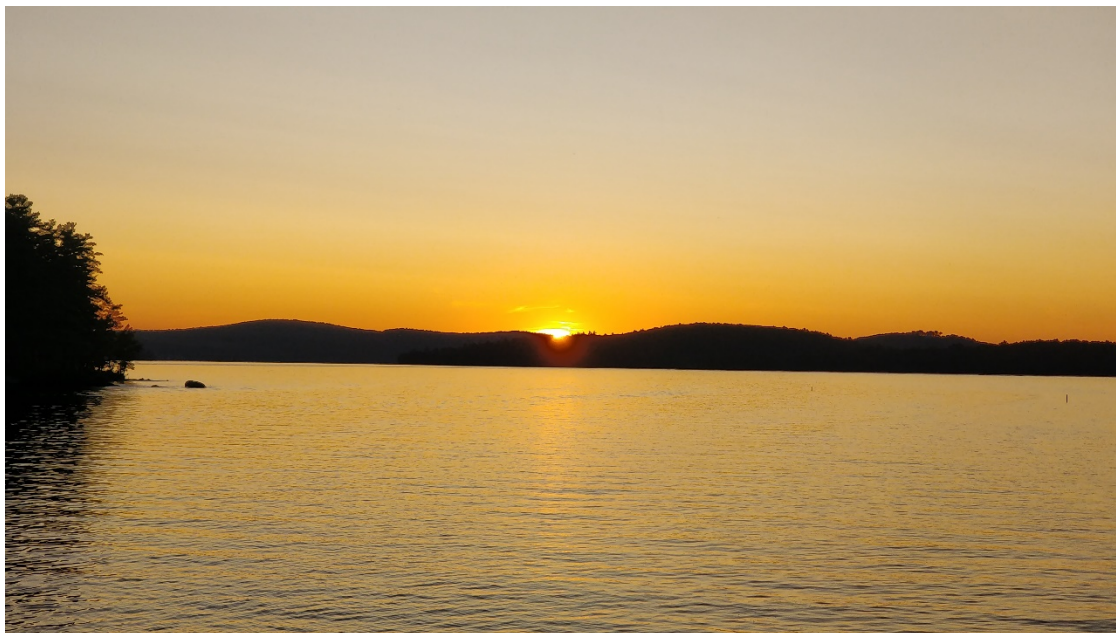


2020 Watershed Management Bureau in Review: Program achievements and data quality report



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EXECUTIVE SUMMARY

The year 2020 was dominated by a worldwide public health pandemic. The SARS-CoV-2, or COVID-19, respiratory virus spread into the United States in January and was widespread by March. As of the time of this report's writing over 70,000 infections and almost 1,200 deaths have occurred in New Hampshire. The impacts of the virus have transcended lifestyle changes from top to bottom worldwide, including field and lab work in the Jody Connor Limnology Center (JCLC) and the Watershed Management Bureau (WMB).

As in past years, the WMB oversaw the implementation of over 20 programs to monitor, protect and restore the state's surface waters, including its lakes and ponds, rivers and streams, coastal, wetlands, and public bathing facilities. In all cases, these programs are designed to promote the health of one of New Hampshire's most valuable natural resources: water. However, 2020 saw major changes in how and where these programs were implemented. In March 2020, almost all NHDES staff transitioned to a remote work environment. That meant most staff began working from home and using remote computer connections to access and work on digital files. It also brought about the mass use of digital meeting platforms such as GoToMeeting, Zoom, and Microsoft Teams. Few if any staff visited their traditional "brick and mortar" office at 29 Hazen Drive in Concord. To this date, this work environment continues and will likely continue for some time.

From a lab and field work perspective, a work-from-home option was not possible and several steps were taken to protect staff and volunteers from infection. From the outset, JCLC staff recognized that this meant remote "contactless" drop off and pickup routines for volunteer samples and equipment, a full reconfiguration of the lab to increase physical distancing, a limitation of one person per vehicle, the constant use of face coverings, hand and spray sanitizing agents, a limitation in the number of interns, and reduction lab capacity. In fact, a separate lab and field work standard operating procedure was developed by JCLC staff that detailed these COVID-19 protective measures.

Unfortunately, implementing these protective measures necessitated a fairly severe reduction the quantity of work that could be completed. New lake trophic surveys and synoptic river monitoring events were suspended entirely. The volunteer lake assessment program (VLAP) cancelled NHDES biologist field visits and reduced the number of volunteer sample events by one-third. Only a minimal amount of freshwater beach sampling was completed. Bacteria sampling was not completed for the river trend or the VLAP program. The volunteer river assessment program (VRAP) saw a reduction in the quantity of samples collected. Minimal electrofishing was completed to assess the condition of wadeable streams fish communities.

Despite these reductions, the JCLC still maintained a robust output of field activities and laboratory services. Approximately 120 field trips were made to complete river monitoring, 20 visits to complete lake trophic surveys, 80 invasive plant surveys and over 800 bacteria samples from beaches. Volunteers continued their amazing support assisting NHDES in monitoring the state's surface waters with VLAP receiving almost 9,000 samples and VRAP around 3,500 samples. Collectively, this translated to nearly 6,000 samples processed in the JCLC and another 3,400 samples processed at the Colby-Sawyer College satellite laboratory. Additionally, as part of its new cyanobacteria / harmful algal bloom program, the JCLC processed over 500 samples for cyanobacteria identification and enumeration. The JCLC continues to serve as the primary hub of activity in preparation for field surveys, water sampling processing and tracking. The laboratory's capabilities range from simple tests of pH in water to toxin concentration in cyanobacteria and the determination of mercury content in fish tissue.

WMB environmental data quality is ensured through Quality Assurance Project Plans (QAPP) or detailed standard operating procedure (SOPs). In both cases, these documents spell out specific procedures to confirm the acceptance of only high quality data. These data are housed in NHDES' environmental monitoring database (EMD). The EMD contains millions of unique data points from over 46,000 monitoring stations and 800 individual projects. The EMD serves as a vital component in meeting the bureau's data management needs and responsibilities. The data is used for a variety of purposes including water quality assessment reports, total maximum daily loads, watershed management plans, water quality criteria development and permit issuance.

As part of NHDES' ongoing efforts to provide reports on the condition of the state's surface waters, data for 150 lakes and ponds collected from 1991 through 2018 was summarized in a report titled, "New Hampshire Lake Trend Report: Status and trends of water quality indicators" (NHDES publication R-WD-20-08) and published in 2020. The report complements others recently completed by Biology Section staff that address river water quality, mercury in fish tissue and acid rain. All of these reports are publically available on the NHDES website on the [River and Lake Monitoring homepage](#).

The following report describes the various program activities within the WMB that collected data, utilized the facilities of the JCLC in 2020, or provided services to the public. The report is organized into three sections; the first section provides individual program summaries in a standardized template for quick reference; the second section includes an account of the various quality assurance efforts that are undertaken, and the third section provides brief description of the lab and field safety measures that are in place.

I. WATERSHED AMBIENT MONITORING PROGRAM SUMMARIES

1.1 Jody Connor Limnology Center (JCLC)

Challenges Addressed: The JCLC practices rigorous science to ensure that water quality data can be used by communities and industry to make decisions about lake and river management. JCLC also has the capacity to respond to water quality emergencies such as toxic algal blooms and chemical spills. The JCLC provides the necessary equipment, expertise, and space to allow for the processing of thousands of water quality samples and field work associated with surface water assessments conducted throughout the state.

Data usage: Data processed through JCLC is used to complete surface water quality assessments, for issuance of public health advisories, completion of waterbody-specific reports, compliance with regulatory activities and general investigations of surface water quality.

Approach: JCLC provides equipment, analytical services and sampling services to support probability based, targeted and trend monitoring activities.

Parameters measured: JCLC and the Colby-Sawyer College satellite laboratory provide analysis for approximately 25 chemical and physical parameters as well as more than a half dozen biological parameters.

Method of data collection: Discrete samples are analyzed by JCLC. Continuous data records are generated by deployment of remote water quality sensors.

Achievements: In 2020, JCLC and the Colby-Sawyer College satellite laboratory created 9,329 chemical records. JCLC analyzed 144 biological samples and made 939 species-specific identifications. For more specific information on the achievements of the JCLC in 2020 see Section 2.2 below.

Quality Assurance Measures: JCLC and the Colby-Sawyer satellite laboratory each maintain a laboratory manual detailing quality assurance measures and procedures for each specific analysis. In-lab quality assurance measures include blanks, duplicate analyses, continuing calibration verification (CCV) samples and spikes where appropriate. An in-depth summary of all quality assurance measures can be found in Section 2 of this report.

Funding: General funds (1000 account) and federal funds (Account 7602).

Program needs: Vital roles within the JCLC are shared amongst WMB monitoring staff. The Lab Safety Officer, QA/QC Officer and Data Administrator all have ambient monitoring programs responsibilities. The JCLC took a small step by hiring a dedicated intern to manage JCLC analysis and data entry operations this past summer, which was quite successful. A full time staff person to assume these important functions in the JCLC would be a good next step.

A recent upgrade to Access 2016 caused several issues in the JCLC Database which took a few months to iron out. Further Access databases are not supported by OIT, the JCLC database plays a critical role in managing sample load outlined above and would really benefit from an update to ensure it is fully compatible with the environmental monitoring database (EMD).

1.2 Volunteer Lake Assessment Program (VLAP)

Challenges Addressed: VLAP works with lake associations to assess and protect the health of New Hampshire's lakes and ponds. Over 500 volunteers monitor summer water quality at 180 lakes. These data allow for the identification of potential problems and to fix them before they impact recreation or fishing. VLAP reports are routinely requested by realtors and lakefront property buyers.

Data usage: Data generated through VLAP are utilized annually to create approximately 180 annual individual lake reports. VLAP is a primary source of lake and pond data utilized to complete surface water quality assessments for the federally required section 305(b) / 303(d) water quality report. VLAP data are also utilized by NHDES to complete Total Maximum Daily Loads (TMDLs), watershed management plans, and by lake associations and organizations to apply for grant funds. A lake trend report utilizing VLAP data collected from 1991 to 2018 in 150 lakes was published in June 2020.

Approach: Trend Monitoring - Repetitive visits to set of established sampling locations annually or on an established schedule for the purpose of tracking water quality parameters over time.

Parameters measured: VLAP measures a total of 13 chemical and biological parameters including: pH, conductivity, turbidity, apparent color, chloride, total phosphorus, alkalinity, *E. coli*, dissolved oxygen, temperature, transparency, chlorophyll-*a* and phytoplankton (including cyanobacteria).

Method of data collection: VLAP collects discrete samples at multiple in-lake and tributary stations.

Achievements: In 2020, despite the COVID-19 pandemic, VLAP and its associated satellite laboratory Colby-Sawyer College, accomplished the following (~35% reduction of workload from previous years):

- 258 individual sampling events conducted by volunteers.
- 134 lake deep spots and 400 river/stream stations monitored.
- 8,912 individual chemical and biological sample results generated.
- Approximately 2,700 hours collecting water quality samples.
- Approximately \$70,000 value of volunteer time collecting water quality samples.

Quality Assurance Measures: VLAP operates under an EPA-approved Quality Assurance Project Plan (QAPP), RFA# 19074, dated April 2019. VLAP is required to update the plan once every five years and submit to EPA for approval. VLAP is also required to complete an annual program audit detailing any deviations from the methods and data criteria stated in the QAPP and resolutions to those deviations.

Funding: General Fund (1000 Account).

Program needs: VLAP receives requests from lake associations and Watershed Management Bureau staff to add lakes or increase monitoring to supplement the development of water quality plans and to understand current lake conditions. VLAP is at its maximum capacity and can no longer accept new lakes. To provide expanded services requires additional staff in order to support operations in the Jody Connor Limnology Center and complete annual biologist visit trainings and audits at participating lakes.

