Massachusetts Department of ENVIRONMENTAL PROTECTION

# 2020 SURFACE WATER MONITORING OVERVIEW

***(CN 542.0)***

## Introduction

The Massachusetts Department of Environmental Protection (MassDEP) Watershed Planning Program (WPP) plans and implements surface water quality monitoring for the state to support various Clean Water Act (CWA) objectives, including reporting on the condition of waters of the state. This report provides a brief overview of the surface water quality monitoring performed in 2020. Information pertaining to the individual components of WPP's Surface Water Monitoring Program is presented at https://www.mass.gov/service-details/water-quality-monitoring-program#1.

The main programmatic objectives of the WPP surface water quality monitoring program are as follows:

- Collect chemical, physical, and biological data to assess the degree to which designated uses, such as aquatic life, primary and secondary contact recreation, fish consumption, and aesthetics, are supported in the waters of the Commonwealth;
- Collect data to support analysis and development of total maximum daily loads (TMDLs) and other plans to reduce pollutant loads to waters of the Commonwealth;
- Screen fish tissue in selected waterbodies for select contaminants (metals, PCBs and organochlorine pesticides) to support public health risk assessments;
- To the extent feasible, locate pollution sources and promote and facilitate timely correction;
- Identify and assess new and emerging water contaminants of concern;
- Collect water quality data to evaluate for trends in parameter concentrations and/or loads;
- Collect data to support the establishment or revision of surface water quality standards and policies; and
- Measure the effectiveness of water quality management projects or programs such as the effectiveness of implementing TMDLs or watershed-based plans.

Quality assurance is maintained for WPP's watershed monitoring program to ensure

implementation of an effective and efficient sampling design, to meet programmatic goals and to provide data meeting specific data quality objectives. The U.S. Environmental Protection Agency (USEPA) has approved a comprehensive Quality Assurance Program Plan (QAPP) that applies to the generation and use of surface water quality data by WPP for a five-year period (2020 – 2024). This five-year *program* QAPP is annually supplemented by project-specific Sampling and Analysis Plans (SAPs), which provide detailed information regarding individual project organization, tasks, background, sampling design and non-direct measurements. More information pertaining to the WPP's Quality Management Program and the 2020 – 2024 QAPP can be found at https://www.mass.gov/guides/water-quality-monitoring-quality-management-program.

The WPP had intended to initiate a new seven-year rotating watershed schedule for targeted assessment monitoring in 2020. However, the Covid-19 virus pandemic led to its postponement until 2021. A revised monitoring plan was developed that could be implemented while adhering to safety guidelines developed for WPP field and laboratory operations during the Covid-19 pandemic. The 2020 monitoring program primarily focused on: 1) Macroinvertebrate sampling to support ongoing biocriteria development activities; and 2) Monitoring of candidate streams for potential designation as cold water fishery resources in the surface water quality standards (SWQS). In addition to these 2020 monitoring activities, long-term monitoring continued in Mount Hope Bay and the Taunton and Connecticut watersheds. Monitoring activities aimed at assessing the impacts of road salt application on surface waters were also continued. These, as well as additional monitoring activities performed in 2020, are described in more detail below.

## Monitoring Project Descriptions

**Biocriteria Development Monitoring (Filling Data Gaps):** The WPP is currently developing biocriteria (multimetric indices of biotic integrity) for streams using benthic macroinvertebrate communities. The implementation of biocriteria increases the accuracy and precision of aquatic life use assessments and improves water quality goal-setting processes. Multimetric indices were developed recently for two regions of Massachusetts: the "Western Highlands" and the "Central Hills". After completing the initial phases of the biocriteria development, it was apparent that gaps existed in the Massachusetts macroinvertebrate dataset that, if filled, would support efforts to refine and improve the accuracy of the biocriteria indices. Biocriteria development monitoring in 2020 focused on high-gradient streams in the "Western Highlands" with high levels of human disturbance. Existing human disturbance gradients were used to select approximately 85 candidate sites meeting the defined disturbance criteria. Macroinvertebrate samples were collected from a total of 71 of the selected sites between July 1 and September 30. Habitat assessments and field observations were also made at each site. Macroinvertebrate samples were delivered to a contractor for processing and taxonomic identifications. The data from this monitoring effort will be used to better characterize the macroinvertebrate communities in highly disturbed streams in the "Western Highlands" and to refine the calibration of the multimetric index for that region. In addition, the data will be used to assess the aquatic life use support status for the sampled streams. A complete list of the sites sampled in 2020 is presented in Appendix A.

**Cold Water Fisheries Resource Assessments to Support Surface Water Quality Standards Designations:** The WPP has developed protocols for designating cold water fisheries (CWF) in the SWQS. For a particular surface water or segment, fish population data can be used to support proposed Cold Water designation in the SWQS. Temperature and DO data can also be used in the absence of fish population data. Working primarily from the Division of Fisheries and Wildlife's (DFW) Cold Water Fisheries Resource (CFR) List, the WPP

identified water bodies that may have been undesignated or under documented CWF as candidates for field verification in 2020. A total of 61 stream sites in northeastern and central Massachusetts were selected for assessment (see Appendix B). Sondes and data loggers were deployed for up to two months in July and August to obtain continuous temperature and dissolved oxygen data from each site. During that same time, and extending into mid-September, fish population assessments were performed once at each site. Streams that qualify as CWF will be designated as such in the next regulatory review of the SWQS.

**Fish Toxics Monitoring:** The Fish Toxics Monitoring Program is a cooperative effort between MassDEP (WPP and Office of Research and Standards), the Massachusetts Department of Public Health (DPH), and the Department of Fish and Game (DFG). The goal of this monitoring is to provide data for the assessment of the risk to human consumers associated with the consumption of freshwater fish, and most of the fish are collected from waters requested by the public. Fish sampling was performed at four sites in 2020 at the recommendation of the Inter-agency Fish Toxics Committee (Table 1). Edible fillets from fish collected at all four waterbodies were analyzed for the presence of mercury, arsenic, cadmium, and selenium. Samples from Bush Pond were also analyzed for PCB and organochlorine pesticides. If necessary, fish consumption advisories will be issued by DPH.

