

**Connecticut River Nitrogen Project**  
***Workgroup Workplan***

**MISSION STATEMENT**

Following the Environmental Protection Agency's (EPA) approval of the Long Island Sound (LIS) Dissolved Oxygen Total Maximum Daily Load (TMDL) on April 3, 2001, the New England Interstate Water Pollution Control Commission (NEIWPC) established the Connecticut River Nitrogen Workgroup in order to develop scientifically-defensible nitrogen load allocations, as well as an implementation strategy, for the Connecticut River Basin in Massachusetts, New Hampshire, and Vermont ("upper States"), which are consistent with TMDL allocations established for LIS.

**STRATEGIC GOALS TO SUPPORT THE MISSION**

The mission of the Connecticut River Nitrogen Project will be accomplished through a multi-phase, adaptive management approach, and will involve the development and implementation of a Total Nitrogen Reduction Plan (or TMDL, as appropriate) for the upper basin.

**GOAL 1: Develop refined nitrogen load and source assessments for Upper Connecticut River Basin.**

- Task 1:** Establish Connecticut River Nitrogen Project Workgroup.
- Task 2:** Compile existing water quality data, develop databases, and conduct data analyses.
- Task 3:** Analyze existing water quality modeling data for the entire basin.
- Task 4:** Implement water quality monitoring program in the upper basin.
- Task 5:** Address uncertainties associated with point source loading in the upper basin.
- Task 6:** Conduct detailed nitrogen attenuation investigation for the entire basin.
- Task 7:** Conduct additional water quality modeling analyses.

**GOAL 2: Develop Upper Connecticut River Total Nitrogen Reduction Plan (or TMDL, as appropriate).**

- Task 1:** Present technical findings to NEIWPC Executive Committee.
- Task 2:** Establish nitrogen load allocations for the upper States.
- Task 3:** Identify cost-effective and realistic nitrogen control strategies and determine feasible and equitable nitrogen load reduction goals the upper States.
- Task 4:** Complete Total Nitrogen Reduction Plan (or TMDL), including implementation strategy.
- Task 5:** Present Total Nitrogen Reduction Plan to NEIWPC Executive Committee.
- Task 6:** Engage in public review process and approve Total Nitrogen Reduction Plan (or TMDL).

**GOAL 3: Implement the Upper Connecticut River Total Nitrogen Plan (or TMDL).**

- Task 1:** Develop watershed action plan.
- Task 2:** Coordinate regional implementation measures.
- Task 3:** Assist individual States with implementation of State-specific controls.

## BACKGROUND

Connecticut's dissolved oxygen standard (exposure based ranging from never less than 3.5 mg/L up to 21 days exposure in the 4.3 – 4.8 mg/L range) is violated in the bottom waters of LIS from New Haven west to Greenwich. Similarly, New York's standard of 5.0 mg/L (currently under revision) is frequently violated in the western part of LIS. The primary pollutant causing the low dissolved oxygen condition, or hypoxia, in LIS is nitrogen. Excess nitrogen levels leads to the elevated growth of algae, which eventually die and decay, consuming oxygen in the process. The ensuing hypoxic conditions have resulted in the violation of water quality standards in LIS each summer, with oxygen levels often falling below 1 or 2 mg/L.

In response to this problem, Connecticut and New York developed a TMDL for dissolved oxygen that specifies the maximum amount of nitrogen that can be discharged to LIS without violating water quality standards for dissolved oxygen. On April 3, 2001, EPA approved the LIS TMDL. According to the TMDL analysis, an annual baseline load of 53,270.9 tons of nitrogen delivered to LIS from all sources in Connecticut and New York combined was established, labeled the "in-basin load." An additional 13,565.0 tons of nitrogen reach LIS annually from the portion of the watershed originating north of Connecticut, labeled "tributary load" in the TMDL. Of the total tributary load, an estimated 12,542.9 tons of nitrogen is delivered to LIS via the Connecticut River. Total nitrogen loads account for pre-colonial, terrestrial, atmospheric, and point sources. The TMDL specifies a 58.5% reduction in human generated nitrogen from (in-basin) point and nonpoint sources. The TMDL requires Connecticut to remove about 6,270 tons of nitrogen delivered to LIS each year from point source dischargers located throughout the State, as well as another 400 tons of nitrogen resulting from nonpoint sources. New York's required nitrogen load reduction from point and nonpoint sources is about 17,150 tons/year.

The LIS TMDL also specifies the need for additional actions beyond the in-basin nitrogen load reduction of 58.5%. In particular, "Phase IV" nitrogen reduction actions are scheduled for out-of-basin sources, including sources of nitrogen that originate in States north of Connecticut (i.e., Massachusetts, New Hampshire, and Vermont) and drain to LIS. According to the LIS TMDL analysis, an estimated 12,542.9 tons of total nitrogen is delivered to LIS via the Connecticut River. The LIS TMDL sets reduction targets for the amount of nitrogen delivered to LIS from the significant tributaries, totaling about 720 tons per year through the application of low-cost BNR retrofits of existing sewage treatment plants (resulting in a 25 percent reduction in point sources) and 425 tons per year through the implementation of urban and agricultural nonpoint source controls (resulting in a 10 percent reduction in nonpoint sources). The Connecticut River's reduction targets, including the portion of Farmington River that drains Massachusetts, are about 640 tons and 400 tons of nitrogen annually from point and nonpoint sources, respectively.

