of areas with elevated nutrient/pathogen concentrations in surface water as well as targeting areas with high rates of groundwater seepage and elevated porewater contaminants can allow for a highly targeted and efficient remediation strategy. Reversing water quality impairments will likely involve implementing a variety of management and remediation efforts including replacement of existing septic systems with innovative and alternative onsite wastewater treatment systems (I/A OWTS) as well as providing immediate water quality relief through use of permeable reactive barrier (PRBs) and nutrient bioextraction techniques. The information gained with this approach can help effectively, and economically, apply management and remediation measures intended to minimize groundwater related pollutant loading.

Methods:

Phase 1 Field Methods

Unfiltered surface water grab samples were collected in 1 L bottles for nitrogen series and 200 mL sterile bottles for coliform analysis in fall 2021 (10/14/21) and spring 2022 (4/27/22) to characterize surface water conditions within the northernmost portion of Accabonac Harbor, east of Springs Fireplace Rd. and north of NYS DEC station 14-12 (Fig. 1). Upon collection, samples were stored on ice and delivered to Long Island Analytical Labs, a NYS ELAP certified laboratory and analyzed for nitrogen series (nitrate, nitrite, ammonia, TKN) as well as total and fecal coliform bacteria. Fecal coliform bacteria were reported as most probable number (MPN) per 100 mL which is considered equivalent to colony forming units (CFU) (Noble et al. 2003) Samples were collected from each of the stations within ~2.5 hours of low tide and a replicate was collected at station AHSW12 for quality assurance. According to the Three Mile Harbor Entrance to Gardiner’s Bay tide gauge (72°11.00'W, 41°2.00'N) low tide on 10/14/21 and 4/27/22 was at approximately 11:15 and 14:04, respectively.

Little to no precipitation occurred for 1 week (collectively ≤ 2.5 mm) prior to sampling events according to East Hampton Airport NOAA precipitation data (https://water.weather.gov/precip/). Sampling during a dry period reduced the influence of stormwater runoff, a known fecal coliform source. Field parameters including pH, temperature (°C), total dissolved solids (TDS), oxygen reduction potential (ORP), and dissolved oxygen (DO), water column height, and qualitative description of sediment type were collected in the field at each station. A GPS capable of sub-meter accuracy was used to map stations and ensure that samples were collected at the same location for each sampling event.

At 5 of the 12 stations, a screw anchor was screwed into the sediment and autonomous data loggers for water level, temperature and conductivity were attached (Fig. 2). The top of the loggers protruded approximately 8 inches above the sediment. A small buoy was also attached to the screw anchor so that stations were visible from the surface. The status of the culvert opening on Gerard Ave. was noted several times throughout the spring and summer of 2022. The culvert is periodically excavated and is known to fill with sediment which reduces water exchange between Accabonac Harbor and Gardiner’s Bay. Although this was not a primary focus of the study, notes and photos were collected in case culvert sedimentation was important for data interpretation.

Data Analysis

Maps of fecal coliform, nitrogen, and field parameters were prepared with a GIS compatible software. For nitrogen and coliform values below the limit of quantitation (LOQ), half of the LOQ was used for average and standard deviation calculations. Pearson's product-moment correlation was used to determine the correlations.

Results:

Precipitation is a source of fresh water which can confound the surface water survey results by both decreasing conductivity via dilution and increasing coliform concentration by introducing stormwater runoff. Data interpretation for this dataset considers that samples were collected in a dry period (at least 7 days with collectively ≤ 2.5 mm) to minimize the influence of precipitation on both conductivity and coliform concentration in surface water samples. By collecting samples in a dry period and at low tide, the procedure maximized the potential to observe a conductivity and coliform signal due to groundwater related inputs which were the focus of this research.

Surface water conductivity is related to the relative proportion of seawater (salty and conductive) versus groundwater (fresh and less conductive) and is highly influenced by tide in shallow tidally influenced waterbodies. Understanding how tidal dynamics influence the water column conditions is a primary step in interpreting the water quality data. Little to no time difference was observed between low tide minimum at station AHSW3 which is furthest from the culvert and low tide minimum at AHSW11 which is closest to the culvert (Fig. 2, Fig. 3). Furthermore, the water level measured with our loggers was consistent with the low and high tide timing measured at the Three Mile Harbor Entrance, Gardiner's Bay tide gauge located at 72°11.00'W, 41°2.00'N.

Lowest surface water conductivities in the fall and spring were measured in the tributaries and mosquito ditches along the western shoreline (Fig. 4) which is where we anticipated the highest groundwater inputs according to the modeled water table elevation contours which converge in these regions (Fig. 2). There was a significant negative correlation ($p=0.0005$) between conductivity and TN in the fall. In other words, as conductivity decreased, total nitrogen increased. This was consistent with our hypothesis that groundwater derived nutrients influence surface water nitrogen concentration in the shallow tributary regions. However, this trend was not observed in the spring.

