# Bantam Lake

## 2025 Watershed Water Quality Monitoring Report

Bantam Lake Protective Association
Morris, CT

*Prepared by:*

Brawley Consulting Group, LLC
95 Pilgrim Drive
Windsor, CT 06095
203-525-5991

March 10, 2026

**Page**

## Table of Contents

# I. Executive Summary

## A. Overview

This report presents the results of water quality monitoring in the Bantam Lake watershed for the 2025 season, with comparative and cumulative analyses of data from 2023 and 2024. The monitoring program, guided by the Connecticut Statewide Lake Nutrient Total Maximum Daily Load (TMDL) and the Bantam Lake and Watershed Quality Assurance Project Plan, aims to identify nutrient sources, track water quality changes, and assess the effectiveness of future restoration efforts.

## B. Key Findings

**Expanded Monitoring**: In 2024, two new sampling sites were added within the Little Pond Outlet portion of the watershed, enhancing spatial coverage and data robustness. The 2025 program continued this expanded monitoring, providing improved statistical analyses.

**Nutrient Sources**: The Bantam Pond Outlet and West Branch Bantam River emerged as significant sources of phosphorus. The portion of the Little Pond Outlet subwatershed between the Little Pond Watershed A site and the Little Pond Outlet site, which includes the Litchfield Country Club, also showed elevated nutrient loading. Some subwatershed areas lack proposed restoration projects despite high phosphorus contributions, such as the Bantam Pond subwatershed, where the Torrington Country Club and large farm fields drain to the Ivory Mountain Brook. Area, which drain to the Bantam River.

**Water Quality Trends**

**Specific Conductance**: Highest at West Branch Bantam River, indicating elevated ion concentrations, possibly due to local geology or anthropogenic influences (e.g., road runoff, wastewater).

**Dissolved Oxygen**: Generally adequate for aquatic life, with occasional low readings.

**Phosphorus & Nitrogen**: Total phosphorus concentrations and loading rates were highest at West Branch Bantam River, Little Pond Outlet, and Bantam Lake Outlet.

Total nitrogen loading rates were highest at Bantam Lake Outlet and Little Pond Outlet, with lowest rates at Whittlesey Brook Inlet and Dog Pond Outlet.

**Statistical Analyses**: Significant differences in nutrient concentrations and loading rates were observed among sites, with West Branch Bantam River and Little Pond Outlet consistently showing higher values.

**Comparison to TMDL Targets**

The 2023-2025 average annual total phosphorus loading (1,034.2 kg/yr) was comparable to the TMDL estimate (1,012 kg/yr), though the target is lower (762.9 kg/yr).

Total nitrogen loading in 2024 and 2025 was below the TMDL estimate, but 2023 data was anomalously high due to record rainfall.

### C. Recommendations

**Targeted Restoration**: Focus restoration efforts on high-contributing areas, such as Bantam Pond watershed, West Branch Bantam River, and Little Pond watersheds, especially where current plans lack projects.

**Continued Monitoring**: Maintain and expand the monitoring program to track changes and assess the impact of implemented Best Management Practices (BMPs).

**Quality Assurance**: Adhere to rigorous quality control protocols, including duplicate and blank sampling, to ensure data reliability.

### D. Conclusion

The Bantam Lake watershed monitoring program has provided valuable insights into nutrient dynamics and water quality trends. While phosphorus loading remains a concern in specific subwatersheds, overall progress aligns with TMDL goals. Continued monitoring and targeted restoration are essential for achieving long-term water quality improvements.

## II. Introduction

Brawley Consulting Group (hereafter BCG) has collected and compiled the Bantam Lake watershed data collected in 2025 with focus on field measurements, total phosphorus, and total nitrogen data. In addition, we combined those data with the available 2023 and 2024 datasets and reported on three-year averages. Following the assessment of the 2023 data, it was recommended that additional sites be added within the larger Little Pond portion of the Bantam watershed. This report also examined investigations subsequent to that recommendation. Nutrient loading in 2023 through 2025 was also examined in context of predicted and target load rates described in the Bantam Lake Appendix of the State's TMDL.

### A. Bantam TMDL and Watershed-Based Plan

Bantam Lake has been studied extensively over the past decade to identify significant nutrients sources resulting in accelerated eutrophication, high cyanobacteria levels, and harmful algal blooms. These conditions have led to public health concerns related to recreational use of the lake for swimming, wading, fishing, and boating. Restoration planning at Bantam Lake has been advanced by the development of a *Connecticut Statewide Lake Nutrient Total Maximum Daily Load Core Document* by the CT DEEP (2021a). That document listed the State's water quality standards, identified nutrient pollution sources to lakes, and established a planning process by which nutrient budgets for lakes could be established through *total maximum daily loading* (TMDL) analyses.

In 2021, CT DEEP initiated a TMDL study specifically for Bantam Lake, documented in Appendix 1 of the Core Document (CT DEEP 2021b). This TMDL assessment identified probable nutrient sources within the Bantam Lake watershed as well as potential internal loading from the terminal waterbody (Bantam), offering preliminary recommendations for watershed-based restoration. The high-level recommendations for restoration were detailed in the Watershed-Based Plan for Bantam Lake (see below). The Bantam Lake TMDL Appendix also provided a framework for a water quality monitoring program to establish baseline data and framework from which the effectiveness of watershed restoration efforts could be assessed.

In conjunction with a TMDL analysis, a *Watershed-Based Plan* was developed to restore Bantam Lake's source waters and achieve compliance with the water quality goals established for the lake (CEI 2021). Detailed recommendations in the Watershed-Based Plan were provided to implement structural *Best Management Practices* (e.g. culvert replacements, stormwater practices, riparian buffer restoration, and erosion controls) within the watershed and to develop a monitoring program to assess changes in water quality resulting from project implementations.

### B. Water Quality Monitoring

In 2021, the Bantam Lake Protective Association (BLPA) commissioned the development of a Quality Assurance Project Plan (QAPP) to standardize and memorialize a lake and watershed monitoring program based on the framework established in the Bantam Lake TMDL Report. That work was initiated by Aquatic Ecosystem

Research, LLC in 2022 and completed by BCG in October of 2023 following revisions in response to comments by the BLPA and Connecticut Department of Energy and Environmental Protection (CT DEEP). In 2023, BCG was contracted to collect and report on data from the selected watershed sampling sites. These sampling efforts were in addition to the data collection and reporting already performed as part of the ongoing annual in-lake water quality monitoring conducted during the growing season (April – October). Many of the methods in the final QAPP were incorporated into the 2023 lake and watershed monitoring efforts prior to the finalization of the approved QAPP document. Additional QAPP recommendations, e.g. collection of water sample blank and duplicate samples and regular calibration of the field instrumentation, were incorporated into the 2024 monitoring efforts and have been adhered to since that time.

This report highlights the analysis of the 2025 data collections, provides comparisons to the data collected in 2023 and 2024, and provides analyses of the combined 2023-2025 data for the original six sampling sites (See Figure 1). Also provided are results from data collections at two additional sites where data collection was initiated in 2024. The quality assurance data prescribed in the QAPP, specifically the results from analyses of duplicate samples and blanks, are provided. Lastly, average phosphorus and nitrogen concentrations and loading rates for the last three seasons are examined in relationship to those estimated in the Bantam Appendix to the TMDL.

### C. Important 2024 Watershed Monitoring Takeaways

The 2024 program more than doubled the data collected from each of the original six sampling sites, providing better more robust statistical analyses. Variables at each site that year could be analyzed with both the 2024 data and the combined 2023/2024 dataset.

Specific conductance in 2024 was found to be significantly higher at sites along West Branch of the Bantam River, i.e., Dog Pond Outlet, West Branch Bantam River, and Little Pond Outlet, as compared to the other sites, i.e., Bantam Pond Outlet, Whittlesey Brook Inlet, and Bantam Lake Outlet. Reasons for the higher specific conductance were not immediately clear.

The areas of the watershed draining to the Bantam Pond Outlet site emerged as an important source for phosphorus within the Bantam Lake watershed. For example, the 2024 and combined 2023/2024 averaged corrected total phosphorus loading at the site was significantly higher than averages of several sites including Whittlesey Brook Inlet and Bantam Lake Outlet. No proposed projects in that section of the watershed, which includes the Torrington Country Club, were found in the Watershed Based Plan for the Bantam Lake Watershed.

The portion of the watershed draining from the Dog Pond Outlet site to the West Branch Bantam River sampling site was also important. The 2024 and 2023/2024 corrected and standardized phosphorus loading averages for that portion of the watershed were statistically higher than the corresponding averages at Bantam Lake Outlet. The Woodridge Lake Wastewater Treatment Plant is situated in the portion of the watershed draining to the West Branch Bantam River site.

The addition of two sampling sites in the watershed, draining to the Little Pond Outlet, proved to be valuable. Corrected loading was found to be higher in the section of the Little Pond watershed where the Litchfield Country Club was situated. This section of the watershed continues to be important as it was found to be from 2023 analyses. The Watershed Based Plan does have BMPs recommended in this area.

To estimate phosphorus and nitrogen loading to the lake, a method was developed to match those methods used in the TMDL. This methodology was used to estimate the 2023 and 2024 loading which were then compared to the TMDL estimate. The combined 2023/2024 average phosphorus loading was comparable to the estimate in TMDL. The same was not true for total nitrogen.

## D. Site Description

Bantam Lake is a 966-acre waterbody located in the Towns of Litchfield and Morris, Connecticut and is the largest natural lake in the State. The lake has a maximum depth of 7.6 meters, a mean depth of 4.4 meters, and an estimated volume of 16,120,000 cubic meters (Canavan and Siver 1995). Geologically, the lake and watershed are situated in the Western Uplands of Connecticut (Bell 1985, Canavan & Siver 1995). That region has erosion resistant, crystalline bedrock comprised of schists, gneiss, granite gneiss, and granofels (Healy & Kulp 1995). Surficial materials are glacial till to thick till with moderate to well drainage soils and with a fragipan (hard pan) present on uplands (CTECO 2010, Stone et.al. 1992).

The watershed of Bantam Lake is 20,218 acres, rendering a large watershed to lake ratio of approximately 23 (Canavan & Siver 1995). In a 1995 survey, land use was characterized as mainly deciduous forest and agriculture with smaller areas of medium-density residential land use, wetlands, and coniferous forests (Healy & Kulp 1995). Analysis of watershed land cover conducted by AER utilized 2016 aerial photography and delineated a composition of approximately 53% forested, 16% agricultural fields, 15% developed, and 9% wetlands (AER 2018). Most of the southern shoreline is lined with homes, beaches, and several camps. Conversely, the northern shoreline and northeastern cove are dominated by open space, with a large portion of the shoreline owned by the White Memorial Foundation.

Table 1. Bantam Lake watershed 2025 sampling dates and sites. The original 6 sites were Bantam Lake Outlet (BLO), Bantam Pond Outlet (BPO), Dog Pond Outlet (DPO), Little Pond Outlet (LPO), West Branch Bantam River (WBBR), and Whittlesey Brook Inlet (WBI). The additional 2 sites were Little Pond Watershed A (LPW-A) and Little Pond Watershed B (LPW-B).

| 2025 Sampling Dates | Original 6 Sites | Additional Two Sites |
|---|---|---|
| 14-Apr-25 | ✓ | ✓ |
| 16-May-25 | ✓ | ✓ |
| 6-Jun-25 | ✓ | ✓ |
| 22-Jul-25 | ✓ | ✓ |
| 19-Aug-25 | ✓ | ✓ |
| 19-Sep-25 | ✓ | ✓ |
| 17-Oct-25 | ✓ | ✓ |

## III. Methods

### A. In-Situ Data and Water Sample Collections

The six original sites in the Bantam Lake watershed (Fig. 1) were visited monthly during the 2025 season by BCG from April through October on the following dates: April 14th, May 16th, June 6th, July 22nd, August 19th, September 19th, and October 17th. The two additional sites added in 2024, were also sampled on the same dates (Table 1). A standardized approach was used to collect water samples for laboratory analysis and for collecting in-situ data including measurements of water temperature (°C), dissolved oxygen (mg/L), % oxygen saturation (%), relative phycocyanin (µg/L), specific conductance (µS/cm), and pH (standard units). The in-situ parameters were measured using a Eureka Manta II Multiprobe meter.

For all but one site, water samples were collected during site visits as near to the middle of the watercourse as possible using a 500 mL sampling cup on the end of a 6-foot pole. Samples were transferred to lab-provided, sterile plastic sampling containers, and stored in an ice-filled cooler. At the LPW-A site, water samples were collected with a Van Dorn water sampling bottle lowered into the Bantam River from the overpass on Route 63 (South Street, Litchfield). All samples were kept on ice until they were frozen at BCG facilities. Samples were later transferred to the UCONN CESE laboratory.

The following laboratory analyses were performed on each water sample: total phosphorus, total nitrogen, ammonia, and alkalinity concentrations. Results were reported in either mg/L or µg/L. Measurements were converted to kg/L and then multiplied by the discharge rate (see below) to determine estimated loading rates in kg/day. Samples were also collected for analysis of the bacteria *Escherichia coli (E. coli)* which were also kept on ice and delivered to EnviroTech Laboratory LLC in Windsor, CT within 24 hours of collection.

### B. Discharge and Loading Rates

As there are no flow gaging stations in the Bantam River Watershed, flow estimates were generated to make meaningful comparisons of nutrient loading between sampling sites. The discharge rates at each site and on each sample collection date were estimated using a Watershed Area Ratio Method (Gianfagna et.al. 2016) that is detailed in the *Bantam Lake and Watershed QAPP*. In summary, surrogate USGS gaging stations within watersheds of comparable size in Connecticut were used to estimate flow at each of the watershed sampling sites. The surrogate watershed used for Bantam Pond Outlet, Dog Pond Outlet, West Branch Bantam River, and Whittlesey Brook subwatersheds was the Bunnel Brook Watershed (USGS 2024a), which is gaged for flow in Burlington, CT. The surrogate for the Bantam Lake Outlet, Little Pond Outlet, Little Pond Watershed A, and Little Pond Watershed B subwatersheds is the Nepaug River Watershed (USGS 2024b) which is located upstream of the Nepaug Reservoir in Nepaug, CT.

Estimated discharge rates were converted from cubic feet per second to liters per day. Total phosphorus and total nitrogen loading rates were calculated by multiplying site concentrations by the site daily discharge rates.

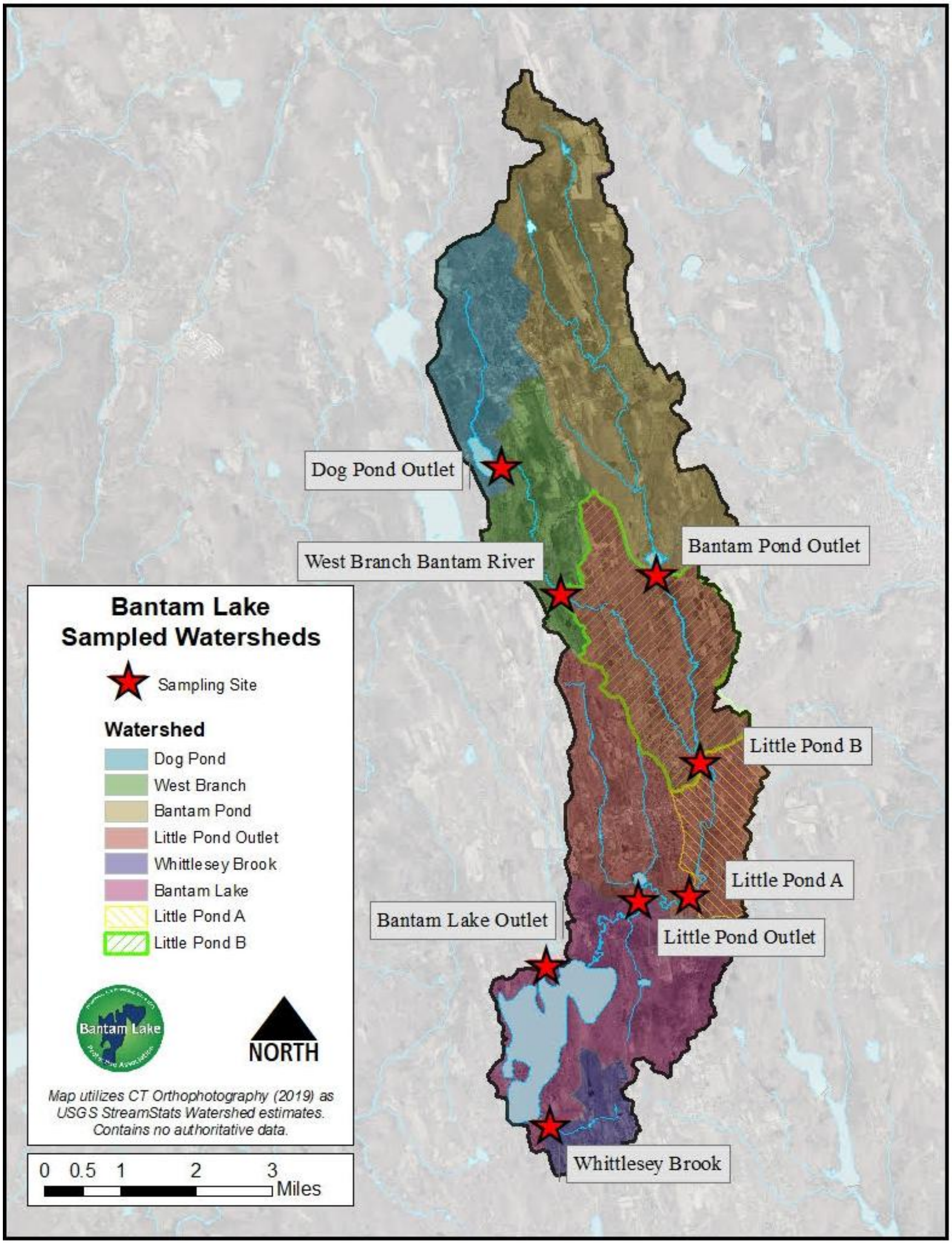


Figure 1. Map of the Bantam Lake Watershed, subsheds and the locations of the sampling sites.

## C. Corrected and Corrected & Standardized Loading Rates

To estimate the daily nutrient load from the drainage area specific to each sampling site (i.e. *corrected loading rate*), the daily loads determined at upstream sites were subtracted from the daily load of the downstream site. For example, the estimated daily load from the Dog Pond Outlet (DPO) site was subtracted from the corresponding daily load at the West Branch of the Bantam River (WBBR) site to assess nutrient exports from the area of the watershed between the two sites (aka *corrected daily load*). Similarly, to determine the corrected daily loading at the Little Pond Outlet (LPO), the daily loads from WBBR and the Bantam Pond Outlet (BPO) site were subtracted out of the LPO load.

Table 2. Areas of subwatersheds within the Bantam Lake Watershed in square miles and acres (USGS 2024c).

| Watershed/Subshed | Sq. Mile | Acres |
|---|---:|---:|
| Bantam Lake Outlet | 32.80 | 20,992.0 |
| Bantam Pond Outlet | 8.63 | 5,523.2 |
| Dog Pond Outlet | 3.14 | 2,009.6 |
| Little Pond Outlet | 25.00 | 16,000.0 |
| Little Pond Watershed-A | 15.43 | 9,875.2 |
| Little Pond Watershed-B | 13.53 | 8,695.2 |
| West Branch Bantam River | 5.88 | 3,763.2 |
| Whittlesey Brook Inlet | 1.15 | 736.0 |

The corrected daily loads estimated from the individual subwatersheds, i.e., areas between adjacent sampling sites, were also standardized by area (aka *corrected / standardized loading rate*) by dividing the corrected daily loads by the surface area (acres) of the individual subwatersheds (Table 2).

## D. Selection of Additional Sampling Sites

Following reporting on the results from the 2023 watershed sampling, a recommendation to add two additional sites within the Little Pond watershed was implemented during the 2024 season. The siting of the additional sites was determined by location within that subsection of the watershed, accessibility for sampling, and proximity to potential nutrient sources. The two additional sites were sampled during each of the seven 2025 sampling events.

The first additional site – Little Pond Watershed B (LPW-B) – was approximately two-thirds down the length of the subwatershed (Table 2; Fig. 1) and was located where Route 202 crosses the Bantam River (41.755997, -73.182899) just south of Rowe Funeral Home and the AmeriGas Station in Litchfield, CT. The site was situated below the convergence of the Bantam River and the West Branch of the Bantam River.

A second site – Little Pond Watershed A (LPW-A) – was located at the bridge crossing over the Bantam River on Route 63 (486-494 S. Plains Road, Litchfield, CT; 41.730582, -73.185821). The site was located just upstream from the portion of the Bantam River paralleling the Litchfield Country Club and situated approximately 1 mile upstream from the outlet of Little Pond.

### E. Statistical Analyses

The 2025 field measurements, total phosphorus- and total nitrogen-related variables (i.e., daily loading, corrected daily loading, corrected / standardized daily loading) were averaged for each site and the standard deviation[1] was calculated. Differences among 2025 site averages were tested mainly with the Kruskal Wallis Test due to small dataset sizes and lack of normality within the datasets.[2] Normality was assessed with the Shapiro-Wilk Test.

Both the Kruskal-Wallis Test and Analysis of Variance (ANOVA) were applied to the combined 2023 – 2025 datasets to determine significant differences in site averages since the combined datasets were larger in size with some datasets exhibiting normal distribution.

## IV. Results

### A. In-Situ Measurements

In-situ measurements of temperature, specific conductance, dissolved oxygen, percent oxygen saturation, pH and relative phycocyanin were compiled in Appendix A and described below. The 2025 season averages for the original six sites were plotted along with corresponding 2023 and 2024 averages for comparisons (Fig. 2).

#### *1. Specific Conductance*

Specific conductance is a surrogate measurement for the ion concentration in water and indicative of total dissolved salts, minerals, and metals concentrations in water. Like in 2023 and 2024, the highest site average was from West Branch Bantam River sit at 292 µS/cm. Conspicuously different from 2023 and 2024, Whittlesey Brook Inlet did not exhibit the lowest season average and instead exhibited great variability (Fig. 2). The 2025 Whittlesey Brook Inlet average was 192 µs/cm and individual measurements ranged from 124 to 251 µS/cm over the season. The Bantam Lake Outlet average was similar at 188 µS/cm but with much less variability. Dog Pond Outlet and Little Pond Outlet sites had season averages of 223 µS/cm and 229 µS/cm, respectively. The lowest site average was observed at the Bantam Pond Outlet site at 164 µS/cm.