**Table 1.** 2020 fish toxics monitoring sites.

| Watershed | Waterbody (Municipality) | Analytes |
|---|---|---|
| Housatonic | Plunkett Reservoir (Hinsdale) | Hg, As, Cd, Se |
| Housatonic | Ashmere Lake (Hinsdale) | Hg, As, Cd, Se |
| Charles | Bush Pond (Norfolk) | Hg, As, Cd, Se, PCB arochlors, organochlorine pesticides, % lipids |
| Islands | Hummock Pond (Nantucket) | Hg, As, Cd, Se |

**Lake Monitoring in the Mystic River Watershed:** In collaboration with the USEPA, the WPP established a monitoring program in 2019 at three nutrient-impaired lakes in the Mystic River Watershed to provide a more recent assessment of their designated use support status (i.e., *Aquatic Life, Recreational,* and *Aesthetic* uses) and to support the calibration of a Lake Loading Response Model (LLRM) as a step toward developing phosphorus TMDLs for these ponds. Horn Pond (Woburn), Spy Pond (Arlington) and Wedge Pond (Winchester) were originally scheduled to be sampled in 2020 but the surveys were postponed due to the Covid-19 pandemic. The work carried out in 2020 was a bathymetry survey of each pond. It is anticipated that water quality monitoring will resume at these three ponds in 2021.

**Monitoring the Effects on Water Quality of Road-Salt Application:** WPP continued to monitor seasonal chloride levels in selected waters at risk of contamination by chlorides originating from road salt application. Continuous conductivity loggers were deployed at twelve sites in the upper Blackstone River Watershed from November/December 2019 through September 2020 (Table 2). This monitoring also included the collection of chloride grab samples to continue to verify and fine-tune (as needed) the accuracy of the specific conductance-chloride regression model developed by WPP. Chloride data will also be used for assessment and may, in the future, support the development of TMDLs for waters impaired by chlorides.

**Table 2.** 2020 chloride and conductivity monitoring sites.

| Site ID | Waterbody Name (Municipality) | Latitude | Longitude |
|---|---|---|---|
| Bla01 | Weasel Brook (Worcester) | 42.30797 | -71.80025 |
| Bla02 | Poor Farm Brook (Worcester) | 42.30648 | -71.76585 |
| Bla03 | Big Bummet Brook (Grafton) | 42.23671 | -71.70492 |
| Bla04 | Quinsigamond River (Grafton) | 42.20836 | -71.69757 |
| Bla05 | Blackstone River (Grafton) | 42.17691 | -71.68828 |
| Bla06 | Cold Spring Brook (Sutton) | 42.17551 | -71.72817 |
| Bla07 | Singletary Brook (Millbury) | 42.18283 | -71.76597 |
| Bla08 | Unnamed tributary to Indian Lake (Worcester) | 42.30793 | -71.81955 |
| Bla09 | Dark Brook I – Southeast (Auburn) | 42.20398 | -71.83572 |
| Bla10 | Unnamed tributary to Dark Brook (Auburn) | 42.19019 | -71.84583 |
| Bla11 | Dark Brook II - Northwest (Auburn) | 42.20659 | -71.85269 |
| Bla12 | Tatnuck Brook (Worcester) | 42.26230 | -71.84823 |

**Participation in the Northeast Regional Monitoring Network (RMN):** In collaboration with its regional offices, states, tribes, and other entities, the USEPA has established Regional Monitoring Networks (RMNs). The goal of the RMNs is to help EPA and their partners collect current, baseline biological, thermal, and hydrologic data from freshwater wadeable streams. Over time, these data can help facilitate a better understanding of relationships between biological, thermal, and hydrologic data, ecosystem responses and recovery from extreme weather events, and effects of climate change and regional phenomena such as drought and pollutant/nutrient deposition on aquatic ecosystems.

As part of the Northeast RMN, MassDEP has established five sites in Massachusetts which have been designated for long-term monitoring for temperature regimes, flow characteristics, and stream macroinvertebrate communities (Table 3). Since 2012 MassDEP has been collecting air and water time-series temperature data, as well as annual macroinvertebrate kick-samples. Time-series streamflow data are obtained from Brown's and Parkers brooks by the Massachusetts Division of Ecological Restoration. Flow data are available for the other three streams from USGS gages located at or near the RMN sampling sites.

**Table 3.** Northeast Regional Monitoring Network (RMN) sites in Massachusetts

| Site ID | Watershed | Waterbody | Description | Latitude | Longitude |
|---|---|---|---|---|---|
| CR01ACC | Deerfield | Cold River | Approximately 70 meters upstream/north of South County Road, Florida. | 42.6669 | -73.0302 |
| HRCC | Farmington | Hubbard Brook | Approximately 245 meters upstream/northwest of West Hartland Road, Granville. | 42.0654 | -72.9675 |
| BB01CC | Quinebaug | Browns Brook | Approximately 645 meters upstream from May Brook Road, Holland | 42.0348 | -72.1616 |
| WSR01CC | Chicopee | West Branch Swift River | Approximately 195 meters upstream from Cooleyville Road Extension, Shutesbury | 42.4647 | -72.3845 |

**Table 3.** Northeast Regional Monitoring Network (RMN) sites in Massachusetts

| Site ID | Watershed | Waterbody | Description | Latitude | Longitude |
|---|---|---|---|---|---|
| PBCC | Chicopee | Unnamed, known as Parkers Brook | Approximately 160 meters west (downstream) of Coldbrook Road, Oakham (due south of Route 122) | 42.3943 | -72.0492 |

**Field and Lab Support for the Assessment and Management of Cyanobacteria Blooms:** MassDEP provided technical expertise and laboratory support for the investigation of potentially toxic algae (cyanobacteria) blooms. Staff biologists performed cyanobacteria counts and identifications on water samples to determine whether cell counts exceeded MassDPH advisory levels for recreational waters. Only two waterbodies were investigated in 2020 (see Table 4).

