Site Specific Project Plan

Watershed-Based Plan for High Quality Waters in the AWWA Region

FB Environmental Associates
December 29, 2008
SITE SPECIFIC PROJECT PLAN FOR:

WATERSHED BASED-PLAN FOR HIGH QUALITY WATERS IN THE ACTON WAKEFIELD WATERSHEDS ALLIANCE (AWWA) REGION

(NHDES PROJECT #B-08-C-02)

Under the New Hampshire 319 Nonpoint Source Grant Program Quality Assurance Project Plan dated October 17, 2008 (RFA# 08262)

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December 29, 2008

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1. Distribution List

Table 1 (below) lists people who will receive copies of the approved Site Specific Project Plan (SSPP) under the Watershed Based-Plan for High Quality Waters in the Acton Wakefield Watersheds Alliance (AWWA) Region dated December 29, 2008.

**Table 1.** SSPP Distribution List

<table>
<thead>
<tr>
<th>SSPP Recipient Name</th>
<th>Project Role</th>
<th>Organization</th>
<th>Telephone number and e-mail address</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>
2. Project Task Organization

Figure 1 (below) outlines the organization structure of the project personnel.

Figure 1. Project Organizational Chart
3. Project Description and Methodology

A. Problem Statement

The communities within the Acton Wakefield Watersheds Alliance (AWWA) region are fortunate to have waters of exceptional quality. The natural amenities that make the AWWA region so unique and attractive also make it vulnerable to the impacts of increasing development. For example, according to the Strafford Regional Planning Commission, the Town of Wakefield, New Hampshire has experienced a population growth of nearly 57% from 1990 – 2005 (NHES 2007). Pollution threats related to development include sediment, nutrients and bacteria from existing and future shoreland development, aging septic systems and roads in the watershed.

The purpose of this project is to develop a Watershed-Based Plan that will help maintain or improve the high quality waters and habitat of the AWWA region lakes. Watershed modeling is a large component of this project, and will be used to determine long-term water quality goals, identify sources of pollution and estimate pollutant load reductions needed to accommodate future watershed development.

B. Historical Data

What type of data is going to be used? What is the Source of the data? What process will be used to determine that the quality of the data is acceptable for use in calculating existing water quality? Please describe.

Several different types of data will be used to complete the Watershed Based Plan for the High Quality Waters of the Acton Wakefield Watershed Alliance (AWWA) Region. The first major data component to be collected is the GIS land use data. These data will be used for determining the total land use area by land use type (in acres) for input into the watershed loading model (see below for model selection criteria). GIS land use data are available from State GIS websites for both Maine and New Hampshire. The Maine land use data, MECLD, is derived primarily from Landsat Thematic Mapping imagery from the years 1999-2001, which was further refined using panchromatic imagery from the spring and summer months of 2004 (MEGIS). The New Hampshire land use data, NH Land Cover Assessment 2001 or NHLC01, consists of the most recent and detailed classification of land cover in New Hampshire based on satellite images acquired between 1990 and 1999, with further revisions in 2001 (GRANIT).

The second major data component is the historical water quality monitoring data for determining the median water quality value and assimilative capacity. These data will be obtained for all five AWWA lakes which include: Great East Lake and Horn Pond located in both Maine and New Hampshire, Lake Ivanhoe and Lovell Lake located in New Hampshire; and Wilson Lake located in Maine. Historical
water quality data for lakes in Maine is collected by the Maine Volunteer Lakes Monitoring Program (VLMP) and the Maine Department of Environmental Protection (Maine DEP). Both groups follow an approved Quality Assurance Project Plan developed by Maine DEP (Maine DEP, 2004) which includes Sampling and Analysis Plans (SAP) that follow Standard Operating Procedures (SOP) for all aspects of lake monitoring, from field procedures to data entry.

The New Hampshire Volunteer Lake Assessment Program (VLAP) and the New Hampshire Lakes Lay Monitoring Program (LLMP) are the two primary volunteer groups collecting water quality data on lakes in New Hampshire. Data is also collected by the UNH Center for Freshwater Biology (CFB). UNH Cooperative Extension (UNHCE) manages all data sampled by the LLMP and the CFB. Data from the VLAP is available through the New Hampshire Department of Environmental Services Environmental Monitoring Database (EMD). Only data that is flagged as final in the EMD will be used. UNHCE will follow the *Watershed-based Management Plan for High Quality Waters in the AWWA Region Water Quality Monitoring Quality Assurance Project Plan* that was developed specifically for this project (UNHCFB and UNHCE, 2008). Data from the UNHCE will only be used if QA/QC measures as outlined in the QAPP have been documented and followed.

