NHDES WATERSHED BUREAU

QUALITY ASSURANCE, QUALITY CONTROL AND WORKLOAD REPORT

2016

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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EXECUTIVE SUMMARY

In 2016, the NHDES Watershed Management Bureau operated 16 individual programs to monitor, protect and restore the state's surface waters, including its lakes and ponds, rivers and streams, coast, wetlands, and public bathing facilities. The diverse nature of these programs is exemplified by their activities that range from water quality monitoring, exotic species management and regular sampling of beaches, to funding vessel waste disposal facilities, support of nonpoint source pollution control activities and inspection of pools and spas. In all cases, these programs are designed to promote the health of one of New Hampshire's most valuable natural resources: water.

A key element to the success of each of these programs is the availability of a modern laboratory. The Jody Connor Limnology Center (JCLC) serves as the primary hub of activity in preparation for field surveys, water sampling processing and tracking. In 2016, the JCLC processed over 11,000 water quality samples and 500 identifications of biological organisms. The laboratory's capabilities range from simple tests of pH in water to the determination of mercury content in fish tissue. In addition, Colby-Sawyer College maintains a satellite laboratory that provides water analyses capabilities in cases where samples cannot be transported to Concord. Collectively, these laboratories are critical to the support of two valuable volunteer surface water quality monitoring programs that successfully monitored over 180 lakes and ponds and 3,000 river miles in 2016.

In 2016, well over 100,000 data records were collected from the state's surface waters by the Watershed Management Bureau. With such a high volume of data, maintaining and managing data quality is critical. Data quality is ensured through program specific 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.

Data meeting the quality assurance standards are stored in NHDES' environmental monitoring database (EMD). The EMD houses millions of unique data points from over 27,000 monitoring stations and 700 individual projects. Data generated by the Watershed Management Bureau are entered through automated lab imports, batch uploads and manual entry. Applicable data are flowed directly to EPA's STORET/WQX using a node-to-node transfer. The EMD serves as a vital component in meeting the bureau's data management needs and responsibilities. In 2016, the overall department generated 17,255 sampling activities in the EMD.

The following report describes the various program activities within the Watershed Management Bureau that collected data or utilized the facilities of the JCLC in 2016. The report is organized into two primary sections; the first section provides individual program summaries in a standardized template for quick reference; the second section includes a more detailed account of the specific accomplishments of each program and, where applicable, data quality assessments.

I. WATERSHED AMBIENT MONITORING PROGRAM SUMMARIES

1.1 Jody Connor Limnology Center (JCLC)

Purpose: Provide support to the Watershed Management Bureau's (WMB) statewide surface water monitoring activities through the completion of benchtop chemical and biological analysis. The lab serves as a preparatory space for field meter calibration, sample bottle organization and field sample login for all WMB field activities. JCLC also is the primary hub for processing samples submitted by the Volunteer Lake Assessment Program (VLAP) and Volunteer River Assessment Program (VRAP).

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.

Monitoring 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.

Number of records generated: In 2016, JCLC and the Colby-Sawyer College satellite laboratory created 14,285 chemical or physical data records. JCLC analyzed 516 biological samples and made 332 species-specific identifications.

Quality Assurance Measures: JCLC and its 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. All quality assurance measures are documented by parameter in individual bench logs as well as the JCLC database; over 1,900 quality assurance measures were performed in 2016.

1.2 Volunteer Lake Assessment Program (VLAP)

Purpose: VLAP was initiated in 1985 in response to an expressed desire of lake associations to be involved in lake protection and watershed management. Over 500 volunteers monitor water quality from May through September at lakes and ponds throughout the state. These data allow NHDES to analyze water quality trends, identify potential problems and fix them before they cause degradation in water quality. VLAP plays an essential role in monitoring water quality trends in New Hampshire's lakes.

Data usage: Data generated through VLAP are utilized annually to create seven regional water quality reports and approximately 180 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.

Monitoring 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 12 chemical and biological parameters including: pH, conductivity, turbidity, 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.

Number of records generated: In 2016, VLAP, and its associated satellite laboratory Colby-Sawyer College, accomplished the following:

- 457 individual sampling events conducted by volunteers and VLAP biologists.
- 184 lake deep spots and 500 river/stream stations monitored.
- 14,172 individual chemical and biological sample results generated.
- Approximately 3,700 hours collecting water quality samples.
- Approximately $87,000 value of volunteer time collecting water quality samples.

Quality Assurance Measures: VLAP operates under an EPA-approved Quality Assurance Project Plan (QAPP), dated June 26, 2014. 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.

1.3 Volunteer River Assessment Program (VRAP)

Purpose: 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 legislative surface water quality standards 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 2016 303(b) report was provided by VRAP. Currently this data contributed to the assessment of over 3,000 miles of rivers and streams.

Monitoring 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, chlorophyll-*a*, metals and cations.

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

Number of records generated: In 2016, data generated by VRAP volunteers are summarized as follows:

- 33 VRAP groups supported.
- 302 river/stream stations monitored.
- 6,228 individual chemical and biological sample results generated.
- Approximately 1,500 hours spent by individuals collecting water quality samples.
- Approximately $30,000 value of volunteer time collecting water quality samples.

Quality Assurance Measures: VRAP operates under an EPA-approved QAPP dated April 6, 2011. 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.

1.4 River Trend Monitoring Program (RTMP)

Purpose: RTMP began is the early 1970s. From its initiation through 2102, it was known as the Ambient River Monitoring Program (ARMP). In 2013, NHDES updated its surface water monitoring strategy including a revision of the ARMP. Since then, it has been known as RTMP and includes 40 river and stream stations that are visited three to five times per year. The revised monitoring network includes approximately 20 new stations that span a wider range of watershed sizes and levels of development. Data collected since 1990 are maintained in NHDES' Environmental Monitoring Database (EMD). RTMP is implemented directly by NHDES staff and measures water quality in rivers and streams throughout the state.

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 are also used to assess if individual river segments are impaired or potentially impaired, based on legislative 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.

Monitoring approach: RTMP conducts trend monitoring via repetitive visits to established sampling locations on an established schedule 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 may also be completed to gain additional information about the condition of New Hampshire surface water resources. Targeted sampling is done primarily through a using a rotating basin design whereby sampling locations are chosen from within eight 10-digit hydrologic drainage units (HUC 10) based on a predetermined schedule.

Parameters measured: RTMP measures field parameters including dissolved oxygen, pH, turbidity, specific conductance, water temperature and flow. These parameters are collected via instantaneous measurements and deployable multi-parameter dataloggers. Laboratory parameters include *E.coli*, 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 2016, over 2,500 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 2015. 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.

1.5 Lake Trophic Survey Program (LTSP)

Purpose: LTSP was initiated in the mid-1970s and continued through 2008 when it was discontinued. The program was reinitiated by the WMB in 2013. The purpose is to determine a trophic rating for a lake or pond as well as gather basic lake data.

Data usage: In addition to a trophic rating, the monitoring approach attempts to gather enough data to determine if waterbodies meet use criteria as required by sections 305(b) / 303(d) report for the Federal Clean Water Act.

Monitoring approach: Lakes are selected from a schedule of targeted watersheds on a rotational basis (eight 10-digit hydrologic drainage units annually). 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, a dissolved oxygen/temperature profile is collected and the degree of stratification is assessed. Secchi depth is measured. A composite water sample from the epilimnion is collected and analyzed for Chlorophyll-*a*, and a plankton haul is collected to mid-metalimnion depth. A discrete sample is collected and analyzed for alkalinity, pH, conductivity, apparent color, chloride, calcium, magnesium, NO_2 and NO_3 nitrogen, TKN nitrogen, total phosphorus, sodium, sulfate and total organic carbon. Shoreline habitat data was collected at 10 stations around each waterbody selected in 2016. The data collected attempts to characterize basic shoreline configuration, littoral substrate, fish cover, aquatic macrophytes, riparian ground cover to canopy cover and human influence on the shoreline. Ice out sampling was also conducted for the first time on the 2016 selections.

Method of data collection: LTSP collects discrete samples.

Number of records generated: In 2016, 31 lakes were sampled. Ten of the 31 were new for 2016 and sampling on the remaining 21 was initiated either in 2013 or 2014. At each lake, a temperature/oxygen profile was collected. Overall, a total of 968 chemical records were generated. Additionally, data collection is complete for the 2014 selections and reports will be generated for these waterbodies. Ten reports have been finalized from the 2013 selection of lakes.

Quality Assurance Measures: LTSP's QAPP was approved by EPA in 2015. 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.

1.6 Biomonitoring

Purpose: 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 legislative surface water quality standards and designated uses (e.g., swimming, fishing and aquatic life support). Biological data are used in the development of water quality standards and in making regulatory decisions. The data are also used to track site-specific trends in biological condition and characterize the variability associated with macroinvertebrate data.

Monitoring approach: Prior to 2013, biological monitoring was either part of a probability-based or targeted sampling design. Starting in 2013, biological monitoring expanded to support three elements of the NHDES surface water quality monitoring strategy; trend, synoptic and probability based monitoring. Trend monitoring encompasses approximately 28 long-term trend stations monitored annually. Synoptic or targeted monitoring selects eight to 10 of the 82 HUC10 watersheds within the state each year. Each watershed is evaluated once every 10 years. Probability-based monitoring of 50 sites includes 20 national and 30 state river and stream assessment sites. 2016 marked year four of five for probability-based monitoring. 2018 will start a new round of national probability-based monitoring.

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: Data are collected using discrete and continuous measures of water quality.
Sample types

- Field chemistry samples.
- Laboratory chemistry for field samples.
- Macroinvertebrate samples.
- Fish surveys.
- Algal observations.
- Habitat assessments.
- Stream gradient assessments.
- Sediment and Pebble count surveys.
- Flow evaluations.

Number of records generated: In 2016 the Biomonitoring Program collected the following data:

- Field chemistry samples: 11 sample sites (55 data points)
- Laboratory chemistry for field samples: 11 sample sites (55 data points)
- Macroinvertebrate samples: 145 samples at 51 sample sites (>30,000 data points)
- Fish surveys: 40 sample sites (>6,836 data points)
- Habitat assessments: 11 sample sites (3,520 data points)
- Stream gradient assessments: 11 sample sites (>22 data points)
- Sediment and pebble count surveys: 11 sample sites (1,675 data points)
- Flow evaluations: 11 samples sites (>400 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 was finalized in May, 2014 and received approval from EPA in 2015. 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. The Biomonitoring Program also tracks QAPP updates which will be incorporated in the 2018 QAPP submittal to EPA.

1.7 Fish Mercury Program

Purpose: To collect data on the elemental mercury content in tissue of freshwater fish species within the State of New Hampshire.

Data usage: The data are used to conduct risk assessments for mercury exposure for the game fish-consuming public. This risk assessment results in statewide and, if appropriate, waterbody-specific fish consumption advisories for various species of fish. 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 will be finalized in 2017. The report includes data from 1992 through 2016.

Monitoring 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 Mercury/kg of fish, weight and length of the fish.

Method of data collection: Discrete.

Number of records generated: At least 100 fish are collected, processed and analyzed annually. In 2016, 189 fish were analyzed.

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.

1.8 Acid Rain Deposition Program

Purpose: To collect data on acid rain deposition and determine its effects on sensitive lakes and ponds.

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 NH Fish & Game Department to make stocking decisions on acid sensitive ponds and lakes. Rain is also collected in Concord, NH and analyzed to verify source inputs to lakes and ponds. In 2015, a summary report was completed utilizing data collected from the mid-1980s through 2014.

Monitoring approach: Trend Monitoring. Lakes and ponds included in this monitoring program have been monitored consistently in excess of 30 years.

Parameters measured:

- Lakes/Ponds **–** pH, acid neutralizing capacity, conductivity, color, dissolved aluminum, dissolved calcium, sulfate, nitrate and chloride.