**Table 4.** Waterbodies for which MassDEP staff performed cyanobacteria cell counts (C) and taxonomic identifications (ID) in 2020.

| Waterbody | Municipality | Number of sampling events | Sample Processing |
|---|---|---|---|
| East Monponsett Pond | Halifax/Hanson | 9 | C, ID |
| West Monponsett Pond | Halifax/Hanson | 2 | C, ID |

**Assessment Monitoring of the Merrimack River Mainstem and Tidal Reaches:** Working collaboratively with MassDEP, the USGS performed water quality surveys of the mainstem and tidal reaches of the Merrimack River in Massachusetts to fill data gaps and support water quality assessment and management decision-making. Data will be used to complete updated assessments for four freshwater and two tidal river assessment units (AU) and to evaluate locations in the Merrimack River estuary for potential longer-term seasonal deployment of continuous water quality monitoring equipment. Water samples were collected monthly from May through September at 13 monitoring sites and analyzed for nutrients and chlorophyll-a. During each sampling event, vertical profile data were obtained at 0.5 m increments at each site using multiprobe sensors that recorded depth, temperature, pH, specific conductance, dissolved oxygen, turbidity, salinity and chlorophyll relative fluorescence. Finally, sensor arrays were deployed for two separate one-month intervals at ten of the monitoring sites. Sensors were configured to measure dissolved oxygen and temperature near the surface and bottom at 15-minute intervals. Sampling site locations and variables measured for this monitoring effort are summarized in tables 5 and 6, respectively.

**Table 5.** Description of sites and corresponding assessment units (AU) surveyed as part of the MassDEP/USGS collaborative monitoring program for the mainstem and tidal reaches of the Merrimack River in Massachusetts.

| USGS ID | Site Description | MassDEP AU |
|---|---|---|
| 010965305 | Merrimack River near Tyngsborough Bridge, Tyngsborough | MA84A-01 |
| 01096568 | Merrimack River at Lowell Motor Boat Club, Lowell | MA84A-01 |
| 010965985 | Merrimack River near Aiken Street Bridge, Lowell | MA84A-02 |
| 01100220 | Merrimack River near power lines, Methuen | MA84A-03 |
| 01100475 | Merrimack River at Bashara Boat House, Lawrence | MA84A-03 |
| 01100671 | Merrimack River downstream Stanley Island, Haverhill | MA84A-04 |

**Table 5.** Description of sites and corresponding assessment units (AU) surveyed as part of the MassDEP/USGS collaborative monitoring program for the mainstem and tidal reaches of the Merrimack River in Massachusetts.

| | | |
|---|---|---|
| 01100806 | Merrimack River near power lines, Merrimac | MA84A-05 |
| 01100823 | Merrimack River at Goodwin Creek Marina, Amesbury | MA84A-06 |
| 01100871 | Merrimack River at Bridge Marina, Salisbury | MA84A-06 |
| 01100873 | Merrimack River estuary near Buoy 16, Newburyport | MA84A-06 |
| 01100874 | Merrimack River estuary near Lunt Rock, Salisbury* | MA84A-06 |
| 01100875 | Merrimack River estuary near Salisbury Beach State Park* | MA84A-06 |
| 01100877 | Merrimack River estuary near Plum Island, Newburyport* | MA84A-06 |

*****Continuous temperature and dissolved oxygen sensor arrays were not deployed at these sites.

**Table 6.** Sampling frequency of water quality variables measured as part of the MassDEP/USGS collaborative monitoring program for the mainstem and tidal reaches of the Merrimack River in Massachusetts.

| Sample Type | Variable | Sample Frequency |
|---|---|---|
| Discrete | Vertical depth profiles (sensor depth, temperature, pH, specific conductance, dissolved oxygen, turbidity, salinity and chlorophyll relative fluorescence) | Monthly (May - September) |
| | Nutrients [Ammonia-nitrogen, Nitrate+Nitrite nitrogen, Nitrite-nitrogen, Total particulate nitrogen, Total nitrogen (filtered), Total phosphorus (filtered and unfiltered), Orthophosphate] | Monthly (May - September) |
| | Total particulate carbon | Monthly (May - September) |
| | Chlorophyll a | Monthly (May - September) |
| One-month Continuous (surface and bottom) | Dissolved oxygen | Twice |
| | Temperature | Twice |
| | Barometric pressure (estuarine sites) | Twice |
| | Specific conductance | Twice |

**Monitoring to Estimate Contaminant Loadings:** Massachusetts' long-term monitoring strategy identifies, as one of its key monitoring objectives, monitoring to support the development, implementation and evaluation of pollution control strategies, and indicates that "limited fixed-site monitoring may be required to quantify pollutant loadings." In 2017-2018 the USGS installed a flow monitoring station in the Connecticut River near Northfield, MA (USGS Station 01161280) and initiated weekly water-quality sampling to provide data for the estimation of nutrient loads entering Massachusetts from upstream sources. In addition, the water-quality sampling frequency was increased to weekly at the USGS monitoring station in the Connecticut River at Thompsonville CT (USGS Station 01184000) to refine estimates of nutrient loads leaving Massachusetts. Funded collaboratively by the Springfield Water and Sewer Commission, MassDEP, and USGS, this monitoring study will increase understanding of the nutrient contributions from Massachusetts to Long Island Sound. Additionally, since 2018, MassDEP has been collaborating with USGS and funding water-quality sampling at existing USGS flow gage stations located near the confluence of each of the Deerfield, Millers, Chicopee and Westfield rivers with the Connecticut River. Monitoring these locations will assist in prioritizing areas for nitrogen load reductions and making informed nutrient management decisions.

MassDEP has also been collaborating with USGS and funding water-quality sampling in the Taunton River Watershed (at existing USGS flow gage stations in the Taunton, Threemile, Mill, and Segreganset rivers) to quantify nutrient loadings to the lower Taunton River and Mount Hope Bay (see **Monitoring Water Quality in Mount Hope Bay** below). Finally, plans are in development to initiate a sampling network in 2021 to estimate contaminant loadings in the Merrimack River Watershed to inform updated water quality assessments and to support future calibration and verification of simulation models to be used in TMDL development.

**Monitoring Water Quality in Mount Hope Bay:** MassDEP maintains two YSI marine water quality monitoring buoys in the Massachusetts portion of Mount Hope Bay (MHB) that are part of the more extensive Narragansett Bay Fixed-Site Monitoring Network (NBFSMN) currently administered by the Rhode Island Department of Environmental Management (RIDEM) and the University of Rhode Island Graduate School of Oceanography (URI). Data from the MHB buoys are helping to define ambient water quality conditions for dissolved oxygen, nitrate-nitrogen, algal abundance, temperature, and other parameters. Specifically, the data may be used to assess trends over time, identify impaired waters, assess the effectiveness of management decisions (i.e., wastewater treatment facilities (WWTF) upgrades, TMDL efforts, and stormwater management), and support refinement, calibration, and validation of water quality models. During the deployment of the buoys (May-November) grab water samples were collected for chemical analysis every two weeks at each buoy location within one meter of the deployed sensors. Instantaneous grab sample data will be compared to corresponding sensor data to validate the accuracy of sensor measurements. MassDEP's long-term plan for the buoys is to continue collecting continuous, real-time data seasonally in coastal systems to address data gaps and aid management decisions.

