**Sampling & Analysis Plan**

2020 Mystic Lakes Monitoring

CN# 524.0

May 2020



Massachusetts Department of Environmental Protection

Division of Watershed Management

Watershed Planning Program

8 New Bond Street

Worcester, MA

***NOTE: This draft sampling plan provides detail re: sampling locations, frequencies, analytes, etc. and is intended to augment WPP’s multi-year programmatic QAPP approved by EPA for 2020 through 2024. The contents mirror selected elements of WPP’s programmatic QAPP (i.e.,QA-R5 EPA Guidance). See the QAPP for relevant information not provided in this SAP.***

TITLE AND APPROVALS

*Sampling and Analysis Plan*

*2020 Mystic Lakes Monitoring*

*Prepared by*

Dahlia Tympanick

Massachusetts Department of Environmental Protection

Watershed Planning Program

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Barbara Kickham, MassDEP Date

Watershed Planning Program- TMDL Section

** \_\_\_\_\_\_5/8/2020\_\_\_\_\_\_

Dahlia Tympanick, MassDEP Date

Watershed Planning Program- Monitoring Coordinator

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Sue Flint, MassDEP Date

Watershed Planning Program- Quality Assurance

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Dan Boudreau, US EPA Date

OEME Chemistry Team Leader

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mark Voorhees, US EPA Date

OEP Lead

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tom Faber, US EPA Date

Technical Lead

**Table of Contents**

[Project Organization 4](#_Toc37766760)

[Project Definition and Background 4](#_Toc37766761)

[Project Description 5](#_Toc37766762)

[Sampling Process Design 5](#_Toc37766763)

[Non-Direct Measurements 12](#_Toc37766764)

[Literature Cited 13](#_Toc37766765)

**List of Tables**

[Table 1. Project Roles and Responsibilities related to monitoring and data use 4](#_Toc37766836)

[Table 2: Laboratory Methodology 6](#_Toc37766837)

[Table 3. 2020 Mystic Lakes Monitoring Sites 6](#_Toc37766838)

[Table 4. Project Schedule for 2020 Mystic Lakes Monitoring 10](#_Toc37766839)

[Table 5: Planned Sampling Schedule and Schedule of Sample Delivery to EPA Laboratory 10](#_Toc37766840)

[Table 6. External data sources used for the 2020 Mystic Lakes Monitoring 12](#_Toc37766841)

**List of Figures**

[Figure 1: 2020 Horn Pond Monitoring Site 7](#_Toc529972883)

[Figure 2: 2020 Wedge Pond Monitoring Site 8](#_Toc529972884)

[Figure 3: 2020 Spy Pond Monitoring Sites 9](#_Toc529972885)

Project Organization

The 2020 Mystic Mystic Lakes monitoring is conducted to provide the assessment of water quality at targeted lakes in the Mystic River Watershed. Data collection efforts will also be targeted towards creation of TMDLs for selected lakes by the United States Environmental Protection Agency (US EPA). The finalized monitoring data will be used by Watershed Planning Program (WPP) staff to assess the status of designated uses (*Aquatic Life Use, Recreational Use, Fish Consumption* and *Aesthetic Use)* within lakes to comply with Section 305(b) of the Clean Water Act (CWA) in the Integrated Report.

This Sampling and Analysis Plan (SAP) provides details of the monitoring plans for collecting data (i.e. water quality, chlorophyll-a, and dissolved oxygen profiles) at three lakes in the Mystic River Watershed. Specific descriptions of WPP staff roles and responsibilities for the 2020 monitoring are detailed in Table 1.

Table 1. Project Roles and Responsibilities related to monitoring and data use

| **Project Personnel** | **Responsibility** |
| --- | --- |
| 2020 Monitoring Coordinators  -Dahlia Tympanick (Lead) | Responsible for defining logistics for efficient monitoring, program implementation and generation of useable data at assigned sites using the procedures contained in WPP SOPs. |
| Water quality survey crews  -WPP TMDL staff  -WPP monitoring staff and seasonal employees | Responsible for the collection of samples and data at assigned lakes using the sample collection techniques and multi-probe use procedures contained in WPP SOPs. |
|
|
|
| Bathymetry survey crews  -Dahlia Tympanick (lead)  -WPP staff and seasonal employees | Responsible for generating bathymetry data using techniques and procedures contained in WPP SOPs. |
| WPP Laboratory (probes)  -Dahlia Tympanick (lead)  -Suzanne Flint (auxillary) | Responsible for calibration of multiprobes (dissolved oxygen, pH, conductivity). |
| WPP Laboratory (algal)  -Joan Beskenis (lead)  -WPP staff and seasonal employees | Responsible for the analysis of chlorophyll samples using procedures contained in WPP SOPs |
| WPP Laboratory (color and turbidity)  Dahlia Tympanick-WPP staff and seasonal employees | Responsible for the analysis of color and turbidity samples using techniques and procedures contained in WPP SOPs |
| EPA Laboratory  -Dan Boudreau  -Tom Faber | Responsible for sample coordination and analysis of nutrient samples. |