Shortly following EPA's approval of the LIS TMDL, NEIWPC was asked to assist in the implementation of the TMDL by coordinating the effort to better define nitrogen sources and loads in the Upper Connecticut River Basin (drainage upstream of the Connecticut-Massachusetts border). Through a cooperative effort, NEIWPC, Connecticut, Massachusetts, New Hampshire, Vermont, and EPA (the Connecticut River Nitrogen Workgroup) are developing an Upper Connecticut River Basin Total Nitrogen Reduction Strategy (or TMDL, as appropriate) that will comply with the LIS TMDL and support the effort to meet water quality goals for LIS.<sup>1</sup>

## METHODOLOGY

### **GOAL 1: Develop refined nitrogen load and source assessments for Upper Connecticut River Basin.**

#### ***Task 1: Establish Connecticut River Nitrogen Project Workgroup.***

Following approval of the LIS TMDL in 2001, NEIWPC was asked to coordinate an effort to better define nitrogen sources and loads in the Upper Connecticut River Basin (drainage upstream of the Connecticut-Massachusetts border); the Connecticut River is one of the significant tributaries that drains directly into LIS. In response to this request from the State of Connecticut and EPA, NEIWPC initiated the Connecticut River Nitrogen Project and established the Connecticut River Nitrogen Workgroup, which serves as an interstate

<sup>1</sup> It should be noted that the results of the Connecticut River Nitrogen Project may impact the tributary load allocation set in the LIS TMDL.

technical advisory committee for the Connecticut River Nitrogen Project. The workgroup is comprised of staff from NEIWPC, Connecticut Department of Environmental Protection (CT DEP), Massachusetts Department of Environmental Protection (MA DEP), New Hampshire Department of Environmental Services (NH DES), Vermont Department of Environmental Conservation (VT DEC), and EPA (Table 1). The workgroup meets 2-3 times a year; in between meetings, the workgroup communicates via monthly teleconferences and frequent emails. The United States Geological Survey (USGS) is also an important collaborator in the project and will play a significant role in conducting and accomplishing the research objectives of the Connecticut River Nitrogen Project.

The workgroup has been charged by the Long Island Sound Study (LISS) Management Committee with the task of developing scientifically-defensible nitrogen load allocations, as well as an implementation plan, for the Connecticut River Basin in the States of Massachusetts, New Hampshire, and Vermont ("upper States") that are consistent with TMDL allocations established for LIS. The effort being undertaken by the Connecticut River Nitrogen Workgroup will result in the development of a Total Nitrogen Reduction Plan (or TMDL, as appropriate) for the Upper Connecticut River Basin. The workgroup serves as the decision-making authority for technical aspects of the project. NEIWPC serves as the project manager and workgroup coordinator, and will cover all corresponding responsibilities. NEIWPC will also serve as a Connecticut River Workgroup representative at LISS Management Committee meetings, providing updates as requested.

**Table 1.** Connecticut River Nitrogen Project Workgroup members.

Member	Affiliation
Laura Blake	NEIWPC
Beth Card	NEIWPC
Paul Stacey	CT DEP
Sally Snyder	CT DEP
Tim Clear	VT DEC
Gregg Comstock	NH DES
Paul Currier	NH DES
Margaret Foss	NH DES
Russell Isaac	MA DEP
Rick Dunn	MA DEP
Paul Hogan	MA DEP
Mark Tedesco	EPA – LIS
Mary Garren	EPA – RI
Lynne Hamjian	EPA – RI

TASK 1 OVERVIEW		
<b>BRIEF DESCRIPTION:</b>	Establish workgroup for the Connecticut River Nitrogen Project.	
<b>STATUS:</b>	Complete.	
<b>PROJECTED COMPLETION:</b>	Workgroup process will be ongoing throughout project.	
ACCOMPLISHMENTS: OCTOBER 2001 – SEPTEMBER 2002		
<input checked="" type="checkbox"/>	Identified project participants: NEIWPC, CT DEP, MA DEP, NH DES, VT DEC, & EPA	
<input checked="" type="checkbox"/>	Established project workgroup and participant roles/responsibilities	
<input checked="" type="checkbox"/>	Defined project goals and objectives	
<input checked="" type="checkbox"/>	Assigned project management and workgroup coordination responsibilities to NEIWPC	
<input checked="" type="checkbox"/>	Developed workplan & budget	
ACCOMPLISHMENTS: OCTOBER 2002 – SEPTEMBER 2003		
<input checked="" type="checkbox"/>	Maintained workgroup process	
<input checked="" type="checkbox"/>	Established workgroup meeting schedule	
<input checked="" type="checkbox"/>	Provided project updates at LISS Management Committee Meetings	
<input checked="" type="checkbox"/>	Presented project to NEIWPC Executive Committee at January Commission Meeting	
<input checked="" type="checkbox"/>	Updated workplan & budget	
PLANNED ACCOMPLISHMENTS: OCTOBER 2003 – SEPTEMBER 2004		
<input type="checkbox"/>	Maintain workgroup process	
<input type="checkbox"/>	Provide project updates at LISS Management Committee Meetings	
<input type="checkbox"/>	Provide project update to NEIWPC Executive Committee at May Commission Meeting	
<input type="checkbox"/>	Establish relationship with Connecticut River Joint Commissions & Connecticut River Watershed Council	
<input type="checkbox"/>	Update workplan & budget	
PLANNED ACCOMPLISHMENTS: OCTOBER 2004 – SEPTEMBER 2005		
<input type="checkbox"/>	Maintain workgroup process	
<input type="checkbox"/>	Provide project updates at LISS Management Committee Meetings	
<input type="checkbox"/>	Attend meetings of the Connecticut River Joint Commissions & the Connecticut River Watershed Council	
<input type="checkbox"/>	Update workplan & budget	
PLANNED ACCOMPLISHMENTS: OCTOBER 2005 – SEPTEMBER 2006		
<input type="checkbox"/>	Maintain workgroup process	
<input type="checkbox"/>	Provide project updates at LISS Management Committee Meetings	
<input type="checkbox"/>	Attend meetings of the Connecticut River Joint Commissions & the Connecticut River Watershed Council	
<input type="checkbox"/>	Update workplan & budget	
TIME PERIOD	FUNDING NEED	FUNDING SOURCE
October 2001 – September 2002	Yes	NEIWPC
October 2002 – September 2003	Yes	NEIWPC
October 2003 – September 2004	Yes	EPA LISS
October 2004 – September 2005	Yes	TBD
October 2005 – September 2006	Yes	TBD