1.3 Volunteer River Assessment Program (VRAP)

Challenges Addressed: VRAP was initiated in 1998 to promote awareness and education of the importance of maintaining water quality in New Hampshire's rivers and streams. VRAP volunteers monitor water quality from May through October in rivers and streams throughout the state, allowing NHDES to analyze water quality trends, identify potential problems and fix them before they cause degradation in water quality.

Data usage: VRAP is primarily a data procurement mechanism to determine whether rivers or streams are impaired or potentially impaired based on surface water quality criteria and designated uses (e.g., swimming, fishing and aquatic life support). Data collected through VRAP are used to develop the federally required section 305(b) / 303(d) water quality report. Almost 40% percent of the surface water quality assessments of riverine assessment units included in the 2020 303(b) report was provided by VRAP. Currently this data contributed to the assessment of over 3,000 miles of rivers and streams.

Approach: VRAP conducts trend monitoring via repetitive visits to established sampling locations on an established schedule. Targeted monitoring is also conducted to investigate suspected sources of pollution or to measure the water quality impacts as they relate to changes in the landscape such as development.

Parameters measured: VRAP measures field parameters including dissolved oxygen, pH, turbidity, specific conductance, water temperature and flow. Laboratory parameters include *E.coli*, nutrients, chloride and chlorophyll-*a*.

Method of data collection: VRAP collects discrete samples at multiple river and riverine impoundment stations.

Achievements: In 2020, data generated by VRAP volunteers are summarized as follows (~70% reduction of workload from previous years):

- 24 VRAP groups supported.
- 130 river/stream stations monitored across 3,000 miles of streams
- Approximately 3,500 individual chemical and biological sample results generated.

Quality Assurance Measures: VRAP operates under an EPA-approved QAPP dated May 17, 2017. VRAP is required to update the plan once every five years and submit to EPA for approval. VRAP is in the process of updating the QAPP. VRAP is also required to complete an annual program audit detailing any deviations from the methods and data criteria stated in the QAPP and the resolutions to those deviations.

Funding: Federal funds (Account 7602).

Program needs: The day to day operations of VRAP are currently done by a part time staff member. If this position were to be made full time it would reduce the need for assistance from current full time staff, reduce turnover in the current part time position, and provide consistency in program operations.

1.4 River Trend Monitoring Program (RTMP)

Challenges Addressed: RTMP began in the early 1970s, and prior to 2012, it was known as the Ambient River Monitoring Program (ARMP). In 2013, NHDES updated its surface water monitoring strategy to include 40 river and stream stations that are visited three to five times per year. The monitoring network includes stations that span a wide range of watershed sizes, levels of development, and geographic locations. Data collected since 1990 are maintained in NHDES' Environmental Monitoring Database (EMD). The RTMP is implemented directly by NHDES staff and measures water quality in rivers and streams throughout the state. Ultimately, it is used by many programs both within the bureau and outside.

Data usage: RTMP is primarily a data procurement mechanism to determine whether river or stream conditions are declining, improving or remaining stable over time. The data from this program was used to create a report that summarizes these condition in 2019. The data are also used to assess if river segments are impaired or potentially impaired, based on surface water quality standards and designated uses (e.g., swimming, fishing and aquatic life support). Data collected through RTMP are used to develop the federally required section 305(b) / 303(d) water quality report. In 2019, data collected, in part, through RTMP was used to complete a [report on the status and trends of water quality conditions in New Hampshire rivers](#).

Approach: RTMP conducts trend monitoring via repetitive visits to established sampling locations with the purpose of tracking water quality parameters over time. RTMP also conducts confirmation monitoring to determine if waterbodies can be removed from the 303(d) list. Targeted monitoring of previously unsampled waterbodies is also completed to gain additional information about the condition of New Hampshire surface water resources. Targeted sampling is done by sampling locations chosen from 10-digit hydrologic drainage units (HUC 10) using predetermined schedule.

Parameters measured: RTMP measures field parameters including dissolved oxygen, pH, turbidity, specific conductance, and water temperature. These parameters are collected via instantaneous measurements and deployable multi-parameter dataloggers. Laboratory parameters include nutrients (nitrogen and phosphorus), chloride, chlorophyll-*a*, metals, cations and other parameters as needed.

Method of data collection: RTMP collects discrete and continuous samples at multiple river and riverine impoundment stations. In 2020, over 2,600 individual chemical and biological sample results were generated.

Quality Assurance Measures: RTMP operates under an EPA-approved QAPP that is required to be updated every five years and submit to EPA for approval. An updated QAPP received approval from EPA in 2019. The RTMP is also required to complete an annual program audit detailing any deviations from the methods and data criteria stated in the QAPP and resolutions to those deviations.

Funding: Federal funds (Account 7602).

Program needs: The River Trend Monitoring Program requires continued financial support for laboratory and equipment costs. Annual costs to process water quality samples through this program are approximately \$30,000. The equipment used by this program includes both handheld meters and multiparameter dataloggers that require regular maintenance and replacement. A recently identified limitation is the lack of funds for laboratory analyses of contaminants of emerging concern, such as PFAS.

1.5 Lake Trophic Survey Program (LTSP)

Challenges Addressed: LTSP was initiated in the mid-1970s to provide basic information on the hundreds of lakes and ponds in New Hampshire. The LTSP was revamped and reinitiated by the Watershed Management Bureau in 2013 in order to generate periodic data on a portion of NH lakes and ponds that are not part of a volunteer program.

Data usage: To establish or update lake trophic ratings and determine if waterbodies meet their designated uses as required by sections 305(b) / 303(d) report for the Federal Clean Water Act. In 2020, a [report documenting the status and trends of lakes in New Hampshire](#) was completed. The report is based, in part, on data collected as part of the LTSP.

Approach: Lakes are selected from an annual schedule of targeted watersheds on a rotational basis using 10-digit hydrologic drainage units. The selection process is conducted by several biologists in the WMB and takes into consideration the age of available water quality data, public accessibility and recreational use.

Parameters measured: At the deep site of a lake, a dissolved oxygen/temperature profile is collected and the degree of stratification is assessed. Secchi depth is measured. A composite water sample from the mid-metalimnion is collected and analyzed for Chlorophyll-*a*, and a plankton haul is collected to mid-metalimnion depth. A discrete mid-epilimnion sample is collected and analyzed for alkalinity, pH, conductivity, apparent color, chloride, calcium, magnesium, NO₂ and NO₃ nitrogen, TKN nitrogen, total phosphorus, sodium, sulfate, silica and dissolved organic carbon. Beginning in 2016, spring sampling after ice-out and shoreline habitat data collection at 10 stations around each waterbody was added for newly selected waterbodies.

Method of data collection: The LTSP collects discrete samples.

Achievements: In 2020, 20 lakes were sampled. Due to the Covid-19 pandemic the 10 new lakes selected for sampling in 2020 were postponed until a future date. The 20 sampled were initiated either in 2018 or 2019. Overall, a total of 318 chemical records were generated. Additionally, 10 summary reports were finalized from the 2017 selection of lakes. Lake trophic survey reports can be found on the [Lake Information Mapper](#).

Since the LTSP participated in the 2017 National Lakes Assessment (NLA) it has been conducting intensification sampling using NLA protocols and random draw to sample a total of fifty NH lakes. This effort was concluded in the 2019 sampling season, the data has been verified, quality assured, and report will be issued in 2021.

In August, the LTSP conducted confirmation monitoring on six waterbodies selected by the Surface Water Quality Assessment Program and the data collected will supplement the data used in 305(b)/303(d) assessments.

Quality Assurance Measures: LTSP's QAPP was approved by EPA in 2015 and updated in 2021. All analyses are performed in accordance with the JCLC laboratory manual or the Department of Health and Human Services (DHHS) water lab's NELAC certification.

Funding: General funds (Account 1000) and federal funds (Account 7602).

Program needs: The LTSP requires continued financial support in order to maintain current staff, laboratory analysis, and field equipment costs. It is important to note, however, that there are often 50 or more candidate lakes with data that are 20 years or older. At the current level of support the program is only able to select 10 new lakes each year for sampling. At this pace the NHDES will not be able to update the data on all lakes and ponds in New Hampshire without increased capacity for sampling.

1.6 Biomonitoring

Challenges Addressed: The biomonitoring program was established in 1995 to determine the ability of the state's surface waters to support a healthy community of aquatic organisms. Sampling is completed each in summer and fall and serves to satisfy federal water quality reporting requirements under sections 303(d) / 305(b) for the Clean Water Act. To date, sampling by the biomonitoring program has been primarily focused in rivers and streams.

Data usage: Data produced through the biomonitoring program are used to complete water quality assessments to determine whether rivers or streams are impaired or potentially impaired, based on surface water quality criteria and designated uses (aquatic life support). Biological data are used in the development of water quality criteria and in making regulatory decisions. Data collected through the biomonitoring program are used to develop the federally required section 305(b) / 303(d) water quality report. The data are also used to track site-specific trends in biological condition and characterize the variability associated with macroinvertebrate data.

Approach: Starting in 2013, biological monitoring expanded to support three elements of the NHDES surface water quality monitoring strategy: trend, synoptic (targeted) and probability-based monitoring. Trend monitoring is conducted in collaboration with River Trend Monitoring Program and encompasses approximately 28 long-term stations monitored annually. Synoptic monitoring selects stations within specified HUC10 watersheds each year. In 2020, the biomonitoring program assisted other WMB staff with deployment and retrieval of 28 water temperature loggers and completing water quality monitoring at 40 trend monitoring sites between May and October. Biomonitoring staff were responsible for coordinating the collection of macroinvertebrate data at 28 trend monitoring sites. With assistance from WMB staff, rock baskets were deployed and retrieved approximately eight weeks later. Macroinvertebrate collection at 12 of the 28 trend sites was also done using kick-nets. Collection of fish data occurred for six events at six locations. For the sixth consecutive year, NHDES and the New Hampshire Fish and Game Department worked cooperatively to complete fish surveys at several trend sites. The biomonitoring program also assisted NHFG with brook trout surveys.

Parameters measured: Fish, macroinvertebrates, dissolved oxygen, pH, specific conductance, water temperature, flow, physical habitat characters and various laboratory generated water chemistry parameters.

Method of data collection: Discrete water quality samples and physical habitat measurements. Continuous water temperature data. Surveys of biological communities including fish and macroinvertebrates.

Achievements: In 2020 the Biomonitoring Program collected the following data:

- Temperature Loggers: Assisted other WMB staff with deployment and retrieval of 28 water temperature loggers.
- Water Quality: Assisted WMB staff with water quality monitoring at 40 trend sites.
- Macroinvertebrate samples: Deployment and retrieval 103 samples at 45 sample sites (>22,000 data points).
- Fish surveys: Six sample sites (>1,800 data points).

Quality Assurance Measures: The Biomonitoring Program operates under the RTMP QAPP, an EPA-approved QAPP that is required to be updated every five years and approved by EPA. The QAPP received EPA approval in 2015 and again in 2019. The Biomonitoring Program is also required to complete a bi-annual program audit detailing any deviations from the methods and data criteria stated in the QAPP and resolutions to those deviations. Specifics on the Biomonitoring Program's QA/QC efforts can be found in Section 2.4.

Funding: Federal funds (Account 7602).

Program needs: The Biomonitoring Program requires continued support for sample processing, supplies and equipment on an annual basis. Although expensive, the program would be enhanced by microalgal sampling and toxological analysis.

1.7 Fish Tissue Mercury Monitoring Program

Challenges Addressed: To collect data on the mercury content in tissue of freshwater fish species within the State of New Hampshire. The source of mercury contamination is from airborne stack emissions regionally and from the west due to prevailing winds. This makes mercury contamination of fish a widespread problem in New Hampshire.

Data usage: The data are used to conduct risk assessments for mercury exposure from fish consumption. Risk assessments are used to update statewide and, if appropriate, waterbody-specific fish consumption advisories. The data are also used to track trends over time in the mercury content in fish tissue. A [summary report](#) was initiated in 2015 and was finalized in 2018. The report includes data from 1992 through 2017.

