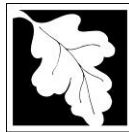


**SAMPLING & ANALYSIS PLAN**  
**2021 MYSTIC LAKES MONITORING**

CN 546.0  
April 2021




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  
2021 Mystic Lakes Monitoring*

*Prepared by*  
Dahlia Tympanick  
Massachusetts Department of Environmental Protection  
Watershed Planning Program

 _____ Dahlia Tympanick, MassDEP Watershed Planning Program- Monitoring Coordinator	 _____ 4/8/2021 _____ Date
 _____ Holly Brown, MassDEP Watershed Planning Program- TMDL Lead	 _____  _____ Date
 _____ Sue Flint, MassDEP Watershed Planning Program- QA Lead	 _____  _____ Date
 _____ Dan Boudreau, US EPA OEME Chemistry Team Leader	 _____  _____ Date
 _____ Mark Voorhees, US EPA OEP Lead	 _____  _____ Date
 _____ Tom Faber, US EPA QA Lead	 _____  _____ Date

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## Project Organization

The 2021 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 2021 monitoring are detailed in Table 1.

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

<b>Project Personnel</b>	<b>Responsibility</b>
<u>Monitoring Coordinators</u> -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.
<u>Water quality survey crews</u> -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.
<u>WPP Laboratory (probes)</u> -Shervon DeLeon (lead) -Suzanne Flint (auxiliary)	Responsible for calibration of multiprobes (dissolved oxygen, pH, conductivity).
<u>WPP Laboratory (algal)</u> -Joan Beskenis (lead) -WPP staff and seasonal employees	Responsible for the analysis of chlorophyll samples using procedures contained in WPP SOPs
<u>WPP Laboratory (color and turbidity)</u> -Shervon DeLeon (lead) -WPP staff and seasonal employees	Responsible for the analysis of color and turbidity samples using techniques and procedures contained in WPP SOPs.
<u>WPP QA</u> -Sue Flint (lead)	Responsible for data quality assurance and quality control.
<u>EPA Laboratory</u> -Dan Boudreau -Tom Faber	Responsible for sample coordination and analysis of nutrient samples.

## Project Definition and Background

The 2021 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.

Prior to the first year of sampling for this project in 2019, 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 2021**

#### *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. Multi-parameter sondes for the vertical profile will be calibrated prior to the survey and calibration checks will be conducted both pre and post survey. 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 170 samples (70 nutrients samples) will be analyzed for the listed indicators during the 2021 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 with as YSI or Hydrolab multi-parameter sonde at each index site location on each sampling date.

Nutrient samples will be acidified in the field with ampoules of acid. 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 was conducted at each pond in October of 2020.

In general, lake sampling will follow current DWM protocols for lake sampling (CN 151.0, MassDEP 2010). 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 EPA 2015a and EPA 2015b respectively. Sampling locations are shown in Figure 1 and listed in Table 2. See Table 3 for the overall project schedule and Table 4 for the planned sampling schedule and sample delivery schedule to the EPA Laboratory for nutrient analysis.