**Task 2: Compile existing water quality data, develop databases, and conduct data analyses.**

An important component to the project, and to the successful completion of the nitrogen loading analysis, is the ability to easily access pertinent water quality data for the Connecticut River Watershed. Therefore, all available water quality data for the Connecticut River Watershed will be compiled into several central databases (Microsoft Excel and/or Microsoft Access). Additionally, various data and trend analyses will be conducted for the existing data (i.e., ambient water quality, point source, streamflow, and precipitation). NEIWPCC will take the lead in conducting the data analyses; however, assistance and input will be requested from the States and EPA. Various graphs, tables, and maps will be generated; a summary report or white paper may be developed.

Ambient Water Quality

A database of ambient water quality data will be developed for the Connecticut River Watershed. A variety of water quality data will be gathered from various sources, including individual States, USGS, and EPA. Individual datasets will be examined and analyzed for trends and relationships in the concentrations, loads, yields, and fluxes of the various parameters of interest. Data from different agencies and sampling locations will be combined (where appropriate) and further analyzed.

Point Sources

A database of point source (treated wastewater discharge) data will be developed for the Connecticut River Watershed. The database will include all available information for flow, BOD, dissolved oxygen, ammonia, TKN, nitrate, nitrite, and phosphorus. Both municipal and industrial (major and minor) facilities will be examined. Data will be obtained from both EPA and individual States. Data analyses will include estimates of loadings for individual facilities. An attempt will be made to develop general estimates for point source loading based on facility size and/or treatment type. If possible, existing point source data will be used to develop statistical relationships that can be used to predict nitrogen loading at unmonitored facilities.

Streamflow

Accurate streamflow data are essential for calculating loading. The USGS operates a Nation-wide continuous streamflow-gauging program, from which data are collected and used by Federal, State, and local agencies for planning and operating water-resources projects and regulatory programs. A streamflow database will be developed and maintained for all continuous streamflow gages located within the Connecticut River Watershed. Streamflow hydrographs will be developed and analyzed; specific factors examined may include annual hydrographs; event hydrographs; determination of inflection points; hydrograph time parameters, storm-runoff hydrographs and storm-runoff volumes; estimations of groundwater storage; estimations of watershed infiltration and recharge; and determination of unit hydrographs.

Precipitation

A database of precipitation data from pertinent weather stations will be developed for the Connecticut River Watershed. The spatial distribution of precipitation in the Connecticut River Watershed will be analyzed, as well as the temporal distribution. A frequency analysis will be conducted for precipitation; specific factors examined may include precipitation variability, frequency, return period, and design rainfall; intensity-duration-frequency analysis; and probable maximum precipitation.

Atmospheric Deposition

Atmospheric deposition estimates for nitrogen input into the Connecticut River Watershed will be considered based on the best available modeling estimates.

Watershed Characteristics

Relevant information on watershed features and characteristics will be compiled, including information on population statistics, land use, land cover, soils, stream networks, and watershed boundaries.

TASK 2 OVERVIEW		
<b>BRIEF DESCRIPTION:</b>	Compile and analyze existing water quality data.	
<b>STATUS:</b>	In progress.	
<b>PROJECTED COMPLETION:</b>	May 2004.	
<i>ACCOMPLISHMENTS: OCTOBER 2001 – SEPTEMBER 2002</i>		
<input checked="" type="checkbox"/>	Initiated water quality data compilation	
<input checked="" type="checkbox"/>	Created a series of GIS maps to display information on data availability (amount and location)	
<input checked="" type="checkbox"/>	Identified critical data gaps	
<i>ACCOMPLISHMENTS: OCTOBER 2002 – SEPTEMBER 2003</i>		
<input checked="" type="checkbox"/>	Updated some of the GIS maps	
<input checked="" type="checkbox"/>	Continued water quality data compilation	
<input checked="" type="checkbox"/>	Developed point source database	
<input checked="" type="checkbox"/>	Developed streamflow database for all USGS gages in the Connecticut River Watershed	
<i>PLANNED ACCOMPLISHMENTS: OCTOBER 2003 – SEPTEMBER 2004</i>		
<input type="checkbox"/>	Continue water quality data compilation	
<input type="checkbox"/>	Complete point source database	
<input type="checkbox"/>	Complete streamflow database	
<input type="checkbox"/>	Develop and complete ambient water quality database	
<input type="checkbox"/>	Develop and complete precipitation database	
<input type="checkbox"/>	Complete atmospheric deposition data compilation	
<input type="checkbox"/>	Conduct data analyses	
<input type="checkbox"/>	Prepare data summary report	
<i>PLANNED ACCOMPLISHMENTS: OCTOBER 2004 – SEPTEMBER 2005</i>		
<input type="checkbox"/>	Update databases	
<input type="checkbox"/>	Update data analyses	
<input type="checkbox"/>	Finalize data summary report	
<i>PLANNED ACCOMPLISHMENTS: OCTOBER 2005 – SEPTEMBER 2006</i>		
<input type="checkbox"/>	Update databases	
<input type="checkbox"/>	TBD	
<b>TIME PERIOD</b>	<b>FUNDING NEED</b>	<b>FUNDING SOURCE</b>
October 2001 – September 2002	Yes	NEIWPCC
October 2002 – September 2003	Yes	NEIWPCC
October 2003 – September 2004	Yes	EPA LISS
October 2004 – September 2005	Yes	TBD
October 2005 – September 2006	Yes	TBD