Statistically significant differences did exist among the 2025 site averages. The seasonal average at the Bantam Pond Outlet was significantly lower than averages at the Little Pond Outlet and West Branch Bantam River sites. The Bantam Lake Outlet site average was also significantly lower than the West Branch Bantam River average.

---

[1] Common Terms and Equations: Standard Deviation. https://www.nlm.nih.gov/oet/ed/stats/02-900.html

[2] Normal Distribution. Statistics.com. https://www.statistics.com/glossary/normal-distribution/

### 2. *Dissolved Oxygen*

Adequate concentrations of oxygen dissolved into the water are important for aquatic ecosystem health. A concentration of 5 mg/L is generally considered the threshold that delineates favorable conditions for most organisms requiring oxygen in freshwater systems (USEPA 2025). As concentrations decrease below that, conditions start to become stressful for many aquatic organisms.

As in 2024, no statistically significant differences were observed among the 2025 dissolved oxygen concentration site averages. The lowest 2025 site averages were observed at the West Branch Bantam River and Little Pond Outlet sites at 6.4 and 6.7 mg/L, respectively (Fig. 2). The Whittlesey Brook Inlet site average was 7.2 mg/L. Site averages at Bantam Lake Outlet, Bantam Pond Outlet and Dog Pond Outlet were between 8 and 9 mg/L.

Measurements taken in June at all sites were conspicuously low (<4 mg/L) and may have been the result of a malfunctioning oxygen probe. All other measurements at Bantam Lake Outlet, Bantam Pond Outlet, and Dog Pond Outlet were >6 mg/L. At Little Pond Outlet, concentrations between 5 and 6 mg/L were measured in July and September, while the August measurement was 4.8 mg/L. At Whittlesey Brook Inlet, concentrations between 5 and 6 mg/L were measured in July and August, and a concentration of 4.25 mg/L was measured in September. West Branch Bantam River concentrations were between 5 and 6 mg/L in May and August, and a 2.0 mg/L measurement was recorded in July.

### 3. *Percent Oxygen Saturation*

Percent oxygen saturation refers to the amount of oxygen in the water relative to 100% saturation as a percentage. One hundred percent oxygen saturation for water varies with water temperature, i.e., 100% saturation decreases with increasing temperature.

No statistically significant differences were observed among the 2025 site percent oxygen saturation season averages. The 2025 Bantam Pond Outlet, Bantam Lake Outlet, and Dog Pond Outlet site averages were between 89 and 95%. Whittlesey Brook Inlet and Little Pond Outlet had similar averages of 70 and 71%, respectively. The lowest site average was from West Branch Bantam River at 64%.

### 4. *Temperature*

Statistically significant differences were not observed among the seasonal average water temperatures for the six sites in 2025. The lowest site temperature averages were from Whittlesey Brook Inlet and West Branch Bantam River at 14.5 and 15.4 °C. Bantam Pond Outlet, Dog Pond Outlet, and Little Pond Outlet exhibited similar averages that were between 17.4 and 17.6 °C. The highest site average was from Bantam Lake Outlet at 19.2 °C.

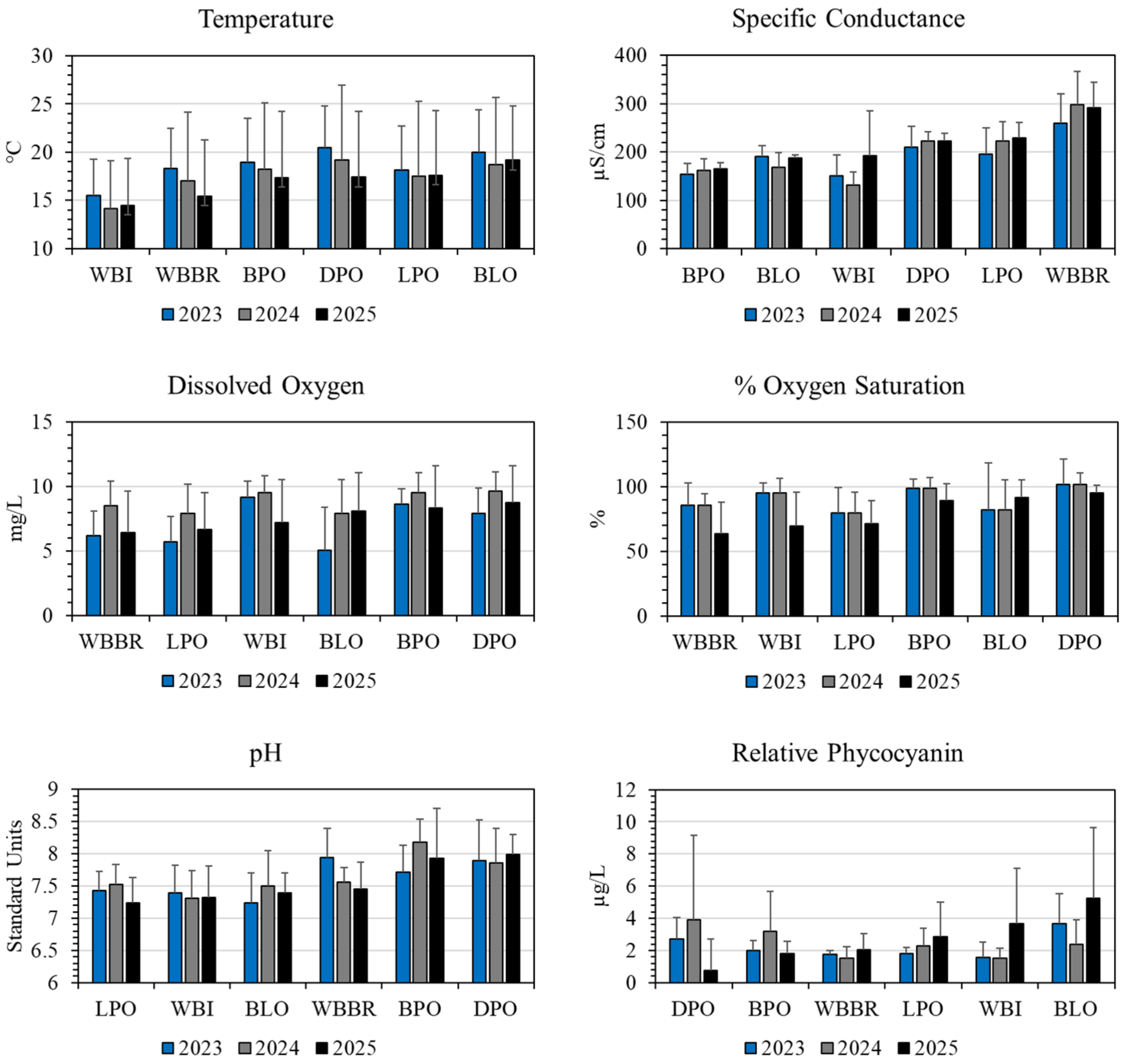


Figure 2. Site averages for in-situ measurements of specific conductance, pH, dissolved oxygen, percent oxygen saturation, water temperature, and relative phycocyanin. Sites were ordered from the lowest to highest 2024 average for each parameter. Error bars are standard deviation. The 2023 data was provided for comparisons. BLO = Bantam Lake Outlet, BPO = Ball Pond Outlet, DPO = Dog Pond Outlet, LPO = Little Pond Outlet, WBBR = West Branch of Bantam River, and WBI = Whittlesey Brook Inlet.

### *5. pH*

The 2025 pH season averages for Little Pond Outlet, Bantam Lake Outlet, West Branch Bantam River, and Whittlesey Brook Inlet sites were all between 7.2 and 7.5 standard units (SU). The Bantam Pond Outlet and Dog Pond Outlet site averages were higher at 7.9 SU and 8.0 SU, respectively. Differences in site averages among all sites were not statistically significant.

### *6. Relative Phycocyanin Concentration*

Phycocyanin is a photosynthetic pigment unique to cyanobacteria and a beneficial surrogate for cyanobacteria biomass. Measurements in this study were relative since a primary standard was not used in instrument calibration, but the relative measurements were useful in comparing sites over time.

Most 2025 measures of relative phycocyanin concentration were generally low. All measures of relative phycocyanin concentrations were <4 µg/L for the entire season at Bantam Pond Outlet, Dog Pond Outlet, and West Branch Bantam River. Sites and dates when measurements exceeded 4 µg/L included: Bantam Lake Outlet in August, September, and October (5.1, 13.9, and 7.7 µg/L, respectively); Little Pond Outlet in June and July (4.5 and 6.5 µg/L, respectively); and Whittlesey Brook Inlet in August and September (7.0 and 8.9 µg/L, respectively).

Table 3. Discharge rates on the 2025 Bantam Lake Watershed sampling dates for Bunnel Brook and Nepaug River USGS gaging stations and the estimated discharge rates at the Bantam Lake Watershed sites. Bunnel Brook discharge rates were used to estimate the discharge rates at the Bantam Pond Outlet, Dog Pond Outlet, West Branch Bantam River, and Whittlesey Brook Inlet sites; the Nepaug River discharge rates were used to estimate the discharge rates at the Bantam Lake Outlet and Little Pond Outlet sites.

| Date | Bunnel Brook (Surrogate) | Bantam Watershed Site Estimates | | | |
|---|---|---|---|---|---|
| | | Bantam Pond Outlet | Dog Pond Outlet | West Branch Bantam River | Whittlesey Brook Inlet |
| | *Cubic Feet per Second* | | | | |
| 14-Apr-25 | 10.5 | 21.6 | 7.9 | 14.7 | 2.9 |
| 16-May-25 | 13.3 | 27.3 | 9.9 | 18.6 | 3.6 |
| 6-Jun-25 | 5.2 | 10.8 | 3.9 | 7.3 | 1.4 |
| 22-Jul-25 | 1.4 | 2.8 | 1.0 | 1.9 | 0.4 |
| 19-Aug-25 | 0.7 | 1.5 | 0.5 | 1.0 | 0.2 |
| 18-Sep-25 | 0.7 | 1.4 | 0.5 | 1.0 | 0.2 |
| 17-Oct-25 | 2.1 | 4.3 | 1.6 | 3.0 | 0.6 |

| Date | Nepaug River (Surrogate) | Bantam Watershed Site Estimates | | | |
|---|---|---|---|---|---|
| | | Bantam Lake Outlet | Little Pond Outlet | Little Pond Watershed A | Little Pond Watershed B |
| | *Cubic Feet per Second* | | | | |
| 14-Apr-25 | 53.4 | 74.9 | 57.1 | 35.2 | 30.9 |
| 16-May-25 | 64.7 | 90.7 | 69.1 | 42.7 | 37.4 |
| 6-Jun-25 | 30.6 | 42.9 | 32.7 | 20.2 | 17.7 |
| 22-Jul-25 | 8.2 | 11.5 | 8.8 | 5.4 | 4.8 |
| 19-Aug-25 | 3.6 | 5.0 | 3.8 | 2.4 | 2.1 |
| 18-Sep-25 | 3.9 | 5.4 | 4.1 | 2.6 | 2.2 |
| 17-Oct-25 | 9.0 | 12.6 | 9.6 | 5.9 | 5.2 |

The lowest 2025 seasonal site average of 0.8 µg/L was observed at the Dog Pond Outlet site. Bantam Pond Outlet and West Branch Bantam River had similar season averages at 1.8 and 2.0 µg/L. Averages for Little Pond Outlet, Whittlesey Brook Inlet, and Bantam Lake Outlook were incrementally higher at 2.8, 3.7, and 5.2 µg/L, respectively. Statistically significant differences were not detected among site averages.

## B. Discharge Rates

The discharge rates for the surrogate watersheds and the estimated discharge rates for the Bantam Lake subwatersheds are provided in Table 3. Surrogate discharge rates were used in combination with the surrogate watershed size / Bantam subwatersheds size ratios to estimate discharge at the Bantam Lake subwatershed sites. The same method was applied to the two additional sites within the Little Pond Outlet subwatershed, i.e., Little Pond Watershed A and Little Pond Watershed B.

## C. Total Phosphorus

All laboratory nutrient analysis results were compiled in Appendix B. Like with the analyses of in-situ data, the 2025 total phosphorus and total nitrogen data were first assessed by calculating site averages and standard deviations. The following variables for both total phosphorus and total nitrogen were determined: concentration, daily loading, corrected daily loading, and corrected daily loading standardized by area.

### *1. Total Phosphorus Concentrations*

Consistent with 2023 and 2024, in 2025 the Dog Pond Outlet and Bantam Lake Outlet sites had the lowest average total phosphorus concentrations at 17.1 and 23.3 µg/L, respectively (Fig. 3). The West Branch Bantam River had the highest 2025 site average at 42.3 µg/L. The Little Pond Outlet, Whittlesey Brook Inlet, and Bantam Pond Outlet sites had similar season averages at 27.4, 28.8, and 31.1 µg/L, respectively. Based on the Kruskal-Wallis test, the West Branch of Bantam River average was significantly greater than the Dog Pond Outlet average. Although sample sizes were small, normality was acceptable, so ANOVA was also applied and resulted in the West Branch Bantam River average not only being statistically greater than the Dog Pond Outlet average, but also the Bantam Lake Outlet average.

### *2. Daily Loading Rates*

Consistent with 2023 and 2024, the highest average loading rates in 2025 were from Little Pond Outlet and Bantam Lake Outlet sites at 1.76 and 1.84 kg/day, respectively. The lowest 2025 average daily loading rates were from the Whittlesey Brook Inlet and Dog Pond Outlet sites at 0.08 and 0.13 kg/day, respectively. The West Branch Bantam River and Bantam Pond Outlet sites had similar average daily loading rates at 0.54 and 0.66 kg/day, respectively.

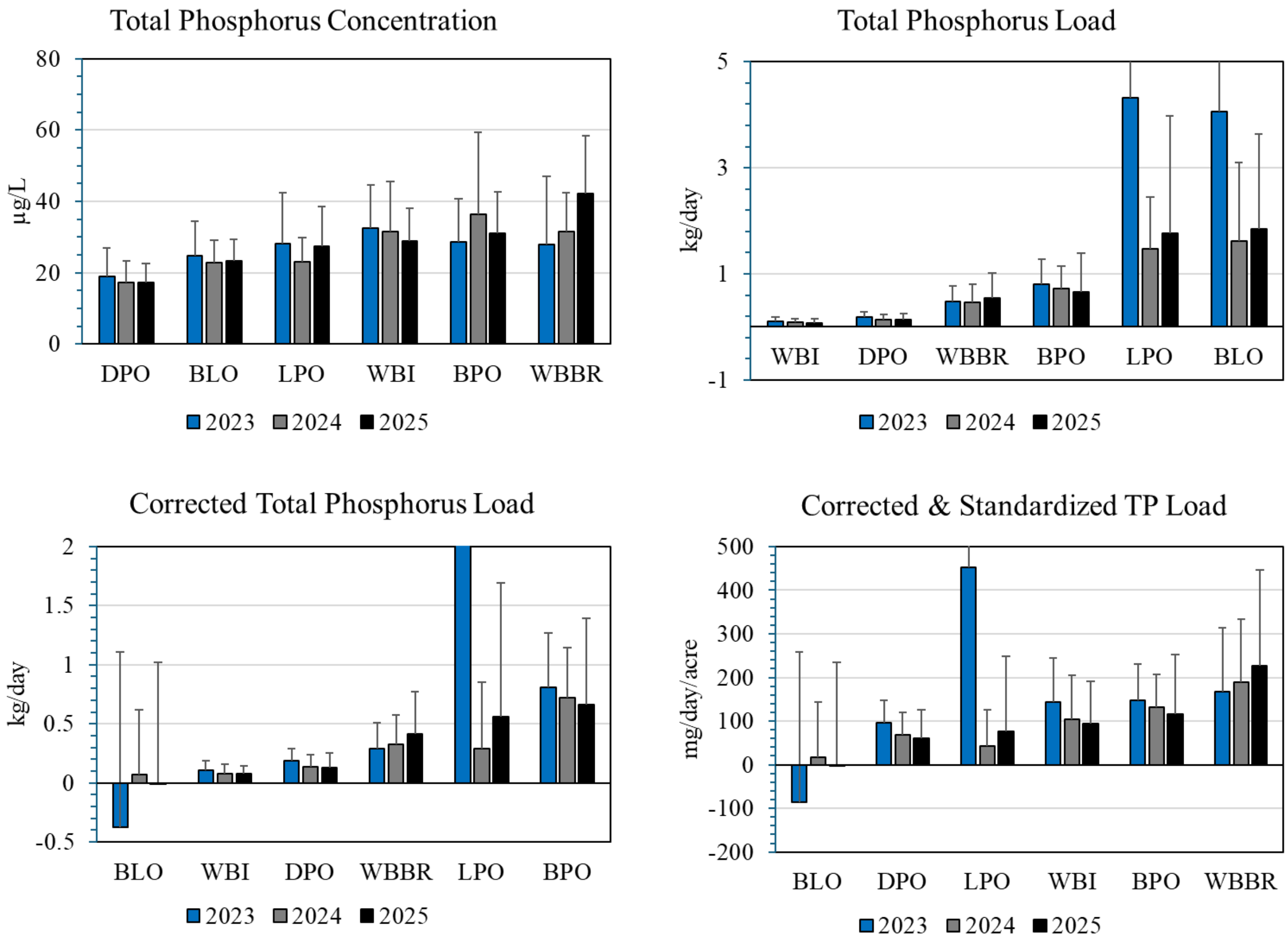


Figure 3. Average total phosphorus concentrations, total phosphorus loading, corrected total phosphorus loading, and corrected and standardized (by subshed area in acres) total phosphorus (TP) loading at the Bantam Lake Outlet (BLO), Bantam Pond Outlet (BPO), Dog Pond Outlet (DPO), Little Pond Outlet (LPO), West Branch Bantam River (WBBR), and Whittlesey Brook Inlet (WBI) sites in the Bantam Lake watershed in 2025. The 2023 and 2024 averages were also added for comparison. The 2023 Little Pond Outlet corrected total phosphorus load average and standard deviation were 3.04 and 5.09 kg/day, respectively. The 2023 Little Pond Outlet corrected and standardized average and standard deviation were 452 and 756 mg/day/acre, respectively.

Statistically significant differences were found among the daily loading site averages. Both the Whittlesey Brook Inlet and Dog Pond Outlet averages were significantly lower than the Little Pond Outlet and Bantam Lake Outlet averages. Site averages at West Branch Bantam River and Bantam Pond Outlet were not significantly different from site averages at the other sites.

### 3. *Corrected Daily Loading Rates*

Like in 2024, average daily loading rates, corrected by subtracting the immediate upstream site rates, fell into one of three groups. The group with the lowest rates contained Bantam Lake Outlet, Whittlesey Brook Inlet and Dog Pond Outlet with daily loading rates between 0.00 and 0.13 kg/day (Fig. 3). The West Branch Bantam River average was 0.41 kg/day, respectively. The Little Pond Outlet and The Bantam Pond Outlet site had the highest site average at 0.56 and 0.66 kg/day, respectively.

Statistically significant differences were not observed among the 2025 sites averages. This differed from past years, e.g., in 2024 season average corrected daily loading rate at Bantam Pond Outlet was significantly higher than that of Bantam Lake Outlet. In 2023, the Bantam Pond Outlet site average was significantly greater than the averages at all other sites except Little Pond Outlet, and the Little Pond Outlet site average was significantly greater than average of all other sites except West Branch Bantam River.

### *4. Corrected and Standardized Daily Loading Rates*

The corrected daily loading rates were standardized by dividing the corrected rate at each subsection of the watershed by the subwatershed area in acres. Phosphorus mass was converted from kilograms to milligrams by multiplying by 1,000,000. Consistent with the past two years, the lowest corrected and standardized average rate was from the Bantam Lake Outlet which in 2025 was -3.6 mg/day/acre. Dog Pond Outlet and Little Pond Outlet had the next lowest averages at 60.2 and 77.3 mg/day/acre, respectively. Whittlesey Brook Inlet and Bantam Pond Outlet had similar averages at 93.8 and 115.6 mg/day/acre, respectively. Like in 2024, the highest 2025 average was from the West Branch Bantam River site at 226.9 mg/day/acre.

Statistically significant differences were observed between two sites. Like in 2024, the West Branch Bantam River corrected and standardized average was significantly greater than the Bantam Lake Outlet average.

## D. Total Nitrogen

### *1. Total Nitrogen Concentrations*

Like in 2024, no significant differences were observed among average total nitrogen concentrations from the six sites in 2025. The lowest site average was once again from the Whittlesey Brook Inlet which was 361 µg/L in 2025. Bantam Pond Outlet, Dog Pond Outlet, and Little Pond Outlet averages were all between 426 to 448 µg/L. West Branch Bantam River had a 2025 average of 477 µg/L. The greatest average total nitrogen concentration was from Bantam Lake Outlet at 488 µg/L.

The 2025 season averages were similar to those in 2024 (Fig. 4). Average from both those years greatly differed from the 2023 averages which ranged from 916 µg/L at Bantam Pond Outlet to 1,218 µg/L observed at Dog Pod Outlet.

### *2. Daily Loading Rates*

The lowest daily loading total nitrogen averages were from Whittlesey Brook Inlet and Dog Pond Outlet at 1.0 and 3.5 kg/day, respectively, which closely compares with corresponding 2024 averages (Fig. 4). West Branch Bantam River and Bantam Pond Outlet averages were 7.2 and 8.2 kg/day, respectively. Like in 2024, the highest daily loading averages were from Little Pond Outlet and Bantam Lake Outlet at 31.9 and 32.9 kg/day, respectively.