- Rain – pH, nitrate, sulfate and total phosphorus.

Method of data collection: Discrete. Rain events are collected and analyzed at NHDES headquarters in Concord.

Number of records generated: Twenty lakes and ponds are sampled twice per year, 10 helicopter-stocked lakes are sampled once per year during stocking activities, and rain is sampled every time there is a rain event significant enough to yield the volume necessary for testing. In 2016, 56 rain events were sampled and 218 analyses performed.

Quality Assurance Measures: All samples per requirements of the JCLC laboratory manual or Health and Human Services (H&HS) water lab protocols. This program is included in the Lake Trophic Survey Program QAPP that was approved by EPA in 2015.

1.9 Surface Water Quality Complaints

Purpose: Investigate concerns impacting surface water quality reported to the WMB by staff and the public.

Data usage: Data are used to evaluate if 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.

Monitoring approach Targeted Monitoring: If investigator deems monitoring is warranted, targeted sampling is completed at strategically located stations.

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.

Number of records generated: In 2016, 31 complaints were received, 25 were investigated and only two required any testing in the JCLC during investigations.

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

1.10 Public Bathing Facility Program (PBFP)

Purpose: 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. Administrative Rule Env-Wq 1100 specifies the design, operation and maintenance requirements for public bathing facilities. PBFP reviews applications for new public bathing facilities, and inspects and tests the water in existing public bathing facilities to ensure that applicable requirements are being met.

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.

Monitoring 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.

Number of records generated: In 2016, PBFP achieved the following:

- 381 facility inspections.
- Collected 697 samples for chemical and microbial analysis.
- Identified 242 water quality violations.
- Found 167 safety/facility violations.
- Issued 19 Letters of Deficiencies.
- Issued 16 full design permits for new construction.

Quality Assurance Measures: Follows and updates the PBFP Field Inspection QA & SOP manual (last updated 11/21/2014). PBFP staff follow 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.

1.11 Public Beach Inspection Program (PBIP)

Purpose: PBIP personnel collect water from coastal and freshwater beaches to test for fecal bacteria to protect the public health of swimmers. During the summer swim season, NHDES personnel monitor about 180 freshwater public bathing beaches on a monthly basis and 16 coastal beaches on a weekly or bi-weekly basis. When bacteria counts 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.

Monitoring 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). Additionally, six other physical parameters are collected during visits to beaches.

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

Number of records generated: In 2016, a total of 2,764 bacteria samples were collected from NH beaches. For freshwater beaches, 1,865 bacteria samples were collected, with 79 advisories and 11 cyanobacteria warnings issued. There were 899 samples collected from coastal beaches resulting in two fecal bacteria advisories from one of the beaches.

Quality Assurance Measures: Quality assurance measures for beach sampling are one trip blank and one field duplicate for every 10 samples collected during each sampling trip. Quality assurance measures are completed daily for coastal beach inspections and twice a week for freshwater beach inspections. An EPA-approved PBIP QAPP was updated in April 2012.

1.12 Boat Inspection Program (BIP)

Purpose: BIP was initiated with the intention to promote proper boating practices and enforce the No Discharge Area designation by conducting inspections of vessels with onboard wastewater containment facilities. Inspections are conducted during weekends of the boating season and are concentrated on waterbodies that accommodate larger vessels with onboard facilities, including Lake Winnipesaukee, Lake Winnisquam and Lake Sunapee.

Data usage: The boat inspections fulfill a regulatory requirement under RSA 487 (Control of Marine Pollution and Aquatic Growth). A database is maintained to track boater onboard wastewater systems compliance. Annual reports are prepared from queries of a database of approvals, violations and re-inspections with all related details as necessary.

Monitoring approach: Targeted – inspections of boats with onboard "heads" are conducted on weekends over the course of the boating season. Boats are boarded only when occupied or with prior permission. A boarding would be requested if an inspection decal was not visible on the port side forward window or the bow number did not return any information from the database. Re-inspections would be prompted by a change in ownership, modifications to the plumbing system, or a complaint. Inspection locations include areas accommodating vessels with onboard facilities for inland waters only.

Parameters measured: Information for the boat inspection database is collected from individual boat registrations and wastewater systems that include graywater and marine sanitation device (MSD) configurations. Details on location, dates of inspections and/or re-inspections, and compliance/non-compliance issues are documented.

Method of data collection: Vessel and owner information is entered into the database by the BIP coordinator.

Number of records generated: During the 2016 season, the boat inspections staff traveled to Lake Winnipesaukee on four events to inspect recreational boats. A total of only nine inspections were complete, however, the inspector was not hired until late in July.

Quality Assurance Measures: Database entries are reviewed by either the boat inspection program staff or Clean Vessel Act program coordinator.

1.13 Clean Vessel Act (CVA) Program

Purpose: The New Hampshire CVA program is administered through NHDES and funded by the U.S. Fish and Wildlife Service Sport Fish Restoration program. The Federal CVA of 1992 authorizes funds to states for the construction, renovation, and the operation and maintenance of stationary and mobile pumpout resources for the recreational boating public. Pumpout options are a key factor in maintaining a No Discharge Area for New Hampshire inland and coastal waters.

Data usage: Locations and availability of pumpout resources are tracked to identify potential projects for CVA funding assistance in areas that would enhance compliance with No Discharge, safety of shellfish harvesting areas, maintenance of water classification status and protection of public health within recreational waters. Seasonal participants and sewage amounts are documented by grantees and contractors to track variations in boater usage from previous years and differing sites.

Monitoring approach: Targeted information is collected annually from stationary and mobile pumpout resources through grantees, contractors and staff site visits.

Parameters measured: Information collected may include the location of the pumpout resource whether stationary or mobile, marina amenities, pumpout system mechanical information, system availability, usage fee collected (if any), participant contact information, vessel name, vessel type, and sewage gallons pumped.

Method of data collection: Staff use data sheets for site visits or may use electronic forms if a physical site visit is not required. Grantees are required to document boat and sewage estimates in logbooks. The mobile pumpout services collect information using a physical receipt each service.

Number of records generated: Two stationary pumpout locations and two mobile pumpout boats are available to the recreational boating public along coastal waters. In 2014, the state-owned mobile pumpout boat experienced engine failure several times throughout the season. In 2015, further issues with the boat repairs, combined with contract negotiation concerns, rendered the boat out of service for the entire season. The service returned for the full 2016 season. The state-owned mobile pumpout boat operated May through November, documented 767 captain hours, more than 335 serviced boats, and approximately 7,700 gallons of sewage pumped from recreational vessels. A new mobile pumpout service dedicated to the Hampton Harbor area began in 2015. This mobile pumpout boat operated in the 2016 season from May through October, documenting 378 captain hours, 350 serviced boats, and approximately 6,000 gallons of sewage pumped from recreational vessels. Since 2002, the combined mobile pumpout services have pumped off approximately 157,000 gallons of boater wastewater.

New Hampshire also has approximately 20 pump/dump facilities. There are 18 (14 of which are public access) devoted to Lake Winnipesaukee and one public facility on Lake Winnisquam. A public dump station is located within Sunapee Harbor on Lake Sunapee. There is no mobile pumpout service for any inland waters at this time.

Quality Assurance Measures: Input from data sheets, logbooks and receipts are verified either by the seasonal intern or Clean Vessel Act program coordinator.

1.14 Exotic Species Program

Purpose: 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).

Data usage: Data generated through the Exotic Species Program are used to guide control activities on waterbodies across New Hampshire that are infested with exotic aquatic plants. 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.

Monitoring approach: Trend Monitoring – Repetitive visits to infested waterbodies to track infestations (size, density, distribution) over time. Water quality monitoring may also be performed along with invasive plant monitoring to determine impacts of the invasive species on the waterbody, or to determine impacts of the control practice on a waterbody.

Parameters measured: The Exotic Species Program monitors for the location, density and percent cover related to exotic plants. Water depth, clarity, dissolved oxygen concentrations, herbicide concentrations, nutrient concentrations, temperature and turbidity may also be monitored as part of this program, depending on any special studies that may be ongoing related to specific management projects.

Method of data collection: Discrete samples at multiple stations in lakes and ponds, as needed based on the requirements of special studies that may be conducted.

Number of records generated: In 2016, the Exotic Species Program collected the following data:

- 86 waterbodies infested (dating back to 1970).
- 1 new infestation discovered in 2016.
- 308 Plant identifications.
- >80 Field inspections (GPS).
- 47 Pet store Inspections (for invasive species sales).

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.

1.15 Interstate 93 (I-93) Chloride TMDL

Purpose: Implementation monitoring for the Total Maximum Daily Loads (TMDL) for chloride for water bodies in the vicinity of the I-93 corridor from Massachusetts to Manchester, NH.

Data usage: The data is used to determine compliance with the TMDL.

Monitoring approach:

- Continuous datasonde monitoring at four stations within the I-93 Corridor.
- Handheld measurement and grab samples at one site weekly.
- Handheld measurement and grab samples at all site every 3 weeks
- Chloride grab samples every three weeks
- Datasonde QA/QC checks, data download, and maintenance every six weeks.

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

Method of data collection: Continuous, handheld and grab.

Number of records generated: 34,000-35,000 data points per station every state fiscal year**.**

Quality Assurance Measures: Datasonde deployments are checked for quality control with handheld measurements taken prior to, at the midpoint and after each deployment. Handheld measurement devices are checked with known standards before field visits. Datasondes are checked for quality control every six weeks by submerging each datasonde in known standards. If these quality control checks fail to meet data quality objectives, the data from the whole deployment are invalidated unless there is sufficient evidence to support retaining the data. A full description of all the data quality control measures are contained in a 2006 EPA-approved QAPP , the 2014 Ambient River Monitoring Program QAPP and updated field SOPs for the I93 Implementation monitoring.

1.16 NHDES Shellfish Program

Purpose: The mission of the NHDES Shellfish Program is to examine the sanitary quality of the state's tidal waters, in order to ensure that the molluscan shellfish in those waters meet standards for human consumption. To this end, the NHDES Shellfish Program: 1) evaluates the sanitary quality of all coastal shellfish growing waters in the state; 2) identifies and monitors pollution sources and other factors that render the state's shellfish resources unfit for human consumption; 3) works with partners and the public to eliminate pollution sources; and 4) coordinates with commercial shellfish farmers and other agencies to site new aquaculture operations, plan harvesting activities, and prevent illness outbreaks.

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 to through a hotline message and internet-based tools.

Monitoring approach: The Ambient 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, Red Tide Monitoring, Shoreline Survey Program, communication with operators of potential pollution sources, 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; Paralytic Shellfish Poison (PSP) toxin in blue mussels and other shellfish species; water temperatures near commercial oyster farms and Vibrio bacteria levels in oysters; and Male Specific Coliphage levels in oysters and blue mussels.

Number of records generated: In 2016, the Shellfish Program accomplished the following:

- 52 rounds of sampling on tidal waters.
- 950 seawater samples collected.
- 21 rounds of sampling in response to rainfall events.
- 50 red tide samples collected.
- 278 commercial harvesting decisions generated.
- 77 wastewater treatment facility calls evaluated.
- 57 harvesting hotline updates implemented.
- 1,360 properties surveyed and tracked for pollution.
- 9 marina/mooring field surveys performed.
- 875 pollution sources tracked.

Quality Assurance Measures: The Shellfish Program operates under three EPA-approved Quality Assurance Project Plans (QAPPs), dated May 2014, addressing Ambient Monitoring, Red Tide Monitoring and Shoreline Survey Monitoring. 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. Information is managed in the state EMD and in GIS format, and is used to support management decisions outlined in the sanitary surveys.

1.17 Special Studies

Purpose: 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.

Monitoring approach: Targeted Monitoring approach.

Parameters measured: Determined by study design.