**Massachusetts Coastal Condition Assessment (MCCA):** The EPA encourages states to adopt networks of randomly selected sampling sites that will allow for statistically unbiased assessments that can be applied at larger scales (e.g., statewide). During 2011 – 2015 the WPP surface water monitoring program carried out probabilistic monitoring and assessment surveys of Massachusetts' shallow streams. This was followed by a statistically-valid (probabilistic) sampling program for Massachusetts' lakes and ponds from 2016 – 2018. In 2019, a probabilistic monitoring network was designed with the overall goal of providing an unbiased assessment of the condition of Massachusetts coastal and estuarine waters. Known as the Massachusetts Coastal Condition Assessment, or MCCA, this network was designed to obtain the data needed to assess a waterbody's level of attainment of a single designated use: "suitable habitat for Fish, other Aquatic Life and Wildlife" (i.e., Aquatic Life). The random sampling design allows for the determination, with a known statistical confidence, of the percentage of coastal waters that are supporting and not supporting this use. Additionally, the MCCA will establish a baseline to measure trends in conditions through future surveys.

The MCCA is administered collaboratively by the Massachusetts Department of Environmental Protection (MassDEP) and the Massachusetts Bays National Estuary Partnership (MassBays). MassBays serves as the field project lead to manage the collection and analysis of field samples and data for the MCCA. A total of 90 coastal and estuarine sites will be monitored from 2020 – 2023.

Field surveys began in 2020 with a pilot study consisting of 15 sampling sites (Table 7). A contractor was selected to perform sample collection and record ambient data at each site once per month from June through September. During each sampling event field crews recorded ambient environment conditions, collected water column profile data, and collected water samples from each site. Sediment samples for chemical analyses and the assessment of the

benthic infauna community were collected once at each site. The presence/absence of eelgrass was surveyed once in July at all 15 stations. Water quality and ecological variables measured at each MCCA monitoring site are listed along with their sampling frequencies in Table 8.

**Table 7.** Location of coastal and estuarine sampling sites included in the 2020 MCCA Pilot Study. Ctrl+Click on the Site ID to follow link to site map.

| Site ID | General Location | Latitude | Longitude |
|---|---|---|---|
| MAP2E-015 | Nahant Bay | 42.445780 | -70.930086 |
| MAP2E-019 | Salem Sound | 42.532229 | -70.795811 |
| MAP2E-023 | Nahant Bay | 42.433383 | -70.909717 |
| MAP2E-028 | Magnolia Point | 42.572127 | -70.712727 |
| MAP2E-030 | Salem Sound | 42.535147 | -70.894588 |
| MAP2E-093 | Plymouth Bay | 41.936000 | -70.550864 |
| MAP2E-097 | Plymouth Bay | 41.946614 | -70.609555 |
| MAP2E-101 | Plymouth Bay | 41.980740 | -70.605467 |
| MAP2E-105 | Duxbury Bay | 42.039644 | -70.649977 |
| MAP2E-113 | Plymouth Bay | 42.000959 | -70.616377 |
| MAP2E-186 | Wild Harbor | 41.637399 | -70.650415 |
| MAP2E-190 | Sippican Harbor | 41.668567 | -70.728566 |
| MAP2E-194 | Wareham River | 41.741721 | -70.701577 |
| MAP2E-202 | Phinney Harbor | 41.709491 | -70.629730 |
| MAP2E-206 | Aucoot Cove | 41.672874 | -70.758260 |

**Table 8.** Sampling frequency of water quality and ecological variables measured at each of fifteen coastal and estuarine sites during the 2020 MCCA Pilot Study.

| Medium | Variable | Sample Frequency |
|---|---|---|
| Water | Vertical profile (Temperature, Salinity, Dissolved oxygen, pH, Turbidity) | Monthly (June, July, August) |
| | Light attenuation/PAR | Monthly (June, July, August) |
| | Water clarity/Secchi depth | Monthly (June, July, August) |
| | Nutrients (Total phosphorus, Orthophosphate, Total nitrogen, Dissolved inorganic nitrogen, Total Kjeldahl nitrogen) | Monthly (June, July, August) |
| | Chlorophyll a | Monthly (June, July, August) |
| Sediment | Grain size | Once (July) |
| | Total organic carbon | Once (July) |
| | Chemistry (metals, mercury, PAHs, PCBs, organochlorine pesticides) | Once (July) |
| | Toxicity (estuarine amphipod, *Leptocheirus plumulosus)* | Once (July) |
| Biological | Benthic macroinvertebrates | Once (August) |
| | Submerged aquatic vegetation | Once (July) |

**Pleasant Bay TMDL Effectiveness Monitoring Study:** MassDEP retained a contractor to carry out benthic invertebrate sampling in Pleasant Bay (Brewster/Chatham/Harwich/Orleans) in September 2020 as part of a post-TMDL assessment of the ecological health of the bay. The data will be used to re-evaluate habitat conditions after TMDL implementation activities including wastewater treatment system upgrades and sewer system construction which resulted in the reduction of nitrogen loading in the watershed. The monitoring study was designed to verify that the 2018 Marine Benthic Monitoring Guidance documents developed by MassDEP will produce quality benthic data that 1) will allow coastal communities to assess current embayment health, 2) are comparable between assessments and embayments, and 3) will aid in future management decisions. The sampling plan included 34 benthic grab sampling locations, sediment grain size analysis, total organic carbon, digital video and photographs of the bottom, and water quality measurement profiles (water temperature, DO, salinity, and pH).