In the fall, 9 out of 13 samples had total nitrogen higher than the Peconic Estuary Partnership (PEP) recommendation of 0.4 mg N/L for shallow marine surface water. In the spring, average total nitrogen concentration was slightly lower (1.7 ± 0.7 mg N/L) than average fall conditions (2.0 ± 0.9 mg N/L). However, 12 out of 12 samples exceeded the PEP recommendation in the spring. In both the fall and spring, the primary nitrogen species in the surface water were NH_4^+

and TKN while nitrate and nitrite were always below the limit of quantitation (<0.4 mg N/L). (Table 2, Table 5, Fig. 5). This result was surprising because nitrate is typically the ubiquitous and stable form of nitrogen found in groundwater and surface water given that microbes present in the soil and in the water column can generate energy by converting NH_4^+ to nitrite and nitrate through an oxygen consuming process called nitrification. Although there are different growth strategies depending on nutrient availability algae will preferentially use ammonium as the form of nitrogen to synthesize biomass when it is available (Gordillo 2012) which may explain the elevated TKN values.

Of the twelve stations sampled in both the fall and spring, total coliform values ranged from <1.8 to 920 MPN/100 mL in the fall and <1.8 to 540 MPN/100 mL in the spring, while fecal coliform ranged from <1.8 to 540 in both the fall and spring (Fig. 6, Fig. 7). Total coliform values are the same or greater than fecal coliform values because fecal coliforms represent of subset of coliform bacteria that are specifically found in the gut and feces of warm-blooded animals including humans.

The sample collected at AHSW13 was an outlier, was only sampled in the fall, and contained >1600 MPN/100 mL fecal and total coliforms. The sample was collected from the wetland along the road right-of-way of Springs Fireplace Road (Fig. 2). The water along the road right-of-way appeared stagnant and was connected to the mosquito ditch within the wetland. This sample also had the highest nitrogen concentration, primarily in the form of TKN (4.3 mg N/L) (Fig. 5).

At station AHSW10 a relatively high fecal coliform concentration (170 MPN/100 mL) was measured in the spring. A consideration when interpreting this dataset is that birds flying over the harbor can introduce fecal matter directly to the water column. However, our data interpretation assumes that avian fecal matter collects on shorelines and is primarily introduced to the water column during storm events through stormwater runoff. AHSW10 is relatively far from the shoreline and was outside of the anticipated SGD zone. However, over multiple sampling days we observed birds congregating on and around boulders which were exposed at low tide near this station. At low tide when the boulders were exposed, they likely acted as a landing zone for birds which released their fecal droppings. Thus, one explanation for the unexpectedly high value at this station is that the sample may have been influenced by recent bird droppings or the boulders acted as a point source of avian derived pathogens as water flushed over them daily. This interpretation is consistent with a previous microbial source tracking study which determined avian derived fecal coliform bacteria was the dominant source in surface water samples collected from Accabonac Harbor in 2021 (Gobler 2022). Another consideration is that the culvert opening in the spring highly influences water flow in the northwest Accabonac Harbor. Therefore, AHSW10 is uniquely located where water from several shoreline SGD zones converges and mixes at low tide before it flows towards the culvert. Since the total and fecal coliform values were below detection in the fall (when the culvert was closed) and 180 MPN/100mL in the spring (when the culvert was open), the convergence of surface water and groundwater discharge with elevated pathogens may play an important role at this station.

Apart from AHSW10, stations with greatest water column heights tended to have lower fecal concentrations. These stations were furthest from the shoreline as well as the anticipated groundwater discharge zones, and had relatively high conductivity, thus the proportion of groundwater was relatively small compared to seawater. Specifically, AHSW5 and AHSW6 had high water column heights and had levels of fecal and total coliform that were below the limit of quantitation (<1.8 MPN/100mL) in both the fall and spring.

At station AHSW5 where we observed the greatest water column height and lowest fecal coliform concentration in the spring, conductivity was relatively stable (Fig. 8). Despite a tidal range of 1 meter at most stations, the water column height at AHSW5 typically remained above 0.5 meter compared to other stations where the water column frequently fell below this threshold (Fig. 3). In comparison, AHSW3 was located furthest from the culvert, had the shallowest water column height, and also experienced the greatest temperature extremes (Fig. 9). At low tide the water column was ~2-3 inches which allowed it to heat up in the midday sun. During our measurement period, a temperature minimum occurred at low tide where the temperature dropped below 5 °C. Shallow water column, cold air temperatures, and wind likely contributed to the low tide temperature minimum. In areas with shallow water column, groundwater discharge would typically buffer against temperature minimums in the spring as groundwater temperature remains relatively stable at (15-16 °C).