Method of data collection: Determined by study design.

Number of records generated: In 2016, four special studies were in progress involving the JCLC, including: 221 analyses for the Nippo Pond Special Study; 87 analyses for the Pawtuckaway Lake instream flow pilot; 10 analyses for the Newport waste water treatment plant; and, seven chloride analyses for the NH Lotic Volunteer Network.

Quality Assurance Measures: Determined by study design.

1.18 Wetland Monitoring Program

Purpose: Wetland monitoring using the protocols described below began in 2014 under an EPA Wetland Program Development Grant to evaluate the applicability of Maine's macroinvertebrate model for wetland assessment in New Hampshire. Additional assessment methods are used to evaluate comparability. Under a second Wetland Program Development Grant, 20 additional wetlands are being sampled in 2016 and 2017.

Data usage: Data produced through the wetlands monitoring project are used to characterize wetlands and their condition via several assessment methods, including the use of Maine's predictive water quality model, Maine's Wetland Human Disturbance Assessment and the Ecological Integrity Assessment developed by NatureServe and the New Hampshire Natural Heritage Bureau. A product of the 2015 WPDG will be the identification of potential biocriteria thresholds for aquatic life support.

Monitoring approach: Sites are targeted for monitoring based on meeting the sampling criteria (at least some open water greater than 10 cm and less than one meter in depth). In addition, sites are targeted to enable characterization of wetlands along a gradient of human disturbance. Sampling is conducted between late June and mid-August.

Parameters measured: Macroinvertebrates (using a dip net), physical and chemical characteristics of water, using hand - held meters, lab analysis of water grab samples and vegetation-based metrics.

Method of data collection: Data are collected as follows:

- Macroinvertebrates are collected with a dip net at three locations in the wetland in water less than one meter in depth.
- Hand-held meters are used to measure water for pH, dissolved oxygen, specific conductance and temperature.
- Water grab samples are analyzed for nitrate-nitrogen, total Kjeldahl nitrogen (TKN), dissolved organic carbon, dissolved ortho-phosphorus, total phosphorus, chlorophyll-a, chlorides and alkalinity.
- Plants are sampled or surveyed in detail at three locations corresponding to the locations where macroinvertebrates are collected.
- Observations of the wetland and landscape characteristics (bare soil, stressed vegetation, etc.) and landscape.

Number of records generated: In 2016, the Wetlands Monitoring project collected the following data for the seven sites sampled:

- Field analyses: measurements at three locations in each wetland.
- Laboratory chemistry for grab samples: one water sample in each wetland.
- Macroinvertebrate samples: sampled at three locations in each wetland.
- Ecological Integrity Assessment: Assessment for each of the wetlands.
- Wetland Human Disturbance Assessment: Assessment for each wetland.
- Vegetation sampling: sampled aquatic vegetation at three locations at each wetland or surveyed vegetation at three locations, as well as the general wetland.

Quality Assurance Measures: The Wetland Monitoring project quality assurance protocols are described in the project-specific QAPP developed in 2014 and 2016, covering physical, chemical, biological and landscape data collection used to evaluate wetland condition. All data are quality assured applying specific measures as specified in the EPA-approved QAPP. Replicates for lab analysis are taken at 10% of the water grab samples. Taxonomic processing and enumeration of macroinvertebrate samples are conducted by an independent contractor who is subject to the QA measures described in the QAPP.

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

Purpose: 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 transmital to Congress. All assessment results are made availiable 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 Supplimental Assessment Database (SADB) for processing and tracking.

Number of records generated:
For 2016 cycle, the Surface Water Quality Assessment Program modified its data pull methodologies and integrated the following into designated use support decisions:

- 197 different project sources of data.
- 8,819 monitored stations.
- 386,666 individual sampling events.
- 304,571 day/parameter combinations from datalogger record sets.
- 1,254,450 individual chemical and biological grab sample results.
- 3,220,224 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 under "Publications" at
http://des.nh.gov/organization/divisions/water/wmb/swqa/index.htm

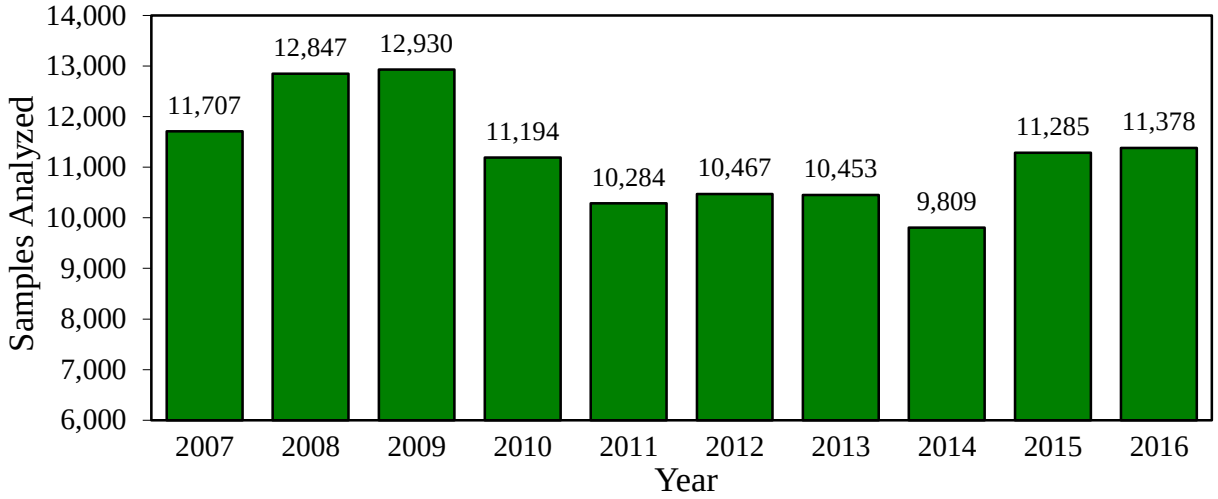
Asessments are conducted in a step wise fashion. First, the SADB manages all imported sample data and performs the initial sample level water quality standard comparisons. Next, each waterbody/parameter combination is summarized in bulk and those bulk assessments are quality assured by a second individual. 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 deimpairments are vetted through professional staff to confirm that the data are sufficient to support those decisions

II. NHDES JODY CONNOR LIMNOLOGY CENTER AND SATELLITE LAB

2.1 Overall Workload

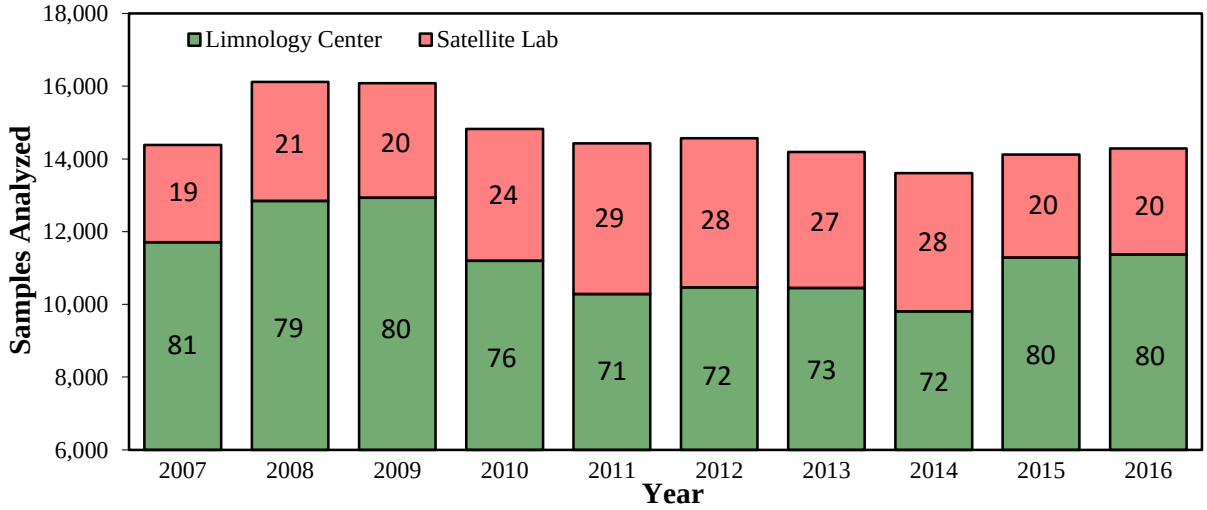
JCLC staff processed 11,378 chemical analyses in 2016 (Figure 1), which is consistent with the analysis workload from 2015. Additionally, approximately 6,700 of the samples from 2016 were collected by JCLC programs but analyzed by DHHS-PHL which represents an increase of roughly 1,000 analyses.

Figure 1: Chemical analyses processed by NHDES JCLC, all programs combined.



JCLC strives to provide volunteer monitors better service by establishing 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 2016, 2,907 chemical analyses were processed at the CSC satellite laboratory. This is also a slight increase over 2015.The workload split between the JCLC (80% of samples) and the CSC-LSPA lab (20% of samples) remains the same as 2015 (Figure 2).

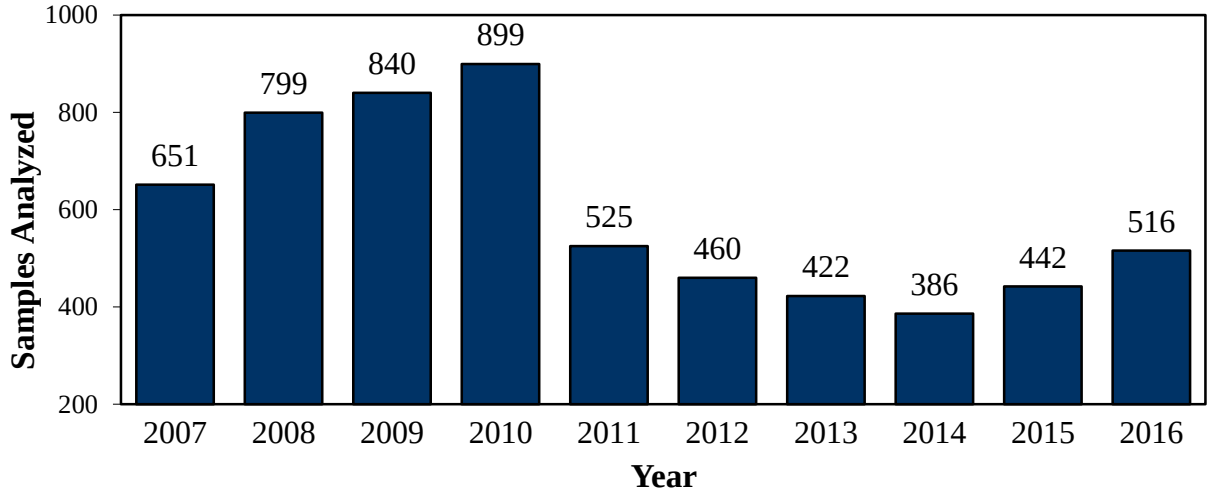
Figure 2: Satellite vs JCLC Analysis 2007-2016 (Numbers inside bars is the annual percentage of data).



Quality control (QC) is an important component in assuring the production of high quality data. At both JCLC and its satellite lab, QC samples are processed regularly. Over 1,900 QC sample analyses were conducted by the two laboratories in 2016.

JCLC also analyses biological samples covering microscopic, phytoplankton, cyanobacteria and macrophyte identifications. The number of annual biological analyses performed rose steadily until 2010 (Figure 3), but has been steadily dropping since. A 10-year low of 386 biological samples was analyzed in 2014. In 2016, 516 biological samples were analyzed in JCLC. These analyses are time consuming and most often performed through microscopic examinations by trained staff. Biological analyses numbers have been fairly stable over the last five years; varying only about 15% from year to year (Figure 3).