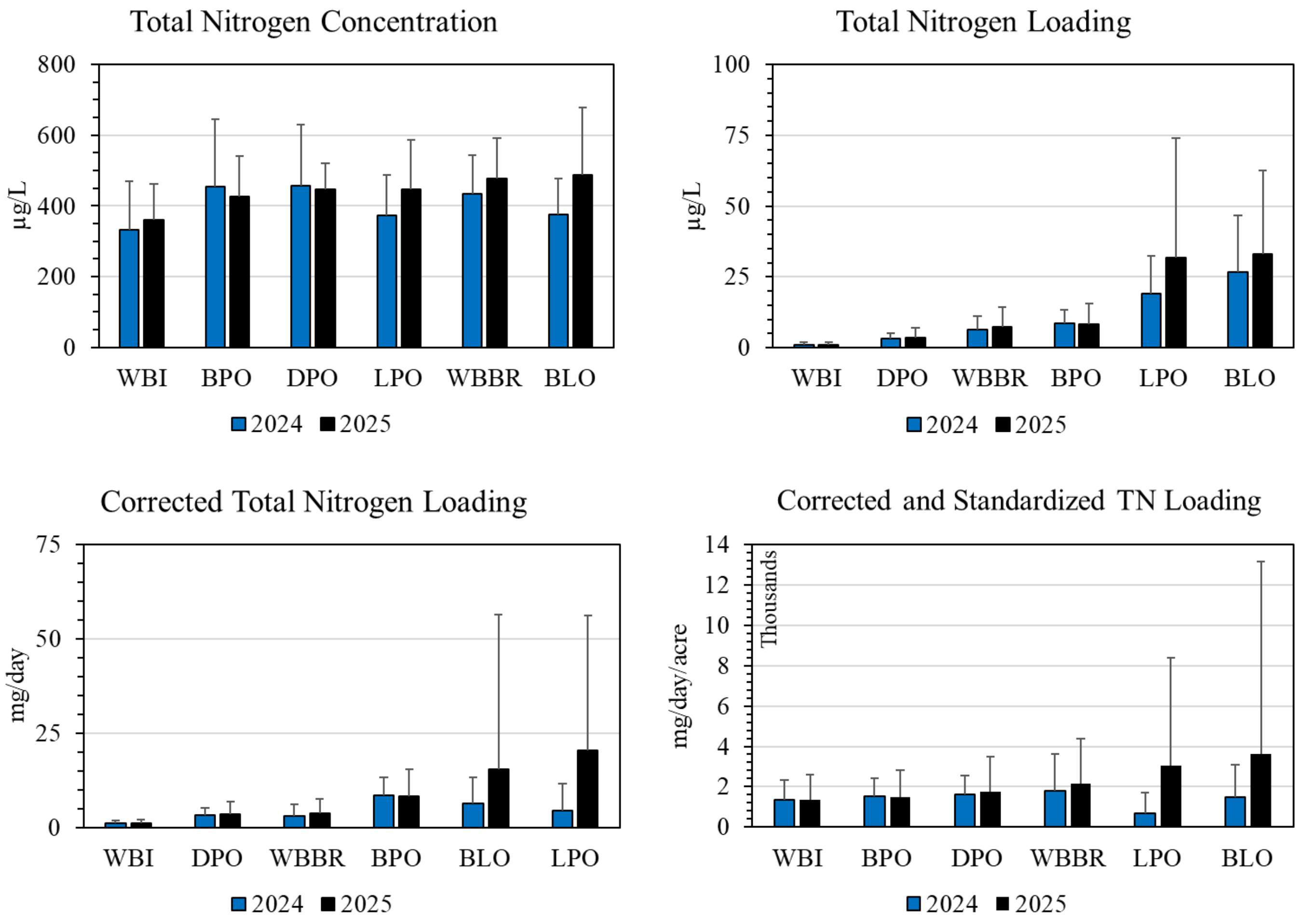


Figure 4. Average total nitrogen concentrations, total nitrogen loading, corrected total nitrogen loading, and corrected and standardized (by subshed area in acres) total nitrogen (TN) loading at the Bantam Lake Outlet (BLO), Bantam Pond Outlet (BPO), Dog Pond Outlet (DPO), Little Pond Outlet (LPO), West Branch Bantam River (WBBR), and Whittlesey Brook Inlet (WBI) sites in the Bantam Lake watershed in 2025. The 2024 data was also added for comparison.

Based on the Kruskal-Wallis test, the Bantam Lake Outlet average total nitrogen daily loading was significantly greater than the Dog Pond Outlet and Whittlesey Brook Inlet averages. The Little Pond Outlet average was also statistically greater than the Whittlesey Brook Inlet average. ANOVA was also performed but resulted in no significant differences among site averages.

### *3. Corrected Daily Loading Rates*

The greatest corrected daily loading average was from the Little Pond Outlet site at 20.6 kg/day. Bantam Lake Outlet recorded the second highest average corrected daily loading rate at 15.6 kg/day. After that, Bantam Pond Outlet had the next highest average at 8.2 kg/day. The averages for Dog Pond Outlet and West Branch Bantam River were very similar at 3.5 and 3.7 kg/L, respectively. The lowest average corrected daily loading rate was from Whittlesey Brook Inlet at 1.0 kg/day. No significant differences were found among the site averages. The 2025 averages were more consistent with the 2024 averages than they were with the 2023 averages.

### 4. *Corrected and Standardized Daily Loading Rates*

Whittlesey Brook Inlet and Bantam Pond Outlet had the lowest 2025 corrected and standardized daily total nitrogen loading averages at 1,332 and 1,492 mg/day/acre, respectively. Dog Pond Outlet and West Branch Bantam River averages were similar at 1,766 and 2,128 mg/day/acre, respectively. The highest averages were from Little Pond Outlet and Bantam Lake Outlet at 3,059 and 3,628 mg/day/acre, respectively. Those sites also had the greatest variability (Fig. 4). No statistically significant differences were detected among the 2025 site averages.

## E. Additional Little Pond Watershed Sites

Data from samples collected in 2025 at the additional two sites in the Little Pond Outlet subwatershed were compiled in Table 4. Those included total phosphorus and total nitrogen concentrations, estimations of daily loading based on discharge at the sites, corrected daily loading and corrected and standardized daily loading.

Table 4. Total phosphorus and total nitrogen concentrations, daily loading and corrected daily loading at the Litte Pond Watershed B, Little Pond Watershed A, and Little Pond Outlet sites in 2024.

| Date | Site | Total Phosphorus | | | | Total Nitrogen | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Conc. (µg/L) | Loading (kg/day) | Corrected (kg/day) | C&S (mg/day/ac) | Conc. (µg/L) | Loading (kg/day) | Corrected (kg/day) | C&S (mg/day/ac) |
| Apr 14 | LPW-B | 11 | 0.831 | -0.968 | -798.280 | 278 | 21.00 | -7.96 | -6562.57 |
| | LPW-A | 29 | 2.498 | 1.667 | 531.365 | 512 | 44.11 | 23.11 | 7364.13 |
| | LPO | 10 | 1.396 | -1.103 | -466.457 | 266 | 37.13 | -21.47 | -9085.15 |
| May 16 | LPW-B | 25 | 2.288 | -1.172 | -967.087 | 351 | 32.13 | -7.88 | -6497.00 |
| | LPW-A | 29 | 3.027 | 0.739 | 235.456 | 329 | 34.34 | 2.22 | 705.89 |
| | LPO | 38 | 6.426 | 3.399 | 1438.252 | 717 | 121.26 | 67.37 | 28504.38 |
| Jun 9 | LPW-B | --- | --- | --- | --- | --- | --- | --- | --- |
| | LPW-A | 30 | 1.481 | -0.176 | -55.993 | 381 | 18.81 | 0.13 | 42.23 |
| | LPO | 34 | 2.719 | 1.238 | 523.978 | 465 | 37.19 | 10.67 | 4512.79 |
| Jul 22 | LPW-B | 18 | 0.209 | -0.406 | -334.875 | 433 | 5.04 | -2.12 | -1747.70 |
| | LPW-A | 26 | 0.345 | 0.135 | 43.176 | 374 | 4.96 | -0.08 | -24.01 |
| | LPO | 31 | 0.666 | 0.321 | 135.926 | 481 | 10.33 | 1.98 | 838.23 |
| Aug 19 | LPW-B | 19 | 0.096 | -0.200 | -165.219 | 470 | 2.39 | -0.94 | -775.79 |
| | LPW-A | 24 | 0.139 | 0.043 | 13.547 | 374 | 2.17 | -0.22 | -70.37 |
| | LPO | 36 | 0.338 | 0.199 | 84.116 | 432 | 4.05 | 0.63 | 266.72 |
| Sep 25 | LPW-B | 12 | 0.066 | -0.147 | -121.451 | 257 | 1.41 | -1.29 | -1061.32 |
| | LPW-A | 15 | 0.094 | 0.028 | 8.932 | 268 | 1.68 | 0.27 | 85.07 |
| | LPO | 25 | 0.254 | 0.160 | 67.546 | 377 | 3.82 | 1.08 | 456.57 |
| Oct 17 | LPW-B | 20 | 0.255 | -0.135 | -111.580 | 360 | 4.58 | -2.34 | -1929.86 |
| | LPW-A | 19 | 0.276 | 0.021 | 6.768 | 310 | 4.50 | -0.08 | -26.24 |
| | LPO | 29 | 0.682 | 0.406 | 171.919 | 396 | 9.32 | 4.81 | 2037.05 |

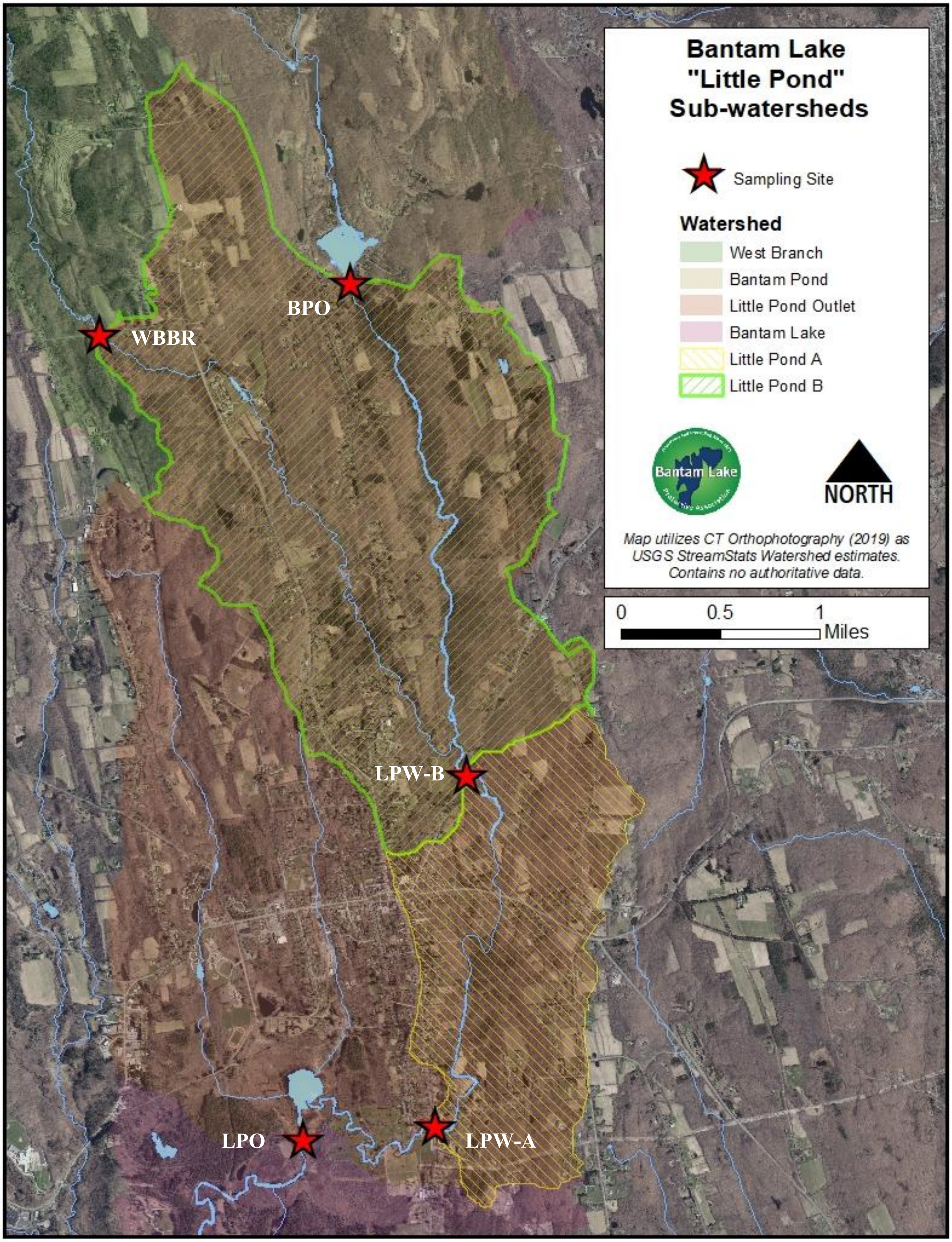


Figure 5. Map of the Little Pond Outlet subwatershed and locations of Little Pond Watershed A (LPW-A) and Little Pond Watershed B (LPW-B), and Little Pond Outlet (LPO) sites. Also shown are the West Branch Bantam River (WBBR) and Bantam Pond Outlet (BPO) sites.

The most northern site within the subwatershed was Little Pond Watershed B which was located below the confluence of the Bantam River and West Branch Bantam River (Fig. 5). Calculations of corrected daily loading for that site included subtracting out the daily loading of West Branch Bantam River and Bantam Pond Outlet site loads on corresponding days. Little Pond Watershed A was located downstream of Little Pond Watershed B. Therefore, calculation of corrected daily loading at Little Pond Watershed A included subtracting out daily loading at Little Pond Watershed B or subtracting out loads from West Branch Bantam River and Bantam Pond Outlet on June 9th when the Little Pond Watershed B sample was unavailable. Corrected daily loading for the original Little Pond Watershed was also recalculated by deducting loading from Little Pond Watershed A.

For total phosphorus, the lowest average concentration was from the Little Pond Watershed B site, and the highest was at the original Little Pond Outlet site. Season site average concentrations for Little Pond B, Little Pond A, and Little Pond Outlet sites were 15, 25, and 29 µg/L, respectively. Daily loading averages followed the same pattern. Respective daily loading averages 0.54, 1.12, and 1.78 kg/day.

Corrected loading at the Little Pond Watershed B site was consistently a negative number meaning more collective loading occurred at the two upstream sites – Bantam Pond Outlet and West Branch Bantam River sites – than was estimated at the Little Pond Watershed B portion. Between Little Pond Watershed B and Little Pond Watershed A, corrected loading increased. The greatest increase often occurred between Little Pond Watershed A and the original Little Pond Outlet site. Average corrected daily loading rates at Little Pond Watershed B, Little Pond Watershed A, and Little Pond Outlet sites were -0.43, 0.32, and 0.66 kg/day, respectively. When those were standardized by area in acres, respective averages were -356.9, 111.9, and 279.3 mg/day/acre.

The same trend in average loading rates was observed with total nitrogen data. For the Little Pond Watershed B, Little Pond Watershed A, and Little Pond Outlet sites, total nitrogen daily loading averages were 11.09, 15.79, and 31.87 kg/day, respectively. Respective corrected daily loading averages were -3.75, 3.62, and 9.30 kg/day. Respective corrected and standardized daily loading averages were -3,097.7, 1,153.8, and 3,932.9 mg/day/acre.

## V. Discussion

### A. General Observations for 2025

All statistically significant differences observed among the 2025 site total phosphorus averages, total nitrogen averages, and field measurement averages, based on the Kruskal-Wallis test are listed in Table 5.

The specific conductance trend observed in 2024 was also observed in 2025. Site averages along the West Branch of the Bantam River, e.g., West Branch Bantam River and Little Pond Outlet sites, were not significantly different from each other but were significantly greater than averages from other sites in the watershed, e.g., Bantam Pond Outlet and Bantam Lake Outlet. A notable difference in specific conductance averages in the last two years was that the Dog Pond Outlet average was significantly greater than the Whittlesey Brook Inlet and Bantam Pond Outlet averages in 2024 but not in 2025.

The highest specific conductance 'annual' averages in 2023, 2024, and 2025 were from the West Branch Bantam River site. The reasons behind this trend have not been investigated. In theory, high conductivity can be due to local geology, but can also be due to anthropogenic factors, e.g., high levels of road runoff carrying deicing salts, septic systems, wastewater treatment plants, or agricultural runoff (NHDES 2011).

The increase in specific conductance at Whittlesey Brook Inlet in 2025 was also notable. Early season levels in 2025 were consistent with the 2024 season average of 131 µS/cm. However, by late July levels had increased to 220 µS/cm and peaked at 251 µS/cm by mid-September. This suggests that a disturbance in that portion of the watershed occurred in the early to mid-part of the season. This finding underlines the value that specific conductance data provides in tracking watershed changes despite the simplicity in data collection.

Table 5. Summary of statistically significant differences among 2025 site averages for nutrient data and in-situ field data. Differences were based on the Kruskal-Wallis test ($p<0.003333$).

| **Variable (Average)** | **Significant Differences Between Averages** |
|---|---|
| Specific Conductance | West Branch Bantam River > Bantam Lake Outlet<br>West Branch Bantam River > Bantam Pond Outlet<br>Little Pond Outlet > Bantam Pond Outlet |
| Total Phosphorus Concentration | West Branch Bantam River > Dog Pond Outlet |
| Total Phosphorus Daily Loading | Bantam Lake Outlet >Dog Pond Outlet<br>Bantam Lake Outlet > Whittlesey Brook Outlet<br>Little Pond Outlet > Whittlesey Brook Outlet |
| Total Phosphorus Corrected & Standardized Daily Loading | West Branch Bantam River > Bantam Lake Outlet |
| Total Nitrogen Daily Loading | Bantam Lake Outlet > Whittlesey Brook Inlet<br>Bantam Lake Outlet > Dog Pond Outlet<br>LPO > Whittlesey Brook Inlet |

There were several sections of the watershed that stood apart with regards to phosphorus exports in 2025. In the uppermost reaches of the watershed, West Branch Bantam River site had a significantly higher average total phosphorus concentration than the Dog Pond Outlet site average. The West Branch Bantam River also had a significantly higher corrected and standardized average total phosphorus loading rate than the Bantam Lake Outlet average. As observed in the past two years, the Bantam Lake Outlet and Little Pond Outlet had significantly higher average uncorrected daily total phosphorus loading rates than the small headwater sections of the watershed resulting from the higher discharge rates from the larger drainage areas (see Table 2).

Statistically significant differences between site average total nitrogen concentrations and loading rates were lacking compared to total phosphorus. Bantam Lake Outlet and Little Pond Outlet daily total nitrogen loading averages were statistically greater than the smaller headwater sites. This finding is consistent with uncorrected total phosphorus findings and likely due to the greater land area and discharge rates for those sites.

The 2025 average phosphorus concentrations and loading rates were generally consistent with 2023 and 2024 averages on a site-by-site basis with a few exceptions (Fig. 3). Total phosphorus at West Branch Bantam River was notably higher in 2025 compared to past years. The 2023 loading rate averages at Little Pond Outlet and Bantam Lake Outlet were notably higher than in 2024 and 2025. This was described in the 2024 report XXX when comparing 2023 and 2024 and was attributed to the high 2023 estimated discharge rates. The same applied to the 2023 corrected and corrected and standardized total phosphorus loading averages at Little Pond Outlet. Corrected and standardized phosphorus loading rate averages at the other sites over the three years appear more stable. There was a three-year decrease in annual average corrected and standardized phosphorus loading at Dog Pond Outlet, Whittlesey Brook Inlet, and Bantam Pond Outlet, and a three-year increase at West Branch Bantam River (Fig. 3).

Although not significantly different from other site averages, Bantam Pond Outlet continued from 2024 to have the highest corrected total phosphorus loading average. In 2024 the Bantam Pond Outlet corrected daily loading average was significantly higher than the sites with the lowest averages. As previously noted, nutrient exports from the Bantam Pond Outlet portion of the watershed appeared overlooked in the Bantam Lake Watershed-Based Plan with no proposed projects in that area. This is despite the presence of the Torrington Country Club (an approximately 132-acre, 18-hole golf course), numerous agricultural fields (over 200 acres) and an impounded waterbody (Ivey Mountain Pond) which directly border Ivory Mountain Brook (Fig. 6). Ivey Mountain Brook is a major tributary to the Bantam River north of Bantam Pond Outlet. Plans are being developed to investigate potential erosion sites and nutrient sources along the watercourses in that part of the watershed in conjunction with Northwest Conservation District.

Bantam Lake Outlet and Little Pond Outlet exhibited the greatest 2025 average total nitrogen loading rates, and for the same reasons that total phosphorus loading rates were greatest at those sites. Average 2025 total nitrogen loading rates continued to be lowest at Whittlesey Brook Outlet and Dog Pond Outlet, like they were in 2023 and 2024, and were significantly lower than the sites with the highest loading rates (Table 5). The highest 2025 averages for corrected daily loading and corrected and standardized daily loading were from the Bantam Lake Outlet and Little Pond Outlet sites (Fig 4). This differed from 2024 results when Bantam Pond Outlet, followed by Bantam Lake Outlet, had the highest average corrected loading rates. In 2024, the West Branch Bantam River had the highest average corrected and standardized loading rate followed by the Dog Pond Outlet and Bantam Pond Outlet averages.

Figure 6. Aerial photograph of agricultural land and an impoundment along the Ivory Mountain Brook in the northern region of the Bantam Lake watershed, in the Bantam Pond Outlet subwatershed.

## B. Multi-year Total Phosphorus and Total Nitrogen Trends

Total phosphorus data collected in the 2023 through 2025 seasons were combined and statistically tested for differences among the three-year site averages (Table 6). For total nitrogen, the 2023 data was omitted from the analyses due to discrepancies. Two statistical tests were applied to the datasets: the Kruskal-Wallis Test with Dunn's Post Hoc Test and Analysis of Variance (ANOVA) with Turky's Test. The latter is considered more rigorous with higher standards for the data including normal distribution and similar variance. When datasets do not meet those standards, as can occur with smaller datasets, the Kruskal-Wallis analysis can be used.

Data was visually displayed using "box and whisker" plots which mathematically separate a dataset into quartiles where each quartile represents one-fourth of all points: the two inner "boxes" or the second and third quartiles, are separated by the median or middle value within the dataset (Figs. 7, 8 & 9). The whiskers represent the first and fourth quartiles; those "whiskers" provide insights into the variability of the dataset, i.e. how dispersed those data are. The "X" in each plot indicates the average for each data set. Outliers are points which did not mathematically fit within the quartiles (e.g., see total phosphorus concentration for Bantam Pond Outlet in Fig. 8).

The three-year average total phosphorus concentrations at Bantam Pond Outlet, Little Pond Outlet, and West Branch Bantam River were statistically greater than the three-year Dog Pond average based on both statistical tests. This differed from analyses of the 2023-2024 dataset, with the addition of the Little Pond Outlet and West Branch Bantam River averages (Table 6). Like with the results from the 2023-2024 nitrogen concentration analysis, no significant differences were detected among total nitrogen concentration site averages using the 2024-2025 dataset.

Average total phosphorus daily loading rates at Bantam Lake Outlet and Little Pond Outlet continued to be significantly higher than the averages of the smaller, headwater sites, e.g., Dog Pond Outlet and Whittlesey Brook Inlet. The addition of the 2025 data also resulted in the Bantam Lake Outlet and Little Pond Outlet averages becoming significantly greater than the Bantam Pond Outlet and West Branch Bantam River site averages as well.

