SECTION A: PROJECT MANAGEMENT
1.1 Title & Approvals

MISSISQUOI BAY BASIN PROJECT: SECONDARY DATA EVALUATION

2009 Quality Assurance Project Plan
Version 4

EPA RFA Number: 09176

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9/10/09
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9/10/09
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9-10-09
Erik Beck, IJC Contract Officer's Representative, EPA — Date

09-17-09
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9/15/09
Michael Jennings, QA/QC Officer, NEIWPCC — Date

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1.3 Distribution List

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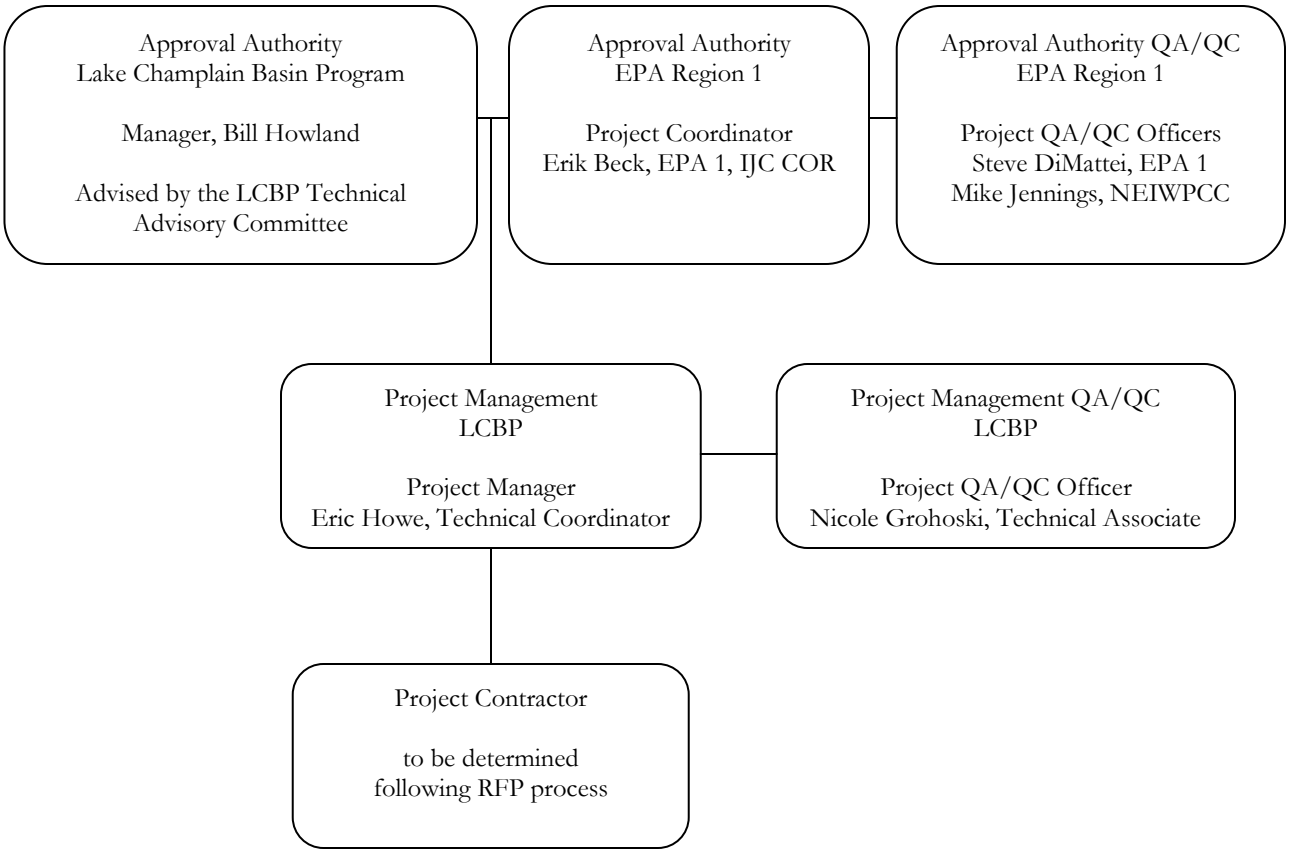
1.4 Project/Task Organization

