CDM

Upper Merrimack and Pemigewasset River Study

Field Sampling Plan

Prepared for:

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New England District

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Abbreviations

BOD: Biological Oxygen Demand

cfs: Cubic feet per second

DO: Dissolved Oxygen

DQO: Data Quality Objectives

D/S: Downstream

EPA: United States Environmental Protection Agency

NHDES: New Hampshire Department of Environmental Services

QA: Quality Assurance

QAPP: Quality Assurance Project Plan

QC: Quality Control

SOD: Sediment Oxygen Demand

SOP: Standard Operating Procedure

USACE: United States Army Corps of Engineers

USGS: United States Geological Survey

U/S: Upstream

WWTF: Wastewater Treatment Facility

Section 1
Introduction

1.1 Study Overview

The Upper Merrimack and Pemigewasset River Study is a jointly funded cost-sharing effort by the federal government, through the United States Army Corps of Engineers (USACE), the New Hampshire Department of Environmental Services (NHDES), and various communities in the watershed.

Over the past several decades, significant improvements have been made to the water quality of the Merrimack River. However there are remaining water quality, quantity, and fish and wildlife habitat issues. Recently the USACE with sponsors in Massachusetts and New Hampshire completed work on the lower Merrimack River to compare the relative contributions and impacts of pollution from nonpoint sources and combined sewer overflows, and to compare alternative bacteria abatement strategies in the watershed.

The previous study area focused on the impacts of bacteria and nutrients in the portion of the river from Hooksett, NH downstream to its confluence with the Atlantic Ocean in Newburyport, MA. The purpose of this new effort is to extend the evaluation of instream water quality in the mainstem Pemigewasset and Merrimack Rivers upstream to Lincoln, NH, close to the headwaters. One of the goals is to create a time dependent model of flow and water quality of the Upper Merrimack and Pemigewasset Rivers that can be used to guide the following activities and decisions:

- The model will be used as a tool to identify the sources of the dissolved oxygen deficit in reaches of the river that are listed on the New Hampshire 303(d) list of impaired waters, and plan for the expected needs of several wastewater treatment facilities for updated discharge permits,

- Assess the water quality and quantity impacts of potential future increases in water withdrawals from the mainstem Merrimack by communities south of Concord, NH.

- Potentially evaluate alternative usage of USACE reservoirs in the watershed to mitigate impacts of treated wastewater discharges and/or water supply withdrawals.

The performance of the model will be tested against data collected from the mainstem Pemigewasset and Merrimack Rivers, and their primary tributaries in New Hampshire. This document outlines the plan to collect water quality data that will assist in the development and calibration of the simulation models.

1.2 Task Description

A comprehensive field sampling program has been developed for the Upper Merrimack and Pemigewasset River Study. The overall goal of the program is to provide an accurate and representative picture of the current water quality conditions at specific sampling stations along the mainstem, with particular emphasis on impounded reaches, as well as the mouths of major tributaries. The environmental data collected under this task will be used as input to the existing water quality and hydrologic/hydraulic models which will be extended upstream under subsequent tasks of the Upper Merrimack and Pemigewasset River Study. These models will serve as the basis for future planning and regulatory decisions in the basin.

The field sampling program consists of the following five major subtasks:

- Low-flow water quality surveys
- High-flow water quality survey
- Impoundment studies
- Continuous dissolved oxygen and temperature monitoring
- Sediment Oxygen Demand and Nutrient Flux monitoring

The surveys will be distributed throughout the Spring, Summer and Fall of 2008 and/or 2009 as streamflow conditions allow. Additional details on each survey are presented in Sections 4 , 5 and 6. Other sampling tasks may take place concurrently with this sampling program to fulfill the needs of other individual parties, but will not be included in this program plan, nor will they be covered by the Quality Assurance Project Plan (QAPP).

This document presents a summary of the sampling and continuous monitoring locations, sampling frequency, and water quality constituents to be measured and collected during the high- and low-flow surveys, impoundment studies, sediment sampling, and continuous monitoring program. Its scope is limited to the logistical specifications for the required field work. All procedural and quality assurance requirements for field work and laboratory analysis are included in the Quality Assurance Project Plan (QAPP) for this project. The QAPP includes a supporting compendium of Standard Operating Procedures (SOPs) for field and analytical methods. These documents collectively describe the full requirements for the intended field monitoring program for the Upper Merrimack and Pemigewasset River Study.

1.2.1 Study Area

For the purposes of the field sampling program, the Study Area has been identified as the mainstem Pemigewasset and Merrimack Rivers south of Lincoln, NH to the New Hampshire-Massachusetts state line in Nashua, NH. The reach of the Merrimack River downstream of Hooksett, NH was included in the Merrimack River Watershed

Assessment Study completed by CDM in 2005, thus the intention of water quality monitoring in that reach is to supplement the data collected as part of the previous study and provide continuity.

Five dams are included in the Study Area: Ayers Island Dam in Bristol/New Hampton, NH; Franklin Falls Dam in Franklin, NH; Eastman Falls Dam in Franklin, NH; Garvins Falls Dam in Concord/Bow, NH; Hooksett Dam in Hooksett, NH; and Amoskeag Dam in Manchester, NH. Franklin Falls Dam is owned and operated by the Army Corps of Engineers and is used primarily for flood control purposes while the other dams are owned and operated by Public Service Company of New Hampshire (PSNH) and are used for hydroelectric power generation.

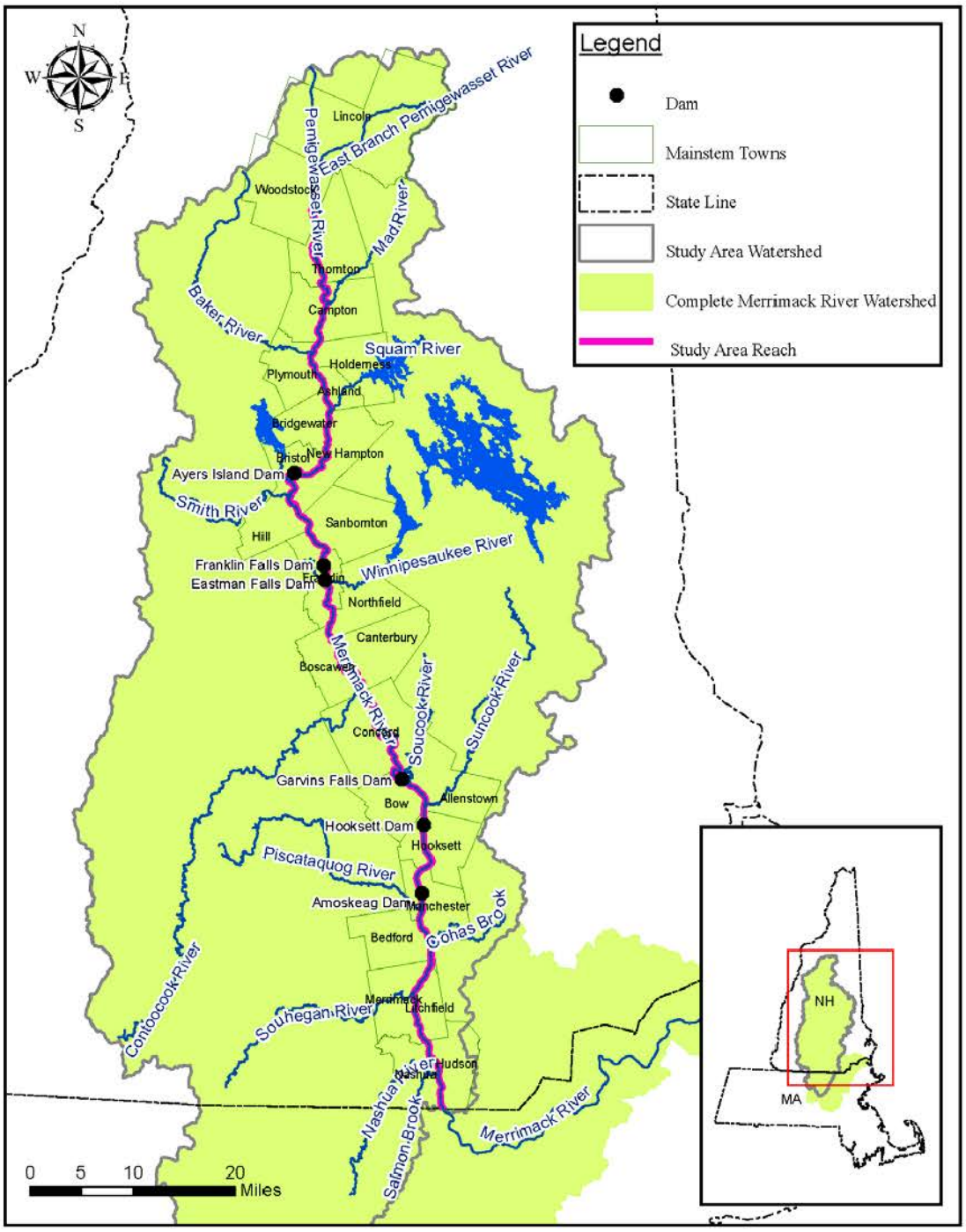
In addition to the mainstem sampling locations, 16 major tributaries have been identified within the Study Area. Impacts of the tributary sub-basins will be evaluated as part of this field sampling program by collecting water quality samples at the mouths of these key tributaries. Table 1-1 lists the tributaries to the mainstem Upper Merrimack and Pemigewasset River that will be monitored and included in the model along with the town where the confluence with the mainstem is located.

Table 1-1: Key Tributaries to the Upper Merrimack and Pemigewasset

Tributary	Town
East Branch Pemigewasset	Woodstock, NH
Mad River	Campton, NH
Baker River	Plymouth, NH
Squam River	New Hampton, NH
Newfound River	Bristol, NH
Smith River	Bristol/Hill, NH
Chance Pond Brook	Franklin, NH
Winnipesaukee River	Franklin, NH
Contoocook River	Boscawen/Concord, NH
Soucook River	Concord/Pembroke, NH
Suncook River	Allenstown/Pembroke, NH
Piscataquog River	Manchester, NH
Cohas Brook	Manchester, NH
Souhegan River	Merrimack, NH
Nashua River	Nashua, NH
Salmon Brook	Nashua, NH

Figure 1-1 shows the entire Pemigewasset and Merrimack River watershed, along with the portion of the mainstem that is targeted by this sampling program.

Figure 1-1: Watershed Map



1.2.2 Sampling Constituents

Table 1-2 presents a summary of the water quality constituents and measurements to be included in the field and laboratory analyses. Each of the following constituents will not be monitored at every sampling location; details of the complete sampling program and sample matrices for each event are provided in Section 5.

Table 1-2: Summary of Sampling Constituents and Field Measurements

Analytical Constituents	Field Measurements
Oxygen and Oxygen Demand	In situ Measurements
Dissolved Oxygen (Winkler Titration)	Temperature
$CBOD_5$	Dissolved Oxygen
$CBOD_{20}$	pH
Sediment Oxygen Demand	Conductivity
Nutrients and Impacts	Turbidity
Total Suspended Solids	Flow
Total Phosphorus	Secchi Disk Depth
Orthophosphorus	Vertical Temperature and DO Profiles
Nitrate/Nitrite	Macrophytes survey
Ammonia-N	
Total Kjeldahl Nitrogen	
Chlorophyll-a (Phytoplankton and Periphyton)	
Sediment Phosphorus Flux	
Indicator Organisms	
E. coli	
Fecal Coliform	
Enterococcus	

Section 2
Data Quality Objectives

Based on the sampling program objectives and proposed data usage requirements for the Upper Merrimack and Pemigewasset River Study, the Data Quality Objectives (DQOs) for the sampling program are as follows:

- Collect water quality, sediment and impoundment data sufficient for extending the existing water quality and hydrologic/hydraulic models from Manchester, NH to Lincoln, NH.

- Develop a comprehensive data base of water quality data with which to:

  - Characterize the impacts of point source loads and non-point source loads on dissolved oxygen and chlorophyll-a (phytoplankton, periphyton and macrophytes) levels in the Upper Merrimack and Pemigewasset Rivers in New Hampshire.
  - Help assess the impacts of alternative flow regimes (resulting from new water supply withdrawals) on water quality in the Merrimack River from Concord, NH to Nashua, NH.

A detailed discussion of the field and laboratory DQOs, measurement performance criteria, and quality assurance objectives is provided in the associated QAPP, submitted under separate cover. It will be necessary for all field crews to be aware of and adhere to the QA requirements for samples that will be submitted to the laboratories for analysis, as discussed in the QAPP.

2.1 Quality Assurance Objectives

Quality assurance objectives for measurement data are included in Sections 1 and 2 of the associated QAPP. These objectives are typically expressed in terms of data precision, accuracy, representativeness, completeness, and comparability. In order to achieve these objectives, field sampling crews will adhere to the instructions provided in Section 2 of the QAPP concerning how the water quality and flow data will be collected during the field sampling program.

Section 3
Low and High Flow Sampling Criteria

This section describes the criteria that will guide the selection of low- and high-flow sampling events during the field sampling program. For the purposes of this Field Sampling Plan, the following seasonal designations will apply:

- Spring – May through mid-June 2008/2009
- Summer – Mid-June through mid-September 2008/2009
- Fall – Mid-September through November 2008/2009

The criteria for low- and high- flow water quality sampling events are based on streamflow conditions, which are summarized for the mainstem Pemigewasset and Merrimack Rivers in the following sections and in Tables 3-1 and 3-2a.

3.1 Low-Flow Sampling Criteria

Low-flow water quality sampling will be conducted twice during the course of the field sampling program, during the summer months, when streamflow conditions are approximately less than or equal to three times 7q10 flows (see Table 3-1). Detailed antecedent dry conditions will not be specified for the low-flow sampling events, since low flows will necessarily be preceded by dry conditions. However, to avoid the possibility of wash-off into the river that may blur the monitoring results, it is recommended that rainfall preceding the monitoring not total more than 0.10 inches in the preceding seven days, and there be no rainfall at all during the preceding two days. However, if streamflow conditions are met without the occurrence of the specified antecedent dry conditions, low-flow sampling may occur after consultation with NHDES and USACE. The low-flow conditions will be determined based on available real-time streamflow data provided by the USGS gages at four locations along the mainstem Upper Merrimack and Pemigewasset River. Figure 3-1 shows the locations of the streamflow tracking gages within the Study Area. Table 3-1 shows the 7Q10 values for those four gages as well as the flow criteria for low-flow sampling.

Figure 3-1: Tracking Gages

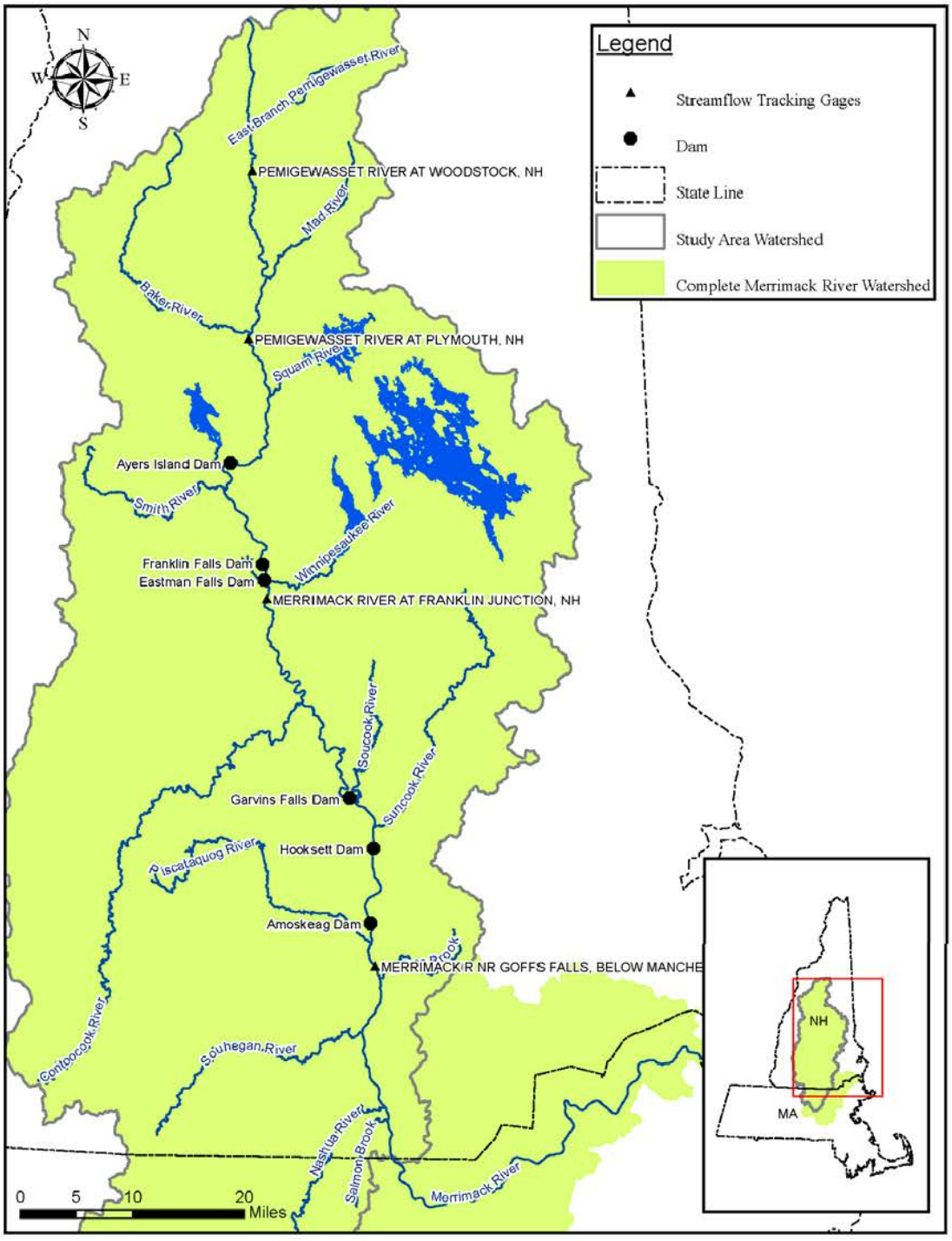


Table 3-1: 7q10 values for Upper Merrimack and Pemigewasset River and Target Streamflow for Low-Flow Sampling Surveys

Gage Name	Gage Number	7Q10 Flow[5]	Target Streamflow (flow should be ≤ value)
Pemigewasset River at Woodstock[1]	01075000	56 cfs	168 cfs
Pemigewasset River at Plymouth[2]	01076500	118 cfs	354 cfs
Merrimack River at Franklin Jct[3]	01081500	551 cfs	1653 cfs
Merrimack River at Goffs Falls[4]	01092000	644 cfs	1932 cfs

1. USGS gage #01075000, historical data from 10/1/1939 – 9/30/2006
2. USGS gage #01076500, historical data from 10/1/1903 – 9/30/2006
3. USGS gage #01081500, historical data from 8/1/1903 – 9/30/2006
4. USGS gage #01092000, historical data from 12/1/1936 – 9/30/2006
5. Source: NHDES Dam Bureau Monthly Drought Data Report, August 2007

Diurnal dissolved oxygen measurements (i.e., "diurnal sweeps") will be conducted during the two summer low-flow sampling events at approximately half of the main stem locations. The sampling stations identified as diurnal sweep locations are listed in Section 5.1 along with the low-flow survey sampling location and frequency information. One round of measurements will be taken at dawn when DO concentrations are typically at their lowest, while a second round of measurements will be performed in the mid to late afternoon when DO concentrations tend to be highest.