Figure 3: NHDES JCLC Total Annual Biological Analyses



2.2 Data Quality Objectives

JCLC and the CSC satellite laboratory met their data quality objective (DQO) requirement of conducting replicate analyses on 10% of the processed samples. Since establishing the 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) and Critical Range (CR) criteria. The CCV and CR processes verify that the laboratory equipment, standard operating procedures and personnel are all meeting established standards and confirming that high quality, reliable data are being produced. Further, during the 2016 NHDES QA Self-Audit, both labs were found to have excellent systems in place to ensure that quality data were being produced and no recommendation was made to improve those systems.

2.2.1 JCLC Laboratory

As a result of requirements set forth in the NHDES Quality Management Plan (QMP), JCLC began to track trained staff in 2003(Table 1). Tracking staff training is a critical component to verify competency on equipment use, DQO procedures, CR and CCV procedures. At the start of each sampling season, in addition to routine training, interns and new permanent staff are required to complete a training checklist prior to conducting analyses. This checklist serves to standardize training for new analysts and to document the proficiency of laboratory staff.

JCLC replicate split mean ranges (SMR) and Relative Percent Difference (RPD) also show consistency in data quality. The JCLC and CSC-LSPA lab analyze two aliquots (sub-samples) from the same sample as a QC for at least 10% of all samples run. 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 SMR is the value difference between QC and original sample and the RPD is the percent difference between the two samples. JCLC generates SMR/RPDs as a non-statistical method to review that replicate ranges are consistent with historical SMR/RPDs. In 2016, all parameters exhibited SMRs or RPDs within their historic levels (Table 1).

Table 1: 2016 calendar year JCLC chemical analyses quality assurance summary.

Parameter	Replicate Analyses	Sample Analyses	Replicate Percent	Mean Relative Percent Difference or Range					
				2011	2012	2013	2014	2015	2016
Alkalinity (ANC) mg/L	58	527	11. 01	0.47	0.52	0.29	0.42	0.58	0.56
Apparent Color (Visual) cpu	15	138	10.87	1.41	0.67	1.07	0.78	1.05	0.53
Chloride mg/L	212	1868	11.35	0.53	2.29	1.02	0.55	0.88	1.55
Chlorophyll-a mg/L	65	556	11.51	0.22	0.35	0.35	0.29	0.60	0.46
Conductivity µmhos/cm	255	2282	11.17	1.18	1.27	0.74	1.41	1.03	1.33
Mercury mg/L	26	190	13.68	0.03	0.04	0.03	0.04	0.02	0.03
pH units	260	2272	11.44	0.25	0.18	0.37	0.25	0.40	0.12
Turbidity NTU	237	2170	10.92	0.11	0.10	0.09	0.13	0.14	0.16

2.2.2 Satellite Laboratory

The CSC Satellite Laboratory successfully managed the transition to a new lab manager in 2016. Teriko McConnell's first full summer as laboratory was a success. Despite change in management in 2016, the CSC facility continues to be well operated and serves as a model satellite laboratory for producing high quality data in support of NHDES' volunteer water quality monitoring programs. CSC has consistently met or exceeded the replicate DQO for all VLAP parameters since 2008. In addition, the 2016 split mean remained consistent with previous years (Table 2). Lastly, CSC laboratory replicates met established critical range criteria for all parameters.

Table 2: 2016 calendar year CSC Laboratory chemical analyses quality assurance summary

Parameter	Replicate Analyses	Sample Analyses	Replicate Percent	Mean Relative Percent Difference or Range					
				2011	2012	2013	2014	2015	2016
Alkalinity (ANC) mg/L	10	84	10.90	0.47	0.52	0.29	0.42	0.70	0.36
Chlorophyll-a mg/L	17	120	14.17	0.19	0.17	0.27	0.42	0.32	0.11
Conductivity µmhos/cm	70	604	13.73	0.10	0.39	0.10	0.17	0.20	0.87
pH units	70	604	11.59	0.25	0.10	0.39	0.11	0.19	0.04
Turbidity NTU	71	604	11.75	0.22	0.21	0.18	0.18	0.19	.07
E. coli counts/100ml	7	70	10.00	0.37	0.00	0.00	0.47	0.00	0.00
Total Phosphorus µg/L	103	651	15.82	1.4	1.6	2.0	2.8	3.5	1.5

III. ANNUAL PROGRAM REPORTS

3.1 Assessment-Based Programs

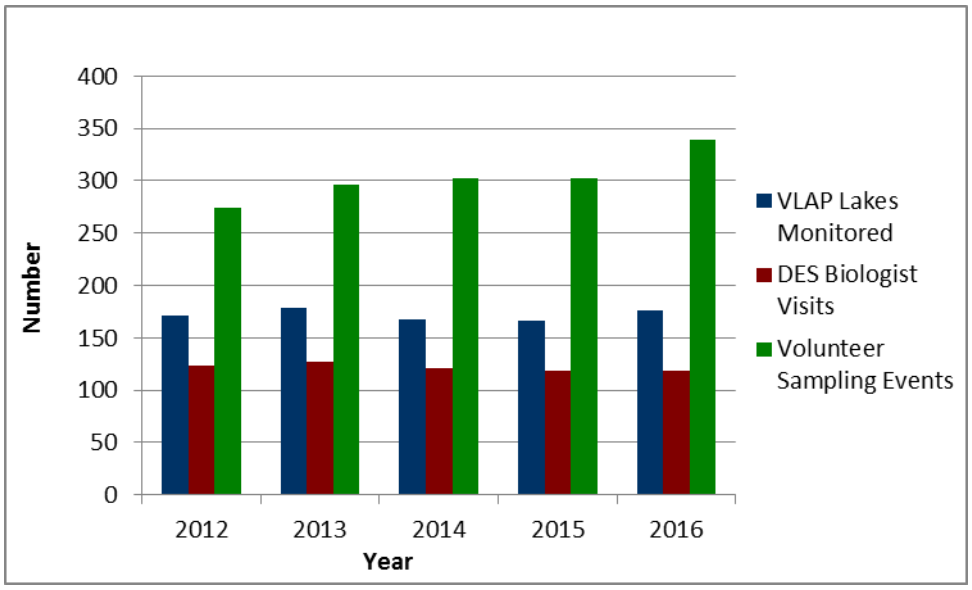
3.1.1 JCLC support summary

JCLC provided analytical services for over a dozen programs in the Watershed Management Bureau in 2015. In addition, JCLC provides bench space where field equipment can be maintained, calibrated and prepared for use. Equipment from JCLC is also loaned to volunteers and other state agencies for the purpose of surface water quality monitoring. The following sections summarize the activities of the programs supported by and operating within JCLC.

3.1.2 Volunteer Lake Assessment Program (VLAP)

VLAP was established in 1985 and trained volunteers collect monthly in-lake and tributary water quality samples during the summer. In 2016, 176 lakes were sampled through the program. This number has remained relatively consistent since 2007. Since its inception, VLAP has regularly enrolled new lakes into the program, with the exception being the period 2011-2012 where additional lakes were not enrolled. However, that did not deter interest in volunteer monitoring (Figure 4) and the continued dedication of volunteers from nearly 200 lakes statewide clearly demonstrates the program's popularity and reflects the public's devotion to watershed management, water quality improvement and lake protection for future generations.

Figure 4: VLAP Monitoring Interest 2012-2016



The VLAP coordinator provides the necessary guidance (training, field inspections, equipment loans and maintenance) to volunteers in order to produce quality data under the auspices of an EPA-approved QAPP. Sample collection and data quality control is extremely important as the data are used to prepare the State's Section 305(b) water quality report and list of impaired waters [303(d) list]. In addition, VLAP data are utilized to complete Total Maximum Daily Load (TMDL) studies, water quality criteria development and watershed planning efforts.

Lake associations are educated on the importance of practicing quality control measures during sampling events and sample preservation during the delivery of samples to JCLC. In addition, volunteer monitor sample techniques are audited

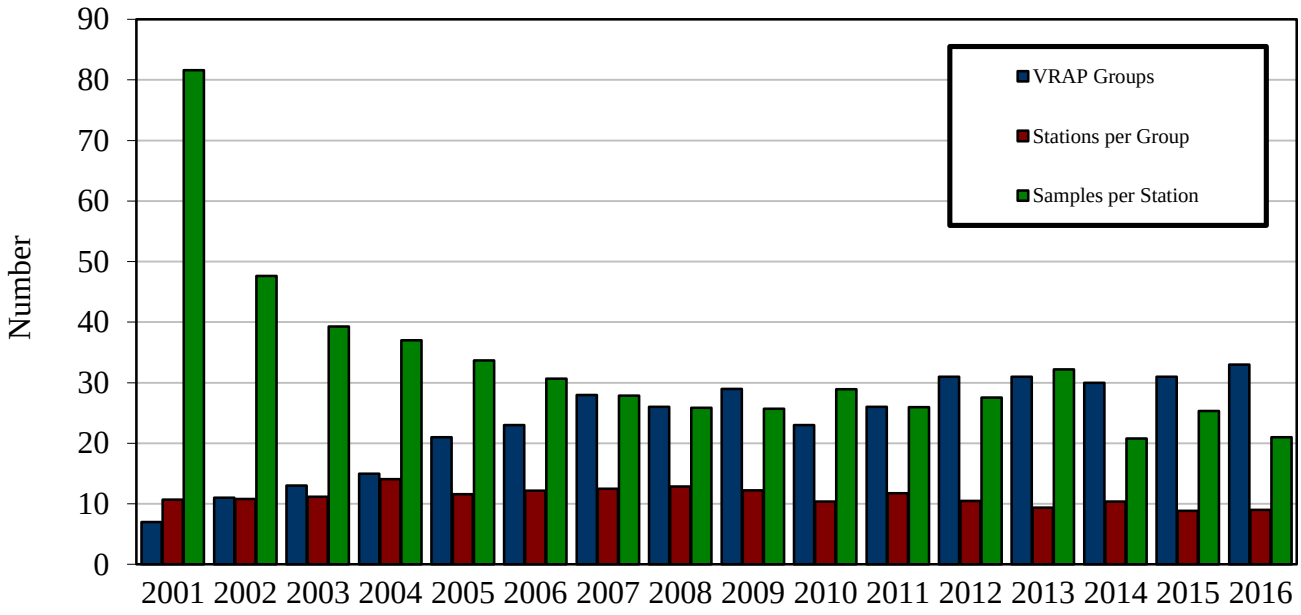
by collecting field duplicate samples during biennial NHDES staff visits to each participating lake and pond. If data are suspect, the VLAP coordinator assesses sample collection techniques and if necessary, provides quality control recommendations to the on-site volunteer monitors.

3.1.3 Volunteer River Assessment Program (VRAP)

In 1998, NHDES established VRAP to promote awareness and education of the importance of maintaining water quality in New Hampshire's rivers and streams. VRAP aims to educate people about river and stream water quality and ecology, and to improve water quality monitoring coverage for the protection of water resources. Today, VRAP loans water quality monitoring equipment, provides technical support, and facilitates educational programs. In 2016, VRAP supported 33 volunteer groups (Figure 5) on numerous rivers and watersheds throughout the state.

VRAP is a cooperative program between NHDES, river groups, local river advisory committees, watershed associations and individuals working to protect New Hampshire's rivers and streams. VRAP volunteers are trained by NHDES staff in the use of water quality monitoring equipment at an annual training workshop. NHDES staff works with VRAP groups to establish monitoring stations and develop a sampling plan. During each sampling season, NHDES receives water quality data from trained volunteers. The data are reviewed for quality assurance, and are entered into the EMD. During the off-season, NHDES staff interprets the data and compiles the results into an annual report for each river. VRAP volunteers can use the data as a means of understanding the details of water quality, as well as to guide future sampling efforts.