**PFAS Sampling in Rivers and Streams in Massachusetts:** Through a joint-funded project with MassDEP, USGS performed water sampling for the analysis of twenty-four (24) individual per- and polyfluoroalkyl substances (PFAS) at 64 river sites in Massachusetts. Samples were collected upstream and downstream from the effluent discharges of 25 municipal or institutional wastewater treatment facilities and from 15 additional stream locations, including sites downstream of industrial or populated areas, as well as sites in less developed watersheds where sources of PFAS were unlikely to be present. To minimize the potential effects from stormwater runoff, sample collection targeted base-flow (dry-weather, low-flow) conditions. The study comprised three rounds of sample collection yielding approximately 192 environmental samples and 50 QC samples (blanks and replicates). Monitoring sites are presented in Appendix C.

## Summary

This document presents a brief overview of the surface water monitoring performed by the WPP in 2020. Several laboratories and contractors process and analyze the water and biological samples collected. The WPP will continue to work with these laboratories to receive the data and complete a rigorous data validation process to ensure that the prescribed data quality objectives are met. Final data will be published on MassDEP's website. Planning is currently underway for monitoring in 2021.

## Appendices

**Appendix A.** This table presents the 71 stream sites sampled in 2020 by personnel of MassDEP's Watershed Planning Program in an effort to expand the dataset on macroinvertebrate communities occurring at highly disturbed streams in the "Western Highlands" region of Massachusetts. Ctrl+Click on the Site ID to follow link to site map.

| Site ID | Waterbody Name | Watershed | Town | Latitude | Longitude |
|---|---|---|---|---|---|
| WH006 | MBr. Westfield River | Westfield | Huntington | 42.25952 | -72.87692 |
| WH007 | Kinderhook Creek | Hudson | Hancock | 42.53896 | -73.33335 |
| WH014 | NBr. Manhan River | Connecticut | Westhampton | 42.29980 | -72.74344 |
| WH017 | Town Brook | Housatonic | Lanesborough | 42.52846 | -73.23374 |
| WH019 | Wahconah Falls Brook | Housatonic | Dalton | 42.48544 | -73.13995 |
| WH020 | Wahconah Falls Brook | Housatonic | Dalton | 42.48612 | -73.13700 |
| WH021 | Daniels Brook | Housatonic | Pittsfield | 42.49002 | -73.27497 |
| WH022 | Wahconah Falls Brook | Housatonic | Dalton | 42.48481 | -73.14801 |
| WH024 | Onota Brook | Housatonic | Pittsfield | 42.46445 | -73.25494 |
| WH025 | EBr. Housatonic River | Housatonic | Pittsfield | 42.46801 | -73.20036 |
| WH026 | EBR. Housatonic River | Housatonic | Dalton | 42.46874 | -73.18213 |
| WH027 | Barton Brook | Housatonic | Pittsfield | 42.46355 | -73.19819 |
| WH032 | SWBr. Housatonic River | Housatonic | Pittsfield | 42.44115 | -73.29898 |
| WH033 | Jacoby Brook | Housatonic | Pittsfield | 42.43969 | -73.30244 |
| WH034 | SWBr. Housatonic River | Housatonic | Pittsfield | 42.43973 | -73.29343 |
| WH035 | WBr. Housatonic River | Housatonic | Pittsfield | 42.44614 | -73.26206 |
| WH036 | WBr. Housatonic River | Housatonic | Pittsfield | 42.45148 | -73.26239 |
| WH037 | WBr. Housatonic River | Housatonic | Pittsfield | 42.44115 | -73.26013 |
| WH038 | SWBr. Housatonic River | Housatonic | Pittsfield | 42.44013 | -73.27120 |
| WH039 | SWBr. Housatonic River | Housatonic | Pittsfield | 42.44177 | -73.27824 |
| WH040 | SWBr. Housatonic River | Housatonic | Pittsfield | 42.43478 | -73.30530 |
| WH047 | Cone Brook | Housatonic | West Stockbridge | 42.34831 | -73.36513 |
| WH049 | Larrywaug Brook | Housatonic | Stockbridge | 42.31372 | -73.33185 |
| WH050 | Goose Pond Brook | Housatonic | Lee | 42.29402 | -73.23964 |
| WH056 | Green River | Housatonic | Great Barrington | 42.19072 | -73.39965 |
| WH057 | Green River | Housatonic | Great Barrington | 42.17855 | -73.37814 |
| WH058 | Green River | Housatonic | Great Barrington | 42.16376 | -73.36525 |
| WH061 | Konkapot River | Housatonic | Sheffield | 42.05408 | -73.33427 |
| WH064 | Konkapot River | Housatonic | New Marlborough | 42.07602 | -73.28281 |
| WH065 | WBr. Housatonic River | Housatonic | Pittsfield | 42.46396 | -73.25323 |
| WH066 | WBr. Housatonic River | Housatonic | Pittsfield | 42.46668 | -73.25056 |
| WH067 | WBr. Housatonic River | Housatonic | Pittsfield | 42.46930 | -73.24925 |
| WH068 | WBr. Housatonic River | Housatonic | Pittsfield | 42.47441 | -73.24602 |
| WH069 | WBr. Housatonic River | Housatonic | Pittsfield | 42.48250 | -73.24689 |
| WH070 | EBr. Housatonic River | Housatonic | Pittsfield | 42.43706 | -73.24775 |

**Appendix A.** This table presents the 71 stream sites sampled in 2020 by personnel of MassDEP's Watershed Planning Program in an effort to expand the dataset on macroinvertebrate communities occurring at highly disturbed streams in the "Western Highlands" region of Massachusetts. Ctrl+Click on the Site ID to follow link to site map.

