



Department of
Environmental
Conservation

HARMFUL ALGAL BLOOM ACTION PLAN LAKE AGAWAM

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1. Introduction

1.1 Purpose

New York State's aquatic resources are among the best in the country. State residents benefit from the fact that these resources are not isolated but can be found from the eastern tip of Long Island to the Niagara River in the west, and from the St. Lawrence River in the north to the Delaware River in the south. These resources, and the plants and animals they harbor, provide both the State and the local communities a wealth of public health, economic, and ecological benefits including potable drinking water, tourism, water-based recreation, and other ecosystem services. Harmful algal blooms (HABs), primarily within ponded waters (i.e., lakes and ponds) of New York State, have become increasingly prevalent in recent years and have impacted the values and services that these resources provide.

This HABs Action Plan for Lake Agawam has been developed by the Village of Southampton in conjunction with NYSDEC and other Lake Agawam stakeholders to:

- Describe existing physical and biological conditions
- Summarize the research conducted to date and the data it has produced
- Identify the potential causative factors contributing to HABs
- Provide specific recommendations to minimize the frequency, duration, and intensity of HABs to protect the health and livelihood of its residents and wildlife.

This Action Plan represents a key element in New York State's efforts to combat HABs now and in the future, both in Lake Agawam and in other lakes of similar morphology, hydrology, and background water quality.

1.2 Scope, Jurisdiction and Audience

The New York State HABs monitoring and surveillance program was developed to evaluate conditions for waterbodies with a variety of uses (public, private, public water supplies (PWSs), non-PWSs) throughout the State. The intended audiences for this HABs Action Plan are as follows

- Members of the public interested in background information about the development and implications of the HABs program
- Local and regional agencies involved in the oversight and management of Lake Agawam
- New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), and New York State Department of Agriculture and Markets (NYSDAM) officials
- State agency staff who are directly involved in implementing or working with the NYSDEC HABs monitoring and surveillance program
- Lake residents, managers, consultants, and others that are directly involved in the management of HABs in Lake Agawam
- Academic and other researchers interested in the water quality of Lake Agawam and/or Harmful Algal Blooms
- As well as local governments which play a significant role in water quality restoration and protection efforts. Local governments have land use authority, storm water management responsibility, operate waste water treatment plants, and are responsible for engineering and implementing roadway and public infrastructure projects.

Analyses conducted in this Action Plan provide insight into the processes that potentially influence the formation of HABs in Lake Agawam, and their spatial extents, durations, and intensities. Implementation of the mitigation actions recommended in this HABs Action Plan are expected to reduce blooms in Lake Agawam.

1.3 Background

Harmful algal blooms in freshwater generally consist of visible patches of cyanobacteria, also called blue-green algae (BGA). Cyanobacteria are naturally present in low numbers in most marine and freshwater systems. Under certain conditions, including adequate nutrient (e.g., phosphorus) availability, warm temperatures, and calm winds, cyanobacteria may multiply rapidly and form blooms that are visible on the surface of the affected waterbody. Several types of cyanobacteria can produce toxins and other harmful compounds that can pose a public health risk to people and animals through ingestion, skin contact, or inhalation. The NYSDEC has documented the occurrence of HABs in Lake Agawam and has produced this Action Plan to identify the primary factors triggering HAB events, and to facilitate decision-making to minimize the frequency, intensity, and duration of HABs as well as the effects that HABs have on both lake users and resident biological communities.

2. Lake Background

2.1 Geographic Location

Lake Agawam watershed is located in the Village of Southampton, in the Shinnecock Bay-Atlantic Ocean hydrologic unit (HUC12) in Suffolk County. The HUC12 watershed is comprised of fourteen (14) sub-drainage areas, including the drainage basin for Lake Agawam, which is approximately 1,400 acres (Figure 1). The watershed includes 2 municipalities; the Village of Southampton, and the Town of Southampton. Lake Agawam is also adjacent to the South Shore Estuary Reserve (SSER), which encompasses the tidal waters and associated watersheds between the Nassau-Queens County line and the eastern boundary of Shinnecock Bay.

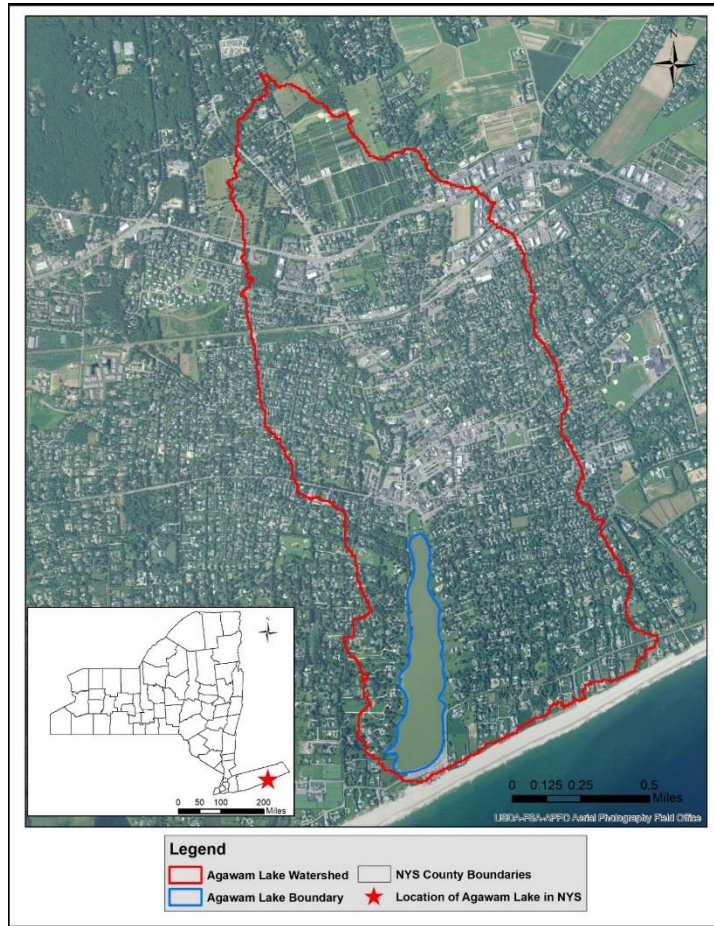


Figure 1: Lake Agawam Watershed

2.2 Morphology

Lake Agawam is a 64-acre freshwater lake, in Suffolk County. Lake Agawam has an average depth of 10 feet, and the volume is approximately 208 million gallons. The surrounding watershed encompasses approximately 1,145 acres in the Village of Southampton (Nelson, Pope & Voorhis, LLC 2009). The shoreline length of Lake Agawam is approximately 1.92 miles, with a fetch length of approximately 1,300 meters, or 0.82 miles. The depth remains relatively constant at the mid sections of the lake, with higher slopes towards the shoreline. The wind rose in **Appendix A. Wind and Wave Patterns** indicates that stronger prevailing wind directions potentially influencing Lake Agawam were generally out of the southwest, as measured from both the Easthampton and Westhampton airports. These wind patterns, combined with the orientation of the lake, likely result in a large area where wind and wave action may mix the water and drive water-borne nutrients and cyanobacteria towards the northeast shore of the lake.

The quantity of soft sediment in the north end of Lake Agawam has been measured by Nelson, Pope and Vorhis, and is approximately 65,000 cubic yards, made up of greater than 10% fine sand and silt (Nelson, Pope and Vorhis, 2019).

2.3 Hydrology

There are 14 sub-drainage basins in the Lake Agawam watershed (Nelson, Pope & Voorhis, LLC 2009). Stormwater inflows were identified in 2007 within the lake and consist of a single system at the northern side of the lake, with two drain openings that discharge during rain events. Three outfalls are located along the northern shoreline, and the fourth along the southern shoreline. The depth to groundwater within the watershed ranges from 0 feet to 36 feet above sea level (Nelson, Pope & Voorhis, LLC 2009).

A stormwater inventory, coordinated by Nelson, Pope & Voorhis, identified a total of 140 catch basins in the watershed. Two areas of concern were also identified as significant flooding zones, including one at the southern end of the lake (Nelson, Pope & Voorhis, LLC 2009). Three outfalls are located along the northern shoreline, and the fourth along the southern shoreline.

Nelson, Pope & Voorhis also conducted an inventory of installed bubblers in 2007, maintained by the Village. Three large fountains, and sixteen bubblers were located, distributed along the length of the lake (Nelson, Pope & Voorhis, LLC 2009).

2.4 Lake Origin

According to Nelson, Pope & Voorhis (2009), Lake Agawam was formed by a glacier and was likely once connected to the ocean, however it is an entirely freshwater lake today, separated from the ocean by a barrier beach. The only existing connection to the ocean is a water level outflow pipe, controlled by a manual release valve (Nelson, Pope & Voorhis, LLC 2009).

3. Designated Uses

3.1 Water Quality Classification – Lake and Major Tributaries

Lake Agawam is a Class C waterbody according to the New York Codes, Rules, and Regulations (NYCRR). Class C waterbodies are best utilized for fishing (6 NYCRR 701.8). Lake Agawam was assessed as an impaired waterbody due to recreational uses that are known to be impaired by phosphorus and low dissolved oxygen. These conditions result in frequent and severe harmful algal blooms in the lake. No specific pollutant or sources were identified, but land use suggests failing onsite wastewater treatment systems and urban non-point source runoff contribute to the impacts.

3.2 Recreation Uses

Recreation uses are known to be impaired due to shoreline harmful algal blooms (NYSDEC 2016). Algae (chlorophyll-a) levels in the open water were well above the 15 µg/l that has been associated with stressed recreational conditions during 2014. (https://www.dec.ny.gov/docs/water_pdf/asmtmeth17.pdf).

Since 2004, Lake Agawam has periodically closed during the summer for recreation and fishing, (Gobler 2017).

3.3 Fish Consumption/Fishing Uses

NYSDEC's website lists Largemouth Bass, Bluegill, Pumpkinseed, White Perch, Carp, Brown Bullhead as fish species in Lake Agawam (<https://www.dec.ny.gov/outdoor/24147.html>).

Fish consumption use is listed as unassessed. Although there are no specific restrictive advisories or records of tissue analysis for fish from Lake Agawam due to the presence of shoreline algae toxins, the statewide NYDOH advice regarding fish consumption should be followed

(https://www.health.ny.gov/environmental/outdoors/fish/health_advisories/regional/long_island.htm#fresh).

3.4 Aquatic Life Uses

Lake Agawam is designated as a Class C water, suitable for fish propagation and survival. Water quality monitoring conducted by the NYSDEC focuses primarily on support of aquatic life and secondary contact recreation. Aquatic life use is considered to be stressed based on nutrient levels and low dissolved oxygen (NYSDEC 2016). NYSDEC's website lists Largemouth Bass, Bluegill, Pumpkinseed, White Perch, Carp, Brown Bullhead as fish species in Lake Agawam (<https://www.dec.ny.gov/outdoor/24147.html>).

Fish kills were observed in 1954, 1981, 2000, 2005 (Nelson, Pope & Voorhis 2009), and 2006 (Gobler 2017).

4. User and Stakeholder Groups

Lake Agawam is used by all age groups of residents and tourists who enjoy the myriad of recreational opportunities that are available. Access to Lake Agawam is available via the adjacent green park and sitting area, owned by the Village of Southampton. Identified stakeholders are as follows:

- Village of Southampton
- Town of Southampton
- SUNY Stony Brook University School of Marine and Atmospheric Sciences
- Lake Agawam Conservancy
- Southampton Village Clean Water Committee
- Southampton Village Board of Trustees
- Town of Southampton Board of Trustees

Much of the property around the Lake is privately owned and considered low density residential, with commercial and medium density ownership around the north and south ends of the lake.

5. Monitoring Efforts

5.1 Lake Monitoring Activities

DEC's earliest monitoring on Lake Agawam occurred in 1938, with additional fish surveys in 1954, 1970 (NYSDEC), 1982, 2003, 2004 and 2007 (NYSDEC). In 1954, there was also a record of a fish kill due to hypoxic conditions, as well as additional reports from 1981 and 2000.

Regular water quality sampling of Lake Agawam was conducted by researchers at SUNY Stony Brook from 2011 to 2015. Annual monitoring by SUNY SB was conducted since 2003, for the following parameters (Gobler 2017):

- Chlorophyll a
- Dissolved oxygen
- Temperature
- Salinity
- Nutrients
- Water clarity
- Coliform bacteria

Sampling sites were at the north and south ends of the lake (Figure 2). Additionally, SUNY Stony Brook monitored visible shoreline scums in 2016 concurrently with in-lake sampling.

SUNY Stony Brook also conducted sampling at stormwater outflow pipes in 2007. And in 2008, a study estimating nitrogen and phosphorus loads into the lake included volumetric loading estimates, benthic nutrient flux and storm runoff estimates (Harke, et al. 2008).

6. Water Quality Conditions

6.1 Physical Conditions

A bathymetric study by Nelson, Pope & Voorhis in 2019 sampled at 6 stations around the lake (Figure 3). Physical results indicated that sediments were generally comprised of sand and silt, with a mix of gravel and sand in the middle of the lake. Sediment depth

ranged from 0-8.2 ft, with the total volume of sediment in the study area at 65,000 cubic yards. Preliminary analysis indicated that the north end of the lake samples contained lead and arsenic, which would necessitate review with NYS DEC's Materials Management group for disposal if dredging were to take place.

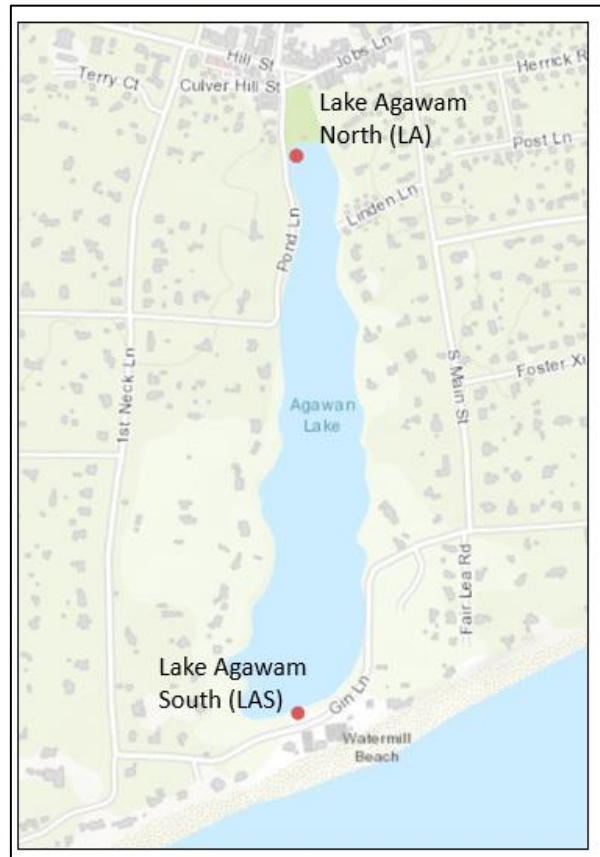


Figure 2: SUNY SB sampling locations, at the north (LA) and south (LAS) end of the lake



Figure 3: Sediment sampling locations for NP&V 2019 Bathymetric study.

Water clarity can be related to the amount of suspended material in the water column including sediment, algae, and cyanobacteria. Water clarity measurements, as represented by Secchi depth (m) measured by SUNY Stony Brook at the north and south ends of the lake were rarely greater than 0.5 m (Figure 4).

6.2 Chemical Conditions

Average yearly levels of chlorophyll a (Figure 5), as well as, dissolved oxygen indicate a consistently eutrophic, oxygenated system since the beginning of the SUNY Stony Brook studies. However, it is important to note that periods of low oxygen may have contributed to fish kills recorded in 2006, when hypoxic levels occurred at night, and outside of the monitoring window (Gobler, 2017).