Project Definition and Background

The 2020 Mystic Lakes is year two of a minimum of 3 year project. The project focuses on obtaining water quality information to aid in both the determination of current trophic status and TMDL development especially calibration of the Lake Loading Response Model (LLRM) that the MassDEP plans to develop for these ponds. Additionally, a primary goal is to assess the status of designated uses (*Aquatic Life Use, Recreational Use, Aesthetic Use)* at sampled lakes.

Until the 2019 sampling last year for this project, Spy Pond (MA71040) had not been sampled by MassDEP since the 1980s. It is believed that the most recent sampling was in the early to mid 2000s (Durant 2007) which showed the sediments were a significant source (20-30%) of phosphorus loading to the pond. In 2004 this pond was treated with alum. Additionally, stormwater best management practices were installed in several areas north and west of the pond in 2001. Updated water quality sampling in the pond will provide for a more accurate picture of the pond’s current trophic status. Previous MassDEP sampling was conducted at two locations within Spy Pond at the northern basin’s deep hole and at the southern basin’s deep hole. Horn Pond and Wedge Pond had not been sampled by MassDEP since 2004. Additional sampling at the Mystic ponds will allow for a better calibration of a Lake Loading Response Model to be developed for these waterbodies.

The types of data that will be collected at each of the sites to reach this goal are:

* Vertical profile (dissolved oxygen, temperature, pH, conductivity)
* Secchi disk transparency
* Nutrients (Total Nitrogen, Total Phosphorus, True Color, Turbidity)
* Chlorophyll a (Depth Integrated)
* Aesthetics observations
* Human disturbance observations
* Bathymetry

Project Description

**Overview of Mystic Lakes Monitoring in 2020**

*Index Site - Water Quality (Chemical, Biological and Physical)*

Water quality (vertical DO/temperature/pH/conductivity profile, nutrients, chlorophyll a, true color and turbidity) samples will be collected approximately once a month between June and October (5 sampling events) at the index site of each lake using techniques described in WPP standard operating procedures (SOP, CN 151.0, CN 59.6). Vertical profiles at each lake will provide information on stratification and lake dynamics in each lake. The index site is located at the maximum depth point (“deep hole”) in each lake. Samples will be field-preserved, as appropriate, and delivered to the EPA Laboratory in Chelmsford, MA for nutrient (total nitrogen, total phosphorus) and the WPP lab in Worcester for chlorophyll a, turbidity and color analyses. A minimum of one field duplicate and one field blank sample per analyte will be tested for QC at least one station per sampling event. In total, approximately 176 samples (76 nutrients samples) will be analyzed for the listed indicators during the 2020 monitoring season.

Sampling Process Design

*Index Site - Water Quality (Chemical, Biological and Physical)*

The single index sites in Horn Pond (Woburn) and Wedge Pond (Winchester), and two index sites in Spy Pond will be sampled for nutrients (total nitrogen and total phosphorus) and color and turbidity in the epilimnion and hypolimnion. Depth integrated chlorophyll a samples will be obtained on each sampling date at each index site. Additionally, secchi disk transparency will also be determined at each index site. Finally, a vertical profile (dissolved oxygen, temperature, pH, conductivity) will be measured at each index site location on each sampling date.

Nutrient samples will be collected in 500 ml HDPE sample bottles and acidified in the field with ampoules of H2SO4 to a pH of <2. Nutrient samples will be kept on ice while in the field and refrigerated at 4°C upon return to the office. The chlorophyll a will be filtered at the Division of Watershed Management (DWM) CERO lab and frozen in a folded aluminum foil wrap.

*Other Sampling*

A bathymetric survey will be conducted at each pond on one occasion.