**Task 3: Analyze existing water quality modeling data for the entire basin.**

A variety of water quality models have been used to predict nitrogen loads and yields for the Connecticut River Watershed, including National SPARROW, New England SPARROW, BASINS PLOAD, Connecticut Watershed Model (CTWM), LIS 3.0, Mullaney & Schwarz's GLS Regression Model, and the Long Island Sound TMDL Estimation. Overall model estimates for nitrogen loading to LIS from the Connecticut River will be examined. The estimates and predictions will be analyzed and compared across different spatial scales (States, basins, sub-basins, tributaries, etc.). Estimates for source contributions will be examined for those models that have a source assessment component. Model parameter coefficients will be examined (where relevant). NEIWPCC will take the lead in conducting the model comparisons; however, assistance and input may be requested from the States, EPA, and USGS. A white paper will be developed for the model comparison analysis.

Despite previous attempts to develop predictions for nitrogen loading in the Upper Connecticut River Basin, uncertainties and data gaps in the upper basin has resulted in equivocal water quality model predictions. Previous water quality modeling efforts have identified significant weaknesses in existing data. The collection of additional (ambient and point source) data is critical to the successful development of refined nitrogen loading estimates. Other uncertainties revealed by previous modeling efforts include estimates for nonpoint source loading, atmospheric deposition, and attenuation rates for nitrogen.

TASK 3 OVERVIEW		
<b>BRIEF DESCRIPTION:</b>	Analyze existing water quality modeling data	
<b>STATUS:</b>	In progress.	
<b>PROJECTED COMPLETION:</b>	May 2004.	
<b>ACCOMPLISHMENTS: OCTOBER 2001 – SEPTEMBER 2002</b>		
<input checked="" type="checkbox"/>	Review existing modeling results for the Connecticut River Watershed	
<b>ACCOMPLISHMENTS: OCTOBER 2002 – SEPTEMBER 2003</b>		
<input checked="" type="checkbox"/>	Analyzed results from the National SPARROW Model	
<input checked="" type="checkbox"/>	Analyzed results from the Connecticut Watershed Model	
<input checked="" type="checkbox"/>	Analyzed results from the LIS 3.0 Model	
<input checked="" type="checkbox"/>	Analyzed results from the Mullaney & Schwarz GLS Regression Model	
<input checked="" type="checkbox"/>	Compared results from existing model analyses	
<input checked="" type="checkbox"/>	Prepared draft white paper for the model comparison analysis	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2003 – SEPTEMBER 2004</b>		
<input type="checkbox"/>	Develop QAPP for the data analysis (if necessary)	
<input type="checkbox"/>	Analyze results from the New England SPARROW Model	
<input type="checkbox"/>	Finalize white paper for the model comparison analysis	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2004 – SEPTEMBER 2005</b>		
<input type="checkbox"/>	None at this time	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2005 – SEPTEMBER 2006</b>		
<input type="checkbox"/>	None at this time	
<b>TIME PERIOD</b>	<b>FUNDING NEED</b>	<b>FUNDING SOURCE</b>
October 2001 – September 2002	Yes	NEIWPCC
October 2002 – September 2003	Yes	NEIWPCC
October 2003 – September 2004	Yes	EPA LISS
October 2004 – September 2005	No	N/A
October 2005 – September 2006	No	N/A