Further ambient monitoring at the north and south ends of the lake from 2014 to 2019 below (Figure 4) show little difference in the yearly bottom vs. surface DO measurements (Table 1), which indicates Lake Agawam is most likely a well-mixed, non-stratified system. For surface DO, the south end of the lake sampling location (LAS) yearly averages were slightly lower than the north end of the lake sampling location (LA). There was little difference between the surface and bottom temperatures by year, however both LA and LAS were ± 1 degree higher in 2019 vs. 2016, while temperature averages for 2017 for surface and bottom were the lowest

measured in the study. A snapshot of the SUNY Stony Brook sampling regime by year is in Figure 7: Summary datasets provided by SUNY SB for Lake Agawam (2014-2019).

Table 1: Yearly averages measured by SUNY SB from 2014-2019.

Year	Name	Temp: Surface	Temp: Bottom	DO (mg/L): Surface	DO (mg/L): Bottom	pH	Secchi Depth (m)
2014	Lake Agawam	22.04826	22.23450	11.14478	10.259500	NaN	0.3891304
2015	Lake Agawam	23.74545	22.76364	11.05478	9.532381	NaN	0.5227273
2016	Lake Agawam	22.86391	22.28043	10.60652	9.722174	9.2	0.3966667
2016	Lake Agawam South	23.20000	22.90000	9.70000	9.200000	NaN	0.5000000
2017	Lake Agawam	18.33226	18.77667	11.33000	11.034333	NaN	0.3283333
2018	Lake Agawam	23.65000	23.32667	11.43625	10.066000	NaN	0.1973333
2019	Lake Agawam	23.19091	23.94500	10.92636	10.096500	NaN	0.3357143
2019	Lake Agawam South	22.53750	23.48571	10.09375	11.101429	NaN	0.2375000

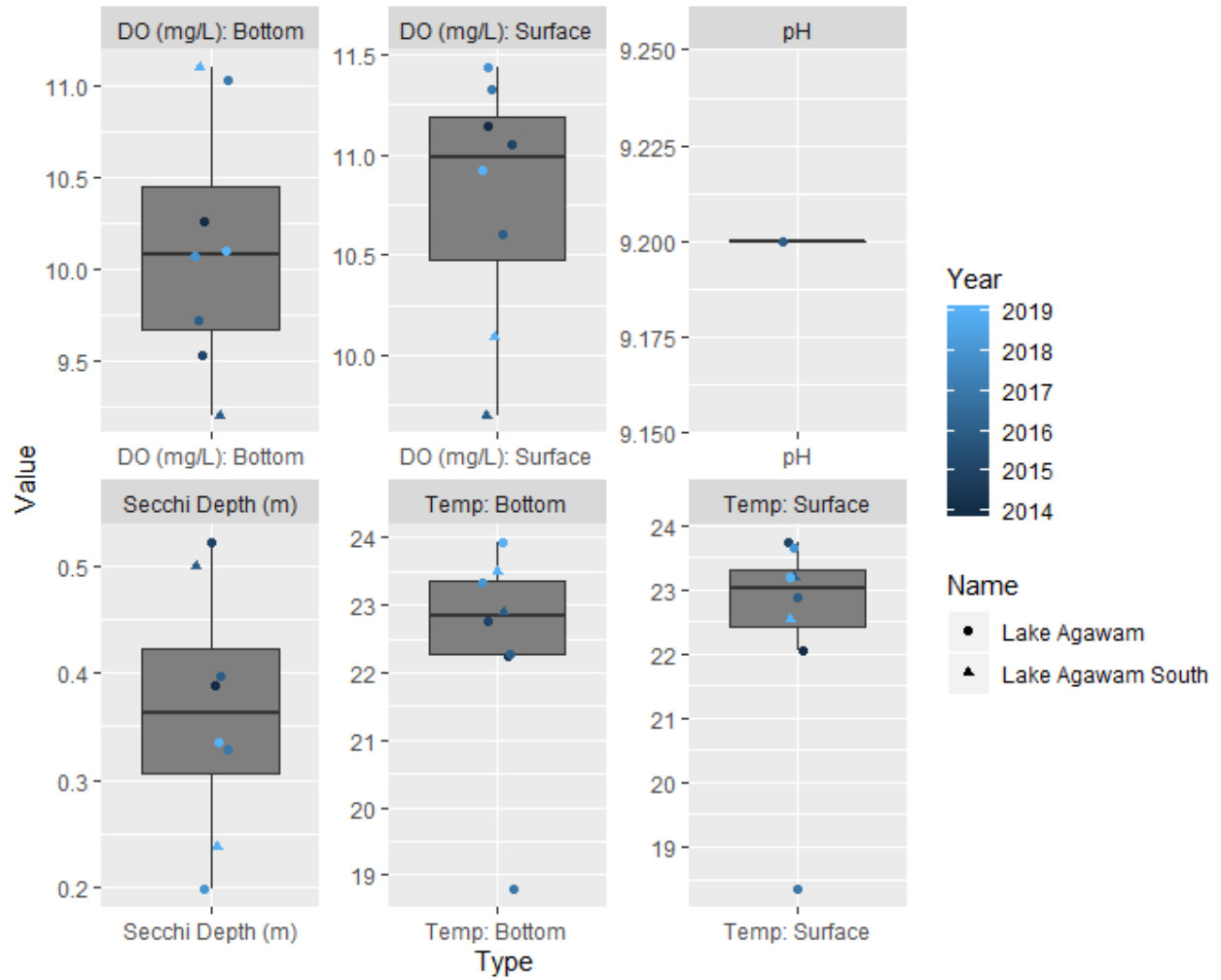


Figure 4: Boxplots and points of yearly summary data for LA and LAS measurements provided by SUNY SB.

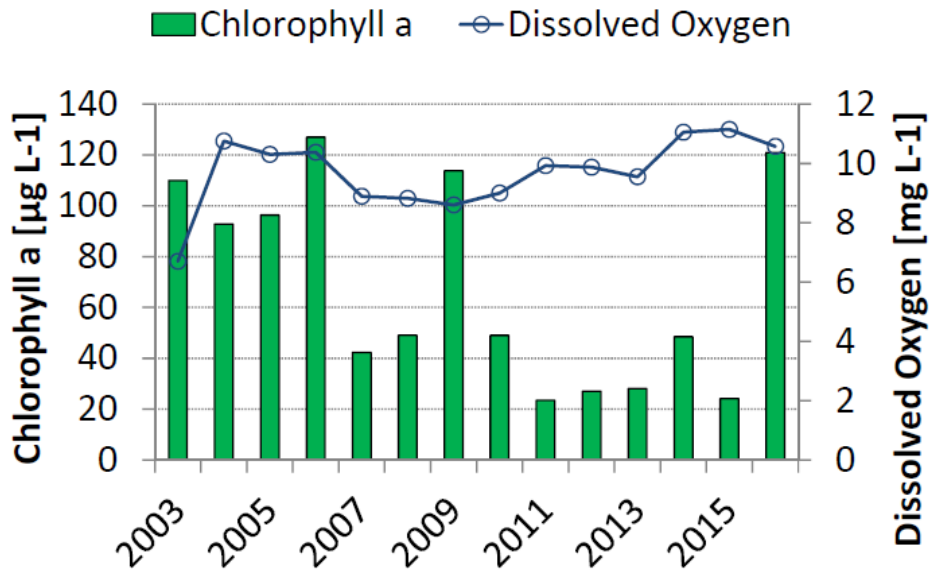


Figure 5: Chlorophyll a and dissolved oxygen (daytime) in Lake Agawam (Gobler 2017).

6.3 Biological Conditions

Sampling conducted by SUNY Stony Brook recorded *Microcystis* and *Anabaena* genera that have dominated Lake Agawam’s HAB community since 2004. Regular sampling for phosphorus, by SUNY Stony Brook, was routinely measured above 20 $\mu\text{g/L}$ (Figure 5). These levels are associated with an elevated risk of HABs occurrence-including potential toxin formation and other water clarity issues. Fluoroprobe measurements from SUNY Stony Brook indicate cyanobacteria dominate the yearly phytoplankton assemblages (Figure 6). Further experimental analysis indicates that nitrogen loading may be a larger contributor to HAB biomass in Lake Agawam than phosphorous loading (Davis et al., 2010). Storm drain runoff monitoring indicated higher levels of phosphorous and coliform bacteria at the north end of the lake vs. the south end (Gobler, 2007).

Estimated loading of nitrogen and phosphorus indicated that groundwater nitrogenous inputs greatly exceeded those from stormwater or atmospheric sources (Harke, et al., 2008), however, this study may have overlooked the contribution of particulate matter to the availability of the system’s nutrient balance.

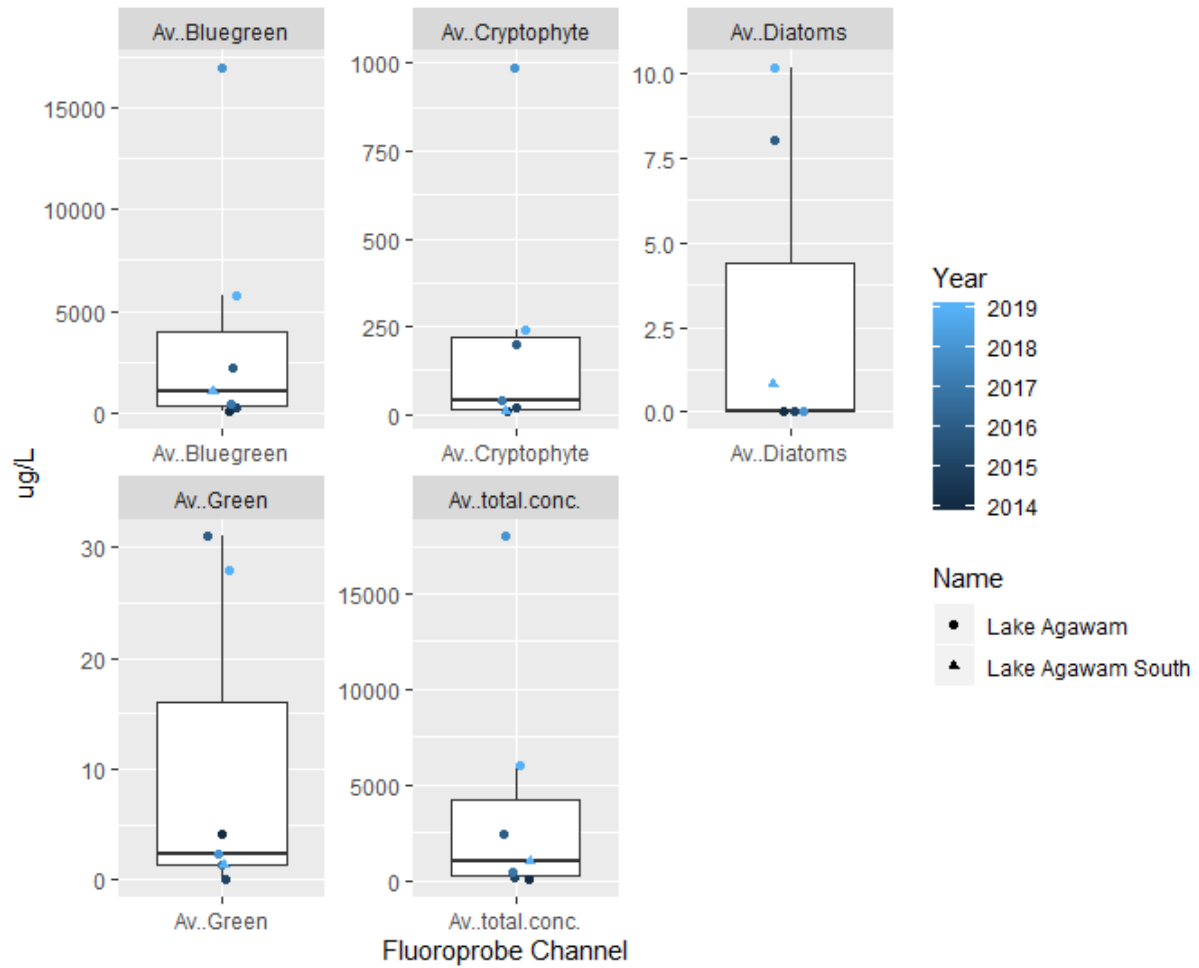


Figure 6: Boxplots of Yearly Fluoroprobe channel measurements at LA and LAS by SUNY SB (2014-2019).

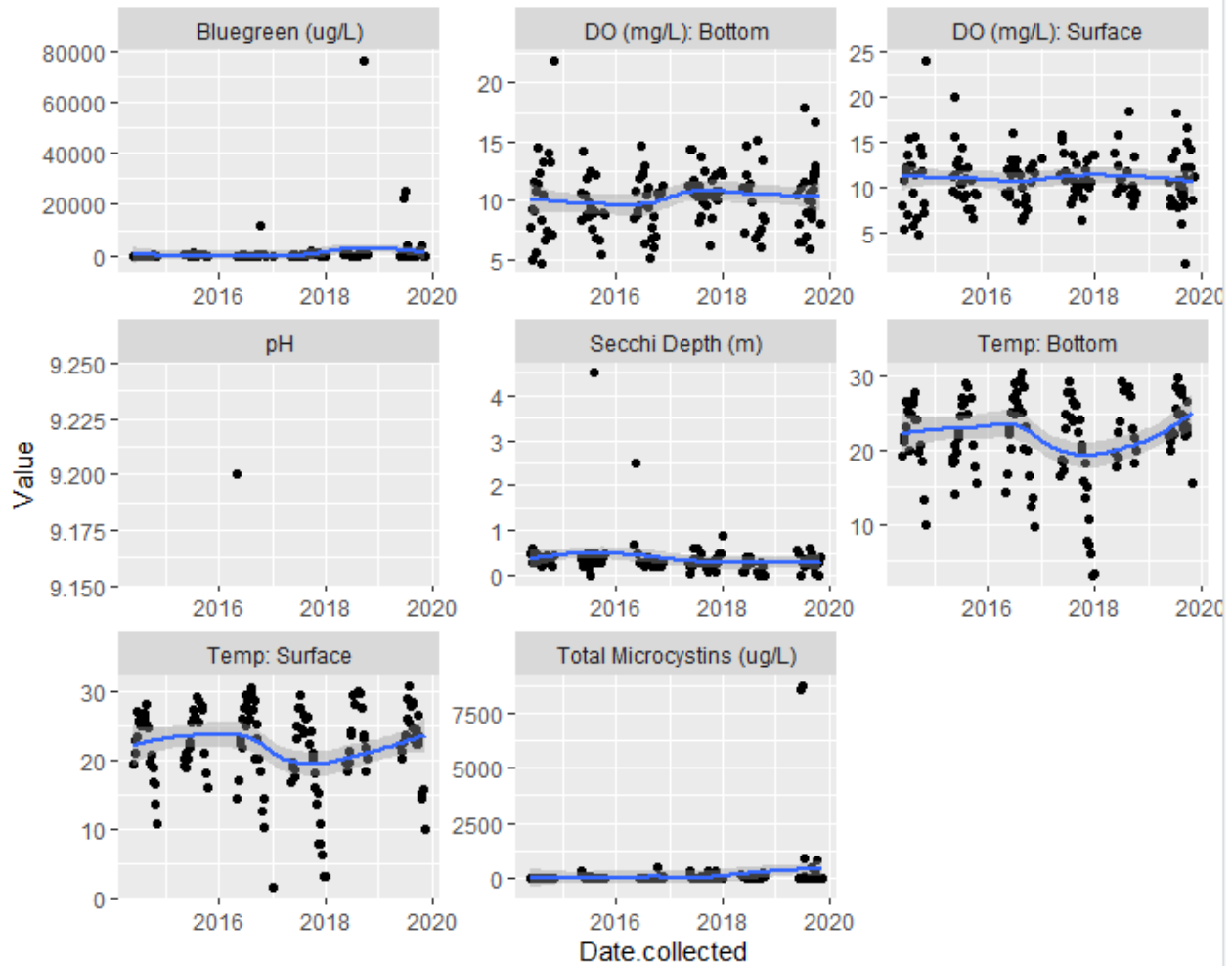


Figure 7: Summary datasets provided by SUNY SB for Lake Agawam (2014-2019).