Key Individuals and Responsibilities

The Lake Champlain Basin Program (LCBP) will identify management objectives and desired outcomes for this project, and outline these in a Request for Proposals (RFP). Respondents will propose a modeling approach to satisfy the RFP, which will be subject to an external peer review process before the final contractor is selected. The selected contractor will then provide a detailed workplan for approval by the LCBP and the IJC study board. The contractor will be responsible for selecting and utilizing secondary data that is of sufficient quality for the future modeling effort briefly described in this document. The selected contractor also will be responsible for creating a separate QAPP that will be directly applicable toward the modeling process, as detailed below in Section 1.7.

The LCBP will oversee the contract but will not be responsible for generating any modeling products. LCBP Technical Coordinator, Eric Howe, will oversee the contractor and evaluate compliance with contract requirements. The Project QA/QC Officer, Nicole Grohoski, LCBP, will maintain the approved QAPP and ensure that the contractor follows QAPP procedures and provides appropriate documentation of methodology and model outputs. LCBP technical staff will provide data collection and documentation assistance to the contractor.

Project Organization



1.5 Problem Definition/Background

Missisquoi Bay has one of the highest in-lake phosphorus concentrations of any segment of Lake Champlain. Phosphorus loads to and concentrations in the Bay greatly exceed target levels designated by water quality criteria for phosphorus endorsed by the governments of New York, Quebec, and Vermont. Furthermore, this phosphorus contributes significantly to blue-green algae blooms (cyanobacteria) in Missisquoi Bay during the summer months. These blooms are frequently dense enough to preclude recreational water contact for many weeks at a time. Loads of sediment and nitrogen to the Bay are also a concern.

While the governments of Vermont and Quebec have made significant progress in reducing the loads of phosphorus to the Bay, more needs to be done in order to meet the target loads. A 2002 agreement between the governments of Vermont and Quebec established that their relative target contributions of phosphorus in the watershed are 60% and 40%, respectively. The Province of Quebec has undertaken several programs to reduce its share of phosphorus loads. Similarly, Vermont has initiated phosphorus reduction programs, but has found reducing phosphorus to be more problematic in its sector of the Basin. On August 1, 2008, the Governments, pursuant to Article IX of the Boundary Waters Treaty of 1909, requested the International Joint Commission (IJC) to assist in the implementation of the transboundary initiative to reduce phosphorus loadings. Recognizing the recent advances made by the Province of Quebec within its areas of jurisdiction, the Commission was requested to coordinate a number of tasks on the U.S. side of the border, in close partnership with the Lake Champlain Basin Program.

As part of this coordination, the IJC has contracted with the LCBP to acquire, assimilate, and publish relevant datasets in order to develop a transboundary understanding of pollutant loads from the Missisquoi Bay Basin (MBB) and to facilitate the development of a pollutant loading model for the Bay. The model will be created, validated, and operated by a contractor in accordance with contract requirements and an approved workplan in order to better inform the current understanding of nutrient pollution to the Missisquoi Bay. The information generated by modeling will be used by local stakeholders and agencies to guide management decisions and efficient implementation of phosphorus reduction strategies. Ultimately, the goal of this work is to reduce external loads of phosphorus, nitrogen, and sediments into Missisquoi Bay so that water quality standards are consistently achieved.