Approach: Trend and targeted monitoring. Most samples are supplied by volunteers who bring in fish from the lake where they live or often fish. Additional fish may be obtained through specific studies related to regulatory changes designed to reduce the deposition of atmospheric mercury. Additionally, certain waterbodies have been targeted for long-term collection to perform trend monitoring.

Parameters measured: Mercury content in fish tissue expressed as mg of elemental mercury/kg of fish, weight and length of the fish.

Method of data collection: Discrete.

Achievements: In 2020, 78 fish were collected and analyzed. A report (R-WD-17-22) titled “Status and trends of mercury in fish tissue in New Hampshire waterbodies, 1992-2016” was released in 2018.

Quality Assurance Measures: The scale used for the weight is inspected and certified annually by a third party (contractor). Blanks, duplicates, continuing calibration verification (CCV) and spikes are performed in accordance with JCLC laboratory manual protocols.

Funding: General Fund (Account 1000B).

Program needs: A revised sampling design is required in order to maintain consistency in the number of fish analyzed, waterbodies sampled, and fish species assessed. Implementation of the revised design requires collaboration from the Fish and Game Department. The Milestone DMA-80 used to analyze fish is 15 years old and starting to become problematic and replacement parts are scarce. A new replacement machine will cost over \$40,000.

1.8 Acid Rain Deposition Program

Challenges Addressed: To collect data on acid rain deposition and determine its effects on sensitive lakes and ponds. Acid deposition results from regional and westerly power plant stack emissions as well as automotive emission sources.

Data usage: Data are used to conduct trend analysis on the effects of acid rain deposition and the effectiveness of air pollution regulations. Data have been used by the New Hampshire Fish & Game Department to make stocking decisions on acid sensitive ponds and lakes. In 2015, a [summary report](#) was completed utilizing data collected from the mid-1980s through 2014.

Approach: Trend Monitoring. Lakes and ponds included in this monitoring program have been monitored consistently in excess of 30 years. Twenty ponds are sampled by WMB staff and 10 remote ponds are sampled cooperatively by Fish & Game during helicopter stocking. Rain is also collected in Concord, NH, and analyzed to verify source inputs to lakes and ponds.

Parameters measured:

- Lakes/Ponds – pH, acid neutralizing capacity, conductivity, color, , sulfate, nitrate and chloride.
- Rain – pH, nitrate, sulfate and total phosphorus.

Method of data collection: Discrete. Samples are collected from specified lake outlets in fall and spring. Rain event samples are collected at NHDES headquarters in Concord.

Achievements: In 2020, 374 chemical records were generated to support the lakes monitoring effort, and 11 rain events were sampled and 49 analyses performed before rain collection was suspended due to COVID-19 building restrictions.

Quality Assurance Measures: This program is included in the Lake Trophic Survey Program QAPP that was approved by EPA in 2015.

Funding: General funds (Account 1000B) and federal funds (Account 7602).

Program needs: Continued support for current staffing, laboratory analyses and equipment needs.

1.9 Surface Water Quality Complaints

Challenges Addressed: Investigate concerns impacting surface water quality reported to the Watershed Management Bureau by staff and the public.

Data usage: Data are used to evaluate whether an issue or water quality violation exists. If an issue exists, there may be administrative action taken by NHDES or a referral to another agency for action to be taken.

Approach: If an investigator deems monitoring is warranted, targeted sampling is completed at strategically located stations. All complaints are logged into a complaint module of the Environmental Monitoring Database.

Parameters measured: Depends on the nature of the complaint.

Method of data collection: Continuous monitoring or discrete samples depending on the nature of the complaint.

Achievements: In 2020, 67 complaints were received, 24 were investigated. Samples were processed for five individual complaints in the JCLC.

Quality Assurance Measures: Parameter specific based on the JCLC Laboratory Manual or DHHS water lab protocols.

Funding: General funds (1000 account).

Program needs: This program is administered by one person who has other duties. In the summer when monitoring activities are at their maximum, resources for a field investigations and sampling are be limited. These resources include vehicles and sampling equipment.

1.10 Public Bathing Facility Program (PBFP)

Challenges Addressed: RSA 485A:26 requires NHDES to operate a year-round statewide PBFP program to ensure public health and safety when using bathing facilities such as pools and spas. The PBFP works to minimize health risks and safety concerns for New Hampshire residents and visitors who use public pool and spa facilities. Exposure to contaminated, poorly managed and maintained pool and spa water in New Hampshire has resulted in lung, skin, ear and eye infections, as well as gastric illness caused by pool chemicals or airborne and waterborne pathogens such as Legionella, Cryptosporidium, Giardia, Staphylococcus, Norovirus and E. Coli. The program has established standards of design to ensure that water quality is regularly sampled and analyzed, that construction designs provide for safe use, and that scheduled maintenance is regularly performed.

Data usage: Data generated through PBFP are used to evaluate facility compliance with state and federal public health and safety laws, determine enforcement actions, prioritize seasonal/regional inspections, shape educational outreach efforts and make historical comparison to evaluate program effectiveness. The U.S. Center for Disease Control makes periodic requests for data in studying chlorinated aquatic venues.

Approach: Targeted monitoring – PBFP conducts periodic routine inspections to evaluate public health and safety and responds to illness complaints.

Parameters measured: PBFP measures a total of 10 chemical and biological parameters. In-situ analysis includes temperature, pH, free chlorine, total chlorine, combined chlorine, bromine, turbidity, total dissolved solids, cyanuric acid, hardness and alkalinity. Field samples are submitted to DHHS-PHL for *E. coli* and total coliform analysis.

Method of data collection: PBFP collects discrete samples at public bathing facilities statewide.

Achievements: In 2020, minimal freshwater beach sampling was completed because of COVID restrictions. In total, the PBFP achieved the following:

- 13 facility inspections.
- Collected 21 samples for chemical and microbial analysis.
- Identified 5 water quality violations.
- Found 3 safety/facility violations.
- Issued 0 Letter of Deficiencies.
- Issued 2 Notice of Deficiencies.
- Issued 17 full design permits for new construction.

Quality Assurance Measures: Follows and updates the PBFP Field Inspection QA & SOP manual (last updated 5/23/2017). PBFP staff follows JCLC quality assurance measures for specific analysis. PBFP is also required to complete an annual program audit detailing any deviations from the methods and data criteria stated in the QA manual and resolutions to those deviations.

Funding: Newly established dedicated account- (1045) – funded by design review fees and annual PBF certifications.

Program Needs: The effectiveness of this program will be dictated by the ability to carefully implement and efficiently administer 2019 changes to the program, effectively manage the data and a develop a broad education/ outreach initiative directed at pool owner and operators.

1.11 Public Beach Inspection Program (PBIP)

Challenges Addressed: PBIP personnel collect water from coastal and freshwater beaches to test for fecal bacteria to protect the public health of swimmers. During the 2020 summer swim season, NHDES personnel sampled 22 freshwater public bathing beaches between July and August. The coastal beach inspection schedule was performed as usual between Memorial Day and Labor Day, with 16 coastal beaches sampled on a weekly, bi-weekly or bi-monthly basis (according to a tiered monitoring plan that varies annually). When the bacteria count at designated public beaches are higher than the State criteria, an advisory is issued to notify the public approximately 24 hours after sampling.

Data usage: The main goal of the program is to use the data collected to protect public health and inform the public of potential health risks at public beaches. Over time, data from beach sampling are used to determine impairment for the 303(d) list of impaired waters.

Approach: Targeted – samples are collected at individual beaches based on a predetermined schedule and used to make daily posting decisions regarding public health and safety. Follow up sampling at beaches with advisories is completed as necessary until fecal bacterial levels fall below State criteria.

Parameters measured: The main parameters measured are fecal bacteria (*E. coli* – freshwater beaches; enterococci – coastal beaches). Beach inspections also include measuring temperature and salinity, recording the number of bathers, waterfowl, and dogs, as well as assessing the general beach and water conditions. Additionally, water clarity, coastal tide levels and any other concerns or comments are noted during visits to beaches.

Method of data collection: Discrete data points are collected during each beach visit.

Achievements: In 2020, a total of 835 bacteria samples were collected from New Hampshire beaches. For freshwater beaches, 70 bacteria samples were collected between mid-July to mid-August. There were five fecal bacteria advisories at five separate freshwater beaches. There were 765 samples collected from coastal beaches between Memorial Day and Labor Day, resulting in 10 fecal bacteria advisories from seven of the coastal beaches.

Quality Assurance Measures: An EPA-approved PBIP QAPP was updated in April 2017 (RFA# 17075).

Funding: Federal funds, Org. Code: 2065, Approximately \$190,000 per year.

Program needs: There is an immediate need to hire a Beach Program Coordinator who can provide technical assistance and data management skills to evaluate the trends of beach conditions in New Hampshire.

1.12 Clean Vessel Act (CVA) Program

Challenges Addressed: The New Hampshire CVA program works to ensure that wastewater from boats is disposed of properly. Given the vast and growing number of boaters in New Hampshire, education is much more important than enforcement. The program works with marinas and the boating public to educate boat owners about how to manage sewage and graywater in a way that protects New Hampshire's surface water quality. The program provides funding for mobile and stationary pumpout facilities to ensure plenty of options for wastewater offload are available.

Data usage: The locations, availability and status of operation of stationary and mobile pumpout resources are tracked to provide this information to the public boating community and to identify potential CVA funding assistance opportunities. Additionally, data from the mobile pumpout services are collected and stored. There is also an Access database that houses boat inspection information.

Approach: Targeted information is collected annually about stationary and mobile pumpout resources through grantees, contractors and facility owners. The CVA program offers grants year-round to help keep pumpouts operational.

Parameters measured: Information collected may include the location of the pumpout resource, whether it is stationary or mobile, marina amenities, pumpout system mechanical information, system availability, usage fee collected (if any), participant contact information, vessel name, vessel type and estimated wastewater gallons pumped. Information for the boat inspection database is collected from individual boat registrations and wastewater systems that include graywater and marine sanitation devices. Details on location, dates of inspections and/or re-inspections, and compliance/non-compliance issues are documented by the boat inspector.

Method of data collection: Staff use data sheets for site visits of a stationary facility. Grantees are required to document boater information and wastewater estimates in logbooks in order to receive annual reimbursement for upkeep costs. The mobile pumpout services collect information using a physical receipt during each service. The boat inspection program collects data on physical forms or may enter directly onto a laptop in the field if one is available.

Achievements: In 2020, the program accomplished the following:

- The mobile pumpout boat documented about 822 captain hours, 620 serviced boats and approximately 18,406 gallons of wastewater pumped.
- Since 2002, the mobile pumpout services have pumped off approximately 217,791 gallons of boater wastewater.
- Two stationary facilities were provided grants to replace failing pumpouts.

Quality Assurance Measures: Input from data sheets, logbooks and receipts are verified either by the seasonal intern or CVA program coordinator. Boat inspection database entries are reviewed by either the boat inspection program staff or CVA program coordinator.

Funding: Federal Funds, Org. Code 2061, SFY 2020 \$317,781.

Program Needs: Currently the program funds 50% of a full-time staff position as the program coordinator and a summer intern position. Since 2018 the boat inspector position has been vacant but typically the position works weekends, about 5 hours a week or less. The summer intern position was filled in 2018 after many years of vacancy and filled again in 2019. In 2020 it was not filled due to pandemic restrictions. Future goals include increasing the percent of time for 100% of a full time staff position. The boat inspector position was difficult to fill due to its very limited hours and the limited hours also led the position to be less effective. It may be beneficial to the inspection program for the program coordinator position to assume the boat inspection responsibilities.

1.13 Exotic Species Program

Challenges Addressed: The primary purpose of New Hampshire’s Exotic Aquatic Plant Program is to “prevent the introduction and further dispersal of exotic aquatic weeds and to manage or eradicate exotic aquatic weed infestations in the surface waters of the state” (RSA 487:17, II). Aquatic invasive species are a constant threat to the ecological, biological, recreational, and economic values of New Hampshire’s waterbodies. Infestations lead to waterbody impairments and reduced values of the resource.