Figure 5: VRAP Group, Station and Sample Count from 2000-2016



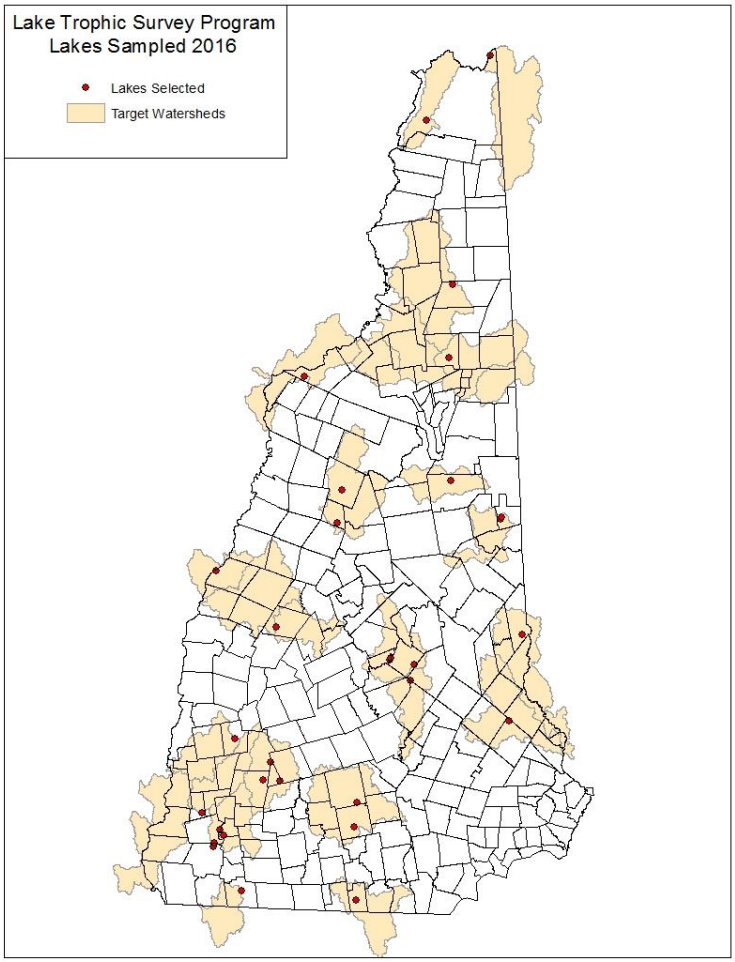
Data collected through VRAP is used to develop the 305(b) / 303(d) report, from which impaired or potentially impaired waters are targeted for additional detailed studies if necessary. Over 40 percent of the surface water quality assessments of riverine assessment units included in the 2014 Section 305(b) report were provided by VRAP. In 2015, this data contributed to the assessment of 2,900 miles of rivers and streams.

3.1.4 Lake Trophic Survey Program (LTSP)

In 2013, WMB reinitiated the lake trophic survey program (LTSP) as part of the NHDES comprehensive surface water monitoring strategy. For 2016, a total of 31 lakes were sampled (10 from those selected in 2016 (Figure 6); 10 from the 2015 selection; 11 from the 2014 selection. In 2016 the LTSP achieved the milestone of producing its first set of reports for lakes that were selected in 2013. The reports have been complete revamped and are being made available on both

the NHDES website and the new Lake Information Mapper (http://nhdes.maps.arcgis.com/apps/webappviewer/index.html?id=1f45dc20877b4b959239b8a4a60ef540).

Figure 6: Lake Trophic Survey Program Lakes Sampled in 2016



3.1.5 Biomonitoring Program

The NHDES biomonitoring program was established in the mid-1990s in response to an EPA directive for states to develop the capacity to characterize the condition of its aquatic communities. Since that time, the program has focused on the development and implementation of biological condition indices for rivers and streams. The program also collects chemical and habitat data, which is used in conjunction with biological data to complete comprehensive water quality assessments of river and stream segments.

In 2016, the biomonitoring program assisted other WMB staff in completing water quality monitoring at 40 trend monitoring sites and 22 synoptic monitoring sites between June and August. At 38 of these locations (28 trend, 10 synoptic), biomonitoring staff were responsible for coordinating the collection of macroinvertebrate data. With assistance from WMB staff, Rock Baskets were deployed and collected. Collection of fish data occurred at 23 of locations (11 trend, 15 synoptic, seven special project).

For the third 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 American Eel and Eastern Brook Trout surveys.

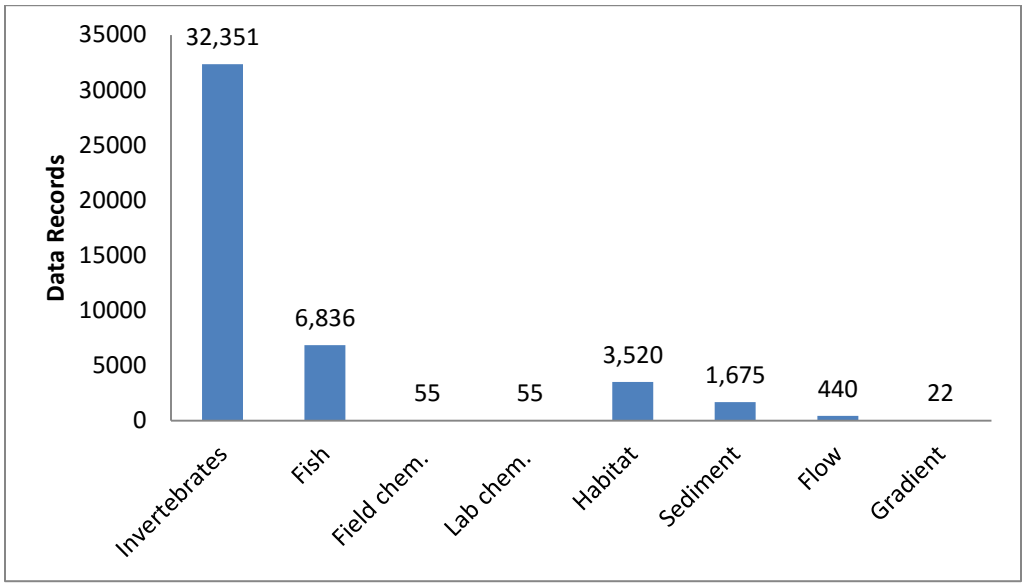
In addition to trend and synoptic monitoring, the biomonitoring program completed 11 probability-based stream surveys in 2016. Between 2014 and 2016, New Hampshire crews of four to eight people completed 34 stream assessment surveys; collecting water quality, habitat, gradient, flow and biological parameters. This data, along with data from the National Rivers and Streams Assessment in 2013 and 2014, will be used to complete a probability-based assessment of the state's wadeable rivers and streams.

Biomonitoring program efforts included in this report summarize the collection chemistry, macroinvertebrate, fish and habitat data satisfying trend, synoptic and probability-based monitoring efforts. In 2016, biological monitoring included 145 macroinvertebrate samples (51 sample sites) and 40 fish samples, resulting in the generation of more than 39,000 combined data points (Figure 7). The number of macroinvertebrate data records is an estimate based on the average number of macroinvertebrates per sample collected from 2000-2013. Actual data will be available in mid-2017. Additional water chemistry, habitat, sediment, flow and stream gradient data were also collected and totaled more than 5,000 additional data points.

Fish identification data quality control measures relied on having an expert fish taxonomist on site during sampling. Any unknown species were documented with photos or retained for laboratory analysis and further consultation with other state agencies and partners. Several samples were preserved for laboratory identification in 2016, including a young of year Fallfish and Creek Chubsucker.

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 Water Quality Exchange Database.

Figure 7: 2016 Biological, water quality and physical parameter data summaries.



3.1.6 Wetland Monitoring Program

In late 2013, EPA awarded NHDES a Wetlands Program Development Grant (WDPG) for several projects, including the development of biomonitoring techniques for wetlands following Maine's wetland biomonitoring protocols (macroinvertebrates) and protocols previously used by New Hampshire. The two-year grant is funding the monitoring and assessment work at 24 wetlands. In late 2015, EPA awarded NHDES a Wetlands Program Development Grant for

several projects, including monitoring and assessment of 20 additional wetlands to support the development of biocriteria.

The protocols involve:

- Sampling benthic macroinvertebrates using a dip-net from a canoe or by wading (three "replicate" samples).
- Taking instantaneous measurements of field parameters including dissolved oxygen, pH, turbidity, specific conductance and water temperature.
- Collecting grab samples that are analyzed for nutrients (nitrate – nitrite, total Kjeldahl nitrogen, dissolved ortho-phosphorus and total phosphorus), chloride, chlorophyll-a, dissolved organic carbon and alkalinity.
- Collecting information on physical habitat parameters (land use, terrain, dominant plant species and substrate composition).
- Applying Maine's landscape-based Wetland Human Disturbance Assessment, which evaluates the landscape around a wetland and its watershed.
- Applying the New Hampshire Ecological Integrity Assessment (EIA) developed by the New Hampshire Natural Heritage Bureau, which also includes a GIS-based landscape analysis, stressor evaluation, as well as vegetation-based surveys that can support application of Floristic Quality Assessments and may further inform the macroinvertebrate assessment results.

Identification of wetland macroinvertebrate samples to genus level and enumeration is being done by a taxonomic contractor that has Society for Freshwater Sciences genus-level certifications (http://www.sfstcp.com/). Biological metrics are calculated from the taxonomic data, which is being run through Maine's statistical model to predict the water quality of the wetland. This will improve New Hampshire's ability to assess the condition of wetlands and support of aquatic life.

In 2016, a team of three NHDES staff sampled seven wetlands across the state. This sampling effort occurred during the same field season as the National Wetland Condition Assessment, for which 12 wetland field surveys were completed.

3.1.7 I-93 Chloride TMDL

In fiscal year 2016 data collection continued for the I-93 TMDL development and implementation. The data quality objective for data completeness is to obtain continuous data for 80% of the fiscal year at each station. The 80% data completeness criterion was met for the datasonde records for North Tributary, Beaver Brook and Dinsmore Brook (Table 3). At station I93-POL-01, valid specific conductance readings were made for 73% of the fiscal year, which did not meet the data completeness requirement. Construction near the monitoring location and equipment failure accounted for the inability to attain the data completeness requirement at I93-POL-01.

Table 3: Data completeness for in-situ specific conductance datasonde readings from 7/1/15 - 6/30/16

Station ID	Valid Specific Conductance Data Points	15 Minute Intervals in Reporting Period	Portion of Reporting Period with Valid Conductance Data
10A-BVR	35,118	35,136	99.9%
I93-DIN-01	31,729	35,136	90.3%
I93-NTC-01	31,792	35,136	90.5%
I93-POL-01V	25,658	35,136	73.0%

The actual number of chloride grab samples (82) was higher than the expected number (79) (Table 4). This result met the data completeness quality objective of 80% of the planned measurements. There were 16 pairs of routine and field duplicate samples for chloride, which exceeded the expected number. The RPD between the routine and duplicate

samples was less than 15% in over 100% of the pairs. Therefore, the quality control samples do not indicate any systematic problems with the chloride samples collected for this study.