1.6 Project/Task Description

Work to support modeling efforts will be determined by the scope of the RFP and the selected approach to identifying critical source areas (CSAs) of phosphorus pollution. Such work might include acquiring relevant monitoring results (e.g. water quality, stream flow, meteorological) in appropriate time units or contacting agencies to aggregate and release confidential agricultural data. A schedule for completing this work and the model construction, corroboration, and application will be defined within the final contract and the project workplan. All work will be completed before September 1, 2011, when the final project report is due to the IJC. The project will be limited to the Missisquoi Bay Basin (defined as all watersheds flowing into the Bay) of Vermont and Quebec, but will be refined further, depending on submissions in response to the RFP.

1.7 Quality Objectives and Criteria for Measurement Data

The selected project contractor (following the RFP process) will be responsible for specifying data quality indicators for all model data inputs. Such indicators should discuss the type and quality of data that are appropriate for use in this project, the spatial and temporal extent of data inputs, data currency, and the technical soundness of the collection methodology. Acceptance criteria will be designed to help assure that the modeling effort meets defined management objectives.

A separate QAPP, to be prepared by the selected project contractor, will address quality assurance procedures specifically related to the modeling process. Acceptance criteria for model calibration will aim to identify an acceptable range of difference between predicted and observed values of the model to optimize the model results. Calibration criteria will be based on relevant literature for the modeling approach specified by the contractor. Statistical tests may be applied as appropriate. Model validation should call upon data excluded from the calibration process, to determine the predictive abilities of the model. Validation techniques will be applied based on the spatial and temporal characteristics of the model. The contractor will assess the sensitivity of the model to determine how changing input parameters affects the model outcome. Potential sources of uncertainty include: estimated model parameter values, observed model input data, and model structure and forcing functions. The LCBP will conduct periodic uncertainty analyses as the model is applied in the future to determine the magnitude and frequency of differences between predicted and observed values. Such analyses will occur after this project is completed and will help to inform users of the character of the model output information and guide related management actions.

1.8 Special Training/Certifications

The contractor selected through a peer review process will be familiar with the modeling approach proposed and how it should be applied to meet specified objectives. Therefore, no special training or certifications should be required for project personnel.

1.9 Documentation and Records

The project contract will require the successful respondent to produce a project workplan, quarterly reports and a comprehensive final report. These reports and the project workplan will detail the following project information, as it is determined or becomes relevant:

- **Model Structure**
  - Explanation of and justification for modeling approach
  - Adjustments made to modeling software or development of new modeling protocols
  - Model parameters
  - Model assumptions
  - Calibration, sensitivity, and validation procedures
  - An approved Quality Assurance Project Plan for the modeling task
- **Data Inputs**
  - List of data inputs to the model
  - Adherence to the QA/QC procedures before use of data
  - Documentation of data limitations and effect on data outputs

  - List of data used to calibrate and validate models
  - Metadata for acquired datasets
  - Documentation of any edits made to acquired datasets
- **Data Outputs**
  - List of data outputs produced
  - Quality assessments of output data
  - Metadata for final geographic data files

Data generated by this project will be stored by the contractor for the duration of the contract and for five years subsequent to the conclusion of the contract and also will be permanently stored by the LCBP after the project is completed. Supporting documentation and submitted reports will be stored by the LCBP. Final products will be made digitally available to the public on the LCBP website. Digital products will be stored both at the LCBP office server and archived on discs. All changes to the QAPP will be distributed to the appropriate officers and the contractor by the Project QA/QC Officer, following approval by NEIWPCC, EPA, and the International Joint Commission Contract Officer's Representative (IJC COR).

SECTION B. DATA GENERATION AND ACQUISITION

2.1 Data Acquisition Requirements

All secondary data and information that will be used for the project, including originating sources, planned uses of the secondary data and information, and limitations on use of this data and information will be identified by the contractor and provided as a deliverable with the final product, following the format guidelines exemplified in Table 1, below. Data to support modeling may be obtained from governmental agency or group databases or files and from geographic data clearinghouses. It may also be collected from other research/modeling efforts. Some data may require aggregation by data-holders before it can be shared with the contractor. All data used must be publicly available so that final results can be published. Values for parameters may be obtained from published scientific literature.