Results from the 2024-2025 total nitrogen data also indicated statistically higher loading rates at Bantam Lake Outlet and Little Pond Outlet sites. The average Bantam Pond Outlet daily loading was significantly greater than that at Whittlesey Brook Inlet average using the 2024-2025 data, like it was when 2023-2024 data was used. Significant differences that were not detected last year with the 2023-2024 data but were with the 2024-2025 data and Kruskal-Wallis test and included: Bantam

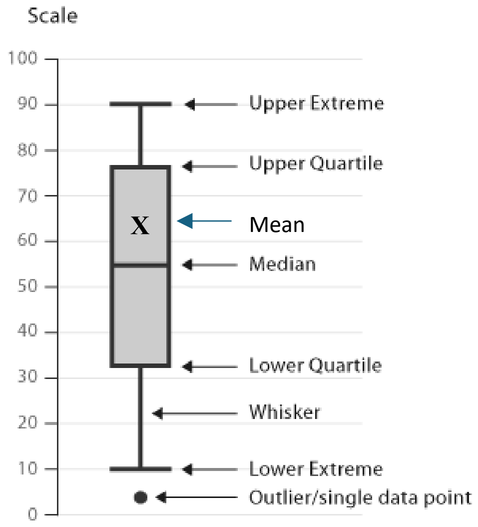
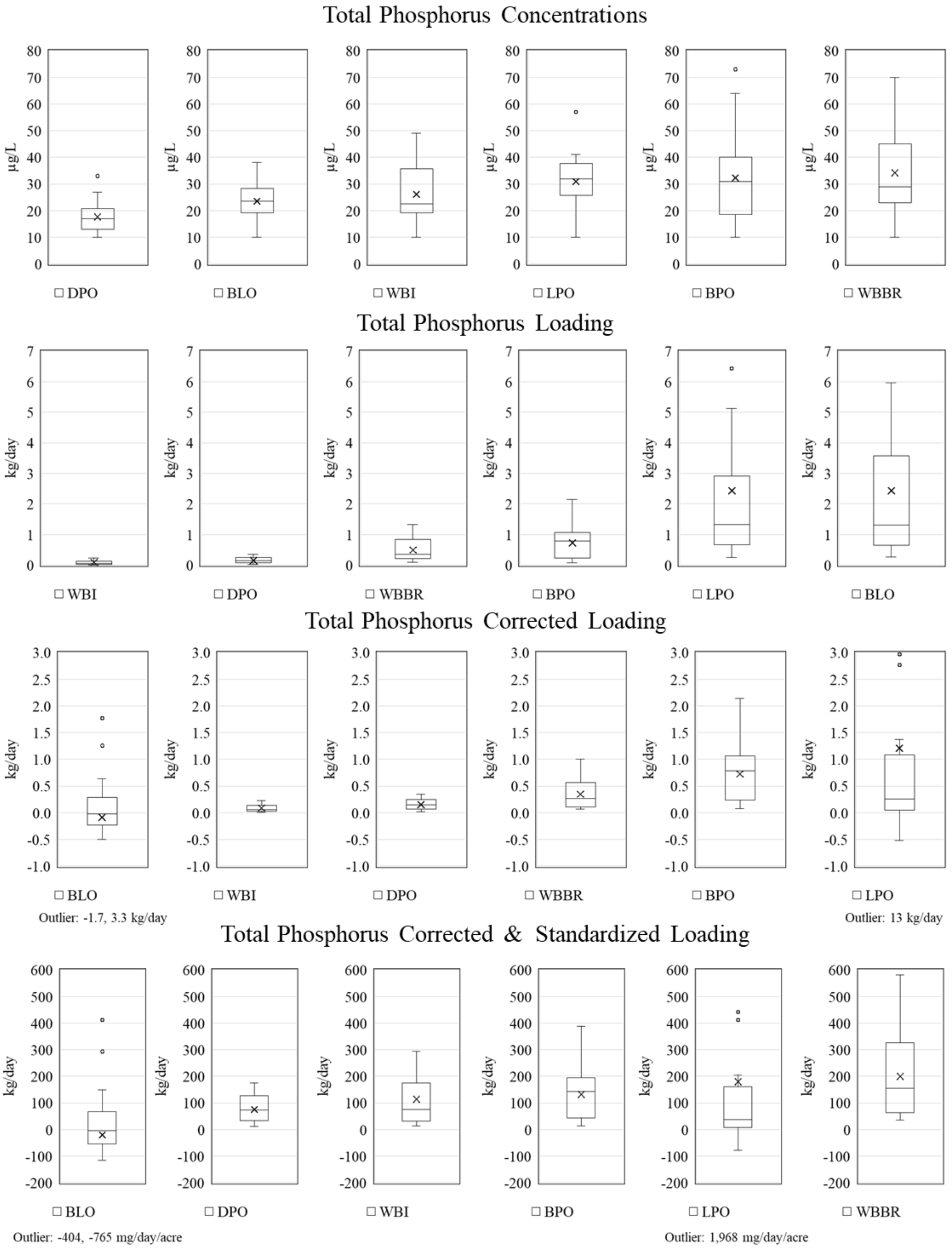


Figure 7. Diagram of a box and whisker plot. https://medium.com/analytics-vidhya/the-box-plot-a-simple-but-informative-visualization-cacc20d9ff25

Lake Outlet total nitrogen loading average being significantly greater than the West Branch Bantam River average; and the West Branch Bantam River average was significantly greater than the Whittlesey Brook Inlet average. Last year no significant differences were detected with ANOVA among the 2023-2024 site average loading rates. This year, with the 2024-2025 data and ANOVA significant differences in site averages were detected and were like those produced with the Kruskal-Wallis test (Table 6).

Table 6. Results of statistical tests for differences among the combined 2023-2025 total phosphorus and 2024-2025 total nitrogen site concentrations and average loading rates. Bold italicized results indicate a change from results using 2023 to 2024 data. Alpha for Kruskal-Wallis = 0.0033. Alpha for ANOVA = 0.05. BLO = Bantam Lake Outlet; BPO = Bantam Pond Outlet; DPO = Dog Pond Outlet; LPO = Little Pond Outlet; WBBR = West Branch Bantam River; and WBI = Whittlesey Brook Inlet.

| Variables | Kruskal-Wallis | | ANOVA | |
|---|---|---|---|---|
| | Sites | p-value | Sites | p-value |
| Total Phosphorus Concentration | ***BPO > DPO*** | p<0.0005 | BPO > DPO | p<0.005 |
| | LPO > DPO | p<0.0001 | ***LPO > DPO*** | p<0.01 |
| | ***WBBR > DPO*** | p<0.00005 | ***WBBR > DPO*** | p<0.0005 |
| Total Phosphorus Daily Loading | BLO > DPO | p<0.00000001 | ***BLO > BPO*** | P<0.05 |
| | BLO > WBI | p<0.00000001 | BLO > DPO | p<0.005 |
| | BPO > DPO | p<0.00005 | ***BLO > WBBR*** | p<0.005 |
| | **BPO > WBI** | p<0.00001 | BLO > WBI | p<0.001 |
| | LPO > DPO | p<0.00000001 | ***LPO > BPO*** | p<0.05 |
| | LPO > WBI | p<0.0005 | LPO > DPO | p<0.005 |
| | | | LPO > WBBR | p<0.01 |
| | | | LPO > WBI | p<0.001 |
| Total Phosphorus Corrected Daily Loading | BPO > BLO | p<0.0005 | ***LPO > BLO*** | P<0.05 |
| | BPO > DPO | p<0.0029 | | |
| | BPO > WBI | p<0.000005 | | |
| | ***WBBR > BLO*** | p<0.003 | | |
| | ***WBBR > WBI*** | p<0.003 | | |
| Total Phosphorus Corrected / Standardized Daily Loading | BPO > BLO | p<0.0005 | ***WBBR > BLO*** | p<0.05 |
| | WBBR > BLO | p<0.000005 | | |
| | ***WBI > BLO*** | p<0.0033 | | |
| Total Nitrogen Concentration | No significant differences | | No significant differences | |
| Total Nitrogen Daily Loading | BLO > DPO | p<0.0001 | ***BLO > BPO*** | p<0.05 |
| | ***BLO > WBBR*** | p<0.003 | ***BLO > DPO*** | p<0.001 |
| | BLO > WBI | p<0.00000001 | ***BLO > WBBR*** | p<0.005 |
| | BPO > WBI | p<0.00005 | ***BLO > WBI*** | p<0.0005 |
| | LPO > DPO | p<0.0005 | ***LPO > DPO*** | p<0.005 |
| | LPO > WBI | p<0.0000001 | ***LPO > WBBR*** | p<0.05 |
| | ***WBBR > WBI*** | p<0.0033 | ***LPO > WBI*** | p<0.005 |
| Total Nitrogen Corrected Daily Loading | ***BLO > WBI*** | P<0.00005 | No significant differences | |
| | BPO > WBI | p<0.0033 | | |
| Total Nitrogen Corrected / Standardized Daily Loading | No significant differences | | No significant differences | |



Outlier: -1.7, 3.3 kg/day

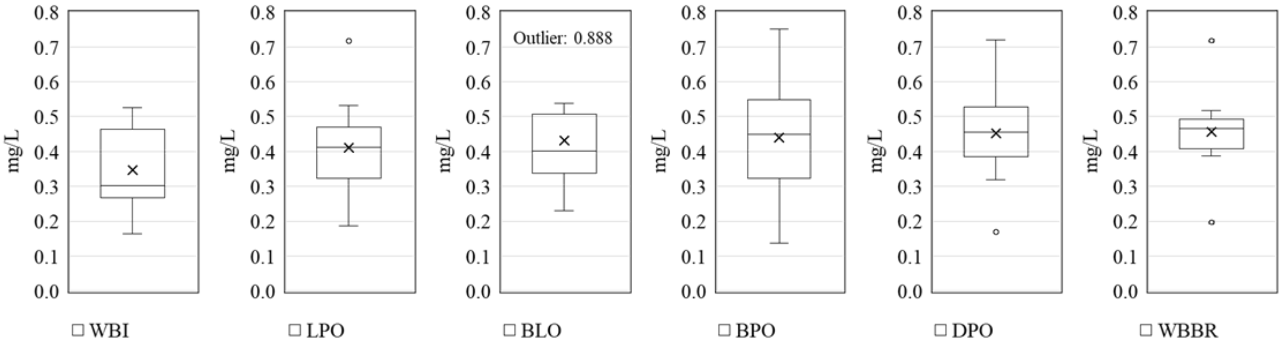
Outlier: 13 kg/day

Outlier: -404, -765 mg/day/acre

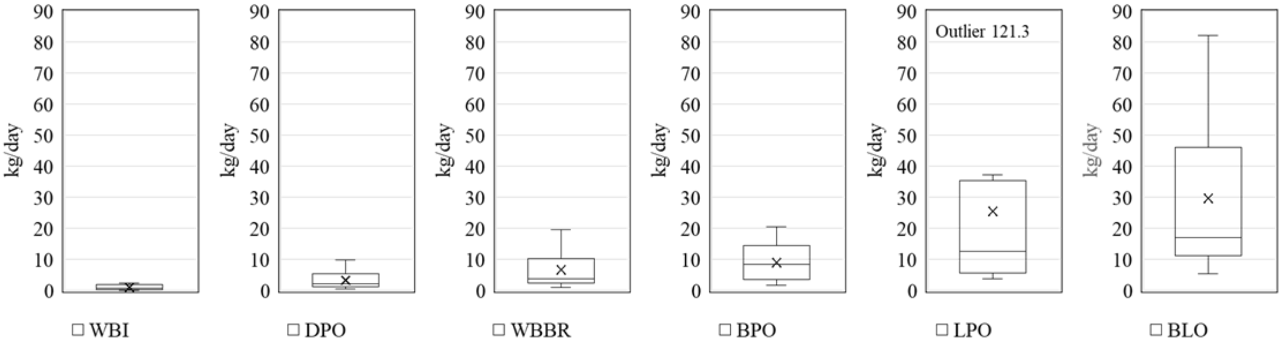
Outlier: 1,968 mg/day/acre

Figure 8. Box and whisker plots for combined 2023-2025 total phosphorus concentrations, loading rates, corrected loading rates, and corrected and standardized loading rates at Bantam Lake Outlet (BLO), Bantam Pond Outlet (BPO), Dog Pond Outlet (DPO), Little Pond Outlet (LPO), West Branch Bantam River (WBBR), and Whittlesey Brook Inlet (WBI). The site order for each series was based on the two-season averages. Outliers not shown on each plot are listed below the plot.

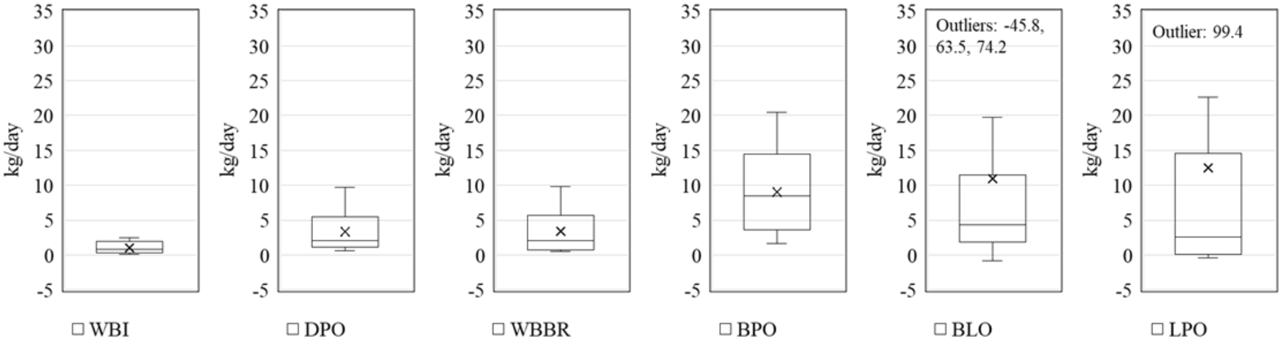
Total Nitrogen Concentrations



Total Nitrogen Loading



Total Nitrogen Corrected Loading



Total Nitrogen Corrected & Standardized Loading

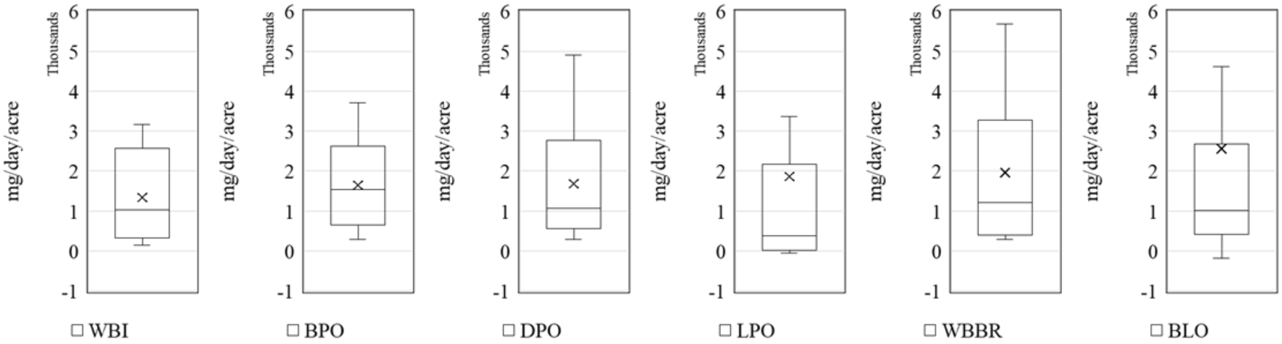


Figure 9. Box and whisker plots for combined 2024/2025 total nitrogen concentrations, loading rates, corrected loading rates, and corrected and standardized loading rates at Bantam Lake Outlet (BLO), Bantam Pond Outlet (BPO), Dog Pond Outlet (DPO), Little Pond Outlet (LPO), West Branch Bantam River (WBBR), and Whittlesey Brook Inlet (WBI). The site order for each series was based on the two-season averages. Outliers were not shown for LPO loading, corrected loading, and corrected and standardized loading; and, for Bantam Lake Outlet corrected and standardized loading.

Analyses of corrected total phosphorus daily loading rates over the three-year period continued to result in averages at several sites being significantly higher than averages of others. Like with analysis of 2023-2024 data, the three-year Bantam Pond Outlet average was significantly greater than the Bantam Lake Outlet, Dog Pond Outlet, and Whittlesey Brook Inlet site averages. With the addition of the 2025 data, West Branch Bantam River 3-year average was significantly greater than the Bantam Lake Outlet and Whittlesey Brook Inlet site averages. Undetected with the 2-year dataset but detected with ANOVA and the 3-year dataset, the Little Pond Outlet corrected total phosphorus loading site average was significantly greater than the Bantam Lake Outlet site average.

The corrected total nitrogen loading average at Bantam Pond Outlet, based on 2024-2025 data and Kruskal-Wallis, was significantly greater than the Whittlesey Brook Inlet site average as it was based on 2023-2024 data. The 2024-2025 analysis also revealed that the Bantam Lake Outlet site average was also significantly greater than the Whittlesey Brook Inlet site average.

As was the case with the 2023-2024 data, no significant differences were detected among the 2024-2025 total nitrogen daily loading site averages that were corrected and standardized by area. Corrected and standardized total phosphorus site averages at Bantam Pond Outlet and West Branch Bantam River, using the 3-year dataset and Kruskal-Wallis, were significantly higher than the Bantam Lake Outlet average, which mirrors last year's results. Unlike with the 2-year datasets, analyses of the 3-year datasets also resulted in the Whittlesey Brook Inlet site corrected and standardized average being significantly greater than the Bantam Lake Outlet site average. Based on ANOVA and the three-year dataset, the West Branch Bantam River corrected and standardized total phosphorus average was significantly greater than the Bantam Lake Outlet average.

It should be noted that the analyses above are not intended to give more importance to results using *corrected and standardized* site averages vs. the *corrected* site averages. Both assessments provide useful insights into the nutrient loading from sections of the watershed and should be considered, along with other analyses, to characterize contributions from different regions of the watershed.

### C. Estimated 2023-2025 Loading Rates vs TMDL

Some of the objectives of the watershed monitoring program were to understand nutrient loads to Bantam Lake, to see how they compare to those estimated in the Bantam Lake Appendix to the State's TMDL, and perhaps more importantly, to see how they compared to the loading rate target goals set in the TMDL document. Once BMP projects from the Watershed-Based Plan are implemented, the monitoring program will also provide a baseline to measure loading reductions due to those implemented projects.

The total phosphorus annual load to the lake was estimated in the TMDL at 1,614 kg/yr. Of that, 1,012 kg/yr or 63% was exported from the watershed. The watershed portion was based on loading from the Bantam River, from Whittlesey Brook, and from the proximal watershed, i.e., that area around the lake that drains directly to the lake. Proximal watershed loading was based on septic system inputs and waterfowl. The Lake Loading

Response Model (LLRM) was used to estimate the loading rate from the Bantam Lake watershed. For more information on the modelling process, see Chapter 6 of the *Appendix 1: Bantam Lake Watershed from the CT State Lake Nutrient TMDL*.

To estimate total phosphorus loading for 2023, 2024, and 2025, the uncorrected daily loading rates from Little Pond Outlet (the analog to loading from the Bantam River watershed in the TMDL) and Whittlesey Brook Inlet were averaged for each year and multiplied by 365 to obtain the *annual* loading rates for each source. The three-year average for each was determined. The proximal total phosphorus loading from the immediate lake watershed, used in the TMDL, of 114.9 kg/yr was applied to the 2023, 2024, and 2025 estimates. Not applied was attenuation of some of the phosphorus in the subwatersheds (as described in the Bantam Appendix of the TMDL) within the whole watershed as it was in the TMDL Bantam Lake Appendix.

Nutrient attenuation refers to the reduction of phosphorus and nitrogen as it moves through the system by a combination of biotic processes such as uptake into organisms living in the water, sediments or streambanks, and through abiotic processes such as sedimentation (MPCA 2022). Attenuation is considered a form of storage. Short-term storage includes plankton and riverbed sediment that is resuspended with every storm. Long-term storage includes that delivered into floodplains, e.g. wetlands along Bantam River and sediments in lakes and ponds, e.g. Bantam Pond or Little Pond.

Recognition of the differences in the modeling methods used in the TMDL analysis and those used to estimate annual loading rates from the last three years are important. Data used in the TMDL was collected in April through October from 2007 to 2016, with two years of data – 2011 and 2016 – deemed outliers and excluded. In addition to the LLRM, another model – BATHTUB – was utilized to determine atmospheric deposition and internal loading of phosphorus. As noted earlier, attenuation was factored into the TMDL model but was not applied in estimates for 2023, 2024 and 2025 loading estimates.

The 2023-2025 average annual total phosphorus loading rate was 1,034 kg/yr, which was comparable to the estimated watershed annual loading rate in the TMDL of 1,012 kg/yr (Table 7). It is worth noting that the summer of 2023 had record rainfall which likely increased the loading that year since the volumes of water passing through each sample collection site was much greater than average. For example, average discharge at the Little Pond Outlet site, based on discharge during sampling events and the surrogate watershed method, was 51.8 cubic feet per second (CFS) in 2023, but only 26.0 CFS in 2024 and 26.5 CFS in 2025.

The same assessment of the combined 2023-2025 total phosphorus loading data was applied to the combined 2023-2025 total nitrogen loading data (Table 8). Differences between the 2023 annual total nitrogen loading and both the 2024 and 2025 annual loads and TMDL estimated load were salient (Table 8). The 2024 and 2025 annual loading rates were more in line with the TMDL estimated annual loading.

