Introduction

Many efforts to improve water quality in Wisconsin’s Lake Superior basin have focused on the “slow the flow” approach, which seeks to reduce peak flows using landscape watershed restoration to increase in-channel roughness, upland roughness, and retention and infiltration. As the frequency of high intensity storms increases, improved methods to prioritize slow the flow efforts and measure success are needed.

Through extensive literature review, we identified metrics and associated thresholds for landscape scale watershed restoration, and compiled the best available datasets to evaluate those metrics. Recommendations based on that review provide a framework for prioritizing and evaluating slow the flow efforts on the south shore of Lake Superior in Wisconsin.

Newly available spatial data layers, for example the updated Wisconsin Wetland Inventory, Potentially Restorable Wetlands and others, now allow us to implement recommendations by identifying and prioritizing specific restoration and protection opportunities across all of Wisconsin’s south shore watersheds.

Watershed Setting

Lake Superior’s south shore watersheds are situated in clay-rich glacial and lacustrine soils deposited during the most recent ice age.

Heavy clay soils line the coast and transition to sandy soils further inland.

Transition zone areas can be more prone to erosion and gully formation due to concentrated runoff flow and/or shallow groundwater seeping at the clay-sand boundary.

Lake Superior Basin in Wisconsin: streams and geomorphic regions

<table>
<thead>
<tr>
<th>Watershed ID</th>
<th>Peak discharge/drainage area ratio</th>
<th>Amount of storage (lakes and wetlands)</th>
<th>Amount of potentially restorable wetlands</th>
<th>% open lands</th>
<th>Transition Area/Soils – Soil Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.40</td>
<td>0.50</td>
<td>0.50</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.50</td>
<td>0.50</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>0.40</td>
<td>0.50</td>
<td>0.50</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>0.40</td>
<td>0.50</td>
<td>0.50</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>0.40</td>
<td>0.50</td>
<td>0.50</td>
<td>16</td>
<td>50</td>
</tr>
</tbody>
</table>

In-channel and Upland Roughness

In-channel and upland roughness controls boundary layer stress and the ability of water to settle sediments. Roughness can be influenced by all types of vegetation and the soil sub-layer for upland areas, and by woody debris and vegetation in channels. Roughness can be influenced by:

- For groundwater driven flows, increases with interception of riparian tree plantings.
- For surface flow driven, increases in roughness to promote infiltration. Use vegetation filters and retention basins at the heads of areas to be preserved.

For Upland Roughness

- Target watersheds with less than 33% storage
- Target watersheds with open lands greater than 50%
- Evaluate distribution and extent of wetlands digitized from aerial photos.
- Potentially Restorable Wetlands (PRW) – Available for Lake Superior basin, with further refinements available for Douglas County and Marinette watershed.
- Wetlands/waterbodies are characterized by Landscape Position, Landform, Waterbody type and Water flow path.

Forestry Land Use

Forests influence stream hydrology through snowpack accumulation, snow melt, interception of rain events, and water temperature. The age composition, and structure of forests impact the volume and timing of runoff received in the waterway. Forest and land use practices have been pre-settlement forest-based dominated communities to aspen-dominated communities, and shifted age structure to be dominated by younger ages.

Recommendations:

- Establish a target for percent open lands and green space.
- Reduce or maintain less than 30–40% open land by subdividing the 1-2.5 ha.
- Maintain forest composition matching pre-settlement conditions with an emphasis on shade tolerant species.
- Establish and expand riparian management zones on public and private lands.
- Prohibit harvest of headwater bays of 10 meters or channeling to promote wood recruitment to streams to increase roughness.

Metrics & Datasets: Establish a regular means to obtain and evaluate open lands by subwatershed to assess open lands targets.

Agricultural Land Use

Wetlands/waterbodies are characterized by Landscape Position, Landform, Waterbody type and Water flow path.

The National Stream Statistics (NSS) is an easy to use program which provides regression equations for every state in the US to estimate streamflow statistics including peak discharge at ungaged sites (Walker and Krog, 2005). Using this program, we first calculated peak discharges for 1,600 point south shore sub-watersheds.

Then, we calculated the 2 year peak discharge to drainage area ratio (map at right). Watersheds/floodplains in the basin:

- Provides an indication of parameters driving accelerated runoff, which can be used to focus investments efforts.

Recommendation:

- Prioritize watersheds with high peak discharge to drainage area ratios for wetland reforestation, reforestation, agricultural BMPs, and increasing in-channel and upland roughness.

Metrics & Datasets: NNH3 wetlands and catchments, 2 year peak discharge/drainage ratio, amount of Potentially Restorable Wetlands, % open lands, % forest, % agricultural land use.

References


