SITE SPECIFIC PROJECT PLAN FOR:

Lake Winnipesaukee Watershed Management Plan: Meredith, Paugus & Sanders Bays
Project Number: B-08-M-04

NEW HAMPSHIRE SECTION 319 NONPOINT SOURCE GRANT PROGRAM QAPP (RFA# 08262)

For the:
Spreadsheet Tool for Estimating Pollutant Load (STEPL),
Dillon-Rigler, and Vollenweider Models

Final Draft
May 21, 2009

Prepared by:
Erica Anderson
Lakes Region Planning Commission
103 Main Street, Suite #3
Meredith, NH 03253
(603)279-8171
eanderson@lakesprc.org

Project Manager: _____
Signature/Date
Erica Anderson, LRPC

NHDES Project Manager: _____
Signature/Date
Stephen Landry, NHDES

Program Quality Assurance Coordinator: _____
Signature/Date
Jillian McCarthy, NHDES

NHDES Quality Assurance Manager: _____
Signature/Date
Vincent Perelli, NHDES

Background/History/Problem Statement: Lake Winnipesaukee is the principal economic and environmental feature in the Lakes Region. Degradation of the lake would have a major environmental and economic impact on the entire NH tourism industry. Despite this importance, the greater Winnipesaukee watershed does not yet have a watershed management plan (WMP). This project is part of a long-term strategy to create a public, web-based WMP, starting with Meredith, Paugus, and Sanders Bays (MPSB).

Project Management:

Project Partner	Organization	Contact Information	Role
Erica Anderson	LRPC	eanderson@lakesrpc.org	Project Manager WQAC organizer
Steve Landry	NHDES	Stephen.landry@des.nh.gov	Project Manager DR & V model analysis
David Jeffers	LRPC	djeffers@lakesrpc.org	GIS analysis STEPL model
Jeffrey Schloss	UNH	Jeff.schloss@unh-edu	WQAC member WQ peer review
Dean Anson	LWWA	deananson@aol.com	WQAC member
Patricia Tarpey	NCRCD	Patricia.tarpey@nh.usda.gov	WQAC member WQ monitoring & analysis WQ & site peer review DR & V model analysis
Paul Currier	NHDES	Paul.currier@des.nh.gov	WQAC member WQ peer review
Steve Kahl	UNH	Steve.kahl@unh.edu	WQ peer review
Bob Craycraft	UNH	Bob.craycraft@unh.edu	WQ peer review
Rick DeMark	NRCS	Richard.demark@nh.usda.gov	WQ & site peer review

SSPP will be distributed to the WQAC members:
Jeffrey Schloss, UNH
Patricia Tarpey, NCRCD
Paul Currier, NHDES
Steve Landry, NHDES
Dean Anson, LWWA
Erica Anderson, LRPC

Historical Data Information

What type of data is going to be used?

The Lakes Region Planning Commission (LRPC) will use historical data from a variety of sources (Table 1) as well as data modified from existing datasets based on local expertise to populate the STEPL model per NH DES guidelines and the STEPL handbook (http://it.tetratech-ffx.com/stepl/models$docs.htm).

Table 1: Datasets for the Lake Winnipesaukee WMP: MPSB STEPL Model

Data	Modifications*	Source(s)
Watersheds	none	NH GRANIT
Nearby weather station	specifies rainfall parameters	NH GRANIT
Land Use	acres	LRPC Land Use Land Cover
Agricultural animals	by type and number	NH Veterinary Department
Agricultural animals	# of months/yr manure is applied to croplands	STEPL default values
Septic system parameters	# of septic tanks	towns of Meredith & Gilford, city of Laconia
Septic system parameters	septic system failure rate	STEPL default
Septic system parameters	persons per septic system	STEPL default
Septic system parameters	calculated direct wastewater discharge	NH DES, STEPL
USLE	if desired	NH GRANIT
Representative Soil Hydrologic Group	none	NH GRANIT/NRCS/ STEPL default
Soil nutrient concentrations	none	NH DES, STEPL
"the curve number table"	none	STEPL default values
Nutrient concentrations in runoff	none	NH DES
detailed urban land use distribution	none	LRPC Land Use Land Cover
cropland irrigation information	none	STEPL default values
BMPs for non-urban land uses	none	STEPL, NH DES, UNH
BMPs for urban land uses	none	STEPL, NH DES, UNH
dimensions of gullies and streambanks	none	STEPL default values

* No modifications were made to the model if 'none' is listed.

What is the source(s) of the data?

See Table 1 for STEPL model data. Water quality data is from the NH DES Environmental Monitoring Database (EMD), but was originally from one of the following entities:

- UNH Lay Lakes Monitoring Program
- DES Volunteer Lake Assessment Program
- Lake Winnipesaukee Watershed Association tributary sampling Program
- The town of Meredith and city of Laconia sampling programs

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

The historical water quality data has been entered into the EMD to ensure data used for this project have met QAQC protocols established and managed by DES. Data generated by the Dillon-Rigler and Vollenweider models will undergo peer review and verification of data entry and outputs by Jeffrey Schloss, UNH and Paul Currier, NHDES.

The data being used for the STEPL model will be verified by the Water Quality Advisory Committee, a panel of experienced experts in the field of water quality, including Paul Currier, NHDES, Jeffrey Schloss, UNH, Patricia Tarpey, NCRCD, and Dean Anson, LWWA. The STEPL model results will also be evaluated based on the water quality results from the assimilative capacity models and water quality analysis by the WQAC. This will provide a quantitative measurement against which the STEPL model can be compared for accuracy and consistency with existing water quality by the WQAC and steering committee, comprised of municipal staff and board members from Meredith, Laconia, and Gilford.