7. Summary of HABs in the Lake

New York State possesses one of, if not the most comprehensive HABs monitoring and notification programs in the country. The NYSDEC and NYSDOH collaborate to document and communicate with New Yorkers regarding HABs. Within NYSDEC, staff in the Division of Water, Lake Monitoring and Assessment Section oversee HAB monitoring and surveillance activities; identify bloom status; communicate public health risks; and conduct outreach, education, and research regarding HABs. The NYSDEC HABs Program has adopted a combination of visual surveillance, algal concentration measurements, and toxin concentration to determine bloom status. This process is unique to New York State and has been used consistently since 2012.

The NYSDEC HABs Program has established four levels of bloom status:

- **No Bloom:** evaluation of a cyanobacteria bloom (HAB) report indicates low likelihood that a cyanobacteria bloom is present

- **Suspicious Bloom:** NYSDEC staff determined that conditions fit the description of a HAB, based on visual observations and/or digital photographs. Laboratory analysis has not been done to confirm if this is a HAB. It is not known if there are toxins in the water.
- **Confirmed Bloom:** Water sampling results have confirmed the presence of a HAB which may produce toxins or other harmful compounds (BGA chlorophyll concentrations $\geq 25 \mu\text{g/L}$ and/or microscopic confirmation that majority of sample is cyanobacteria and present in bloom-like densities). For the purposes of evaluating HABs sample, chlorophyll-a is quantified with a Fluoroprobe (bbe Moldaenke) which can effectively differentiate relative contributions to total chlorophyll-a by phytoplankton taxonomic group (Kring et al. 2014). BGA chlorophyll-a concentrations (attributed to most types of cyanobacteria) are utilized by the NYSDEC HABs Program for determining bloom status. This method provides an accurate assessment of cyanobacteria density and can be accomplished more quickly and cost effectively than traditional cell counts.
- **Confirmed with High Toxins Bloom:** Water sampling results have confirmed that there are toxins present in sufficient quantities to potentially cause health effects if people and animals come in contact with the water through swimming or drinking (microcystin $\geq 20 \mu\text{g/L}$ (shoreline samples) or microcystin $\geq 10 \mu\text{g/L}$ (open water samples)).

The spatial extent of HABs are categorized as follows:

- **Small Localized:** Bloom affects a small area of the waterbody, limited from one to several neighboring properties.
- **Large Localized:** Bloom affects many properties within an entire cove, along a large segment of the shoreline, or in a specific region of the waterbody.
- **Widespread/Lakewide:** Bloom affects the entire waterbody, a large portion of the lake, or most to all of the shoreline.
- **Open Water:** Sample was collected near the center of the lake and may indicate that the bloom is widespread and conditions may be worse along shorelines or within recreational areas.

7.1 Ambient Lake HABs History

Lake Agawam has received considerable attention by state agencies, nongovernmental organizations, community interest groups, lake users, and other stakeholders because of the long history of documented HABs in the lake. HABs have been reported to DEC primarily by Dr. Gobler's research team from Stony Brook University, School of Marine and Atmospheric Sciences. HABs in Lake Agawam have primarily been sampled along the northern shoreline. Samples were collected weekly when HAB conditions were present, 2013-2019. The frequency at which HABs samples exceeded NYSDEC blooms status thresholds are summarized in Table below.

Table 2: Lake Agawam HAB monitoring data (DEC 2019).

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

7.2 Other Bloom Documentation

Cyanobacteria Chlorophyll-a

Cyanobacteria cell counts and/or chlorophyll-a concentrations can be used to trigger HABs alerts and advisory systems. BGA chlorophyll-a concentrations were quantified at a laboratory at Stony Brook University, School of Marine and Atmospheric Sciences with a Fluoroprobe (bbe Moldaenke) for all samples collected from 2013 to 2019.

Cyanotoxins

Some cyanobacteria taxa also produce toxins (cyanotoxins) that are harmful to people and pets. As a result, several different toxins are monitored during blooms. Microcystin is the most commonly detected cyanotoxin in New York State (NYSDEC 2017). The 20 µg/L microcystin “high toxin” threshold for shoreline blooms was, like the BGA chlorophyll-a criterion, established based on WHO criteria. Since 2003, microcystin has been continually detected in Lake Agawam. Further, microcystin was found in all samples taken by Gobler Lab between 2013 and 2016, and 40% of those samples exceeded the 20 µg/L threshold for DEC’s bloom threshold criteria (Gobler 2017; and http://www.dec.ny.gov/docs/water_pdf/habsprogramguide.pdf). Lake Agawam microcystin levels are consistently higher than what is currently prescribed by NYSDOH guidance to allow a regulated bathing beach to reopen. NYSDOH and NYSDOH believe that all cyanobacteria blooms should be avoided, even if measured microcystin levels are less than the recommended threshold level. Other toxins may be present, and illness is possible even in the absence of measured toxins.

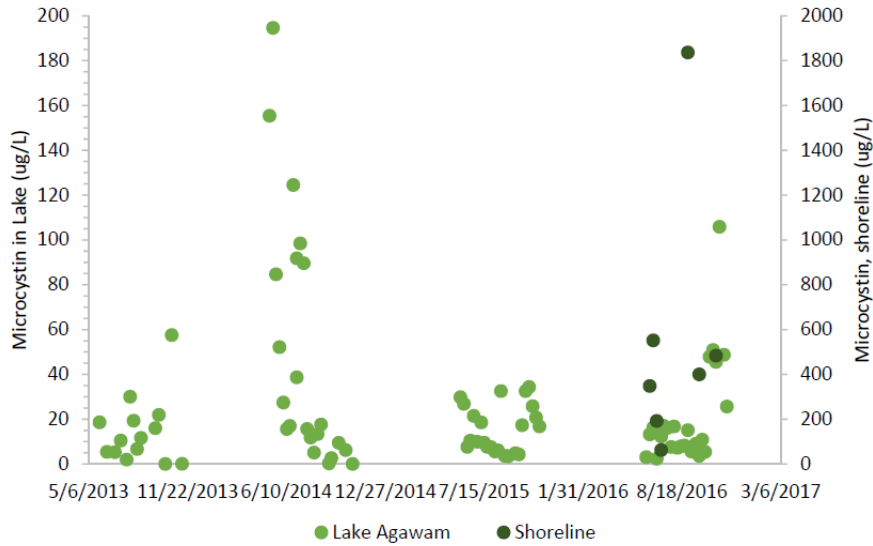


Figure 8: Microcystin in Lake Agawam from 2013-2016 (Gobler 2017).

Cyanobacteria Taxa

Multiple genera of cyanobacteria were identified in samples collected from 2013 to 2017; however, *Microcystis* is the most common genus in qualitative microscopy samples analyzed. *Microcystis* cells can regulate their buoyancy, moving up into the water column to harvest light for photosynthesis, and move down into the water column towards the metalimnion to acquire nutrients (Mantzouki et al. 2016).

Other genera of cyanobacteria documented in Lake Agawam samples include *Dolichospermum*, *Oscillatoria*, *Planktothrix*, and *Aphanizomenon*. Some of these genera are able to fix nitrogen (N₂), providing a competitive advantage over non-nitrogen fixing algae during periods when nitrogen is limiting (Mantzouki et al. 2016). Further research and analysis is warranted to document how the cyanobacteria assemblage in Lake Agawam contributes to documented HABs.

7.3 WI/PWL Assessment

The Waterbody Inventory/Priority Waterbodies List (WI/PWL) is an inventory of water quality assessments that characterize known/and or suspected water quality issues and determine the level of designated use support in a waterbody. It is instrumental in directing water quality management efforts to address water quality impacts and for tracking progress toward their resolution. In addition, the WI/PWL provides the foundation for the development of the state Section 303(d) List of Impaired Waters Requiring a Total Maximum Daily Load (TMDL). The WI/PWL assessments reflect data and information drawn from numerous NYSDEC programs (e.g. CSLAP) as well as other federal, state and local government agencies, and citizen organizations. All data and information used in these assessments has been evaluated for adequacy and quality as per the NYSDEC Consolidated Assessment and Listing Methodology (CALM). The current WI/PWL assessment for Lake Agawam (Appendix E) 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 (phosphorus and low dissolved oxygen).

Lake Agawam is currently included on the NYS Section 303(d) List of Impaired/TMDL Waters for phosphorus, and related low dissolved oxygen.

8. Conditions Triggering HABs

Resilience is an important factor in determining an ecosystem's ability to respond to and overcome negative impacts (Zhou et al. 2010), including the occurrence and prevalence of HABs. Certain lakes may not experience HABs even though factors hypothesized to be "triggers" (e.g., elevated P concentrations) are realized (Mantzouki et al. 2016), and conversely, lakes that have historically been subject to HABs may still be negatively affected even after one or more triggers have been reduced. Thus, phytoplankton dynamics may cause the presence of HABs to lag behind associated triggers (Faassen et al. 2015). Further, unusual climatic events (e.g., high TP input from spring runoff and hot calm weather in fall) may create unique conditions that contribute to a HAB despite implementation of management strategies to prevent them (Reichwaldt and Ghadouani 2012).

Ecosystems often exhibit a resistance to change that can delay outcomes associated with HABs management. This system resilience demands that prevention and management of these triggers be viewed long-term through a lens of both watershed and in-lake action. It may take significant time following implementation of recommended actions for the frequency, duration, and intensity of HABs to be reduced.

A dataset spanning 2012 to 2017 of 163 waterbodies in New York State has been compiled to help understand the potential triggers of HABs at the state-scale (CSLAP data). This dataset includes information on several factors that may be related to the occurrence of HABs, e.g., lake size and orientation (related to fetch length, or the horizontal distance influenced by wind); average total phosphorus and total nitrogen concentrations; average surface water temperatures; as well as the presence of invasive zebra and quagga mussels (i.e., dreissenid mussels). This data set has been analyzed systematically, using a statistical approach known as logistic regression, to identify the minimum number of factors that best explain the occurrences of HABs in NYS. A minimum number of factors are evaluated to provide the simplest possible explanation of HABs occurrences (presence or absence) and to provide a basis for potential targets for management. One potential challenge to note with this data set is that lakes may have unequal effort regarding HABs observations which could confound understanding of underlying processes of HABs evaluated by the data analysis.

Across New York, four of the factors evaluated were sufficiently correlated with the occurrence of HABs, namely, average total phosphorus levels in a lake, the presence of dreissenid mussels, the maximum lake fetch length and the lake compass orientation of that maximum length. The data analysis shows that for every 0.01 mg/L increase in total phosphorus levels, the probability that a lake in New York will have a HAB in a given year increases by about 10% to 18% (this range represents the 95% confidence interval based on the parameter estimates of the statistical model). The other factors, while statistically significant, entailed a broad range of uncertainty given this initial analysis. The presence of dreissenid mussels is associated with an increase in the annual HAB probability of 18% to 66%. Lakes with long fetch lengths are associated with an increased occurrence of HABs; for every mile of increased fetch length, lakes are associated with up to a 20% increase in the annual probability of HABs. Lastly, lakes with a northwest orientation along their longest fetch length are 10% to 56% more likely to have

a HAB in a given year. Each of these relationships are bounded, i.e., the frequency of blooms cannot exceed 100%, meaning that as the likelihood of blooms increases the marginal effect of these variables decreases. While this preliminary evaluation will be expanded as more data are collected on HABs throughout New York, these results are supported by prior literature. For example, phosphorus has long been known to be a limiting nutrient in freshwater systems and a key driver of HABs, however the potential role of nitrogen should not be overlooked as HABs mitigation strategies are contemplated (e.g., Conley et al. 2009). Similarly, dreissenid mussels favor HABs by increasing the bioavailability of phosphorus and selectively filtering organisms that may otherwise compete with cyanobacteria (Vanderploeg et al. 2001). The statistically-significant association of fetch length and northwest orientation with HABs may suggest that these conditions are particularly favorable to wind-driven accumulation of cyanobacteria and/or to wind-driven hydrodynamic mixing of lakes leading to periodic pulses of nutrients. While each of these potential drivers of HABs deserve more evaluation, the role of lake fetch length and orientation are of interest and warrant additional study.

There is continuing interest in the possible role of nitrogen in the occurrence and toxicity of HABs (e.g., Conley et al. 2009), and preliminary analysis of this statewide data set suggests that elevated total N and total P concentrations are both statistically significant associates with the occurrence of toxic blooms. When total N and total P concentrations are not included in the statistical model, elevated inorganic nitrogen (NH₄ and NO_x) concentrations are also positively associated with toxic blooms. The significant association of inorganic N forms with toxic blooms may provide a more compelling association than total N, which may simply be a redundant measure of the biomass associated with toxins. It should be noted that while this analysis may provide some preliminary insight into state-scale patterns, it is simplistic in that it does not account for important local, lake-specific drivers of HABs such as temperature, wind, light intensity, and runoff events.

9. Sources of Pollutants

Nutrients enter waterbodies via overland flow, tributaries, and other nonpoint sources, as well as point sources, where they become available for use by cyanobacteria and aquatic plants or are deposited and stored in lakebed sediments.

Two different tools were used to estimate nutrient loading from the watershed. Land use and potential phosphorus pollutant loading data provided in this section were estimated using NYSDEC's Loading Estimator of Nutrient Sources (LENS) screening tool (NYSDEC, undated). Nitrogen loading analysis was completed using the Nitrogen Load Model (NLM) in Dr. Christopher Gobler's study to evaluate the potential impact on water quality with the creation of a sewer district (Gobler 2017).

9.1 Land Uses

Based on NYSDEC's LENS model analysis, the watershed comprises the following land use types (Figure 5):

- Developed land = 85%
- Forest = 6%
- Pasture/Hay = 5%

- Open Water = 4%

The distribution of the land use is depicted in Figure 9. Much of the watershed is assessed as developed, and several high intensity septic density areas are present on the northern side of the watershed (Figure 11).