Data usage: Data generated through the Exotic Species Program are used to guide control activities on waterbodies. Data are also used to track concentrations of aquatic herbicides that may be used in various waterbodies and to determine the presence/absence of invasive aquatic plants in waterbodies.

Approach: Trend Monitoring. Repetitive visits are made to infested waterbodies to track infestations (size, density, distribution) over time. Targeted water quality monitoring may also be performed to document conditions before, during, and after implementation of the control practices

Parameters measured: Plant location, density and percent cover are surveyed annually on infested waters. Water depth, clarity, dissolved oxygen concentrations, herbicide concentrations, nutrient concentrations, temperature and turbidity may also be monitored.

Method of data collection: Discrete samples and observations at multiple stations in lakes and ponds for plant surveys or as needed for special studies. Data loggers are occasionally deployed for continuous data collection for parameters like dissolved oxygen.

Achievements: In 2020, the Exotic Species Program collected the following data:

- 90 waterbodies infested (dating back to 1970).
- One new infestation of a state-listed aquatic invasive plant (variable milfoil, *Myriophyllum heterophyllum*) was documented in Deer Meadow Pond in Chichester/Epsom.
- >200 plant identifications.
- >80 field inspections (GPS).

Quality Assurance Measures: Activities performed by the Exotic Species Program are described in the Quality Assurance Project Plan for the program, which was approved in 2014 by EPA, with an update and revision approved by EPA in 2019. It is currently under review and revision, in advance of a renewal of the plan.

Funding: State Fee Funds derived from boat registrations total approximately \$893,000 annually.

Program Needs: Additional funding is needed to expand control efforts. Currently, just under half of the waterbodies with infestations are being managed. Grant awards for management are provided by the state, but local entities assume at least 60% of the cost of management on the municipal or non-profit level.

1.14 Chloride Reduction efforts

Challenges Addressed: Chlorides are toxic to aquatic organisms, plants and to the infrastructure that supports our roads and bridges. NHDES has measured increasing chloride pollution in both lakes and rivers over the past 20 years. The primary source of those chlorides is road salt used for winter maintenance. NHDES has a number of programs to address this issue that include implementation monitoring for chloride Total Maximum Daily Loads (TMDL) of water bodies in the vicinity of the I-93 corridor from Massachusetts to Manchester, NH, and a voluntary commercial salt applicator certification program (Green SnowPro or GSP). Each of these programs has been successful in their respective efforts to reduce chloride contamination of the environment.

Data usage: The data is used to determine compliance with the TMDL and judge success of the commercial salt applicator program.

Approach:

- Continuous datasonde monitoring at four stations within the I-93 Corridor.
- Handheld measurement and grab samples at one site weekly and all sites every three weeks.
- Datasonde QA/QC checks, data download and maintenance every six weeks.
- Number of approved certified applicators.

Parameters measured (TMDL): Temperature, specific conductance and chloride. The chloride samples are processed and tested at the Jody Connor Limnology Center.

Parameters measured (GSP): Applications received and meeting the approval criteria as specified in RSA 489-C.

- Method of data collection (TMDL): Continuous (datasonde) and discrete (chloride).
- Method of data collection (GSP): Electronic (PDF or Word attachments), facsimile or direct mailing of hard copy applications.

Achievements:

- 34,000-35,000 data points per station per year.
- Over 1,200 certified salt applicator certificates issued since 2011.

Quality Assurance Measures (TMDL): A full description of all the data quality control measures are contained in a 2006 EPA-approved QAPP, the 2018 Ambient River Monitoring Program QAPP and updated field SOPs for the I93 Implementation monitoring.

Quality Assurance Measures (GSP): Certified Salt Applicators must apply for certification annually and meet the requirements listed in the RSA.

Funding (TMDL): NHDES has expended all the funding dedicated for the TMDL and monitoring by NHDOT as part of the I-93 study. Addition monitoring funds may become available as a result of the future Exit 4A project.

Funding (GSP): The Commercial Certified Salt Applicator Program became fee-based as of June 2018. Application costs are tiered and written into the RSA. These funds support a part-time Salt Reduction Coordinator position within NHDES.

Program Needs (GSP): The Green SnowPro salt reduction coordinator position was filled in August 2018. The position is part time and tasked with processing hundreds of applications each year, planning for the annual Salt Symposium, organizing and hosting full and refresher training courses, assisting with database development, conducting outreach, education, and evaluating and implementing new marketing opportunities. The scope of work associated with this program merits a full-time coordinator.

1.15 NHDES Shellfish Program

Challenges Addressed: The mission of the Shellfish Program is to ensure that the shellfish harvested in New Hampshire meet standards for human consumption. The program monitors coastal waters for bacteria, viruses and algal blooms that produce biotoxins that can accumulate to potentially fatal levels in shellfish. The program creates the regulatory conditions that allow the commercial shellfish industry to legally harvest and engage in interstate commerce. Recently, the commercial shellfish industry has grown rapidly in New Hampshire, adding two to three commercial aquaculture farms per year since 2011. In 2020, there were 27 oyster farms, four oyster upwellers and five blue mussel farms. The program also ensures the safety of recreational shellfishing.

Data usage: Data generated by the Shellfish Program are used to prepare and update Sanitary Survey reports for the eight major shellfish growing areas in the state's jurisdiction. Data generated by the program are also used to make daily and weekly management decisions regarding which harvesting areas are open or closed based on current information on public health threats such as red tide levels, recent rainfall, boating and mooring surveys and others. These decisions are communicated through a hotline message and internet-based tools.

Approach: The shellfish monitoring program implements a systematic random sampling program to maintain updated bacteria data on 70 monitoring stations in the state's tidal waters. Data from event-based seawater and shellfish tissue testing after pollution events such as heavy rainfall events are used to supplement the ambient program and to support management decisions. Additional monitoring programs include Harmful Algal Bloom Monitoring, Shoreline Survey Program, and new monitoring programs focused on *Vibrio* bacteria risk assessment and on viral indicators of sewage pollution.

Parameters measured: Seawater and shellfish tissue sampling programs document fecal coliform bacteria, water temperature, salinity and other observations; phytoplankton monitoring and biotoxin levels in blue mussels and other shellfish species; water temperatures near commercial oyster farms and *Vibrio* bacteria levels in oysters; and Male Specific Coliphage (virus) levels in municipal wastewater treatment facility effluent, as well as in oysters, softshell clams and blue mussels.

Achievements: In 2020, the Shellfish Program accomplished the following:

- 55 rounds of sampling on tidal waters.
- 1,052 seawater samples collected.
- 21 rounds of sampling in response to rainfall events.
- 74 red tide samples collected.
- 669 commercial harvesting decisions generated.
- 95 wastewater treatment facility calls evaluated.
- 68 harvesting hotline updates implemented.
- 1,985 properties surveyed and tracked for pollution.
- 11 marina/mooring field surveys performed.
- 884 pollution sources tracked.
- 45 rounds of pollution source sampling completed.

Quality Assurance Measures: The Shellfish Program operates under three EPA-approved Quality Assurance Project Plans (QAPPs), dated May 2013, addressing ambient monitoring, Red Tide monitoring and shoreline survey monitoring. All three are currently being redrafted for the five-year updates. The "Red Tide" monitoring QAPP is being revised into a "Harmful Algal Bloom" QAPP that will incorporate new monitoring programs involving weekly sampling and enumeration of selected marine phytoplankton. The Shellfish Program is also required to complete a program audit every other year detailing any deviations from the methods and data criteria stated in the QAPPs and resolutions to those deviations.

Funding: General fund (1523) FY 21 \$515,334.

Program Needs: Increased capacity for offshore/nearshore monitoring of Harmful Algal Blooms needs to be developed, especially with respect to the algae genus *Pseudo-nitzschia*, and the biotoxin domoic acid. Increased capacity for managing growing commercial aquaculture industry also needed.

1.16 Special Studies

Challenges Addressed: Short-term monitoring to collect data for the purposes of evaluating the environmental impact of a temporary event such as construction, answer a specific scientific question, evaluate a data collection method, or solve a specific problem within a waterbody or watershed.

Data usage: The primary use of data will fulfill the goal of the study. Any ambient monitoring data will be available via the EMD for other programs to use.

Approach: Targeted monitoring approach.

Parameters measured: Determined by study design.

Method of data collection: Determined by study design.

Achievements: In October 2020, NHDES partnered with EPA for a one-year special study investigating dissolved organic carbon (DOC) levels in rivers around the state. Twenty rivers are sampled monthly for DOC and other water quality parameters to better understand temporal and spatial DOC variability and to assist NHDES in adopting EPA's 2018 aquatic life criteria for aluminum. Eight special studies were in progress involving the JCLC, including: 18 analyses for the Nippo Lake Special Study; 99 analyses for the Silver Lake Special Study; 51 analyses for the Spiny Water Flea monitoring project; 288 analyses for the Lake Regional Monitoring Network; 52 analyses for the River Regional Monitoring Network; 13 analyses for the Partridge Lake special study; and 519 analyses for the River DOC project.

Quality Assurance Measures: As determined by study design.

Funding: Various.

Program Needs: A sustained source of funds is required to support focused lake studies where cyanobacteria blooms occur regularly. These funds would be used to identify the source of nutrient loads, level of cyanobacteria toxicity and bloom likelihood.

1.17 Harmful Algal/Cyanobacterial Bloom Program (HAB)

Challenges Addressed: HAB personnel collect water from lakes, ponds and rivers in response to the presence of algal and cyanobacterial blooms. When a cyanobacterial bloom is observed, the public are encouraged to take a photo and report the location of the bloom. When the cyanobacteria cell counts are higher than the State criteria, an advisory is issued to notify the public of its severity. The program also responds to complaints about other algae and suspicious anomalies needing microscopic identification.

Data usage: The main goal of the program is to use the data collected to protect public health and inform the public of potential health risks. These data are also used to determine impairment for the 303(d) list of impaired waters. Cyanobacteria data further help to inform the safety of surface water supplies for public drinking water.

Approach: Targeted data collection. Samples are collected from the location(s) of the complaint that was reported. Public access sites such as beaches and boat launches are also sampled. Follow up sampling at waterbodies with advisories is completed weekly until cyanobacteria levels fall below state criteria.

Parameters measured: Samples are analyzed for the identification of the algae or cyanobacteria, the concentration of the cells per volume of water, and concentrations of select cyanotoxins. Additionally, water clarity, weather, temperatures and any other concerns or comments are noted during site inspections. Data are entered under complaints of the EMD.

Method of data collection: Grab samples or discrete data points are collected during each inspection.

Achievements: In 2020, a total of 555 samples were collected from New Hampshire waterbodies for cyanobacteria or microscopic identification due to algae complaints.

Quality Assurance Measures: SOPs and QAPPs under development.

Funding: General funds, Org. Code: 1000.

Program needs: This newly formed program is need of an approved QAPP that details the operations for data management, communication and reporting for cyanobacterial blooms and algal complaints.

1.18 Surface Water Quality Assessments (305(b)/303(d))

Challenges Addressed: The water quality status of New Hampshire's surface waters are reported in accordance with Section 305(b) and 303(d) of the Clean Water Act (CWA), and New Hampshire Statutes Chapter 485-A:4.XIV. Per the Clean Water Act, assessments are to be completed biennially on even numbered years.

Data usage: Assessments are viewed and used by the general public, local, state and federal agencies, as well as non-governmental organizations. Assessment results are formally sent to EPA for transmittal to Congress. All assessment results are made available to the public via the program website and a web-based data mapper.

Assessments determine if a waterbody meets its designated uses. Waters that do not meet one or more designated use are considered impaired. In cases where a waterbody meets one or more of its designated uses, protection measures may be an appropriate management action. The Surface Water Quality Assessment Program does not take any actions based upon the attainment determinations, but rather provides that information to other programs. Impaired waters become eligible for 319 restoration funds. Impairment status may influence certain permitting actions.

Method of data collection: The primary source of data for the assessments is the EMD. Every two years, as part of the assessment process, a snapshot of "recent" samples is imported to the Supplemental Assessment Database (SADB) for processing and tracking. The snapshot includes discrete and continuous data records.