*QAQC*

In addition to standard field blanks and field duplicates, split samples will be taken from each sampling station in both July and October. In both July and October two matrix spike samples and QC known samples will also be submitted to the laboratory for testing.

In general, lake sampling will follow current DWM protocols for lake sampling (CN 151.0, MassDEP 2010). Shoreline sampling surveys will follow Field Operations Manual Lakes (CN 476.0, MassDEP 2017). Boat and equipment decontamination shall also take place in accordance with current DWM protocols (CN 59.6). Total nitrogen and total phosphorus samples will be analyzed according to the following Methodologies.

Table 2: Laboratory Methodology

|  |  |  |
| --- | --- | --- |
| Compound | Methodology | Reporting Limit |
| Total Phosphorous | EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) | 5 ug/L |
| Total Nitrogen | EPA Series Method 353.2 (LSBSOP-NO2NO30) | 45 ug/L |
| Combined Nitrate & Nitrite | EPA Series Method 353.2 (LSBSOP-NO2NO30) | 23 ug/L |

Sampling locations are shown in Figure 1 through 3 and listed in Table 3. See Table 4 for the overall project schedule and Table 5 for the planned sampling schedule and sample delivery schedule to the EPA Laboratory for nutrient analysis.

Table 3. 2020 Mystic Lakes Monitoring Sites

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station ID | Waterbody | Water Code | Unique ID | Site | Latitude | Longitude | Station Type | Sampling Parameters |
| A | Horn Pond | 71019 | W1087 | [deep hole, Woburn] | 42.470 | -71.158 | Index Site | N,A,S,B |
| A | Wedge Pond | 71045 | W1226 | [deep hole, Winchester] | 42.453 | -71.142 | Index Site | N,A,S,B |
| A | Spy Pond | 71040 | W2837 | [A, deep hole- Northern Lobe, Arlington] | 42.410 | -71.152 | Index Site | N,A,S,B |
| B | Spy Pond | 71040 | W2839 | [B, deep hole- Southern Lobe, Arlington] | 42.406 | -71.159 | Index Site | N,A,S,B |

N = Nutrients (Total Nitrogen, Total Phosphorus), Color, Turbidity

A = Depth Integrated Algae Sample (Chl a)

S=Single event multiprobe for dissolved oxygen, pH, conductivity and temperature

B= Bathymetry

A picture containing text, map

Description automatically generated

**Figure 1:** 2020 Horn Pond Monitoring Site

A picture containing text, map

Description automatically generated

**Figure 2:** 2020 Wedge Pond Monitoring Site

A picture containing text, map

Description automatically generated

**Figure 3:** 2020 Spy Pond Monitoring Sites

| Table 4. Project Schedule for 2020 Mystic Lakes Monitoring | | | |
| --- | --- | --- | --- |
| **Activity** | **Approx. Date of Initiation** | **Approx. Date of Completion** | **Deliverable** |
| *Lake Surveys: (subject to revision)* | | | |
| Coordination, meetings, lake sampling plan development, etc. | Dec 2019 | Jan 2020 | Draft sampling plan; meeting notes, etc. |
| Draft sampling plan review and approval | Jan 2020 | April 2020 | Internal WPP concurrence on sampling plan |
| Scoping Discussions with EPA Chelmsford Laboratory | May 2020 | May 2020 | Updated SAP, Clear procedures for sample delivery, COC and bottles delivered to MassDEP |
| Water quality surveys (5 visits)  *(index site)* | Jun 2020 | October 2020 | Field data; lab samples to WES |
| Bathymetry surveys | May 2020 | July 2020 | Bathymetric maps |
| Data QA/QC review and validation | December 2020 | January 2022 | 2020 Data Validation Report |
| Interim Tech Memos *(optional)* | January 2022 | March 2022 | WQ tech memo |
| *Final Report for the 2022 Integrated Report (subject to revision)* | | | |
| Assess designated uses, summarize condition of lakes, etc. | April 2022 | October 2022 | Data for repository document |

Table 5: Planned Sampling Schedule, Nutrient Analysis and Schedule of Sample Delivery to EPA Laboratory

\*Due to the COVID-19 pandemic we are uncertain when field and laboratory access will be available. The sampling and delivery dates of this schedule are subject to change.