Data availability varies by lake, dating back to the year in which each lake was first sampled and ending with the most recent sampling event. Phosphorus data is not always available for each year that data was collected. However, there is a deep data set (Table 2, below) that will be used to establish target water quality goals.

**Table 2.** Years of available sampling data for AWWA lakes

<table>
<thead>
<tr>
<th>Lake</th>
<th>Location</th>
<th>Water Quality Data</th>
<th>Phosphorus Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>First Sampled</td>
<td>Last Sampled</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1974</td>
<td>2008</td>
</tr>
<tr>
<td>Great East Lake</td>
<td>ME/NH</td>
<td>1974</td>
<td>2008</td>
</tr>
<tr>
<td>Lovell Lake</td>
<td>NH</td>
<td>1979</td>
<td>2008</td>
</tr>
<tr>
<td>Lake Ivanhoe</td>
<td>NH</td>
<td>1981</td>
<td>2008</td>
</tr>
<tr>
<td>Horn Pond</td>
<td>ME/NH</td>
<td>1982</td>
<td>2008</td>
</tr>
<tr>
<td>Wilson Lake</td>
<td>ME</td>
<td>1977</td>
<td>2007</td>
</tr>
</tbody>
</table>

Source: NH Environmental Monitoring Database (EMD), UNH Cooperative Extension (includes data from LLMP and CFB), Maine DEP, and PEARL.

Water quality data will be combined to determine the median water quality and assimilative capacity for the two waterbodies that are situated within both Maine and New Hampshire (Great East Lake, and
Horn Pond). Where multiple stations exist for these lakes, best professional judgment will be used to determine which station is most representative of the whole lake. Where data was collected by two different state entities at the same sampling location, data will be combined to determine the median value.

Where available and applicable, shoreline and watershed surveys are a third data component that will be used in conjunction with the GIS land use data to model the external watershed load. Shoreline surveys were conducted by FB Environmental, AWWA, and NH DES staff on all five lakes during the summer/fall of 2008. Watershed surveys have been completed for Great East Lake, Lovell Lake, and Horn Pond.

Additional data needed for input into the watershed loading model include: the hydrological soil group and soil nutrient concentrations, which can be acquired from the USDA/NRCS STATSGO2 database, the number of agricultural animals, population using septic tanks, which can be acquired from the 2000 US Census Bureau; and the number of agricultural animals which can be estimated from the USDA 1997 Census of Agriculture.

C. Establishing Water Quality Goals
   What pollutants are water quality goals being established for? What process will be used to determine the water quality goals? Please describe.

Pollution threats to the high quality waters of the AWWA region include sediment and nutrients from existing and future development, aging septic systems and roads in the watersheds. All of these land uses have the potential to deliver phosphorus, the limiting nutrient in freshwater systems, via stormwater runoff to streams and lakes in the watershed. As such, the water quality goals for the five lakes of the AWWA Region will focus on Total Phosphorus in the watershed.

Once the median water quality has been determined for each of the five waterbodies, the total, reserve and remaining assimilative capacity for each waterbody will be determined using procedures described in the Standard Operating Procedures for Assimilative Capacity Analysis for New Hampshire Waters (NH DES, 2008), on file on the NHDES Watershed Management Bureau network drive (H Drive). Tier 2, or high quality waterbodies are described as having water quality in which one or more parameters is better than the standard plus the reserve capacity (the reserve capacity is 10% of the total assimilative capacity). Tier 2 waters have some assimilative capacity remaining, whereas impaired and Tier 1 waters do not.
The process of establishing water quality goals will be guided by data analyses conducted by FB Environmental (FBE). FBE will first determine whether the current median water quality of each waterbody is greater than the reserve assimilative capacity. If median water quality values for each waterbody are greater than the reserve assimilative capacity (Tier 2 - exceeds standards), then the water quality goal will be considered based on the current median value and historic water quality data. If the median water quality values fall within the reserve capacity (Tier 1), then the water quality goal will be determined based on historical water quality and potential reductions needed to get water quality values back to the high quality range.

A duplicate analysis will be conducted for calculating both the median water quality values and the assimilative capacity. Once the initial calculations have been completed, an advisory group consisting of town selectmen, conservation commission, and planning board members for the Towns of Acton and Wakefield, representatives of area lake associations, and NH DES staff will help finalize the water quality goals.

D. Loading Models

For each model please include the name, date, revision number, name of the organization or individual who developed the model/method, and the person(s) responsible for running the model as well as reference the user manual or method for the model.

Which model will be used to estimate the current and future pollution sources and loadings?