Table 7. Estimates of total phosphorus loading from the Bantam watershed in 2023, 2024, 2025 and in the TMDL. Also provided is the annual target loading rate from the Bantam Appendix of the TMDL. Bantam River Loading from 2023-2025 was based on data collected at the Little Pond Outlet site.

| | 2023 Annual (kg/year) | 2024 Annual (kg/year) | 2025 Annual (kg/year) | 2023-2025 Average (kg/year) | TMDL Estimated (kg/yr) | TMDL Target (kg/yr) |
|---|---|---|---|---|---|---|
| Bantam River | 1,578.7 | 105.7 | 204.5 | 887.3 | 846.2 | |
| Whittlesey | 40.1 | 29.3 | 27.7 | 32.0 | 51.2 | |
| Proximal | 114.9 | 114.9 | 114.9 | 114.9 | 114.9 | |
| Watershed | 1,735.5 | 680.7 | 855.6 | 1034.2 | 1012.3 | 762.90 |
| Internal | | | | | 560.0 | |
| Atmosphere | | | | | 42.0 | |
| | | | | TMDL Totals | 1614.3 | 1211.1 |

Table 8. Estimates of total nitrogen loading from the Bantam watershed in 2023, 2024, 2025, and in the TMDL. Also provided is the annual target loading rate from the Bantam Appendix of the TMDL. Bantam River Loading from 2023-2025 was based on Little Pond Outlet.

| | 2023 Annual (kg/year) | 2024 Annual (kg/year) | 2025 Annual (kg/year) | 2024-2025 Average (kg/year) | 2024-2025 Average (kg/year) | TMDL Estimated (kg/yr) | TMDL Target (kg/yr) |
|---|---|---|---|---|---|---|---|
| Bantam River | 77,929.4 | 1,639.7 | 6,015.6 | 37,387.1 | 9,323.0 | 19,427.2 | |
| Whittlesey | 1,152.1 | 375.7 | 373.5 | 710.6 | 374.6 | 1,130.9 | |
| Proximal | 2,303.2 | 2,303.2 | 2,303.20 | 2,303.2 | 2,303.2 | 2,303.2 | |
| Watershed | 81,384.7 | 4,318.6 | 8,692.3 | 40,400.9 | 12,000.8 | 22,861.3 | 20,326.0 |
| Internal | | | | | | NA | |
| Atmosphere | | | | | | 3,945.0 | |
| | | | | | TMDL Totals | 26,806.3 | |

The relationship between the total nitrogen concentrations in 2023, 2024, and 2025 was analyzed with ANOVA. A highly significant difference ($p<0.005$) was detected between the 2023 average and averages for both 2024 and 2025 ($p<0.00005$). The 2023 average was 1,058 µg/L and more than twice the 2024 and 2025 averages of 405 and 441 µg/L, respectively. The 2023 nitrogen data was characterized in earlier reports as suspect which led to the change in laboratory services to the University of Connecticut Center of Environmental Science and Engineering. By omitting the 2023 data from these analyses, the average annual total nitrogen loading was 12,000.8 kg/yr, which was below but more in line with the TMDL estimate.

In future years, the 2023 data may be characterized as anomalous and omitted from future analyses. As noted above, the development of loading estimates in the Bantam TMDL included omission of several years of anomalous data.

## D. Subwatershed Contributions

The total phosphorus and total nitrogen exports from each of the five subwatersheds draining to Bantam Lake were examined. For total phosphorus, the average annual corrected loading estimates and average annual corrected and standardized estimates for Bantam Pond subwatershed, Dog Pond subwatershed, Little Pond subwatershed, West Branch Bantam River subwatershed, and Whittlesey Brook subwatershed, based on data collected from 2023 to 2025, were expressed as a percentage of the total watershed export to the lake. For total nitrogen, the same loading estimates were used for the same subwatersheds, but only the data collected in 2024 and 2025 were used. Numeric results are provided in Table 9. Those values were used in creating maps exhibiting contributions as a percentage of the whole. The total average annual corrected and standardized total phosphorus map is below (Fig. 10). The other maps can be found in Appendix D.

Table 9. Percentage of annual corrected and corrected and standardized total phosphorus (TP) and total nitrogen (TN) by subwatersheds within the Bantam Lake watershed. BLO = Bantam Lake Outlet; BPO = Bantam Pond Outlet, LPO = Little Pond Outlet; WBBR = West Branch Bantam River; WBI = Whittlesey Brook Inlet

| | BPO | DPO | LPO | WBBR | WBI |
|---|---|---|---|---|---|
| % Annual Corrected TP Export (Avg. Rate: kg/yr) | 28.9%<br>(265.2 kg/yr) | 6.0%<br>(54.8 kg/yr) | 48.0%<br>(441.1 kg/yr) | 13.7%<br>(126.1 kg/yr) | 3.5%<br>(32.0 kg/yr) |
| % Annual Corrected and Standardized TP Export (Avg. Rate: g/yr/acre) | 18.8%<br>(48.2 g/yr/ac) | 10.8%<br>(27.6 g/yr/ac) | 25.6%<br>(65.6 g/yr/ac) | 28.5%<br>(73.0 g/yr/ac) | 16.3%<br>(41.6 g/yr/ac) |
| % Annual Corrected TN Export (Avg. Rate: kg/yr) | 31.3%<br>(3,040 kg/yr) | 12.6%<br>(1,218 kg/yr) | 39.5%<br>(3,828 kg/yr) | 12.8%<br>(1,237 kg/yr) | 3.9%<br>(375 kg/yr) |
| % Annual Corrected and Standardized TN Export (Avg. Rate: g/yr/acre) | 18.8%<br>(552 g/yr/ac) | 20.9%<br>(614 g/yr/ac) | 19.4%<br>(570 g/yr/ac) | 24.4%<br>(716 g/yr/ac) | 16.6%<br>(487 g/yr/ac) |

The highest average annual corrected total phosphorus and total nitrogen loading rates were from the Little Pond subwatershed, followed by the Bantam Pond subwatershed, and the West Branch Bantam River subwatershed. Average annual total phosphorus loading on a per acre basis was highest at West Branch Bantam River subwatershed, followed by Little Pond subwatershed, and Bantam Pond subwatershed. Percent contributions for average annual total nitrogen on a per acre basis was highest at West Branch Bantam River with several of the other subwatershed within 2% of each other.

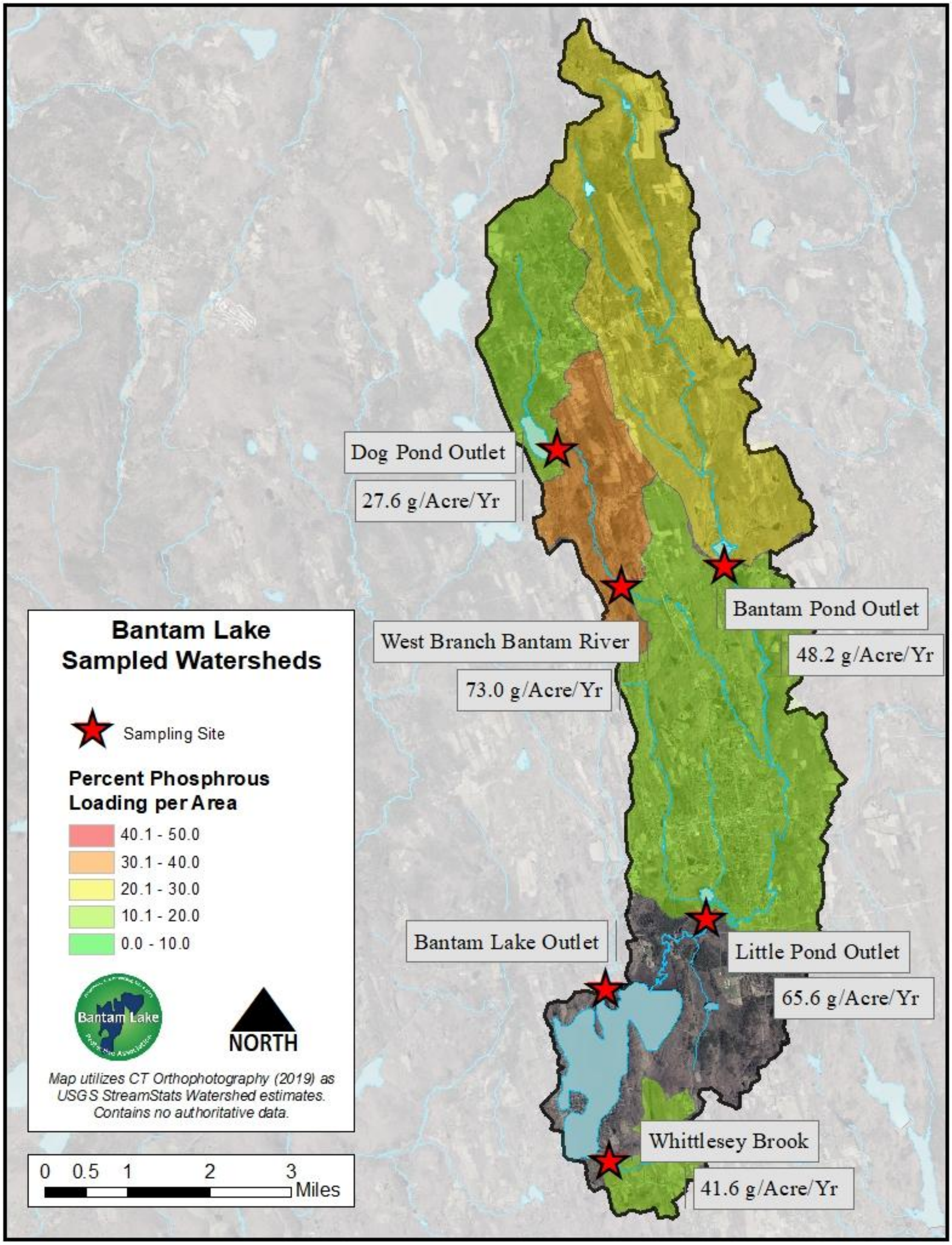


Figure 10. Map displaying relative percentage of average annual total phosphorus loading rate from the five subwatershed areas in the Bantam Lake Watershed on a per acre basis. Average annual loading rates per acre are also provided.

### E. Little Pond Watershed

All data collected at the sites within the Little Pond Outlet subwatershed (Fig. 5) over the last two years were analyzed for trends. The combined 2024-2025 data exhibited the same type of trends as observed with the 2025 data. The lowest average uncorrected, corrected, and corrected and standardized loading rates were generally from the Little Pond Subwatershed B site, and the highest averages were from the Little Pond Outlet site.

Additionally, Kruskal-Wallis tests and ANOVA were applied to the data. Results from analyses are shown in Table 9. Significant differences were detected using both tests. The Little Pond Watershed B average total phosphorus concentration was significantly less than the Little Pond Outlet average using Kruskal-Wallis, and Little Pond Outlet average was significantly greater than averages at the other two sites based on ANOVA. Kruskal-Wallis test results were the same for averages of total phosphorus and total nitrogen corrected daily loading and corrected and standardized daily loading, i.e., the Little Pond Watershed B averages were significantly less than the averages at the other two sites. Similar results were observed using ANOVA.

Table 10. Results from statistical tests of 2024-2025 averages from the three sites in the Little Pond Outlet subwatershed: Little Pond Outlet (LPO), Little Pond Watershed A (LPW-A), and Little Pond Watershed B (LPW-B). Kruskal-Wallis corrected $\alpha = 0.01667$ for. ANOVA $\alpha = 0.05$.

| 2024-2025 Averages | Kruskal-Wallis | ANOVA |
|---|---|---|
| Total Phosphorus Concentration | LPW-B < LPO | LPW-A, LPW-B < LPO |
| Total Phosphorus Daily Loading | No differences | No difference |
| Total Phosphorus Corrected Daily Loading | LPW-B < LPW-A, LPO | LPW-B < LPO |
| Total Phosphorus Corrected and Standardized Daily Loading | LPW-B < LPW-A, LPO | LPW-B < LPW-A, LPO |
| Total Nitrogen Concentration | No differences | No differences |
| Total Nitrogen Daily Loading | No differences | No differences |
| Total Nitrogen Corrected Daily Loading | LPW-B < LPW-A, LPO | No differences |
| Total Nitrogen Corrected and Standardized Daily Loading | LPW-B < LPW-A, LPO | LPW-B < LPO |

Of the three sites, significantly lower average corrected and corrected and standardized loading rates for both phosphorus and nitrogen were from the Little Pond Watershed B site which is downstream of the West Branch Bantam River (at Brook Road) and Bantam Pond Outlet (at Weed Road) sites. Much of the area between the upstream sites and Little Pond Watershed B site, i.e., northern half of the subwatershed, is undeveloped and nutrient attenuation may be occurring. Nutrient loading in the Little Pond Outlet subwatershed appears to occur below the Little Pond Watershed B site, i.e. southern half of the subwatershed, where there is a higher concentration of development, impervious surfaces, and the Litchfield Country Club.

## F. Blanks and Duplicate Sampling

The Bantam Lake and Watershed QAPP (BCG 2022) included quality assurances and quality control practices, including collections of duplicates and blank samples for the laboratory performing analyses. These practices were included in the 2025 lake and watershed monitoring. For duplicates, a second sample was collected at one site for each sampling event and identified as duplicate. For a blank, a laboratory provided sample container was filled with store bought distilled water and labeled blank. This was performed for both the watershed and lake for most sampling events. Results from the analyses of those samples were provided Appendix D. Those data were used in analyses below.

Table 11. Relative Percent Differences for duplicate samples collected in the Bantam Lake watershed and in Bantam Lake. $NH_3$ = ammonia; TN = total nitrogen; TP = total phosphorus; ALK = alkalinity.

| Watershed | Date | $NH_3$ | TN | TP | ALK |
|---|---|---|---|---|---|
| | 14-Apr-25 | 200.0 | 22.8 | 60.9 | 0.0 |
| | 16-May-25 | 8.7 | 8.8 | 37.0 | 0.0 |
| | 9-Jun-25 | 10.5 | 4.7 | 5.3 | 2.3 |
| | 22-Jul-25 | 6.1 | 2.1 | 4.8 | 0.0 |
| | 19-Aug-25 | 8.7 | 5.3 | 11.8 | 4.9 |
| | 18-Sep-25 | 16.2 | 6.3 | 14.0 | 1.2 |
| | 17-Oct-25 | 15.4 | 2.5 | 0.0 | 0.0 |
| | Average | 37.9 | 7.5 | 19.1 | 1.2 |

| Lake | Date | $NH_3$ | TN | TP | ALK |
|---|---|---|---|---|---|
| | 14-Apr-25 | 0.0 | 8.1 | 11.8 | 0.0 |
| | 16-May-25 | 50.0 | 1.0 | 22.2 | 6.3 |
| | 9-Jun-25 | 28.6 | 3.5 | 4.3 | 2.4 |
| | 22-Jul-25 | 28.6 | 16.1 | 60.0 | 0.0 |
| | 19-Aug-25 | 0.0 | 3.4 | 15.4 | 5.0 |
| | 18-Sep-25 | --- | --- | --- | --- |
| | 17-Oct-25 | 16.0 | 6.8 | 2.2 | 2.3 |
| | Average | 20.5 | 6.5 | 19.3 | 2.7 |

A common method of comparing a sample and its duplicate is by calculating the *Relative Percent Difference* using the following formula:

$$RPD = \frac{|C_1 + C_2|}{\left(\frac{(C_1 + C_2)}{2}\right)} * 100$$

where RPD is Relative Percent Difference; $C_1$ is the concentration of the analyte from the identified sample, and $C_2$ is the concentration of the analyte from the duplicate sample. Results of those analyses were provided in Table 9. A RPD of ≤ 20% is generally considered an acceptable result for a duplicate sample when results are 5 to 10 times greater than the laboratory reporting limit. When results are closer to the reporting limit, the RPD can exceed 20%. The RPD can also be influenced by the analyte and matrix.

All watershed and lake alkalinity RPD values were <7%. All but one total nitrogen RPD were <20% (Table 10). Two total phosphorus RPDs from watershed samples and one from lake samples were >20% but the season averages for both were <20%. Ammonia RPD values and its season average were the highest of the set of analytes tested. This was largely due to measured levels being very low and very close to the reporting limits.

## VI. Conclusions and Recommendations

The continued development of the Bantam Lake watershed database since 2023 has improved the robustness of statistical analyses and the ability to see trends more clearly. Three subwatersheds within the Bantam Lake watershed proper have emerged as generating more total phosphorus and total nitrogen than the other subwatersheds: Bantam Pond Outlet subwatershed, West Branch Bantam River subwatershed, and Little Pond Outlet subwatershed (Table 11). Each of those a has potential nutrient sources that could be an important contributor to those subwatersheds. Within the Bantam Pond Outlet subwatershed lies the Torrington Country Club which drains toward the Ivory Mountain Brook which flows into the Bantam River north of Bantam Pond. There are also large tracts of farmland abutting Ivory Mountain Brook. The Woodridge Lake Sewage Treatment Facility lies within the West Branch Bantam River subwatershed and discharges to the West Branch of the Bantam River. The Litchfield Country Club lies adjacent to the Bantam River upstream of Little Pond and within the Little Pond Outlet subwatershed. That subwatershed also has a high concentration of development and impervious surfaces.

The additional sampling sites within the Little Pond Outlet subwatershed has provided insights into the nutrient sources within that subwatershed. The approximately lower 1/3rd of that subwatershed is contributing more total phosphorus and total nitrogen than the upper 2/3rds of that subwatershed. It is the bottom 1/3rd of the subshed that has the greatest residential areas, town centers, and the Litchfield Country Club. Similar types of subwatershed "dissections" could be performed to help identify sections of the watershed that might be contributing more nutrients than other. For example, a site on Ivory Mountain Brook above the Torrington Country Club or a site above the Woodridge Lake Sewage Treatment Facility on the West Branch of the Bantam River could aid in understanding how much or how little nutrients those potential sources are contributing to the system.

There are already several BMP implementation sites within the watershed in the planning process. The Bantam Watershed Monitoring Program should soon begin to fulfill its purpose of gauging how well the BMPs are reducing nutrient exports to Bantam Lake. A recommendation in the Bantam Lake Appendix of the State TMDL was to test for total suspended solids in water samples collected above and below the BMP sites for reference control and downstream test sites.

Table 12. Summary of results from analyses where an average of total phosphorus or total nitrogen concentration or loading rates (uncorrected, corrected, and corrected & standardized) is greater at a subwatershed than it is at another subwatershed. Analyses included use of just 2025 data, use of 2023-2025 phosphorus data, and use of 2024-2025 nitrogen data. BLO = Bantam Lake Outlet; BPO = Bantam Pond Outlet, LPO = Little Pond Outlet; WBBR = West Branch Bantam River; WBI = Whittlesey Brook Inlet

| Average | Dataset | Statistically Higher Than Others |
|---|---|---|
| Total Phosphorus Concentration | 2025 | WBBR |
| | 2023-2025 | BPO, LPO, WBBR |
| Total Nitrogen Concentration | 2025 | None |
| | 2024-2025 | None |
| Total Phosphorus Uncorrected Daily Loading | 2025 | BLO, LPO |
| | 2023-2025 | BLO, LPO |
| Total Nitrogen Uncorrected Daily Loading | 2025 | BLO, LPO |
| | 2024-2025 | BLO, LPO, WBBR |
| Total Phosphorus Corrected Daily Loading | 2025 | None |
| | 2023-2025 | BPO, LPO, WBBR |
| Total Nitrogen Corrected Daily Loading | 2025 | None |
| | 2024-2025 | BPO, BLO |
| Total Phosphorus Corrected & Standarized Daily Loading | 2025 | WBBR |
| | 2024-2025 | BPO, WBBR, WBI |
| Total Nitrogen Corrected & Standarized Daily Loading | 2025 | None |
| | 2024-2025 | None |

The Bantam Lake Watershed Monitoring Program has provided valuable information on nutrient exports from the individual subwatersheds. Average total phosphorus loading to Bantam Lake based on the last three years of data are consistent with that in the Bantam Appendix of the TMDL. The 2023 total nitrogen loading appears anomalous. However, with the exclusion of the 2023 data, the average total nitrogen loading falls below that in the TMDL. Continuing with the Bantam Lake Watershed monitoring program will provide additional resolution into both phosphorus and nitrogen loading into Bantam Lake and provide a robust baseline dataset.

Planning is already underway to implement BMPs from the Bantam Lake Watershed Based Plan (CEI 2021). The monitoring program will soon fulfill its second purpose of evaluating efficacy of implemented BMPs. The Bantam Appendix of the TMDL recommends adding total suspended solids to the analyses performed at sites above and below BMP implementation sites once work starts to take place. Strong lines of communication will be necessary between watershed stakeholders and the BLPA as BMP planning continues so the additional samples can be incorporated into the program.

The addition of two sampling sites within the Little Pond Outlet subwatershed has enriched our understanding of nutrient export from within that subwatershed. Similar site additions could increase understanding in other subwatersheds. For example, an additional site above the Torrington Country Club would aid in understanding how much or how little may be coming for that source. The same applies to the Woodridge Lake Sewage Treatment Facility. The BLPA and the Bantam Watershed Coalition should consider the addition of sites.

Little is currently known about the water quality in the ponds in the watershed, e.g., Bantam Pond (aka Timber Pond), Dog Pond, and Little Pond. Homeowner associations on those ponds should be engaged to develop an information sharing agreement. The Bantam Watershed Monitoring program data from the sites situated at the outlets of those ponds may be valuable to those homeowner groups. In exchange, water quality data from those ponds would be useful in understanding nutrient dynamics within the Bantam Watershed system. The Town of Goshen has a fact sheet that provides information on lake management efforts and names of committee members and is provided in Appendix F along with the URL. The Bantam Pond (aka Timber Pond) Homeowners Association has a Facebook site at https://www.facebook.com/profile.php?id=100061144534560&sk=directory_contact_info.

Land use and land cover (LULC) play an important role in watershed nutrient export understanding and management and was included in the Bantam Appendix of the TMDL using the UCONN CLEAR (2025) data (Fig. 6 in CT DEEP 2021b). That analysis quantified different land use / land cover types for the whole watershed. A similar assessment on a subwatershed by subwatershed basis could provide useful information with regards to prioritizing BMP implementation.

## VII. References

[AER] Aquatic Ecosystem Research. 2018. Bantam Lake Watershed Land Use Land Cover Analysis and Mapping

Bell, M. 1985. The Face of Connecticut. State Geological and Natural History Survey of Connecticut. Bull. 110.

Canavan RW, Siver PA. 1995. Connecticut Lakes: A study of the chemical and physical properties of fifty-six Connecticut Lakes. New London (CT): Connecticut College Arboretum.

[CEI] Comprehensive Environmental Inc. 2021. Bantam Lake Watershed Based Plan. EPA Contract Number BPA-68HE0118A0001-003. https://portal.ct.gov/-/media/deep/water/watershed_management/bantamlake/final-bantam-lake-watershed-based-plan.pdf

[CTECO] Connecticut Environmental Conditions Online. 2024. https://maps.cteco.uconn.edu/

[CT DEEP] Connecticut Department of Energy and Environmental Protection. 2021a. Connecticut Statewide Lake Nutrient Total Maximum Daily Load Core Document. https://portal.ct.gov/-/media/DEEP/water/watershed_management/BantamLake/CT-Statewide-Lake-Nutrient-TMDL_Core-FINAL.pdf

[CT DEEP] Connecticut Department of Energy and Environmental Protection. 2021b. Appendix 1: Bantam Lake Watershed TMDL. https://portal.ct.gov/-/media/DEEP/water/watershed_management/BantamLake/FINAL-Bantam-TMDL-Appendix.pdf

Healy DF and KP Kulp. 1995. Water Quality Characteristics of Selected Public Recreational Lakes and Pond in Connecticut. US Geological Survey Water-Resource Investigations Report 95-4098. 227pp.