Achievement: For 2020 cycle, the Surface Water Quality Assessment Program reviewed the following to complete designated use support decisions:

- 230 different project sources of data.
- 9,815 monitored stations.
- 466,520 individual sampling events.
- 488,477 day/parameter combinations from datalogger record sets.
- 1,758,189 individual chemical and biological grab sample results.
- 4,867,942 individual water quality standard comparisons were made.

Quality Assurance Measures: In addition to the quality assurance methods of each of the data sources, the assessment is guided by set of standard procedures called the Consolidated Assessment and Listing Methodology (CALM). More information is available on CALM on the [Surface Water Quality Assessment publications website](#).

Assessments are conducted in a stepwise fashion. First, the SADB manages all imported sample data and performs the initial sample level water quality standard comparisons. Next, each waterbody/parameter combination is summarized in bulk and those bulk assessments are quality assured by a second individual. Third, the detailed lists of waterbodies with significant changes and/or borderline assessments are subjected to detailed review using a tool that allows all samples to be paired up with weather and flow data. Finally, all new impairments and de-impairments are vetted through professional staff to confirm that the data are sufficient to support those decisions.

Funding: Federal funds, Org. Code: 7602.

Program Needs: The process of the biennial vetting of assessments through NHDES professional staff could be streamlined

1.19 TMDL Program

Challenges Addressed: The TMDL Program develops pollution budgets for impaired waters. TMDLs have been developed for rivers/streams and lakes/ponds. In the past several years the focus of TMDL development has been on bacteria and nutrient impairments. A lake phosphorous TMDL was completed on Locke Lake in Barnstead in 2020. In 2021, the TMDL Program is developing another lake phosphorous TMDL on Daniels Lake in Weare.

Data usage: The TMDL Program uses in the NHDES Environmental Database (EMD) to estimate nutrient loads and develop estimated reductions necessary to achieve water quality targets. Where needed, supplemental data are collected to develop, update and/or confirm existing data.

Approach: Data used in the development of TMDLs are targeted to the specific waterbody of interest or those draining into or out of the waterbody of interest.

Method of data collection: When necessary, the TMDL program collects discrete and continuous data in lakes, ponds, rivers and streams where applicable to develop each TMDL project. Samples are collected following the applicable EPA approved programmatic QAPP(s).

Achievement: Since 2000, EPA has approved 947 TMDLs in New Hampshire. In 2017, EPA approved the Northeast Regional Mercury TMDL, which accounted for 5,124 additional TMDLs.

Quality Assurance Measures: The TMDL program uses data in the EMD that has been collected according to an EPA approved programmatic QAPP. The TMDL program is also required to complete an annual program audit detailing any deviations from the methods and data criteria and resolutions to those deviations.

Funding: Federal funds, Org. Code: 7602.

Program Needs: The program would benefit from additional staff resources to develop TMDLs.

1.20 Rivers and Lakes Management and Protection Programs

Challenges Addressed: The Rivers and Lakes Management and Protection Programs provide a mechanism for public recognition and management of important state waterbodies. In addition, it participates in the development and implementation of statewide surface water management policies.

Data usage: The Instream Flow (ISF) Program uses stream flow data to determine when management such as water use restrictions and flow releases is needed on designated rivers for which protected instream flows have been established. The Program also measures river stage and flow to develop rating curves for locations without stream gages.

Method of data collection: Continuous data records are obtained for stream flow and water temperature. Discrete field measurements of stream velocity, depth and width are collected to estimate streamflow when gages are not available.

Achievements:

- 1 New ISF Program staff hired to develop and administer water management plans for all Designated Rivers.
- 19 Designated Rivers; 1,010 total Designated River miles.
- 22 Local River Management Advisory Committees (LACs).
- 200+ active volunteers.
- 237 permit applications reviewed by local citizens in 2020.
- 7 State-owned surplus land disposals reviewed in 2020 ensuring that public access to state waters is maintained.
- 8 letters of testimony submitted during the 2020 New Hampshire legislative session by the state-wide Rivers and Lakes Management Advisory Committees.
- Installed three staff gages on Designated Rivers for river management.
- Extended stream flow data at two gages to provide continuous 50-year records for protected flow modeling.

Rivers Program staff worked with staff in the Wetlands Bureau to modify the wetland rules released late in 2019 with regard to the types of permit applications reviewed by LACs. The modifications reduced the number of permit applications to only those most likely to impact the designated river.

In 2020, most of the field work necessary to develop protected instream flow criteria on the Cold River was completed, and field work was begun on the Warner River. Staff placed loggers in these and two other rivers to collect baseline water quality data in preparation for future studies, and prepared an RFP for studies in the Ashuelot and Isinglass rivers.

Quality Assurance Measures: Stream flow measurements are assessed by repeated measurements to evaluate the variability of individual measurements and estimate the overall accuracy of the results.

Funding: General Funds: Org. Code 1518 (FY2020 \$481,364); Federal Funds: Org. Code 7602 (FY2020 \$114,996).

Program Needs: In 2020, two part-time and one full-time staff took positions in other areas of NHDES, leaving these positions vacant due to the hiring freeze. LAC, RMAC and LMAC support was significantly impacted with these personnel losses. The ISF Program needs one additional full-time biologist to evaluate fish, wildlife and riparian plant community health in order to develop a long-term monitoring protocol for determining the effectiveness of program implementation. Additional contract funds of \$100,000 to \$175,000 per year over FY21 funding levels, depending on the length of the river under development, are also needed for hiring consultants to develop protected instream flows at the rate of one river per year, which is critical to expanding the program to all 19 designated rivers in the state as mandated in RSA 483. Currently one river and one river segment have been largely completed and are being actively evaluated and managed to maintain protected flows, and protected instream flow studies have begun on two additional rivers.

The Lakes Management and Protection Program requires funding for a Lakes Coordinator in order to provide support to the Lakes Management Advisory Committee and lake management efforts throughout the state. The Lakes Program is currently unfunded.

1.21 Coastal Program

Challenges Addressed: The Coastal Program protects clean water, restores coastal habitats, and helps make communities more resilient to flooding and other natural hazards through staff assistance and funding to 42 coastal towns and cities as well as other local and regional groups. Coastal areas are especially vulnerable to storm surge, flooding and sea level rise, putting coastal infrastructure, property and habitats at risk. The Coastal Program helps local decision-makers to minimize damage and increase preparedness for these natural hazards.

Achievements:

Wagon Hill Farm Living Shoreline Project

The Town of Durham received a NHDES Coastal Program Coastal Resilience Grant to complete design plans to control erosion problems at Wagon Hill Farm, a popular public recreation spot at the mouth of the tidally influenced Oyster River, through the construction of a living shoreline. This includes saltmarsh habitat and provides space for the marsh to move inland as sea levels rise. Thanks in part to the Coastal Program grant and staff technical assistance, the Wagon Hill Farm living shoreline project was awarded construction funding by the NHDES ARM fund. Construction was completed in 2019.

“Building a Flood Smart Seacoast” Workshop Series

From cracked foundations, totaled cars and destroyed utility systems, recurrent coastal flooding has already inflicted considerable damage in Hampton Beach. This issue is prompting residents to search for ways to protect and continue enjoying their properties for years to come. The Coastal Program, in partnership with the Seabrook-Hamptons Estuary Alliance, hosted the first-in-the-state “Building a Flood Smart Seacoast” workshop series focused on helping property owners make better-informed decisions about how to make their properties more flood resilient.

Dune Restoration Hampton-Seabrook Estuary

New Hampshire’s Hampton-Seabrook Estuary has lost 86% of its historic sand dunes since they were first mapped out in 1776. Sand dunes create a natural buffer from storms, shield from flooding and provide habitat. A project initiated by the NH Sea Grant and UNH Cooperative Extension with the support of two Coastal Program resiliency grants continues to restore and protect dunes. The project has focused on replanting and protecting vulnerable and eroded areas in Hampton. Work has included the installation of signs showing where people can access the paths across the sand dunes to the beach and re-vegetation by community volunteers.

Funding: Federal Funds (The Coastal Program is funded by The National Oceanic and Atmospheric Administration). Org. Code 3642; Received \$1,172,000 for FFY20.

Program Needs: Funding and staff to help communities prepare for coastal hazards through grants, technical assistance and outreach and training.

II. NHDES WATERSHED MANAGEMENT BUREAU DATA QUALITY CONTROL

2.1 Watershed Management Bureau QAPPs and Standard Operating Procedures (SOPs)

The Watershed Management Bureau maintains several Quality Assurance Project Plans (QAPP) and Standard Operating Procedures (SOP) (Table 1). QAPPs are documents submitted to and approved by the Environmental Protection Agency (EPA), which describe the scope of a monitoring project, defining what is to be monitored, how it is to be monitored, and the procedures to be carried out to ensure data quality. SOPs outline specific procedures for things such as field data collection, laboratory sample handling, sample preparation and sample analysis.

Table 1: Current Watershed Management Bureau QAPPs and SOPs

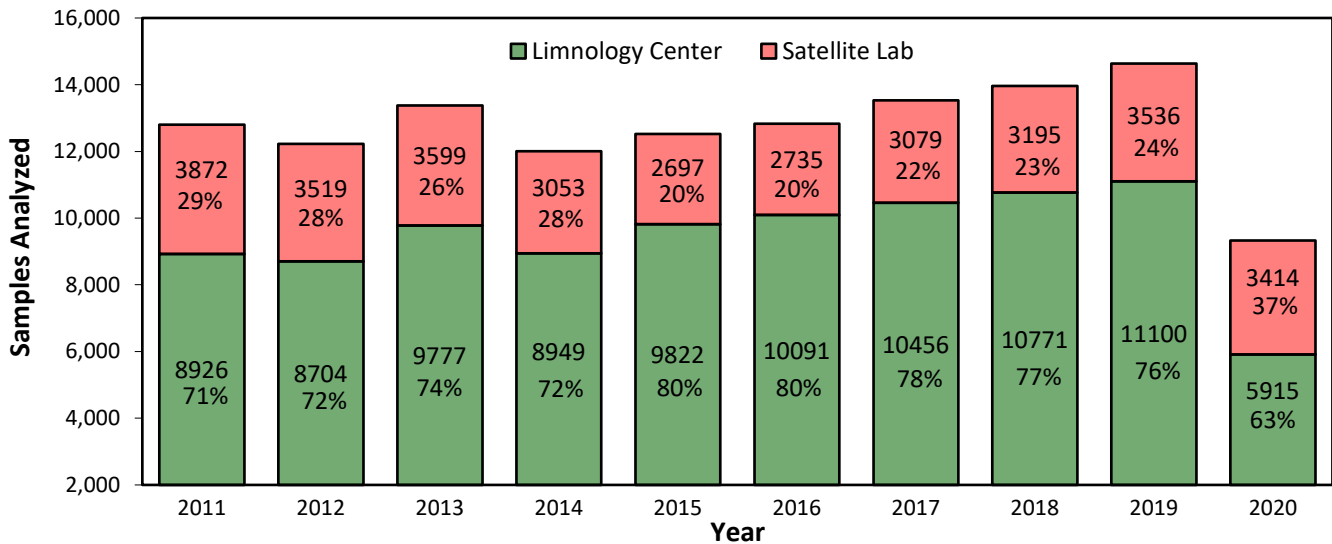
Program Name	Document Title	Type	Year Created	Last Update
Jody Connor Limnology Center (JCLC)	NHDES Jody Connor Limnology Center Laboratory Manual	SOP	2001	2019
Lake Assessment Program and special projects	Lake Assessment Program Quality Assurance Plan	QAPP	2015	2021
Volunteer Lake Assessment Program	NHDES Volunteer Lake Assessment Program Quality Assurance Project Plan RFA 19074	QAPP	2003	2019
Beach Inspection Program	NHDES Beach Program Generic Quality Assurance Project Plan; RFA #NH17075	QAPP	2003	2017
Shellfish Program	Quality Assurance Project Plan for Shellfish Ambient Water Quality Monitoring	QAPP	2002	2013
Shellfish Program	Quality Assurance Project Plan for Shellfish Sanitary Surveys	QAPP	2002	2013
Shellfish Program	Quality Assurance Project Plan for Paralytic Shellfish Poisoning Monitoring	QAPP	2002	2013
Exotic Species Program	NHDES Exotic Species Program Quality Assurance Project Plan	QAPP	2014	2019
River Monitoring Program	NHDES River Monitoring Program Quality Assurance Project Plan	QAPP	2014	2019
Instream Flow Program	NHDES Instream Flow Priorities for Annual Monitoring/Sampling	SOP	2020	2020
Instream Flow Program	NHDES Instream Flow Protocols for Conductivity, Temperature, and Water Level Dataloggers	SOP	2018	2020
Instream Flow Program	NHDES Protocols for Stream Flow Measurement and Staff Gage Installation and Monitoring	SOP	2020	2020
Instream Flow Program	NHDES Protocols for Prioritizing Protected Instream Flow Studies	SOP	2020	2020
Instream Flow Program	NHDES Protocols for Long-Term Monitoring of Riparian Ecosystems	SOP	2020	2020
Instream Flow Program	NHDES Protocols for Stream Gradient and Floodplain Transect Survey	SOP	2020	2020