**Task 4: Implement water quality monitoring program in the upper basin.**

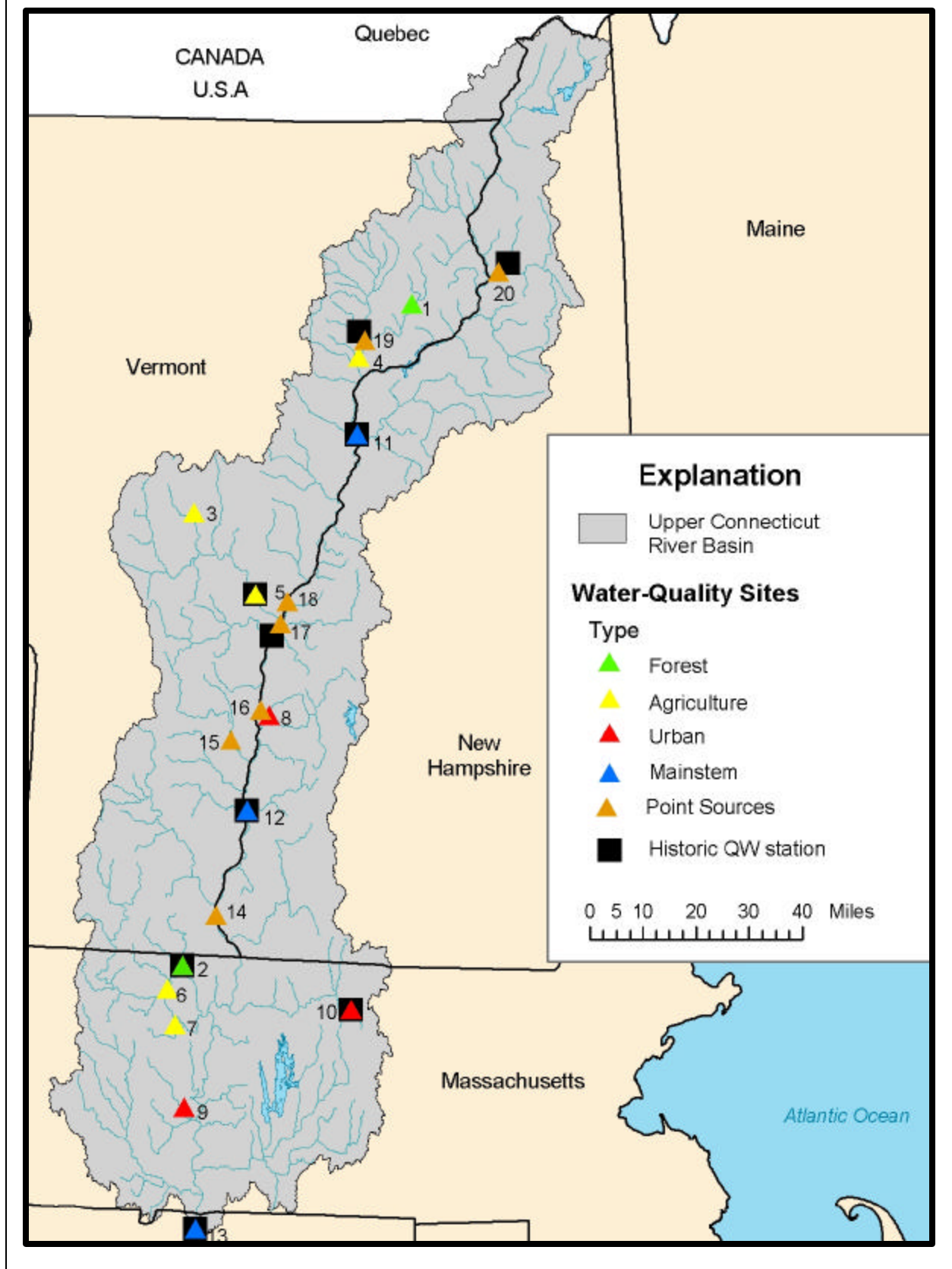
In order to address data gaps, a water quality monitoring program (designed to further characterize nitrogen loads and sources) will be implemented for the Upper Connecticut River Basin. Twelve sites in the Upper Connecticut River Basin will be sampled as part of a long-term (e.g., 2-3 year) monitoring program (Table 2, Figure 1). The monitoring program will provide detailed spatial coverage of sites with water-quality data and will assist in the definition of land use contributions of total nitrogen and the determination of total nitrogen loads in the Upper Connecticut River. Site locations and sampling frequency will be based on an analysis of data gaps and error in previous load estimates; sites will be chosen based on the anticipated ability of the data to better characterize land uses and nitrogen sources, as well as improve nitrogen loading estimates. Samples will be collected for ammonia, nitrite plus nitrate, total kjeldahl nitrogen (TKN), orthophosphate, total phosphorus, and suspended sediment; samples will also be analyzed for dissolved oxygen, specific conductance, temperature, and pH. The USGS will take the lead on developing and implementing the Upper Connecticut River Nitrogen monitoring program<sup>2</sup>. A summary report (of the data) will be developed.

**Table 2.** Sampling Sites in the Upper Connecticut River Basin.

Site No.	Site Name
1	Moose River at Victory, VT
2	Green River near Corlain, MA
3	Ayers Brook at Randolph, VT
4	Passumpsic River at Passumpsic, VT
5	White River at West Hartford, VT
6	North River at Shattuckville, MA
7	South River near Conway, MA
8	Sugar River at West Claremont, NH
9	Mill River at Northhampton, MA
10	Otter River at Otter River, MA
11	Connecticut River at Wells River, VT
12	Connecticut River at North Walpole, NH
13	Connecticut River at Thompsonville, CT
14	Brattleboro WWTF, VT
15	Claremont WWTF, NH
16	Springfield WWTF, VT
17	Lebanon WWTF, NH
18	Hanover WWTF, NH
19	St. Johnsbury WWTF, VT
20	Wasau Paper, NH

<sup>2</sup> See the Upper Connecticut River Nitrogen Monitoring Program workplan for details

Figure 1. Water-quality monitoring sites in the Upper Connecticut River Basin (see Table 2 for site names and locations).



TASK 4 OVERVIEW		
<b>BRIEF DESCRIPTION:</b>	Implement water quality monitoring program in upper basin.	
<b>STATUS:</b>	In progress.	
<b>PROJECTED COMPLETION:</b>	December 2004.	
ACCOMPLISHMENTS: OCTOBER 2001 – SEPTEMBER 2002		
<input checked="" type="checkbox"/>	Identified need for additional ambient monitoring in the upper basin	
<input checked="" type="checkbox"/>	Developed nitrogen monitoring program for the upper basin	
<input checked="" type="checkbox"/>	Quality Assurance Project Plan (QAPP) for the monitoring program developed and approved	
ACCOMPLISHMENTS: OCTOBER 2002 – SEPTEMBER 2003		
<input checked="" type="checkbox"/>	Initiated the nitrogen monitoring program for the upper basin	
<input checked="" type="checkbox"/>	Completed 1 <sup>st</sup> year of the nitrogen monitoring program for the upper basin	
PLANNED ACCOMPLISHMENTS: OCTOBER 2003 – SEPTEMBER 2004		
<input type="checkbox"/>	Review results for the 1 <sup>st</sup> year of the nitrogen monitoring program for the upper basin	
<input type="checkbox"/>	Assess need for 3 <sup>rd</sup> year of nitrogen monitoring in the upper basin	
<input type="checkbox"/>	Complete 2 <sup>nd</sup> year of the nitrogen monitoring program for the upper basin	
PLANNED ACCOMPLISHMENTS: OCTOBER 2004 – SEPTEMBER 2005		
<input type="checkbox"/>	Summarize results for the 2-year nitrogen monitoring program for the upper basin	
<input type="checkbox"/>	Complete 3 <sup>rd</sup> year of the nitrogen monitoring program for the upper basin ( <i>unconfirmed</i> )	
PLANNED ACCOMPLISHMENTS: OCTOBER 2005 – SEPTEMBER 2006		
<input type="checkbox"/>	Summarize results for the 3-year nitrogen monitoring program for the upper basin ( <i>unconfirmed</i> )	
TIME PERIOD	FUNDING NEED	FUNDING SOURCE
October 2001 – September 2002	Yes	NEIWPC
October 2002 – September 2003	Yes	NEIWPC
October 2003 – September 2004	Yes	EPA LISS
October 2004 – September 2005	TBD	TBD
October 2005 – September 2006	TBD	TBD