On average surface water DO values were lower in the fall (7.3 mg/L) than the spring (10.1 mg/L) (Table 3, Table 6). Values measured along the tributary and mosquito ditches regions, specifically at stations AHSW1, AHSW2, AHSW7, and AHSW13, in the fall were below the NYS DEC marine waterbody ambient water quality standard for DO (4.8 mg/L) (Table 1). In general, low DO values in surface water tend to occur due to a combination of factors such as shallow water depth, high temperatures, and excess nutrients which creates the conditions for organic matter remineralization, a process which consumes oxygen.

Discussion:

The culvert on Gerard Road which connects Accabonac Harbor to Gardiner's Bay was closed during the fall 2021 sampling (Fig. 10), was opened on April 4th 2022 (Fig. 11) and remained open throughout the spring and summer of 2022 (Fig. 12). The culvert opening likely helped to flush the harbor and reduce the residence time of water in the northwest region which is generally beneficial. However, during the survey, we observed shallow water levels at the culvert opening and what appeared to be freshly deposited sand present along the western side of Gerard Road and the culvert. It's possible that roadside sand replenishment followed by storm related erosion along the road led to the conditions. Alternatively, the culvert may facilitate transport of both water and sediment, leading to shoaling within the harbor over time. Bathymetry data and a time series of sedimentation near the culvert opening could help sort out this open question.

In 2021 there was 2-4 inches above normal rainfall while in 2022 there was 8-12 inches below normal rainfall according to the departure from normal precipitation analysis at the East Hampton airport NOAA weather station for the water year (Oct. 1st). The 2022 departure from normal conditions primarily occurred during a prolonged summer drought. The lack of precipitation and the maintained culvert opening likely reduced the incidence of pathogen contamination from surface water runoff in 2022.

The US FDA National Shellfish Sanitation Program and the NYSDEC requires that mean fecal coliform values are below 14 CFU/100 mL and 90% of all values are below 49 CFU/100 mL. The areas closed to shellfishing in Accabonac Harbor were recently updated and the New York State Department of Environmental Conservation shellfish closure map now indicates the northernmost portion of Accabonac Harbor has 17.08 acres of permanently closed and 31.71 acres seasonally closed to shellfishing due to pathogen contamination. At the stations with highest water column height, in other words "open water", the fecal coliform values were below threshold value of 14 CFU/100 mL. However, collectively among the 12 stations our study found that only 62% and 75% of the samples collected were below 49 CFU/100 mL in the fall and spring, respectively. Thus, our data are consistent with the DEC findings that the northwest section of Accabonac is impacted by pathogens and levels are above acceptable thresholds. However, apart from AHSW10, elevated coliforms are highly concentrated in the tributary regions rather than open water.

Results of this study are consistent with previous reports that tidal exchange and distance from the ocean inlet is a major contributor to water quality conditions. Similar to the Gobler 2022 report, we found that saltier and oxygen rich conditions were observed closer to the culvert while fresher and oxygen poor conditions were observed deeper into the wetland system within shallow mosquito ditches. In the fall we observed patterns which were consistent with our hypothesis that groundwater derived nutrients influence surface water nitrogen in the shallow tributary regions. In the early spring we did not see the same patterns. The conditions at the end of summer and early fall such as seasonal population and land use increase may make it more likely to observe the anticipated pattern in SGD derived nitrogen.

Recommendations:

Based on the elevated surface water nitrogen and pathogens found especially in the upper reaches of the mosquito ditches along the western shoreline CCE and its associated contractor CLEAR recommend performing Phase 2 of the study which includes a groundwater, porewater, and SGD survey. Phase 2 includes deploying the Trident Probe porewater evaluation instrument to locate SGD zones using conductivity and temperature contrast between the porewater at 1 foot into the sediment and surface water 1 foot above the sediment. The Trident Probe will also be used to collect porewater samples for nitrogen and pathogenic bacteria. This will be accomplished by probing primarily along the western shoreline of the northernmost portion of Accabonac Harbor and establishing transects starting nearshore and moving offshore to delineate the SGD zone. The approach will also include contingency stations selected in the field and thus allow for adaptive sampling, ensuring more accurate delineation.

Based on the porewater data, locations which show the evidence of nitrogen and pathogen pollution, stations will be selected for groundwater seepage rate measurements. This includes using a patented UltraSeep meter at selected locations for a 24-48 hour period to quantify groundwater seepage flow rate over the tidal period. By combining flow rate data and the concentration of nitrogen and pathogenic bacteria in groundwater discharge, a nitrogen and pathogen loading factor can be calculated. Quantification of this loading factor will allow a prioritization of locations within the northernmost portion of Accabonac Harbor for mitigation. If elevated pathogen and nutrient levels are measured in the groundwater seepage, the next step would be to use DNA source tracking to determine the origin of the bacteria. These data will help drive the decision-making process concerning what, if any mitigation is needed and the appropriate technique to do so.