Establishing Water Quality Goals

What pollutants are water quality goals being established for?

phosphorus and chlorophyll-*a*

What process will be used to determine the water quality goals? Please describe.

Part of the process for establishing the assimilative capacity thresholds for Meredith, Paugus, and Sanders Bays will involve participation with DES to calculate phosphorus loading and surface overflow rate relationships by utilizing both the Dillon-Rigler and Vollenweider models. Both of the models will also yield a trophic classification summary for each of the basins studied under this project. These resultant trophic classifications will inform the Water Quality Advisory Committee when compared with the current NH Lake Classification for all of Lake Winnipesaukee (oligitrophic).

Both the Dillon-Rigler and Vollenweider models have been used to determine pollutant loadings in lakes and ponds for decades. NH DES personnel, Steve Landry, has extensive experience working with both models on NH waterbodies, and will employ quality control checks on all calculations associated with these two models through peer review and verification of data entry and outputs. Data generated by DES will be shared with program partners to satisfy the deliverable outlined in the Grant Agreement. Patricia Tarpey, NCRCD and Steve Landry, NHDES will be running the models and conducting the preliminary verification process. The WQAC will convene to examine the data used in the model, verify the data entry and method of results, and document any changes that need to occur.

The STEPL model will also provide information the communities can use to determine water quality goals. “For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices (see Table 1 for datasets and sources). The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies” (STEPL 4.0 User’s Guide, 2006).

The STEPL model will be used to provide the communities with land use information upon which they may make educated decisions regarding future regulations and policy. Therefore, the water quality goals will be based on the results of the assimilative capacity models, the historical water quality data for each sub-watershed, and the STEPL model results. Each of the steps listed below will be conducted by LRPC staff and reviewed by project partners including NHDES, UNH, NCRCD, and Lake Winnipesaukee Watershed Association. Any necessary modifications to the model, as determined by the project partners, will be carried out by LRPC. The process will include the following steps:

1. Use the best data available under current conditions, as shown in Table 1;
2. Run the model with this data;
3. Validate the results with the water quality data results;
4. Modify the datasets as necessary;
5. Run the final STEPL model;
6. Present the results to the Steering Committee and Water Quality Advisory Committee; and
7. The committees will use these results to reach consensus on the water quality goals for each subwatershed.

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.

Each model noted below will be calibrated based on the historical water quality and land use data used as inputs, peer review by the Water Quality Advisory Committee, and 'ground-truthing' by the project partners and steering committee who include LRPC, NCRCD, NHDES, UNH, PSU, and municipal representatives. This ground-truthing will be based on what is currently happening in the watershed through site visits, mapping review, and comparative review of neighboring watershed analysis.

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

Dillon-Rigler Model – an empirical model that predicts average summer chlorophyll-*a* concentrations in temperate lakes from total phosphorus concentrations at spring overturn (phosphorus concentrations are near-constant from surface to bottom during spring mixing). In general, average summer chlorophyll-*a* concentrations in temperate lakes increases with increasing spring overturn phosphorus concentration. The model has been well documented and widely used by lake managers, limnologists and researchers to set phosphorus loading guidelines for lakes and to set lake restoration objectives.

Personnel from the DES Watershed Management Bureau and Limnology Center will calculate the loading summaries per the established reference guidance: Dillon & Rigler 1974. *Limnology and Oceanography* 19: 767–773; Prepas & Trew 1983. *Canadian Journal of Fisheries and*

Aquatic Sciences 40: 27–35; French & Petticrew 2007. *Hydrobiologia* 575: 285–289. See also *Phosphorus*, *Chlorophyll*, *Spring mixing, Empirical model*.

Vollenweider Model – examines phosphorus load and response characteristics for the relative general acceptability of the water for recreational use (Vollenweider, 1975). The model was developed by Vollenweider, working on the Organization for Economic Cooperation and Development (OECD) Eutrophication Study. Vollenweider found that when the annual phosphorus load to a lake is plotted as a function of the quotient of the mean depth and hydraulic residence time, lakes that were eutrophic tended to cluster in one area and oligotrophic lakes in another. Vollenweider developed a statistical relationship between areal annual phosphorus loading to a lake normalized by mean depth and hydraulic residence time, to predict lake phosphorus concentration. More information on the model can be found in: Vollenweider, R.A. 976, Advances in defining critical loading levels for phosphorus in lake eutrophication. Mem. Ist. Ital. Idrobiol., 33: 53-83. Personnel from the DES Watershed Management Bureau and Limnology Center will calculate the Vollenweider model.

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?

Spreadsheet Tool for Estimating Pollutant Load (STEPL) – "Spreadsheet Tool for Estimating Pollutant Load (STEPL) employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices" (STEPL 4.0 User's Guide, 2006).

STEPL Version 4.1, 12/13/07, developed by Tetra Tech, Inc. for the Grants Reporting and Tracking System of the U.S. Environmental Protection Agency (EPA). LRPC staff responsible for running STEPL is David Jeffers per the *User's Guide: Spreadsheet Tool for the Estimation of Pollutant Load (STEPL), Version 4.0*. Revised November 2006 (http://it.tetratech-ffx.com/stepl/models$docs.htm)