3.2 High-Flow Sampling Criteria

A third water quality survey will be conducted when the streamflow is at a value which is greater than or equal to the monthly average for the wettest month of the year. The high-flow sampling survey can occur at any time from May to October, although it is anticipated that conditions will be met in the Spring. Table 3-2a shows the mean monthly streamflow for four USGS gaging stations along the Upper Merrimack and Pemigewasset River. The boxed values are the mean streamflow for the wettest month of the year at that location, which are the target values for the high-flow sampling survey (Table 3-2b).

Table 3-2a: Mean Monthly Streamflow, cfs[5]

Gage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pemigewasset River at Woodstock[1]	264	214	421	1310	1350	497	269	222	269	410	576	448
Pemigewasset River at Plymouth[2]	886	733	1700	3920	2770	1170	642	513	600	1000	1360	1170
Merrimack River at Franklin Jct[3]	2170	2070	3410	7030	5040	2600	1600	1320	1450	1890	2450	2480
Merrimack River at Goffs Falls[4]	4620	4710	7860	13900	8810	4730	2530	2000	2120	3270	4810	5430

1. USGS gage #01075000, historical data from 10/1/1939 – 9/30/2006
2. USGS gage #01076500, historical data from 10/1/1903 – 9/30/2006
3. USGS gage #01081500, historical data from 8/1/1903 – 9/30/2006
4. USGS gage #01092000, historical data from 12/1/1936 – 9/30/2006
5. Source: http://waterdata.usgs.gov/nwis

Table 3-2b: Target Streamflow for High-Flow Sampling Survey

Gage Name	Gage Number	Target Streamflow (flow should be ≥ value)
Pemigewasset River at Woodstock	01075000	1,350 cfs
Pemigewasset River at Plymouth	01076500	3,920 cfs
Merrimack River at Franklin Junction	01081500	7,030 cfs
Merrimack River at Goffs Falls	01092000	13,900 cfs

Section 4
Streamflow Tracking and Team Mobilization

This section describes the weather tracking and team mobilization procedures that will be employed during the field sampling program for the streamflow-dependant sampling events.

4.1 Low-Flow Water Quality Sampling Events

Potential dates for low-flow sampling events will be identified approximately five days in advance based on streamflow conditions, predicted forecasts and prior antecedent dry conditions as required by the criteria specified in Section 3. CDM's Field Program Coordinator, Ms. Jamie Lefkowitz, will monitor the four USGS streamflow gages identified in Section 3 on a daily basis via real-time flow data available from USGS on-line at http://waterdata.usgs.gov/nwis. Weather tracking and monitoring will be performed by CDM's in-house meteorologist, Mr. Mark Wallace, to identify potential dry-weather time periods when conditions for low-flow sampling events are likely, as well as confirm that no rain event is likely to happen on the day of sampling.

Ms. Lefkowitz will notify the Field Program Coordinators from other involved parties, as well as the laboratory contacts, approximately five days in advance of the proposed low-flow sampling event to schedule equipment and personnel. Ms. Lefkowitz will confirm the scheduled event with the Project Team approximately 24 hours in advance. It is anticipated that each low-flow sampling survey will be completed in one working day. Ms. Lefkowitz will prepare a memo for the project files and USACE and NHDES Study Managers documenting the streamflow and weather conditions approaching and the day of the low-flow sampling event to confirm that the low-flow sampling criteria specified in Section 3.1 were met.

4.2 High-Flow Water Quality Sampling Events

Potential dates for high-flow sampling events will be identified approximately three days in advance based on streamflow conditions and predicted forecasts. CDM's Field Program Coordinator, Ms. Jamie Lefkowitz, will monitor the four USGS streamflow gages identified in Section 3 on a daily basis via real-time flow data available from USGS on-line at http://waterdata.usgs.gov/nwis. Weather tracking and monitoring will be performed by CDM's in-house meteorologist, Mr. Mark Wallace, to identify potential wet-weather time periods when conditions for high-flow sampling events are likely, as well as confirm that no rain event is likely to happen on the day of sampling.

Ms. Lefkowitz will notify the Field Program Coordinators from other involved parties, as well as the laboratory contacts, approximately three days in advance of the proposed high-flow sampling event to schedule equipment and personnel. Ms. Lefkowitz will confirm the scheduled event with the Project Team approximately 24 hours in advance. It is anticipated that each high-flow sampling survey will be completed in one working day. Ms. Lefkowitz will prepare a memo for the project files and USACE and NHDES Study Managers documenting the streamflow and weather conditions approaching and

the day of the high-flow sampling event to confirm that the high-flow sampling criteria specified in Section 3.2 were met.

4.3 Field Mobilization Efforts

Once a low- or high-flow sampling event has been identified, the respective Field Program Coordinators and sampling crews are responsible for ensuring that all sampling-preparation activities are completed. These activities include ensuring that all personnel have reviewed the Quality Assurance Project Plan (QAPP) section pertaining to quality assurance objectives, Standard Operating Procedures (SOPs), procurement of field equipment, and confirmation of site access. Ms. Lefkowitz is responsible for obtaining and distributing the required bottles and coolers from the respective laboratories.

In the field, initial set-up procedures include the establishment of sample staging areas and the distribution of required equipment, bottles, and coolers. An Equipment Checklist will be provided to all sampling teams.

Section 5
Sampling Event Details

This section summarizes the sampling locations and frequency at which water quality surveys, impoundment studies, sediment sampling, and continuous monitoring will be performed as well as which constituents will be analyzed during each event. Sampling stations were selected to meet the overall Project and Data Quality Objectives, as discussed in Sections 1 and 2 and in the associated QAPP.

Sampling will be conducted in the mainstem Pemigewasset and Merrimack Rivers from Lincoln, NH to the New Hampshire/Massachusetts state line in Nashua, as well as at the mouths of 16 major tributaries. The water quality sampling program will also include sampling effluent from the major wastewater treatment facilities (WWTFs) that discharge into the Merrimack and Pemigewasset Rivers. Based on monitoring on the Lower Merrimack River, it is assumed that the rivers in the Study Area will be laterally mixed, and that samples from the center of the channel will be representative of water quality across the river. However, in-situ monitoring will be conducted prior to the first sampling event to confirm this, especially downstream of known point source discharges (i.e., WWTFs). Dissolved oxygen and pH measurements will also be taken during the three water quality surveys at areas that may not be completely mixed in order to confirm mixing. Field crews will be instructed to collect lateral composite samples if in-situ tests fail to confirm completely mixed conditions at a sampling location. The tributary sampling stations will be located a short distance upstream of the confluence with the main stem, far enough upstream (if possible) to avoid backwater effects.

In addition to the mainstem and tributary river water quality samples, effluents will be sampled from all of the study area WWTFs that discharge directly into the Merrimack and Pemigewasset Rivers, which are listed in Table 5-1. These samples will be analyzed for bacteria, CBOD and nutrients.

Table 5-1: Mainstem Wastewater Treatment Facilities

Facility Name	Town	Receiving Waters
Lincoln WWTF	Lincoln	Pemigewasset River
Woodstock WWTF	Woodstock	Pemigewasset River
Plymouth Village WWTF	Plymouth	Pemigewasset River
Bristol WWTF	Bristol	Pemigewasset River
Winnipesaukee WWTF	Franklin	Merrimack River
Merrimack County Facilities	Boscawen	Merrimack River
Penacook WWTF	Concord	Merrimack River
Hall Street WWTF	Concord	Merrimack River
Suncook WWTF	Allenstown	Merrimack River
Hooksett WWTF	Hooksett	Merrimack River
Manchester WWTF	Manchester	Merrimack River
Derry WWTF	Litchfield	Merrimack River
Merrimack WWTF	Merrimack	Merrimack River
Nashua WWTF	Nashua	Merrimack River

Table 5-2 provides a summary of the specific criteria used to select sampling locations and frequency, including which constituents will be analyzed during each type of survey. Subsequent tables in this section provide detailed lists of the sampling stations for each survey, and Section 6 contains maps of the sampling station locations.

Table 5-2: Summary of Sampling Program

	Locations[1]	**Frequency[2]**	**Constituents[3]**
Low-Flow Water Quality Surveys	86 total sites (54 mainstem, 18 tributary[4], 14 WWTF) -Upstream and downstream of 6 major dams -Upstream and downstream of wastewater treatment facilities (WWTFs) -Fill-in sites to provide adequate longitudinal coverage -At the mouth of major tributaries -WWTF effluent samples	2 surveys during the summer months, with diurnal DO measurements	Analytical Constituents: Oxygen and Oxygen Demand Nutrients and Impacts Indicator Organisms Field Measurements: In situ Measurements Secchi Disk Depth Diurnal DO Sweeps during low-flow surveys Flow measurements at un-gaged tributaries
High-Flow Water Quality Survey		1 survey during the late spring or early summer months	
Impoundments Studies	18 total sites 3 locations evenly spaced within the 5 impoundments (Ayers Island, Franklin Falls, Eastman Falls, Garvins Falls, Hooksett, and Amoskeag)	5 surveys, once per month, from May to September	Field Measurements: In situ Measurements Vertical DO/Temperature Profiles Laboratory Analysis: Total Phosphorus Chlorophyll-a
Continuous Monitoring	15 total sites -Upstream and downstream of 6 major dams -Downstream of the regional Winnipesaukee WWTF -Upstream and downstream of the Nashua WWTF	Monitoring equipment will be installed over a two month period, mid-July to mid-September	Continuous DO/Temperature Measurements
Sediment Testing	20 total sites -3 locations within each of the 6 impoundments -Downstream of the Winnipesaukee WWTF -Downstream of the Nashua WWTF	2 initial rounds, during 2nd and 4th impoundment surveys	Laboratory Analysis: SOD Sediment phosphorus flux

1. Complete list of sampling locations provided in Tables 5-4, 5-7, 5-9 and 5-10
2. See Table 6-7, Target Sampling Timeline
3. See Table 1-1 for specific constituents, more detailed information provided in Tables 5-5, 5-6, 5-8, and 5-11
4. Total of 16 different tributaries; there are two sampling sites on the East Branch Pemigewasset River due to a major WWTF location, resulting in 18 tributary sampling locations.

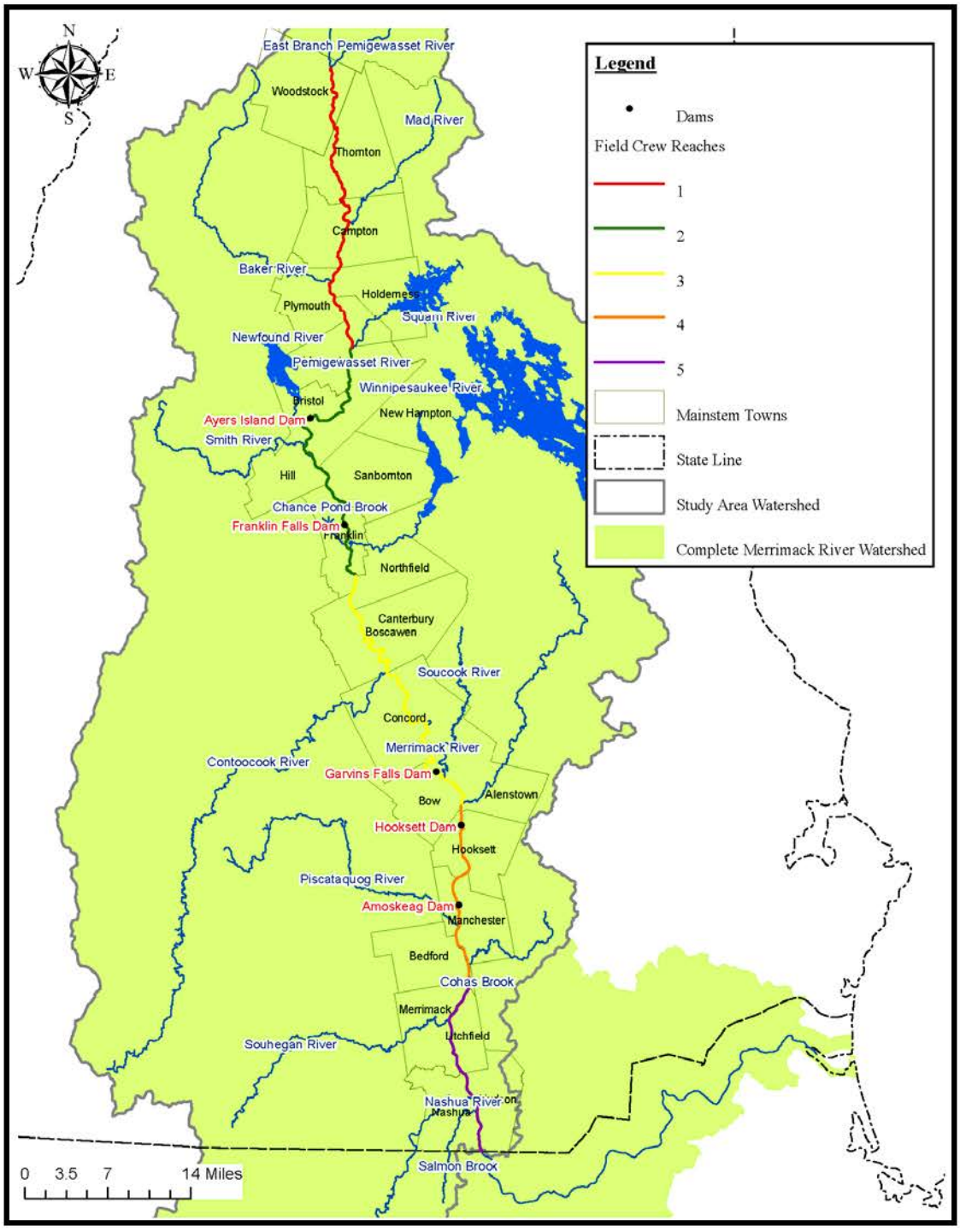
5.1 Low-Flow Sampling Events

Two low-flow surveys including 53 sampling stations within the study area will be conducted during the summer months as part of the sampling program. The study area has been divided into five reaches for the low-flow sampling program. Sampling crews will be assigned to each reach in accordance with the following general boundaries:

- Reach 1: Pemigewasset headwaters to downstream of the Squam River confluence
- Reach 2: Upstream of Ayers Island Dam to downstream of the Winnipesaukee WWTF
- Reach 3: Merrimack County Facilities to downstream of the Suncook River confluence
- Reach 4: Upstream of Hooksett Dam to downstream of the Cohas Brook confluence
- Reach 5: Derry WWTF to downstream of Nashua

Figure 5-1 highlights the boundaries of the five reaches on a map of the study area watershed.

Figure 5-1: Water Quality Sampling Program Reaches



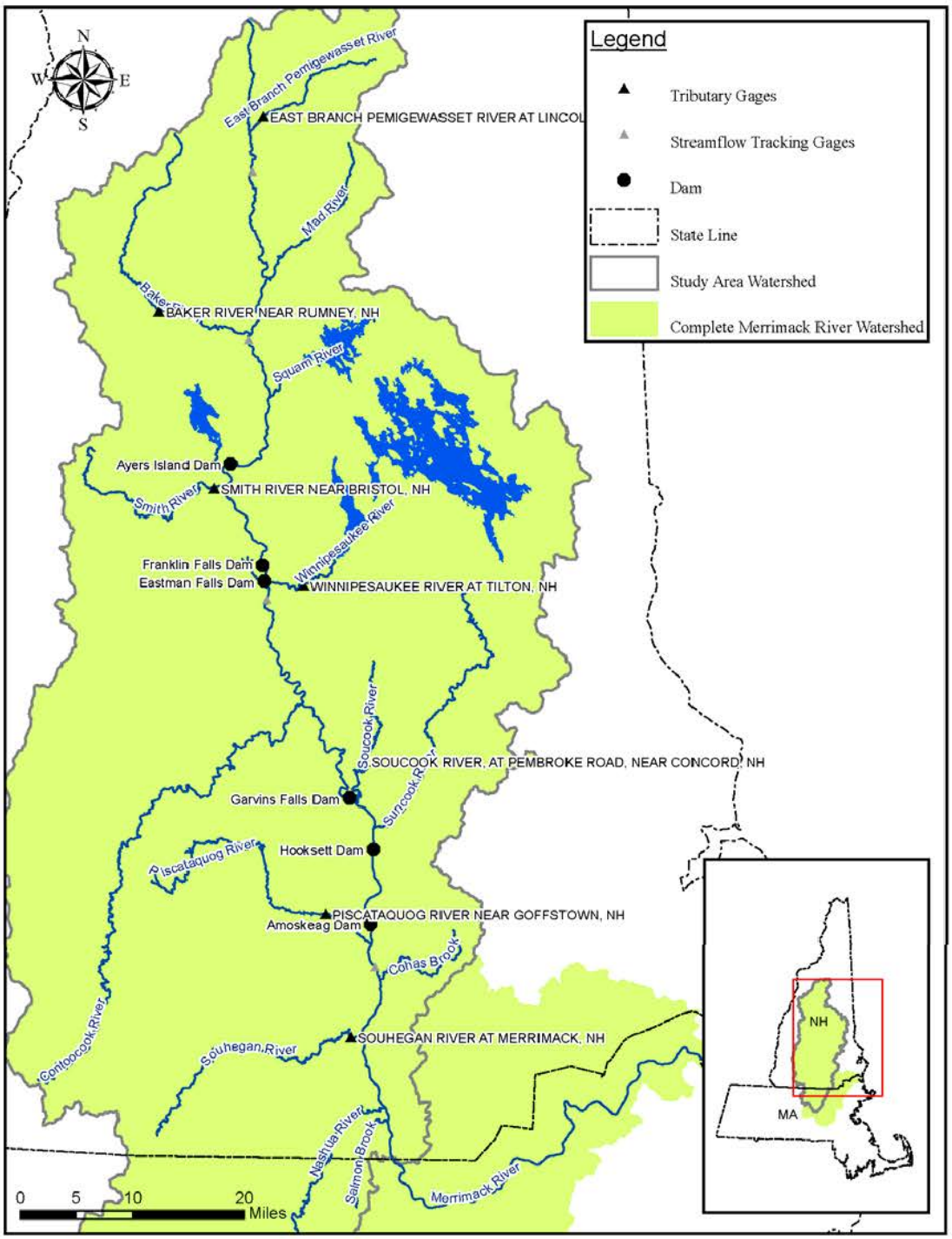
Low-flow samples will be collected at the mouth of 16 major tributaries, upstream and downstream of WWTFs in the mainstem (plus the Lincoln WWTF that lies on the East Branch Pemigewasset River), and upstream and downstream of the 6 impoundments (Ayers Island, Franklin Falls, Eastman Falls, Garvins Falls, Hooksett and Amoskeag). The sampling locations have also been selected so as to give full coverage over the entire Study Area.