| Site ID | Waterbody Name | Watershed | Town | Latitude | Longitude |
|---|---|---|---|---|---|
| WH071 | EBr. Housatonic River | Housatonic | Pittsfield | 42.44077 | -73.24808 |
| WH072 | EBr. Housatonic River | Housatonic | Pittsfield | 42.44270 | -73.24646 |
| WH077 | Housatonic River | Housatonic | Lee | 42.31370 | -73.24689 |
| WH078 | Housatonic River | Housatonic | Lee | 42.32296 | -73.24216 |
| WH079 | Housatonic River | Housatonic | Lee | 42.29378 | -73.24161 |
| WH080 | Housatonic River | Housatonic | Lee | 42.30338 | -73.25068 |
| WH081 | Housatonic River | Housatonic | Lee | 42.28337 | -73.24086 |
| WH082 | Willow Brook | Housatonic | Lee | 42.28337 | -73.24729 |
| WH084 | Seekonk Brook | Housatonic | Great Barrington | 42.21348 | -73.39197 |
| WH088 | Onota Brook | Housatonic | Pittsfield | 42.46968 | -73.25650 |
| WH089 | SWBr. Housatonic River | Housatonic | Pittsfield | 42.43994 | -73.28895 |
| WH091 | Glen Brook | Deerfield | Leyden | 42.67868 | -72.62892 |
| WH093 | Hinsdale Brook | Deerfield | Shelburne | 42.63169 | -72.65607 |
| WH095 | Clesson Brook | Deerfield | Buckland | 42.60170 | -72.77793 |
| WH096 | Dragon Brook | Deerfield | Shelburne | 42.57791 | -72.68462 |
| WH097 | UBr. Clesson Brook | Deerfield | Ashfield | 42.55487 | -72.80962 |
| WH098 | South River | Deerfield | Ashfield | 42.51072 | -72.77398 |
| WH100 | South River | Deerfield | Conway | 42.51623 | -72.74638 |
| WH103 | Hemlock Brook | Hudson | Williamstown | 42.72550 | -73.20740 |
| WH104 | Hoosic River | Hudson | Williamstown | 42.72871 | -73.20692 |
| WH105 | Hoosic River | Hudson | Williamstown | 42.73027 | -73.21564 |
| WH106 | Hemlock Brook | Hudson | Williamstown | 42.71939 | -73.20967 |
| WH109 | Hoosic River | Hudson | North Adams | 42.70404 | -73.17363 |
| WH110 | Hoosic River | Hudson | North Adams | 42.69984 | -73.16141 |
| WH111 | Paull Brook | Hudson | Williamstown | 42.70385 | -73.17689 |
| WH112 | Green River | Hudson | Williamstown | 42.67436 | -73.23235 |
| WH113 | WBr. Green River | Hudson | Williamstown | 42.66013 | -73.24149 |
| WH115 | Hoosic River | Hudson | Adams | 42.63996 | -73.10859 |
| WH119 | Green River | Hudson | Williamstown | 42.71029 | -73.19413 |
| WH120 | Green River | Hudson | Williamstown | 42.70560 | -73.19925 |
| WH121 | Green River | Hudson | Williamstown | 42.69107 | -73.20127 |
| WH122 | Hoosic River | Hudson | North Adams | 42.70298 | -73.12374 |
| WH123 | Sweet Brook | Hudson | Williamstown | 42.68585 | -73.23118 |
| WH124 | Unnamed Tributary | Hudson | Adams | 42.60745 | -73.12563 |
| WH125 | EBr. Housatonic River | Housatonic | Hinsdale | 42.44764 | -73.13050 |
| WH200 | Hoosic River | Hudson | North Adams | 42.69678 | -73.14003 |

**Appendix B.** This table presents the 61 stream sites sampled in 2020 by personnel of MassDEP's Watershed Planning Program in an effort to verify cold water fisheries (CWF) for designation in the Massachusetts Surface Water Quality Standards (SWQS).

| Waterbody Name | Watershed | Latitude | Longitude |
|---|---|---|---|
| Fox Brook | Blackstone | 42.02820 | -71.54040 |
| Round Top Brook | Blackstone | 42.00792 | -71.70506 |
| Emerson Brook | Blackstone | 42.04626 | -71.63013 |
| Rock Meadow Brook | Blackstone | 42.09246 | -71.59144 |
| Miscoe Brook (1) | Blackstone | 42.12288 | -71.59914 |
| Miscoe Brook (2) | Blackstone | 42.22538 | -71.65267 |
| Steamburg Brook | Blackstone | 42.10853 | -71.69456 |
| UNT to Wellman Brook | Blackstone | 42.07256 | -71.70276 |
| Axtell Brook | Blackstone | 42.22356 | -71.68764 |
| Coal Mine Brook | Blackstone | 42.29070 | -71.76730 |
| Poor Farm Brook | Blackstone | 42.30650 | -71.76600 |
| Sewall Brook | Blackstone | 42.32472 | -71.74141 |
| Tatnuck Brook | Blackstone | 42.26072 | -71.84794 |
| Silver Spring Brook | Blackstone | 42.30550 | -71.87770 |
| Mill Brook | Boston Harbor | 42.18920 | -71.24016 |
| Purgatory Brook | Boston Harbor | 42.20928 | -71.18480 |
| Dix Brook | Charles | 42.06030 | -71.42140 |
| Seaverns Brook | Charles | 42.34154 | -71.26663 |
| Cherry Brook | Charles | 42.38896 | -71.29708 |
| Fuller Brook | Chicopee | 42.16320 | -72.53470 |
| UNT to Higher Brook | Chicopee | 42.18858 | -72.45233 |
| Broad Brook (2) | Chicopee | 42.21049 | -72.40260 |
| Blodgett Mill Brook | Chicopee | 42.17390 | -72.25330 |
| O'Neil Brook | Chicopee | 42.22285 | -72.22523 |
| Meadow Brook | Chicopee | 42.28937 | -72.12806 |
| Sucker Brook (2) | Chicopee | 42.29793 | -72.11710 |
| Sevenmile River | Chicopee | 42.26514 | -72.00530 |
| Cranberry River | Chicopee | 42.21653 | -72.00015 |
| Turkey Hill Brook | Chicopee | 42.27080 | -71.98280 |
| Fivemile River | Chicopee | 42.33886 | -72.03408 |
| Maynard Brook | Chicopee | 42.33175 | -72.05032 |
| Murdock Brook | Chicopee | 42.21659 | -72.37554 |
| Chaffee Brook | Chicopee | 42.33666 | -72.36874 |
| UNT to Quabbin (Dickey Brook) | Chicopee | 42.44412 | -72.37156 |
| Prescott Brook | Chicopee | 42.36452 | -72.32489 |
| Giles Brook | Chicopee | 42.50354 | -72.31803 |

**Appendix B.** This table presents the 61 stream sites sampled in 2020 by personnel of MassDEP's Watershed Planning Program in an effort to verify cold water fisheries (CWF) for designation in the Massachusetts Surface Water Quality Standards (SWQS).