Upon review of porewater and groundwater seepage data, we recommend installing temporary groundwater profile wells upgradient of areas identified as contributing high nutrient/pathogen loads to the surface water. Profile wells (~40 ft deep) near the shoreline will help identify the depth and dimensions of the nitrogen/pathogenic bacteria plume. Samples will be collected from the profile wells at 5 ft intervals below the water table. Groundwater sampling protocals will include following industry best practices such as purging the well at least 3 times prior to sampling. Groundwater sampling and water tabel elevation information will be also collected from existing nearby well networks if possible.

The data and recommendations gained from Phase 1 and Phase 2 can help efficiently, and economically, apply management and remediation measures intended to minimize groundwater related pollutant loading. Phase 2 recommendations will likely identify specific shoreline regions where replacement of existing septic systems with innovative and alternative onsite wastewater treatment systems (I/A OWTS) is necessary. Additionally specific shoreline areas where responsible use of permeable reactive barrier (PRBs) and nutrient bioextraction techniques will likely also be included in Phase 2 recommendations.

Figures:

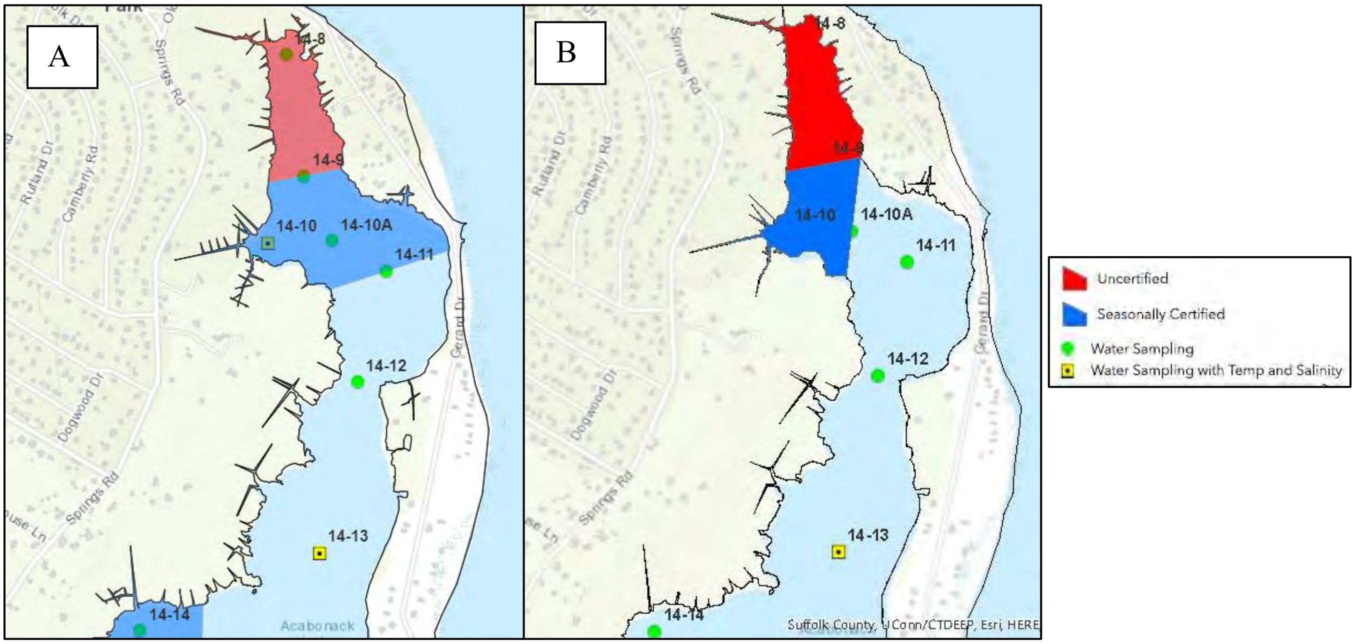

Figure 1: New York State Department of Environmental Conservation map of seasonally certified and uncertified waters for shellfishing as of 2022 (A) and as of 2021 (B) in the northernmost portion of Accabonac Harbor.

Figure 2: Station IDs for 13 stations. Stations 1-12 were sampled in both the fall and spring. Blue lines represent the modeled water table elevation contours from the CDM Smith and Suffolk County Subwatershed Wastewater Plan. The difference in water table height between each contour line is 0.1 ft. Black bold outline indicate stations which had screw anchors where autonomous data loggers were deployed for continuous water level, conductivity, and temperature monitoring.