In order to define total pollutant load entering the mainstem from each tributary, it will be necessary to gather flow data to accompany the water quality data collected at each tributary sampling station. Table 5-3 lists the 7 gaged tributaries with corresponding USGS gaging stations (see Figure 5-2 for the locations of these gages). Additional flow measurements will be required beyond the USGS operated stations to account for pollutant mass loads discharging to the Pemigewasset and Upper Merrimack Rivers and their major tributaries. These sites are identified in Table 5-4. Stage-discharge relationships will be developed at select stations along the mainstem and at the mouth of the major tributaries to quantify the variability of flow throughout the Study Area. Staff gages will be installed at each flow monitoring station so that the stage of the River or tributary can be determined during the low- and high-flow sampling events. These gages will be subject to periodic maintenance to confirm that the gage position has not changed. Figure 5-3 shows the locations of these gages within the Study Area.

Table 5-3: USGS Gages on Tributaries to the Upper Merrimack and Pemigewasset Rivers

Tributary	**USGS Gage**	**Location**
East Branch Pemigewasset	01074520	Lincoln, NH
Baker River	01076000	Rumney, NH
Smith River	01078000	Bristol, NH
Winnipesaukee River	01081000	Tilton, NH
Soucook River	01089100	Concord, NH
Piscataquog River	01091500	Goffstown, NH
Souhegan River	01094000	Merrimack, NH

Figure 5-2: Tributary USGS Streamflow Gages



As discussed in Section 3.1, diurnal sweeps will be performed at approximately half of the low-flow sampling locations as part of the low-flow surveys. The 27 diurnal sweep locations are indicated in Table 5-4, and each fulfills one of the following criteria: the station is within an impoundment; the station is directly downstream of a WWTF; or the station is at the mouth of one of the seven largest tributaries (drainage area greater than 100 square miles). More details on the logistics of the diurnal sweeps are provided in Section 6.3.3.

A detailed description of each sampling location is provided in Table 5-4; maps showing the location of each station are provided in Section 6. Sampling matrices describing the frequency and type of samples to be collected during each low-flow sampling event are provided in Table 5-5 (a and b). Sampling teams will be asked to note any wildlife in the immediate area of sample collection that may have an impact on contaminant concentration, such as pigeon roosting areas under bridges for samples collected on the downstream sides.

Table 5-4: Sampling Stations – Low- and High-Flow Surveys

River Reach	Station ID	Estimated River Mile (from Newburyport light)[1]	Landmark	Station Description	Within Impoundment?	Diurnal Sweep	Flow Meter	Estimated Streambed Slope[2]
Pemigewasset River	M001	169.9		Headwaters				5.0E-03
	T002	NA	Lincoln WWTF	U/S Lincoln WWTF		X		-
	T003	NA		D/S Lincoln WWTF 1		X		-
	T004	169.7		D/S Lincoln WWTF 2				-
	M005	169.3	Woodstock WWTF	U/S Woodstock WWTF				2.0E-03
	M006	169.2		D/S Woodstock WWTF1		X		2.0E-03
	M007	168.9		D/S Woodstock WWTF 2				2.0E-03
	M008	165.3		Woodstock Gage				2.0E-03
	M009	154.1		Campton				NA
	T010	153.2	Mad River	Mad River			X	-
	T011	147.2	Baker River	Baker River		X		-
	M012	146.9	Plymouth Village WWTF	U/S Plymouth Village WWTF				1.9E-04
	M013	146.4		D/S Plymouth Village WWTF 1		X		1.9E-04
	M014	146.2		D/S Plymouth Village WWTF 2				1.9E-04
	T015	141.0	Squam River	Squam River			X	-
	M016	137.4		U/S Ayers Island 1	X	X		-3.2E-03
	M017	134.5	Ayers Island Dam	U/S Ayers Island 2	X	X		NA
	M018	131.3		D/S Ayers Island, U/S Bristol WWTF				NA
	M019	130.9	Bristol WWTF	D/S Bristol WWTF 1		X		NA
	M020	130.6		D/S Bristol WWTF 2				NA
	T021	130.4	Newfound River	Newfound River			X	NA
	T022	127.9	Smith River	Smith River				NA
	M023	122.0	Franklin Falls Dam	U/S Franklin Falls 1	X	X		NA
	M024	118.7		D/S Franklin Falls, U/S Eastman Falls 1	X			-4.7E-04
	M025	117.5	Eastman Falls Dam	U/S Eastman Falls 2	X	X		7.3E-03
	M026	117.1		D/S Eastman Falls				4.7E-04
	T027	117.0	Chance Pond Brook	Chance Pond Brook			X	-
Merrimack River	T028	116.2	Winnipesaukee River	Winnipesaukee River		X		-
	M029	114.3	Winnipesaukee WWTF	U/S Winnipesaukee WWTF				-9.5E-04
	M030	113.6		D/S Winnipesaukee WWTF 1		X		3.5E-03
	M031	113.4		D/S Winnipesaukee WWTF 2				3.7E-03
	M032	110.6	Merrimack County Facilities	U/S Merrimack County WWTF				-2.4E-03
	M033	109.8		D/S Merrimack County WWTF 1		X		5.1E-04
	M034	109.4		D/S Merrimack County WWTF 2				5.1E-04
	T035	101.0	Contoocook River	Contoocook River		X	X	-

1 Estimated distance upstream from mouth of river, values given for confluence of tributaries, NA on tributaries
2 Mainstem stations only, based on available FEMA profiles and Lower Merrimack Study data, ft/ft

Table 5-4: Sampling Stations – Low- and High-Flow Surveys (continued)

River Reach	Station ID	Estimated River Mile (from Newburyport light)[1]		Station Description	Within Impoundment?	Diurnal Sweep	Flow Meter	Estimated Streambed Slope[2]
Merrimack River	M036	100.9	Concord Penacook WWTF	U/S Penacook WWTF				-2.4E-04
	M037	98.9		D/S Penacook WWTF 1		X		-6.9E-04
	M038	97.6		D/S Penacook WWTF 2				1.7E-03
	M039	94.5		U/S Concord	X			4.1E-03
	M040	90.3	Concord Hall Street WWTF	U/S Hall Street WWTF	X			-1.9E-02
	M041	88.7		D/S Hall Street WWTF 1, U/S Garvins Falls 1	X	X		-1.4E-03
	M042	88.0	Garvins Falls Dam	D/S Hall Street WWTF 2, U/S Garvins Falls	X	X		9.5E-04
	M043	86.4		D/S Garvins Falls	X			0.0E+00
	T044	86.0	Soucook River	Soucook River				-
	M045	84.7		U/S Hooksett 1	X	X		-1.5E-03
	T046	83.1	Suncook River	Suncook River		X	X	-
	M047	82.7	Suncook WWTF	U/S Suncook WWTF		X		NA
	M048	82.2		D/S Suncook WWTF 1		X		NA
	M049	81.8	Hooksett Dam	U/S Hooksett 2, D/S Suncook WWTF 2	X	X		1.6E-03
	M050	80.7		D/S Hooksett Dam	X			5.3E-03
	M051	79.2	Hooksett WWTF	U/S Hooksett WWTF	X			0.0E+00
	M052	78.7		D/S Hooksett WWTF 1	X			0.0E+00
	M053	77.6		D/S Hooksett WWTF 2, U/S Amoskeag 1	X	X		-1.1E-03
	M054	73.4	Amoskeag Dam	U/S Amoskeag 2	X	X		1.2E-03
	M055	71.9		D/S Amoskeag		X		3.2E-03
	T056	71.3	Piscataquog River	Piscataquog River		X		-
	M057	69.1	Manchester WWTF	U/S Manchester WWTF				3.2E-03
	M058	68.0		D/S Manchester WWTF 1		X		-1.4E-02
	T059	67.7	Cohas Brook	Cohas Brook			X	-
	M060	67.5		D/S Manchester WWTF 2				4.0E-03
	M061	65.6	Derry WWTF	U/S Derry WWTF				9.5E-04
	M062	63.8		D/S Derry WWTF 1		X		1.7E-04
	M063	63.1		D/S Derry WWTF 2				-9.5E-05
	T064	62.3	Souhegan River	Souhegan River		X		-
	M065	59.0	Merrimack WWTF	U/S Merrimack WWTF				-2.6E-04
	M066	57.5		D/S Merrimack WWTF 1		X		2.7E-03
	M067	56.5		D/S Merrimack WWTF 2				-1.3E-03
	T068	54.6	Nashua River	Nashua River			X	-
	T069	53.3	Salmon Brook	Salmon Brook			X	-
	M070	53.0	Nashua WWTF	U/S Nashua WWTF				1.1E-03
	M071	51.6		D/S Nashua WWTF 1		X		6.3E-04
	M072	51.5		D/S Nashua WWTF 2				6.3E-04

1 Estimated distance upstream from mouth of river, values given for confluence of tributaries, NA on tributaries
2 Mainstem stations only, based on available FEMA profiles and Lower Merrimack Study data, ft/ft

Table 5-5a: Sampling Matrix - Low-Flow Sampling Event 1

River Reach	Station ID	Station Description	Notes: Yellow Cells: QA samples (**Blue**=Field Blank, Black = Dup) White Cells: Single point samples (from center of river), or lateral composites (based on mixing conditions) Numbers listed are *Total Samples* at each station.	Required Constituents: Grab Samples or Lateral Composites for Laboratory Analysis: Total Suspended Solids		Total Phosphorus		Orthophosphorus		Nitrate/Nitrite		Ammonia-N		TKN		Phytoplankton Chlorophyll-a		Periphyton Chlorophyll-a*		$CBOD_5$		$CBOD_{20}$ (D/S major WWTFs)		DO (Winkler Titration)		E-coli		Fecal Coliform		Enterococcus		In-Situ Measurements: Notes: White Cells: Single point samples (from center of river) or lateral composites (based on mixing conditions) **Red** Text: Discrete lateral point samples (to confirm complete mixing) **Green** Text: Early morning sample for diurnal sweep Numbers listed are *Total Samples* at each station.	DO, Temp, pH, Cond.		Turbidity	Secchi Disk Depth	Vertical Temp/DO Profile	Flow
Pemigewasset	M001	Headwaters		1		1		1		1		1		1		1				1				1		1		1		1				1		
	T002	U/S Lincoln WWTF		1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1			1	1	1	1	1	1	1	1		1	1		
	linc-wwtf	Lincoln WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1						
	T003	D/S Lincoln WWTF 1		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1		1	**1**	1		1	**1**	1	**1**	1	**1**	1	**1**		**5**	**1**	1	1		
	T004	D/S Lincoln WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	M005	U/S Woodstock WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	wood-wwtf	Woodstock WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1						
	M006	D/S Woodstock WWTF1		1		1		1		1		1		1		1		1		1				1		1		1		1			**5**	**1**	1	1		
	M007	D/S Woodstock WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	M008	Woodstock Gage		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	M009	Campton		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	T010	Mad River		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	T011	Baker River		1		1		1		1		1		1		1				1				1		1		1		1			1	**1**	1	1		
	M012	U/S Plymouth Village WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	pv-wwtf	Plymouth Village WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1						
	M013	D/S Plymouth Village WWTF 1		1		1		1		1		1		1		1		1		1				1		1		1		1			**5**	**1**	1	1		
	M014	D/S Plymouth Village WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T015	Squam River		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	M016	U/S Ayers Island 1		1		1		1		1		1		1		1		1		1				1		1		1		1			1	**1**	1	1		
	M017	U/S Ayers Island 2		1		1		1		1		1		1		1				1				1		1		1		1			1	**1**	1	1		
	M018	D/S Ayers Island, U/S Bristol WWTF		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1	1	
	bris-wwtf	Bristol WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1						
	M019	D/S Bristol WWTF 1		1		1		1		1		1		1		1		1		1				1		1		1		1			**5**	**1**	1	1		
	M020	D/S Bristol WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T021	Newfound River		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	T022	Smith River		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	M023	U/S Franklin Falls 1		1		1		1		1		1		1		1		1		1				1		1		1		1			1	**1**	1	1	1	
	M024	D/S Franklin Falls, U/S Eastman Falls 1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1			1	1	1	1	1	1	1	1		**5**		1	1		
	M025	U/S Eastman Falls 2		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**			1	**1**			1	**1**	1	**1**	1	**1**	1	**1**		1	**1**	1	1		
	M026	D/S Eastman Falls		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T027	Chance Pond Brook		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
Upper Merrimack	T028	Winnipesaukee River		1		1		1		1		1		1		1				1				1		1		1		1			1	**1**	1	1		
	M029	U/S Winnipesaukee WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	winn-wwtf	Winnipesaukee WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1						
	M030	D/S Winnipesaukee WWTF 1		1		1		1		1		1		1		1		1		1		1	**1**	1		1		1		1			**5**	**1**	1	1		
	M031	D/S Winnipesaukee WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	M032	U/S Merrimack County WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	mc-wwtf	Merrimack County WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1						
	M033	D/S Merrimack County WWTF 1		1		1		1		1		1		1		1		1		1		1	1	1		1		1		1			**5**	**1**	1	1		
	M034	D/S Merrimack County WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T035	Contoocook River		1		1		1		1		1		1		1				1				1		1		1		1			1	**1**	1	1		1
	M036	U/S Penacook WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	pena-wwtf	Penacook WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1						
	M037	D/S Penacook WWTF 1		1		1		1		1		1		1		1		1		1				1		1		1		1			**5**	**1**	1	1		
	M038	D/S Penacook WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	M039	U/S Concord		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	M040	U/S Hall Street WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	hall-wwtf	Hall Street WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1						
	M041	D/S Hall Street WWTF 1, U/S Garvins Falls 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			**5**	**1**	1	1		
	M042	D/S Hall Street WWTF 2, U/S Garvins Falls 2		1		1		1		1		1		1		1				1				1		1		1		1			**5**	**1**	1	1	1	
	M043	D/S Garvins Falls		1		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T044	Soucook River		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		

River Reach	Station ID	Station Description	Required Constituents																																			
				Grab Samples or Lateral Composites for Laboratory Analysis																												**In-Situ Measurements**						
River Reach	**Station ID**	**Station Description**	**Notes:** Yellow Cells: QA samples (**Blue**=Field Blank, Black = Dup) White Cells: Single point samples (from center of river), or lateral composites (based on mixing conditions) Numbers listed are *Total Samples* at each station.	Total Suspended Solids		Total Phosphorus		Orthophosphorus		Nitrate/Nitrite		Ammonia-N		TKN		Phytoplankton Chlorophyll-a		Periphyton Chlorophyll-a*		$CBOD_5$		$CBOD_{20}$ (D/S major WWTFs)		DO (Winkler Titration)		E-coli		Fecal Coliform		Enterococcus		**Notes:** White Cells: Single point samples (from center of river) or lateral composites (based on mixing conditions) **Red** Text: Discrete lateral point samples (to confirm complete mixing) **Green** Text: Early morning sample for diurnal sweep Numbers listed are *Total Samples* at each station.	DO, Temp, pH, Cond.		Turbidity	Secchi Disk Depth	Vertical Temp/DO Profile	Flow
Upper Merrimack	M045	U/S Hooksett 1		1		1		1		1		1		1		1		1		1				1		1		1		1			1	1	1	1		
	T046	Suncook River		1		1		1		1		1		1		1				1				1		1		1		1			1	1	1	1		1
	M047	U/S Suncook WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	sun-wwtf	Suncook WWTF Effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M048	D/S Suncook WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5		1	1		
	M049	U/S Hooksett 2, D/S Suncook WWTF 2		1		1		1		1		1		1		1		1		1				1		1		1		1			1	1	1	1	1	
	M050	D/S Hooksett Dam		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	M051	U/S Hooksett WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	hook-wwtf	Hooksett WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M052	D/S Hooksett WWTF 1		1		1		1		1		1		1		1		1		1				1		1		1		1			5		1	1		
	M053	D/S Hooksett WWTF 2, U/S Amoskeag 1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1			1	1	1	1	1	1	1	1		5	1	1	1		
	M054	U/S Amoskeag 2		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**			1	**1**			1	**1**	1	**1**	1	**1**	1	**1**		1	1	1	1	1	
	M055	D/S Amoskeag		1		1		1		1		1		1		1				1				1		1		1		1			5	1	1	1		
	T056	Piscataquog River		1		1		1		1		1		1		1				1				1		1		1		1			1	1	1	1		
	M057	U/S Manchester WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	manc-wwtf	Manchester WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M058	D/S Manchester WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5	1	1	1		
		Totals for U/S of Manchester		**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**17**		**69**	**6**	**6**	**2**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**		**162**	**25**	**58**	**58**	**6**	**6**
Lower Merrimack	T059	Cohas Brook		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	M060	D/S Manchester WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	M061	U/S Derry WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	derr-wwtf	Derry WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M062	D/S Derry WWTF 1		1		1		1		1		1		1		1		1		1				1		1		1		1			5	1	1	1		
	M063	D/S Derry WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	T064	Souhegan River		1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1			1	1	1	1	1	1	1	1		1	1	1	1		
	M065	U/S Merrimack WWTF		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**			1	**1**			1	**1**	1	**1**	1	**1**	1	**1**		1		1	1		
	merr-wwtf	Merrimack WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M066	D/S Merrimack WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5	1	1	1		
	M067	D/S Merrimack WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	T068	Nashua River		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	T069	Salmon Brook		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	M070	U/S Nashua WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	nash-wwtf	Nashua WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M071	D/S Nashua WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5	1	1	1		
	M072	D/S Nashua WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
		Totals for D/S of Manchester		**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**3**		**17**	**2**	**2**	**0**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**		**42**	**4**	**14**	**14**	**0**	**3**
			Total QA Samples		*8*		*8*		*8*		*8*		*8*		*8*		*8*				*8*		*2*		*8*		*8*		*8*		*8*							
			REF: QA Requirements (5% Duplicates)		*4*		*4*		*4*		*4*		*4*		*4*		*4*				*4*		*1*		*4*		*4*		*4*		*4*							
			REF: QA Requirements (5% Field Blanks)		***4***		***4***		***4***		***4***		***4***		***4***		***4***				***4***		***1***		***4***		***4***		***4***		***4***							