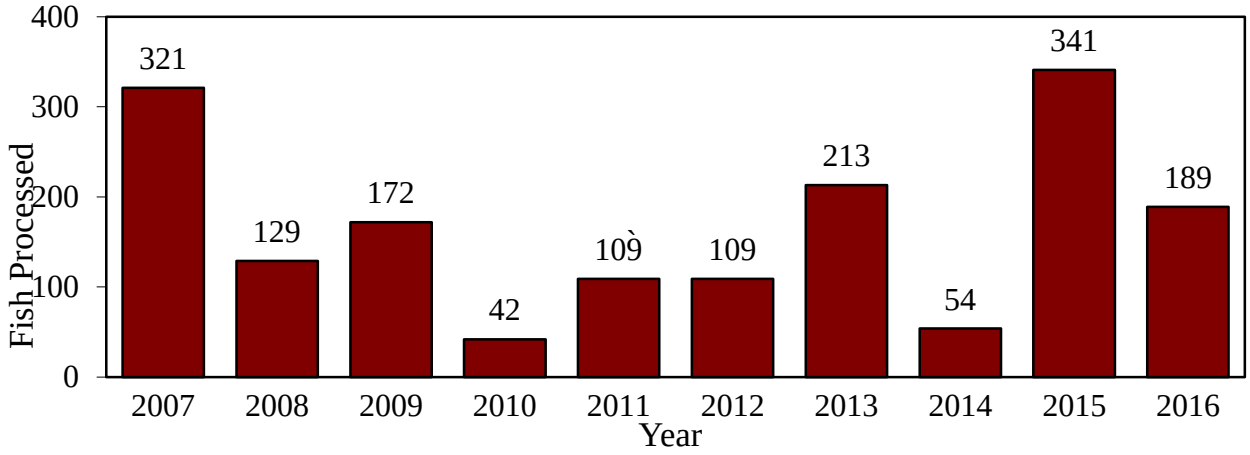
Table 4: Data completeness for grab samples and field meter measurements for 7/1/14 - 6/30/15

Parameter	Actual Samples or Measurements	Expected Samples or Measurements	Completion Rate
Temperature	82	79	>100%
Specific Conductance	82	79	>100%
Chloride	82	79	>100%
Temperature Duplicates	16	9	>100%
Specific Conductance Duplicates	16	9	>100%
Chloride Duplicates	16	9	>100%

3.1.8 Mercury in Fish Tissue Program

JCLC plays a critical role in the state's mercury in fish tissue study program. NHDES is responsible for organizing the collection of fish specimens for state and national fish tissue studies. All data collected in this program is used to support both state-wide advisories as well as individual lake advisories for human fish consumption. Fish are collected by VLAP volunteers using traditional fishing methods, by NHDES and NHFG staff using fish electroshock boats during the summer months, and at ice fishing tournaments during the winter. The number of fish collected and processed by JCLC over the past several years has ranged from a high of 341 in 2015 to a low of 42 in 2010 (Figure 8). The number of fish processed in 2016 was 189.

Figure 8: Number of Fish Processed for Mercury Analyses



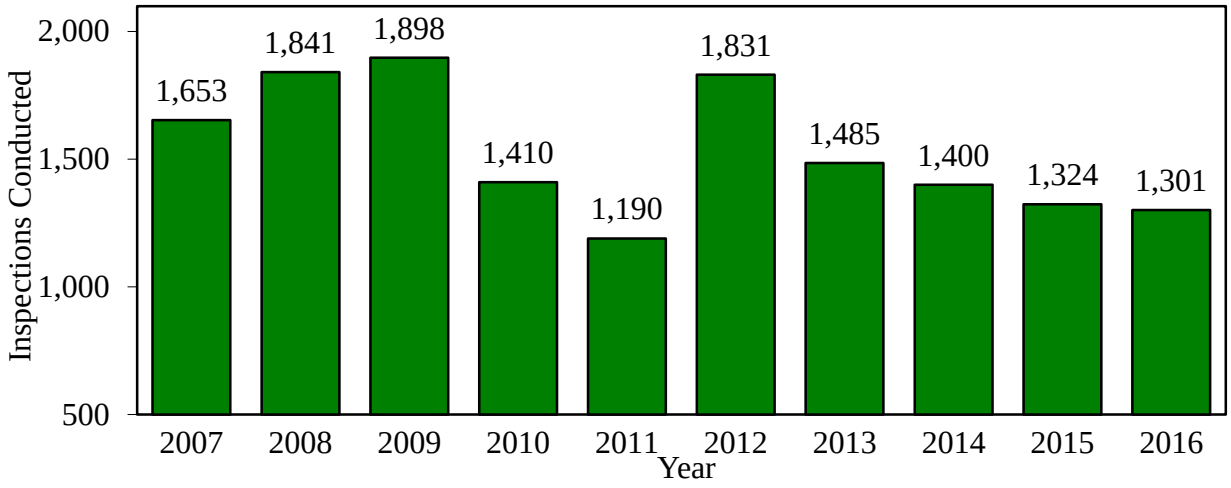
3.2 Inspection-Based Programs

3.2.1 JCLC Support Summary

Several programs are responsible for conducting field inspections. These include inspections of public bathing facilities, coastal and freshwater public beaches, recreational boats, and pet and plant suppliers. In 2016, these inspections totaled 1,301 (Figure 9), which was nearly identical to the previous year. Program inspections may be either routine, a result of complaints or inquiries. In addition, suspect exotic aquatic plant samples are regularly submitted by the public

to JCLC for identification. These programs protect public health and welfare and require a significant investment of JCLC staff time and resources.

Figure 9: Inspections Conducted by NHDES JCLC for All Programs

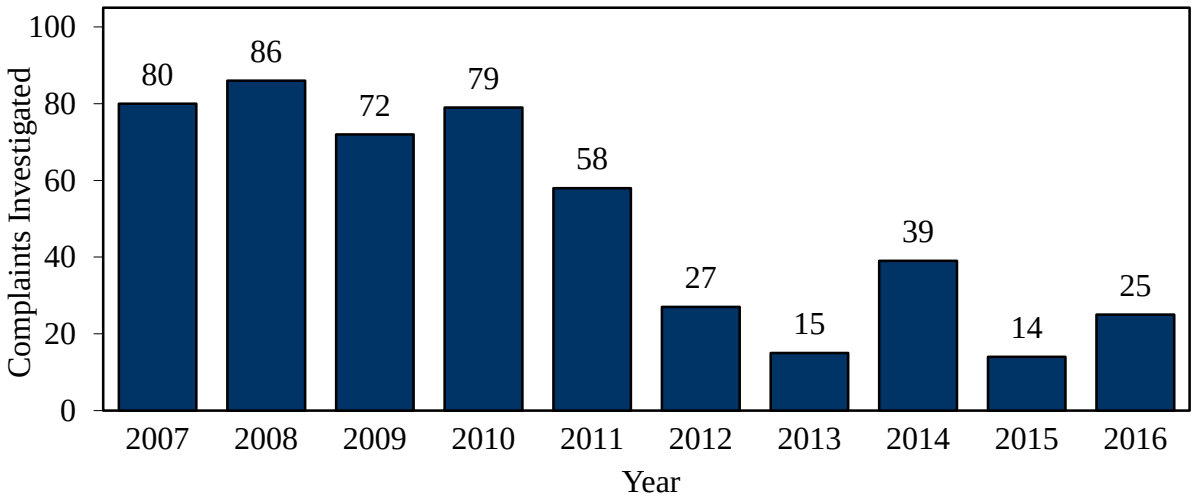


3.2.2 Complaints

Thirty-one new complaints were added to the EMD during the 2016 calendar year. Watershed bureau staff conducted site visits for 25 (81%) of the complaints (Figure 10). Most others were resolved with a phone call to the responsible party or referral of issues to another agency.

The EMD complaint module is now used department wide to track complaints. The integration of all complaints into the EMD not only has an advantage with tracking, but also facilitates the process of referral of complaints received by one bureau to another bureau which has jurisdiction in the issue involved in the complaint.

Figure 10: NHDES biology section complaint summary



3.2.3 Public Bathing Facility Inspection Program

The Public Pool and Spa Program oversee more than 1,300 active facilities. In 2016, 381 facility inspections were conducted, including 363 routine/follow-up inspections, three complaint inspections and 15 pre-opening inspections (Figure 11). This is an increase over 2015 when 330 inspections were administered. The inspection rate varies from year

to year depending on funding levels and the amount of time spent on additional program activities other than field work. Currently, inspections are carried out by the program coordinator and two dedicated summer interns. In addition, an intern from the legal department was on loan to the program in 2016. Historically (Pre-2004) the pool program received significant inspection assistance from the subsurface bureau, specifically in the North Country. That additional support began to significantly decrease in 2005 and ended completely in 2009. The loss of that assistance made the goal of inspecting all indoor facilities no longer possible.

Over the last 10 years of inspection activity, water quality violations, as a percentage of inspections conducted, have averaged 69%. Sixty-three percent of all inspections in 2016 had one or more deficiency. Bacterial violations increased in number from 24 in 2015 to 59 in 2016. Of the 697 samples collected in 2016, 98 were positive for bacteria. This summer was the hottest on record and pools had extremely heavy use. The high temperatures and bather loads are reflected by the higher than average bacterial violations. The number of water quality violations varies from year to year with several factors contributing. Those factors include, but are not limited to weather, inadequate or improper water testing, equipment failure, higher than typical bather loads, insufficient owner/operator education and poor construction. With the additional inspection intern and legal intern we were able to focus on facilities that had not been inspected in over three years.

Safety violations often involved direct potential hazards to bathers such as missing break float safety lines or broken, lose or missing drain covers. In comparison to 2015, the number of safety violations increased dramatically from 28% to 44%. Of the 167 safety/facility violations identified in 2016, the majority were issues with record keeping/testing and up-to-date signage. Five inspections revealed unapproved or broken main drain covers. The increase in violations is directly related to the inability to get to facilities in a timely manner. The high risk venues that we have to inspect every year tend to have fewer violations because they are more familiar with our rules and expectations to achieve compliance.

Sixteen permit applications were submitted and issued in 2016. Over the last 10 years, 2006 witnessed the highest number of permits issued in one year at 44. The economic downturn of 2008 resulted in a rapid decrease in construction activity, with the fewest number of submitted applications (10) in 2010. Pool construction in 2016 came from a broad spectrum of categories including hotels, condos, campgrounds, health clubs, assisted living facilities and a municipal pool.

Enforcement activity in 2016 resulted in 19 Letters of Deficiency (LOD) and 92 Notices of Deficiency (NOD) being issued. LODs are reserved for more extreme cases of non-compliance. Thirty facilities were closed on site due to significant water quality or safety violations where a threat to public health and safety was imminent. Typically immediate closures involve bottom drain cover problems; extremely low disinfection levels; severe water clarity issues and equipment failures. The responses to closures are typically rapid, with many operators taking action during the inspections to correct deficiencies.