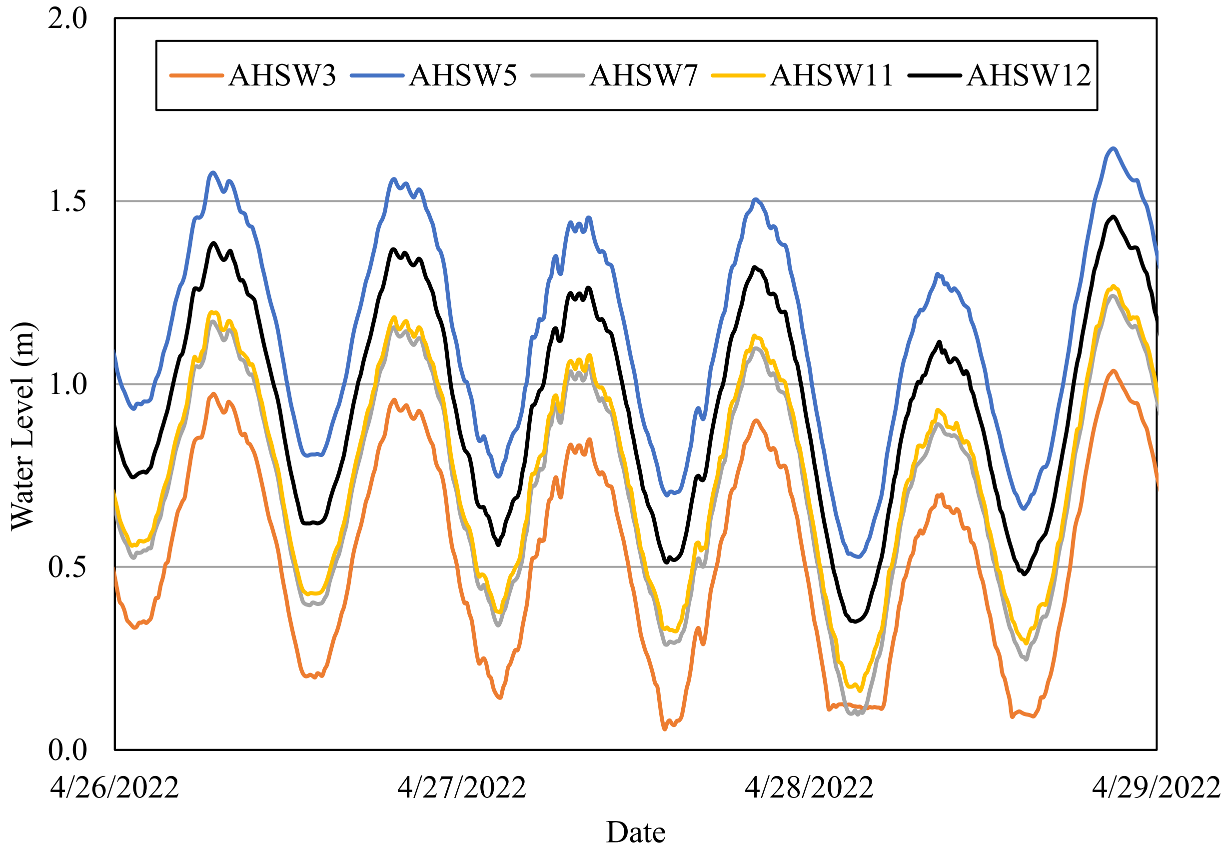

Figure 3: Water level at multiple stations during the spring 2022 sampling event.

Figure 4: Surface water conductivity (mS/cm). Values in red and blue were measured on 10/17/21 and 4/27/22, respectively.

Figure 3: Surface water total nitrogen (mg N/L). Values in red and blue were measured on 10/17/21 and 4/27/22, respectively.

Figure 6: Total coliform (MPN/100 mL). Values in red and blue were measured on 10/17/21 and 4/27/22, respectively.

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Figure 7: Fecal coliform (MPN/100 mL). Values in red and blue were measured on 10/17/21 and 4/27/22, respectively.