**Task 5: Address uncertainties associated with point source loading in the upper basin.**

Data on point source nitrogen discharges in the upper basin are limited. In order to develop a Total Nitrogen Reduction Plan (or TMDL) for the upper basin, better estimates for the point source contribution are necessary. CT DEP currently requires nitrogen monitoring in permits they issue to point source dischargers within the entire State. In recent years, MA DEP began including requirements for nitrogen monitoring in some of the permits they issue to dischargers in the Connecticut River Basin. NH DES and VT DEC do not currently include general nutrient monitoring requirements in the permits they issue. In order to improve nitrogen loading estimates in the Upper Connecticut River Basin, ambient water quality sampling will need to be supplemented with the collection of point source (treated wastewater discharge) data from facilities in the upper States. If resources do not support the implementation of an adequate point source monitoring program in the upper basin, other options (for data collection) will need to be considered; specifically, collecting a limited amount of point source data from which projections could be made for regional point source loading estimates.

As part of the Upper Connecticut River Nitrogen Monitoring Program, the USGS has agreed to collect a limited number of samples from five to seven point source facilities (Table 2, Figure 1). During summer 2003, monthly grab samples will be collected from five different facilities (Claremont, NH; Springfield, VT; Lebanon, NH; Hanover, NH; and St. Johnsbury, VT); one additional sample will be collected during a high-flow period. When feasible (e.g., every other month), samples will be collected at two additional facilities (Brattleboro, VT and Wasau Paper, NH). Although the collection of these samples will provide some information on point source loading in the upper basin, additional monitoring will be necessary to properly characterize the point source contribution in the Upper Connecticut River Basin. NEIWPC will work with the upper States and EPA to address this issue.

TASK 5 OVERVIEW		
<b>BRIEF DESCRIPTION:</b>	Address uncertainty with point source data in upper basin.	
<b>STATUS:</b>	In progress.	
<b>PROJECTED COMPLETION:</b>	December 2004.	
<b>ACCOMPLISHMENTS: OCTOBER 2001 – SEPTEMBER 2002</b>		
<input checked="" type="checkbox"/>	Identified need for additional point source data collection New Hampshire & Vermont	
<b>ACCOMPLISHMENTS: OCTOBER 2002 – SEPTEMBER 2003</b>		
<input checked="" type="checkbox"/>	Discussed need for nitrogen point source monitoring in NH & VT	
<input checked="" type="checkbox"/>	Collected samples from several NH & VT facilities during June, July, August, & September	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2003 – SEPTEMBER 2004</b>		
<input type="checkbox"/>	Develop plan to collect additional point source data from NH & VT facilities	
<input type="checkbox"/>	Collect additional point source samples from NH & VT facilities	
<input type="checkbox"/>	Identify permanent or long-term solutions for collecting point source data in NH & VT	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2004 – SEPTEMBER 2005</b>		
<input type="checkbox"/>	TBD	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2005 – SEPTEMBER 2006</b>		
<input type="checkbox"/>	TBD	
<b>TIME PERIOD</b>	<b>FUNDING NEED</b>	<b>FUNDING SOURCE</b>
October 2001 – September 2002	No	N/A
October 2002 – September 2003	No	N/A
October 2003 – September 2004	Yes	TBD
October 2004 – September 2005	TBD	TBD
October 2005 – September 2006	TBD	TBD

**Task 6: Conduct detailed nitrogen attenuation investigation for the entire basin.**

Numerous estimates have been developed for nitrogen attenuation (in-stream nitrogen loss) rates for various watersheds, including the Connecticut River Watershed. The amount of variability associated with nitrogen loss and transport in New England streams coupled with the wide range of current nitrogen attenuation estimates has provided the basis for the need to conduct an extensive nitrogen attenuation (monitoring/modeling) study in the Connecticut River Basin (in both the mainstem and in the tributaries and smaller headwater streams). NEIWPCC will coordinate the development of a study to investigate nitrogen attenuation in the Connecticut River Basin; responsibilities will include a literature review, development of white papers, establishment of a smaller workgroup, organization of a technical workshop, and development and implementation of a (monitoring/modeling) project.<sup>3</sup>