*estimated locations for budget purposes, final periphyton sampling sites will be determined based on further field reconnaissance

Table 5-5b: Sampling Matrix - Low-Flow Sampling Event 2

River Reach	Station ID	Station Description	Required Constituents: Grab Samples or Lateral Composites for Laboratory Analysis — Notes: Yellow Cells: QA samples (**Blue**=Field Blank, Black = Dup) White Cells: Single point samples (from center of river), or lateral composites (based on mixing conditions) Numbers listed are *Total Samples* at each station.	Total Suspended Solids		Total Phosphorus		Orthophosphorus		Nitrate/Nitrite		Ammonia-N		TKN		Phytoplankton Chlorophyll-a		Periphyton Chlorophyll-a*		$CBOD_5$		$CBOD_{20}$ (D/S major WWTFs)		DO (Winkler Titration)		E-coli		Fecal Coliform		Enterococcus		In-Situ Measurements — Notes: White Cells: Single point samples (from center of river) or lateral composites (based on mixing conditions) **Red** Text: Discrete lateral point samples (to confirm complete mixing) **Green** Text: Early morning sample for diurnal sweep Numbers listed are *Total Samples* at each station.	DO, Temp, pH, Cond.		Turbidity	Secchi Disk Depth	Vertical Temp/DO Profile	Flow
Pemigewasset	M001	Headwaters		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	T002	U/S Lincoln WWTF		1	1	1	1	1	1	1	1	1	1	1	1	1			1	1			1	1	1	1	1	1	1	1	1	1			
	linc-wwtf	Lincoln WWTF effluent		1		1		1		1		1		1					1				1		1		1		1						
	T003	D/S Lincoln WWTF 1		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1		1	**1**	1		1	**1**	1	**1**	1	**1**	1	**1**	**5**	**1**	1	1		
	T004	D/S Lincoln WWTF 2		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	M005	U/S Woodstock WWTF		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	wood-wwtf	Woodstock WWTF effluent		1		1		1		1		1		1				1				1		1		1		1								
	M006	D/S Woodstock WWTF1		1		1		1		1		1		1		1		1				1		1		1		1			**5**	**1**	1	1		
	M007	D/S Woodstock WWTF 2		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	M008	Woodstock Gage		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	M009	Campton		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	T010	Mad River		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	T011	Baker River		1		1		1		1		1		1				1				1		1		1		1			1	**1**	1	1		
	M012	U/S Plymouth Village WWTF		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	pv-wwtf	Plymouth Village WWTF effluent		1		1		1		1		1		1				1				1		1		1		1								
	M013	D/S Plymouth Village WWTF 1		1		1		1		1		1		1		1		1				1		1		1		1			**5**	**1**	1	1		
	M014	D/S Plymouth Village WWTF 2		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T015	Squam River		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	M016	U/S Ayers Island 1		1		1		1		1		1		1		1		1				1		1		1		1			1	**1**	1	1		
	M017	U/S Ayers Island 2		1		1		1		1		1		1				1				1		1		1		1			1	**1**	1	1		
	M018	D/S Ayers Island, U/S Bristol WWTF		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1	1	
	bris-wwtf	Bristol WWTF effluent		1		1		1		1		1		1				1				1		1		1		1								
	M019	D/S Bristol WWTF 1		1		1		1		1		1		1		1		1				1		1		1		1			**5**	**1**	1	1		
	M020	D/S Bristol WWTF 2		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T021	Newfound River		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	T022	Smith River		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	M023	U/S Franklin Falls 1		1		1		1		1		1		1		1		1				1		1		1		1			1	**1**	1	1	1	
	M024	D/S Franklin Falls, U/S Eastman Falls 1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1		1	1	1	1	1	1	1	**5**		1	1		
	M025	U/S Eastman Falls 2		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**			1	**1**			1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	1		
	M026	D/S Eastman Falls		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T027	Chance Pond Brook		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
Upper Merrimack	T028	Winnipesaukee River		1		1		1		1		1		1				1				1		1		1		1			1	**1**	1	1		
	M029	U/S Winnipesaukee WWTF		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	winn-wwtf	Winnipesaukee WWTF effluent		1		1		1		1		1		1				1				1		1		1		1								
	M030	D/S Winnipesaukee WWTF 1		1		1		1		1		1		1		1		1		1	**1**	1		1		1		1			**5**	**1**	1	1		
	M031	D/S Winnipesaukee WWTF 2		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	M032	U/S Merrimack County WWTF		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	mc-wwtf	Merrimack County WWTF effluent		1		1		1		1		1		1				1				1		1		1		1								
	M033	D/S Merrimack County WWTF 1		1		1		1		1		1		1		1		1		1	1	1		1		1		1			**5**	**1**	1	1		
	M034	D/S Merrimack County WWTF 2		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T035	Contoocook River		1		1		1		1		1		1				1				1		1		1		1			1	**1**	1	1		1
	M036	U/S Penacook WWTF		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	pena-wwtf	Penacook WWTF effluent		1		1		1		1		1		1				1				1		1		1		1								
	M037	D/S Penacook WWTF 1		1		1		1		1		1		1		1		1				1		1		1		1			**5**	**1**	1	1		
	M038	D/S Penacook WWTF 2		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	M039	U/S Concord		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	M040	U/S Hall Street WWTF		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	hall-wwtf	Hall Street WWTF effluent		1		1		1		1		1		1				1				1		1		1		1								
	M041	D/S Hall Street WWTF 1, U/S Garvins Falls 1		1		1		1		1		1		1		1		1		1		1		1		1		1			**5**	**1**	1	1		
	M042	D/S Hall Street WWTF 2, U/S Garvins Falls 2		1		1		1		1		1		1				1				1		1		1		1			**5**	**1**	1	1	1	
	M043	D/S Garvins Falls		1		1		1		1		1		1				1				1		1		1		1			**5**		1	1		
	T044	Soucook River		1		1		1		1		1		1				1				1		1		1		1			1		1	1		

River Reach	Station ID	Station Description	**Notes:** Yellow Cells: QA samples (**Blue**=Field Blank, Black = Dup) White Cells: Single point samples (from center of river), or lateral composites (based on mixing conditions) Numbers listed are *Total Samples* at each station.	Total Suspended Solids		Total Phosphorus		Orthophosphorus		Nitrate/Nitrite		Ammonia-N		TKN		Phytoplankton Chlorophyll-a		Periphyton Chlorophyll-a*		$CBOD_5$		$CBOD_{20}$ (D/S major WWTFs)		DO (Winkler Titration)		E-coli		Fecal Coliform		Enterococcus		**Notes:** White Cells: Single point samples (from center of river) or lateral composites (based on mixing conditions) **Red** Text: Discrete lateral point samples (to confirm complete mixing) **Green** Text: Early morning sample for diurnal sweep Numbers listed are *Total Samples* at each station.	DO, Temp, pH, Cond.		Turbidity	Secchi Disk Depth	Vertical Temp/DO Profile	Flow
			Required Constituents — Grab Samples or Lateral Composites for Laboratory Analysis																													In-Situ Measurements						
Upper Merrimack	M045	U/S Hooksett 1		1		1		1		1		1		1		1		1		1				1		1		1		1			1	1	1	1		
	T046	Suncook River		1		1		1		1		1		1		1				1				1		1		1		1			1	1	1	1		1
	M047	U/S Suncook WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	sun-wwtf	Suncook WWTF Effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M048	D/S Suncook WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5		1	1		
	M049	U/S Hooksett 2, D/S Suncook WWTF 2		1		1		1		1		1		1		1		1		1				1		1		1		1			1	1	1	1	1	
	M050	D/S Hooksett Dam		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	M051	U/S Hooksett WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	hook-wwtf	Hooksett WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M052	D/S Hooksett WWTF 1		1		1		1		1		1		1		1		1		1				1		1		1		1			5		1	1		
	M053	D/S Hooksett WWTF 2, U/S Amoskeag 1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1			1	1	1	1	1	1	1	1		5	1	1	1		
	M054	U/S Amoskeag 2		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**			1	**1**			1	**1**	1	**1**	1	**1**	1	**1**		1	1	1	1	1	
	M055	D/S Amoskeag		1		1		1		1		1		1		1				1				1		1		1		1			5	1	1	1		
	T056	Piscataquog River		1		1		1		1		1		1		1				1				1		1		1		1			1	1	1	1		
	M057	U/S Manchester WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	manc-wwtf	Manchester WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M058	D/S Manchester WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5	1	1	1		
		Totals for U/S of Manchester		**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**17**		**69**	**6**	**6**	**2**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**		**162**	**25**	**58**	**58**	**6**	**6**
Lower Merrimack	T059	Cohas Brook		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	M060	D/S Manchester WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	M061	U/S Derry WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	derr-wwtf	Derry WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M062	D/S Derry WWTF 1		1		1		1		1		1		1		1		1		1				1		1		1		1			5	1	1	1		
	M063	D/S Derry WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	T064	Souhegan River		1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1			1	1	1	1	1	1	1	1		1	1	1	1		
	M065	U/S Merrimack WWTF		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**			1	**1**			1	**1**	1	**1**	1	**1**	1	**1**		1		1	1		
	merr-wwtf	Merrimack WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M066	D/S Merrimack WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5	1	1	1		
	M067	D/S Merrimack WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	T068	Nashua River		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	T069	Salmon Brook		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	M070	U/S Nashua WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	nash-wwtf	Nashua WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M071	D/S Nashua WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5	1	1	1		
	M072	D/S Nashua WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
		Totals for D/S of Manchester		**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**3**		**17**	**2**	**2**	**0**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**		**42**	**4**	**14**	**14**	**0**	**3**
			Total QA Samples		*8*		*8*		*8*		*8*		*8*		*8*		*8*				*8*		*2*		*8*		*8*		*8*		*8*							
			REF: QA Requirements (5% Duplicates)		*4*		*4*		*4*		*4*		*4*		*4*		*4*				*4*		*1*		*4*		*4*		*4*		*4*							
			REF: QA Requirements (5% Field Blanks)		***4***		***4***		***4***		***4***		***4***		***4***		***4***				***4***		***1***		***4***		***4***		***4***		***4***							

*estimated locations for budget purposes, final periphyton sampling sites will be determined based on further field reconnaissance

5.2 High-Flow Sampling Event

One high-flow survey will be done during the late spring or summer months as part of the sampling program. Currently, the locations and constituents of the high-flow survey are the same as those for the low-flow surveys, however they may be altered prior to the initiation of the sampling program. A sampling matrix describing the frequency and type of samples to be collected during the high-flow sampling event is provided in Table 5-6.

Table 5-6: Sampling Matrix - High-Flow Sampling Event

River Reach	Station ID	Station Description	Notes: Yellow Cells: QA samples (**Blue**=Field Blank, Black = Dup) White Cells: Single point samples (from center of river), or lateral composites (based on mixing conditions) Numbers listed are *Total Samples* at each station.	Required Constituents: Grab Samples or Lateral Composites for Laboratory Analysis: Total Suspended Solids	Total Phosphorus	Orthophosphorus	Nitrate/Nitrite	Ammonia-N	TKN	Phytoplankton Chlorophyll-a	Periphyton Chlorophyll-a*	$CBOD_5$	$CBOD_{20}$ (D/S major WWTFs	DO (Winkler Titration)	E-coli	Fecal Coliform	Enterococcus	Notes: White Cells: Single point samples (from center of river) or lateral composites (based on mixing conditions) **Red** Text: Discrete lateral point samples (to confirm complete mixing) **Green** Text: Early morning sample for diurnal sweep Numbers listed are *Total Samples* at each station.	In-Situ Measurements: DO, Temp, pH, Cond.	Turbidity	Secchi Disk Depth	Vertical Temp/DO Profile	Flow
Pemigewasset	M001	Headwaters		1	1	1	1	1	1	1		1		1		1		1		1			1	1		
	T002	U/S Lincoln WWTF		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1		
	linc-wwtf	Lincoln WWTF effluent		1		1		1		1		1		1				1								
	T003	D/S Lincoln WWTF 1		1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1		
	T004	D/S Lincoln WWTF 2		1		1		1		1		1		1				1								
	M005	U/S Woodstock WWTF		1		1		1		1		1		1				1					1	1		
	wood-wwtf	Woodstock WWTF effluent		1		1		1		1		1		1				1								
	M006	D/S Woodstock WWTF1		1		1		1		1		1		1		1		1					1	1		
	M007	D/S Woodstock WWTF 2		1		1		1		1		1		1				1					1	1		
	M008	Woodstock Gage		1		1		1		1		1		1				1					1	1		
	M009	Campton		1		1		1		1		1		1				1					1	1		
	T010	Mad River		1		1		1		1		1		1				1					1	1		1
	T011	Baker River		1		1		1		1		1		1				1					1	1		
	M012	U/S Plymouth Village WWTF		1		1		1		1		1		1				1					1	1		
	pv-wwtf	Plymouth Village WWTF effluent		1		1		1		1		1		1				1								
	M013	D/S Plymouth Village WWTF 1		1		1		1		1		1		1		1		1					1	1		
	M014	D/S Plymouth Village WWTF 2		1		1		1		1		1		1				1					1	1		
	T015	Squam River		1		1		1		1		1		1				1					1	1		1
	M016	U/S Ayers Island 1		1		1		1		1		1		1		1		1					1	1		
	M017	U/S Ayers Island 2		1		1		1		1		1		1				1					1	1		
	M018	D/S Ayers Island, U/S Bristol WWTF		1		1		1		1		1		1				1					1	1		
	bris-wwtf	Bristol WWTF effluent		1		1		1		1		1		1				1								
	M019	D/S Bristol WWTF 1		1		1		1		1		1		1		1		1					1	1		
	M020	D/S Bristol WWTF 2		1		1		1		1		1		1				1					1	1		
	T021	Newfound River		1		1		1		1		1		1				1					1	1		1
	T022	Smith River		1		1		1		1		1		1				1					1	1		
	M023	U/S Franklin Falls 1		1		1		1		1		1		1		1		1					1	1		
	M024	D/S Franklin Falls, U/S Eastman Falls 1		1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1		
	M025	U/S Eastman Falls 2		1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1		
	M026	D/S Eastman Falls		1		1		1		1		1		1				1					1	1		
	T027	Chance Pond Brook		1		1		1		1		1		1				1					1	1		1
Upper Merrimack	T028	Winnipesaukee River		1		1		1		1		1		1				1					1	1		
	M029	U/S Winnipesaukee WWTF		1		1		1		1		1		1				1					1	1		
	winn-wwtf	Winnipesaukee WWTF effluent		1		1		1		1		1		1				1								
	M030	D/S Winnipesaukee WWTF 1		1		1		1		1		1		1		1		1		1	1		1	1		
	M031	D/S Winnipesaukee WWTF 2		1		1		1		1		1		1				1					1	1		
	M032	U/S Merrimack County WWTF		1		1		1		1		1		1				1					1	1		
	mc-wwtf	Merrimack County WWTF effluent		1		1		1		1		1		1				1								
	M033	D/S Merrimack County WWTF 1		1		1		1		1		1		1		1		1		1	1		1	1		
	M034	D/S Merrimack County WWTF 2		1		1		1		1		1		1				1					1	1		
	T035	Contoocook River		1		1		1		1		1		1				1					1	1		1
	M036	U/S Penacook WWTF		1		1		1		1		1		1				1					1	1		
	pena-wwtf	Penacook WWTF effluent		1		1		1		1		1		1				1								
	M037	D/S Penacook WWTF 1		1		1		1		1		1		1		1		1					1	1		
	M038	D/S Penacook WWTF 2		1		1		1		1		1		1				1					1	1		
	M039	U/S Concord		1		1		1		1		1		1				1					1	1		
	M040	U/S Hall Street WWTF		1		1		1		1		1		1				1					1	1		
	hall-wwtf	Hall Street WWTF effluent		1		1		1		1		1		1				1								
	M041	D/S Hall Street WWTF 1, U/S Garvins Falls 1		1		1		1		1		1		1		1		1					1	1		
	M042	D/S Hall Street WWTF 2, U/S Garvins Falls		1		1		1		1		1		1				1					1	1		
	M043	D/S Garvins Falls		1		1		1		1		1		1				1					1	1		
	T044	Soucook River		1		1		1		1		1		1				1					1	1		