| | | | |
|---|---|---|---|
| Manning Brook | Chicopee | 42.51855 | -72.31728 |
| East Branch Swift River | Chicopee | 42.43775 | -72.20826 |
| UNT to East Branch Swift River (McManus Brook) | Chicopee | 42.45200 | -72.16650 |
| Muddy Brook | Chicopee | 42.35630 | -72.23090 |
| Danforth Brook (2) | Chicopee | 42.31551 | -72.20667 |
| Fish Brook | Chicopee | 42.31604 | -72.18082 |
| Moose Brook | Chicopee | 42.41375 | -72.14289 |
| Pratt Brook | Chicopee | 42.37749 | -72.10762 |
| Burrow Brook | Chicopee | 42.37476 | -72.08738 |
| Natty Pond Brook | Chicopee | 42.45145 | -72.02946 |
| East Branch Ware River | Chicopee | 42.41615 | -72.00791 |
| UNT to East Branch Ware River | Chicopee | 42.44674 | -71.93977 |
| Run Brook | Concord | 42.38603 | -71.43967 |
| Dugan Brook | Concord | 42.44790 | -71.37850 |
| Wickett Brook | Millers | 42.55699 | -72.42509 |
| Shingle Swamp Brook | Millers | 42.55640 | -72.30080 |
| Lawrence Brook | Millers | 42.68350 | -72.17190 |
| Rich Brook | Millers | 42.62957 | -72.16371 |
| Thousand Acre Brook | Millers | 42.60698 | -72.16342 |
| Chickering Brook | Millers | 42.55493 | -72.12750 |
| Bailey Brook | Millers | 42.58925 | -72.03684 |
| Asnebumskit Brook | Nashua | 42.35240 | -71.89120 |
| Pearl Hill Brook | Nashua | 42.58519 | -71.77108 |
| Baker Brook | Nashua | 42.56351 | -71.76140 |
| Catacoonamug Brook | Nashua | 42.56710 | -71.69660 |

**Appendix C.** This table presents the 64 stream sites sampled in 2020 by USGS for the analysis of twenty-four (24) individual per- and polyfluoroalkyl substances (PFAS). Forty-eight sites were upstream (US) and downstream (DS) from the effluent discharges of 25 municipal or institutional wastewater treatment facilities. The remaining 15 stream locations were downstream of industrial or populated areas, or in less developed watersheds where sources of PFAS were unlikely to occur.

| Site Description | Latitude | Longitude | Notes |
|---|---|---|---|
| NASHUA RIVER NEAR AYER, MA | 42.578192 | -71.609675 | DS Ayer WWTP |
| NASHUA RIVER NEAR MCPHERSON ROAD, SHIRLEY, MA | 42.555192 | -71.611008 | US Ayer WWTP |
| CONCORD RIVER AT LOWELL, MA | 42.627758 | -71.298014 | DS Billerica WWTP |
| CONCORD R POLLAND ST | 42.585019 | -71.287164 | US Billerica WWTP |
| BLACKSTONE RIVER NEAR MILLBURY, MA | 42.207148 | -71.781649 | DS UBWPAD[1] |
| BLACKSTONE RIVER RT 146 AT WORCESTER, MA | 42.227852 | -71.787653 | US UBWPAD[1] |
| TOWN RIVER AT HAYWARD ST NEAR BRIDGEWATER, MA | 41.997539 | -70.953676 | DS Bridgewater WWTP |
| TOWN RIVER AT BRIDGEWATER, MA | 41.996954 | -70.972360 | US Bridgewater WWTP |
| SALISBURY PLAIN R NR MATFIELD ST E BRIDGEWATER, MA | 42.038123 | -70.983998 | US Brockton WWTP |
| SALISBURY PLAIN R AT SARGENT'S WAY, BROCKTON, MA | 42.053631 | -71.009803 | DS Brockton WWTP |
| CHARLES RIVER NEAR MILLIS, MA | 42.133426 | -71.362015 | DS CRPCD[2] |
| CHARLES RIVER AT MEDWAY, MA | 42.139862 | -71.389883 | US CRPCD[2] |
| NASHUA RIVER AT ROUTE 110, CLINTON, MA | 42.432696 | -71.680058 | DS MWRA-Clinton WWTP |
| NASHUA RIVER 0.4 MI UPSTREAM RT 110 AT CLINTON, MA | 42.429702 | -71.679566 | US MWRA-Clinton WWTP |
| CONCORD R RT225 CARLISLE-BEDFORD, MA | 42.509168 | -71.314030 | DS Concord WWTP |
| CONCORD RIVER NEAR LOWELL ROAD, CONCORD, MA | 42.466479 | -71.355662 | US Concord WWTP |
| NORTH NASHUA RIVER AT NORTH LEOMINSTER, MA | 42.54155 | -71.746063 | DS East Fitchburg WWTP |
| NORTH NASHUA R NR LANDIES LN, E. FITCHBURG, MA | 42.549508 | -71.750858 | US East Fitchburg WWTP |
| HOUSATONIC RIVER AT NEW LENOX, MA | 42.39399 | -73.240415 | DS Pittsfield WWTF[3] |
| ASSABET RIVER AT ROUTE 62, HUDSON, MA | 42.404409 | -71.525970 | DS Hudson WWTP |
| ASSABET RIVER AT COX ST NEAR HUDSON, MA | 42.39981547 | -71.54589859 | US Hudson WWTP |
| MERRIMACK RIVER NEAR HAVERHILL, MA | 42.7704833 | -71.0869111 | DS GLSD[4] WWTP |
| MERRIMACK RIVER AT LAWRENCE, MA | 42.7048333 | -71.15313889 | US GLSD[4] WWTP |
| NORTH NASHUA RIVER AT LEOMINSTER, MA | 42.52592408 | -71.7367379 | DS Leominster WWTP |
| NORTH NASHUA RIVER AT MECHANIC ST, LEOMINSTER, MA | 42.51961667 | -71.72733889 | US Leominster WWTP |

**Appendix C.** This table presents the 64 stream sites sampled in 2020 by USGS for the analysis of twenty-four (24) individual per- and polyfluoroalkyl substances (PFAS). Forty-eight sites were upstream (US) and downstream (DS) from the effluent discharges of 25 municipal or institutional wastewater treatment facilities. The remaining 15 stream locations were downstream of industrial or populated areas, or in less developed watersheds where sources of PFAS were unlikely to occur.