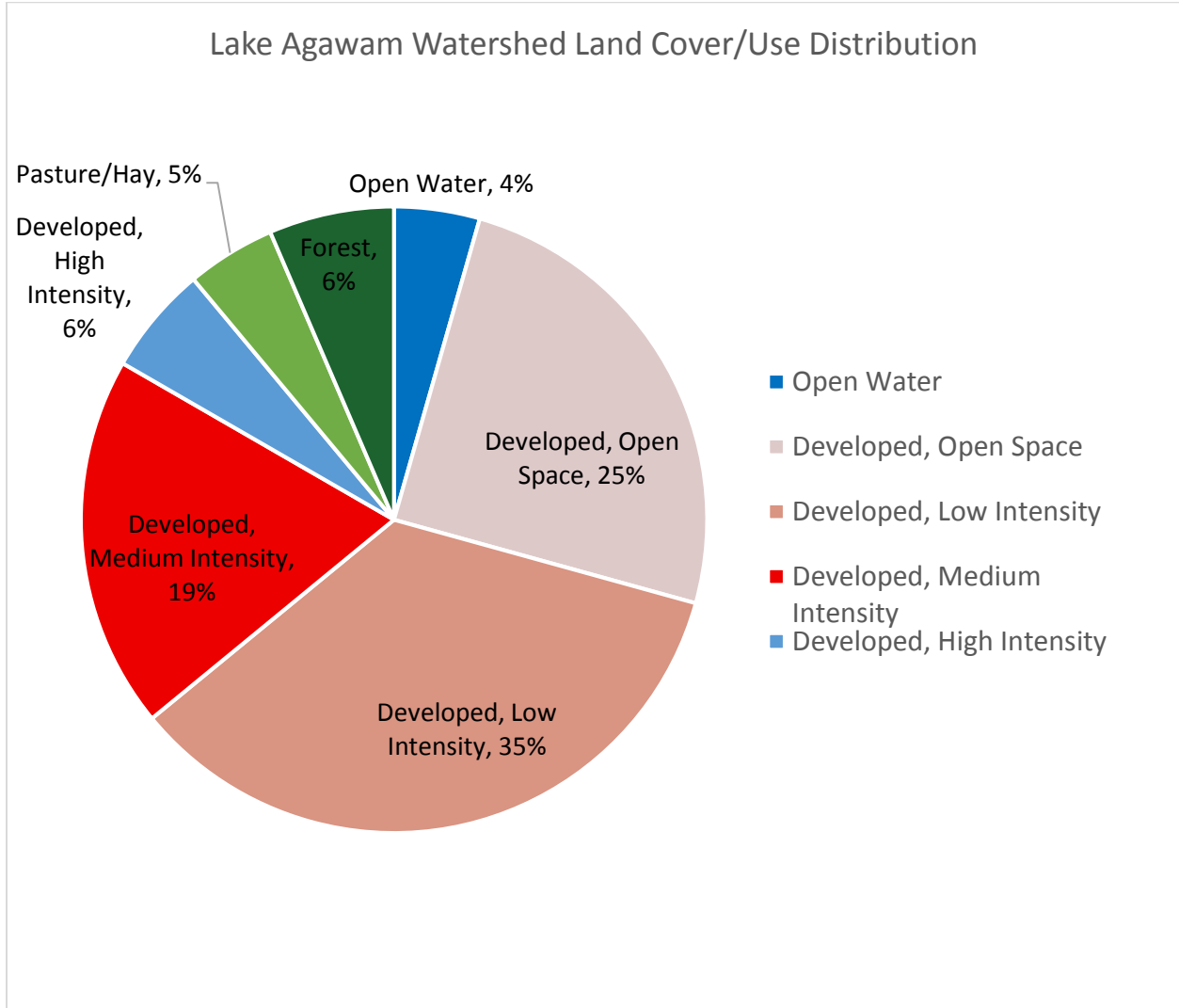


Figure 9: Land use categories and percentages for the Lake Agawam watershed.

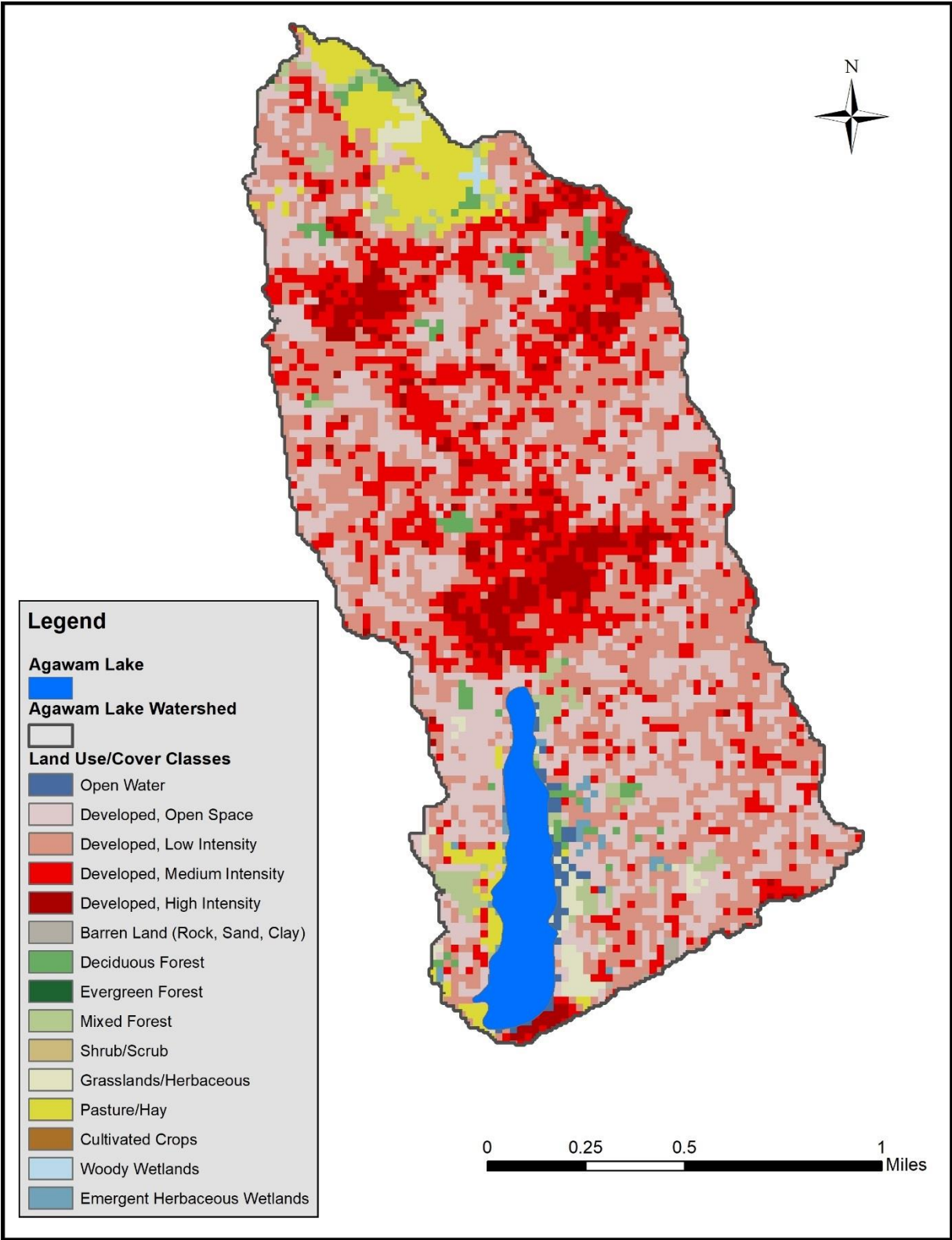


Figure 10: Lake Agawam watershed land use.

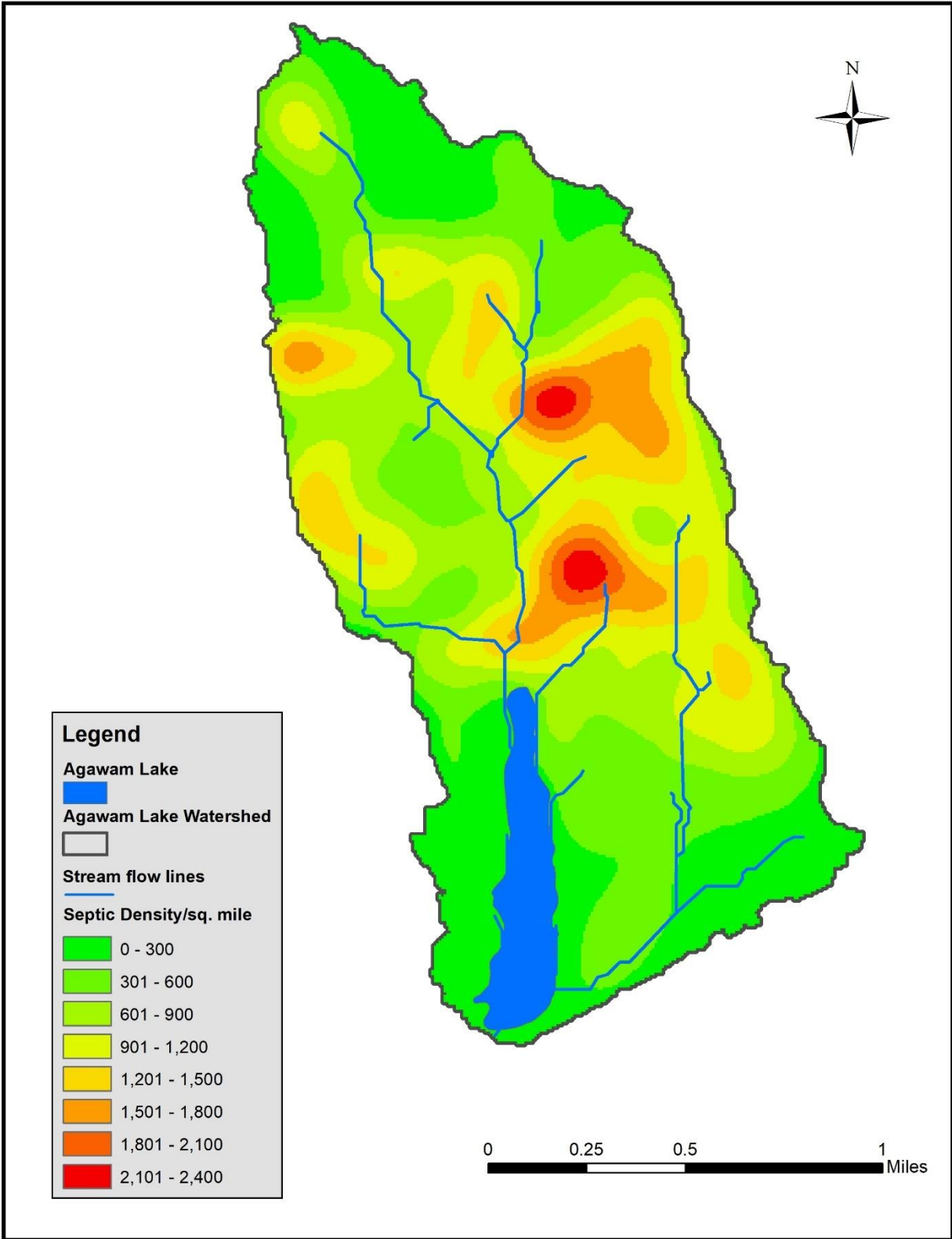


Figure 11: Sanitary/septic system density in the Lake Agawam watershed.

9.2 External Pollutant Sources

According to the LENS model, developed land contributes to the majority of external phosphorous loading in the lake (Figure 12). Phosphorus loading from developed land is categorized by stormwater runoff, including fertilizer, atmospheric deposition, phosphorus transport from soil, and particulate matter (pet waste, plant material).

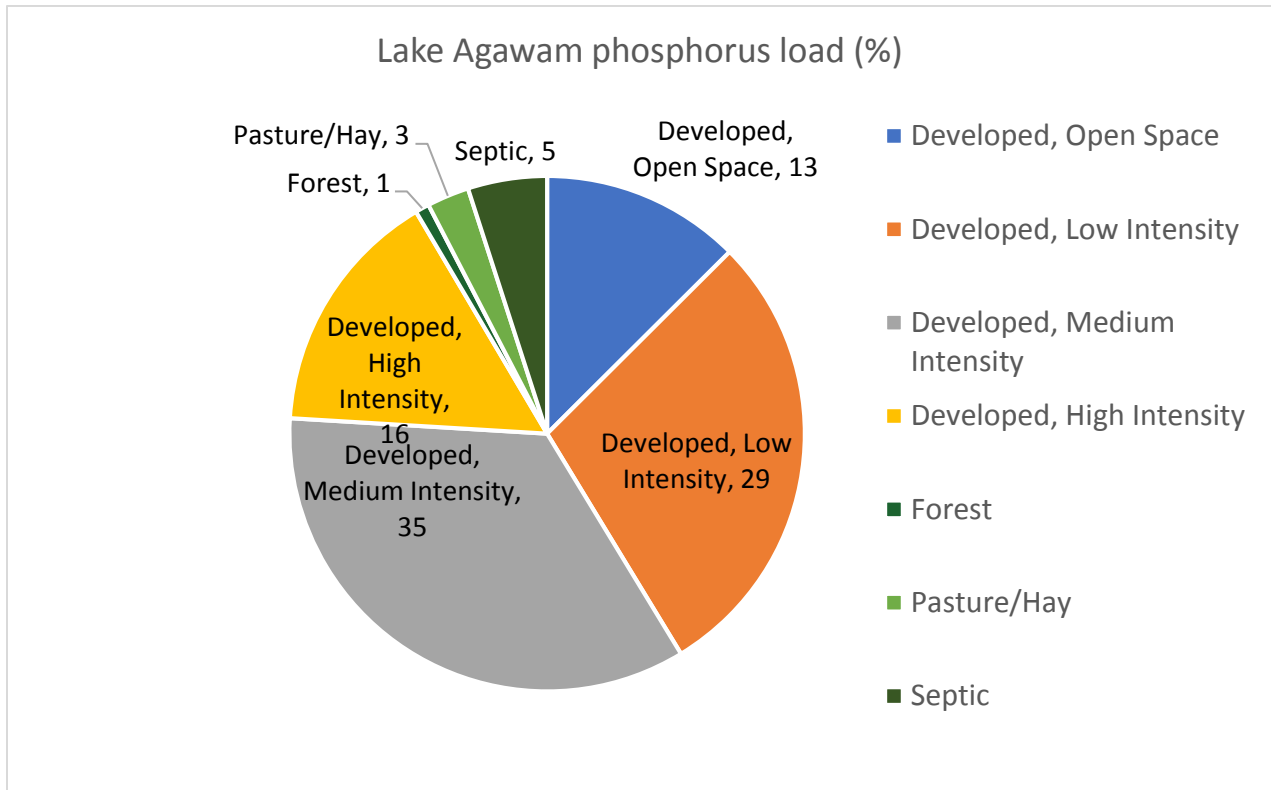


Figure 12: Phosphorus load into Lake Agawam.