River Reach	Station ID	Station Description	Notes: Yellow Cells: QA samples (**Blue**=Field Blank, Black = Dup) White Cells: Single point samples (from center of river), or lateral composites (based on mixing conditions) Numbers listed are *Total Samples* at each station.	Total Suspended Solids		Total Phosphorus		Orthophosphorus		Nitrate/Nitrite		Ammonia-N		TKN		Phytoplankton Chlorophyll-a		Periphyton Chlorophyll-a*		$CBOD_5$		$CBOD_{20}$ (D/S major WWTFs)		DO (Winkler Titration)		E-coli		Fecal Coliform		Enterococcus		Notes: White Cells: Single point samples (from center of river) or lateral composites (based on mixing conditions) **Red** Text: Discrete lateral point samples (to confirm complete mixing) **Green** Text: Early morning sample for diurnal sweep Numbers listed are *Total Samples* at each station.	DO, Temp, pH, Cond.		Turbidity	Secchi Disk Depth	Vertical Temp/DO Profile	Flow
			Required Constituents: Grab Samples or Lateral Composites for Laboratory Analysis																													Required Constituents: In-Situ Measurements						
Upper Merrimack	M045	U/S Hooksett 1		1		1		1		1		1		1		1		1		1				1		1		1		1			1	1	1	1		
	T046	Suncook River		1		1		1		1		1		1		1				1				1		1		1		1			1	1	1	1		1
	M047	U/S Suncook WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	sun-wwtf	Suncook WWTF Effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M048	D/S Suncook WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5		1	1		
	M049	U/S Hooksett 2, D/S Suncook WWTF 2		1		1		1		1		1		1		1		1		1				1		1		1		1			1	1	1	1	1	
	M050	D/S Hooksett Dam		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	M051	U/S Hooksett WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	hook-wwtf	Hooksett WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M052	D/S Hooksett WWTF 1		1		1		1		1		1		1		1		1		1				1		1		1		1			5		1	1		
	M053	D/S Hooksett WWTF 2, U/S Amoskeag 1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1			1	1	1	1	1	1	1	1		5	1	1	1		
	M054	U/S Amoskeag 2		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**			1	**1**			1	**1**	1	**1**	1	**1**	1	**1**		1	1	1	1	1	
	M055	D/S Amoskeag		1		1		1		1		1		1		1				1				1		1		1		1			5	1	1	1		
	T056	Piscataquog River		1		1		1		1		1		1		1				1				1		1		1		1			1	1	1	1		
	M057	U/S Manchester WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	manc-wwtf	Manchester WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M058	D/S Manchester WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5	1	1	1		
		Totals for U/S of Manchester		**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**	**17**		**69**	**6**	**6**	**2**	**69**	**6**	**69**	**6**	**69**	**6**	**69**	**6**		**162**	**25**	**58**	**58**	**6**	**6**
Lower Merrimack	T059	Cohas Brook		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	M060	D/S Manchester WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	M061	U/S Derry WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	derr-wwtf	Derry WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M062	D/S Derry WWTF 1		1		1		1		1		1		1		1		1		1				1		1		1		1			5	1	1	1		
	M063	D/S Derry WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	T064	Souhegan River		1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1			1	1	1	1	1	1	1	1		1	1	1	1		
	M065	U/S Merrimack WWTF		1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**			1	**1**			1	**1**	1	**1**	1	**1**	1	**1**		1		1	1		
	merr-wwtf	Merrimack WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M066	D/S Merrimack WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5	1	1	1		
	M067	D/S Merrimack WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
	T068	Nashua River		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	T069	Salmon Brook		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		1
	M070	U/S Nashua WWTF		1		1		1		1		1		1		1				1				1		1		1		1			1		1	1		
	nash-wwtf	Nashua WWTF effluent		1		1		1		1		1		1		1				1				1		1		1		1								
	M071	D/S Nashua WWTF 1		1		1		1		1		1		1		1		1		1		1		1		1		1		1			5	1	1	1		
	M072	D/S Nashua WWTF 2		1		1		1		1		1		1		1				1				1		1		1		1			5		1	1		
		Totals for D/S of Manchester		**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**	**3**		**17**	**2**	**2**	**0**	**17**	**2**	**17**	**2**	**17**	**2**	**17**	**2**		**42**	**4**	**14**	**14**	**0**	**3**
			Total QA Samples		*8*		*8*		*8*		*8*		*8*		*8*		*8*				*8*		*2*		*8*		*8*		*8*		*8*							
			REF: QA Requirements (5% Duplicates)		*4*		*4*		*4*		*4*		*4*		*4*		*4*				*4*		*1*		*4*		*4*		*4*		*4*							
			REF: QA Requirements (5% Field Blanks)		***4***		***4***		***4***		***4***		***4***		***4***		***4***				***4***		***1***		***4***		***4***		***4***		***4***							

*estimated locations for budget purposes, final periphyton sampling sites will be determined based on further field reconnaissance

5.3 Impoundment Studies

Understanding the water quality and hydrodynamics of the 6 impoundments that lie in the Study Area is important in order to identify the source(s) of the dissolved oxygen deficits of the Merrimack and Pemigewasset Rivers. To do this, surveys of the riverine impoundments will be conducted as part of this sampling program. Once a month for five months (May to September, targeted for 2008), sampling teams will take vertical profiles of dissolved oxygen and temperature and limited water quality samples at three stations within each of the five impoundments. Table 5-7 provides the locations of the impoundment sampling stations; a sampling matrix detailing the frequency and type of samples to be collected during the impoundment studies is provided in Table 5-8.

Table 5-7: Sampling Stations – Impoundment Studies

River Reach	Impoundment	Station ID	Station Description
Pemigewasset	Ayers Island	I001	Ayers Island 1
		I002	Ayers Island 2
		I003	Ayers Island 3
	Franklin Falls	I004	Franklin Falls 1
		I005	Franklin Falls 2
		I006	Franklin Falls 3
	Eastman Falls	I007	Eastman Falls 1
		I008	Eastman Falls 2
		I009	Eastman Falls 3
Upper Merrimack	Garvins Falls	I010	Garvins Falls 1
		I011	Garvins Falls 2
		I012	Garvins Falls 3
	Hooksett Falls	I013	Hooksett Falls 1
		I014	Hooksett Falls 2
		I015	Hooksett Falls 3
	Amoskeag	I016	Amoskeag 1
		I017	Amoskeag 2
		I018	Amoskeag 3

Table 5-8: Sampling Matrix - Impoundment Studies

River Reach	Impoundment	Station ID	Station Description	Notes: Yellow Cells: QA samples (Blue=Field Blank, Black = Dup) White Cells: Single point samples (from center of river) Green Text: Discrete vertical point samples Red - Additional samples added at multiple depths	May					June					July					August					September					October				
					In-situ	Lab				In-situ	Lab				In-situ	Lab				In-situ	Lab				In-situ	Lab				In-situ	Lab			
					DO, Temp, pH, Cond.	Phosphorus		Phytoplanton Chlorophyll-a		DO, Temp, pH, Cond.	Phosphorus		Phytoplanton Chlorophyll-a		DO, Temp, pH, Cond.	Phosphorus		Phytoplanton Chlorophyll-a		DO, Temp, pH, Cond.	Phosphorus		Phytoplanton Chlorophyll-a		DO, Temp, pH, Cond.	Phosphorus		Phytoplanton Chlorophyll-a		DO, Temp, pH, Cond.	Phosphorus		Phytoplanton Chlorophyll-a	
Pemigewasset	Ayers Island	I001	Ayers Island 1		5	2	1	1	1	5	2		1		5	2		1		5	2		1		5	2		1		5	2		1	
		I002	Ayers Island 2		5	1	1	1	1	5	1		1		5	1		1		5	1		1		5	1		1		5	1		1	
		I003	Ayers Island 3		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1	
	Franklin Falls	I004	Franklin Falls 1		5	2		1		5	2	1	1	1	5	2		1		5	2		1		5	2		1		5	2		1	
		I005	Franklin Falls 2		5	1		1		5	1	1	1	1	5	1		1		5	1		1		5	1		1		5	1		1	
		I006	Franklin Falls 3		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1	
	Eastman Falls	I007	Eastman Falls 1		5	2		1		5	2		1		5	2	1	1	1	5	2		1		5	2		1		5	2		1	
		I008	Eastman Falls 2		5	1		1		5	1		1		5	1	1	1	1	5	1		1		5	1		1		5	1		1	
		I009	Eastman Falls 3		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1	
Upper Merrimack	Garvins Falls	I010	Garvins Falls 1		5	2		1		5	2		1		5	2		1		5	2	1	1	1	5	2		1		5	2		1	
		I011	Garvins Falls 2		5	1		1		5	1		1		5	1		1		5	1	1	1	1	5	1		1		5	1		1	
		I012	Garvins Falls 3		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1	
	Hooksett Falls	I013	Hooksett Falls 1		5	2		1		5	2		1		5	2		1		5	2		1		5	2		1		5	2		1	
		I014	Hooksett Falls 2		5	1		1		5	1		1		5	1		1		5	1		1		5	1	1	1	1	5	1		1	
		I015	Hooksett Falls 3		5	1		1		5	1		1		5	1		1		5	1		1		5	1	1	1	1	5	1		1	
	Amoskeag	I016	Amoskeag 1		5	2		1		5	2		1		5	2		1		5	2		1		5	2		1		5	2		1	
		I017	Amoskeag 2		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1		5	1	1	1	1
		I018	Amoskeag 3		5	1		1		5	1		1		5	1		1		5	1		1		5	1		1		5	1	1	1	1
			Totals		90	24	2	18	2	90	24	2	18	2	90	24	2	18	2	90	24	2	18	2	90	24	2	18	2	90	24	2	18	2
			REF: QA Requirements (5% Duplicates)				*1*		*1*			*1*		*1*			*1*		*1*			*1*		*1*			*1*		*1*			*1*		*1*
			REF: QA Requirements (5% Field Blanks)				*1*		*1*			*1*		*1*			*1*		*1*			*1*		*1*			*1*		*1*			*1*		*1*

5.4 Continuous DO and Temperature Monitoring

Continuous dissolved oxygen and temperature measurements will be made at 15 locations in the Study Area between mid-July and mid-September. Table 5-9 shows the details of the continuous monitoring locations. Measurements will be logged at 15-minute intervals between mid-July and mid-September 2008 and downloaded weekly by members of the CDM Project Team.

Table 5-9: Sampling Stations – Continuous Monitoring

River Reach	Station ID	Station Type	Station Description
Pemigewasset	C001	I	U/S Ayers Island
	C002	M	D/S Ayers Island
	C003	I	U/S Franklin Falls
	C004	I	D/S Franklin Falls and U/S Eastman Falls
	C005	I	D/S Eastman Falls
Upper Merrimack	C006	M	D/S Winnipesaukee WWTF
	C007	I	U/S Garvins Falls
	C008	M	D/S Garvins Falls
	C009	I	U/S Hooksett
	C010	M	D/S Hooksett
	C011	I	U/S Amoskeag
	C012	M	D/S Amoskeag
Lower Merrimack	C013	M	D/S Manchester WWTF
	C014	M	U/S Nashua WWTF
	C015	M	D/S Nashua WWTF

M: Mainstem
I: Impoundment

5.5 Sediment Oxygen Demand and Nutrient Flux Sampling

The role of sediments as contributors to the dissolved oxygen deficits in the Merrimack and Pemigewasset Rivers is currently unknown. This sampling program includes a preliminary assessment of the SOD and sediment nutrient flux at select locations in the Study Area. The following 20 locations have been initially identified as potential SOD evaluation areas:

- 18 stations within the six impoundments (3 within each; Ayers Island, Franklin Falls, Eastman Falls, Garvins Falls, Hooksett and Amoskeag)
- Downstream of the regional Winnipesaukee WWTF, where the reach is not impaired
- Within the Nashua impaired reach, downstream of the Nashua WWTF

Preliminary sediment sampling will be done during the summer months. If the results of the SOD and nutrient flux analyses show that sediments may be contributing to the oxygen deficits in the river, a plan for more extensive sediment sampling will be developed.

Table 5-10 provides more details on the sediment sampling locations; exact sediment sampling locations will be determined based on river bed characteristics in those areas specified in Table 5-10. Table 5-11 shows the sampling matrix for the sediment sampling events.

Table 5-10: Sampling Stations – Sediment Sampling

River Reach	Station ID	Station Type	Station Description
Pemigewasset	S001	I	U/S Ayers Island Dam 1
	S002	I	U/S Ayers Island Dam 2
	S003	I	U/S Ayers Island Dam 3
	S004	I	U/S Franklin Falls Dam 1
	S005	I	U/S Franklin Falls Dam 2
	S006	I	U/S Franklin Falls Dam 3
	S007	I	U/S Eastman Falls Dam 1
	S008	I	U/S Eastman Falls Dam 2
	S009	I	U/S Eastman Falls Dam 3
Upper Merrimack	S010	M	D/S Winnipesaukee WWTF
	S011	I	U/S Garvins Falls Dam 1
	S012	I	U/S Garvins Falls Dam 2
	S013	I	U/S Garvins Falls Dam 3
	S014	I	U/S Hooksett Dam 1
	S015	I	U/S Hooksett Dam 2
	S016	I	U/S Hooksett Dam 3
	S017	I	U/S Amoskeag Dam 1
	S018	I	U/S Amoskeag Dam 2
	S019	I	U/S Amoskeag Dam 3
Lower Merrimack	S020	M	Nashua Impairment

M: mainstem
I: impoundment

Table 5-11: Sampling Matrix – Sediment Sampling

River Reach	Station ID	Station Type	Station Description	# Samples	
				Sediment Oxygen Demand	Sediment Phosphorus Flux
Pemigewasset	S001	I	U/S Ayers Island Dam 1	2	4
	S002	I	U/S Ayers Island Dam 2	2	2
	S003	I	U/S Ayers Island Dam 3	2	2
	S004	I	U/S Franklin Falls Dam 1	2	4
	S005	I	U/S Franklin Falls Dam 2	2	2
	S006	I	U/S Franklin Falls Dam 3	2	2
	S007	I	U/S Eastman Falls Dam 1	2	4
	S008	I	U/S Eastman Falls Dam 2	2	2
	S009	I	U/S Eastman Falls Dam 3	2	2
Upper Merrimack	S010	M	D/S Winnipesaukee WWTF	2	2
	S011	I	U/S Garvins Falls Dam 1	2	4
	S012	I	U/S Garvins Falls Dam 2	2	2
	S013	I	U/S Garvins Falls Dam 3	2	2
	S014	I	U/S Hooksett Dam 1	2	4
	S015	I	U/S Hooksett Dam 2	2	2
	S016	I	U/S Hooksett Dam 3	2	2
	S017	I	U/S Amoskeag Dam 1	2	4
	S018	I	U/S Amoskeag Dam 2	2	2
	S019	I	U/S Amoskeag Dam 3	2	2
Lower Merrimack	S020	M	Nashua Impairment	2	2
			Totals	**40**	**52**

5.6 Additional Sampling Requests

Additional sampling task requests by stakeholders in the Upper Merrimack and Pemigewasset River Study will be conducted concurrently with the components of the field sampling program outlined in this document, and conducted as funding allows. These tasks are not covered in the associated QAPP or SOP Compendium.

Manchester Water Works has requested that drinking water treatability samples be collected while sampling crews are in the field collecting samples for the water quality and/or impoundment surveys. The treatability samples will be taken near the intake for the water treatment plant, which is located just north of the Interstate-93 bridge in Hooksett, NH (see Map 8 in Appendix A). In order to capture the full range of river conditions, the treatability samples collected during this 6 month summer sampling program should be incorporated with samples taken during a consecutive 6 month winter sampling program. The samples should also be taken at fixed intervals (monthly or biweekly) over the entire year of sampling. Table 5-12 shows the constituents and number of drinking water treatability samples likely to be included as part of the Upper Merrimack Field Sampling Program.

Table 5-12: Drinking Water Treatability Sampling

Constituent	Total #
Alkalinity	6
Total Organic Carbon	6
UV254 absorption	6
UV254 absorption - filtered	6
MIB and Geosmin	6
Algae	6
Actinomycetes plate count	6
Iron	6
Manganese	6
MTBE	6
Perchlorate	6
Others:	
Sample Filtration	6
Total Metal Prep	6

Due to the requirement that the treatability samples be taken at fixed intervals over the entire 6 month sampling period, it is logical for this effort to coincide with the monthly impoundment surveys (see Section 5.3). Additional treatability samples may be taken during the water quality events if the streamflow conditions are such that those events fall half-way between two impoundment surveys.

Section 6
Sampling Program Logistics

This section outlines the sample collection and delivery logistics that will be implemented by the CDM Project Team during sampling events.

6.1 Centralized Sampling Coordination

One centralized coordination point will be established at a location with easy road access that is fairly central to the Study Area sampling points during low- and high-flow sampling events. This location will serve as the centralized drop-off location for samples from sample runners and sampling teams. If the volume of bacteria samples for one survey exceeds the capabilities of the central location's laboratory, a mobile lab will be contracted to perform bacteria analysis so that the four hour holding time constraint is not violated. This collection point will be staffed by at least one Field Program Coordinator, who will serve as the primary point of contact between the sampling teams and the other Coordinators.

Prior to event mobilization, sample runners will be given a list of all sample containers provided to the sampling teams. The runners will be responsible for checking items off the list as they are received. Runners will deliver the samples to the centralized collection point and double check their list prior to transferring custody of the samples at the centralized collection point.

The Field Program Coordinator located at the central location will be responsible for confirming that all items on the runners' lists have been delivered to the central collection point and will confirm with the deliverer that the labeling is correct. The designated Field Program Coordinator will enter the receipt of the samples into a master log as they are received at the central collection point and will coordinate the transfer of sample custody to the appropriate laboratory.

6.2 Field Reconnaissance

The locations of the sampling points are preliminary and may need to be adjusted based on a final field reconnaissance survey. The final field reconnaissance is needed to confirm and finalize sampling locations and accessibility, verify WWTF outfall discharge points into the main stem, determine where complete lateral mixing is achieved downstream of WWTF and tributary confluences, and to determine whether some of the sampling locations will be accessed by boat (and if so the type of boat required) or by land (either from a bridge crossing or by wading into the river where possible).