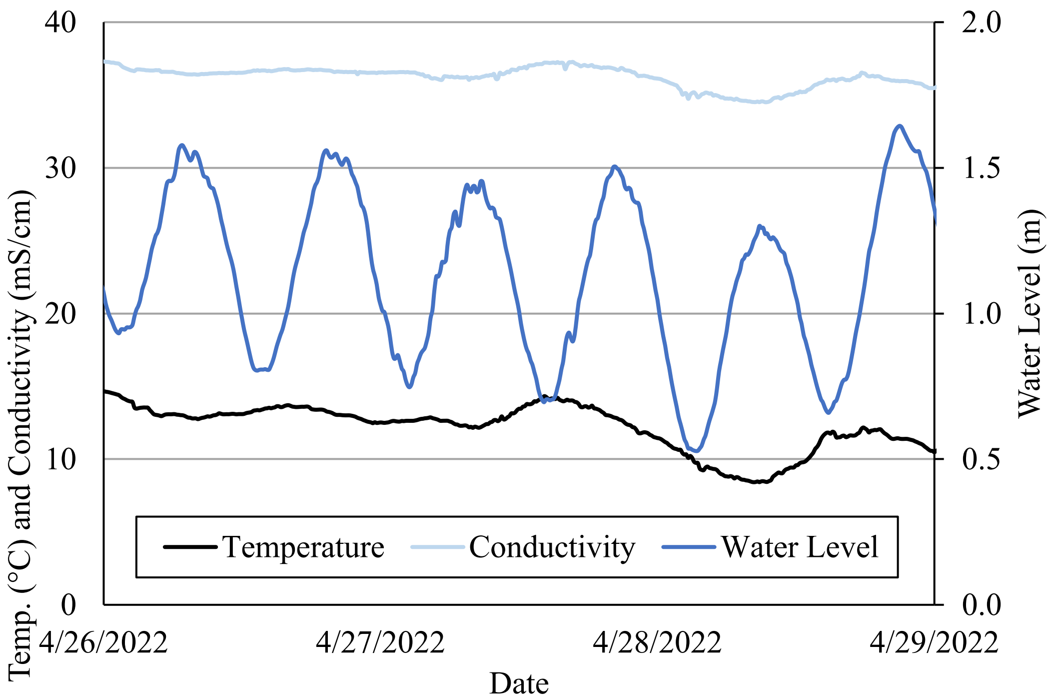

Figure 8: Temperature, conductivity, and water level measured at station AHSW5. Surface water nitrogen and coliform samples were collected around the first low tide on 4/27/22.

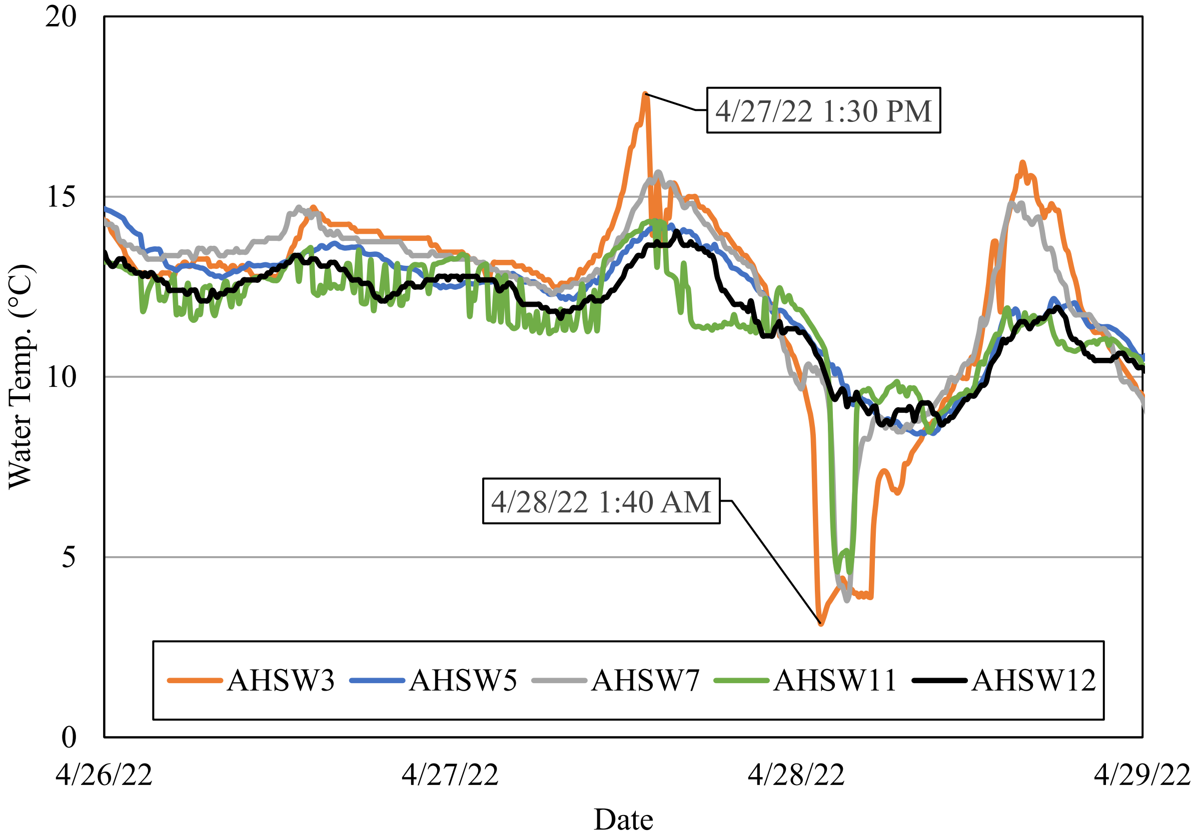

Figure 9: Temperature at multiple surface water stations during the spring 2022 sampling event. Date-time of the maximum and minimum temperatures for AHSW3 over the 3-day period are highlighted.


Figure 10: Photo taken on Oct 14th 2021 of closed culvert.