Gianfagna CC, CE Johnson, DG Chandler, C Hofmann. 2015. Watershed area ratio accurately predicts daily streamflow in nested catchments in the Catskills, New York. Journal of Hydrology. 4:583-594

[MPCA] Minnesota Pollution Control Agency. 2022. Attachment A: Approach and Methods for the interim guidance, “Watershed Nutrient Loads to Accomplish Minnesota’s Nutrient Reduction Strategy Goals”. https://www.pca.state.mn.us/sites/default/files/wq-s1-86a.pdf

[NHDES] New Hampshire Department of Environmental Services. 2011. Interpreting VRAP Water Quality Monitoring Parameters: Chemical Parameters. https://www.wildlife.nh.gov/sites/g/files/ehbemt746/files/inline-images/vrap-parameter-description.pdf

Stone, J., Schafer, J., London, E.H., and Thompson, W.B., 1992, Surficial materials map of Connecticut, 2 Plates: 54.57 x 41.79 inches and 53.99 x 37.42 inches, https://doi.org/10.3133/70046712.

[USEPA] United States Environmental Protection Agency. 2025. National Aquatic Resource Surveys. Indicators: Dissolved Oxygen. https://www.epa.gov/national-aquatic-resource-surveys/indicators-dissolved-oxygen#:~:text=What%20can%20dissolved%20oxygen%20tell,and%20usually%20devoid%20of%20life.

[USGS] United States Geological Survey. 2024a. USGS 01188000 BUNNELL BROOK NEAR BURLINGTON, CT. https://waterdata.usgs.gov/nwis/dv?cb_00010=on&cb_00060=on&cb_00065=on&format=html&site_no=01188000&legacy=&referred_module=sw&period=&begin_date=2021-12-10&end_date=2022-12-10

[USGS] United States Geological Survey. 2024b. USGS 01187800 NEPAUG R NR NEPAUG, CT. https://waterdata.usgs.gov/nwis/dv?cb_00060=on&format=html&site_no=01187800&legacy=&referred_module=sw&period=&begin_date=2021-12-10&end_date=2022-12-10

[USGS] United States Geological Survey. 2024c. StreamStats. https://streamstats.usgs.gov/ss/

## Appendix A. 2025 Bantam Lake Watershed Field Data

In-situ field data collected from the Bantam Lake Watershed in 2024. Site abbreviations: BLO = Bantam Lake Outlet; BPO = Bantam Pond Outlet; DPO = Dog Pond Outlet; LPO = Little Pond Outlet; WBBR = West Branch Bantam River; WBI = Whittlesey Brook Inlet; Little Pond Watershed A = LPW-A; and Little Pond Watershed B = LPW-B. Field variable abbreviations: Temp = temperature; DO = dissolved oxygen; Sat = saturation; Rel. Phyco = Relative phycocyanin; Spec. Cond = specific conductance; SU = standard units.

| Site | Date | Temp. (°C) | DO (mg/L) | DO (% Sat) | Rel. Phyco. (µg/L) | Spec. Cond. (µS/cm) | pH (SU) |
|---|---|---|---|---|---|---|---|
| BLO | 14-Apr-25 | 10.23 | 12.73 | 113 | 1.31 | 177.1 | 7.69 |
| BLO | 16-May-25 | 19.99 | 8.52 | 94.1 | 2.94 | 181.5 | 7.32 |
| BLO | 9-Jun-25 | 20.91 | 3.25 | --- | 1.67 | 184.9 | 7.52 |
| BLO | 22-Jul-25 | 25.24 | 7.12 | 78.1 | 3.98 | 192.3 | 7.02 |
| BLO | 19-Aug-25 | 24.01 | 7.33 | 86.7 | 5.12 | 192.7 | 7.05 |
| BLO | 18-Sep-25 | 21.24 | 6.84 | 76.6 | 13.89 | 194.4 | 7.35 |
| BLO | 17-Oct-25 | 12.66 | 10.65 | 99.7 | 7.69 | 190.9 | 7.83 |
| BPO | 14-Apr-25 | 6.16 | 13.34 | 107.3 | 0.63 | 179.4 | 8.21 |
| BPO | 16-May-25 | 18.56 | 9.12 | 97.9 | 1.19 | 144.5 | 7.82 |
| BPO | 9-Jun-25 | 20.51 | 3.39 | --- | 2.04 | 160.8 | 7.77 |
| BPO | 22-Jul-25 | 24.18 | 7.53 | 81.1 | 2.83 | 163.9 | 7.28 |
| BPO | 19-Aug-25 | 23.09 | 6.44 | 74.8 | 2.47 | 153.2 | 7.13 |
| BPO | 18-Sep-25 | 19.71 | 7.17 | 77.9 | 1.88 | 167.7 | 7.77 |
| BPO | 17-Oct-25 | 9.4 | 11.23 | 97.5 | 1.56 | 181.5 | 9.49 |
| DPO | 14-Apr-25 | 6.45 | 12.98 | 105.1 | 1.06 | 229.2 | 8.16 |
| DPO | 16-May-25 | 19.76 | 8.61 | 94.7 | -3.59 | 194 | 7.52 |
| DPO | 9-Jun-25 | 21.2 | 3.37 | --- | 1.77 | 211.6 | 8 |
| DPO | 22-Jul-25 | 24.19 | 9.06 | 97.6 | 1.6 | 232.4 | 8.15 |
| DPO | 19-Aug-25 | 21.91 | 8.31 | 94.4 | 1.93 | 232.3 | 7.66 |
| DPO | 18-Sep-25 | 19.39 | 8.33 | 90 | 1.63 | 228.3 | 7.97 |
| DPO | 17-Oct-25 | 8.99 | 10.5 | 90.3 | 0.92 | 232.1 | 8.43 |
| LPO | 14-Apr-25 | 7 | 12.17 | 99.9 | 1.99 | 202.5 | 8.03 |
| LPO | 16-May-25 | 18.77 | 8.18 | 88.2 | 0.11 | 184.2 | 7.21 |

| Site | Date | Temp. (°C) | DO (mg/L) | DO (% Sat) | Rel. Phyco. (µg/L) | Spec. Cond. (µS/cm) | pH (SU) |
|---|---|---|---|---|---|---|---|
| LPO | 9-Jun-25 | 19.48 | 3.32 | --- | 4.54 | 203.6 | 7.34 |
| LPO | 22-Jul-25 | 24.98 | 5.32 | 58.1 | 6.5 | 253 | 7 |
| LPO | 19-Aug-25 | 23.28 | 4.83 | 56.3 | 3.43 | 263.5 | 6.79 |
| LPO | 18-Sep-25 | 19.89 | 5.69 | 62.1 | 1.66 | 249.6 | 7.03 |
| LPO | 17-Oct-25 | 9.89 | 7.11 | 62.5 | 1.63 | 249.8 | 7.23 |
| WBBR | 14-Apr-25 | 5.99 | 11.54 | 92.3 | 1.65 | 234.7 | 7.98 |
| WBBR | 16-May-25 | 17.99 | 5.8 | 61.5 | 0.95 | 232.1 | 7.07 |
| WBBR | 9-Jun-25 | 18.33 | 3.98 | --- | 2.66 | 257.1 | 7.62 |
| WBBR | 22-Jul-25 | 20.46 | 1.97 | 19.7 | 3.97 | 298.6 | 7.14 |
| WBBR | 19-Aug-25 | 20.09 | 5.68 | 62.3 | 2.25 | 367.9 | 7 |
| WBBR | 18-Sep-25 | 17.04 | 6.5 | 66.9 | 1.18 | 346.7 | 7.35 |
| WBBR | 17-Oct-25 | 8.18 | 9.44 | 79.6 | 1.57 | 304.6 | 8 |
| WBI | 14-Apr-25 | 8.65 | 12.37 | 105.7 | 1.31 | 123.6 | 7.72 |
| WBI | 16-May-25 | --- | --- | --- | --- | --- | --- |
| WBI | 9-Jun-25 | 16.19 | 5.01 | --- | 1.15 | 127.1 | 7.77 |
| WBI | 22-Jul-25 | 18.16 | 5.45 | 52.2 | 2.39 | 220.2 | 6.88 |
| WBI | 19-Aug-25 | 19.15 | 5.5 | 59.2 | 7.03 | 242.1 | 6.75 |
| WBI | 18-Sep-25 | 16.65 | 4.25 | 43.4 | 8.91 | 251 | 7.01 |
| WBI | 17-Oct-25 | 8.15 | 10.43 | 87.9 | 1.23 | 185.3 | 7.8 |
| LPW-A | 14-Apr-25 | 7.72 | 12.88 | 107.6 | 0.39 | 179.8 | 8.0 |
| LPW-A | 16-May-25 | 18.28 | 9.16 | 97.8 | 26.23 | 176.5 | 7.83 |
| LPW-A | 9-Jun-25 | 18.34 | 4.46 | 2528 | 2.66 | 197.9 | 8.37 |
| LPW-A | 22-Jul-25 | 20.86 | 10.15 | 102.7 | 1.97 | 237.2 | 8.17 |
| LPW-A | 19-Aug-25 | 21.01 | 9.31 | 104 | 1.77 | 269.3 | 7.78 |
| LPW-A | 18-Sep-25 | 18.55 | 9.07 | 96.4 | 24.21 | 283.7 | 8.28 |
| LPW-A | 17-Oct-25 | 9.69 | 11.68 | 102.1 | 31.7 | 243.9 | 8.25 |
| LPW-B | 14-Apr-25 | 6.67 | 13.58 | 110.6 | 3.61 | 175.6 | 7.92 |

| Site | Date | Temp. (°C) | DO (mg/L) | DO (% Sat) | Rel. Phyco. (µg/L) | Spec. Cond. (µS/cm) | pH (SU) |
|---|---|---|---|---|---|---|---|
| LPW-B | 16-May-25 | 17.75 | 9.15 | 96.6 | 27.96 | 173.9 | 7.64 |
| LPW-B | 9-Jun-25 | 18.28 | 4.45 | 2504 | 1.65 | 194.9 | 7.96 |
| LPW-B | 22-Jul-25 | 18.68 | 10.07 | 97.6 | 1.84 | 245.5 | 7.84 |
| LPW-B | 19-Aug-25 | 18.8 | 7.93 | 84.8 | 1.22 | 268 | 7.08 |
| LPW-B | 18-Sep-25 | 16.93 | 8.3 | 85.3 | 6.57 | 271.6 | 7.58 |
| LPW-B | 17-Oct-25 | 8.35 | 11.46 | 97.1 | 1.54 | 243.2 | 8.34 |

# Appendix B. 2024 Bantam Lake Watershed Total Phosphorus and Total Nitrogen Data

| | | Total Phosphorus | | | | Total Nitrogen | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Site | µg/L | kg/day | kg/day corrected | mg/day/ acre | mg/L | kg/day | kg/day corrected | mg/day/ acre |
| 9-Apr-24 | Bantam Lake Outlet | 19 | 4.665 | 1.257 | 293.22 | 231 | 56.721 | 19.755 | 25722.683 |
| | Bantam Pond Outlet | 17 | 1.111 | 1.111 | 201.85 | 137 | 8.953 | 8.953 | 11657.968 |
| | Dog Pond Outlet | 13 | 0.309 | 0.309 | 155.81 | 169 | 4.019 | 4.019 | 5232.483 |
| | Little Pond Outlet | 17 | 3.182 | 1.136 | 168.98 | 187 | 34.998 | 17.272 | 22489.923 |
| | West Branch Bantam River | 21 | 0.935 | 0.626 | 362.25 | 197 | 8.772 | 4.753 | 6189.330 |
| | Whittlesey Inlet | 26 | 0.226 | 0.226 | 294.82 | 226 | 1.968 | 1.968 | 2562.700 |
| 13-May-24 | Bantam Lake Outlet | 12 | 1.663 | -0.055 | -12.877 | 300 | 41.564 | 8.338 | 10856.793 |
| | Bantam Pond Outlet | 25 | 1.195 | 1.195 | 217.151 | 328 | 15.681 | 15.681 | 20418.004 |
| | Dog Pond Outlet | 11 | 0.191 | 0.191 | 96.443 | 340 | 5.914 | 5.914 | 7700.824 |
| | Little Pond Outlet | 15 | 1.584 | -0.523 | -77.867 | 296 | 31.258 | 0.137 | 177.933 |
| | West Branch Bantam River | 28 | 0.912 | 0.721 | 417.084 | 474 | 15.440 | 9.526 | 12403.261 |
| | Whittlesey Inlet | 21 | 0.134 | 0.134 | 174.199 | 309 | 1.969 | 1.969 | 2563.215 |
| 17-Jun-24 | Bantam Lake Outlet | 24 | 1.004 | -0.211 | -49.241 | 413 | 17.279 | 2.819 | 3670.038 |
| | Bantam Pond Outlet | 64 | 0.772 | 0.772 | 140.292 | 569 | 6.865 | 6.865 | 8938.866 |
| | Dog Pond Outlet | 22 | 0.097 | 0.097 | 48.678 | 488 | 2.142 | 2.142 | 2789.387 |
| | Little Pond Outlet | 37 | 1.180 | 0.128 | 19.082 | 427 | 13.617 | 2.756 | 3589.125 |
| | Little Pond Watershed A | 32 | 0.630 | 0.267 | NA | 530 | 10.431 | 2.320 | NA |
| | Little Pond Watershed B | 21 | 0.362 | -0.689 | NA | 470 | 8.111 | -2.749 | NA |
| | West Branch Bantam River | 34 | 0.279 | 0.183 | 105.856 | 486 | 3.995 | 1.853 | 2412.644 |
| | Whittlesey Inlet | 22 | 0.035 | 0.035 | 46.055 | 525 | 0.844 | 0.844 | 1099.048 |
| 15-Jul-24 | Bantam Lake Outlet | 31 | 0.905 | -0.417 | -97.243 | 403 | 11.761 | -0.796 | -1036.198 |
| | Bantam Pond Outlet | 73 | 0.818 | 0.818 | 148.686 | 751 | 8.419 | 8.419 | 10962.351 |
| | Dog Pond Outlet | 16 | 0.065 | 0.065 | 32.894 | 452 | 1.844 | 1.844 | 2400.607 |
| | Little Pond Outlet | 57 | 1.268 | 0.068 | 10.178 | 531 | 11.812 | -0.381 | -495.849 |
| | Little Pond Watershed B | 38 | 0.457 | -0.742 | NA | 479 | 5.766 | -6.426 | NA |
| | West Branch Bantam River | 50 | 0.381 | 0.316 | 182.803 | 494 | 3.773 | 1.930 | 2512.512 |
| | Whittlesey Inlet | 36 | 0.054 | 0.054 | 70.025 | 499 | 0.745 | 0.745 | 970.625 |

| | | Total Phosphorus | | | | Total Nitrogen | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Site | mg/L | kg/day | kg/day corrected | mg/day/ acre | mg/L | kg/day | kg/day corrected | mg/day/ acre |
| 23-Aug-24 | Bantam Lake Outlet | 23 | 2.145 | -0.135 | -31.427 | 457 | 42.629 | 8.725 | 11360.797 |
| | Bantam Pond Outlet | 31 | 0.852 | 0.852 | 154.878 | 486 | 13.364 | 13.364 | 17401.333 |
| | Dog Pond Outlet | 20 | 0.200 | 0.200 | 100.859 | 536 | 5.363 | 5.363 | 6982.805 |
| | Little Pond Outlet | 31 | 2.196 | 0.913 | 135.793 | 460 | 32.584 | 11.557 | 15048.459 |
| | Little Pond Watershed B | 18 | 0.690 | -0.593 | NA | 297 | 11.386 | -9.641 | NA |
| | West Branch Bantam River | 23 | 0.431 | 0.231 | 133.577 | 409 | 7.663 | 2.300 | 2995.025 |
| | Whittlesey Inlet | 23 | 0.084 | 0.084 | 109.739 | 360 | 1.319 | 1.319 | 1717.654 |
| 23-Sep-24 | Bantam Lake Outlet | 29 | 0.610 | 0.104 | 24.261 | 521 | 10.953 | 4.761 | 6199.616 |
| | Bantam Pond Outlet | 31 | 0.229 | 0.229 | 41.622 | 484 | 3.577 | 3.577 | 4657.165 |
| | Dog Pond Outlet | 27 | 0.073 | 0.073 | 36.591 | 720 | 1.936 | 1.936 | 2520.737 |
| | Little Pond Outlet | 32 | 0.492 | 0.051 | 7.629 | 387 | 5.948 | -0.096 | -124.840 |
| | Little Pond Watershed A | 13 | 0.123 | 0.032 | NA | 205 | 1.945 | -0.609 | NA |
| | Little Pond Watershed B | 11 | 0.091 | -0.349 | NA | 307 | 2.554 | -3.490 | NA |
| | West Branch Bantam River | 42 | 0.211 | 0.139 | 80.367 | 490 | 2.467 | 0.531 | 691.731 |
| | Whittlesey Inlet | 14 | 0.014 | 0.014 | 17.951 | 247 | 0.243 | 0.243 | 316.709 |
| 21-Oct-24 | Bantam Lake Outlet | 21 | 0.369 | -0.058 | -13.546 | 306 | 5.383 | 0.993 | 1292.339 |
| | Bantam Pond Outlet | 14 | 0.075 | 0.075 | 13.682 | 422 | 2.270 | 2.270 | 2955.664 |
| | Dog Pond Outlet | 11 | 0.022 | 0.022 | 10.851 | 502 | 0.982 | 0.982 | 1279.279 |
| | Little Pond Outlet | 32 | 0.413 | 0.254 | 37.738 | 331 | 4.274 | 0.201 | 261.609 |
| | Little Pond Watershed A | 11 | 0.088 | 0.032 | NA | 221 | 1.761 | -0.035 | NA |
| | Little Pond Watershed B | 8 | 0.056 | -0.104 | NA | 257 | 1.796 | -2.277 | NA |
| | West Branch Bantam River | 23 | 0.084 | 0.063 | 36.323 | 492 | 1.803 | 0.821 | 1068.593 |
| | Whittlesey Inlet | 20 | 0.014 | 0.014 | 18.666 | 163 | 0.117 | 0.117 | 152.131 |

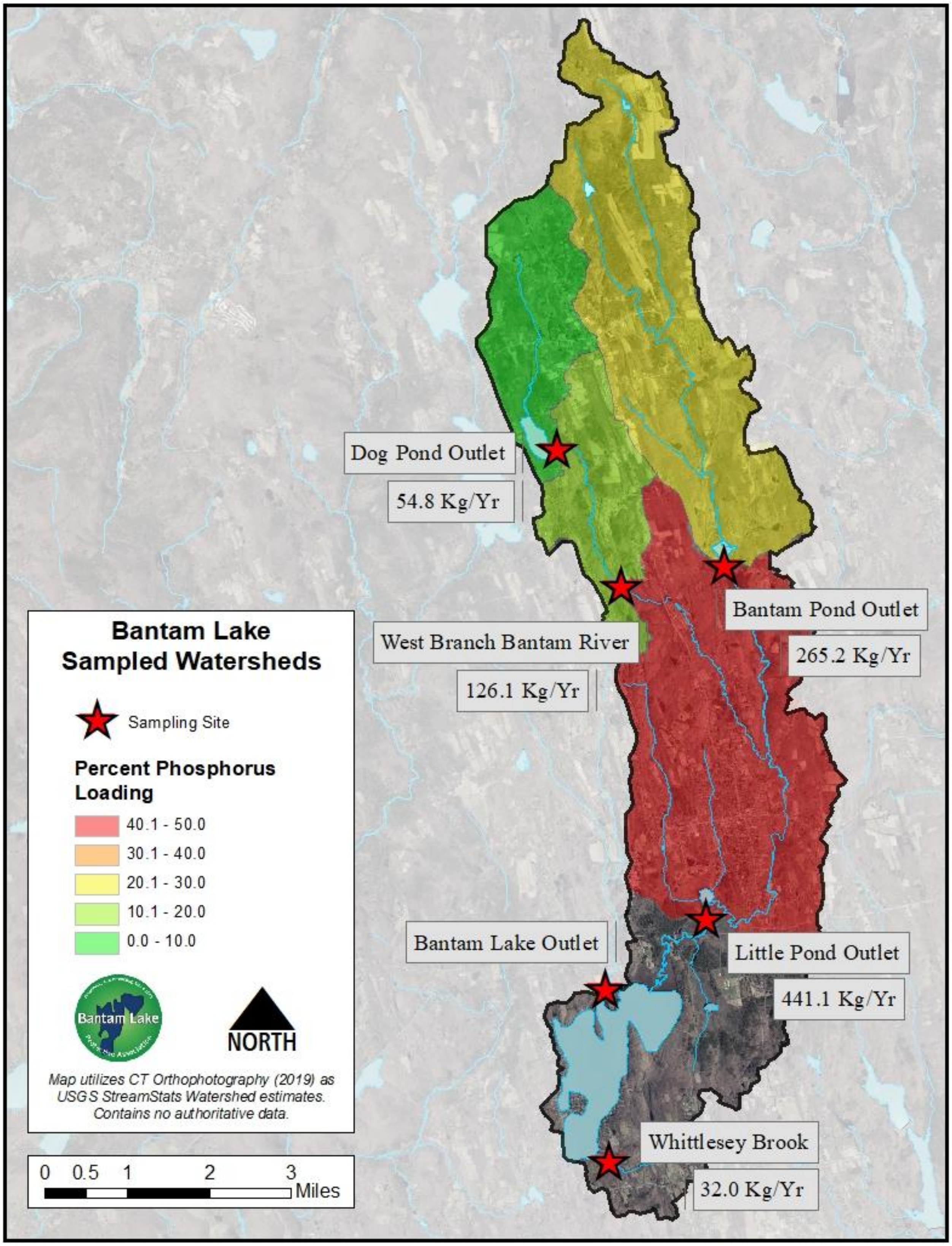
## Appendix C. Bantam Lake Watershed Additional Laboratory Data