Preliminary field screening of in-situ constituents will be performed to confirm that the sampling stations are at points in the river with sufficient lateral mixing (at locations downstream of WWTFs and tributaries, especially those that discharge into impoundments, and downstream of dam outlets). This will be done during conditions

"representative" of the flows expected during the low-flow sampling events. If due to spatial constraints a sample would need to be collected from a point where the mixing is incomplete, quarter-point samples will be collected and composited to form a more representative sample (the procedure for quarter-point sampling is outlined in the QAPP).

The field reconnaissance will also include a general visual survey of macrophytes along the mainstem, which will include their species, spatial coverage and location.

6.3 Water Quality Sampling Events

The following section describes the water quality (low- and high-flow events) sampling logistics for sampling teams and sample runners. Water quality sampling station locations are shown in Appendix A with an accompanying table that gives additional information on each site.

6.3.1 In-stream Sampling by Boat and Land Crews

As discussed in Section 5, the Study Area has been divided into five reaches for the low- and high-flow sampling program (see Figure 5-1). Boat crews will sample all mainstem and tributary sampling stations along their assigned reach that are accessible from in-stream locations. Five, one person "land" crews will be assigned to sample from the locations listed in Table 6-1.

Table 6-1: Land Crew Sampling Stations

Land Crew	Reach	Sampling Stations*
1	Pemigewasset headwaters to downstream of Squam River Confluence	M001; T002; T003; M004; M005; M006; M007; T008; T009; M010; M011; T012
2	Upstream of Ayers Island Dam to downstream of Winnipesaukee WWTF	M015; M016; T017; T018; M019; M020; T021; M023
3	Merrimack County Facilities to downstream of Suncook River confluence	T025; M026; M027; M028; M029; M030
4	Upstream of Hooksett Dam to downstream of Cohas Brook confluence	M039; T040; M042; T043
5	Derry WWTF to NH/MA state line	M042; T043; M044; T045

*this is a preliminary list of locations, more stations may be added if necessary based on the final field reconnaissance

All crews will be equipped with Global Positioning Systems (GPS) to field-locate the sampling stations in accordance with the coordinates provided in Table 5-4. All sampling teams (boat and land crews) and sample runners will be equipped with hand-held radio/cellular communication devices. Sampling teams will be required to check-in with their respective Field Program Coordinators when they are in place and prepared to start sampling.

6.3.2 Sample Runners

Two sample runners will coordinate sample pick-up/drop-off and transportation logistics for the boat and land crews, as needed. The runners will be responsible for delivering the boat trailer to the end of the reach and for collecting samples from the crews following the event. The runner will also be responsible for picking up samples from the sampling teams as necessary to meet required holding times, transporting samples to the designated central collection points, and either transporting samples to the laboratory or transferring sample custody to designated laboratory couriers. Bacteria samples must be provided to the central location laboratory within four-hours of sample collection to provide adequate time for sample preparation and analysis within the required holding time (which is 6 hours, please refer to the QAPP for more complete details on sample holding times).

Sampling teams will be responsible for notifying their respective runners when they have reached a designated location to provide adequate time for runners to meet them at assigned drop-off locations.

6.3.3 Diurnal Sweeps

Diurnal dissolved oxygen measurements will be conducted during the two low-flow sampling surveys to capture the conditions at dawn when DO concentrations tend to be at their lowest and at mid to late afternoon when DO concentrations tend to be at their highest. All samples collected during the morning sweep will be taken between 5:00 AM and 8:00 AM; all samples collected during the afternoon sweep will be taken between 2:00 PM and 7:00PM. Table 6-2 lists the water quality sampling stations where diurnal sweeps will also take place.

6.3.4 Wastewater Treatment Effluent Sampling

In order to quantify the loads from wastewater treatment facilities, 24 hour composite samples will be collected for the periods surrounding the low-flow and high-flow sampling events. Wherever possible, composite samples will be collected by WWTF staff and picked up by sampler runners after the water quality surveys, then brought to the appropriate labs for analysis. The CDM project team will work with the WWTF operators on the details of composite sample collection.

Table 6-2: Sampling Stations for Diurnal Sweeps

River Reach	Station ID	Station Description	Impoundment
Pemigewasset River	T002	U/S Lincoln WWTF	
	T003	D/S Lincoln WWTF 1	
	M006	D/S Woodstock WWTF1	
	T011	Baker River	
	M013	D/S Plymouth Village WWTF 1	
	M016	U/S Ayers Island 1	Ayers Island
	M017	U/S Ayers Island 2	Ayers Island
	M019	D/S Bristol WWTF 1	
	M023	U/S Franklin Falls 1	Franklin Falls
	M025	U/S Eastman Falls 2	Eastman Falls
Merrimack River	T028	Winnipesaukee River	
	M030	D/S Winnipesaukee WWTF 1	
	M033	D/S Merrimack County WWTF 1	
	T035	Contoocook River	
	M037	D/S Penacook WWTF 1	
	M041	D/S Hall Street WWTF 1, U/S Garvins Falls 1	Garvins Falls
	M042	D/S Hall Street WWTF 2, U/S Garvins Falls	Garvins Falls
	M045	U/S Hooksett 1	Hooksett
	T046	Suncook River	
	M047	U/S Suncook WWTF	
	M048	D/S Suncook WWTF 1	
	M049	U/S Hooksett 2, D/S Suncook WWTF 2	Hooksett
	M053	D/S Hooksett WWTF 2, U/S Amoskeag 1	Amoskeag
	M054	U/S Amoskeag 2	Amoskeag
	M055	D/S Amoskeag	
	T056	Piscataquog River	
	M058	D/S Manchester WWTF 1	
	M062	D/S Derry WWTF 1	
	T064	Souhegan River	
	M066	D/S Merrimack WWTF 1	
	M071	D/S Nashua WWTF 1	

6.4 Continuous DO and Temperature Monitoring

The continuous water quality monitoring will be conducted during a selected two-month period between mid-June to mid-September when DO concentrations are typically at critical levels for aquatic life support due to low-flow conditions. Dissolved oxygen and temperature will be measured using continuous reading water quality meters temporarily installed at each of the locations. The depth of the meters at each of the locations will be determined based upon the vertical profile findings. In accordance with NHDES guidelines, for areas that are stratified, the probe should be installed within the epilimnion. If however, there is no stratification, the probe should be installed within the top 25% of depth.. Routine maintenance will be conducted on a weekly basis to ensure the meters are still working and properly calibrated. Data will

also be downloaded from the meters during each weekly visit. The approximate locations of the continuous monitoring sites are shown in the maps in Appendix A.

6.5 Impoundment Studies

The impoundment studies will include five surveys that will take place each month from June to September. As shown in Tables 5-7 and 5-8, the surveys will include 18 sampling stations within the six impoundments where boat crews will conduct vertical dissolved oxygen and temperature profiles. One round of sampling will be performed in each impoundment each month. The approximate locations of the impoundment sampling sites are shown in the maps in Appendix A.

6.6 Sediment Sampling

An initial sediment sampling survey is included in this plan in order to assess the potential impacts that sediments have on the dissolved oxygen issues in the Upper Merrimack and Pemigewasset rivers. Samples for sediment oxygen demand (SOD) and nutrient flux analyses will be collected from the 20 locations detailed in Table 5-10. If the SOD and nutrient flux analyses indicate that the sediments are a driving factor in oxygen depletion in the Study Area, a more detailed plan will be developed for additional sediment sampling. The approximate locations of sediment sampling sites are shown in Appendix A.

6.7 Target Sampling Timeline

The target sampling timeline for the field sampling program is shown in Table 6-3. Due to the availability of funding, unpredictable nature of weather and streamflow conditions, and due to the adaptive nature of this Field Sampling Plan, this timeline is currently a preliminary estimate and is subject to change.

Table 6-3: Target Sampling Timeline

Task	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Field Reconnaissance				◆								
Water Quality Sampling						◄	═	═	═	►		
*Dry-Weather Events (2)**								◆	◆			
*High-Flow Event (1)**						◆						
Continuous DO and Temperature Monitoring							■	■				
Impoundment Studies					◄	═	═	═	►			
Monthly					◆	◆	◆	◆	◆			
Sediment Sampling						◆		◆				

*Estimated date; subject to streamflow conditions

Section 7
Field Documentation

Proper documentation of all field activities is essential to ensure that the prescribed Data Quality Objectives are achieved. Sample crews should document any unusual or anomalous conditions that may later be useful for data interpretation and analysis.

7.1 Field Data Collection Forms

The data for this project will include field measurements and analytical sampling. Most field data recording and record keeping will be made on standard forms to ensure consistency across sampling teams. The following sections describe the standard forms that for this project.

Field Program Coordinators are responsible for ensuring that all of their respective sampling teams have sufficient data collection forms for each sampling event.

Event Procedure Forms

These forms will be used to document sample collection activities, flow measurements, and sample compositing. They include:

- Low- and High-Flow Sample Collection Sheets (Includes sample compositing and grab sampling forms, in situ temperature, pH, DO, conductivity, and Secchi disk measurements, stage height, and QA samples collected)
- Vertical Temperature/DO Profile Measurement Sheet
- Diurnal DO Measurement Sheet
- Sediment Sample Collection Sheets

Equipment Inspection, Servicing, Calibration Forms

These forms will be used to document routine inspection and maintenance of sampling equipment and calibration of probes. They include:

- Equipment Inspection, Testing, and Maintenance Sheet
- Equipment Calibration Sheet
- Equipment Problem Report Sheet

Laboratory Forms

Standard forms will be used for coordination with the laboratories. These include a bottle request form and chain-of-custody form to be submitted to each laboratory by the CDM Project Team and chain-of-custody forms supplied by each laboratory to ensure proper handling of samples.

Field Logbooks

Field logbooks will provide a means for documenting all investigation and data collection activities performed at a site that are not covered by the standard data collection forms. Logbooks should be filled out in accordance with the following procedures and SOP-DOC-001: Field Logbook Content and Control (included in the Standard Operating Procedure Compendium).

Field logbooks will be bound, hardcover, waterproof books. The pages of the logbooks shall be consecutively numbered prior to the initial entry to ensure that missing pages may be identified after completion. The logbooks shall be permanently assigned to field personnel, but will be stored in a master project file at the respective CDM Project Team member's office.

The cover of each notebook must contain the following information:

- Project name
- Field logbook document control number
- Name of the CDM Project Team member and contact number
- Start date

If a logbook is transferred to another staff person, notation should be made of the transfer, date, and signatures.

Entries into the logbook may contain a variety of information, including:

- Date and purpose of site visit (i.e. high- and low-flow sampling)
- Sampling team's responsibilities (i.e. sampling station locations, etc.)
- Summary of sampling activities performed at each location, including number of samples collected and data collection forms completed
- Summary of problems encountered and corrective actions

Section 8
Sample Designation

Sample labels will be attached to individual sample aliquots for each investigation or quality control sample. Sample labels will be provided by the laboratories along with the sample bottles. Field Program Coordinators will be responsible for ensuring that all labels are affixed to the bottles prior to event mobilization. Sample labels will include the following information:

- Name of the investigation
- Sample identification number
- Sample collection location
- Date and time (military) of collection
- Number of sampling event
- Analysis requested
- Preservative

The unique sample identification numbers will be specified in accordance with the following guidance:

8.1 Water Quality Surveys

UMP-MXXX-ABC or UMP-TXXX-ABC

UMP – denotes Upper Merrimack and Pemigewasset River surveys and will be the same for all samples

MXXX or TXXX– four letter/digit Station ID, as per Table 5-4, also designates type of sampling location (i.e. M001 for mainstem or T001 for tributary)

A – Type of sample – "C" for spatial composite sample, "G" for grab sample, "R" for equipment rinsate

B - Number of sampling event (chronological order, 1-3)

C – Analysis requested (abbreviated), see Table 8-1

Fictitious station numbers will be developed to identify the field blanks and duplicate samples in accordance with the following designations:

Series 000 – regular water quality samples

Series 100 – field blanks

Series 200 – duplicates

Series 300 – equipment blanks

The following two examples show how a water quality sample and a QA/QC sample would be labeled.

UMP-M023-G1TKN: water quality grab sample from Water Quality Survey 1, collected from D/S of the Winnipesaukee WWTF (M023), will be analyzed for Total Kjeldahl Nitrogen

UMP-M223-G1NO23: field duplicate grab sample from Water Quality Survey 1, collected D/S of the Winnipesaukee WWTF, will be analyzed for Nitrate/Nitrite

Table 8-1 presents a summary of the abbreviations to be used for each of the water quality parameters on the sample labels.

Table 8-1: Water Quality Constituent Abbreviations for Sample Labels

Analytical Constituent	Abbreviation
Dissolved Oxygen (Winkler Titration)	DO
BOD_5	BOD5
BOD_{20}	BOD20
Total Suspended Solids	TSS
Total Phosphorus	TP
Orthophosphorus	OP
Nitrate/Nitrite	NO23
Ammonia-N	NH3
Total Kjeldahl Nitrogen	TKN
Phytoplankton Chlorophyll-a	Phy-Chla
Periphyton Chlorophyll-a	Per-Cha
E. coli	EC
Fecal Coliform	FC
Enterococcus	ENT
Sediment Oxygen Demand	SOD
Sediment Phosphorus Flux	PFX

An example label is shown in Figure 8-1, for a total phosphorus composite sample collected during the second survey from the mouth of the Mad River:

Figure 8-1: Example Water Quality Sample Label

CDM Upper Merrimack and Pemigewasset River WQ Survey

Date: 08/04/08 Time: 0200
UMP-T008-C2TP
Station: T008 Preservative: H_2SO_4
Low Flow/Survey 2 Analysis: Total Phosphorus

8.2 Impoundment Studies

UMP-IXXX-ABC

UMP – denotes Upper Merrimack and Pemigewasset River surveys and will be the same for all samples

IXXX – four letter/digit Station ID, as per Table 5-7, also designates sampling location type (i.e. I001 for impoundment)

A – Type of sample – "C" for spatial composite sample, "G" for grab sample, "R" for equipment rinsate

B - Number of sampling event (chronological order, 1-5)

C – Analysis requested (abbreviated), see Table 9-1

Fictitious station numbers will be developed to identify the field blanks and duplicate samples in accordance with the aforementioned series designations.

The following example shows how an impoundment sample would be labeled:

UMP-I005-C4TP: Impoundment composite sample from Impoundment Survey 4, collected from the Franklin Falls impoundment, will be analyzes for Total Phosphorus

An example label is shown in Figure 8-2, for a Total Phosphorus composite sample collected during the fourth survey within the Ayers Island Dam impoundment.

Figure 8-2: Example Impoundment Sample Label

CDM Upper Merrimack and Pemigewasset River Impoundment Survey

Date: 08/15/08	Time: 0100
UMP-I002-C4TP	
Station: I002	Preservative: H_2SO_4
Impoundment Survey 2	Analysis: Total Phosphorus

8.3 Sediment Sampling

UMP-SXXX-ABC

UMP – denotes Upper Merrimack and Pemigewasset River surveys and will be the same for all samples

SXXX – four letter/digit Station ID, as per Table 5-10, also designates sampling location type (i.e. S001 for sediment)

A – Type of sample - "S" for all sediment samples

B - Number of sampling event (chronological order)

C – Analysis requested (abbreviated), see Table 9-1

The following example shows how an impoundment sample would be labeled:

UMP-S005-A1SOD: Sediment sample from Sediment Survey 1, collected from the Hooksett Dam impoundment area, will be analyzed for sediment oxygen demand

An example label is shown in Figure 8-3, for a sediment oxygen demand sample collected during the first survey within the Hooksett Dam impoundment area.

Figure 8-3: Example Sediment Sample Label

CDM Upper Merrimack and Pemigewasset River Sediment Survey

Date: 08/15/08	Time: 0100
UMP-S015-A1SOD	
Station: S015	Preservative: N/A
Sediment Survey 1	Analysis: SOD

Section 9
Sample Handling and Custody

This section describes the sample handling and custody procedures that will be used during the high- and low-flow sampling events and the impoundment studies.

9.1 Sample Handling

All spatial composite and grab samples will be provided to the laboratories in clean, pre-preserved (as needed) bottles supplied directly by the laboratories in accordance with the applicable collection SOPs. Sampling crews will be supplied with extra bottles during each event in case of breakage. All samples will be preserved in accordance with the requirements provided in the QAPP. Samples will be placed in laboratory-supplied coolers with sufficient ice to meet holding requirements. A return name and address for the sample cooler will be written on the inside of the lid in permanent ink to ensure that the cooler is returned to its owner.

9.2 Sample Custody and Documentation

Sample chain-of-custody protocols shall be maintained through receipt of the sample containers, sample collection, transfer between personnel, transport to the laboratories, and final disposal of the sample. The purpose of the protocols and procedures established herein is to ensure that the integrity of the samples is maintained throughout collection and analysis. The sample custody shall be properly documented to provide a mechanism for tracking each sample submitted for laboratory analysis.

Chain-of-Custody Protocols

Chain-of-custody procedures are established to provide sample integrity, to ensure the timely analysis of all constituents, and to track the progress of samples in the laboratory. Sample custody procedures will be based on procedures described in this Field Sampling Plan and the associated QAPP.

Laboratories will provide chain-of-custody forms to be used for all samples collected during high- and low-flow sampling events. The forms will be filled out by each boat, land, and outfall crew prior to relinquishing custody to the sample runners; the chain-of-custody forms will be placed in a plastic, waterproof bag and affixed to the top inside cover of the cooler. Sample runners, or outfall crews where necessary, will transfer custody of the sample to the appropriate laboratory personnel. When transferring sample custody, the individuals relinquishing and receiving the samples will sign, date, and note the time of transfer on the record. Representatives from both the CDM Project Team and the laboratories will retain a copy of the forms.

Section 10
Health and Safety Procedures

10.1 Health and Safety Plans

All members of the CDM Project Team will be responsible for reviewing and following the most recent Health and Safety Plan approved by their respective employer.

Field personnel must observe common field and water safety procedures when working on the water. Boat crews must wear personal floatation devices (PFD's) while on the water, must operate the sampling vessel in a safe manner, and should never work alone on the water.

Steel-toed boots and reflective safety vests must be worn at all times during low- and high-flow surveys to prevent injury. As necessary, land and outfall crews will be equipped with traffic cones to prevent accidental injury from traffic.