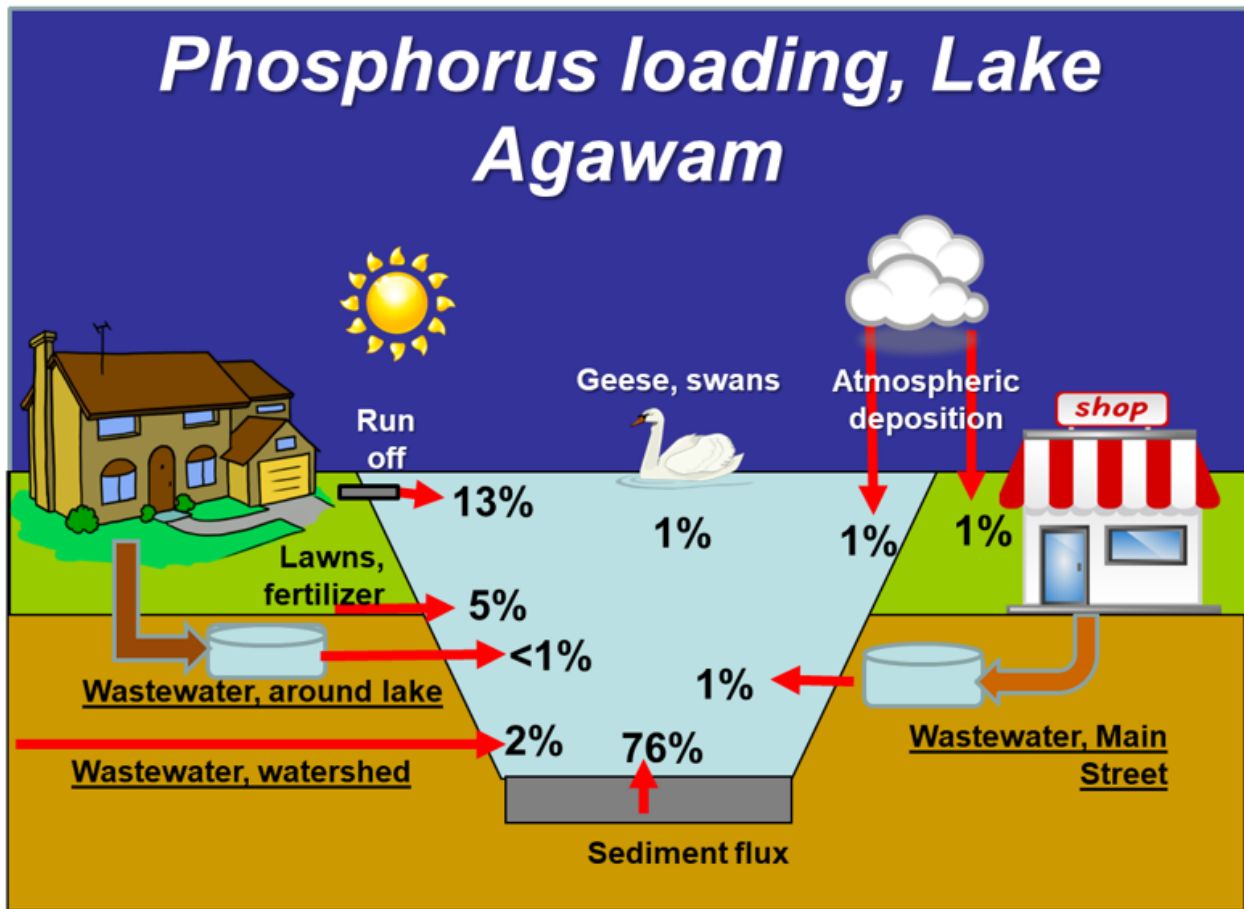


Figure 13: Phosphorus Loading to Lake Agawam (Gobler, 2017)

Models developed by SUNY SB indicate the majority of the phosphorus load to Lake Agawam is legacy nutrients released from lake sediment (“sediment flux”) (Figure 13). Excess phosphorus within the lake sediments may be released back into the lake waters when conditions are favorable. Such conditions can include resuspension of sediments by wind mixing or fish activity (e.g. feeding off bottom of lake), sediment anoxia (i.e. low dissolved oxygen levels near the sediment water interface), high pH levels, die-offs of heavy growths of rooted aquatic plants, and other mechanisms that result in the release of phosphorus (Wetzel 2001). Other sources of phosphorus include runoff during rain events and fertilizer applications.

SUNY SB’s Nitrogen Loading Model (NLM) model indicates that wastewater from sanitary on-site septic systems (groundwater) contribute the majority of nitrogen loading to the lake (Figure 14).

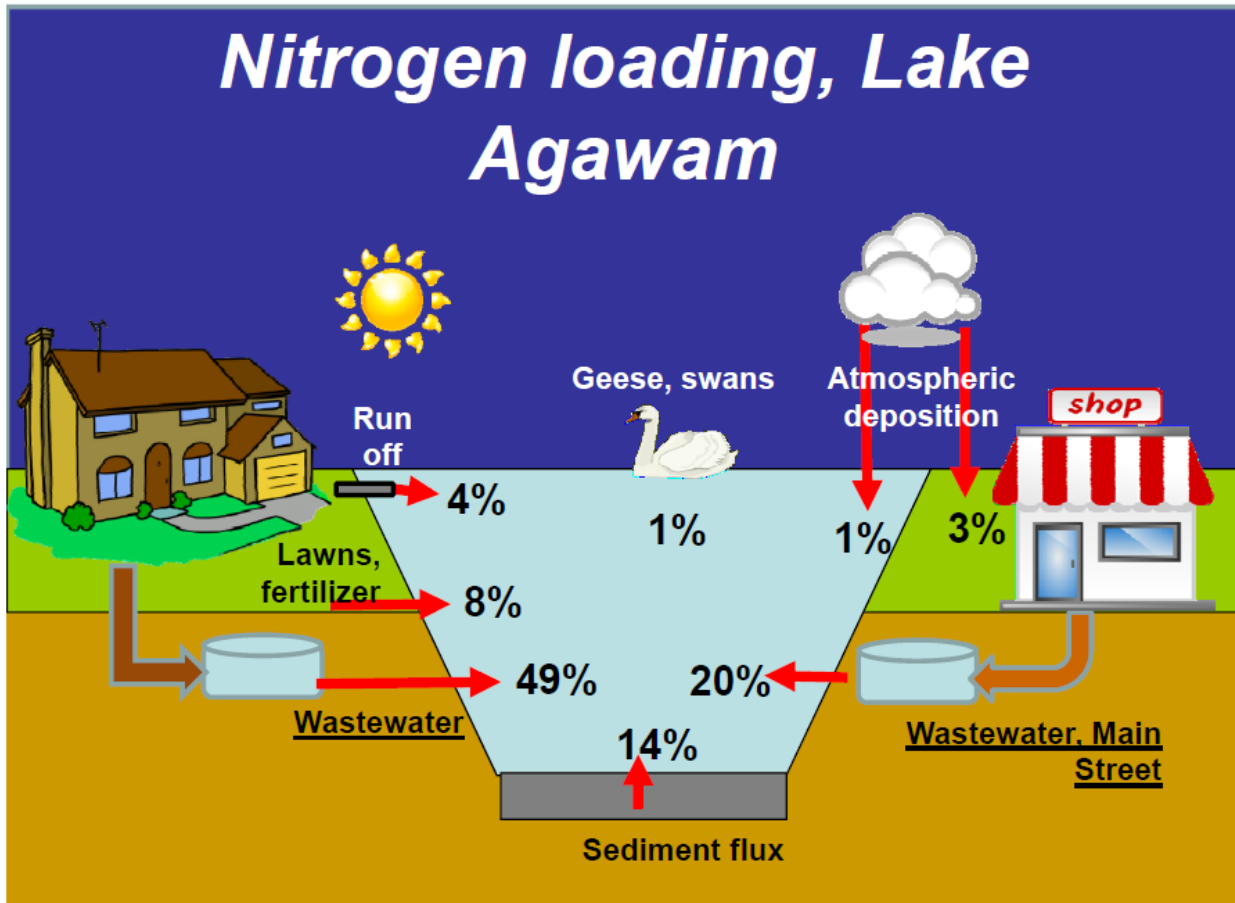


Figure 14: Nitrogen loading to Lake Agawam (Gobler 2017).

Gobler's "Quantifying Nitrogen Loading to from Southampton Village to Surrounding Water Bodies and their Mitigation by Creating a Sewer District," 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%

Waterfowl were also identified as a source of nutrient pollution (Nelson, Pope & Voorhis, LLC 2009).

9.3 Internal Pollutant Sources

Internal sources were estimated to be 14% of the nitrogen loading to Lake Agawam, using the NLM model. Internal phosphorus loads have not been estimated by DEC, however measurements in 2008 (Harke et al., 2008) suggested that both organic and inorganic phosphorus loading from storm drain runoff contribute to only 12% of the total P flux of the

system, with the majority originating from the lake bottom. Note that the Village has made several improvements to the stormwater system.

9.4 Summary of Priority Land Uses and Land Areas

As discussed in **Section 9.1**, nitrogen loading occurs predominately through groundwater contamination from sanitary/septic systems, while phosphorus loading is primarily due to internal loading with some external loading through stormwater runoff. Predominant land use categories are developed, with dense septic density areas in the northern portion of the watershed. See Appendix F: Parcels abutting Lake Agawam.

10. Lake Management / Water Quality Goals

The primary lake management/water quality goal for Lake Agawam is to implement proactive management to minimize the potential for HABs occurring in the future.

The lake has been studied in five (5) prior reports that involve recommendations to address issues to assist in restoring Lake Agawam. These reports are summarized below and are listed in the references to this document.

Nelson, Pope & Voorhis completed the “Comprehensive Management Plan for Lake Agawam” for the Village of Southampton in 2007. This plan provided a full assessment of the lake as well as complete recommendations for improvements to lake water quality, habitat and conditions. A total of twenty-two (22) recommendations were provided for incremental water quality improvements. These recommendations included buffer area recommendations; watershed area recommendations; lake management recommendations; and, water quality monitoring and research. The plan provided an action plan matrix for implementation of recommendations. This plan remains valid for lake management. Dredging of lake sediments was identified as a control measure to improve lake water quality and conditions. Specifically, recommendation 19 of the report was as follows: “Evaluate potential for removal of organically enriched surface sediments from the lake bottom in order to reduce the release of nutrients into the water column.” (Nelson, Pope & Voorhis, 2007).

Lombardo Associates Inc. (LAI) developed the “Lake Agawam Water Quality Restoration Action Plan” for the Peconic Baykeeper in 2013. This plan addressed phosphorus as primary water quality concern and estimated phosphorus and other nutrient inputs. The plan provided recommendations to reduce phosphorus in the lake to improve quality (LAI, 2013).

H2M prepared the “Map and Plan for the Formation of the Inc. Village of Southampton Sewer System” for the Village in November, 2015. The report established a plan to create a service area (sewer district) including options to provide treatment and conveyance to a treatment facility for the downtown area. The report indicates: “The existing onsite sanitary wastewater disposal systems within the core commercial area are impacted by shallow groundwater and are identified as a contributor to the degradation of Lake Agawam. Establishing a sewer system to collect and treat the sanitary wastewater generated within this core commercial area will help improve the quality of Lake Agawam and the South Shore Estuary, protect public health, and also allow change of use and business expansion to occur within the Village.” The Map and Plan provided

information regarding service area boundaries, sanitary flow, engineering, cost information and associated tax implications for residents/business as related to the construction, operation and maintenance of sanitary treatment facilities in the Village (H2M, 2017).

Stony Brook University (SBU) prepared the report “Quantifying Nitrogen Loading to from Southampton Village to Surrounding Water Bodies and their Mitigation by Creating a Sewer District” report for the Village of Southampton in 2017. This report supported the prior finding that nitrogen is the primary nutrient contributing to HABs in Lake Agawam. The document quantified nitrogen loading to the lake and provided recommendations, most notably wastewater treatment for the downtown Southampton Village area. The SBU report summarized the status of recommendations in the NP&V action plan matrix finding that some had been completed and others remained (SBU, 2017).

Nelson, Pope & Voorhis completed the document, “Dredging Assessment Report, Lake Agawam, Village of Southampton” for the Village of Southampton in November 2019. The report addressed lake sediments as related to recommendation 19 of the 2007 Nelson, Pope & Voorhis Comprehensive Management Plan for Lake Agawam. The report determined the sediment depth in the north part of the lake by using hard and soft bottom measurements, and further characterized the material through analytical testing. The report identifies options for removal of sediment material from the lake. The scope of the report was to examine hard and soft bottom depths in the north end of Lake Agawam and determine the quantity of soft sediment. The second phase was to screen sediments for quality based on sediment testing to determine contaminant levels and potential disposal options. The final phase was to examine sediment removal options and cost (Nelson, Pope & Voorhis, 2019). Recommendations include continued sampling to define limits of the elevated concentrations of organics and some minor contaminants (pesticides, arsenic, lead and mercury) found in 2 sampling locations, in preparation of a sediment testing work plan for submission of applicable permits to DEC. NP&V also suggested using lead as a potential indicator for contaminant levels, and TOC as an indicator of organic content. In the northern end of the lake only, there is an estimated soft sediment volume of 65,000 cubic yards that would need to be dredged.

11. Summary of Management Actions to Date

11.1 Local Management Actions

Several local management actions have been implemented by the local communities in the Lake Agawam Watershed. In 2009 the Comprehensive Management Plan for Lake Agawam was developed by Nelson, Pope & Voorhis, LLC (NP&V, 2019) to guide management actions within the watershed. Local management actions implemented within the Village/watershed include several of the projects below (Gobler 2017). Please see appendix C for completed, partially implemented and proposed projects included in 2019. Highlights include:

- Stormwater infrastructure improvements.
 - The village highway department continues to install drainage infrastructure in village roads within the Lake Agawam watershed, with the Village coordinating and securing grant funding.
- Incorporation of water quality provisions into local municipality zoning codes.
- Community outreach for homeowner Best Management Practices (BMPs).
- In-waterbody BMPs, including

- Pond Lane Bioswale installation: on the Wyman property. This BMP will reduce stormwater overflow from a sloped bank toward the lake.

11.2 Funded Projects

Local funding has supported the implementation of BMPs within the Lake Agawam Watershed.

Suffolk County Grant Drainage Projects

- Culver/Ox Pasture/Pond Lane (completed)
- Bowden Square (completed)
- Hill Street (completed)
- Gin Lane (anticipated completion Spring 2020): This project will eliminate the outfall pipe at Gin Lane through the installation of a rain garden and 13 leaching basins at the south end of Lake Agawam.

The Lake Agawam Conservancy Aquatic Invasive Species (AIS) Removal Project, Buoy deployment and educational outreach

- The Lake Agawam Conservancy has been issued permits by the Village and Town Trustees to remove native water lily from the southwest part of the Lake to reduce the biomass that decays annually in the lake, thus reducing nutrient accumulation in sediments.
- The Lake Agawam Conservancy has committed to purchase an up-graded real-time monitoring buoy to be maintained and deployed by Dr. Gobler out of SUNY Stonybrook for the 2020 season.
- The Conservancy has also prepared and scheduled several public outreach sessions.
 - January 17, 2020; Toxic Free Landscapes: A Professional Seminar
 - Oct 2020 – Doug Tallamy (entomologist; University of Delaware)

Community Preservation Fund Drainage Projects

- Jobs Lane
- Railroad Plaza

11.3 NYSDEC Issued Permits

Article 17 of New York’s Environmental Conservation Law (ECL) entitled “Water Pollution Control” was enacted to protect and maintain the state’s surface water and groundwater resources. Under Article 17, the State Pollutant Discharge Elimination System (SPDES) program was authorized to maintain reasonable standards of purity for state waters. NYSDEC issues Municipal Separate Storm Sewer System (MS4s) under the SPDES Program for stormwater discharges from MS4s. The Village of Southampton (ID: NYR20A456) is a regulated MS4, and therefore stormwater discharges from their MS4 system may influence water quality in Lake Agawam.

For more information about NYSDEC’s SPDES program and to view permits issued in the Lake Agawam watershed visit <http://www.dec.ny.gov/permits/6054.html>.

The Village also issues wetland permits for activities surrounding Lake Agawam. The Village seeks expanded natural buffers, removal of fertilizer dependent vegetation and installation of

Innovative/Alternative Onsite Wastewater Treatment Systems (I/A OWTS) wherever possible in connection with permit issuance.

11.4 Research Activities

As stated previously, SUNY Stony Brook's monitoring comprises much of the research on Lake Agawam to date. HAB monitoring and reporting through DEC has also been performed by SUNY Stony Brook since 2012. Under Governor Cuomo's HABs Initiative, an innovative new project to combat harmful algal blooms (HABs) was piloted in Lake Agawam. The algae harvester successfully removed cyanobacteria and toxins during the 10-day pilot. DEC is continuing to review and evaluate the results. DEC, Southampton Village, and Lake Agawam stakeholders continue to work together to identify solutions to address the long-term health of Lake Agawam.