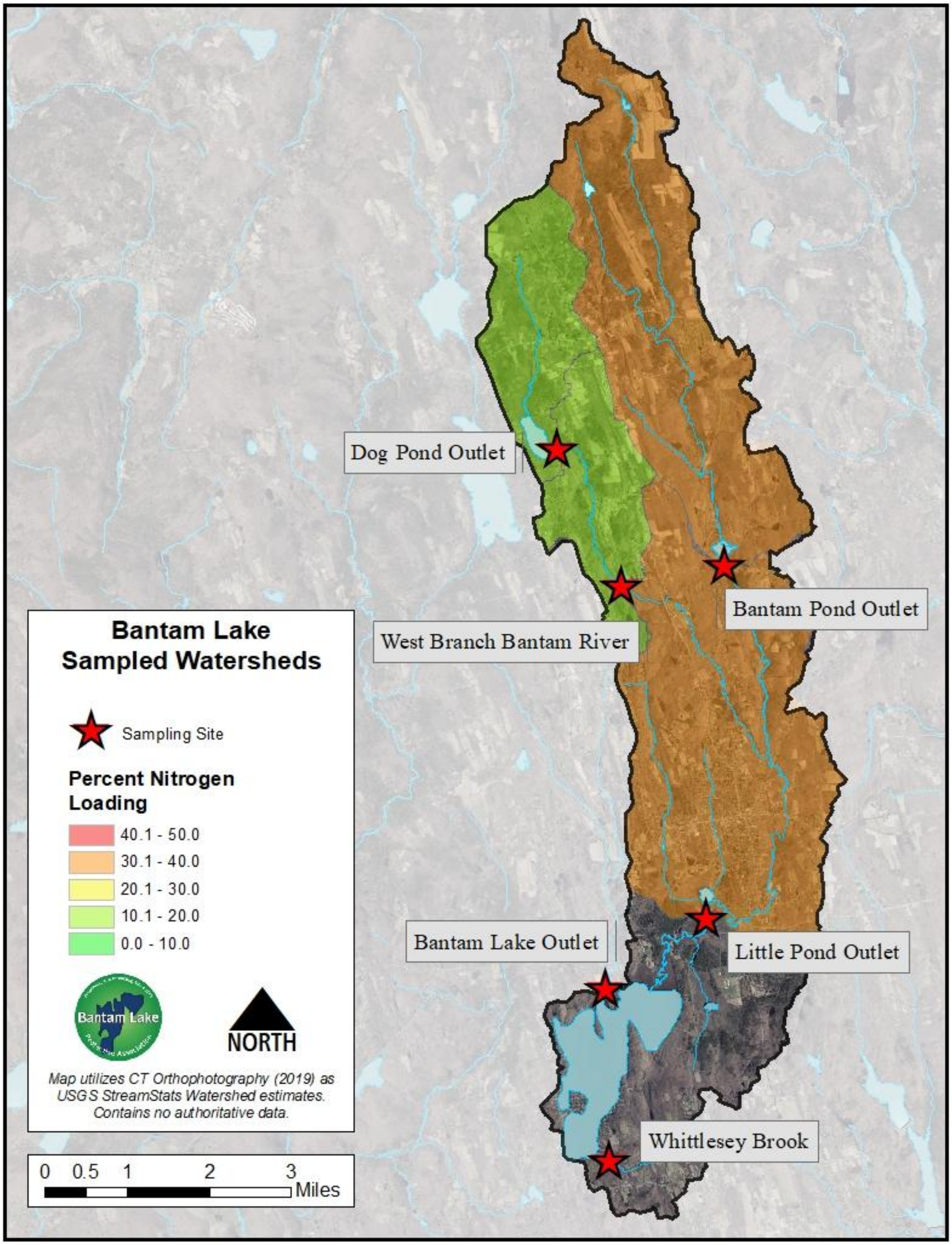
NH3 is ammonia reported in mg/L; ALK is alkalinity reported in mg/L; E. coli is Escherichia coli reported in organisms per 100mL

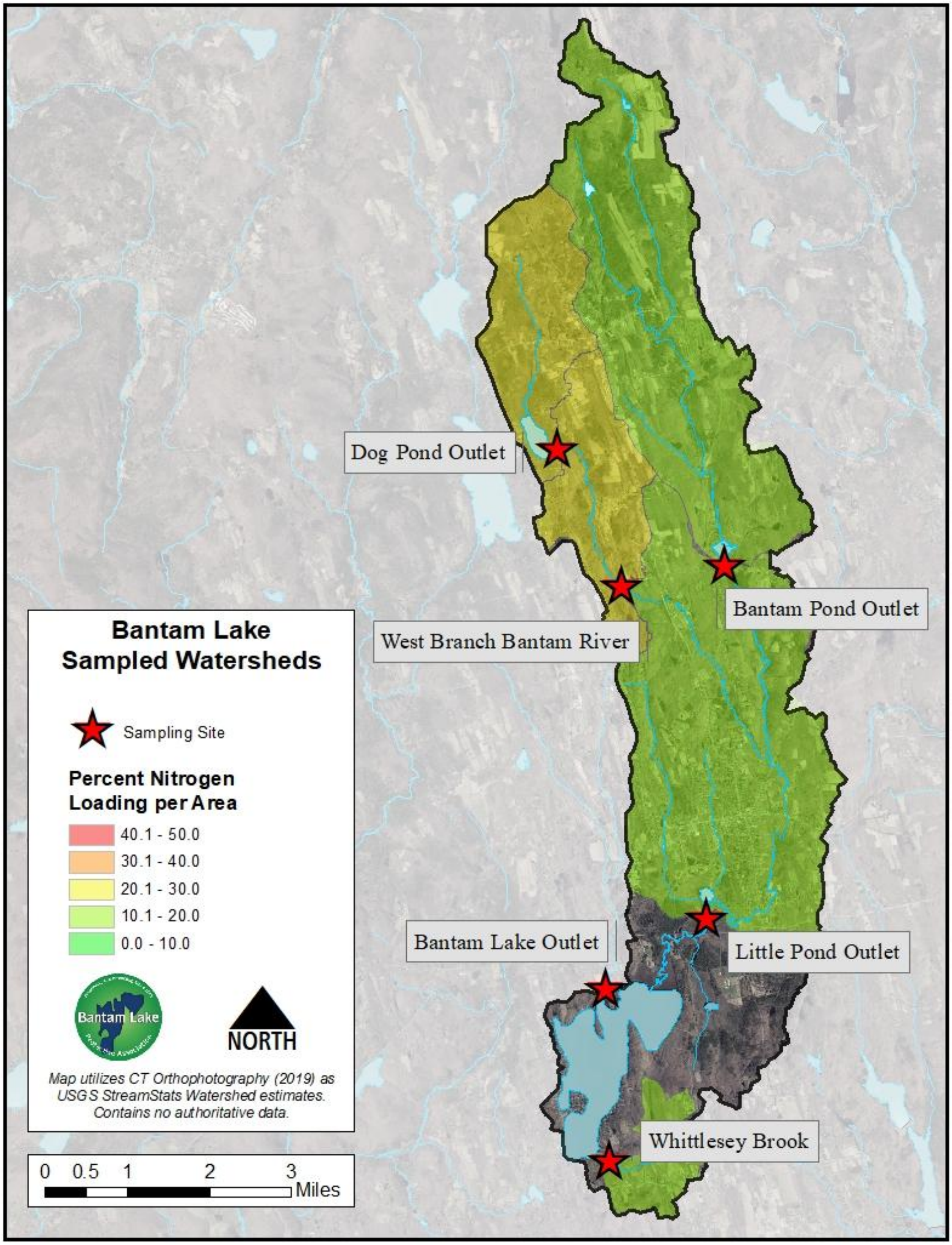
| Date | Site | NH3 | ALK | E. coli |
|---|---|---|---|---|
| 9-Apr-24 | Bantam Lake Outlet | 0.003 | 30 | 8 |
| | Bantam Pond Outlet | ND | 31 | 0 |
| | Dog Pond Outlet | 0.005 | 40 | 0 |
| | Little Pond Outlet | 0.006 | 38 | 0 |
| | West Branch Bantam River | 0.008 | 39 | 0 |
| | Whittlesey Brook Inlet | 0.004 | 17 | 8 |
| 13-May-24 | Bantam Lake Outlet | 0.007 | 33 | 2 |
| | Bantam Pond Outlet | 0.005 | 33 | 5 |
| | Dog Pond Outlet | 0.013 | 44 | 1 |
| | Little Pond Outlet | 0.007 | 50 | 21 |
| | West Branch Bantam River | 0.031 | 56 | 16 |
| | Whittlesey Brook Inlet | 0.008 | 21 | 27 |
| 21-Jun-24 | Bantam Lake Outlet | ND | 37 | 22 |
| | Bantam Pond Outlet | 0.093 | 53 | 6 |
| | Dog Pond Outlet | 0.019 | 57 | 294 |
| | Little Pond Outlet | 0.016 | 65 | 190 |
| | Little Pond Watershed B | 0.016 | 61 | 10 |
| | Little Pond Watershed A | 0.045 | 60 | 502 |
| | West Branch Bantam River | 0.041 | 82 | 60 |
| | Whittlesey Brook Inlet | 0.028 | 29 | 136 |
| 15-Jul-24 | Bantam Lake Outlet | 0.014 | 37 | No data |
| | Bantam Pond Outlet | ND | 46 | No data |
| | Dog Pond Outlet | 0.013 | 56 | No data |
| | Little Pond Outlet | 0.005 | 64 | No data |
| | Little Pond Watershed B | 0.003 | 60 | No data |
| | West Branch Bantam River | 0.015 | 78 | No data |
| | Whittlesey Brook Inlet | 0.007 | 28 | No data |

| Date | Site | NH3 | ALK | E. coli |
|---|---|---|---|---|
| 23-Aug-24 | Bantam Lake Outlet | 0.021 | 38 | No data |
|  | Bantam Pond Outlet | 0.015 | 45 | No data |
|  | Dog Pond Outlet | ND | 62 | No data |
|  | Little Pond Outlet | 0.019 | 48 | No data |
|  | Little Pond Watershed B | 0.009 | 42 | No data |
|  | West Branch Bantam River | 0.018 | 65 | No data |
|  | Whittlesey Brook Inlet | 0.015 | 21 | No data |
| 23-Sep-24 | Bantam Lake Outlet | 0.026 | 45 | 36 |
|  | Bantam Pond Outlet | 0.037 | 55 | 4 |
|  | Dog Pond Outlet | 0.027 | 64 | 26 |
|  | Little Pond Outlet | ND | 67 | 4 |
|  | Little Pond Watershed B | 0.003 | 67 | 168 |
|  | Little Pond Watershed A | ND | 73 | 42 |
|  | West Branch Bantam River | 0.012 | 92 | 56 |
|  | Whittlesey Brook Inlet | ND | 29 | 36 |
| 21-Oct-24 | Bantam Lake Outlet | 0.004 | 69 | No data |
|  | Bantam Pond Outlet | 0.019 | 60 | No data |
|  | Dog Pond Outlet | 0.007 | 63 | No data |
|  | Little Pond Outlet | ND | 74 | No data |
|  | Little Pond Watershed B | ND | 77 | No data |
|  | Little Pond Watershed A | ND | 77 | No data |
|  | West Branch Bantam River | 0.026 | 86 | No data |
|  | Whittlesey Brook Inlet | ND | 35 | No data |

## Appendix D. Total Phosphorus and Total Nitrogen Loading by Subwatershed




Bantam Lake
Sampled Watersheds
Sampling Site
Percent Nitrogen Loading
40.1 - 50.0
30.1 - 40.0
20.1 - 30.0
10.1 - 20.0
0.0 - 10.0
NORTH
Map utilizes CT Orthophotography (2019) as USGS StreamStats Watershed estimates. Contains no authoritative data.
0 0.5 1 2 3
Miles
Dog Pond Outlet
West Branch Bantam River
Bantam Pond Outlet
Bantam Lake Outlet
Little Pond Outlet
Whittlesey Brook


Dog Pond Outlet
Bantam Pond Outlet
West Branch Bantam River
Bantam Lake Outlet
Little Pond Outlet
Whittlesey Brook
Bantam Lake
Sampled Watersheds
Sampling Site
Percent Nitrogen
Loading per Area
40.1 - 50.0
30.1 - 40.0
20.1 - 30.0
10.1 - 20.0
0.0 - 10.0
Bantam Lake
NORTH
Map utilizes CT Orthophotography (2019) as
USGS StreamStats Watershed estimates.
Contains no authoritative data.
0 0.5 1 2 3
Miles

## Appendix E. Quality Assurance / Quality Control Data

### Bantam Watershed Duplicate and Blank Data

| Nutrients LIM # | FIELD # | Collection Date | Received Date | NH3 | TN | TP | ALK |
|---|---|---|---|---|---|---|---|
| 250077-003 | BPO 041425 | 4/14/25 | 4/16/25 | 0.003 | 0.274 | 0.015 | 31 |
| 250077-010 | Dup-W- 041425 | 4/14/25 | 4/16/25 | 0.000 | 0.218 | 0.008 | 31 |
| 250077-009 | BLNK-W-041425 | 4/14/25 | 4/16/25 | 0.000 | 0.000 | 0.000 | 4 |
| 250115-003 | BPO 051625 | 5/16/25 | 5/23/25 | 0.012 | 0.306 | 0.032 | 33 |
| 250115-010 | BLW Dup 051625 | 5/16/25 | 5/23/25 | 0.011 | 0.334 | 0.022 | 33 |
| 250115-009 | BLW BLNK 051625 | 5/16/25 | 5/23/25 | 0.003 | 0.000 | 0.001 | 0 |
| 250148-003 | BPO 060925 | 6/9/25 | 6/16/25 | 0.009 | 0.416 | 0.037 | 44 |
| 250148-010 | BLW Dup 060925 | 6/9/25 | 6/16/25 | 0.010 | 0.436 | 0.039 | 43 |
| 250148-009 | BLW BLNK-060925 | 6/9/25 | 6/16/25 | 0.012 | 0.057 | 0.004 | 0 |
| 250227-003 | BPO 072225 | 7/22/25 | 7/29/25 | 0.017 | 0.542 | 0.041 | 48 |
| 250227-010 | BLW Dup 072225 | 7/22/25 | 7/29/25 | 0.016 | 0.531 | 0.043 | 48 |
| 250227-009 | BLW BLNK-072225 | 7/22/25 | 7/29/25 | 0.000 | 0.016 | 0.000 | 0 |
| 250281-003 | BPO 081925 | 8/19/25 | 8/29/25 | 0.036 | 0.580 | 0.045 | 42 |
| 250281-010 | BLW Dup 081925 | 8/19/25 | 8/29/25 | 0.033 | 0.550 | 0.040 | 40 |
| 250281-009 | BLW BLNK-081925 | 8/19/25 | 8/29/25 | 0.003 | 0.066 | 0.007 | 0 |
| 250331-005 | WBBR 091825 | 9/18/25 | 9/25/25 | 0.017 | 0.458 | 0.046 | 83 |
| 250331-010 | BLW Dup 091825 | 9/18/25 | 9/25/25 | 0.020 | 0.430 | 0.040 | 84 |
| 250331-009 | BLW BLNK-091825 | 9/18/25 | 9/25/25 | 0.004 | 0.000 | 0.000 | 0 |
| 240420-008 | WBI 101725 | 10/17/25 | 10/21/25 | 0.007 | 0.278 | 0.019 | 35 |
| 240420-010 | BLW Dup 101725 | 10/17/25 | 10/21/25 | 0.006 | 0.285 | 0.019 | 35 |
| 240420-009 | BLW BLNK-101725 | 10/17/25 | 10/21/25 | 0.004 | 0.051 | 0.001 | 0 |

Bantam Lake Duplicate and Blank Data

| Nutrients LIM # | FIELD # | Collection Date | Received Date | NH3 | TN | TP | ALK |
|---|---|---|---|---|---|---|---|
| 250077-019 | BL 4 Epi 041425 | 4/14/25 | 4/16/25 | 0.000 | 0.318 | 0.016 | 32 |
| 250077-024 | Dup 041425 | 4/14/25 | 4/16/25 | 0.000 | 0.345 | 0.018 | 32 |
| 250077-023 | BLNK 041425 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 250114-005 | BL 2 Epi 051625 | 5/16/25 | 5/23/25 | 0.005 | 0.300 | 0.016 | 31 |
| 250114-014 | BL Dup 051625 | 5/16/25 | 5/23/25 | 0.003 | 0.303 | 0.020 | 33 |
| 250114-013 | BL BLNK 051625 | 5/16/25 | 5/23/25 | NSS | NSS | NSS | NSS |

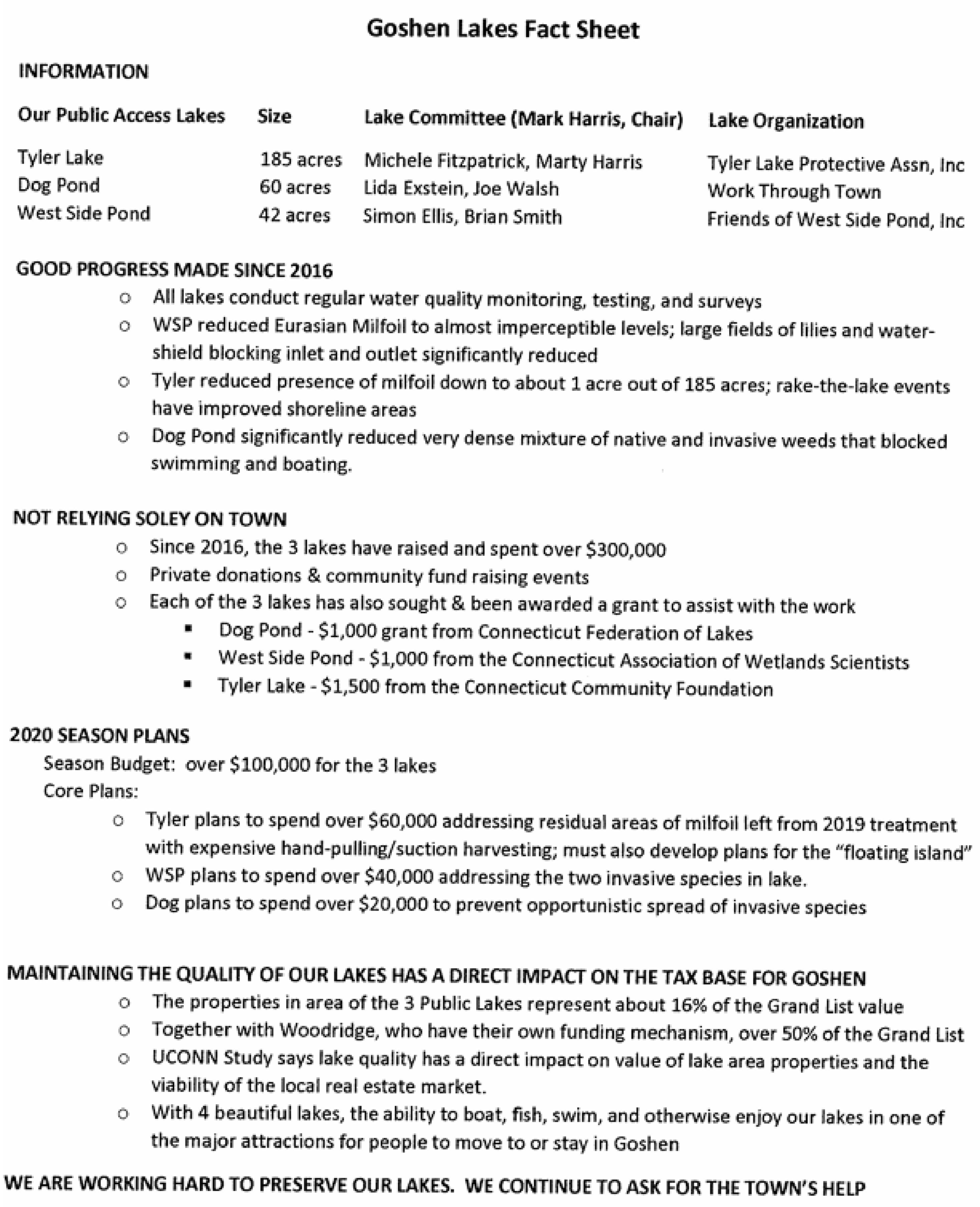
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 250149-007 | BL 2 Hypo 061325 | 6/13/25 | 6/16/25 | 0.006 | 0.338 | 0.024 | 41 |
| 250149-014 | BL Dup 061325 | 6/13/25 | 6/16/25 | 0.008 | 0.350 | 0.023 | 42 |
| 250149-013 | BL BLNK 061325 | 6/13/25 | 6/16/25 | ND | 0.041 | ND | ND |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 250222-009 | BL 4 Epi 072225 | 7/22/25 | 7/29/25 | 0.008 | 0.450 | 0.021 | 39 |
| 250222-014 | BL Dup 072225 | 7/22/25 | 7/29/25 | 0.006 | 0.529 | 0.039 | 39 |
| 250222-015 | BL Dup Chl 072225 | 7/22/25 | 7/29/25 | NSS | NSS | NSS | NSS |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 250282-005 | BL 2 Epi 081925 | 8/19/25 | 8/29/25 | 0.004 | 0.549 | 0.018 | 39 |
| 250282-014 | BL Dup 081925 | 8/19/25 | 8/29/25 | 0.004 | 0.568 | 0.021 | 41 |
| 240334-013 | BL BL 082324 | 8/23/24 | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 240417-003 | BL 4 Meta 101725 | 10/17/25 | 10/21/25 | 0.027 | 0.658 | 0.047 | 43 |
| 240417-014 | BL Dup 101725 | 10/17/25 | 10/21/25 | 0.023 | 0.704 | 0.046 | 44 |
| 240417-013 | BL Blnk 101725 | 10/17/25 | 10/21/25 | 0.004 | 0.025 | 0.002 | ND |

## Appendix F. Goshen Lakes Fact Sheet



### Goshen Lakes Fact Sheet

**INFORMATION**

| Our Public Access Lakes | Size | Lake Committee (Mark Harris, Chair) | Lake Organization |
|---|---|---|---|
| Tyler Lake | 185 acres | Michele Fitzpatrick, Marty Harris | Tyler Lake Protective Assn, Inc |
| Dog Pond | 60 acres | Lida Exstein, Joe Walsh | Work Through Town |
| West Side Pond | 42 acres | Simon Ellis, Brian Smith | Friends of West Side Pond, Inc |

**GOOD PROGRESS MADE SINCE 2016**

- All lakes conduct regular water quality monitoring, testing, and surveys
- WSP reduced Eurasian Milfoil to almost imperceptible levels; large fields of lilies and water-shield blocking inlet and outlet significantly reduced
- Tyler reduced presence of milfoil down to about 1 acre out of 185 acres; rake-the-lake events have improved shoreline areas
- Dog Pond significantly reduced very dense mixture of native and invasive weeds that blocked swimming and boating.