Figure 11: Photo taken on April 4th 2022 within 24 hrs of the culvert being opened

Figure 12: Photo taken on August 9th 2022 of partially closed culvert.

Data Tables:

Table 1: Field parameters measured on 10/14/21

Station ID	Time	Lat.	Long.	Water Column height (in)	Cond. (mS/cm)	TDS (ppt)	pH	Temp (°C)	ORP (mv)	DO (mg/L)
AHSW1	12:37	41.04193	-72.14583	2	38.1	24.0	7.18	21.1	-213	2.2
AHSW2	12:27	41.04231	-72.14481	5	43.4	27.6	7.19	22.2	-103	4.1
AHSW3	12:11	41.04201	-72.14309	18	44.4	28.3	7.28	22.3	22	6.0
AHSW4	13:00	41.04093	-72.14206	36	44.2	28.1	7.78	21.5	34	9.7
AHSW5	13:10	41.03949	-72.14173	42	43.9	27.9	7.90	22.5	42	10.3
AHSW6	13:17	41.03743	-72.14112	42	44.1	28.1	7.99	21.8	41	11.4
AHSW7	11:52	41.03675	-72.14377	12	43.8	27.9	7.11	21.4	33	7.3
AHSW8	11:30	41.03656	-72.14482	1	29.1	17.6	7.10	20.6	-116	5.6
AHSW9	11:40	41.03644	-72.14553	0.5	35.2	21.8	7.04	20.2	-190	3.0
AHSW10	13:36	41.03656	-72.13948	42	44.2	28.1	8.16	22.1	44	13.3
AHSW11	13:28	41.03668	-72.13682	36	44.0	28.0	8.09	21.7	42	10.8
AHSW12	13:50	41.03344	-72.13958	48	44.2	28.1	8.05	21.6	54	10.0
AHSW12(2)	13:50	41.03344	-72.13958	48	44.2	28.1	8.05	21.6	54	10.0
AHSW13	14:42	41.04161	-72.14645	2	20.3	11.9	7.14	20.9	-163	1.0

Table 2: Nitrogen and coliform concentrations measured on 10/14/21

Station ID	Time	Nitrate (mg N/L)	Nitrite (mg N/L)	Ammonia (mg N/L)	TKN (mg N/L)	Total Nitrogen (mg N/L)	Fecal coliform (MPN/ 100 mL)	Total coliform (MPN/ 100mL)
AHSW1	12:37	<0.4	<0.4	1.4	2.5	2.5	540	540
AHSW2	12:27	<0.4	<0.4	1.2	1.9	1.9	540	920
AHSW3	12:11	<0.4	<0.4	0.6	2.1	2.1	540	540
AHSW4	13:00	<0.4	<0.4	1.0	1.9	1.9	4.5	13
AHSW5	13:10	<0.4	<0.4	1.4	1.9	1.9	<1.8	<1.8
AHSW6	13:17	<0.4	<0.4	<0.4	2.5	2.5	<1.8	<1.8
AHSW7	11:52	<0.4	<0.4	0.8	<1.0	<1.8	<1.8	<1.8
AHSW8	11:30	<0.4	<0.4	0.6	2.7	2.7	240	240
AHSW9	11:40	<0.4	<0.4	0.6	2.7	2.7	350	540
AHSW10	13:36	<0.4	<0.4	<0.4	1.1	<1.8	<1.8	<1.8
AHSW11	13:28	<0.4	<0.4	<0.4	1.5	<1.8	<1.8	<1.8
AHSW12	13:50	<0.4	<0.4	0.8	1.7	<1.8	<1.8	<1.8
AHSW12(2)	13:50	<0.4	<0.4	1.6	1.7	<1.8	<1.8	<1.8
AHSW13	14:42	<0.4	<0.4	0.8	4.3	4.3	>1,600	>1,600

Table 3: Statistics for samples collected on 10/14/21

	Average ± Std.Dev.	Minimum	Maximum
Water Column Height (in)	22 ± 18	0.5	48
Conductivity (mS/cm)	39.9 ± 7.2	20.29	44.4
TDS (ppt)	25.2 ± 5.0	11.85	28.3
pH	7.54 ± 0.43	7.04	8.16
Temp. (°C)	21.5 ± 0.7	20.2	22.5
ORP (mV)	-36 ± 99	-213	54
DO (mg/L)	7.3 ± 3.8	1.0	13.3
NO_3^- (mg N/L)	<0.4	<0.4	<0.4
NO_2^- (mg N/L)	<0.4	<0.4	<0.4
NH_3 (mg N/L)	0.8 ± 0.4	0.4	1.4
TKN (mg N/L)	2.1 ± 0.9	1	4.3
TN (mg N/L)	2.0 ± 0.9	<1.8	4.3
Fecal Coliform (MPN/100 mL)	294 ± 438	<1.8	>1600
Total Coliform (MPN/100 mL)	338 ± 468	<1.8	>1600