**Table 2.** 2021 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





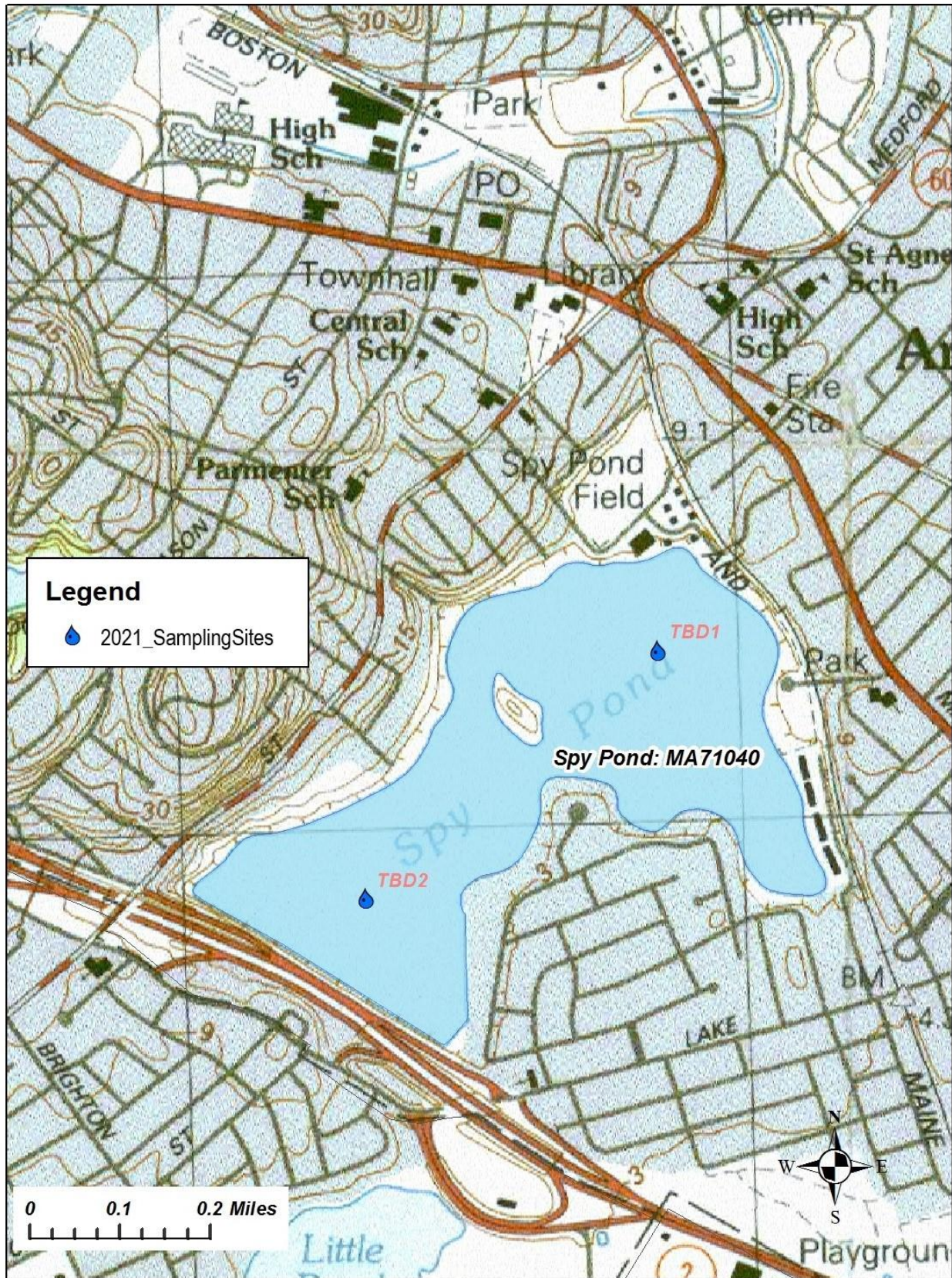
Figure 1: 2021 Horn Pond Monitoring Site





**Figure 2: 2021 Wedge Pond Monitoring Site**





**Figure 3: 2021 Spy Pond Monitoring Sites**

**Table 3.** Project Schedule for 2021 Mystic Lakes Monitoring

Activity	Approx. Date of Initiation	Approx. Date of Completion	Deliverable
<i>Lake Surveys: (subject to revision)</i>			
Coordination, meetings, lake sampling plan development, etc.	December 2020	January 2021	Draft sampling plan; meeting notes, etc.
Draft sampling plan review and approval	January 2021	April 2021	Internal WPP concurrence on sampling plan
Water quality surveys (5 visits) ( <i>index site</i> )	June 2021	October 2021	Field data; lab samples to WES
Bathymetry surveys	October 2020	March 2021	Bathymetric maps
Data QA/QC review and validation	December 2021	January 2022	2021 Data Validation Report
Interim Tech Memos ( <i>optional</i> )	January 2022	March 2022	WQ tech memo
<i>Final Report for the 2022 Integrated Report (subject to revision)</i>			
Assess designated uses, summarize condition of lakes, etc.	April 2022	October 2022	Data for repository document