2.2 Jody Connor Limnology Center

Jody Connor Limnology Center (JCLC) staff processed 5,915 chemical analyses in 2020, which is a 40% reduction compared to the 10-year average (Figure 1). Additionally, 2,729 samples were collected by JCLC programs in 2020 but analyzed by Department of Health and Human Services – Public Health Lab (DHHS-PHL). The substantial reduction in all sample loads is due to changes made in the JCLC operations to maintain safety during the COVID-19 pandemic. For further information on the changes made to JCLC operations during the COVID-19 pandemic, see Section 3.4.

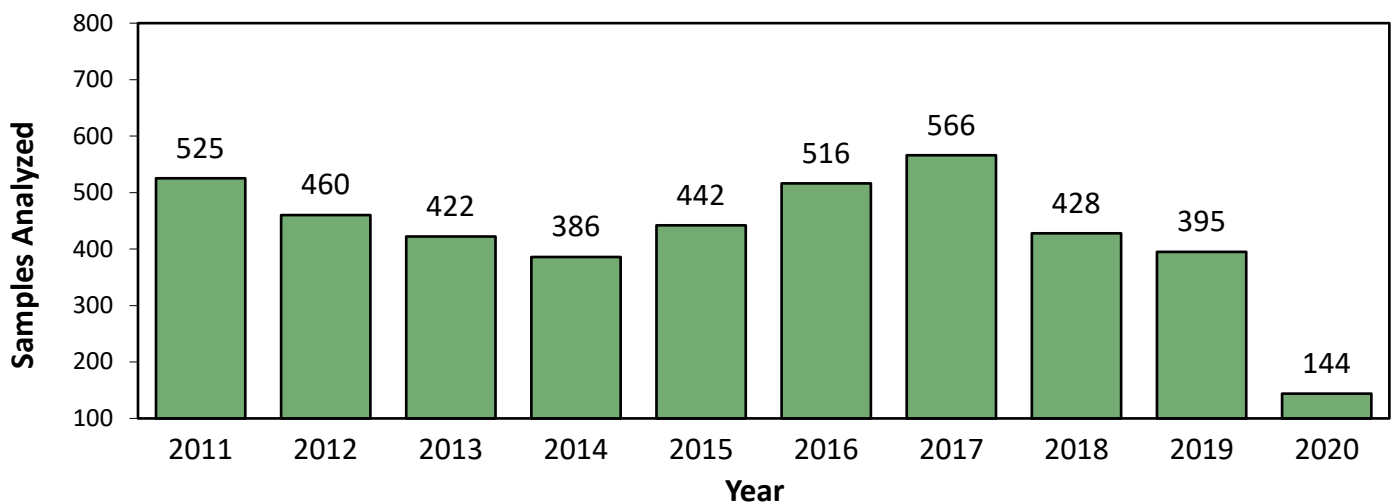
JCLC provides volunteer monitors additional services by making available and providing oversight to a satellite laboratory at Colby-Sawyer College (CSC). The laboratory is a cooperative effort between CSC and the Lake Sunapee Protective Association (LSPA). In 2020, 3,414 chemical analyses were processed at the CSC satellite laboratory.

Figure 1: Satellite vs JCLC Analysis 2011-2020.



The JCLC also processes biological samples of phytoplankton, zooplankton, cyanobacteria, and macrophyte identifications. The number of annual biological analyses performed has hovered between 400 and 500 for several years. In 2020, 144 biological samples were processed in the JCLC.

Figure 2: NHDES JCLC Total Annual Biological Analyses.



2.2.1 JCLC and Satellite Lab Data Quality Objectives

Quality control (QC) is an important component assuring the production of high quality data. At both JCLC and the CSC satellite lab, QC samples are processed regularly. Over 1,300 QC sample analyses were conducted by the two laboratories in 2020.

JCLC and the CSC satellite laboratory met their data quality objective (DQO) requirement of completing replicate analyses on 10% of the processed samples. Since establishing this DQO objective in 1999, the cumulative laboratory replicate percentage has surpassed the 10% requirement each year. All laboratories also continued to follow both Continuing Calibration Verification (CCV) (Table 2) and Critical Range (CR) criteria (Table 3). The CCV and CR processes verify that the laboratory equipment and personnel are all meeting established standards and confirming that high quality, reliable data are being produced. Further, based on a required 2019 NHDES QA Self-Audit, both labs were found to have excellent systems in place to ensure that high quality data were being produced and the only recommendation was to update the link to the JCLC Lab Manual in the NHDES QAPP library file. The next self-audit will be completed in early 2021.

Table 2: JCLC and CSC Laboratory CCV Acceptance Criteria

Parameter	Frequency	CCV Standard	Acceptance Limit
pH and Alkalinity	10% or at the end of the day's analyses, whichever comes first	6.0 pH	+/- 0.1 pH unit
Conductivity		100 µS/cm	+/- 10% = 90-110 µS/cm
Chloride		100 mg/l	+/- 15% = 85-115 mg/L
Turbidity		10 NTU	+/- 10% = 9-11 NTUs
Color Hanna		50 CPU	+/- 10 CPU
Total Phosphorus*		50 PPB	+/- 10%

* CSC lab only

Table 3: JCLC and CSC Laboratory Duplicate Critical Range Criteria

Parameter	Acceptance Limit	Parameter	Acceptance Limit
pH	+/- .5 units	Chlorophyll-a	+/- 3.0 µg/L= 3mg/m3
Alkalinity	+/- 1.20 mg/L	T. Phosphorus*	+/- 0.004 mg/L
Conductivity	< 10%	Color Hanna	+/- 10 CPU
Turbidity	0-20 NTU: +/- 1	Color Nessler	+/- 2.0 CPUs
	>20-100 NTU: +/- 3	Chloride	< 15%
	>100 NTU +/- 10	E. coli*	< 5% of count

* CSC lab only

2.2.2 JCLC Laboratory

As a result of requirements set forth in the [NHDES Quality Management Plan](#) (QMP), JCLC began to track new staff training in 2003. Tracking staff training is a critical component to verify competency on equipment use, DQO procedures, CR and CCV procedures. Over the past two field seasons the JCLC has improved intern training in laboratory procedures. Now each newly hired intern attends a full-day training session consisting of different elements including JCLC lab procedures and safety, training on database entry, and sample login procedures. The training also includes an afternoon of hands-on, practical training using JCLC bench meters with oversight by full-time JCLC staff. As part of this training, each intern has to pass a competency check on each meter in the JCLC.

In 2020 the QC Officer/Database Administrator began an initiative to document quality control and data administration procedure within the JCLC database. The videos consist of screen recordings along with narration outlining particular procedures and functions within the JCLC database. Thus far six videos have been produced and more are planned for 2021. These videos can be used as a training tool as well as documentation of JCLC data management and quality control procedures.

The JCLC and CSC-LSPA lab analyze two aliquots (replicates) from the same sample as a QC for at least 10% (Table 4). Replicate samples processed in the JCLC are evaluated using split mean range (SMR) and relative percent difference (RPD) measures and are used to demonstrate consistency in data quality. The SMR is the range and the RPD is the percent difference, which is calculated when a replicate QC analysis is performed. Depending on analysis factors such as

the range of the analytical instrument used, either a SMR or RPD is calculated for each QC sample. The JCLC generates SMR/RPDs as a quantitative measure to review that replicate ranges are consistent with historical SMRs/RPDs. In 2020, all parameters exhibited SMRs or RPDs that were well within the acceptable range established range for the parameter (Table 4). Lastly, over 98% of laboratory replicates met established critical range criteria for their respective parameters.

Table 4: 2019 calendar year JCLC chemical analyses quality assurance summary.

Parameter	2020 Replicate Analyses	2020 Sample Analyses	2020 Replicate Percent	Mean Relative Percent Difference or Split Mean Range					
				2015	2016	2017	2018	2019	2020
Alkalinity (ANC) mg/L (Range)	36	366	10.71	0.58	0.56	0.49	0.27	0.16	0.58
Apparent Color cpu (Range)	16	148	10.81	1.05	0.53	0.69	0.71	0.71	0.88
Color in Water - Hanna (Range)	35	312	11.22			4.32	5.09	4.51	4.29
Chloride mg/L (Range)	144	1314	10.96	0.88	1.55	1.53	1.89	1.46	1.44
Chlorophyll-a mg/L (Range)	38	311	12.22	0.60	0.46	0.38	0.54	0.51	0.34
Conductivity μ mhos/cm (RPD)	123	1102	11.16	1.03	1.33	1.38	1.78	1.61	1.95
Mercury mg/L (Range)	9	78	11.54	0.02	0.03	0.01	0.05	0.02	0.01
pH units (Range)	140	1257	11.14	0.40	0.12	0.27	0.07	0.06	0.08
Turbidity NTU (Variable Range)	118	1062	11.11	0.14	0.16	0.13	0.14	0.18	0.13

2.2.3 Satellite Laboratory

The Colby Sawyer College – Lake Sunapee Protective Association (CSC-LSPA) Satellite Laboratory continues to be well operated and serves as a model for producing high quality data in support of NHDES' volunteer water quality monitoring programs. In 2018 the lab gained the ability to analyze for chloride and color. It will take a few years to establish a SMR trend for the new parameters. The CSC-LSPA lab is still gathering SMR data for the new parameters thus it is not as useful a tool as it is for the other parameters, however this year's SMRs for both new parameters were between previous year's data. The CSC-LSPA lab has consistently met or exceeded the replicate DQO for all parameters since 2008 (Table 5). In addition, the 2020 split mean remained consistent with previous years (Table 5). Lastly, 98% of CSC-LSPA lab replicates met established critical range criteria for their respective parameters.

Table 5: 2019 calendar year CSC-LSPA Laboratory chemical analyses quality assurance summary.