11.5 Clean Water Plans (TMDL, 9E, or Other Plans)

Lake Agawam was listed on Part 1 of the NYS Section 303(d) List of Impaired Waters requiring the development of a TMDL or other strategy to address impairments due to phosphorus/low dissolved oxygen. The models used in Section 10 to estimate nutrient loading are a starting point for the development of a clean water plan. Clean water plans are a watershed-based approach to outline a strategy to improve or protect water quality. Total maximum daily load (TMDL) and 9E Plans are examples of clean water plans; these plans document the pollution sources, pollutant reduction goals and recommend strategies/actions to improve water quality:

- A TMDL calculates the maximum amount of a single pollutant that a waterbody can receive and still meet water quality standards. TMDLs are developed by determining the amount that each source of a pollutant can discharge into the waterbody and the reductions from those sources needed to meet water quality standards. A TMDL is initiated by NYSDEC for waterbodies that are on the 303d impaired waters list with a known pollutant.
- 9E Watershed Plans are consistent with the USEPA's framework to develop watershed-based plans. USEPA's framework consists of nine key elements intended to identify the contributing causes and sources of nonpoint source pollution, involve key stakeholders in the planning process, and identify restoration and protection strategies that will address the water quality concerns. The nine minimum elements to be included in these plans are:
 - A. Identify and quantify sources of pollution in watershed.
 - B. Identify water quality target or goal and pollutant reductions needed to achieve goal.
 - C. Identify the best management practices (BMPs) that will help to achieve reductions needed to meet water quality goal/target.
 - D. Describe the financial and technical assistance needed to implement BMPs identified in Element C.
 - E. Describe the outreach to stakeholders and how their input was incorporated and the role of stakeholders to implement the plan.
 - F. Estimate a schedule to implement BMPs identified in plan.

- G. Describe the milestones and estimated time frames for the implementation of BMPs.
- H. Identify the criteria that will be used to assess water quality improvement as the plan is implemented.
- I. Describe the monitoring plan that will collect water quality data need to measure water quality improvement (criteria identified in Element H).

Nine Element Plans are best suited for waterbodies where the pollutant of concern is well understood and nonpoint sources are likely a significant part of the pollutant load; the waterbody does not need to be on the 303d impaired waters list to initiate a 9E Plan.

12. Proposed HABs Actions

12.1 Overarching Considerations

When selecting projects intended to reduce the frequency and severity of HABs, lake and watershed managers may need to balance many factors. These include budget, available land area, landowner willingness, planning needs, community priorities or local initiatives, complementary projects or programs, water quality impact or other environmental benefit (e.g., fish/habitat restoration, flooding issues, open space). Additional important considerations include (1) the types of nutrients, particularly phosphorus and nitrogen, involved in triggering HABs, (2) confounding factors including climate change, and (3) available funding sources (discussed in Section 13.2).

Phosphorus Forms

As described throughout this Action Plan, a primary factor contributing to HABs in the waterbody is excess nutrients, in particular, phosphorus. Total phosphorus (TP) is a common metric of water quality and is often the nutrient monitored for and targeted in watershed and lake management strategies to prevent or mitigate eutrophication (Cooke et al. 2005).

However, TP consists of different forms (Dodds 2003) that differ in their ability to support algal growth. There are two major categories of phosphorus: particulate and dissolved (or soluble). The dissolved forms of P are more readily bioavailable to phytoplankton than particulate forms (Auer et al. 1998, Effler et al. 2012, Auer et al. 2015, Prestigiacomo et al. 2016). Phosphorus bioavailability is a term that refers to the usability of specific forms of phosphorus by phytoplankton and algae for assimilation and growth (DePinto et al. 1981, Young et al. 1982).

Because of the importance of dissolved P forms affecting receiving waterbody quality, readers of the Action Plan should consider the source and form of P, in addition to project-specific stakeholder interest(s), when planning to select and implement the recommended actions, best management practices or management strategies in the Action Plan. Management of soluble P is an emerging research area; practices designed for conservation of soluble phosphorus are recommended in Sonzogni et al. 1982, Ritter and Shiromohammadi 2000, and Sharpley et al. 2006.

Nitrogen

Nitrogen is also an important factor that may be contributing to HABs. Nitrogen comes from natural and human sources, including wet and dry atmospheric deposition, sewage treatment

plants, stormwater runoff, and groundwater that becomes enriched as a result of excess fertilizer being applied to lawns, landscaping, and agricultural crops, as well from on-site waste water disposal systems (“septic systems”).

Climate Change

Climate change is also an important consideration when selecting implementation projects. There is still uncertainty in the understanding of BMP responses to climate change conditions that may influence best management practice efficiencies and effectiveness. More research is needed to understand which BMPs will retain their effectiveness at removing nutrient and sediment pollution under changing climate conditions, as well as which BMPs will be able to physically withstand changing conditions expected to occur because of climate change.

Where possible, selection of BMPs should be aligned with existing climate resiliency plans and strategies (e.g., floodplain management programs, fisheries/habitat restoration programs, or hazard mitigation programs). When selecting BMPs, it is also important to consider seasonal, inter-annual climate or weather conditions and how they may affect the performance of the BMPs. For example, restoration of wetlands and riparian forest buffers not only filter nutrient and sediment from overland surface flows, but also slow runoff and absorb excessive water during flood events, which are expected to increase in frequency due to climate change. These practices not only reduce disturbance of the riverine environment but also protect valuable agricultural lands from erosion and increase resiliency to droughts.

In New York State, ditches parallel nearly every mile of our roadways and in some watersheds, the length of these conduits is greater than the natural watercourses themselves. Although roadside ditches have long been used to enhance road drainage and safety, traditional management practices have been a significant, but unrecognized contributor to flooding and water pollution, with ditch management practices that often enhance rather than mitigate these problems. The primary objective has been to move water away from local road surfaces as quickly as possible, without evaluating local and downstream impacts. As a result, elevated discharges increase peak stream flows and exacerbate downstream flooding. The rapid, high volumes of flow also carry nutrient laden sediment, salt and other road contaminants, and even elevated bacteria counts, thus contributing significantly to regional water quantity and quality concerns that can impact biological communities. All of these impacts will be exacerbated by the increased frequency of high intensity storms associated with climate change. For more information about road ditches, see Appendix F.

For more information about climate change visit NYSDEC’s website (<https://www.dec.ny.gov/energy/44992.html>).

Water Quality Improvement Process

The water quality improvement process addressed in this action plan to combat HABs in Lake Agawam is a multi-faceted approach to improve overall water quality in the lake. Eradicating HABs is a long-term effort that will require active collaboration at all levels of government and citizen engagement moving forward.

This Action Plan is intended to be a 'living document' and interested members of the public are encouraged to submit comments and ideas to DOWInformation@dec.ny.gov to assist with HABs prevention and treatment moving forward. Local support and implementation of the plan's recommended actions are crucial to successfully preventing and combatting HABs.

Communities and watershed organizations are encouraged to review the plan for their lake, particularly the proposed actions, and work with state and local partners to implement those recommendations. Individuals can get involved with local groups and encourage their communities or organizations to act.

12.2 Priority Project Development and Funding Opportunities

The priority projects listed below have been developed by an interagency team and local steering committee that has 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 Village, the Lake Agawam Conservancy, consultants, residents and stakeholders continue to explore methods for improve water quality of Lake Agawam. The Village is seeking input on the feasibility of using clustered sanitary systems for treatment in the downtown area, on a temporary basis until a full sewage treatment plant can be installed. Other efforts are continually examined for lake improvements.

These projects have been assigned priority rankings based on the potential for each individual action to achieve one of two primary objectives of this HABs Action Plan:

1. In-lake management actions: Minimize the internal stressors (e.g., nutrient concentrations, dissolved oxygen levels, temperature) that contribute to HABs within Lake Agawam.
2. Watershed management actions: Address watershed inputs that influence in-lake conditions that support HABs.

As described throughout this HABs Action Plan, the primary factors that contribute to HABs in Lake Agawam include:

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

The management actions identified below have been prioritized to address these sources. Projects were prioritized based on the following cost-benefit and project readiness criteria: local support or specific recommendation by steering committee members, eligibility under existing funding mechanisms, and expected water quality impacts as determined by the interagency team. Additionally, nutrient forms and the impacts of climate change were considered in this prioritization as described above.

The implementation of the actions outlined in this Plan is contingent on the submittal of applications (which may require, for example, landowner agreements, feasibility studies, match [financial or in-kind], permits, or engineering plans), award of funding, and timeframe to complete implementation. Due to these contingencies, recommended projects are organized into broad implementation schedules: short-term (0-3 years), mid-term (3-5 years), and long-term (5-10 years).

Funding Programs

The recommended actions outlined in this Section may be eligible for funding from the many state, federal and local/regional programs that help finance implementation of projects in New York State (see <https://on.ny.gov/HABsAction>). The New York State Water Quality Rapid Response Team stands ready to assist all partners in securing funding. Some of the funding opportunities available include:

The New York State Environmental Protection Fund (EPF) was created by the state legislation in 1993 and is financed primarily through a dedicated portion of real estate transfer taxes. The EPF is a source of funding for capital projects that protect the environment and enhance communities. Several NYS agencies administer the funds and award grants, including NYSDAM, NYSDEC, and Department of State. The following two grant programs are supported by the EPF to award funding to implement projects to address nonpoint source pollution:

The Agricultural Nonpoint Source Abatement and Control Program (ANSACP), administered by the NYSDAM and the Soil and Water Conservation Committee, is a competitive financial assistance program for projects led by the Soil and Water Conservation Districts that involves planning, designing, and implementing priority BMPs. It also provides cost-share funding to farmers to implement BMPs. For more information visit <https://www.nys-soilandwater.org/aem/nonpoint.html>.

The Water Quality Improvement Program (WQIP), administered by the NYSDEC Division of Water, is a competitive reimbursement program for projects that reduce impacted runoff, improve water quality, and restore habitat. Eligible applicants include municipalities, municipal corporations, and Soil and Water Conservation Districts. <https://www.dec.ny.gov/pubs/4774.html>

Non-Agricultural Nonpoint Source Planning Grant (NPG) administered by NYSDEC Division of Water, is a competitive, reimbursement grant program that funds planning reports for nonpoint source water quality improvement projects. Eligible applicants are municipalities and Soil and Water Conservation Districts. The goal of the program is to get projects ready for construction and future implementation funding through the Water Quality Improvement Project grant program or other funding opportunities. For more information visit <https://www.dec.ny.gov/pubs/116725.html>.

The Environmental Facilities Corporation (EFC) is a public benefit corporation which provides financial and technical assistance, primarily to municipalities through low-cost financing for water quality infrastructure projects. EFC's core funding programs are the Clean Water State Revolving Fund and the Drinking Water State Revolving Fund. EFC administers both loan and grant programs, including the Green Innovation Grant Program (GIGP), Engineering Planning Grant Program (EPG), Water Infrastructure Improvement Act (WIIA), and the Septic System Replacement Program. For more information about the programs and application process visit <https://www.efc.ny.gov/>.

Wastewater Infrastructure Engineering Planning Grant is available to municipalities with median household income equal to or less than \$65,000 according to the United States Census 2015 American Community Survey or equal to or less than \$85,000 for Long Island, NYC and Mid-Hudson Regional Economic Development Council (REDC) regions. Priority is usually given to smaller grants to support initial engineering reports and plans for wastewater treatment

repairs and upgrades that are necessary for municipalities to successfully submit a complete application for grants and low interest financing.

Clean Water Infrastructure Act (CWIA) Septic Program funds county-sponsored and administered household septic repair grants. This program entails repair and/or replacement of failing household septic systems in hot-spot areas of priority watersheds. Grants are channeled through participating counties. For more information visit <https://www.efc.ny.gov/SepticReplacement>.

CWIA Inter-Municipal Grant Program funds municipalities, municipal corporations, as well as soil and water conservation districts for wastewater treatment plant construction, retrofit of outdated stormwater management facilities, as well as installation of municipal sanitary sewer infrastructure.

CWIA Source Water Protection Land Acquisition Grant Program funds municipalities, municipal corporations, soil and water conservation districts, as well as not-for-profits (e.g., land trusts) for land acquisition projects providing source water protection. This program is administered as an important new part of the Water Quality Improvement Project program.

Consolidated Animal Feeding Operation Waste Storage and Transfer Program Grants fund soil and water conservation districts to implement comprehensive nutrient management plans through the completion of agricultural waste storage and transfer systems on larger livestock farms.

Water Infrastructure Improvement Act Grants funds municipalities to perform capital projects to upgrade or repair wastewater treatments plants and to abate combined sewer overflows, including projects to install heightened nutrient treatment systems.

Green Innovation Grant Program provides municipalities, state agencies, private entities, as well as soil and water conservation districts with funds to install transformative green stormwater infrastructure.

Peconic Bay Region Community Preservation Fund administered by the Town of Southampton, allows for utilization of a maximum of 20% of the annual Community Preservation Fund revenue to fund local water quality improvement projects.

Suffolk County Water Quality Protection and Restoration Program administered by the Suffolk County Department of Economic Development and Planning, supports eligible projects as defined in Article 12 Section 2(B) of the Suffolk County Charter.

Town of Southampton Community Preservation Fund water quality improvement projects.

Readers of this Action Plan interested in submitting funding applications are encouraged to reference this Action Plan and complementary planning documents (i.e., TMDLs or 9E Plans) as supporting evidence of the potential for their proposed projects to improve water quality. However, applicants must thoroughly review each funding program's eligibility, match, and documentation requirements before submitting applications to maximize their potential for securing funding.

There may be recommended actions that are not eligible for funding through existing programs, however, there may be opportunities to implement actions through watershed programs (<https://www.dec.ny.gov/chemical/110140.html>) or other mechanisms.

12.3 Lake Agawam Priority Projects

Priority Projects 1

Priority 1 projects are considered necessary to manage water quality and reduce HABs in Lake Agawam, and implementation should be evaluated and begin as soon as possible.

Short-term (0-3 years)

1. Continued water quality and HAB monitoring by Stony Brook University to document lake water quality and HABs.
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.
3. Complete sounding and sediment quantity sampling and engineering analysis of the balance of the lake to supplement the NP&V 2019 dredging documentation of the north end of the lake.
4. Develop village-wide water quality improvement plan to be adopted by the Village of Southampton.
5. Utilize emerging bloom reduction treatments, including hydrogen peroxide and ultrasonic technologies, as well as an algae harvester.
 - a. Contingent on any necessary permit application and approval.
6. Create bioswales, emergent marsh or other constructed wetland, including floating islands, in/around the lake for nutrient binding.
 - a. Install floating treatment wetlands
 - b. Implement current plans for bioswales (ie. Gin Lane, Pond Lane and Linden Lane).
 - i. Delay for bioswale creation should depend on completion of projects that may affect additional priority 1 projects (ex. Dredging or harvesting).
7. Continue with voluntary upgrades to septic systems within the Village, as well as the legislated new construction/addition upgrades to IA (Innovative Alternative) systems.
 - a. Incorporate Town of East Hampton's Law into legislation, which would require IA systems beyond solely transfer of property.
8. Complete dredging feasibility study.
 - a. Evaluate 2019 dredging report (NP&V. 2019) and address any missing elements.
 - i. Consider dewatering methods and locations, and dredged material disposition, consider using novel dewatering methods.