Non-direct measurement data type	**Data source** (originating organization, report title, publication date)	**Data generator(s)** (originating organization, data type, data generation/collection date)	**How data will be used**	**Limitations on data use**
Land use/land cover grid	Vermont Center for Geographic Information, "LandLandcov_ LCLULCB01 ", 03/2007	University of Vermont Spatial Analysis Lab, raster file of 8-class land use/cover data, 2001	To represent land use/cover in the Basin for 2001, especially agricultural and urban	1. Overall accuracy calculated at 88%. 2. Limited classification of land use/cover. 3. Coarse resolution (30m)

Table 1. Example of a table to be filled out by the contractor for any data considered for use in a model.

Such a table will be used to document types of data needed from non-direct measurements, including their sources, relevancy, uses, and limitations on use. The contractor will use publicly-available data that are the most recent, high resolution, and spatially uniform available and required by the modeling approach. In the case of low-resolution or outdated data, the modeler must justify how use of these data will help refine the model outputs, rather than confound them, and document how use of these data will affect the accuracy and precision of the model output.

2.2 Data Management

Both non-direct measurement data and primary data used in this project will be compiled from relevant data sources by the contractor and shared with the LCBP for permanent, electronic storage. All data will be obtained in a digital format from their generators, thus eliminating database entry error by the contractor. In addition to this data, the LCBP maintains a geospatial database for this project and a spreadsheet describing included files, which will be shared with the contractor. The contractor will then update this file as data is added or eliminated from the project database. Any data obtained for this project must include metadata, whether written in a standard format by the data generator or documented with the best information available to the contractor.

Once the project is completed, the LCBP will permanently archive relevant input and output datasets in its office. The LCBP will then publish a list of these datasets on its website. Each data entry on the list will be hyperlinked to metadata, so that users can determine the utility of the data for their needs. This data list will be updated as new data is developed or becomes available, so that it is not a static source. Users interested in acquiring data will be instructed to contact the LCBP or original data providers in order to receive desired data. The website also will provide links and/or contact information for primary data sources of spatial or monitoring data. All LCBP data handling tasks will be organized and overseen by the Project QA/QC Officer.

The contractor shall provide any software and hardware necessary for data and model processing during this project. The performance capacity of these software and hardware packages will be documented by the contractor and must be adequate to accomplish specified project goals. Minimum hardware requirements for the software packages must be met, as specified by the manufacturer.

SECTION C. ASSESSMENT AND OVERSIGHT

3.1 Assessment and Response Actions

The contractor will evaluate data generated as part of the modeling during the validation process by comparison with observed historical data. This assessment will be included in the final project report, with modeling decisions and parameters explained. Data and intermediary project deliverables will be reviewed by the LCBP to ensure that methodologies and processes are consistent with this QAPP and the project workplan. Deviations from the QAPP will be addressed by the Project QA/QC Officer and subject to NEIWPCC, EPA, and IJC COR approval, in order to either correct the problem or amend the QAPP as needed. Contractors will be notified in writing of any nonconformance and must take appropriate corrective action. NEIWPCC may implement, at its

discretion, various audits or reviews of this project to assess conformance and compliance to the quality assurance project plan in accordance with the NEIWPCC Quality Management Plan.

The LCBP will conduct a confidential peer review of the contractor's final project report and will obtain a technical assessment of the results of the review from the LCBP Technical Advisory Committee (TAC). Once approved by the LCBP, the contractor's final report will be submitted to the IJC COR in the final Missisquoi Bay Basin Project report. The final Missisquoi Bay Basin Project report by the LCBP, submitted to the IJC COR, will include a summary of the steps taken to select the modeling approach.