| Site Description | Latitude | Longitude | Notes |
|---|---|---|---|
| MERRIMACK R AT ABE BASHARA BOAT HOUSE LAWRENCE, MA | 42.69291666 | -71.17661111 | DS Gr. Lowell WWTP |
| MERRIMACK RIVER BL CONCORD RIVER AT LOWELL, MA | 42.64592464 | -71.2983937 | US Gr. Lowell WWTP |
| SEWAGE BROOK NEAR MARLBOROUGH, MA | 42.350888 | -71.490878 | DS Marlborough Easterly WWTP |
| WARD BROOK NEAR MARLBOROUGH, MA | 42.35203856 | -71.4947859 | US Marlborough Easterly WWTP |
| ASSABET RIVER, DS MARLBOROUGH WWTP | 42.34520556 | -71.6142667 | DS Marlborough Westerly WWTP |
| ASSABET RIVER AT BOUNDARY ST. NR NORTHBOROUGH, MA | 42.3414824 | -71.6159002 | US Marlborough Westerly WWTP |
| ASSABET R POWDERMILL RD ACTON, MA | 42.440688 | -71.429196 | DS Maynard WWTP |
| ASSABET RIVER AT MAYNARD, MA | 42.432038 | -71.4497848 | US Maynard WWTP |
| SAWMILL BROOK AT ROUTE 28, BRIDGEWATER, MA | 41.948906 | -70.968574 | DS MCI Bridgewater |
| SAWMILL BROOK AT CONANT ST BRIDGEWATER, MA | 41.94901944 | -70.9683361 | US MCI Bridgewater |
| ASSABET RIVER AT RT 2 NEAR CONCORD, MA | 42.466253 | -71.390669 | DS MCI Concord |
| ASSABET RIVER AT MAIN ST NEAR CONCORD, MA | 42.456557 | -71.389955 | US MCI Concord |
| THREEMILE RIVER AT NORTON AVE, TAUNTON, MA | 41.933303 | -71.154267 | DS MFNRWD[5] WWTP |
| THREEMILE RIVER AT CRANE ST, TAUNTON, MA | 41.946758 | -71.160412 | US MFNRWD[5] WWTP |
| NEMASKET RIVER AT PLYMOUTH ST, MIDDLEBOROUGH, MA | 41.921878 | -70.923362 | DS Middleborough WWTP |
| NEMASKET R AT OLIVER MILL PARK, MIDDLEBOROUGH, MA | 41.907009 | -70.913628 | US Middleborough WWTP |
| CHARLES RIVER AT MELLON STREET, MILFORD, MA | 42.116912 | -71.501376 | DS Milford WWTP |
| CHARLES RIVER AT MILFORD SEWER PLANT, MILFORD, MA | 42.119908 | -71.507000 | US Milford WWTP |
| NASHUA RIVER DS PEPPERELL WWTF, PEPPERELL, MA | 42.67585556 | -71.55976389 | DS Pepperell WWTP |
| NASHUA RIVER US PEPPERELL WWTF, PEPPERELL, MA | 42.672973 | -71.563149 | US Pepperell WWTP |
| TAUNTON RIVER DS WWTF, TAUNTON, MA | 41.8715611 | -71.1025556 | DS Taunton WWTP |

**Appendix C.** This table presents the 64 stream sites sampled in 2020 by USGS for the analysis of twenty-four (24) individual per- and polyfluoroalkyl substances (PFAS). Forty-eight sites were upstream (US) and downstream (DS) from the effluent discharges of 25 municipal or institutional wastewater treatment facilities. The remaining 15 stream locations were downstream of industrial or populated areas, or in less developed watersheds where sources of PFAS were unlikely to occur.

| Site Description | Latitude | Longitude | Notes |
|---|---|---|---|
| TAUNTON RIVER US WWTF, TAUNTON, MA | 41.87751389 | -71.0934333 | US Taunton WWTP |
| ASSABET RIVER DS FROM WESTBOROUGH WTP AT ROUTE 9 | 42.2833333 | -71.6386111 | DS Westborough WWTP |
| ASSABET RIVER NEAR WESTBOROUGH, MA | 42.2795385 | -71.63812279 | US Westborough WWTP |
| BASHBISH BROOK NEAR MT. WASHINGTON, MA | 42.106819 | -73.482548 | -- |
| CHICOPEE RIVER AT INDIAN ORCHARD, MA | 42.160549 | -72.510558 | -- |
| COLD RIVER NEAR CHARLEMONT, MA | 42.636282 | -72.934349 | -- |
| DEERFIELD R, STILLWATER BR, AT WEST DEERFIELD, MA | 42.526753 | -72.632589 | -- |
| WEST BRANCH FARMINGTON RIVER NEAR NEW BOSTON, MA | 42.078861 | -73.072883 | -- |
| GREEN RIVER NEAR GREENFIELD, MA | 42.645778 | -72.619166 | -- |
| HOOSIC RIVER AT WILLIAMSTOWN, MA | 42.702957 | -73.167689 | -- |
| HOOSIC RIVER NEAR GROVE STREET, ADAMS, MA | 42.600574 | -73.138151 | -- |
| HOUSATONIC RIVER NEAR GREAT BARRINGTON, MA | 42.23191667 | -73.3546667 | -- |
| MILLERS RIVER AT BRIDGE STREET, MILLERS FALLS, MA | 42.580185 | -72.496861 | -- |
| SHAWSHEEN RIVER AT BRIDGE STREET NR TEWKSBURY, MA | 42.5946527 | -71.1952 | -- |
| STILLWATER RIVER AT WEST STERLING, MA | 42.44675787 | -71.818128 | -- |
| WARE RIVER NEAR PALMER, MA. | 42.20461944 | -72.3186111 | -- |
| WESTFIELD RIVER AT HUNTINGTON, MA | 42.2256454 | -72.8706533 | -- |
| WESTFIELD RIVER AT BRIDGE ST AT NORTH AGAWAM, MA | 42.09944444 | -72.6363056 | -- |

Notes:

[1]Upper Blackstone Pollution Abatement District

[2]Charles River Pollution Control District

[3]No upstream site for Pittsfield WWTP

[4]Greater Lawrence Sanitary District

[5]Mansfield/Foxborough/Norton Regional Wastewater District