<sup>3</sup> See the Nitrogen Attenuation Project Planning Matrix for details

TASK 6 OVERVIEW		
<b>BRIEF DESCRIPTION:</b>	Conduct nitrogen attenuation study.	
<b>STATUS:</b>	Preliminary discussions in progress; project not yet initiated	
<b>PROJECTED COMPLETION:</b>	TBD	
<b>ACCOMPLISHMENTS: OCTOBER 2001 – SEPTEMBER 2002</b>		
<input checked="" type="checkbox"/>	N/A	
<b>ACCOMPLISHMENTS: OCTOBER 2002 – SEPTEMBER 2003</b>		
<input checked="" type="checkbox"/>	Developed small workgroup for proposed nitrogen attenuation study	
<input checked="" type="checkbox"/>	Initiated literature review	
<input checked="" type="checkbox"/>	Developed a draft project planning matrix for the proposed nitrogen attenuation study	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2003 – SEPTEMBER 2004</b>		
<input type="checkbox"/>	Complete the nitrogen attenuation project planning matrix	
<input type="checkbox"/>	Complete literature review and develop annotated bibliography	
<input type="checkbox"/>	Develop a white paper summarizing key findings from the literature	
<input type="checkbox"/>	Develop a white paper summarizing range of research methods	
<input type="checkbox"/>	Develop a white paper summarizing various estimates for loss rates	
<input type="checkbox"/>	Organize a technical workshop on nitrogen attenuation	
<input type="checkbox"/>	Develop nitrogen attenuation project proposal for the Connecticut River Basin	
<input type="checkbox"/>	Initiate nitrogen attenuation project	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2004 – SEPTEMBER 2005</b>		
<input type="checkbox"/>	Continue nitrogen attenuation project	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2005 – SEPTEMBER 2006</b>		
<input type="checkbox"/>	Continue nitrogen attenuation project	
<b>TIME PERIOD</b>	<b>FUNDING NEED</b>	<b>FUNDING SOURCE</b>
October 2001 – September 2002	No	N/A
October 2002 – September 2003	Yes	NEIWPCC
October 2003 – September 2004	Yes	TBD
October 2004 – September 2005	Yes	TBD
October 2005 – September 2006	Yes	TBD

**Task 7: Conduct additional water quality modeling analyses**

The collection of new data (and other information) will be used to readjust/recalibrate previous model estimates (e.g., New England SPARROW Model) for nitrogen loading in the Connecticut River Basin and to LIS. Additionally, new modeling analyses may be conducted; such analyses may include the application of models such as BASINS, QUAL2E, etc. The workgroup will discuss the need for additional/new model applications and, if it is determined that additional modeling is necessary, the workgroup will explore all model options. Recalibration and/or development of new models will also take into account updated model estimates for atmospheric deposition, which take into account existing and proposed Clean Air Act programs.

TASK 7 OVERVIEW		
<b>BRIEF DESCRIPTION:</b>	Conduct additional water quality modeling analyses	
<b>STATUS:</b>	In progress.	
<b>PROJECTED COMPLETION:</b>	May 2004.	
<b>ACCOMPLISHMENTS: OCTOBER 2001 – SEPTEMBER 2002</b>		
<input checked="" type="checkbox"/>	Conducted BASINS PLOAD modeling	
<input checked="" type="checkbox"/>	Continued development of New England SPARROW Model	
<b>ACCOMPLISHMENTS: OCTOBER 2002 – SEPTEMBER 2003</b>		
<input checked="" type="checkbox"/>	Continued development of New England SPARROW Model	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2003 – SEPTEMBER 2004</b>		
<input type="checkbox"/>	Develop QAPP for the data analysis (if necessary)	
<input type="checkbox"/>	Complete development of New England SPARROW Model	
<input type="checkbox"/>	Prepare summary report of the New England SPARROW Model results for the Connecticut River Basin	
<input type="checkbox"/>	Begin additional water quality modeling	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2004 – SEPTEMBER 2005</b>		
<input type="checkbox"/>	Complete additional water quality modeling	
<input type="checkbox"/>	Prepare water quality modeling summary report	
<b>PLANNED ACCOMPLISHMENTS: OCTOBER 2005 – SEPTEMBER 2006</b>		
<input type="checkbox"/>	TBD	
<b>TIME PERIOD</b>	<b>FUNDING NEED</b>	<b>FUNDING SOURCE</b>
October 2001 – September 2002	Yes	NEIWPCCC
October 2002 – September 2003	Yes	NEIWPCCC
October 2003 – September 2004	Yes	EPA LISS
October 2004 – September 2005	Yes	TBD
October 2005 – September 2006	TBD	TBD

## **GOAL 2: Develop Upper Connecticut River Total Nitrogen Reduction Plan (or TMDL, as appropriate).**

The information generated from Tasks 1-7 of Goal 1 will provide the technical basis for the development of a Total Nitrogen Reduction Plan (or TMDL, as appropriate) for the Upper Connecticut River Basin that is consistent with the Long Island Sound TMDL. If deemed appropriate and desirable, the plan can be formally adopted through the TMDL process.

### **Task 1: Present technical findings to NEIWPCCC Executive Committee.**

Prior to embarking on the development of the Total Nitrogen Reduction Plan (or TMDL), NEIWPCCC will present the technical findings and results to its Executive Committee and to the LISS Management Committee. In order to proceed with development of the reduction plan for the Upper Connecticut River Basin, the workgroup will need to obtain endorsement by the NEIWPCCC Executive Committee, specifically the committee members from the States of Massachusetts, New Hampshire, and Vermont.

### **Task 2: Establish nitrogen load allocations for the upper States.**

Loading allocations necessary to restore compliance with State standards for dissolved oxygen levels in LIS will be established. The data and information gathered from Tasks 1-7 of Goal 1 will be used to identify the different nitrogen sources, as well as the locations of those sources, in the upper States. Source contributions will be determined and both current and projected loadings will be identified for all sources by calculating or estimating loads from water quality and flow data, estimating loads with mathematical models, or using a combination of these methods. All sources, including point, nonpoint, and natural background, of nitrogen will be examined. Significant discussion regarding source priorities will take place during the load allocation process.

In order to account for foreseeable increases in nitrogen sources (e.g., population growth, increased wastewater discharge, growth of industrial activity, etc.), the workgroup will need to establish a projection horizon (e.g., fifteen years) that is consistent with the LIS TMDL schedule. Similarly, the workgroup will also need to set a projected date for meeting water quality target(s), which is consistent with the LIS TMDL. A

number of factors will be considered when developing nitrogen load allocations, including: future growth allocations; variations in flow and pollutant load; temporal aspects; antibacksliding requirements; antidegradation requirements; and differing State standards (for nitrogen).