Parameter	2020 Replicate Analyses	20 Sample Analyses	2020 Replicate Percent	Mean Relative Percent Difference or Split Mean Range					
				2015	2016	2017	2018	2019	2020
Alkalinity (ANC) mg/L (Range)	8	72	11.11	0.70	0.36	0.28	0.63	0.11	0.14
Color in Water (Hanna) (Range)	29	257	11.28				1.25	6.79	2.76
Chloride (Range)	56	496	11.29				1.82	0.68	1.37
Chlorophyll-a mg/L (Range)	15	107	14.02	0.32	0.11	0.37	0.53	0.16	0.41
Conductivity μ mhos/cm (RPD)	68	608	11.18	0.20	0.87	1.54	1.37	1.46	1.25
pH units (Range)	62	557	11.13	0.19	0.04	0.07	0.05	0.07	0.06
Turbidity NTU (Range)	60	540	11.11	0.19	.07	0.23	0.28	0.17	0.18
<i>E. coli</i> counts/100ml (Range)	41	108	37.96	0.00	0.00	.33	1.62	0.44	0.34
Total Phosphorus μ g/L (Range)	88	6.15	14.31	3.5	1.5	1.0	0.8	0.6	1.0

2.3 Volunteer Lake Assessment Program (VLAP)

VLAP program participation has remained fairly stable since 2016 due to staffing resources, and at this time, VLAP is not accepting new lakes. VLAP received one request from a lake association to join the program in 2020. Since 2018, the total number of requests to participate has increased, likely due to increased concern over noticeable changes in water quality, plant and algal growth, and concerns of climate impacts to New Hampshire lakes. In 2020, despite the COVID-19 pandemic and alterations to VLAP sampling and laboratory operations, the concern over local lake quality persisted and volunteers accomplished much more than expected in 2020. The pandemic also resulted in increased recreational use of lakes throughout the state and maintaining surface water quality monitoring program was crucial to evaluate these impacts as well as impacts from climate change driven drought conditions. COVID-19 and resulting modifications to 2020 VLAP sampling resulted in 70% participation rate and a decrease in sampling events and results generated (Table 6). However, VLAP operating under normal conditions has resulted in an overall significant increase in results generated in the past 20 years (Figure 3 and Table 7).

Table 6: Program Participation.

Year	# of volunteers	# of lakes	New or returning lakes	# of deep spots	# of annual bio visits	# of volunteer sampling events	Total # sampling events*	Est. # of volunteer hours	Monetary value of vol. hrs.	# of individual sample results generated
2020	300	127	0	134	0	258	258	~2667	\$70,000	8,912

Figure 3: Analytical Results Generated for the Volunteer Lake Assessment Program (VLAP) 1998-2020.

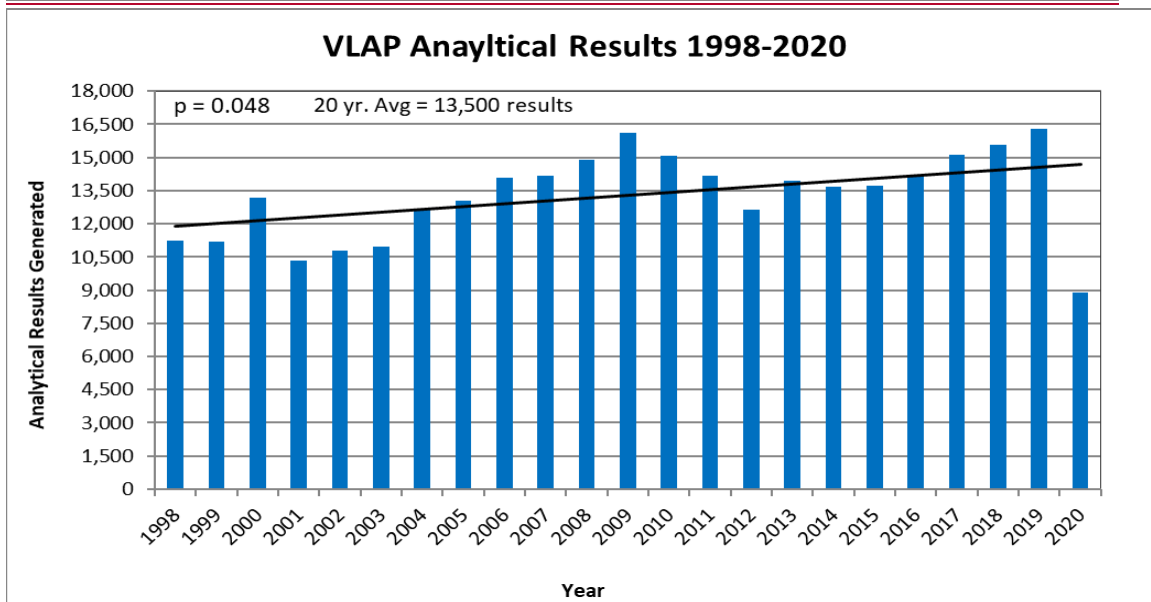
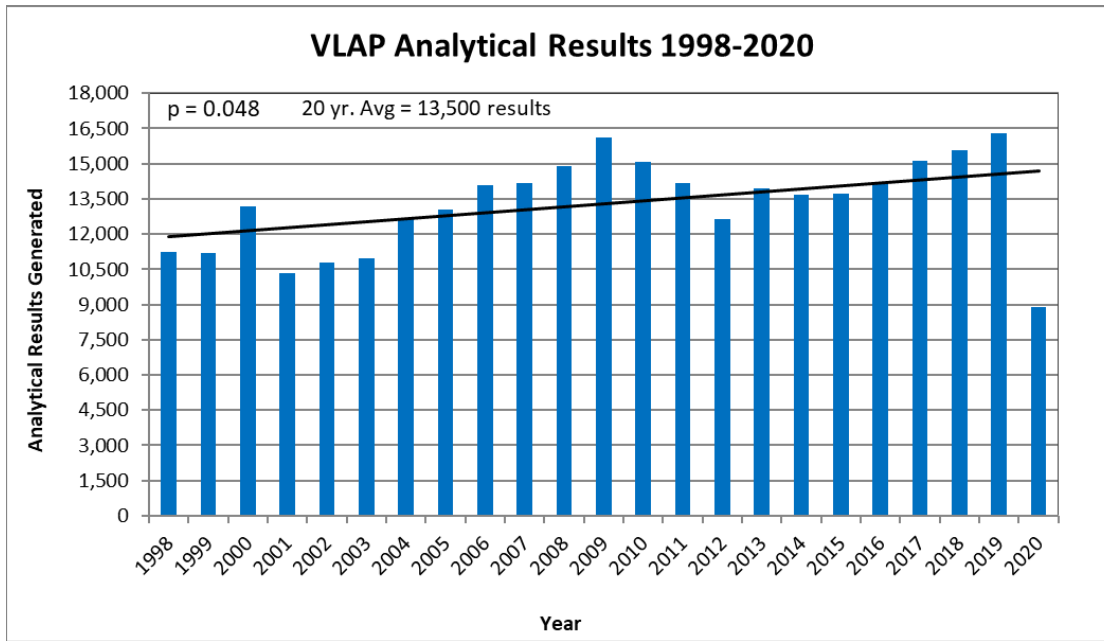


Table 7: Number of VLAP Sample Results Generated by Parameter and by Laboratory (2020).

Lab	Alk.	App. Color	Chl-a	Cl-	Cond.	Do/Temp Profile	<i>E. coli</i>	TN	TP	Phyto	Secchi	Secchi Scope	pH	Turb.
CSC/LSPA*	70	247	105	484	611	45	56		601		60	95	561	544
NHDES**	201	206	197	506	976	61			941	44	192	186	962	961
Total	271	453	302	990	1587	106	56	0	1542	44	252	281	1523	1505

* = The Colby-Sawyer College - Lake Sunapee Protective Association Satellite Laboratory

** = NHDES JCLC and NH DHHS Water Analysis Laboratory. The NH DHHS Laboratory analyzes the total phosphorus, and *E. coli* samples, while pH, ANC, conductivity, chloride, turbidity, chlorophyll, and phytoplankton are analyzed in the JCLC and Secchi disk depth is measured in the field.

2.3.1 Quality Assurance and Quality Control Management

The Generic VLAP Quality Assurance Project Plan (QAPP) was submitted to EPA in 2019 for its five-year review and revision. The VLAP QAPP review was completed and the QAPP approved by EPA in June 2019. The QAPP, which outlines the standard operating procedures for sample collection, sample analysis, data management, data assessment and data reporting, was followed by all NHDES JCLC and satellite laboratory staff during the 2019 sampling season. Volunteer

monitors were provided updated training materials in 2020 to access online in lieu of an in-person workshop typically held in May. In-person biologist visits were not conducted in 2020, however the VLAP Coordinator and Satellite Lab Manager were in constant communication with volunteers, reviewed sampling procedures upon sample drop-off if necessary, and made corrective actions to ensure each monitoring followed the standard operating procedures for sample collection as outlined in the QAPP.

2.3.2 Quality Assurance and Quality Control

The VLAP QAPP specifies that Quality Assurance and Quality Control (QA/QC) samples, including field duplicate samples, are collected and analyzed for specific parameters sampled through the program. However, the majority of volunteers from the lakes and ponds participating in the program do not collect field duplicate samples as standard practice. This is due to the following reasons:

1. Long-term water quality trend analysis, not a single sample result, is used for decision making within NHDES.
2. There are no available funds within NHDES to pay for the analysis of VLAP QA/QC samples, including total phosphorus and E. coli duplicate samples.

Therefore, in 2002, the VLAP Coordinator, Biology Section QA/QC Officer and the JCLC Director decided that the field collection and laboratory analysis of QA/QC samples, as outlined in the VLAP QAPP, will be incorporated into the program as feasible under the existing program structure and the operating constraints of the JCLC.

Specifically, volunteer monitoring groups that decide to pursue additional federal grant programs, and wish to use VLAP monitoring activities as a match, are required to conduct QA/QC sampling in accordance to the VLAP QAPP. In this case, the JCLC agrees to run these additional QA/QC samples, but the volunteer monitoring group is required to bear the additional cost, as necessary.

2.3.3 VLAP Duplicate Sampling

In 2020, due to the COVID-19 pandemic, no VLAP biologists visits were conducted with volunteers as these would have had to be in-person and would have violated social distancing measures. Therefore, field duplicate sample collection was limited to the Lake Sunapee Protective Association (LSPA), which has a robust monitoring program and continued to collect field duplicate samples in 2020. These duplicate samples were analyzed at the Colby-Sawyer College (CSC) satellite laboratory for total phosphorus, chlorophyll-a, conductivity, turbidity, pH and chloride (if applicable).

The duplicate samples were compared not just to the total number of routine samples conducted during the LSPA sampling events, but for the total number of routine samples collected and process through the CSC satellite laboratory. This resulted in duplicated percentage around 5%, however if compared with just the total number of routine samples collected by LSPA it would represent the 10% duplicate analysis target.

Table 8: VLAP Duplicate Quality Assurance Samples Collected (2020).

Parameter	Duplicate Samples Collected	Routine Samples Collected	Percentage of Duplicate Samples Collected	Meets Target (10%)
Alkalinity*	0		n/a	n/a
Apparent Color	26	247	10.5	n/a
Chlorophyll-a	5	105	4.8	n/a
Chloride	28	484	5.8	n/a
Conductivity	31	611	5.1	n/a
DO/Temp Profile	0		n/a	n/a
pH	31	561	5.5	n/a
Total Phosphorus**	31	601	5.2	n/a
Turbidity	32	544	5.9	n/a

* = During the Spring of 2002, the Biology Section QA Officer determined that it was not feasible for the Limnology Center to handle the additional workload of duplicate samples for Alkalinity and phytoplankton parameters. These analyses take much longer to conduct than the pH, turbidity, and conductivity analyses.

** = Volunteers are asked to collect and pay for duplicate sample analysis for phosphorus and *E. coli* on a voluntary basis. There is no internal funding source available to pay for the analysis of QA/QC samples that are processed in the NH DHHS Water Analysis Laboratory. All total phosphorus duplicate samples are conducted through the CSC-LSPA laboratory and paid for by the LSPA.

Field duplicate sample results were analyzed at the end of the season to determine if the relative percent difference (RPD) or critical range for each parameter of interest exceeded the QA/QC standard outlined in the VLAP QAPP. A very low number and percentage of duplicate samples failed to meet the QA/QC standard during the 2020 sampling season (Table 9).

Table 9: VLAP Duplicate QA/QC Samples (2020).

Parameter	Duplicate Samples Collected	Duplicate Samples Failing QA/QC	Percentage of Failed Duplicate Samples
Alkalinity*	0	0	0
Apparent Color	26	0	0
Chloride*	28	0	0
Chlorophyll-a*	5	0	0
Conductivity*	31	0	0
DO/Temp Profile***	0	0	0
pH*	31	0	0
Total Phosphorus*	31	1	3.2
Turbidity**	32	0	0

* = The QA/QC standard for duplicate ANC, chloride, chlorophyll, conductivity, pH and total phosphorus samples is the 20% Relative Percent Difference.