1. See Appendix G: Storage Rendering for potential dredged material de-watering (NP&V).
 - ii. Consider odor control measures as related to dredged material dewatering, either through geotextile bags or other dewatering methods.
- b. If needed: additional strategic sampling of the lake bottom sediments to identify nutrient rich areas for targeted removal of sediments, and characterization of southern end dredged material.
9. Harvest water lilies, manage phragmites and augment natural buffers.
10. Reduce applications of synthetic fertilizers and chemicals on landscapes throughout the watershed and encourage holistic, toxin-free landscape management practices. The Lake Agawam Conservancy is sponsoring an educational program directed at homeowners and professionals in the landscape industry that includes seminars and workshops that are free and open to the public throughout the year.
11. Encourage the planting of buffers on properties adjacent to Lake Agawam.
12. Establish point of sale septic system improvement to low N septic systems for any homes upon real estate transfer.
13. Install aeration devices, including nano-bubbling technology, in the center of the lake.
 - a. Request landowner donations for power.

Mid-term (3 to 5 years)

1. If feasible, install Permeable reactive barrier following groundwater study.
2. Establish point of sale improvement recommendations for any homes upon real estate transfer.
3. If feasible and established by Priority 1-3, Dredge areas indicated as priorities identified in Lake Agawam dredging assessment report 2019.
4. Encourage local municipalities to prepare water quality plans to prioritize implementation and to prepare for funding opportunities at the county and state level.
5. Continue to educate land owners on natural landscape and buffer options.
6. Coordinate set up of a council and sewer district for the Village.
7. Investigate uses and restriction of the Community Preservation Fund land owned by the village, potentially seek a vote or referendum change to allow installation of wetlands near the north end of the lake to treat and mitigate run-off and/or lake water.
 - a. Establish natural planting areas to intercept stormwater.

Long-term (5 to 10 years)

1. Dredge the remaining lake bottom.
2. Begin development of a Sewer District in the village of Southampton.
 - a. Begin “map and plan” aspect of sewer district creation, initiated by the Village.
 - b. Obtain necessary RFQ/RFP for incurred legal services.
 - c. Investigate potential for STP system(s) including location and funding.
 - Financing for P3 (Public Private Partnership) may be available.
 - STP treatment is superior to traditional microbial breakdown.
3. Connect hospital and schools to an alternative WWTP or the newly created SD from above.

4. Coordinate with local health department about the use of cluster systems.
5. Recommend septic inspection upon real estate transfer in high priority areas

Priority Projects 2

Priority 2 projects are considered necessary but may not have a similar immediate need as Priority 1 projects.

Short-term (0-3 years)

1. Evaluate efficacy of existing aeration systems and identify potential upgrades or system alterations to better address eliminating/minimizing anoxia.
2. Develop bioswale projects for the south and east ends of Lake Agawam.
3. If appropriate, complete a bench scale test and engineering study in preparation of nutrient inactivant application to sequester the legacy phosphorus within the bottom sediments.

Mid-term (3 to 5 years)

1. Target areas in the watershed not immediately adjacent to Lake Agawam for stormwater improvement projects.

Long-term (5 to 10 years)

1. If results from bench test and engineering study suggest that a nutrient inactivant (e.g., Phoslock) would be appropriate, then apply nutrient inactivant to targeted portions of the lake that are likely to be associated with internal phosphorus release based on the results of the bench scale test. This project would need to include the following prior to field implementation:
 - a. Preparation of an environmental impact statement (EIS) to comply with the State Environmental Quality Review Act (SEQRA).
 - b. Apply for and receive regulatory approvals from the NYSDEC, USACE, and other agencies.
 - c. Note that New York State is developing an approach for safely and legally using nutrient inactivants, and until that process is completed, the use of any inactivants in Lake Agawam is prohibited.

Priority Projects 3

Priority 3 projects are considered important but may not have a similar immediate need as Priority 1 and 2 projects.

Short-term (0-3 years)

1. Evaluate potential effectiveness and feasibility of hydromodification. This would include a pro vs. cons list and a literature review, as well as infrastructure cost estimates.
2. Initiate a carp removal program analogous to Mill Pond
 - a. Characterize site locations for box nets.
 - b. Contingent on DEC permitting where applicable.

Mid-term (3 to 5 years)

1. Land acquisition to purchase properties in the watershed.
2. Remove invasive vegetation, including phragmites, from the lake.

Long-term (5 to 10 years)

1. Create a waterfowl management plan.
2. Create a fish management plan.

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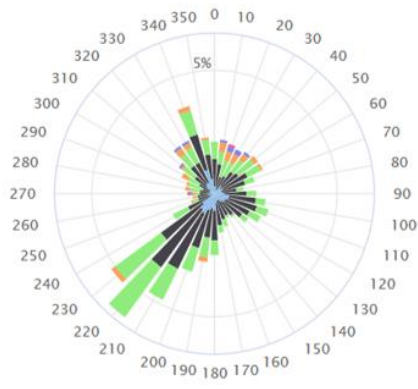
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Appendix A. Wind and Wave Patterns



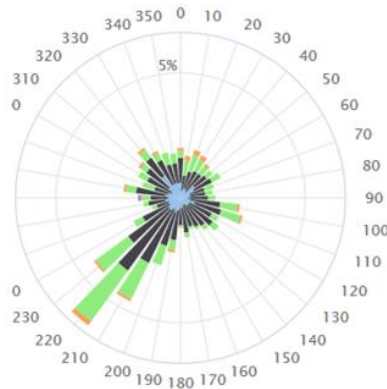
WESTHAMPTON GABRESKI AP, NY

Percent of winds blowing from the indicated direction
Date range: 2019-05-01 through 2019-10-31



EAST HAMPTON AP, NY

Percent of winds blowing from the indicated direction
Date range: 2019-05-01 through 2019-10-31



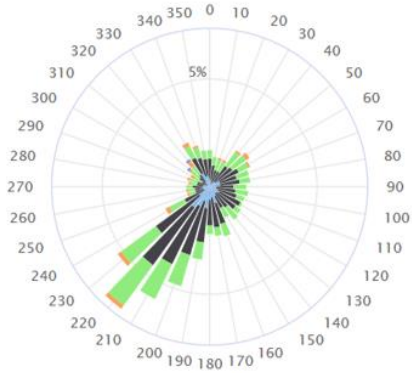
Wind speed (miles/hr)

- ≤5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25
- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 45
- >45

<http://www.nrcc.cornell.edu/wxstation/windroses/windroses.html>

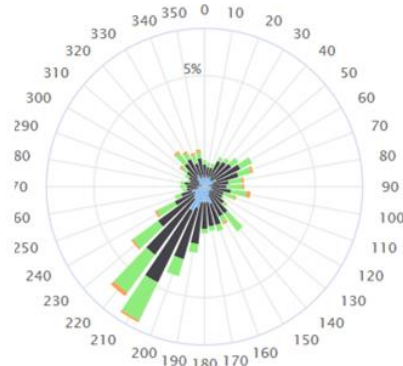
WESTHAMPTON GABRESKI AP, NY

Percent of winds blowing from the indicated direction
Date range: 2018-05-01 through 2018-10-31



EAST HAMPTON AP, NY

Percent of winds blowing from the indicated direction
Date range: 2018-05-01 through 2018-10-31

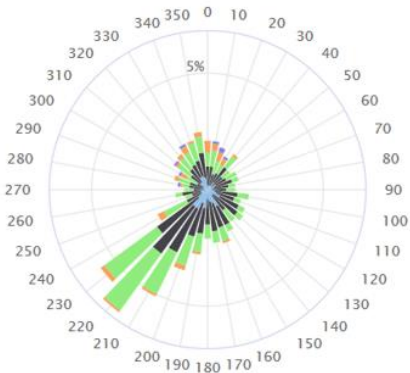


Wind speed (miles/hr)

- ≤5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25
- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 45
- >45

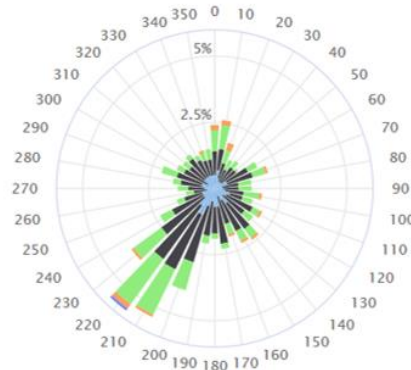
WESTHAMPTON GABRESKI AP, NY

Percent of winds blowing from the indicated direction
Date range: 2017-05-01 through 2017-10-31



EAST HAMPTON AP, NY

Percent of winds blowing from the indicated direction
Date range: 2017-05-01 through 2017-10-31



Wind speed (miles/hr)

- ≤5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25
- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 45
- >45

Appendix B. Waterbody Classifications.

Class N: Enjoyment of water in its natural condition and where compatible, as source of water for drinking or culinary purposes, bathing, fishing and fish propagation, recreation and any other usages except for the discharge of sewage, industrial wastes or other wastes or any sewage or waste effluent not having filtration resulting from at least 200 feet of lateral travel through unconsolidated earth. These waters should contain no deleterious substances, hydrocarbons or substances that would contribute to eutrophication, nor shall they receive surface runoff containing any such substance.

Class AA_{special}: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival, and shall contain no floating solids, settleable solids, oils, sludge deposits, toxic wastes, deleterious substances, colored or other wastes or heated liquids attributable to sewage, industrial wastes or other wastes. There shall be no discharge or disposal of sewage, industrial wastes or other wastes into these waters. These waters shall contain no phosphorus and nitrogen in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.

Class A_{special}: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These international boundary waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes

Class AA: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These waters, if subjected to approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes

Class A: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes

Class B: The best usage is for primary and secondary contact recreation and fishing. These waters shall be suitable for fish propagation and survival

Class C: The best usage is for fishing, and fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

Class D: The best usage is for fishing. Due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or stream bed conditions, the

waters will not support fish propagation. These waters shall be suitable for fish survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

Class (T): Designated for trout survival, defined by the Environmental Conservation Law Article 11 (NYS, 1984b) as brook trout, brown trout, red throat trout, rainbow trout, and splake.

Class (TS): Designated for trout spawning waters. Any water quality standard, guidance value, or thermal criterion that specifically refers to trout, trout spawning, trout waters, or trout spawning waters applies.

Appendix C. Completed, partially implemented and proposed projects.

Lake Agawam 2009 Management Plan, Action Plan Updates - 8.1 Shoreline Improvements, Riparian (Buffer) Area			
Lake Management Recommendations	Actions	Priority	Target
Control waterfowl populations through management practices. 1a. - Discourage lawns fronting lake shore areas. 1b. - Discourage feeding of waterfowl populations.	Partially Implemented: Signage placed along Pond Lane to not feed waterfowl.		
2. Encourage homeowners to remove fertilizer dependent vegetation and establish native planting areas: Consider mandate for buffer zones with swale areas to eliminate direct run off, application of nitrogen and phosphorous-free fertilizers.	Partially Implemented	High Priority	
2a. - Naturalized meadow, woodland and shrub planting areas intercept and filter stormwater and reduce fertilizer/nutrient input: In 3/2019, Southampton Town Board authorized purchase of 2.9 acre property at 111 Pond Lane as a park using Community Preservation Funds. Water treatment use may require a state-level change.	Consider natural water treatment center.	High Priority	
2b. - Village laws encourage natural plantings within 125 feet of wetlands through Zoning Board of Appeals issued wetland permits.	Village Code 116-19 enacted.		Completed
2c. - Place shade trees near shore that will provide soil stability, biological uptake and shading of surface water to maintain lower water temperatures and allow higher dissolved oxygen levels: Weeping willow trees suggested to Zoning Board of Appeals/Village Board of Trustees for Gin Lane.	Partially Implemented		After dredging is completed.
3. Remove invasive vegetation in favor of natural habitat areas under controlled re-vegetation restoration programs.	Not Implemented	Low Priority	After dredging is completed.
4. Examine municipally owned lakefront areas for improvement opportunities (control direct stormwater overflow from paved surfaces in close proximity to the lake; establish lake front walking trails in areas where public access can be provided; provide public education and interpretive signage in appropriate lakefront areas).	Partially Implemented. Bioswale proposals under consideration.		Funding has been approved from State and County for thr Gin Lane corner Bioswale project
4a. - Consider installation of a drainage bioswale and subsurface detention along Pond Lane in connection with pedestrian walks, landscape improvements and sitting areas for lake enjoyment.	Bioswale installation under consideration		
4b. - Consider potential for invasive species removal, stormwater control and lake front walking trails for Gin Lane area at south and southeast part of the lake. Several planting proposals are under consideration.	Partially Implemented	Low Priority	After dredging is completed.
4c. Work cooperatively with the Town Trustees to improve the Gin Lane and Bathing Corporation parking area by reducing pavement, installing a "rain garden" along the shoreline, installing a low sill bulkhead along the southern shoreline (to retain parking capacity), installing subsurface drainage improvements, pedestrian circulation/traffic calming and providing aesthetic improvements through landscaping.	Bulkhead, Rain Garden: Havemeyer Park		Completed 12/2013
5. Provide educational opportunities in form of pamphlets, newsletters, web site information and other media tools through the Village of Southampton and the Lake Agawam Conservation Association.	"Owners Guide to Lake Agawam" pamphlet posted online.		Completed
6. Examine potential for removal of existing hardened shorelines; discourage expansion of new hardened shoreline structures.	Not Implemented		

Lake Agawam 2009 Management Plan, Action Plan Updates – 8.2 Stormwater and Watershed Improvements			
Lake Management Recommendations	Actions	Priority	Target
7. Intercept and recharge stormwater runoff in higher elevations of the watershed. Gin Lane Stormwater Drainage Improvements: Suffolk County Water Quality Protection and Restoration Program grant award & New York State Department of Environmental Conservation, Water Quality Improvement Program grant request. Suffolk County Grant: \$116,697 requested with matching funds to total \$233,394. DEC WQIP: \$186,714/\$46,679 matching funds to total \$233,393. Project utilizes rain garden & installation of 13 leaching basins at the south end of Lake Agawam. Outfall eliminated at Lake Agawam playground pipe; outflow reduced 50% at culvert on Pond Lane. The Gin Lane stormwater drainage improvement project at the south end of Lake Agawam will eliminate outflow at Gin Lane pipe. Suffolk County Grant - Culver/Ox Pasture/Pond Lane Drainage: \$111,224 with matching funds to total \$222,448. Suffolk County Grant - Bowden Square	Drainage installations on Hampton Road and Meetinghouse Lane corridors WQPRP award approved 7/11/19; WQIP request 7/26/19, award approved 12/19/2019. Playground outfall drainagae installed 2016 Award 2013 & 2011	High Priority	January 2020 Spring 2020 Completed Completed Completed
7a. - Install more street catch basins along Hill Street, and other streets where feasible.	CPF Application 7/11/2018		Completed
7b. - Examine Village/Town owned land opportunities for recharge facilities such as Windmill Lane and Nugent Street; the west side of Windmill Lane; and north of Bowden Square.	CPF Application 7/11/2018		Completed
7c. - Cordinate with CPF Stormwater for future grants.	Partially Implemented. West Main St. parking area targeted for future stormwater action.		
7d. - Consider maximum stormwater retention and on-site recharge for any site plans and subdivisions in the watershed area; ensure compliance with SPDES GP 0-08-01			
7e. - Review Village parking areas for potential subsurface stormwater detention installation in connection with parking lot improvement plans.	Partially Implemented.		
8. Maintain catch basins and leaching pools on a regular basis by removing accumulated sediment.	Vacuum truck cleans catch basins twice a week.		Ongoing
9. Maintain roads on a regular basis through street sweeping to reduce potential for sediments to accumulate and/or enter the lake: Cleaning of the business district sidewalk area and sweeping of the Village occur 7 days a week in summer and weather permitting 5 days a week in winter.	Implemented		Ongoing
10. Explore potential for sewerage in areas of the watershed with commercial downtown development and shallow depth to groundwater.	Partially Implemented	High Priority	
11. Encourage homeowners to regularly inspect and maintain sanitary systems in high groundwater areas and elsewhere in the watershed. 12. Encourage, and enforce when appropriate, upgrade of malfunctioning sanitary systems: Innovative & Alternative On-Site Wastewater Treatment System legislation for new residential construction & certain high priority areas, with rebate program.	Partially Implemented		Completed 9/2017
13. Ensure appropriate land use density within the Village and the watershed area for Lake Agawam through coordination with SCDHS on the implementation of Article 6 of the SCSC; sanitary credit transfers to the Lake Agawam watershed area should be reviewed and limited based on nitrogen load.	Partially Implemented		
14. Encourage and facilitate "pick up after your pet" practices. 14a. - Educational pamphlets, Village newsletter and public information media. 14b. - Install dispensers in Village parks and key areas for convenience.	Partially Implemented Mutt dispensers installed		