Protective gloves must be worn by all boat, land, and outfall crews sampling at stations suspected of being contaminated with sewage.

10.2 Emergency Procedures and Contacts

In case of an accident or emergency, the land, boat, or outfall sampling crew should call 911 (if necessary) and notify their respective Field Program Coordinator immediately via hand-held communication devices. Maps showing the location of the major hospitals in the Study Area will be provided to each sampling team.

Section 11
References

New Hampshire Department of Environmental Services. November 2006. *State of New Hampshire 2006 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology*. NHDES-R-WD-04-5.

New Hampshire Department of Environmental Services. August 2007. *NHDES Dam Bureau Draught Study Plan*.

Appendix A
Sampling Location Maps

Upper Merrimack and Pemigewasset River Study - Water Quality Event Sampling Locations

River Reach	Station ID	Estimated River Mile (from Newburyport light)[1]	Landmark	Station Description	Within Impoundment?	Diurnal Sweep	Flow Meter	Estimated Streambed Slope[2]
Pemigewasset River	M001	169.9		Headwaters				5.0E-03
	T002	NA	Lincoln WWTF	U/S Lincoln WWTF		X		-
	T003	NA		D/S Lincoln WWTF 1		X		-
	T004	169.7		D/S Lincoln WWTF 2				-
	M005	169.3	Woodstock WWTF	U/S Woodstock WWTF				2.0E-03
	M006	169.2		D/S Woodstock WWTF1		X		2.0E-03
	M007	168.9		D/S Woodstock WWTF 2				2.0E-03
	M008	165.3		Woodstock Gage				2.0E-03
	M009	154.1		Campton				NA
	T010	153.2	Mad River	Mad River			X	-
	T011	147.2	Baker River	Baker River		X		-
	M012	146.9	Plymouth Village WWTF	U/S Plymouth Village WWTF				1.9E-04
	M013	146.4		D/S Plymouth Village WWTF 1		X		1.9E-04
	M014	146.2		D/S Plymouth Village WWTF 2				1.9E-04
	T015	141.0	Squam River	Squam River			X	-
	M016	137.4		U/S Ayers Island 1	X	X		-3.2E-03
	M017	134.5	Ayers Island Dam	U/S Ayers Island 2	X	X		NA
	M018	131.3		D/S Ayers Island, U/S Bristol WWTF				NA
	M019	130.9	Bristol WWTF	D/S Bristol WWTF 1		X		NA
	M020	130.6		D/S Bristol WWTF 2				NA
	T021	130.4	Newfound River	Newfound River			X	NA
	T022	127.9	Smith River	Smith River				NA
	M023	122.0	Franklin Falls Dam	U/S Franklin Falls 1	X	X		NA
	M024	118.7		D/S Franklin Falls, U/S Eastman Falls 1	X			-4.7E-04
	M025	117.5	Eastman Falls Dam	U/S Eastman Falls 2	X	X		7.3E-03
	M026	117.1		D/S Eastman Falls				4.7E-04
	T027	117.0	Chance Pond Brook	Chance Pond Brook			X	-
Merrimack River	T028	116.2	Winnipesaukee River	Winnipesaukee River		X		-
	M029	114.3	Winnipesaukee WWTF	U/S Winnipesaukee WWTF				-9.5E-04
	M030	113.6		D/S Winnipesaukee WWTF 1		X		3.5E-03
	M031	113.4		D/S Winnipesaukee WWTF 2				3.7E-03
	M032	110.6	Merrimack County Facilities	U/S Merrimack County WWTF				-2.4E-03
	M033	109.8		D/S Merrimack County WWTF 1		X		5.1E-04
	M034	109.4		D/S Merrimack County WWTF 2				5.1E-04
	T035	101.0	Contoocook River	Contoocook River		X	X	-

1 Estimated distance upstream from mouth of river, values given for confluence of tributaries, NA on tributaries

2 Mainstem stations only, based on available FEMA profiles and Lower Merrimack Study data, ft/ft

River Reach	Station ID	Estimated River Mile (from Newburyport light)[1]		Station Description	Within Impoundment?	Diurnal Sweep	Flow Meter	Estimated Streambed Slope[2]
Merrimack River	M036	100.9	Concord Penacook WWTF	U/S Penacook WWTF				-2.4E-04
	M037	98.9		D/S Penacook WWTF 1		X		-6.9E-04
	M038	97.6		D/S Penacook WWTF 2				1.7E-03
	M039	94.5		U/S Concord	X			4.1E-03
	M040	90.3	Concord Hall Street WWTF	U/S Hall Street WWTF	X			-1.9E-02
	M041	88.7		D/S Hall Street WWTF 1, U/S Garvins Falls 1	X	X		-1.4E-03
	M042	88.0	Garvins Falls Dam	D/S Hall Street WWTF 2, U/S Garvins Falls	X	X		9.5E-04
	M043	86.4		D/S Garvins Falls	X			0.0E+00
	T044	86.0	Soucook River	Soucook River				-
	M045	84.7		U/S Hooksett 1	X	X		-1.5E-03
	T046	83.1	Suncook River	Suncook River		X	X	-
	M047	82.7	Suncook WWTF	U/S Suncook WWTF		X		NA
	M048	82.2		D/S Suncook WWTF 1		X		NA
	M049	81.8	Hooksett Dam	U/S Hooksett 2, D/S Suncook WWTF 2	X	X		1.6E-03
	M050	80.7		D/S Hooksett Dam	X			5.3E-03
	M051	79.2	Hooksett WWTF	U/S Hooksett WWTF	X			0.0E+00
	M052	78.7		D/S Hooksett WWTF 1	X			0.0E+00
	M053	77.6		D/S Hooksett WWTF 2, U/S Amoskeag 1	X	X		-1.1E-03
	M054	73.4	Amoskeag Dam	U/S Amoskeag 2	X	X		1.2E-03
	M055	71.9		D/S Amoskeag		X		3.2E-03
	T056	71.3	Piscataquog River	Piscataquog River		X		-
	M057	69.1	Manchester WWTF	U/S Manchester WWTF				3.2E-03
	M058	68.0		D/S Manchester WWTF 1		X		-1.4E-02
	T059	67.7	Cohas Brook	Cohas Brook			X	-
	M060	67.5		D/S Manchester WWTF 2				4.0E-03
	M061	65.6	Derry WWTF	U/S Derry WWTF				9.5E-04
	M062	63.8		D/S Derry WWTF 1		X		1.7E-04
	M063	63.1		D/S Derry WWTF 2				-9.5E-05
	T064	62.3	Souhegan River	Souhegan River		X		-
	M065	59.0	Merrimack WWTF	U/S Merrimack WWTF				-2.6E-04
	M066	57.5		D/S Merrimack WWTF 1		X		2.7E-03
	M067	56.5		D/S Merrimack WWTF 2				-1.3E-03
	T068	54.6	Nashua River	Nashua River			X	-
	T069	53.3	Salmon Brook	Salmon Brook			X	-
	M070	53.0	Nashua WWTF	U/S Nashua WWTF				1.1E-03
	M071	51.6		D/S Nashua WWTF 1		X		6.3E-04
	M072	51.5		D/S Nashua WWTF 2				6.3E-04

1 Estimated distance upstream from mouth of river, values given for confluence of tributaries, NA on tributaries
2 Mainstem stations only, based on available FEMA profiles and Lower Merrimack Study data, ft/ft

Sampling Location Maps Index

	Communities	Dams/Impoundments	WWTPs	Tributaries
Map 1	Lincoln Woostock Thornton		Lincoln WWTP Woodstock WWTP	East Branch Pemigewasset
Map 2	Thornton Campton Plymouth Holderness			Mad River
Map 3	Plymouth Holderness Ashland Bridgewater New Hampton		Plymouth Village WWTP	Baker River Squam River
Map 4	Bridgewater New Hampton Bristol Hill Sanbornton Franklin	Ayers Island Dam Ayers Island Impoundment	Bristol WWTP	Newfound River Smith River
Map 5	Sanbornton Franklin Northfield Boscawen	Franklin Falls Dam Franklin Falls Impoundment Eastman Falls Dam Eastman Falls Impoundment	Winnipesaukee WWTP	Chance Pond Brook Winnipesaukee River
Map 6	Boscawen Canterbury Concord		Merrimack County Facilities Concord-Penacook WWTP	Contoocook River
Map 7	Concord Pembroke Allenstown Bow Hooksett	Garvins Falls Dam Garvins Falls Impoundment Hooksett Dam Hooksett Impoundment Amoskeag Impoundment	Concord-Hall Street WWTP Suncook WWTP	Soucook River Suncook River
Map 8	Hooksett Manchester	Hooksett Dam Amoskeag Dam Amoskeag Impoundment	Hooksett WWTP	Piscataquog River
Map 9	Manchester Bedford Merrimack Litchfield		Manchester WWTP Derry WWTP	Cohas Brook Souhegan River
Map 10	Merrimack Litchfield Nashua Hudson		Merrimack WWTP Nashua WWTP	Nashua River Salmon Brook

N
W E
S

Legend

- WWTP
- Streamflow Gage
- Dam
- Water Quality Surveys
- Impoundments (approx.)
- Sediment Core
- Continuous Monitoring

EAST BRANCH PEMIGEWASSET RIVER AT LINCOLN, NH

T002

Lincoln WWTP

T003

M001

T004

Woodstock WWTP

M005

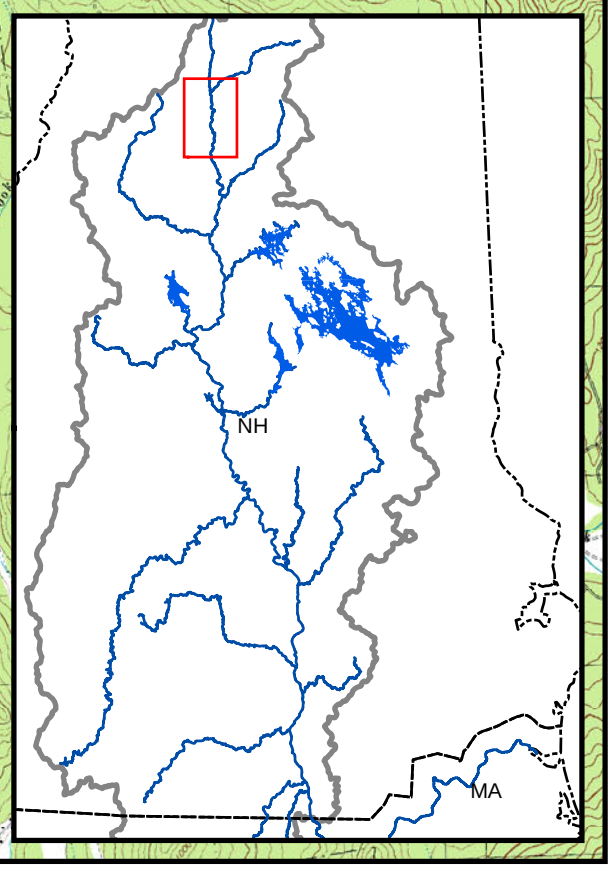
M006

M007

PEMIGEWASSET RIVER AT WOODSTOCK, NH

M008

0 0.25 0.5 1 Miles



CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 1 of 10

Legend

- WWTP
- Streamflow Gage
- Dam
- Water Quality Surveys
- Impoundments (approx.)
- Sediment Core
- Continuous Monitoring

M009

T010

0 0.25 0.5 1 Miles

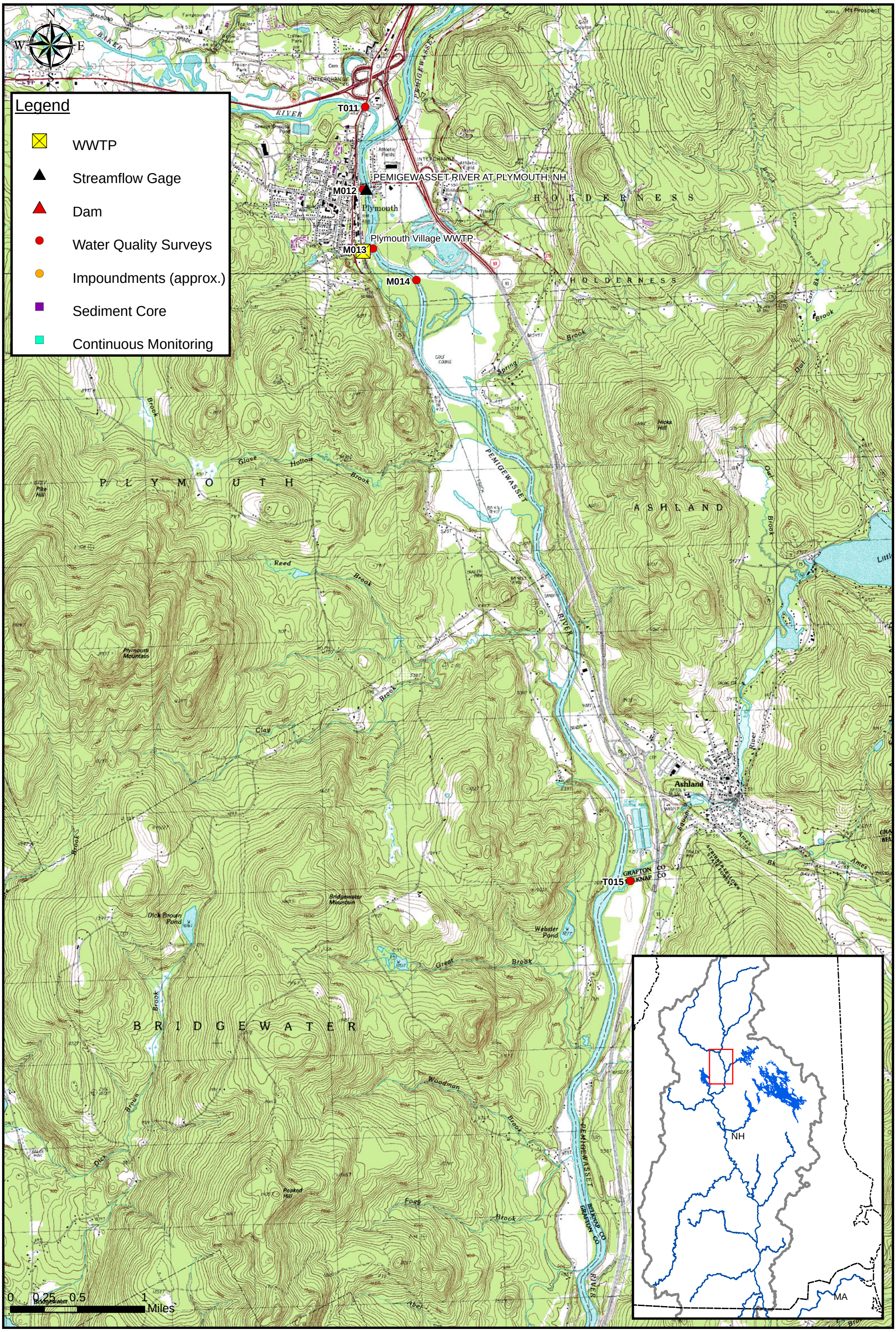
NH

MA

CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 2 of 10



CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 3 of 10

Legend

- WWTP
- Streamflow Gage
- Dam
- Water Quality Surveys
- Impoundments (approx.)
- Sediment Core
- Continuous Monitoring

M016

APPROX. EXTENT OF AYERS ISLAND IMPOUNDMENT

M017

Bristol WWTP

Ayers Island Dam

M018

M019

M020

T021

T022

SMITH RIVER NEAR BRISTOL, NH

NH

MA

0 0.25 0.5 1 Miles

CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 4 of 10

Legend

- WWTP
- Streamflow Gage
- Dam
- Water Quality Surveys
- Impoundments (approx.)
- Sediment Core
- Continuous Monitoring