Figure 11: Public bathing facility inspections

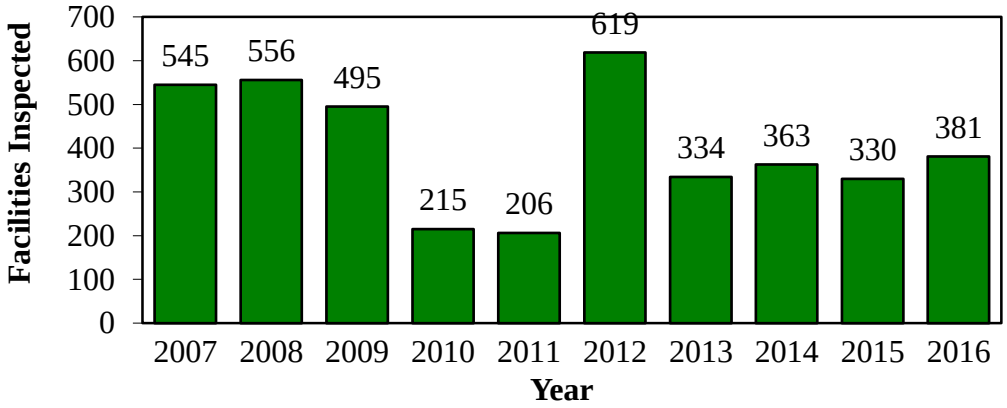
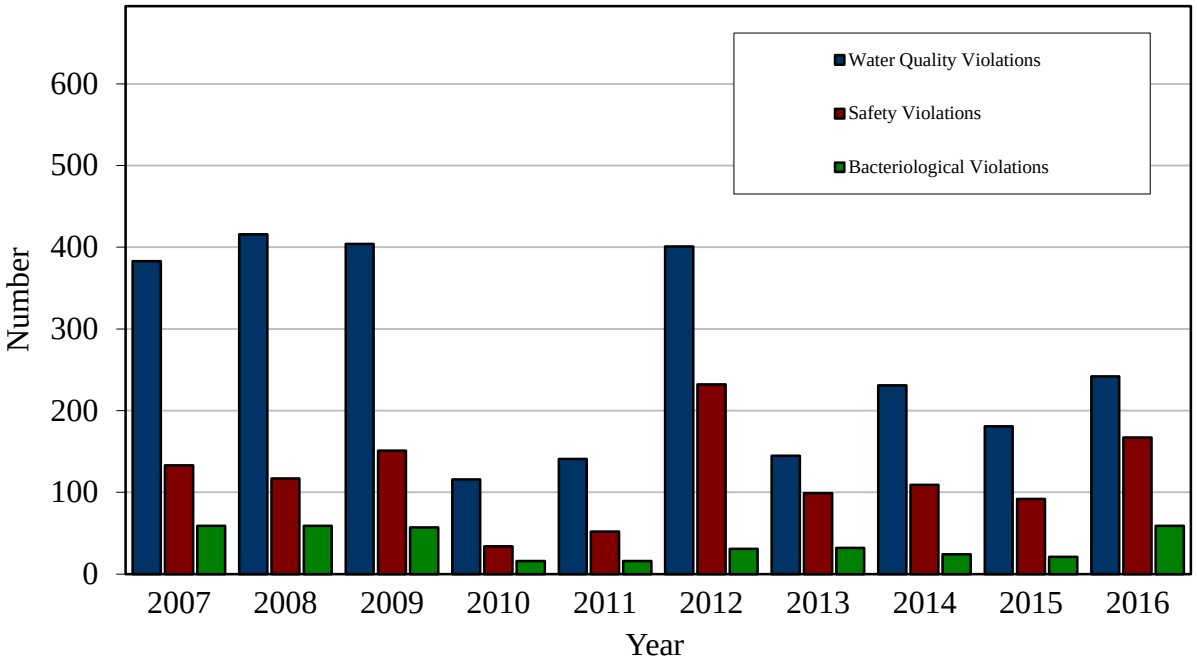


Figure 12: New Hampshire public bathing facility violations

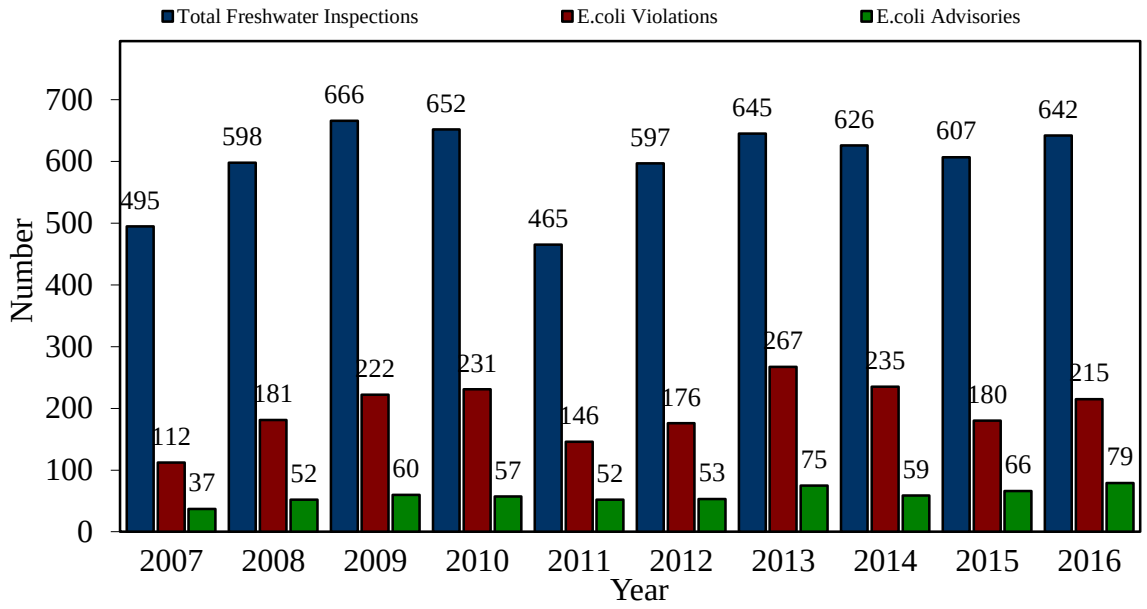


3.2.4 Freshwater Beach Program

In 2016, freshwater beaches were inspected by the Public Bathing Beach Inspection Program from June 13 to August 25. The goal of the freshwater beach program is to inspect each beach in the program three times between Memorial Day and Labor Day. The Beach Program inspects about 170 freshwater- town, state, federal and private association beaches, plus nearly 30 NH beaches are sampled by other agencies and municipalities. During 2016, 527 beach inspections were conducted by NHDES and 115 were inspected by others for a total of 642 beach inspections in 2016. A total of 1,865 *E. coli* samples were analyzed by the state laboratory, including field duplicates and additional samples collected by towns and federal agencies that sample water at New Hampshire beaches. In 2016, 215 *E. coli* samples exceeded the state standards, resulting in the issuance of 79 freshwater beach advisories, an increase of 13 advisories from the summer of 2015, which had the highest number of bacteria advisories issued in during the summer season. Bacterial-based advisories were issued at 48 beaches in 2016.

Since 2008, NHDES has issued cyanobacteria lake warnings if a bloom occurs at a beach, far away from a beach or on a lake without a public beach. Beach advisories were issued for cyanobacteria at seven different beaches that routinely monitor and an additional two beaches had also confirmed blooms with NHDES. In 2016, cyanobacteria warnings were issued for Elm Brook Pond, Hopkinton where two advisories were issued for two weeks at a time. Cyanobacteria warnings were also issued at French Pond, Henniker; Norway Pond, Hancock; Darrah Pond, Litchfield; Milton Three Ponds, Milton; Otter Brook Lake, Keene and Silver Lake, Hollis. Cyanobacteria blooms were also confirmed at Greenwood Pond of Kingston and Sunrise Lake of Middleton. There were 11 cyanobacteria warnings recorded by NHDES in 2016. The greatest number of annual warnings was issued in 2008 and 2009 with 14 cyanobacteria advisories each summer. Since 2003, nearly 40 freshwater beaches have been reported by NHDES to have had a cyanobacteria bloom event occurring at least once in a summer.

Figure 13: Water quality violations and advisories at freshwater beaches



3.2.5 Coastal Beach Program

The Beach Program is a federally funded program that provides resources for coastal beach research and monitoring. NHDES inspected 16 coastal public swimming beaches in 2016. During the swim season, Memorial Day through Labor Day, six beaches were inspected twice weekly, four were inspected weekly, and six beaches were sampled twice a month according to a tiered monitoring assessment. In 2015, the summer sampling frequency was reduced from weekly to twice a month at both Sawyer and Seabrook Town Beach because both had been removed from the 303(d) impaired list in the most recent NHDES report to EPA.

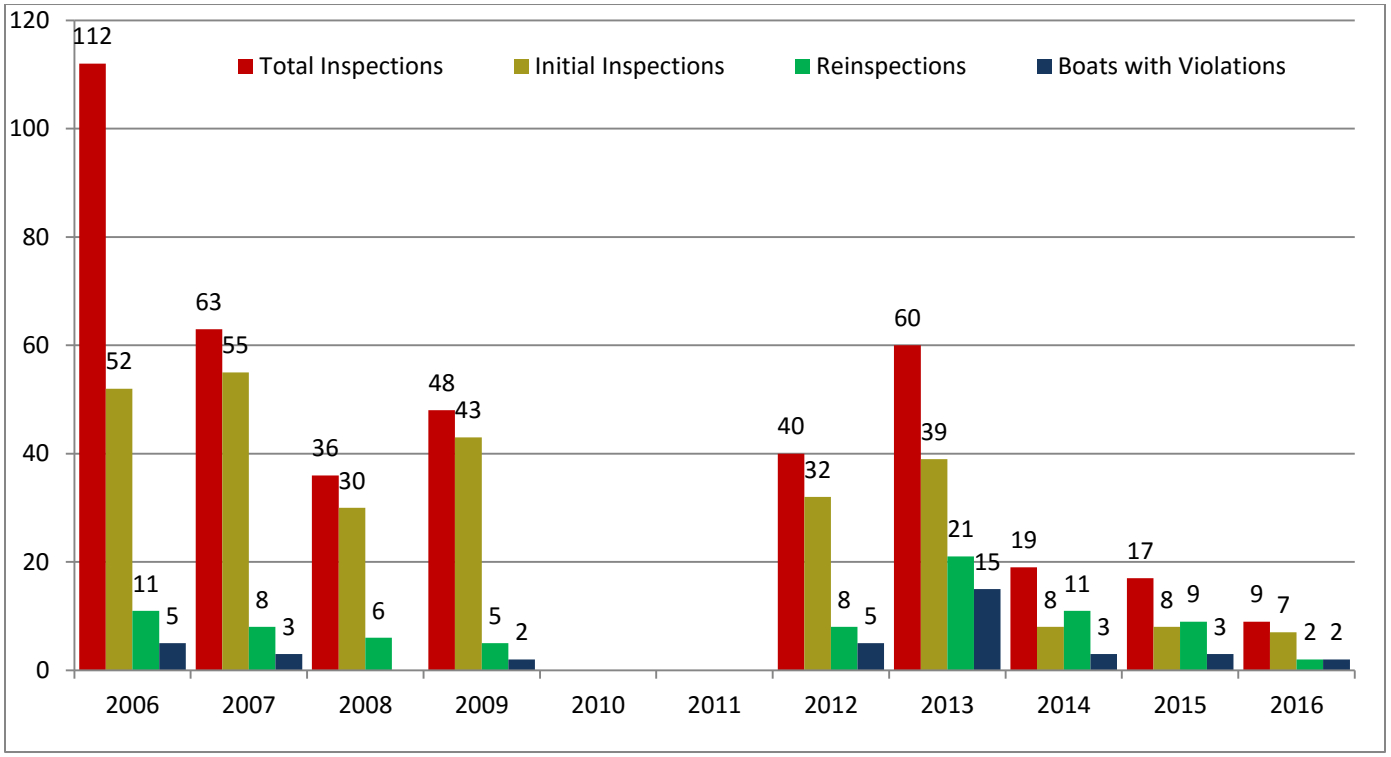
Staff members conducted 232 inspections and collected 899 samples for Enterococci analysis during the swim season. No off-season sampling was conducted in 2016. During the swim season, only four Enterococci samples exceeded the state standard, resulting in two coastal advisories from one beach. The only beach to issue coastal advisories in 2016 was North Hampton State Beach for a total of three days for each advisory or six beach days overall. The 2016 swim season in New Hampshire was 104 days long, translating into 1,664 beach days collectively for all 16 beaches. With only six total advisory days during the entire summer at coastal beaches, the chance of a beach being under a swimming advisory was less than 0.36% in 2016.

3.2.6 Boat Inspection Program

Promotion of proper boating practices and enforcement of the No Discharge Area designation was continued in 2016 by conducting inspections of vessels with onboard marine sanitation devices (MSD) that operate on inland waters. No marine toilet, sink or shower on any boat operated upon fresh waters of the state shall be so constructed or operated as to discharge graywater or sewage (whether it's treated or not) per RSA 487:2-3.