** = The QA/QC standard for duplicate turbidity standards is the critical range standard used in the NHDES JCLC.

*** = Individual dissolved oxygen duplicate profiles acceptance limit of +/- 2 mg/L.

2.3.4 VLAP Intern Training

The training and assessment of the VLAP intern’s ability to perform field sampling activities according to the program standard operating procedures is the responsibility of the Coordinator. At the beginning of the sampling season, the Coordinator trains or re-trains the intern in the proper field sampling standard operating procedures, as outlined in Appendix C of the VLAP QAPP.

In 2020, due to the COVID-19 pandemic, one part-time three-month and one part-time five-month intern were hired to conduct laboratory analyses and assist VLAP program operations in the JCLC. This resulted in one intern in the laboratory Monday-Friday. The VLAP Coordinator trained each intern on Coronavirus safety measures, preparing equipment and bottle pick-ups for volunteers, receiving samples from volunteers, laboratory sample analysis and monthly data reporting. Each VLAP intern was required to fulfill the JCLC training requirements before they were allowed to independently log-in and analyze samples in the JCLC.

2.3.4 VLAP Volunteer Training

During the annual visit to each lake or pond, the biologist (the VLAP coordinator, biologist, or one of the interns) conducts a “Sampling Procedures Assessment Audit” for each monitoring group. Specifically, the biologist observes the performance of each monitoring group and fills out an assessment audit form to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor’s Field Manual).

The assessment identifies areas of sample collection in which volunteer monitors are not following the proper procedures and provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that samples collected by volunteer monitors are truly representative of actual lake and tributary

conditions. Overall, the assessments show that the majority of the monitoring groups follow the proper sampling techniques.

In 2011, it was necessary for VLAP to alter its schedule for annual biologist visits. The schedule for biologist visits changed from an annual visit at each lake to a biennial visit at each lake depending on a lake's name. In 2020, due to the COVID-19 pandemic, no biologist visits were conducted.

To compensate for the lack of an annual biologist sampling procedure assessment audit, VLAP developed additional training videos for volunteers to view and review sampling procedures prior to sampling on their own. The videos are posted on YouTube and a link is available via the VLAP website. The video has also proved a useful training tool during the VLAP annual refresher workshop. VLAP developed a Volunteer Monitor Field Sampling Procedure Checklist for volunteers to complete every time they sample without a biologist. The checklist acted as a self-audit for field sampling procedures to minimize improper sampling techniques, and has been very successful. Volunteer feedback has been positive and resulted in overall better quality samples collected. The form will continue to be implemented in subsequent sampling seasons.

When volunteer monitors dropped off samples at the JCLC and the CSC-LSPA Satellite Laboratory, the laboratory staff continued to use the sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. Specifically, the purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques. When necessary, volunteer monitors were contacted by laboratory personnel with questions so that the samples could be logged into the system properly. In some cases, it was necessary to retrain volunteers in proper sample collection techniques, and, in a few severe cases, samples were not accepted for analysis.

2.4 Biomonitoring Program QAQC

Fish identification data quality control measures relied on having an expert fish taxonomist on-site during sampling. Any unknown species were documented with photos and/or retained for laboratory analysis and further consultation with other state agencies and partners.

All field data are reviewed for quality assurance and entered into the biomonitoring program's Ecological Data Application System (EDAS) database. Additional data checks for completeness and accuracy are performed prior to uploading data to the NHDES Environmental Monitoring Database and later to the Environmental Protection Agency's WQX Database.

Macroinvertebrate data quality control measures rely on enumeration and identification by outside contractors: primary and quality control. In addition to in-house quality control measures performed by the primary contractor, quality control measures are performed by a separate quality control (QC) contractor. Ten percent of all samples are sent to the QC contractor and re-picked to account for individuals missed by the primary contractor. If the primary contractor does not meet the required threshold (95% of individuals found during the initial pick), sorted debris from all samples are re-picked, with additional individuals identified and enumerated. In addition to re-picking the sorted debris, a voucher set of all individuals found in a given year is assembled by the primary contractor and sent to the QC contractor for identification. This is completed as a "blind" voucher set with voucher identifications sent to NHDES for review. Any discrepancies are reconciled and data updated to reflect any necessary corrections.

Taxonomy must be performed by a professional freshwater macroinvertebrate taxonomist that, at a minimum, holds and maintains for the duration of the contract a certification from the Society of Freshwater Science for eastern genera in group 1 (Crustacea and Arthropods other than EPT and Chironomidae), group 2 (Ephemeroptera, Plecoptera, and Trichoptera nymphs and larvae only) and group 3 (Chironomidae larvae only).

III. NHDES WATERSHED BUREAU SAFETY PROCEDURES

3.1 Watershed Management Bureau Safety Training

The Watershed Management Bureau (WMB) workload involves various types of work in multiple environments. Safety is of great importance and guidelines and training are provided and updated as concerns and new methods arise. NHDES institutes agency-wide training, which the Watershed Management Bureau participates in.

Department-wide trainings cover topics such as Active Shooter Training, Defensive Driving and Cyber Security, the last covering the safety of our data and our business. Some of these training programs are required to be repeated every year, with the defensive driving every three years at a minimum. All NHDES employees, full time, part time and interns, are required to take these safety programs.

3.2 Watershed Management Bureau Vehicle and Watercraft Safety

Defensive Driving is required before any individual may operate a state vehicle. Those individuals that use large vehicles or trailers are also required to take a safe backing course that deals with issues involving trailers, blind spots and trucks. Much of the work the WMB does requires trailering or using full-sized vehicles, therefore many WMB personnel are required to take this extra defensive driving training. Each WMB vehicle is equipped with a first aid kit, insurance information and a procedure in case of accident.

Some of the work load done by the WMB requires the use and operation of boats. New Hampshire law requires all PWC or boat operators who are 16 years old or older and operating a motorboat over 25 horsepower to complete the New Hampshire Boater Safety Course and to carry a Safe Boating Certificate. The official NHDES policy goes a step further as any employee who wishes to operate a NHDES power boat is required to take the course and obtain the certificate. This course covers basic watercraft rules and operation as well as the safety involved in the use of state boats, and is offered by the state of New Hampshire's Department of Safety as an online course. WMB staff that routinely use our boats also accompany and train new personnel and interns in the operation of the individual watercraft that are available for use. This training covers canoes and kayaks as well as tiller-steered outboards, steering-wheeled driven outboards, and a Diver assisted Suction Harvester (DASH) unit. All individuals are required to wear a personnel flotation device (PFD) whenever in a boat. To facilitate the comfortable use of PFDs, inflatable suspender style PFDs are purchased for all employees who commonly use boats as well as sufficient spares to accommodate those who need them on occasions. All of our boats carry a fire extinguisher and a noise-making device as well as extra PFDs. All power boats are equipped with a usage log to record usage time and note any issues. Trailer wiring and lights are inspected and tested annually each spring and necessary repairs and replacements are made. All tires and spares are inspected and worn tires are replaced.

3.3 Watershed Management Bureau Lab and Field Safety

The Jody Connor Limnology Center (JCLC) contains laboratory equipment designed to analyze surface waters along with the chemicals associated with the analysis and, as such, safety procedures and training that go beyond normal workplace safety have been developed. This training involves personnel protective equipment, the operation of laboratory equipment, and safe handling and disposal of chemicals. Locations of fire extinguishers, acid spill kits, broken glass containers and other safety equipment are labeled and obvious in the lab. Small group training is given to all new hires and interns of the Watershed Management Bureau. A copy of the training manual can be found electronically on the NHDES network and in the JCLC Laboratory Manual. This manual is reviewed and updated yearly. The lab also includes a ventilation hood that is inspected regularly and a small chemical storage cabinet.

A majority of sampling and monitoring done by the WMB involves working in the field in both urban and remote sites. Working in the field requires yet another set of safety items. These include things like personnel attire and protection to weather and field conditions. Wading in fast moving or deep water, insect and plant interactions, as well as interactions with the public, also bring up safety concerns. These safety issues and procedures are addressed in the NHDES Standard Operating Procedure for Field Safety. However, each monitoring program within the WMB present unique safety risks. For this reason, supervisors spend several days training staff on the field and safety protocols for each specific program.

The biomonitoring program completes fish surveys regularly using backpack electroshocking units that discharge an electrical current into the water. To prevent injury, non-breathable waders and electrical gloves must be worn. Optional, but highly recommended, additional personal equipment include a hat and polarized sunglasses. Electrofishing is strenuous work and staff are encouraged to drink fluids and eat food regularly to maintain proper hydration and energy levels. Staff typically work in teams of four and are in constant communication with each other during a sampling event and use simple code words to indicate start and stop of electrical discharge.

The WMB also has a few people certified as “Self Contained Underwater Breathing Apparatus” (SCUBA) divers. Most of this work involves aquatic invasive species. This is done in water less than 30 feet deep (one atmosphere); most operations are in 10 feet or less of water. Diving operations are always done in pairs. Safety procedures can be found in the NHDES Water Division, Watershed Management Bureau SCUBA Dive Safety Protocol.

3.4 JCLC COVID-19 Lab and Field Safety Procedures

Lab and field safety operations in 2020 were severely affected by the worldwide outbreak of the SARS-CoV-2, or COVID-19, respiratory virus which began in March. In New Hampshire, infection rates through the summer 2020 were relatively low with approximately 20 to 50 new infections daily with total cumulative infections statewide less than 7,500. During this time, NHDES staff were primarily working remotely. Prior to undertaking any field or lab operations, a lab and field standard operating procedure (SOP) was developed. The SOP was followed from May through the end of 2020 and continues to be followed into 2021. No known COVID-19 infections occurred to staff working within the JCLC from summer through the end of 2020.

In the lab, occupancy was limited to 10 individuals at any given time and aisles were limited to 2 to 3 individuals. While in the lab, all staff were expected to wear face coverings at all times. In order to accommodate a 6-foot physical distancing requirement, lab equipment workstations were reconfigured to alternate locations within the lab and Plexiglas shields constructed to isolate staff working opposite and adjacent to one another. Several bottles of hand sanitizer were made available, spray sanitizer was provided to wipe down work spaces and equipment, and hand soap offered for hand washing. On a daily basis, an assigned staff person was assigned to wipe down common “touch points” such as door handles, faucets, phones, etc. Staff tracked their date and approximate time in the lab on a separate spreadsheet file in order to maintain a record in case contact tracing was necessary. No staff were allowed in the lab without first passing through the building checkpoint, which required body temperature checks and “no” answers to health and travel questions.

Travel to and from field sample or investigation destinations was limited to a single individual per vehicle. Vehicle reservations were typically made several days in advance using a digital calendar file. In each vehicle, hand and spray sanitizer was supplied, and staff were required to check for and use these supplies to sanitize the vehicle prior to departing. Drivers were also required to bring face coverings. Upon completion of the field trip, sanitizing fluids were required to be used to clean common touch points. Drivers were also required to fill out the gas log with their name and date of operation in case contact tracing was required. In the event of the need for several field crews on a given day, individuals were asked to coordinate their departure and return times in order to minimize laboratory congestion.

Field activities were typically limited to two individuals and a “plan of action” discussed among team members prior to departure. The plan of action included a general discussion of the division of labor, equipment organization and operation, data records, and boat operation (if required). During field activities, face coverings were required to be worn any time staff people could not maintain at least 6 feet of physical distance. Staff were also required to keep their personal belongings contained within a backpack or similar bag and to not share personal care products, such as sunscreen. If field activities required the use of watercraft, a maximum of two individuals was allowed and face coverings were to be worn any time 6 feet of distance could not be maintained.

Several additional safety measures were put in place to reduce the risk of spreading COVID-19 especially with respect to the sample login procedures, lab instrument operation and microscope use. These are detailed in a document entitled “Jody Connor Limnology Center COVID-19 Standard Operating Procedures.”