The US EPA Spreadsheet Tool for Estimating Pollutant Load (STEPL) Model will be used to estimate current nutrient and sediment loads from different land uses, and the load reductions that would result from the implementation of different best management practices (BMPs). This model provides the best fit for the watershed based on land use types (limited amount of agriculture), and is a commonly used and accepted model for watershed planning nationwide. Tricia Rouleau, Project Manager for FBE will be running the model. Tricia is proficient in the use of running watershed loading models, including direct experience with AVGWLF, PREDICT, and the USEPA Region 5 Model. FBE Senior Scientist, Ken Hickey, has direct experience using the STEPL model, and will provide necessary training and technical oversight of the modeling process.

The STEPL version 4.0 model and manual were downloaded directly from the US EPA STEPL website at: http://it.tetratech-ffx.com/stepl/. Jennifer Jespersen, Project Manager for FBE will verify the input values and conduct a duplicate run to identify and correct potential transcription errors. STEPL version 4.0 was last updated on November 26, 2006, and was designed for the Grants Reporting and Tracking System of the U.S. Environmental Protection Agency (EPA) by the following individuals: EPA Work
Which model will be used to estimate in-situ pollutant concentrations, and as a result, the pollutant reductions or limitations needed to meet the water quality goals?

**Total Phosphorus Retention Model**
The Dillon-Rigler model (Dillon and Rigler, 1974) will be used to model the increased phosphorus source loading under future watershed loading conditions and the reductions needed to meet in-lake phosphorus water quality goals. Previous use of the Dillon-Rigler type empirical model has been shown to be an effective approach for linking watershed total phosphorus (external) loadings to in-lake total phosphorus concentrations for thirty-two Maine Total Maximum Daily Load (TMDL) lakes between 2000 and 2008.

**Indirect Watershed Loading Model**
A simple indirect watershed loading model will be used to determine loading estimates from indirect watersheds. An indirect watershed contains a lake or pond that is hydrologically connected to the waterbody of interest without first passing through another waterbody. The indirect loading model has been utilized extensively by Maine DEP through their TMDL process to determine the extent of phosphorus loading to downstream lakes from their upstream counterparts. The indirect load is determined on the basis of $\text{flushing rate} \times \text{lake volume} \times \text{total phosphorus concentration}$ of the upstream waterbody. Alternately, if an external watershed load was previously determined for the indirect watershed through other modeling methods (as described in A. above), then those data will be used.

**Future Loading Model/Build-Out Analysis**
FB Environmental has proposed two different methods for analyzing the effects of new development on the lakes in the AWWA region. The first is a simple, yet inherently conservative method for calculating phosphorus loading from new development, as it provides for relatively high-end regional growth estimates, and largely non-mitigated P-export from new development. Developed by Dennis et al. (1992), this method has been used exclusively in Maine for estimating loading from new development to TMDL lakes. The simple calculation multiplies a 1ppb change in trophic state (kg) by a known constant (either 0.75 if development pressure is high, or 0.5 if development pressure is considered moderate/low). The second method that has been proposed is a build-out analysis using GIS zoning data and CommunityViz software to estimate future development within the watershed. This method will determine the % of developable area in the watershed including the number of residential and commercial buildings, as well as their associated environmental impacts. This method will project future
phosphorus loading under full build-out and an assessment of the potential effects of future development as it relates to water quality goals.

The Dillon-Rigler, indirect watershed loading model and future phosphorus loading estimate using Dennis et al. (1992) will be run by Jennifer Jespersen, Project Manager for FBE. Jennifer used these models to determine assimilative capacity, indirect watershed loading, and future loading for TMDL lakes in Maine (for the Maine Department of Environmental Protection and US EPA) between 2005 and 2008. Tricia Rouleau, Project Manager for FBE will verify the input values and conduct a duplicate run to identify and correct potential transcription errors. If the build-out analysis is added to the current AWWA/FBE contract, the Build-Out analysis will be conducted by Fred Dillon, Project Manager for FBE. Fred is an experienced GIS technician. His capstone at the University of Southern Maine involved running a build-out analysis for Penjajawok Stream Watershed in Bangor, Maine, which was utilized for watershed planning by both the City of Bangor and the Maine DEP.
References


EMD. New Hampshire Environmental Monitoring Database. New Hampshire Department of Environmental Services.  
www2.des.state.nh.us/OneStop/Environmental_Monitoring_Menu.aspx.


NH GRANIT. [www.granit.unh.edu](http://www.granit.unh.edu).

PEARL. [www.pearl.maine.edu](http://www.pearl.maine.edu). The Source for Environmental information in Maine. Maintained by the Senator George J. Mitchell Center for Environmental and Watershed Research, University of Maine, Orono.