The 2016 season boat inspections were done on Lake Winnipesaukee on four separate events (Figure 14). Fewer inspections were done in both 2014 and 2015 due to unexpected health concerns for the boat inspector. At the request of the boat inspector, a replacement inspector was hired in 2016. The number of events and inspections were lower than previous years as the replacement inspector was hired at the end of July and thereby the time for inspections was shorter than it has been in past years. It is anticipated that in 2017 the inspections will occur roughly once a week from Memorial Day to Labor Day.

Figure 14: NHDES biology section boat inspection summary, 2006-2016.



3.2.7 Clean Vessel Act Program

The New Hampshire Clean Vessel Act (CVA) program is a result of a cooperative effort between NHDES and the U.S. Fish and Wildlife Service. The Federal Clean Vessel Act of 1992 was established to support adequate facilities for recreational boaters to dispose of waste from marine sanitation devices. Through grants from the U.S. Fish and Wildlife Service Sport Fish Restoration program, the CVA program has funding available to construct, operate, maintain and repair stationary pumpout facilities and mobile pumpout services. These federal funds can be used to account for 75% of all approved projects with a minimum of 25% supplemented by the applicant, including state and local government, and private businesses or associations.

New Hampshire funding has been applied to the operation of a mobile pumpout service along the coast since 2002. Beginning in 2006, these grants were also used to implement an Operation and Maintenance Funding program that continues to assist marinas in seasonal upkeep costs to ensure existing pumpout resources remain in proper working condition. Eligible state activities include general program administration and educational outreach to marina owners, boat dealers, and the boating community.

Pumpout options are a key factor in maintaining No Discharge Areas (NDA) throughout New Hampshire waters. All waters within three miles of the New Hampshire shoreline and the Isles of Shoals are part of the coastal NDA where treated or untreated boat sewage is prohibited. Tidal and estuarine waters, including all bays and rivers to the tidal dams, are also incorporated into the coastal NDA. Important goals of the CVA program continue to include educating the boating community of their environmental responsibilities and encouraging public awareness of sources of pollution and pumpout resources.

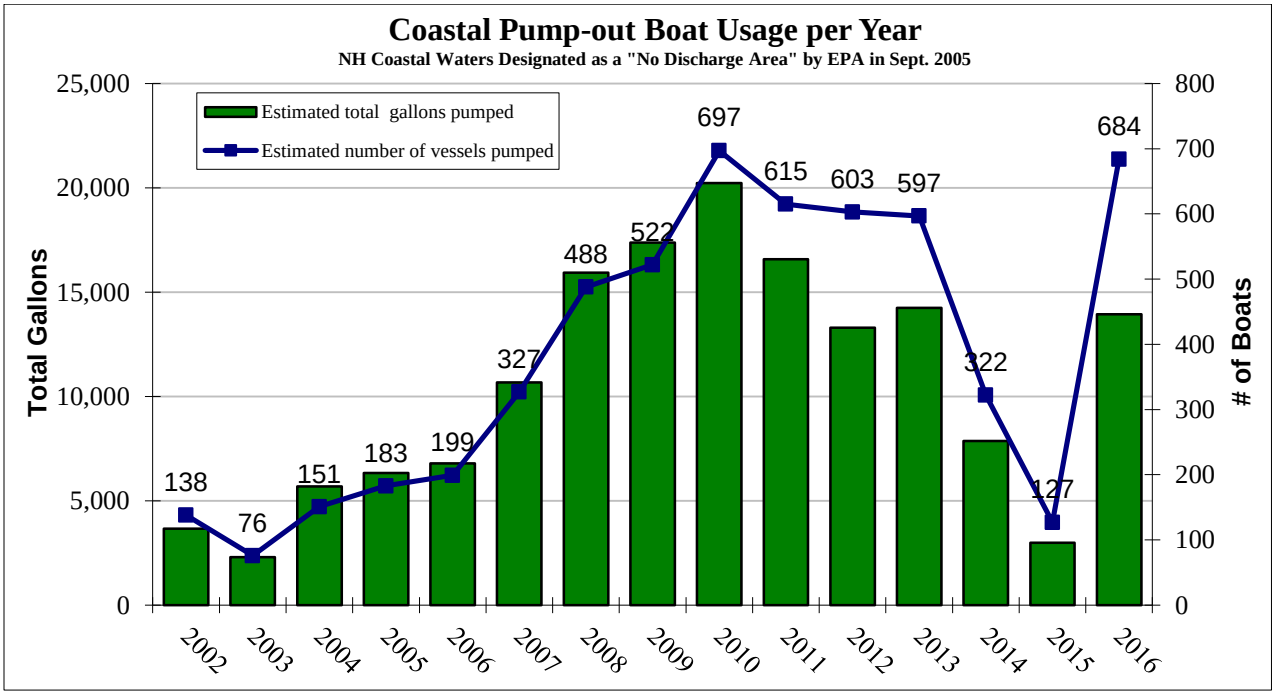
Coastal Waters – Two stationary pumpout locations and two mobile pumpout boats are available to the recreational boating public along New Hampshire's coast. Both stationary facilities have taken part in CVA funds at one point either for initial installation or seasonal repairs. One of the three marina locations was awarded 2016 CVA operation and maintenance funding for their stationary pumpout units. Under this grant, Great Bay Marine in Newington continued routine operation and maintenance. One stationary facility that was out of order for the 2016 season has expressed an interest in replacing that stationary facility in the beginning of 2017. A grant to provide funds for this replacement is currently pending.

The mobile pumpout service receives CVA funding annually through a multi-year contract. Since 2002, approximately 157,000 gallons of sewage have been removed from recreational boats through the use of the mobile pumpout service. During 2016, a mobile pumpout vessel operated in Hampton Harbor from May through October. A state-owned mobile pumpout vessel operated in all other coastal waters from May through November. The two services documented 1,145 captain hours, more than 685 serviced boats and the disposal of an estimated 13,700 gallons of sewage (Figure 15. The popularity and effectiveness of the mobile resource has been evident in the consistency in boater user numbers and sewage pumped since program implementation. Seasonal activity within the recreational boating community varies from year to year depending on economic and weather conditions.

Inland Waters – New Hampshire has approximately 20 pump/dump facilities with 18 (14 of which are public access) devoted to Lake Winnipesaukee and one public facility on Lake Winnisquam. A public dump station is also located within Sunapee Harbor on Lake Sunapee. Approximately 50% of the available pump/dump facilities have taken part in CVA funding at one point or another either for initial installation or seasonal repairs. Three marinas on Lake Winnipesaukee were awarded 2016 CVA operation and maintenance funding for their stationary pumpout units.

The CVA program anticipates funding construction, renovation and maintenance of systems as necessary in 2017. The mobile pumpout service dedicated to Hampton Harbor is expected to continue in 2017. Education and outreach to marinas, pumpout/dump stations and the boater community in general will continue both for inland waterbodies and coastal waters.

Figure 15: NHDES Clean Vessel Act Pumpout Service



3.2.8 Exotic Aquatic Species Program

The primary purpose of the exotic aquatic species 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). The program has five focal areas: 1) Prevention of new infestations; 2) Early detection of new infestations; 3) Control of established infestations; 4) Research towards new control methods with the goal of reducing or eliminating infested areas; and 5) Regional and national cooperation.

There was one new infestation of exotic aquatic plants in New Hampshire in 2016. Variable milfoil was found in Crooked Pond in Loudon.

The exotic aquatic species program inspected 87 waterbodies in 2016 (several of them multiple times) for exotic plant species infestations (Figure 16). It anticipates conducting at least the same number of lake inspections in 2017 for waterbodies with a high potential for exotic species infestations. The total number of management actions for exotic plant control in 2016 is shown in Figure 17.

Figure 16: Exotic species program lake inspections

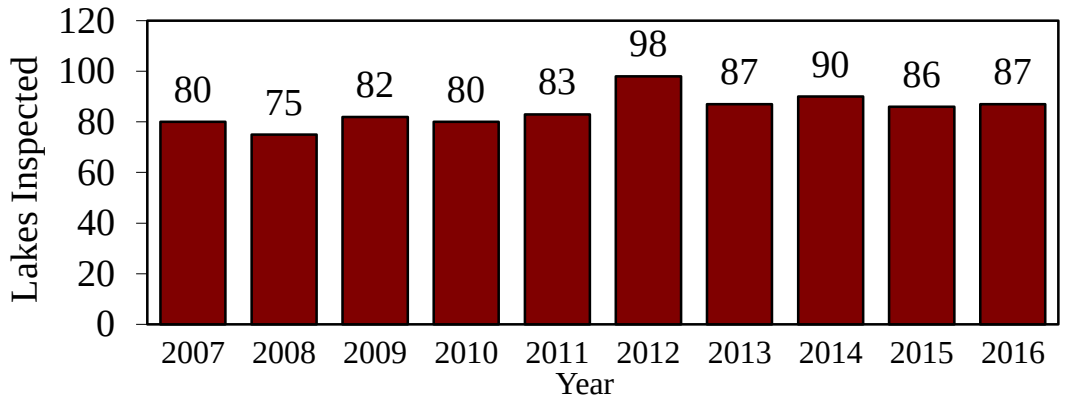
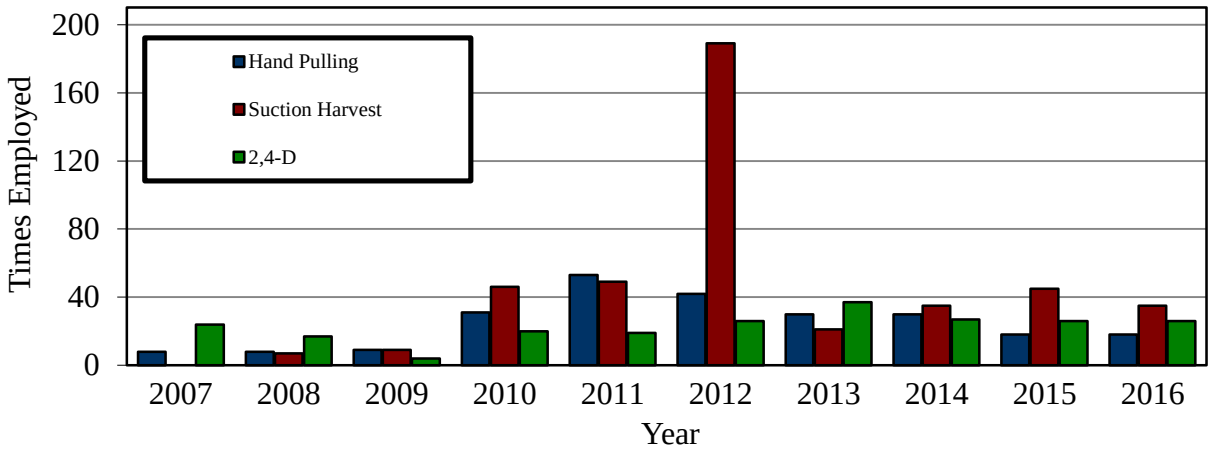


Figure 17: Exotic Species Program Control Practices



4. Summary

In summary, the NHDES WMB operated 16 programs dedicated to monitoring and protecting surface waters. Collectively, these programs provide critical information regarding the status and trends of the condition of our lakes, ponds, rivers, streams, estuaries and oceans. Many of these programs also supply valuable data used to estimate public health risks. JCLC serves as a vital component in the operation of each of these programs, not only through the facilities and equipment it supplies, but also the consistency maintained in data quality control and data management. In 2016, over 11,000 data points were processed in JCLC. The data quality control measures for all the data were adequately maintained. In total, surface water quality programs operating within JCLC are covered under seven EPA QAPPs that have been approved or are pending approval. Programs without a formal QAPP have a dedicated SOP included in the JCLC laboratory manual, which is updated annually. Changes in 2016 included the purchase of an automated plate reader for microcystin analysis.