South Center – North Center Lakes Phosphorus TMDL

Background.

A reconnaissance report by the U.S. Army Corps of Engineers in 2007 outlined problems of high phosphorus and sediment in the St. Croix River Basin. Due to land use changes in the St. Croix River basin there has been significant increases in land disturbance (Niemela et al., 2005). A study by the USGS (2003) during the period 1997-1999 showed that the Sunrise River is the largest contributor of phosphorus and sediment to the St. Croix River.

The objective for the St. Croix River study group is that the phosphorus concentration in the river should be reduced to 1950 levels, or a reduction of 20% from current conditions. Based on the proportions of phosphorus being contributed by the various sub-basins to the phosphorus in the St. Croix River, it has been decided that the phosphorus loads from the Sunrise River should be reduced by 50%.

The Chisago Lakes Chain (CLC) sub-basin is one of the major sub-basins of the Sunrise River watershed. The sub-basin contains the cities of Center City, Lindstrom, and Chisago City. The sub-basin has seen major increases in population during the last two decades. Landuse was primarily agriculture up until the mid-1980’s, after which the use has been shifting to residential. Industrial landuse in the sub-basin is relatively minor.

The CLC sub-basin contains a number of lakes, several of which (North Center Lake, South Center Lake, Kroon Lake, and Walmark Lake) are impaired by phosphorus. The CLC lakes are connected to each other when the elevation is high enough, and the flow occurs from the east to the west, and eventually the flow passes through a large wetland to end up entering into a tributary to the Sunrise River. The lakes have been (and continue to be) impacted by the past agricultural land use, and the shifting to largely residential landuse is also having an impact. Whether the shift will lead to better water quality than in the past remains to be determined.

Request.

The MPCA requests to have several TMDL studies completed for the CLC sub-basin. The larger objectives of the TMDL studies are two-fold. First and foremost, it is desired to improve the understanding (quantification) of the phosphorus loading from the CLC sub-basin to the Sunrise River. Second, it is desired to be able to determine the major sources of phosphorus and sediment entering the CLC impaired lakes, and to determine what load allocations could be imposed to lead to water quality improvement in those lakes. In the current request the MPCA would like to have a detailed study of two of the impaired lakes, North Center Lake and South Center Lake.

The agency expects that performance of the assessments will require the use of at least two types of models, a hydrology-water quality model to quantify loadings to the lakes, and a lake model for sediment and nutrient balances. In addition, assessments using a load-duration curve
approach may be useful. The contractor should describe the type of assessment tools to be used and justify the use of those tools based on the quality/quantity of available data. Estimates of uncertainty (MOS) should be quantified (or assigned) for each of the assessment tools.

The contractor is requested to provide a level-of-effort (LOE) proposal to the MPCA outlining the proposed work necessary to fulfill this request. In developing this LOE the contractor should outline the proposed workplan in a format that describes the work in terms of individual tasks. The list of required tasks is outlined below.

The MPCA expects that the contractor will require employees from the following categories of specialization: Project Manager, Project Engineer, Project Hydrologist, GIS specialist, and Field Technician I. The hourly rates to charge for each of these categories are: $220, $175, $92, $75, and $55, respectively. These hourly rates already assume a built-in profit for the contractor.

The LOE should contain the details of the cost proposal for personnel and for non-personnel costs. Use the format of Table 1 and Table 2 in the development of the cost proposal.

Questions of clarification will arise during the development of the LOE proposals. Submit your questions by email. A response to questions will be sent to all contractors.

The due date to submit the LOE proposal is **4:30 pm, November 24**. Proposals received after that due date will not be considered.

**Task 1. Review of existing data, and provide analyses and summary of the data.**

- Compile, review, and analyze all existing water quantity and quality information that pertains to the impaired reach/watershed, including flow, background technical information, and relevant geographic data.
- Assess and interpret all available existing monitoring data and studies that have been done to determine the nature and extent of the problem. Determine needs beyond what the existing studies provide.
- Prepare intermediate report with appropriate charts and tables that describes current understanding of the water quality variables based on data analyses and the future needs of the project. Provide six copies of the report for review.

**Task 2. Recommend an assessment approach.**

The assessment approach selected could involve the use of mainstream public domain models, or some simpler type of analysis that will provide the required information for the load allocations.

- Describe how tools and/or model(s) is (are) appropriate for the land use in the watershed. Present methods and statistics to be used in calibrating and validating your choice of assessment tool and/or model(s).
• Discuss how Margin of Safety (MOS) could best be worked into the selected modeling processes based on the current understanding of the data.
• Prepare technical memorandum recommending a suitable assessment approach for review and comment. The memorandum should include additional data needs if any, and a description of model/assessment tool calibration and validation procedures, including tolerances.

