# Rock Lake Surface Water Assessment

## Description of project area

Rock Lake (58011700) is in southern Pine County near Pine City and is on the EPA 303d impaired waters list due to elevated nutrients. The Lake is in the Rock Creek HUC 12 Watershed, which is in the HUC 8 Lower St. Croix Watershed. The Lower St. Croix Watershed (07030005) is one of four major watersheds on the Minnesota side of the St. Croix River Basin. The rock Lake watershed is 6,182 acres in size and the primary land use in the catchment is agriculture.

There are three inflows to Rock Lake. Rock Creek enters Rock Lake from the northeast and two inlets enters from the southwest.

Rock Lake has a surface area of 87.64 acres, a shore length of 2.77 miles and a maximum depth of 32 feet.

The soils of the watershed are not known at this time as the NRCS has not finished the Pine County soil survey.

## Problem to be addressed by project

The purpose of this assessment is to form the basis for a future water quality plan to work in concert with the Goose Creek TMDL and the Lower St. Croix One Watershed One Plan (1W1P) to understand the hydrology and improve the quality of Rock Lake, it’s tributaries and downstream waters. Currently Rock Lake is considered an impaired water body by the Minnesota pollution Control agency.

The most recent water quality assessment of Rock lake was done in 2012 and focused solely on Phosphorus and Chlorophyll *a.* All other water quality work in the Rock Creek Watershed has taken place outside of Pine County and a significant distance from the direct outlet of the lake. There has however been citizen monitoring of Secchi depth from 2014-2019.

The EPA Spreadsheet Tool for Estimating Pollutant Load (STEPL) was used to estimate the watershed runoff volumes and phosphorus loads from the direct drainage of Rock Lake for the Goose Creek TMDL. The STEPL model estimates the annual average overland runoff flow and phosphorus load based on land cover, runoff curve numbers, annual rainfall, and event mean concentration. However, the STEPL model has a coarse resolution and is only intended as a planning tool.

Because of the lack of monitoring and soils data Rock Lake/Rock Creek was considered a priority watershed for the implementation of the Lower St. Croix 1W1P (Table 5-1 Part D). Much of this work is considered a local priority or is not eligible for Watershed Based Implementation Funds. Collaboration with other entities and use of additional funding sources will be needed to accomplish most of the actions. The highest priority activity in the “Prioritization and Analysis” program area is to conduct analyses to identify and prioritize water quality improvement projects within a priority subwatershed. The methods and types of analyses may vary depending on the available data, the ability to collect additional data, modeling capabilities, staff capacity, etc. Types of analyses can include site or field scale subwatershed analyses, diagnostic monitoring, spatial analysis and mapping, modeling, cost benefit analyses, or other data-driven targeting activities.

A 2004 Report on the Recommended Water Quality Goals of the St. Croix Basin Water Resources Planning Team recommends a 20% reduction in total phosphorus loading withing the St. Croix Basin. Monitoring of inlets, tributaries, ditches and culverts will help determine the areas of highest loading to the lake so the SWCD/County can adequately install lake protection programs through a comprehensive lake management plan. Best Management practices which will yield the best results will be detailed in the comprehensive plan that may be used as an addendum to the Lower St. Croix 1W1P

## Project goals and objectives

One goal of this project is to enhance knowledge and understanding of the Rock Lake watershed conditions that are currently affecting, or have the potential to affect, the lake’s ecosystem. To meet this goal the lakes watershed will be delineated, existing land uses, and acreages will be estimated and QSWAT, HSPF, or another appropriate model will be used to estimate annual pollutant loading. Additionally, boundaries of individual reaches and catchments will be delineated using the most recent LiDAR data and GIS tools. Loads will be partitioned for each catchment/reach through monitoring and modeling. Data will be used to identify surface runoff patterns and delineate environmentally sensitive areas in the Rock Lake watershed. Based on data collected, the most effective identified best management practices will be suggested for funding and implementation.

Given the uncertainty of the level of impairment in Rock Lake and the historic lack of understanding about hydrologic pathway and process in the lake this proposal seeks to build a water and nutrient budget as another goal. Tributary and ditch subwatershed modeling will be used to develop a nutrient budget for the lake and used to calibrate other watershed loading scenarios to generate an appropriate lake condition response model (Canfield-Bachmann, Rechow, Vollenweider, etc.). Hypolimnetic samples are not available so a mass balance equation will be used to create a nutrient budget and internal load scenario (Nurnberg) and used in the lake condition response.

To construct a water budget, we will use precipitation data to model what falls upon the lakes and the amount that falls in the surrounding watershed. In a wooded watershed 95% of the precipitation that makes to the ground surface, enters the ground and contributes to interflow and groundwater recharge. In rare instances, snow can melt and runoff over frozen ground and/or storm events can be very intense and of a magnitude and duration to cause overland runoff in some portions of a watershed. We will attempt to model surface inflow and outflow and seepage inflow and outflow if data becomes availible (MOD-FLOW).

## Methods and activities

Mapping and watershed delineation from the Lower St. Croix 1W1P will be ground truthed and used as a basis for modeling as well as delineation for the Rock Lake watershed. The Metro Conservation Districts SWA protocols will be utilized for targeting and prioritizing areas for catchment and reach assessment withing the Rock Lake (<https://23eb5e34-24a9-4c0a-ae19-16b53e245249.filesusr.com/ugd/0b511c_ac0f9eddb594432ca2e9035e372846b5.pdf>, <https://23eb5e34-24a9-4c0a-ae19-16b53e245249.filesusr.com/ugd/0b511c_1e77f8daf2cd4a198149c45c3013da36.pdf>) , An appropriate model such as STEPL, WiLMS, or BATHTUB will be updated to determine the phosphorus loading from land and upstream tributaries and how and the effects on Rock Lake. Scenarios of land use change can be show how to improve water quality.

Tributaries/ditches and other areas perceived to be of interest for water quality improvement will be identified in field surveys. Potential high sources of phosphorus will be investigated for possible BMPs and/or wetland restoration.

Data will be organized into a data base and analyzed using appropriate statistical software and GIS. Select tests will be run and the data will be interpreted, and a final report will be produced.

## Project products or deliverables

A final report, executive summary, and work plan for distribution to the public, cooperating agencies, and elected officials will be prepared which includes:

* Evaluation of watershed conditions and land use including annual pollutant loading determined through modeling and actual load partitioning
* Delineation of environmentally sensitive areas in the Rock Lake Watershed and potential wetland restoration sites
* Delineation of critical sites and shoreline restoration strategies