3.2 Reports to Management

The contractor will be responsible for submitting quarterly reports to the LCBP for the duration of the project. These reports will describe the status of the project, accomplishments made during the reporting period, activities planned for the next period, and any challenges or problems faced. Other intermediary reports addressing topics such as data assessment, model construction, and model calibration/validation may be specified in the project contract. All reports must be submitted to the LCBP according to the project schedule or be granted extensions by the Project Manager. The Project Manager will determine if the reports satisfy the contract, workplan, and QAPP requirements before accepting them.

SECTION D. MODEL APPLICATION

4.1 Model Parameterization and Corroboration

Model parameterization and corroboration activities will be defined within the contractor's workplan once the scope and methodology of this project are defined. This may include methods for: calibration, stopping calibration, parameter estimation, determining uncertainty, sensitivity analyses, validation, use of independent datasets for validation, and future calibration/validation maintenance. The contractor will provide a separate Model QAPP addressing quality assurance issues for each of these steps in the workplan.

4.2 Reconciliation with User Requirements

The LCBP is committed to the development of a representative modeling product that meets the management goals specified in the RFP. The LCBP will ensure that the contractor maintains complete documentation so that the modeling data can be properly reviewed. The final project report will be peer-reviewed to assess adherence to quality assurance requirements and the ability of the model to produce results of sufficient quality. The reviewers will provide recommendations about the effectiveness of the modeling effort for watershed planning and decision-making, which will be submitted to the LCBP TAC and the Project Manager. Once approved by this group and the IJC COR, the model and its results will begin to inform local management decisions.

4.3 Model Limitations

All models are a simplification of environmental processes and cannot precisely represent natural systems. There is no simple test that can determine the validity of a model; models cannot be expected to be more accurate than the sampling and statistical error inherent in the input and calibration data. Thus, the following principles provide a final set of evaluation criteria for this modeling project.

- Exact duplication of observed data is not possible, so the model validation process must assess the ability of the model to simulate these values.
- All model and observed data comparisons must recognize, either qualitatively or quantitatively, the inherent error and uncertainty in both the model and the observations. Model sensitivity and uncertainty will be documented, where possible.

SECTION E. MODELING REPORTS

The final modeling report submitted by the contractor should follow the format outlined below. Additional information to include may be specified in the contract or required by the Project Manager, as deemed necessary. This final report, once reviewed by the LCBP and its TAC, will be submitted to the IJC COR with a summary of LCBP activities, including the process of choosing the successful applicant to the RFP.

- Introduction
- Background
- Purpose of modeling/modeling objectives
- Scope and approach for each model used (including physical setting and hydrology)
- Observational data used to support modeling
    - Quality of acquired data (and references to data quality reports)
    - Achievement in meeting acceptance criteria
- References to monitoring data
- Discussion of excluded data and basis for exclusion
- Description of model including benefits of this approach as compared to other models
- Model configuration (discusses how model was applied)
    - Spatial and temporal resolution
    - Nature of grid, network design or sub-watershed delineation
    - Application of sub-models
    - Model inflows, loads and forcing functions
    - Key assumptions (and associated limitations)
    - Changes and verification of changes made in code
- Model parameterization (calibration) and corroboration (validation)
    - Objectives, activities and methods
    - Parameter values and sources
    - Rationale for parameter values in the absence of data
    - Model validation results
    - Calibration targets
    - Measures of calibration performance
    - Calibration input, output and results analysis
    - Model validation results
- Model use scenario analysis and results (should relate to purpose)
    - Output of model runs and interpretation
    - Summary of assessments and response actions
    - Soundness of calibration, validation and simulations
    - Review of initial assumptions and model suitability evaluation
- Performance against acceptance criteria for calibration, validation, sensitivity and uncertainty
- Pre- and post-processing software development
- Maps and schematics (if appropriate)
- Complete copies of the applicable approved Modeling QAPP and Secondary Data QAPP
- Deviations from either the Modeling QAPP or the Secondary Data QAPP
    - List of non-applicable reporting elements with explanations
- Conclusions and recommendations
- References and appendices