***Task 3: Identify cost-effective and realistic nitrogen control strategies and determine feasible and equitable nitrogen load reduction goals for the upper States.***

An inventory of all known factors in the watershed which influence nitrogen loading in the Connecticut River Basin will be developed. These factors might include permitted industrial and municipal wastewater discharges, concentrated animal feeding operations (CAFOs), waste application sites, cropland, forestry operations, industrial stormwater, urban stormwater, construction activities, and other sources such as natural background. Policy and management options will be carefully reviewed and discussed by the workgroup. Numerous management scenarios will be developed and tested for their effectiveness. The potential for various strategy elements to succeed will be evaluated. Cost estimates will be developed and considered. This process will result in the development of specific nitrogen reduction goals and an implementation strategy, including targets and schedules, to meet those goals. This decision-making process will require an extensive amount of discussion and negotiation within each State, between States, and between the States and EPA. This step is critical to the success of the reduction plan and may require a significant amount of time and effort.

***Task 4: Complete Total Nitrogen Reduction Plan (or TMDL), including implementation strategy.***

Upon reaching agreement on the nitrogen reduction goals, the Upper Connecticut River Total Nitrogen Reduction Plan (or TMDL, as appropriate) will be written. If deemed appropriate and desirable, the reduction plan can be formally submitted and approved as a TMDL and/or a Memorandum of Agreement (MOA) can be drafted. The reduction plan will carefully document the Connecticut River Nitrogen Project in its entirety, including all technical findings and management decisions. The reduction plan will also incorporate an implementation strategy, which will describe control actions and management measures that will be implemented to achieve the water quality target(s). The implementation strategy will include a schedule for implementing specific activities determined necessary to achieve nitrogen reduction objectives (e.g., permitting, nonpoint source management measures, etc.). The implementation strategy may identify responsible entities. The implementation strategy may also include a follow-up surface water quality monitoring plan to determine the effectiveness of the control actions and management measures and to determine whether loading allocations are achieved. The implementation strategy will also establish measurable outcomes for determining whether the implementation plan is being properly executed and water quality standards are being achieved.

***Task 5: Present Total Nitrogen Reduction Plan (or TMDL) to NEIWPCC Executive Committee.***

Upon finalization of the Upper Connecticut River Total Nitrogen Reduction Plan (or TMDL), NEIWPCC will present the reduction plan to the NEIWPCC Executive Committee and the LISS Management Committee. At this time, the workgroup will be looking to the LISS Management Committee and the NEIWPCC Executive Committee, specifically the committee members from the States of Massachusetts, New Hampshire, and Vermont, for endorsement of the reduction plan. Upon reaching agreement, Connecticut, Massachusetts, New Hampshire, Vermont, NEIWPCC, and EPA will enter into an MOA to adhere to the Upper Connecticut River Total Nitrogen Reduction Plan or submit the reduction plan as a TMDL for formal approval.

***Task 6: Engage in public review process and approve Total Nitrogen Reduction Plan (or TMDL).***

Drafts of the Total Nitrogen Reduction Plan (or TMDL) will be formally presented for public review and comment before being presented to the NEIWPCC Executive Committee and LISS Management Committee for final approval.

**GOAL 3: Implement the Upper Connecticut River Total Nitrogen Reduction Plan (or TMDL).**

Once the Total Nitrogen Reduction Plan has been finalized, and a MOA signed or a TMDL adopted, the workgroup will focus on implementations. A watershed action plan (or watershed based plan) will be developed to provide direction to stakeholders and water resource managers at the local, regional, State, and Federal levels. Additionally, funding options will be sought out to support implementation measures. *The specific details of the implementation process (Goal 3) will be defined at a later date, likely during the next workplan update (Summer 2004); however, potential tasks may include:*

**Task 1: Develop watershed action plan.**

**Task 2: Coordinate regional implementation measures.**

**Task 3: Assist individual States with implementation of State-specific controls.**

**PROEJCT SCHEDULE OVERVIEW**

Task Number	Task Description	Completion Date
<b>GOAL 1: Develop refined nitrogen load and source assessments for Upper Connecticut River</b>		
<i>Task 1</i>	Establish workgroup	October 2001
<i>Task 2</i>	Compile & analyze WQ data	May 2004
<i>Task 3</i>	Analyze existing WQ modeling data	May 2004
<i>Task 4</i>	Upper basin WQ monitoring	December 2004
<i>Task 5</i>	Address PS data uncertainties	December 2004
<i>Task 6</i>	Nitrogen attenuation study	TBD
<i>Task 7</i>	Conduct additional WQ modeling	March 2005
<b>GOAL 2: Develop Upper Connecticut River Total Nitrogen Reduction Plan (or TMDL, as</b>		
<i>Task 1</i>	NEIWPCC Executive Committee agreement (plan development)	January 2005
<i>Task 2</i>	Establish load allocations	April 2005
<i>Task 3</i>	Identify nitrogen control strategies and reduction goals	April 2005
<i>Task 4</i>	Finalize reduction plan (including implementation strategy)	May 2005
<i>Task 5</i>	NEIWPCC Executive Committee agreement (plan finalization)	July 2005
<i>Task 6</i>	Public review process <b>and plan (or TMDL) approval</b>	August 2005
<b>GOAL 3: Implement the Upper Connecticut River Total Nitrogen Reduction Plan (or TMDL, as</b>		
<i>Task 1</i>	Develop watershed action plan	October 2005
<i>Task 2</i>	Implement regional nitrogen control strategies	TBD
<i>Task 3</i>	Implement States-specific nitrogen control strategies	TBD

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