**NOT RELYING SOLEY ON TOWN**

- Since 2016, the 3 lakes have raised and spent over $300,000
- Private donations & community fund raising events
- Each of the 3 lakes has also sought & been awarded a grant to assist with the work
    - Dog Pond - $1,000 grant from Connecticut Federation of Lakes
    - West Side Pond - $1,000 from the Connecticut Association of Wetlands Scientists
    - Tyler Lake - $1,500 from the Connecticut Community Foundation

**2020 SEASON PLANS**

Season Budget: over $100,000 for the 3 lakes

Core Plans:

- Tyler plans to spend over $60,000 addressing residual areas of milfoil left from 2019 treatment with expensive hand-pulling/suction harvesting; must also develop plans for the "floating island"
- WSP plans to spend over $40,000 addressing the two invasive species in lake.
- Dog plans to spend over $20,000 to prevent opportunistic spread of invasive species

**MAINTAINING THE QUALITY OF OUR LAKES HAS A DIRECT IMPACT ON THE TAX BASE FOR GOSHEN**

- The properties in area of the 3 Public Lakes represent about 16% of the Grand List value
- Together with Woodridge, who have their own funding mechanism, over 50% of the Grand List
- UCONN Study says lake quality has a direct impact on value of lake area properties and the viability of the local real estate market.
- With 4 beautiful lakes, the ability to boat, fish, swim, and otherwise enjoy our lakes in one of the major attractions for people to move to or stay in Goshen

**WE ARE WORKING HARD TO PRESERVE OUR LAKES. WE CONTINUE TO ASK FOR THE TOWN'S HELP**

## Appendix G. Preparers' Qualifications

**Laurence J. Marsicano**
**25 Nutmeg Drive, New Milford, CT 06776, (860) 354-5969, larry.marsicano@gmail.com**

## RELEVANT EXPERIENCE

- Thirty years as a lake ecologist, manager, advocate, educator, and leader in Connecticut. Successful in the academic, public, and private sectors.
- Advanced the mission of the Candlewood Lake Authority from 1998 through 2017 with the last 14 of those as Executive Director. The board and staff of that agency served the five municipalities surrounding Candlewood Lake, the largest lake in the State and one of Connecticut's most important inland water resources.
- Developed meaningful relationships and worked with the general CT lake community, local and state environmental agency staff, academic researchers, elected leaders at all levels of government, and educators from middle school through college/university levels.
- Co-directed an interdistrict grant program that utilized Candlewood Lake as a living, learning laboratory. The program ran for 10+ years and engaged ~150 high school students and teachers each year.
- Have trained and supervised employees and/or students in Limnological and Paleolimnological field and laboratory methods.
- Founding member of the Connecticut Federation of Lakes, have, and served as a volunteer and an officer of Connecticut's lake advocacy, nonprofit organization until 2022.

## PROFESSIONAL EXPERIENCE

- **Principal Limnologist – Brawley Consulting Group, LLC.** 2023 to present
- **Principal Partner – Aquatic Ecosystem Research, LLC.** July 2017 to 2022
- **Adjunct Faculty** – Western Connecticut State University, Biol. and Enviro. Science Dept. August 2011 to present.
- **Executive Director –** Candlewood Lake Authority, Sherman, CT 06784. April 2003 to July 2017
- **Lake Preservation Director –** Candlewood Lake Authority, Sherman, CT 06784. April 1998 to Oct. 2002
- **Academic Research Associate –** Connecticut College, New London, CT 06320. Sept. 1989 to Jan. 1998
- **Visiting Lecturer –** Connecticut College, New London, CT 06320. August 1997 to January 1998
- **Research Assistant** – Western Connecticut State University, Danbury, CT 06810. 1987 to 1989

## CERTIFICATION, EDUCATION, AND TRAINING

- **Certified Lake Manager**, North American Lake Management Society, 2017
- **Professional Certification** in GIS, Pace University, 2014
- **Graduate Certification** in GIS Technology, University of New Haven 2001
- **M.A. in Botany**, Connecticut College 1993
- **B.A. in Biology**, Western Connecticut State University 1988

## AWARDS

- **Excellence in Environmental Stewardship** from the **Connecticut Outdoor and Environmental Education Association** in 2018
- **Recognition of Service** in the **Congressional Record** by **US Rep. Elizabeth Esty** on June 14, 2017
- **Watershed Conservationist Award** from the **Housatonic Valley Association** in 2011
- **Conservation Professional of the Year** from the **Litchfield County Conservation District** in 2002
- **Honor Award**, **Southern New England Chapter of the Soil and Water Conservation Society** in 2000.
- **Green Circle Award** from the **Connecticut Department of Environmental Protection** in 1999.
- **Conservation Award** from **Housatonic Valley Association** for publication entitled *Candlewood Lake: Watershed Awareness and Lake Preservation* in 1998.

## ORGANIZATIONS

- **Connecticut Federation of Lakes** – Founding member 1995; Treasurer from 1995 – 2001; Vice President from 2009 – 2011, 2018 - present; President from 2011 - 2015
- **Connecticut Forest and Park Association** – Board member from 1994 – 2002
- **North American Lakes Management Society** – Member since 1990

## SELECTED PUBLICATIONS

### *PEER-REVIEWED SCIENTIFIC PAPERS*

Siver, P.A., Sibley, J., Lott, AM., **Marsicano**, L.J. Temporal changes in diatom valve diameter indicate shifts in lake trophic status. J Paleolimnology 66, 127–140 (2021). https://doi.org/10.1007/s10933-021-00192-y

Siver, P., L. **Marsicano**, A. Lott, S. Wagener, N. Morris. 2018. Wind Induced Impacts on Hypolimnetic Temperature and Thermal Structure of Candlewood Lake (Connecticut, U.S.A.) from 1985-2015. Geo: Geography and the Environment. 5(2). https://doi.org/10.1002/geo2.56

Kohli, P., Siver, P.A., **Marsicano**, L.J., Hamer, J.S., and Coffin, A.M. 2017. Statistical Assessment of Long-term Trends for Management of Candlewood Lake, Connecticut, USA. Journal of Lake and Reservoir Management. 33:280-300

Lonergan, T., L. **Marsicano**, and M. Wagener. 2014. A laboratory examination of the effectiveness of winter seasonal drawdown to control invasive Eurasian watermilfoil (*Myriophyllum spicatum*). Journal of Lake and Reservoir Management. 30:381-392

Moore H.H., Niering W.A., **Marsicano** L.J, and Dowdell M. 1999. Vegetation change in created emergent wetlands (1988–1996) in Connecticut (USA). Wetland Ecology and Management. 7:177-191.

Siver, P.A. A. M. Lott, E. Cash, J. Moss, and L.J. **Marsicano**. 1999. Century changes in Connecticut, USA, lakes as inferred from siliceous algal remains and their relationship to land use changes. Limnology and Oceanography 44:1928-1935.

Siver, P.A. and L.J. **Marsicano**. 1996. Inferring trophic conditions using scaled chrysophytes. Beiheft zur Nova Hedwigia 114:233-246.

Siver, P.A., Canavan, R.W. IV, Field, C., **Marsicano**, L.J. and A.M. Lott. 1996. Historical changes in Connecticut lakes over a 55-year period. Journal of Environmental Quality 25: 334-345

**Marsicano**, L.J., J.L. Hartranft, P.A. Siver, and J.S. Hamer. 1995. An historical account of water quality changes in Candlewood Lake, Connecticut, over a sixty-year period using paleolimnology and ten years of water quality data. Journal of Lake and Reservoir Management 11:15-28.

Lott, A.M., Siver, P.A., **Marsicano**, L.J., Kodama, K.P. and R.E. Moeller. 1994. The paleolimnology of a small waterbody in the Pocono Mountains of Pennsylvania, USA: reconstructing 19th-20th century specific conductivity trends in relation to changing land use. Journal of Paleolimnology 12: 75-86.

**Marsicano**, L.J. and P.A. Siver. 1993. A paleolimnological assessment of lake acidification in five Connecticut lakes. Journal of Paleolimnology 9:202-221.

Siver, P.A. and L.J. **Marsicano**. 1993. *Mallomonas connensis* sp. nov., a new species of Synurophyceae from a small New England lake. Nordic Journal Botany. 13: 337-342

Siver, P.A. and L.J. **Marsicano**. 1991. Assessing acidification trends in Connecticut lakes using a paleolimnological approach. CT. Department of Environmental Protection Bulletin, 44 pp. + appendices

### *POLICY PAPERS AND SUBMITTALS*

**Marsicano**, LJ. 2009. An Examination of Recreational Pressures on Candlewood Lake, CT. Candlewood Lake Authority. Sherman, CT. 68 pp.

**Marsicano**, L.J., et al. 2000 – 2017. Submittals of the Candlewood Lake Authority to the Federal Energy Regulatory Commission during license renewal and management plan processes for Housatonic Hydro, FERC Docket No. P-2576.

## A. Hunter Brawley

95 Pilgrim Drive, Windsor CT 06095
Mobile: 203-525-5991

hbrawley@gmail.com

---

## *PROFESSIONAL EXPERIENCE*

**Owner/Manager,** Brawley Consulting Group LLC, Windsor, CT

(January 2008 to present).

Provides land conservation and management services to local land trusts and conservation organizations, including designing and implementing habitat restoration projects, grant writing, trail design and construction, crafting and monitoring conservation easement, boundary posting, Baseline Documentation Reports and developing property management plans. www.brawleycg.com

**Land Manager,** Naromi Land Trust, Sherman, CT

(March 2004 to present).

Manage all land trust properties and help acquire, monitor and enforce conservation easements. Responsibilities also include designing and building trails, securing funding for habitat restoration projects, and assisting with organizational and administrative tasks. Work cooperatively with the town and other conservation organizations to identify and prioritize lands for future acquisition. www.naromi.org

**Land Manager,** Kent Land Trust, Kent, CT

(September 2008 to August 2014).

Manage all land trust properties and help acquire, monitor and enforce conservation easements. Responsibilities also include securing funding for habitat restoration projects and preparing Baseline Documentation Reports (BDRs) and property management plans. Addressed backlog of stewardship items required for Kent Land Trust to become the second land trust in Connecticut accredited by the Land Trust Alliance.

**Project Manager**, Northeast Instream Habitat Program, Amherst MA.

(January 2004 to March 2005).

Coordinated all facets of two fisheries habitat assessment projects working with researcher at the University of Massachusetts, including project planning, data collection, hiring and overseeing seasonal staff, data analysis and report preparation. http://www.neihp.org/index.htm

**Executive Director**, Pomperaug River Watershed Coalition, Southbury, CT

(July 2001 to May 2003).

Managed all activities of non-profit watershed management organization dedicated to conserving regional water resources, including research, outreach, budgets, grant writing, website development, fundraising, and volunteer relations. www.pomperaug.org

**Senior Project Manager**, LabLite, LLC, New Milford, CT

(January 2000 to June 2001).

Product development, testing, sales, and customer service for a software company that provides Laboratory Information Management Software (LIMS) to environmental and other laboratories. www.lablite.com

**Research Coordinator**, The National Audubon Society, Southbury, CT

(March 1998 to January 2000).

Designed and implemented all research on birds and other wildlife at the 625-acre wildlife sanctuary. Conducted natural resources inventory, created checklists of wildlife and plants, established environmental education programs, and coordinated cooperative research projects with state agencies and regional conservation organizations. http://ct.audubon.org/IBA_BOR.html

**Environmental Analyst**, Land-Tech Consultants, Inc., Southbury, CT

(November 1996 to February1998).

As Project Manager conducted environmental impact statements, wetland assessments, and wildlife surveys; prepared federal, state and local permit applications; designed pond and tidal wetland restoration projects; and conducted lake diagnostic studies. Worked with state agencies and local land use agencies to mitigate impacts of residential and commercial development projects. www.landtechconsult.com

**Wetland Ecologist**, The Deep River Land Trust, Deep River, CT.

(July to October 1995).

Worked in association with The Nature Conservancy Connecticut Chapter on a conservation project at two freshwater tidal marshes in the lower Connecticut River. Position entailed mapping dominant vegetation communities, identifying potential environmental impacts, researching information on appropriate buffer zones and recommending methods for long-term monitoring of the system.

**Research Assistant,** The Nature Conservancy CT Chapter, Weston, CT.

(May to July 1995).

Assisted with research on the productivity and survivorship of Worm-eating Warblers at the 1700-acre Devil's Den Preserve in Weston, CT. Responsibilities included mist-netting, bird banding, and locating and monitoring approximately 25 nest sites throughout the breeding season.

http://www.nature.org/wherewework/northamerica/states/connecticut/

**Master's Thesis Research,** Connecticut College, New London, CT.

(September 1993 to May 1995).

Conducted two-year study investigating relationships between bird populations and environmental conditions in tidal wetlands of Connecticut. Quantified bird use, vegetation, and selected environmental parameters in eight tidal marsh systems on the Long Island Sound to assess the use of birds as indicators of environmental quality.

http://www.conncoll.edu/departments/botany/index.htm

**Research Associate**, Connecticut College Arboretum, New London, CT.

(Sept. 1992 to January 1994).

Conducted a natural resources inventory of The Harriet C. Moore Foundation property in Westerly, RI, including producing lists of all plants and animals (flora and fauna), conducting a breeding bird census, and identifying and tagging over 100 ornamental trees. Developed a five-year plan for the management and use of this 35-acre public land preserve.

http://arboretum.conncoll.edu/

**Principal Investigator,** The Nature Conservancy CT Chapter, Middletown, CT

(Summer 1994).

Studied five marshes in the tidelands of the lower Connecticut River to assess the impacts of the spread of common reed (*Phragmites australis*) on bird populations. Designed project that included the systematic collection of data on bird use, vegetation sampling and an analysis of physical site characteristics.

http://www.nature.org/wherewework/northamerica/states/connecticut/

## *EDUCATION*

Connecticut College, New London, CT. Master of Arts in Botany, 1995.

Connecticut College, New London, CT. Bachelor of Arts in American History, 1982.

The Loomis Chaffee School, Windsor, CT. Graduated 1978.

## *PUBLICATIONS*

Brawley, A. H., Zitter, R. and L. Marsicano, Editors. 2005. Candlewood Lake Buffer Guidelines. Candlewood Lake News *Special Edition*, Vol 1:21.

Warren, R.S., P. E. Fell, R. Rozsa, A. H. Brawley, A. C. Orsted, E. T. Olson, V. Swamy and W. A. Niering. 2002. Salt Marsh Restoration in Connecticut: 20 years of Science and Management. *Restoration Ecology* 10 (3) 497-513.

Markow, J. and H. Brawley. 2001. Herpetofaunal and Avifaunal Surveys of Vaughn's Neck Peninsula, Candlewood Lake, Connecticut. Report to the Town of New Fairfield, CT. 32 p.

Brawley, A. H. 1998. A Vegetation Survey and Conservation Analysis of Vaughn's Neck Peninsula. Report to The Candlewood Lake Authority. The National Audubon Society. 11 p.

Brawley, A. H., R. S. Warren and R. A. Askins. 1998. Bird Use of Restoration and Reference Marshes Within the Barn Island Wildlife Management Area, Stonington, Connecticut, USA. *Environmental Management* 22(4): 625-633.

Marsicano, L. J. and A. H. Brawley. 1997. Land Use, Watersheds, and Aquatic Resources. *Connecticut Woodlands* 62(3): p. 21.

Niering, W. A., and A. H. Brawley. 1996. Functions and Values Assessment of Area A Downstream Wetlands and Watercourses. Naval Submarine Base New London, Groton, CT. Report to Brown & Root Environmental, The Environmental Protection Agency, and The United States Navy. 36 p.

Brawley, A.H. 1995. Pratt and Post Coves: A Vegetation Survey and Conservation Analysis. Report to the Deep River Land Trust, Deep River, CT. 62 p.

Brawley, A.H. 1995. Birds of Connecticut's Tidal Wetlands: Relating Patterns of Use to Environmental Conditions. Master's Thesis, Connecticut College, New London, CT. 87 p.

Brawley, A.H. 1994. Birds of the Connecticut River Estuary: Relating Patterns of Use to Environmental Conditions. Report to the Nature Conservancy Connecticut Chapter Conservation Biology Research Program, Middletown, CT. 23 p.

Brawley, A.H., G.D. Dreyer. 1994. Master Plan for the Future Management and Use of Moore Woods. Connecticut College Arboretum Publication. New London, CT. 65 p.

Brawley, A.H., G.D. Dreyer and W.A. Niering. 1993. Connecticut College Arboretum Phase One Report to the Harriet Chappell Moore Foundation. Connecticut College Arboretum Publication. New London, CT. 100 p.

## *ACTIVITIES*

Forest and Trails Conservation Committee, Connecticut Forest & Park Association (CFPA)

Coverts Project Cooperator, UConn Cooperative Extension System

WILLIAM HENLEY
250 Laurel Street, East Haven, CT
Phone: (203)-710-8968 • Email: henley.williame@gmail.com

## EXPERIENCE

**Sr. Aquatic Resource Scientist** **May 2018 – Present**
**South Central Connecticut Regional Water Authority, New Haven, CT**

- Supervise source water quality monitoring at a regional water company serving 400,000+ customers in 15 towns
- Coordinate field work on 11 active reservoirs totaling over 2,000 acres as well as watershed lands (26,000 acres)
- Manage environmental programs and initiatives as they relate to source waters (streams, reservoirs, aquifers)
- Administer program budgets as well as plan and manage special projects
- Collect in situ profile data and water samples at reservoirs to monitor reservoir ecosystem health
- Process samples at the Authority's laboratory; analyze, interpret, and report the results
- Conduct aquatic macrophyte surveys and manage downstream release compliance
- Attend public events and participate in environmental outreach and education
- Contribute to ecological restoration by collaborating with various departments and external stakeholders
- Operate/maintain water quality sampling equipment as well as company boat and vehicle

***Core accomplishments:***

- Played a focal role in the realization of a new stream water quality monitoring initiative
- Worked on the discovery and management of an invasive species in one of the Authorities waterbodies
- Provided management and oversight of downstream release from reservoirs, and determined needs to meet new regulations.

**Fisheries Durational Resource Technician** **Apr – Nov 2016, July 2017 – Mar 2018**
**DEEP Inland Fisheries Division, Marlborough, CT**

- **Provided support to fisheries biologists by collecting biological data as it relates to fish and** aquatic ecosystems at over 65 stream sites and 25 lakes and ponds
- Conducted monitoring of stream and lake fish species utilizing electrofishing boats, backpacks, and trap nets
- Performed surveys of freshwater anglers on statewide lakes 2-3 days weekly in open water and ice conditions
- Collected and cataloged freshwater mussels for identification in conjunction with the CT DEEP Wildlife Division
- As a lead observer, facilitated stream crossing and culvert assessments for the North Atlantic Aquatic Connectivity Collaborative (NAACC)
- Collected dissolved oxygen profiles on lakes intended for stocking as part of a long-term dataset
- Provided direction to new technicians and oversaw volunteers

***Core accomplishments:***

- Served as a leader for sampling crews as well as managed several critical projects
- Participated in the discovery/confirmation of an invasive plant now found in the Connecticut River
- Contributed to a study of winter road sand impact presented at the Connecticut Natural Resource Conference
- Certified as North Atlantic Aquatic Connectivity Collaborative (NAACC) Lead Observer
- Participated in wild Brook Trout PIT tagging initiative

**Adjunct Limnologist** **July 2015 – January 2023**
**Aquatic Ecosystem Research, Branford, CT**

- Worked as a technician under the companies' principal limnologist executing field work on over a dozen freshwater bodies of water totaling over 2,500 acres
- Performed water quality monitoring and algal sampling using YSI Water Quality Sondes and Van Dorn samplers

- Conducted aquatic plant community surveys, including invasive species monitoring
- Collected various geospatial data, aquatic plant data, bathymetric data, and infrastructure data to conduct research, analyze trends, and create geospatial products and maps
- Compiled and managed large data sets and generated accurate reports on a regular basis
- Closely collaborated with freshwater and coastal stakeholders on the creation and planning of conservation and management projects

***Core accomplishments:***

- Developed various geospatial methodologies for assessment of ecological systems
- Implemented new techniques for monitoring aquatic plant communities
- Created standardized templates for company map products
- Integrated new technologies for bathymetric and plant mapping
- Participated in research initiatives for various projects, including authorship on a research paper

**Wildlife, Geospatial & Field Technician** **May 2016 – May 2018**
**Davison Environmental, Chester, CT**

- Worked independently on a variety of projects performing various assorted environmental work as a subcontracted environmental technician
- Accountable for geospatial data collection and analysis
- Participated in wetland and plant surveys as well as mapping initiatives
- Conducted wildlife surveys for amphibians, herps, birds, and bats
- Solely developed geospatial techniques and maps

**Environmental & Aquatic Field Technician** **Summer 2013 – 2015**
**All Habitat Services, Branford, CT**

- Identified and removed invasive wetland, upland, and aquatic vegetation by applying pesticides
- Conducted aquatic vegetation surveys and water quality sampling as well as produced professional map products
- Implemented new geospatial methodologies to survey sediments and bathymetry

## EDUCATION

**B.A. in Geography with minor in Wildlife Conservation • *University of Delaware*** **Spring 2015**
**Graduate Certificate Geographic Information Science • *University of Delaware*** **Spring 2015**

## VOLUNTEER & COMMUNITY SERVICE

**White-tailed Deer Capture & Tracking • University of Delaware, Milton, Delaware** **Jan – Apr 2015**
**Marsh Bird Surveys • St. Jones Reserve, Dover, Delaware** **June – July 2014**
President of National Meteorological Society Student Chapter, University of Delaware
Boy Scouts of America • Rank of Life Scout

## PUBLICATIONS

June-Wells M, Simpkins T, Coleman AM, **Henley W**, Jacobs R, Aarrestad P, Buck G, Stevens C, Benson G. (2017) Seventeen years of grass carp: an examination of vegetation management and collateral impacts in Ball Pond, New Fairfield, Connecticut. Lake and Reservoir Management 33:84–100

## SKILLS & QUALIFICATIONS

Proficient with Microsoft Word, Excel, and PowerPoint
Proficient with ArcMap, ENVI, and GIS Data Procurement
Basic knowledge of NCL, Python, R, and Unix
Proficient in use of GPS hand and backpack units (Garmin, Trimble)
Proficient in a variety of water quality sampling techniques/equipment
North Atlantic Aquatic Connectivity Collaborative (NAACC) Lead Observer
National Weather Service Skywarn storm spotter training
North American Lake Management Society Certified Lake Manager