Lake Agawam 2009 Management Plan, Action Plan Updates - 8.3 Lake Aeration and Water Quality Improvements			
Lake Management Recommendations	Actions	Priority	Target
<p>15. Provide water circulation equipment to improve dissolved oxygen levels in the lake.</p> <p>15a. - Maintain and install forced air bubblers to improve dissolved oxygen levels and further the coverage already achieved by this cooperative Town/Village effort.</p> <p>15b. - Consider discontinuing fountains in favor of bubblers, particularly during algae blooms.</p>	<p>Village installed 6 air stations 2014- 2019 (Town installed one air station). Lake fountain removed in 2010. Find two private homeowners to provide power for install two bubbler systems for the center of the lake.</p>		<p>Partially completed</p>
<p>15c. - Algae Harvester 10-day pilot program to reduce Harmful Algal Blooms.</p>	<p>DEC Pilot completed October 2019</p>	<p>High Priority</p>	<p>Completed 10/19/2019</p>
<p>16. Improve fish populations in the lake favoring native fish assemblages.</p>	<p>Not Implemented</p>		
<p>16a. - Stock bass, perch and bluegill fish assemblages, if necessary.</p>	<p>Not implemented.</p>		
<p>16b. - Remove or reduce carp populations in the lake, if necessary, ensuring that harvested fish are managed in a manner that considers public health and safety.</p>	<p>Under consideration: Carp traps for Lake Agawam.</p>		
<p>17. Maintain, but do not expand areas of aquatic vegetation on the west side of the lake; such vegetation provides fish habitat, food source and shading.</p>	<p>Not Implemented</p>		
<p>18. Examine wetland biological treatment options for north end of lake near stormwater outfall.</p>	<p>Village has installed Fabco canisters in catch basins for Railroad Plaza drainage project.</p>		
<p>19. Evaluate potential for removal of organically enriched surface sediments from the lake bottom in order to reduce the release of nutrients into the water column:</p> <p>Dredging of Sediments: New York State Department of Environmental Conservation, Non-agricultural Nonpoint Source Planning Grant Program request, Lake Agawam Dredging Feasibility Study. Nelson & Pope conducted survey of Lake Agawam sediment in Summer 2019. Sediment has large sand content, will consider options for sediment removal. Suffolk County WQPRP Survey: \$30,000/\$3,000 Total Cost: \$33,000.</p>	<p>Lake Agawam sediment testing overview presented to Trustees 9/24/2019. NYS DEC request 7/26/19, NPG Award Notification 12/19/2019; Overview presented to Trustees 9/24/2019.</p>	<p>High Priority</p>	<p>In process.</p>

Lake Agawam 2009 Management Plan, Action Plan Updates - 8.4 Water Quality Monitoring and Research			
Lake Management Recommendations	Actions	Priority	Target
20. Continue water quality and cyanobacteria monitoring to determine effectiveness of implemented management recommendations and to track trends in water quality: Village Board of Trustees agreed to share the costs of in-water monitoring buoys with the Southampton Town Trustees; installation July 2019.	Partially Implemented		
21. Continue associated ecological-based studies and research (e.g. chemical, physical and biological factors) to further elucidate the factors which promote the presence of cyanotoxins.	Partially Implemented		
22. Implement an adaptive management approach for Lake Agawam as the understanding of cyanotoxins is expanded, and strive to improve water quality while minimizing health risks to humans and animals.	Partially Implemented		

Lake Agawam 2009 Management Plan, Action Plan Updates - Community Preservation Funds			
Water Quality Improvement Project Plan, Lake Agawam Stormwater Improvements. Lake Agawam is included in NYS Section 303(d) List of Impaired Waters. These improvements could result in a potential reduction of 28.2 pounds-per-year of nitrogen (42% reduction), and a reduction of 4.8 pounds-per year of phosphorous (44% reduction going into Lake Agawam.	Actions	Priority	Target
Remove dated catch basins at Meeting House Lane/Oak Street and replace with curb inlet catch basins.	Village Matching Funds: \$54,555		Completed May 2019
Install two new catch basins at Meeting House Lane/either side of SH Village volunteer Ambulance driveway.	Village Matching Funds: \$34,836		Completed May 2019
Install 19 leaching pools along Jobs Lane	Town CPF Recommended Funds: \$292,040		Completed May 2019
O'Connell Drive Parking Lot, install replacement pipe, with catch basins and 14 10' leaching pools along the pipe.	Village Matching Funds: \$166,495		Completed 1/2018
Total Project Cost	\$547,926		
Southampton Town CPF Recommended Funds		\$292,040	
Village Matching Funds Committed		\$255,886	
Railroad Plaza drainage, WQIP proposal 3/15/19 for capture and treatment of stormwater runoff to reduce contaminants entering Lake Agawam. Construction of drainage improvements began 8/05/2019. Board of Trustees Village of Southampton accepted Southampton CPF award 8/8/2019.	Town CPF request: \$211,600 Village match: \$21,160	High Priority	Completed August 2019
Total Project Cost	\$232,760		
Southampton Town CPF Recommended Funds		\$211,600	
Village Matching Funds Committed		\$21,160	

Appendix D. WI/PWL Summary

Agawam Lake (1701-0117)

Impaired

Waterbody Location Information

Revised: 05/17/2016

Water Index No:	(MW7.1b) AO-P815	Water Class:	C
Hydro Unit Code:	Shinnecock Bay-Atlantic Ocean (0203020206)	Drainage Basin:	Atlantic-Long Island Sound
Water Type/Size:	Lake/Reservoir 64.0 Acres	Reg/County:	1/Suffolk (52)
Description:	entire lake		

Water Quality Problem/Issue Information

(CAPS indicate MAJOR Pollutants/Sources)

Uses Evaluated	Severity	Confidence
Water Supply	N/A	-
Public Bathing	N/A	-
Recreation	Impaired	Known
Aquatic Life	Stressed	Suspected
Fish Consumption	Unassessed	-

Conditions Evaluated

Habitat/Hydrology	Unassessed
Aesthetics	Unassessed

Type of Pollutant(s)

Known:	HARMFUL ALGAL BLOOMS,
Suspected:	Nutrients (phosphorus, nitrogen), LOW D.O./OXYGEN DEMAND
Unconfirmed:	- - -

Source(s) of Pollutant(s)

Known:	- - -
Suspected:	URBAN/STORM RUNOFF, Onsite/Septic Systems
Unconfirmed:	- - -

Management Information

Management Status:	Verification of Sources Needed
Lead Agency/Office:	DOW/Reg 1
IR/305(b) Code:	Impaired Water Requiring a TMDL (IR Category 5)

Further Details

Overview

Agawam Lake is assessed as an impaired waterbody due to recreational uses that are known to be impaired by phosphorus and low dissolved oxygen. These conditions result in frequent and severe harmful algal blooms in the lake. No specific pollutant or sources have been identified, but land use suggests failing onsite wastewater treatment systems and urban non-point source runoff contribute to the impacts.

Use Assessment

Agawam Lake is a Class C waterbody, suitable for general recreation use and support of aquatic life, but not as a water supply or for public bathing.

Recreation uses are considered to be impaired due to elevated nutrients (phosphorus), excessive algae, poor water clarity and shoreline harmful algal blooms. Algae (chlorophyll-a) levels in the open water were well above the threshold of 10 µg/l associated with impaired recreational conditions during 2014, consistent with phosphorus levels that at all times exceed the DEC threshold of 20 µg/l. Aesthetic conditions of the lake are considered to be poor because of lake wide algal blooms. (DEC/DOW, BWAM/LMAS, December 2015)

Aquatic life is considered to be supported but stressed by shoreline toxic algae blooms and low dissolved oxygen. Periodic fish kills (including a large event in 1981 that was reported on national news) have been reported in the past. There are no health advisories in place limiting the consumption of fish from this waterbody (beyond the general advice for all waters). There are no records of tissue analysis on fish collected from Lake Agawam. However, due to the presence of shoreline algae toxins, fish consumption use may be threatened, despite the lack of information about contaminants in fish flesh. (NYS DOH Health Advisories and DEC/DOW, BWAM/LMAS, December 2015)

Water Quality Information

Regular water quality sampling of Agawam Lake was conducted by researchers at SUNY Stony Brook from 2011 to 2015. Phosphorus levels in the lake frequently exceed the state guidance values of 20 µg/l, and chlorophyll a levels most always exceed the 10 µg/l threshold associated with elevated risk for algae blooms, unsafe water clarity, algae toxins, and poor aesthetic conditions. Water clarity was severely restricted because of cyanobacteria blooms. Water transparency measurements often failed to meet the minimum recommended criteria for swimming beaches and water clarity was determined to be severely restricted as a result of high algae levels. Harmful algae bloom samples collected over this period revealed algal toxin levels that frequently exceeded the World Health Organization (WHO) threshold for safe swimming; however, these toxin samples were limited to shoreline locations. (DEC/DOW, BWAM/LMAS, SUNY Stony Brook unpublished data, December 2015 WHO, 2009)

Source Assessment

Based on surrounding land use and other knowledge of the waterbody, the most likely source(s) of phosphorus/nutrients to the waterbody are urban/storm water runoff and/or failing onsite septic systems.

Management Actions

Agawam Lake is included on the Section 303(d) List for eventual development of a TMDL or other restoration strategy (see below).

The NYS Legislature authorized \$5 million to DEC and the Long Island Regional Planning Council (LIRPC) for a Long Island nitrogen management and mitigation plan. Plan development – with active input from local stakeholders and public – is underway. Chief among the expectations for the plan is a focus on wastewater issues, including sewerage of unsewered communities in Suffolk County and the evaluation and use of advanced alternative onsite wastewater treatment systems to reduce nitrogen loads from individual septic systems where sewerage is not viable. (DEC/DOW, BRWM, November 2015)

This waterbody is also included within the South Shore Estuary Reserve (SSER). The SSER encompasses the tidal waters and watershed between the Nassau–Queens County line and the eastern boundary of Shinnecock Bay. The goals of the SSER Program outlined in the 2001 Comprehensive Management Plan (CMP) include improvement and maintenance of water quality, protection and restoration of living resources, expansion of public use and enjoyment, sustaining and of the estuary–related economy, and increasing education, outreach and stewardship. Program activities focus on point and nonpoint source pollution reduction, protection and restoration of water quality and coastal habitat, increasing shellfish harvesting, open space preservation and enhancing other public uses of the estuary. A vessel waste no discharge zone was established for the entire South Shore Estuary in 2009 to address impacts from boat pollution. (DEC/DOW, Region 1, March 2010)

Section 303(d) Listing

Agawam Lake is included on the current (2016) NYS Section 303(d) List of Impaired/TMDL Waters. The waterbody is included on Part 1 of the List as an impaired waterbody requiring TMDL development for phosphorus and related low dissolved oxygen. This waterbody was first listed on the 2008 List in Appendix B – Waters Not Meeting Dissolved Oxygen Standards. (DEC/DOW, BWAM/WQAS, January 2016)

Segment Description

This segment includes the total area of the Agawam Lake.

Appendix E. Road Ditches

In New York State, ditches parallel nearly every mile of our roadways and in some watersheds, the length of these conduits is greater than the natural watercourses themselves. Although roadside ditches have long been used to enhance road drainage and safety, traditional management practices have been a significant, but unrecognized contributor to flooding and water pollution, with ditch management practices that often enhance rather than mitigate these problems. The primary objective has been to move water away from local road surfaces as quickly as possible, without evaluating local and downstream impacts. As a result, elevated discharges increase peak stream flows and exacerbate downstream flooding. The rapid, high volumes of flow also carry nutrient laden sediment, salt and other road contaminants, and even elevated bacteria counts, thus contributing significantly to regional water quantity and quality concerns that can impact biological communities. All of these impacts will be exacerbated by the increased frequency of high intensity storms associated with climate change. Continued widespread use of outdated road maintenance practices reflects a break-down in communications among scientists, highway managers, and other relevant stakeholders, as well as tightening budgets and local pressures to maintain traditional road management services. Although road ditches can have a significant impact on water quality, discharges of nutrients and sediment from roadways can be mitigated with sound management practices.

Road Ditch Impacts

Roadside ditch management represents a critical but overlooked opportunity to help meet watershed and clean water goals in the Honeoye Lake watershed by properly addressing the nonpoint sources of nutrients and sediment entering the New York waters from roadside ditches. The three main impacts of roadside ditch networks are: (1) hydrological modification, (2) water quality degradation, and (3) biological impairment.

Mitigation Strategies to Reduce Impacts

Traditional stormwater management focused on scraping or armoring ditches to collect and rapidly transport water downstream. The recommended mitigation strategies described below focus on diffusing runoff to enhance sheet flow, slowing velocities, and increasing infiltration and groundwater recharge. This approach reduces the rapid transfer of rainwater out of catchments and helps to restore natural hydrologic conditions and to reduce pollution while accommodating road safety concerns.

These strategies can be divided into three broad, but overlapping categories:

1. Practices designed to hold or redirect stormwater runoff to minimize downstream flooding.
 - a. Redirect the discharges to infiltration or detention ponds.
 - b. Restore or establish an intervening wetland between the ditch and the stream.
 - c. Divert concentrated flow into manmade depressions oriented perpendicular to flow using level lip spreader systems.
 - d. Modify the road design to distribute runoff along a ditch, rather than a concentrated direct outflow.
2. Practices designed to slow down outflow and filter out contaminants.
 - a. Reshape ditches to shallow, trapezoidal, or rounded profiles to reduce concentrated, incisive flow and the potential for erosion.

- b. Optimize vegetative cover, including hydroseeding and a regular mowing program, instead of mechanical scraping. Where scraping is necessary, managers should schedule roadside ditch maintenance during late spring or early summer when hydroseeding will be more successful.
 - c. Build check dams, or a series of riprap bars oriented across the channel perpendicular to flow, to reduce channel flow rates and induce sediment deposition while enhancing ground water recharge.
 - d. Reestablish natural filters, such as bio-swales, compound or “two-stage” channels, and level lip spreaders.
3. Practices to improve habitat.
- a. Construct wetlands for the greatest potential to expand habitat.
 - b. Reduce runoff volumes to promote stable aquatic habitat.

The Upper Susquehanna Coalition (USC) is developing a technical guidance document in the form of a Ditch Maintenance Program Guide that can be used by any local highway department. The guide will include an assessment program to determine if the ditch needs maintenance and what is necessary to stabilize the ditch. It will also contain a group of acceptable and proven management guidelines and practices for ditch stabilization. In addition, the USC is developing a broad-based education and outreach program to increase awareness and provide guidance to stakeholder groups. This program will take advantage of existing education programs, such as the NY’s Emergency Stream Intervention (ESI) Training program, USC, Cornell University and the Cornell Local Roads program. This new program will be adaptable in all watersheds.

Appendix F: Parcels abutting Lake Agawam.



Appendix G: Storage Rendering for potential dredged material dewatering (NP&V)

Potential Geotube® Dewatering Cell Area