**Table 4:** Planned Sampling Schedule, Nutrient Analysis and Schedule of Sample Delivery to EPA Laboratory

Proposed Dates	Locations	Analysis/Action*	Bottle Count	Bottle Count Weekly Delivery
6/2/2021	Horn Pond, Wedge Pond	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	
6/3/2021	Spy Pond 1, Spy Pond 2	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	
Friday June 4, 2021	Horn Pond, Wedge Pond, Spy Pond Samples	<i>Delivery to EPA Chelmsford Laboratory</i>		14
7/7/2021	Horn Pond, Wedge Pond	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	
7/8/2021	Spy Pond 1, Spy Pond 2	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	
Friday July 9, 2021	Horn Pond, Wedge Pond, Spy Pond Samples	<i>Delivery to EPA Chelmsford Laboratory</i>		14
8/11/2021	Horn Pond, Wedge Pond	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	



<b>Proposed Dates</b>	<b>Locations</b>	<b>Analysis/Action*</b>	<b>Bottle Count</b>	<b>Bottle Count Weekly Delivery</b>
8/1/2021	Spy Pond 1, Spy Pond 2	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	
Friday August 13, 2021	Horn Pond, Wedge Pond, Spy Pond Samples	<i>Delivery to EPA Chelmsford Laboratory</i>		14
9/15/2021	Horn Pond, Wedge Pond	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	
9/16/2021	Spy Pond 1, Spy Pond 2	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	
Friday September 17, 2021	Horn Pond, Wedge Pond, Spy Pond Samples	<i>Delivery to EPA Chelmsford Laboratory</i>		14
10/13/2021	Horn Pond, Wedge Pond	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	
10/14/2021	Spy Pond 1, Spy Pond 2	EPA Series Method 365.1 (LSBSOP-OPHOS-TP0) 353.2 (LSBSOP-NO2NO30)	7	
Friday October 15, 2021	Horn Pond, Wedge Pond, Spy Pond Samples	<i>Delivery to EPA Chelmsford Laboratory</i>		14
<b>Total Samples To EPA</b>				<b>70</b>

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



**Table 5:** Planned Sampling Schedule, Color, Turbidity and Chlorophyll-a Analysis and Schedule of Sample Delivery to WPP Laboratory

<b>Proposed Dates</b>	<b>Locations</b>	<b>Analysis/Action*</b>	<b>Bottle Count Daily Delivery</b>
6/2/2021	Horn Pond, Wedge Pond	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
6/3/2021	Spy Pond 1, Spy Pond 2	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
7/7/2021	Horn Pond, Wedge Pond	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
7/8/2021	Spy Pond 1, Spy Pond 2	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
8/11/2021	Horn Pond, Wedge Pond	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
8/1/2021	Spy Pond 1, Spy Pond 2	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
9/15/2021	Horn Pond, Wedge Pond	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
9/16/2021	Spy Pond 1, Spy Pond 2	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
10/13/2021	Horn Pond, Wedge Pond	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
10/14/2021	Spy Pond 1, Spy Pond 2	WPP Standard Operating Procedure CN 002.3 (True color) & CN 095.1 (Turbidity) CN 003.42 (Chlorophyll-a)	6 4
<b>Total Samples To WPP</b>			100

\* color and turbidity samples collected in a 120 milliliter HDPE bottles and chlorophyll samples collected in 250 milliliter amber HDPE bottles, kept at < 4°C

## 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.

**Table6.** External data sources used for the 2021 Mystic Lakes Monitoring

Organization	Data
National Climatic Data Center (NCDC) <a href="http://www.ncdc.noaa.gov/oa/ncdc.html">http://www.ncdc.noaa.gov/oa/ncdc.html</a>	Daily precipitation and temperature data weather stations within the northeastern basin group.
The Weather Underground <a href="http://www.wunderground.com/">http://www.wunderground.com/</a>	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. 2009. Standard Operating Procedure: Turbidity Measurement (CN 095.1). Massachusetts Department of Environmental Protection, Worcester, MA.

MassDEP. 2009. Standard Operating Procedure: True Color Analysis (CN 002.3). Massachusetts Department of Environmental Protection, Worcester, MA.

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.

MassDEP. 2018. Standard Operating Procedure: Extracted Chlorophyll a (SM -10200H) (USEPA Fluorometric Method 445 and 445 with the Welschmeyer modification) (CN 003.42). 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