**Task 3: Collect Additional Monitoring and/or Specialized Field Studies Data**

• Write a detailed monitoring plan for 2010 and 2011 according to model requirements (based on the modeling/assessment approach selected in Task 2) and considering available resources. Project modeling approach and the associated monitoring plan should be completed well before the 2010 and 2011 field seasons, to optimize the monitoring plans for coming years.
• Collect required geographic data and GIS coverages including soils information, agricultural surveys (where appropriate), and surveys of land use practices, ranging from general landscape trends to specific plot information available from all pertinent sources.
• Collect water quality and quantity data for model input as necessary. This may involve stream gauging and collection of water samples, as well as stream channel survey work.

**Task 4: Develop, Calibrate and Apply Lake Phosphorus and Phosphorus Delivery Model**

• Produce a model or other appropriate assessment tool that predicts responses of the stressor variable(s) (e.g., sediment load, turbidity, chloride, phosphorus load, etc.) over a range of flow conditions, to current and changing land use and land management conditions.
• Prepare model input files and develop an operational phosphorus delivery model.
• Prepare model input files and develop an operational lake phosphorus model.
• Calibrate an appropriate lake phosphorus model using data from the proposed calibration period to meet the minimum calibration/validation tolerances proposed.
• Assess the performance of the lake phosphorus model using the data from the proposed validation period. Perform sensitivity analysis of critical input parameters.

**Task 5: Develop TMDL Components**

• Provide background information, summarize impairments, and describe the watershed and its common land uses. Include documentation or suggestions regarding the magnitude of the existing impairments.
• Provide discussion of lake water quality indicators as they relate to the stressor variable, and develop numeric targets to be used in the load and wasteload allocation processes.
• Compute the existing loads and the loading capacities for the designated listing. This could include a flow-based model application or a load duration curve. It will be necessary to determine the internal loading of phosphorus for the lakes. Include atmospheric loading as well.
• Construct load allocations and waste load allocations, according to modeling results and output.
• Detail the pollutant reductions required to meet water quality standards, according to multiple reduction scenarios.

Task 6. Project Meetings

• Three project meetings (one kickoff meeting, one after the completion of Task 2, and last one after the completion of Task 5) to permit comment on the work completed by the consultants and to provide inputs. All the formal project meetings will be held in BAE 308.
• One stakeholder meeting will be held in BAE 308. The goal of the meeting is to provide an opportunity for locals to participate in the decision making process, present model(s) results to citizens and common interest groups, and demonstrate the use of the model(s) as a tool to assess the potential impact of point and nonpoint sources of pollution on the impair water body. The BBE 5095 course instructors will lead these meetings and the selected consultant will present technical information. Additional project meetings, if needed, will be arranged with amendments to the original contract.

Task 7: Write Final TMDL Report

• Prepare a draft final TMDL report summarizing the results of the tasks with appropriate tabulations, colored maps, charts, figures, and attachments. The final report must contain results of all the Tasks, technical documentation of the model(s), and the recommendation for further improvements in the model(s). The final report must also include a TMDL for the designated impaired water body including all the required elements in the EPA review document for TMDLs – Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992 (May 20, 2002 or later).
• Submit one copy of the report for BBE 5095 instructor and stakeholder review and comments.
• Prepare final project report by incorporating the instructor and stakeholder comments on the draft project report. The final TMDL, following necessary revisions, will be submitted to EPA for their approval.

Task 8. Develop Implementation Strategies

• Model Application - apply the model(s) developed in the TMDL process (or develop a new model if necessary) to predict the effectiveness of various potential management strategies aimed at reducing pollutant loading to surface waters.
• Management Recommendations - provide to the stakeholder group and the technical advisory group: 1) general recommendations for the impaired water body and 2) specific recommendation to the various sub-landscapes of the watershed and/or the individual impaired waters, regarding approaches to reducing pollutant loading to surface waters.
• **Develop Effectiveness Tracking Program** - discuss the best means by which to measure effectiveness of implementation strategies. Also, provide a monitoring plan to track (1) progress of implementation of management measures, and (2) changes in water quality.

• **Prepare Implementation Report** - summarizing the results of the task with appropriate tabulations, colored maps, charts, figures, and attachments. Submit one copy of the draft implementation report for BBE 5095 instructor and stakeholder review and comments. Prepare final report based on comments received.

**References**