| **Proposed Dates** | **Locations** | **Analysis/Action\*** | **Bottle Count** | **Bottle Count Weekly delivery** |
| --- | --- | --- | --- | --- |
| 6/3/2020 | Horn Pond, Wedge Pond | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 6 |  |
| 6/4/2020 | Spy Pond TBD 1, Spy Pond TBD 2 | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 6 |  |
| Friday June 5, 2020 | Horn Pond, Wedge Pond, Spy Pond Samples | ***Delivery to EPA Chelmsford Laboratory***  by 12:00 PM |  | 12 |
| 7/8/2020 | Spy Pond TBD 1, Spy Pond TBD 2 | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 8 |  |
| 7/9/2020 | Spy Pond TBD 1, Spy Pond TBD 2 | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 8 |  |
| 7/9/2020 | Matrix Spikes  QC Knowns | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 4 |  |
| Friday July 10, 2020 | Horn Pond, Wedge Pond, Spy Pond Samples | ***Delivery to EPA Chelmsford Laboratory***  by 12:00 PM |  | 20 |
| 8/12/2020 | Horn Pond, Wedge Pond | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 6 |  |
| 8/13/2020 | Spy Pond TBD 1, Spy Pond TBD 2 | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 6 |  |
| Friday August 14, 2020 | Horn Pond, Wedge Pond, Spy Pond Samples | ***Delivery to EPA Chelmsford Laboratory***  by 12:00 PM |  | 12 |
| 9/16/2020 | Horn Pond, Wedge Pond | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 6 |  |
| 9/17/2020 | Spy Pond TBD 1, Spy Pond TBD 2 | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 6 |  |
| Friday September 18, 2020 | Horn Pond, Wedge Pond, Spy Pond Samples | ***Delivery to EPA Chelmsford Laboratory***  by 12:00 PM |  | 12 |
| 10/21/2020 | Horn Pond, Wedge Pond | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 8 |  |
| 10/22/2020 | Spy Pond TBD 1, Spy Pond TBD 2 | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 8 |  |
| 10/22/2020 | Matrix Spikes  QC Knowns | EPA Series Method  365.1 (LSBSOP-OPHOS-TP0)  353.2 (LSBSOP-NO2NO30) | 4 |  |
| Friday October 23, 2020 | Horn Pond, Wedge Pond, Spy Pond Samples | ***Delivery to EPA Chelmsford Laboratory***  by 12:00 PM |  | 20 |
| **Total Samples To EPA** | | | | 76 |

\* All nutrient samples collected in a 500 milliliter HDPE bottle, preserved with Sulfuric Acid to pH<2 and kept at < 6C

Non-Direct Measurements

Table 5 is a brief list of relevant external data sources that may be used in coordinating monitoring efforts or the interpretation of monitoring data. Rain data from the National Climatic Data Center (NCDC) could be used to determine if a sampling event was conducted during wet or dry weather.

Table 6. External data sources used for the 2020 Mystic Lakes Monitoring

|  |  |
| --- | --- |
| **Organization** | **Data** |
| National Climatic Data Center (NCDC)  <http://www.ncdc.noaa.gov/oa/ncdc.html> | Daily precipitation and temperature data weather stations within the northeastern basin group. |
| The Weather Underground  <http://www.wunderground.com/> | Daily precipitation and temperature data weather stations within the northeastern basin group. |

Literature Cited

Durant, et al. 2007. Long-Term Fate of a Pulse Arsenic Input to a Eutrophic Lake. Environmental Science & Technology/ Vol 41, NO. 9, 2007.

MassDEP. 2010. Standard Operating Procedure: Lake Sampling (CN 151.0). Massachusetts Department of Environmental Protection, Worcester, MA.

MassDEP. 2015. Standard Operating Procedure: Field Equipment Decontamination to Prevent the Spread of Invasive Aquatic Organisms (CN 59.6). Massachusetts Department of Environmental Protection, Worcester, MA.

MassDEP. 2017. Massachusetts Probabilistic Monitoring and Assessment Program Field Operations Manual Lakes:Version 1.1 May 2017. Massachusetts Department of Environmental Protection, Worcester, MA.

EPA. 2015a. Standard Operating Procedure for Nitrate/ Nitrite and Total Nitrogen By Lachat Analyzer. United States Environmental Protection Agency, Lab services & Applied Sciences Divison, EPA Region 1 New England, North Chelmsford, MA 01863

EPA. 2015b. Standard Operating Procedure for Total Phosphate and Orthophosphate Analysis By Lachat Analyzer. United States Environmental Protection Agency, Lab services & Applied Sciences Divison, EPA Region 1 New England, North Chelmsford, MA 01863