Table 4: Field parameters measured on 4/27/22

Station ID	Time	Lat.	Long.	Water Column height (in)	Cond. (mS/cm)	TDS (ppt)	pH	Temp (°C)	ORP (mv)	DO (mg/L)
AHSW1	11:40	41.04193	-72.14583	4.5	37.8	23.8	5.82	14.5	-27	4.4
AHSW2	11:50	41.04231	-72.14481	6	43.2	27.4	6.19	16.8	79	10.2
AHSW3	12:14	41.04201	-72.14309	NA	43.5	27.6	6.99	16.8	85	10.2
AHSW4	12:28	41.04093	-72.14206	30	43.4	27.6	7.35	14.5	84	10.9
AHSW5	12:39	41.03949	-72.14173	36	43.8	27.9	7.63	14.1	87	11.0
AHSW6	12:50	41.03743	-72.14112	36	43.9	27.8	7.80	13.5	84	11.0
AHSW7	13:45	41.03675	-72.14377	12	43.1	27.3	7.39	15.4	92	11.4
AHSW8	13:09	41.03656	-72.14482	6	23.3	13.7	7.60	16.2	-6	10.0
AHSW9	13:27	41.03644	-72.14553	3	19.6	11.2	7.54	23.6	17	7.5
AHSW10	13:55	41.03669	-72.13682	24	43.8	27.7	7.67	13.5	82	11.4
AHSW11	14:18	41.03656	-72.13948	12	43.6	27.8	7.92	13.4	77	12.0
AHSW12	14:04	41.03344	-72.13958	24	43.8	27.9	7.87	13.5	85	11.5

Table 5: Nitrogen and coliform concentrations measured on 4/27/22

Station ID	Time	Nitrate (mg N/L)	Nitrite (mg N/L)	Ammonia (mg N/L)	TKN (mg N/L)	Total Nitrogen (mg N/L)	Fecal coliform (MPN/ 100 mL)	Total coliform (MPN/ 100mL)
AHSW1	11:40	0.09	<0.4	<1.0	2.1	2.2	17	17
AHSW2	11:50	0.09	<0.4	<1.0	1.3	1.4	<1.8	<1.8
AHSW3	12:14	0.09	<0.4	<1.0	3.3	3.4	70	70
AHSW4	12:28	0.22	<1.0	<1.0	1.5	1.7	4.5	4.5
AHSW5	12:39	<1.5	<1.5	0.8	1.3	2.1	<1.8	<1.8
AHSW6	12:50	<1.5	<1.5	0.8	1.3	2.1	<1.8	<1.8
AHSW7	13:45	<1.5	<1.5	0.6	<1.0	0.6	<1.8	<1.8
AHSW8	13:09	<1.5	<1.5	<1.0	1.3	1.3	17	17
AHSW9	13:27	<1.5	<1.5	<1.0	2.5	2.5	540	540
AHSW10	13:55	<1.5	<1.5	<1.0	1.1	1.1	170	170
AHSW11	14:18	<1.5	<1.5	<1.0	1.1	1.1	<1.8	<1.8
AHSW12	14:04	<1.5	<1.5	<1.0	1.3	1.3	<1.8	<1.8

Table 6: Statistics for samples collected on 4/27/22

	Average ± Std.Dev.	Minimum	Maximum
Water Column Height (in)	18 ± 12	3	24
Conductivity (mS/cm)	39.4 ± 8.2	19.6	43.9
TDS (ppt)	24.8 ± 5.6	11.2	27.9
pH	7.31 ± 0.64	5.82	7.92
Temp. (°C)	15.5 ± 2.7	13.4	23.6
ORP (mV)	62 ± 40	-27	92
DO (mg/L)	10.1 ± 2.1	4.4	12.0
NO_3^- (mg N/L)	0.5 ± 0.3	0.09	<1.5
NO_2^- (mg N/L)	<1.5	<0.4	<1.5
NH_3 (mg N/L)	0.6 ± 0.1	0.6	<1.0
TKN (mg N/L)	1.6 ± 0.7	<1.0	2.1
TN (mg N/L)	1.7 ± 0.7	0.6	2.5
Fecal Coliform (MPN/100 mL)	69 ± 150	<1.8	540
Total Coliform (MPN/100 mL)	69 ± 150	<1.8	540

References:

Gobler, C. (2022). East Hampton Town Trustees 2021 Water Quality Study Final Report

Gordillo, F. J. (2012). Environment and algal nutrition. In *Seaweed biology* (pp. 67-86). Springer, Berlin, Heidelberg.

Noble, R. T., Moore, D. F., Leecaster, M. K., McGee, C. D., & Weisberg, S. B. (2003). Comparison of total coliform, fecal coliform, and enterococcus bacterial indicator response for ocean recreational water quality testing. *Water research*, *37*(7), 1637-1643.