M023

APPROX. EXTENT OF FRANKLIN FALLS IMPOUNDMENT

Franklin Falls Dam

APPROX. EXTENT OF EASTMAN FALLS IMPOUNDMENT

M024

M025

Eastman Falls Dam

M026

T027

T028

MERRIMACK RIVER AT FRANKLIN JUNCTION, NH

Winnipesaukee River Basin WWTP

M029

M030

M031

M032

SANBORNTON

FRANKLIN

BOSCAWEN

NORTHFIELD

STATE FOREST NURSERY

Webster Lake

Pemigewasset River

Winnipesaukee River

Merrimack River

0 0.25 0.5 1 Miles

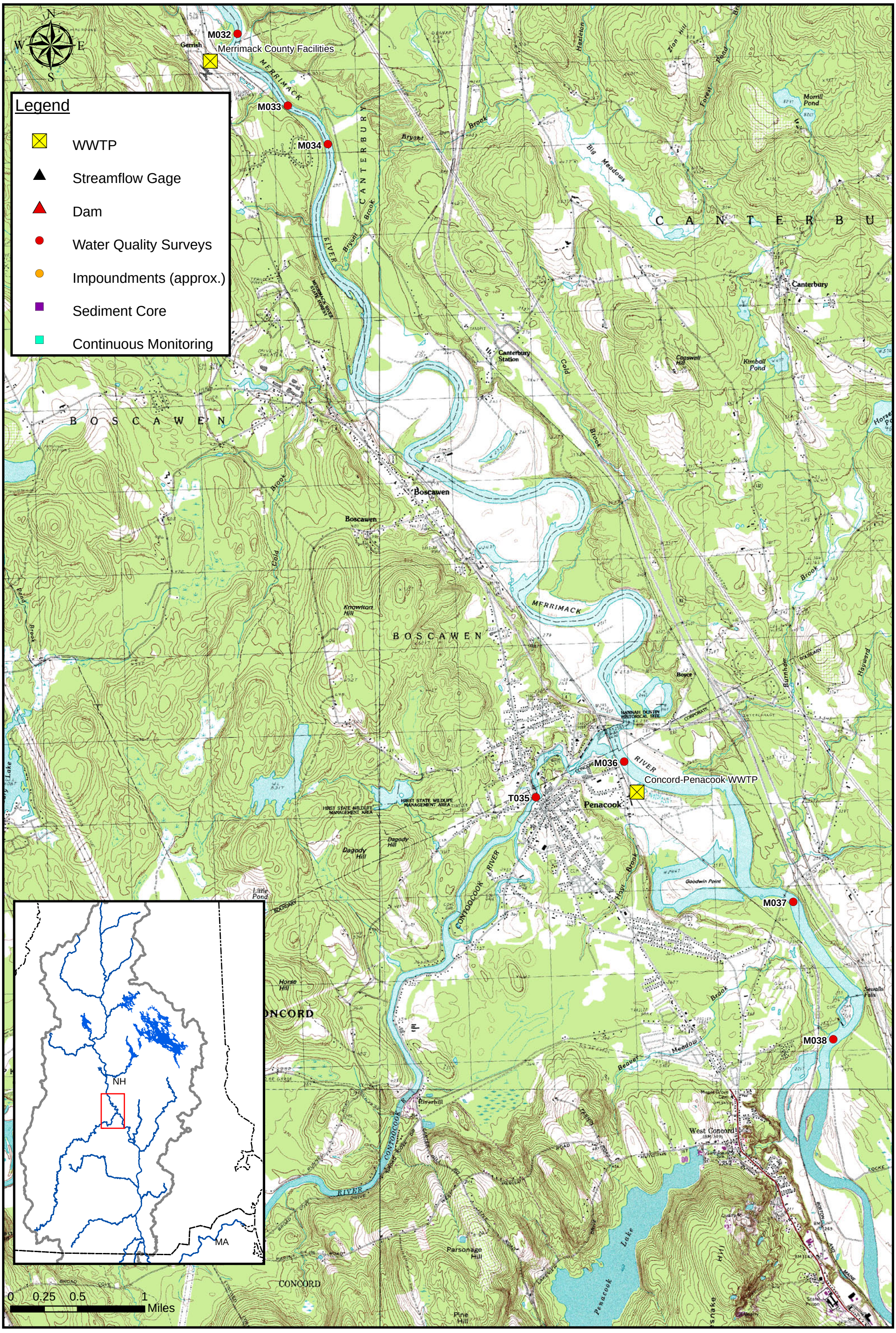
NH

MA

CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 5 of 10



CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 6 of 10

EXTENT OF GARVINS FALLS IMPOUNDMENT

M039

SOUCOOK RIVER, AT PEMBROKE ROAD, NEAR CONCORD, NH

M040

Concord- Hall Street WWTP

M041

M042

Garvins Falls Dam

APPROX. EXTENT OF HOOKSETT IMPOUNDMENT

M043

T044

M045

Suncook WWTF

T046

M047

M048

M049

Hooksett Dam

APPROX. EXTENT OF AMOSKEAG IMPOUNDMENT

M050

Legend

- WWTP
- Streamflow Gage
- Dam
- Water Quality Surveys
- Impoundments (approx.)
- Sediment Core
- Continuous Monitoring

NH

MA

0 0.25 0.5 1 Miles

CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 7 of 10

Legend

- WWTP
- Streamflow Gage
- Dam
- Water Quality Surveys
- Impoundments (approx.)
- Sediment Core
- Continuous Monitoring

Hooksett Dam

APPROX. EXTENT OF AMOSKEAG IMPOUNDMENT

M050

M051

Hooksett WWTP

M052

M053

M054

Amoskeag Dam

T056

M055

MERRIMACK RIVER

BEAR BROOK STATE PARK

Hooksett

South Hooksett

MANCHESTER

Martins Corner

Pinardville

Rundlett Hill

NH

MA

0 0.25 0.5 Miles

CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 8 of 10

Legend

- WWTP
- Streamflow Gage
- Dam
- Water Quality Surveys
- Impoundments (approx.)
- Sediment Core
- Continuous Monitoring

MERRIMACK R NR GOFFS FALLS, BELOW MANCHESTER, NH

M057

Manchester WWTP

M058

T059

M060

M061

Derry WWTP

M062

M063

T064

SOUHEGAN RIVER AT MERRIMACK, NH

0 0.25 0.5 1 Miles

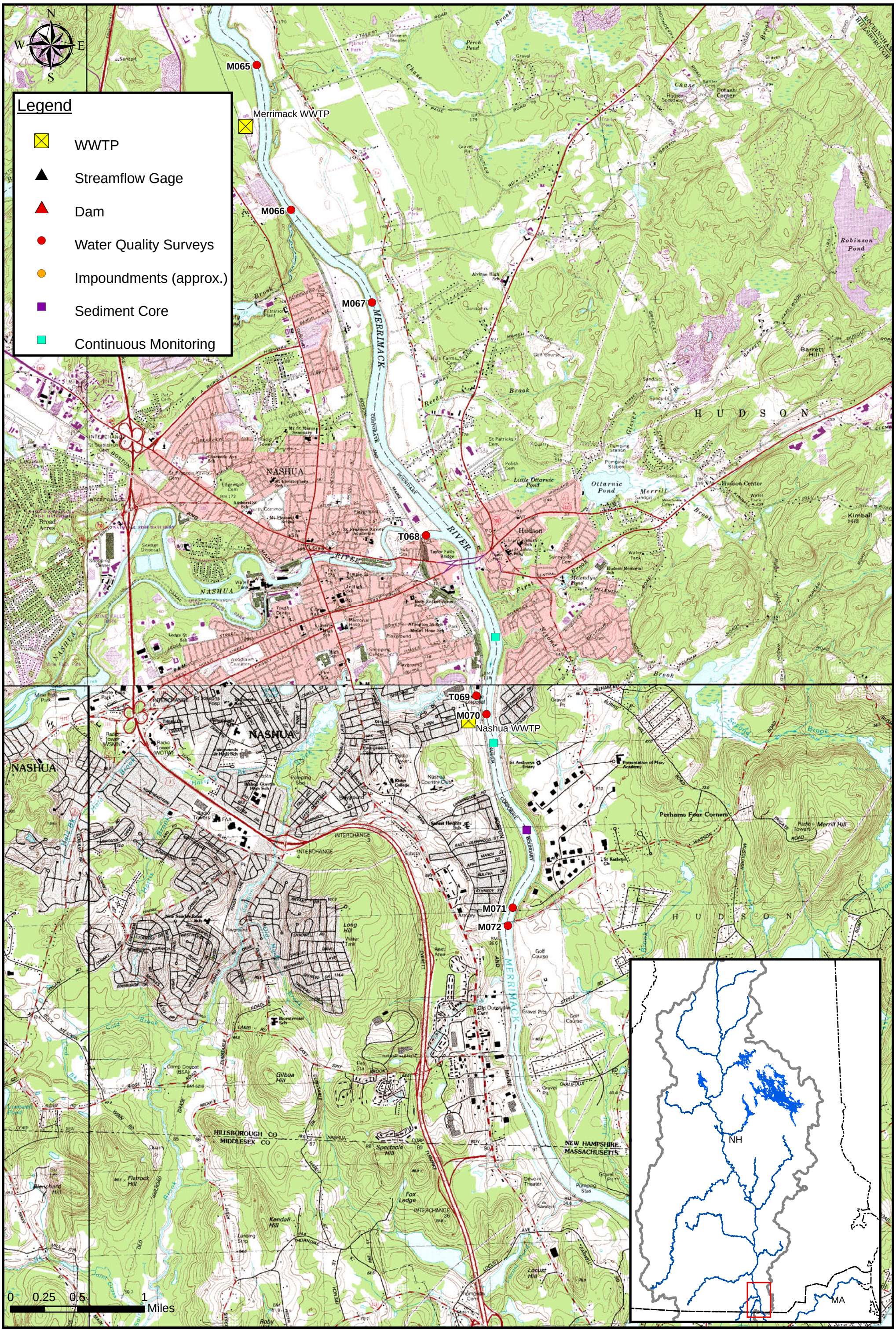
NH

MA

CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 9 of 10



CDM

11/21/2007

Upper Merrimack and Pemigewasset River Study
Sampling Locations
Map 10 of 10

Appendix B
Comments and Responses on Draft Field Sampling Plan

This appendix summarizes comments and CDM's responses to comments on the Draft Field Sampling Plan, distributed in October 2007. Three sets of comments were received, including: EPA (David Pincumbe), NHDES (various staff) and NHDES Winnipesaukee River Basin Program, Wastewater Treatment Plant (Dick Flanders).

EPA Comments and CDM Response

1. Providing a good understanding of the fate and transport of phosphorus in the system requires the inclusion of periphyton/attached algae and macrophytes in the monitoring program.

Response: Periphyton chlorophyll-a will be sampled at select shallow stations.

2. It is also important to have good spatial coverage in order to understand how phosphorus from the significant sources is being utilized in the system. The proposed monitoring plan should include a table with proposed sampling locations, dams, point sources and a description of the sampling station as well as the reaches between sampling stations (estimated low flow velocity and depth information at a minimum). River miles for the sampling locations, dams, and point sources should be included in the table.

Response: Sampling location maps and tables were provided to EPA previously under separate cover, and the maps are included in Appendix A of the Field Sampling Plan.

3. More stations on the Squam River may be warranted given that the Ashland POTW only has a dilution factor of 10.

Response: The scope of this sampling and monitoring program includes only the mainstem Merrimack and Pemigewasset Rivers, with quantification of major tributaries' impacts at their confluence with the mainstem.

4. In general there seems to be a lack of stations immediately upstream of point sources. Data at these locations is critical for evaluating the potential effects of point source discharges.

Response: Stations have been added so every point source has at least one sampling site immediately upstream, one immediately downstream, and another further downstream to quantify impacts.

5. A single station may not be adequate for evaluating the larger impoundments.

Response: The impoundment studies portion of this sampling program includes three stations within each impoundment which will take samples for DO/temp profiles, phytoplankton and phosphorus.

6. The impacts of the Merrimack Station (up to 275 MGD with a maximum temperature of 104 degrees) on eutrophication levels needs to be incorporated into the study.

Response: There are several water quality stations, continuous monitoring sites, and impoundment study sites upstream and downstream of the Merrimack Station (see Map 7 in Appendix E).

NHDES Comments and CDM Response

1. Page 2, Section 1.2, Task Description: It is our understand that QA staff at EPA in Chelmsford is reviewing the QAPP and that it will be distributed as soon as it is complete, which is expected soon.

Response: The QAPP is currently under review with Nora Conlon at EPA.

2. Page 4, Section 1.2.1. Study Area: The Soucook River label is missing from the Watershed Map. Also, the locations of the Newfound River, Winnipesaukee River, Chance Pond Brook and Cohas Brook should be re-positioned to indicate their proper locations.

Response: Modifications have been made to the study area aap (Figure 1-1) in the final FSP.

3. Page 5, Section 1.3,Sampling Constituents - Table 1-2:

a. It is our understanding that model input will be ultimate CBOD (i.e. CBOD20) Therefore CBOD20 should be added as an analytical constituent for all sampling locations (river and WWTFs). In addition, CBOD5 samples should be collected at WWTF so that the CBOD20 to CBOD5 ratio can be determined; this information is needed to translate modeling results to WWTF permit limits which are expressed in terms of CBOD5.

b. It is our understanding that samples will be collected at the WWTFs (by using ISCOs and/or collecting grab samples)in the study area. These sample parameters should be added to Table 1-2 and discussion about how/when they will be collected should be added to the text of the document where appropriate.

c. It is our understanding that SOD samples will be collected in the impoundments and potentially along the main stem of the river where it is conducive for sampling. This should be mentioned where appropriate throughout the document.

d. Should also add time of travel to table 1-2.

e. Chlorophyll and phytoplankton are shown. Does this refer to phytoplankton chlor a and phytoplankton biomass? If so, please clarify. Might also be helpful to collect periphyton chlor a and biomass in shallow sections.

f. How will macrophytes be measured?

Response:

a. CBOD20 tests are much more expensive than CBOD5 tests, thus in the interest of budget CDM has added CBOD20 analysis at select stations downstream of larger WWTFs and downstream of the dams. CBOD5 will be analyzed at all of the stations so that a ratio can be developed.

b. WWTF effluent samples were added to the lab analysis sample number totals, and added text to Section 6.3.4 describing the effluent sampling.

c. Section 6.6 describes the frequency and locations for SOD sampling.

d. Time of travel studies are not included in the scope of this task order, and will be done as part of a future river hydraulics and hydrology study.

e. The sampling plan has been adjusted to specify phytoplankton chlorophyll-a samples to be taken at all stations, and periphyton chlorophyll-a samples to be taken at select shallow stations, especially within impoundments and downstream of WWTFs.

f. Field reconnaissance will include a general visual survey of macrophytes along the mainstem of the river, which will include their species, spatial coverage and location.

4. Page 6, Section 2, Data Quality Objectives - 3 rd bullet: As discussed at our meeting, please revise as follows (revisions are in italics): "Characterize the impacts of point source loads on dissolved oxygen *and chlorophyll a (phytoplankton, periphyton and macrophytes)* in the Upper Merrimack and Pemigewasset Rivers. Please make similar changes elsewhere in the document where appropriate.

Response: These changes have been made in the final version of the FSP.

5. Page 7, Section 3.1, Low Flow Sampling Criteria; As discussed, please indicate that the 0.1 inches of rain is a target and that sampling may occur if conditions are slightly outside the target after consultation with DES and the ACOE.

Response: This clarification has been made in the final FSP.

6. Page 8, Section 3.1, Low Flow Sampling Criteria - 1st paragraph, "location" should be changed to "locations".

Response: CDM has made this change in the final FSP.

7. Page 10, Section 4.2, High Flow Water Quality Sampling Events: The last sentence in the first paragraph ("… as well as confirm that no rain event is likely to happen on the day of sampling"), suggests that sampling won't occur if it rains. It is our understanding that rain should not impact the high flow sampling event. Please revise.

Response: The high flow samples should be taken immediately following a rain event, when the river flows are increased, and not while it is still raining. For modeling purposes, there is a need for consistent, reproducible conditions during sampling events.

8. Page 11, Section 4.3 , Field Mobilization Efforts: In the second sentence, please add that personnel will have reviewed the QAPP (in particular the section pertaining to Quality Assurance Objectives, which typically contains information

pertaining to frequency of Dups (Reps), measurement performance criteria/ranges etc.).

Response: Clarification provide in the final FSP.

9. Page 16, Section 5.1, Low Flow Sampling Events: QA requirements for low and high flow are shown as 5% for dups and 5% for blanks. In the past, EPA as required DES to use 10% for Reps and Blanks for TMDL studies. As stated above, we understand that EPA is currently reviewing the QAPP.

Response: In the Lower Merrimack River field sampling program, EPA allowed 5% dups and blanks because of the high volume of samples taken each round. CDM expects this to be the case again for the Upper Merrimack field sampling program, but is prepared to revise the plan based on EPA requirements.

10. Page numbers should be added to the parts of the document where tables and maps consume the entire sheet.

Response: Change incorporated into final FSP.

11. The word "Reg" in the notes section in Figures 5-4a, 5-4b and 5-5 should be changed to "Red".

Response: The word "Reg" refers to duplicate QA samples (represented in black text) versus blank QA samples (represented in blue text); this clarification has been made where appropriate.

12. Page 22, Section 5.3, Impoundment Studies – first sentence: There may be more than one source of impairments in impoundments, therefore, "source" should be changed to "source(s)" or the words "or sources" added to the text.

Response: Change incorporated into final FSP.

13. Page 24 and 25, Section 5.5, Sediment Oxygen Demand and Nutrient Flux Sampling: Franklin Falls Dam is not proposed to be sampled for SOD or nutrient flux because it is run-of-river. Our experience has been that SOD can be high even in run-of-river. We suggest that SOD and nutrient flux be taken at the Franklin Falls Dam too unless the investigations indicate that there is little to no sediment in the impoundment (this was suggested at our meeting but should be confirmed).

Response: Franklin Falls impoundment stations have been added to the initial rounds of sediment testing sites.

14. Page 27, Section 6.1, Centralized Sampling Coordination: In the first sentence, "the a" before location should be changed to either "the" or "a".

Response: Change incorporated into final FSP.

NHDES Winnipesaukee River Basin Program, Wastewater Treatment Plant Comments and CDM Response

1. Section 1.1, first paragraph. Please add reference to the funding support from the WWTFs and other interested parties.

Response: Clarification is provided in the final FSP mentioned the jointly funded effort between USACE, NHDES, and various communities in the watershed.

2. Table 1-1 is titled Major Tributaries. Why is Chance Pond Brook in Franklin cited?

Response: Chance Pond Brook is located in an area of high interest; two dams within close proximity (Franklin Falls, Eastman Falls), a large tributary (Winnipesaukee River), major community (Franklin) and a WWTF. It is important to quantify all impact sources in order to correctly identify any problem areas. Other smaller tributaries in similar situations are included in the sampling plan as well (Cohas Brook), while smaller tributaries in large, undeveloped reaches will not be included.

3. Sampling the rivers at the center of the channel in areas that are laterally mixed to take into account WWTF discharges will present particular challenges given low flow conditions that often limit boat access in the upper reaches. Use of GPS to verify theses locations will be critical for subsequent sampling.

Response: GPS devices are intended to be used for all boat crew sampling.

4. Continuous monitoring of DO/temp downstream of the Winnipesaukee WWTF would presumably be at the same point as the aforementioned discrete sampling. Protection of equipment from loss from river users may be a challenge.

Response: We are aware of this potential problem, and will have provisions in place to provide for the safety of all monitoring equipment.

5. Section 5.5, sediment sampling locations. A site downstream of the Franklin WWTF "where the reach is not impaired" suggests it is impaired! We are not aware of any such impairment. If the intent is to sample where the discharge plume is fully mixed laterally, I presume this is the same location that the discrete sampling and DO/temp will be done?

Response: This specification is made to emphasize that the reach downstream of the Winnipesaukee/Franklin WWTF is *not* impaired (as other intended monitoring sites downstream of WWTFs in Manchester and Nashua *are* impaired). It will be monitored to compare against similar reaches that *do have* impairments.

6. Paragraph under Table 6-1. Just a heads up-cellular communications are poor in the vicinity of the Franklin WWTF!

Response: Thank you, the field team will take this into consideration when planning communications in that area.

7. Last paragraph. What parameters will the AMRO laboratory be responsible for? Will there be any provision for splits between labs for a QA/QC check?

Response: No laboratories are under contract for this assignment to date. Every effort will be made to use the same laboratories for analysis of like parameters for QA/QC control.