Lake Superior Tributary Streams in Bayfield County

Background Information for the Bayfield County Comprehensive Plan
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Bayfield County is home to a large number of outstanding trout streams. Forty-six are recognized as “Outstanding Resource Waters” and an additional twenty-one are recognized as “Exceptional Resource Waters” by the State of Wisconsin. Many of these streams flow over the highly erodible red clay plain and feed into river-mouth marshes designated as “Primary Coastal Wetlands” of Lake Superior. In spite of their erodible banks, many of the Lake Superior tributary streams in Bayfield County support rare species of aquatic invertebrates. These streams and their river-mouth wetlands are also important to the lake ecosystem. They provide spawning habitat for several Lake Superior fish species and nursery habitat and food for the shallower lake habitat that, ecologically, is the richest zone of the world’s largest fresh water lake.

Gift of the Glaciers

The streams (Figure 1) owe their existence to the glaciers whose advance and retreat carved Lake Superior out of soft sandstone bedrock 30,000 years ago and then retreated to the northeast 10,000 years ago.[1] The Bayfield Peninsula lay between two lobes of a massive ice sheet (Figure 2).[2] Outwash sand and giant blocks of ice were deposited on the “backbone” of the peninsula as thousands of cubic miles of water flowed between the lobes of the receding glacier. The sandy region left behind is what we call “the barrens,” a globally rare and imperiled ecosystem. Mounds of rocks, silt and sand gouged from the lake basin were deposited as “end moraines” around the edges of each receding lobe. Some of the more notable moraines are now called Mt. Ashwabay, Mt. Valhalla, Maple Hill and Grandview.

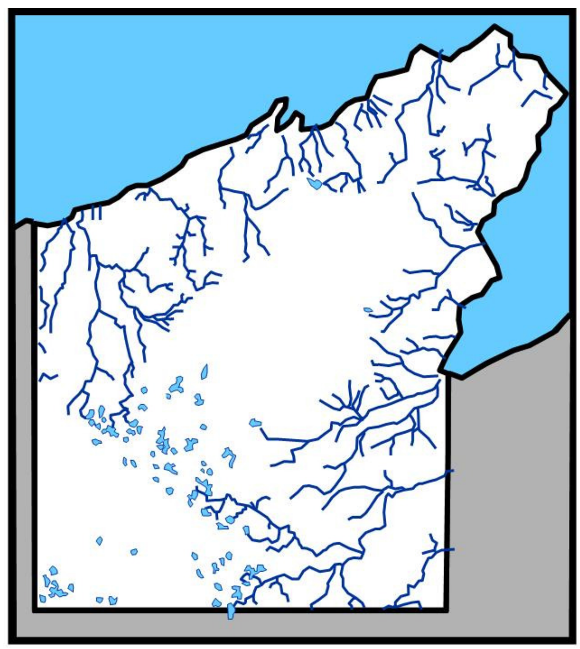

Figure 1: Streams in Bayfield County's clay plain.

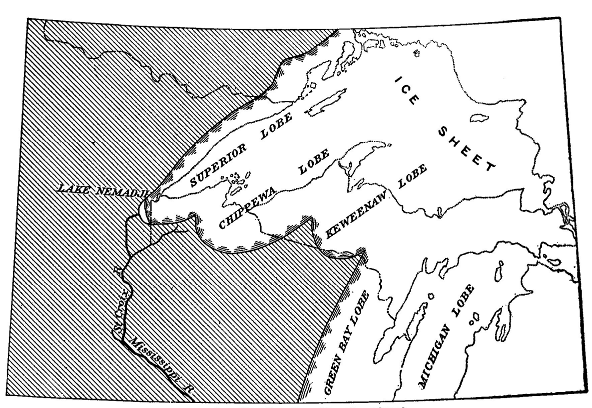

Figure 2: Wisconsin glaciation.

As the glacier receded into the basin that is now Lake Superior, a lake formed. The current outlet at Sault St. Marie was blocked by ice extending well over a thousand feet above the ground surface. The surface of the lake was nearly 500 feet higher than the current lake surface, and the lake drained to the Mississippi River through the Bois Brule River valley (Figure 3).[3] As rocks and till flowed off of the massive ice sheet, fine sediment settled on the bottom of the glacial lake and formed what is now the Lake

Superior Clay Plain. Beaches formed where waves lapped the shoreline of fresh glacial deposits. Wedges of sand were deposited and later covered with clay.

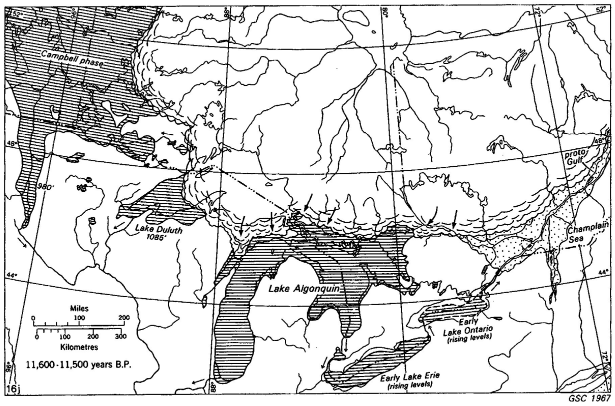

Figure 3: Glacial Lake Duluth preceded Lake Superior.

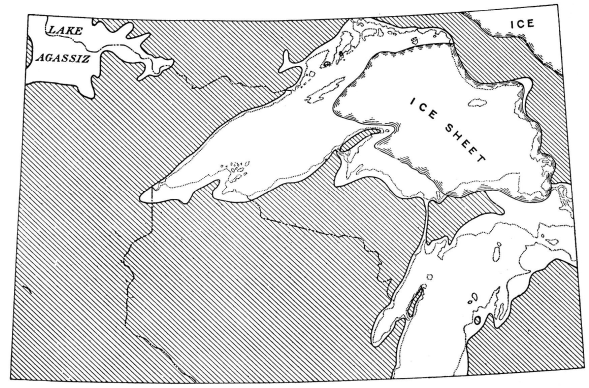

Figure 4: Post- Lake Duluth

As the glacier receded to the northeast past the Keweenaw Peninsula, the lake level dropped several hundred feet when the outlet shifted to the Whitefish River valley in the Upper Peninsula and flowed in Lake Michigan and on to the Illinois River at the south end of that lake (Figure 4).[4] Once again the lake level of the Lake Superior's predecessor stabilized long enough to erode coastal bluffs and for beach sands more than one hundred feet above the current lake level.

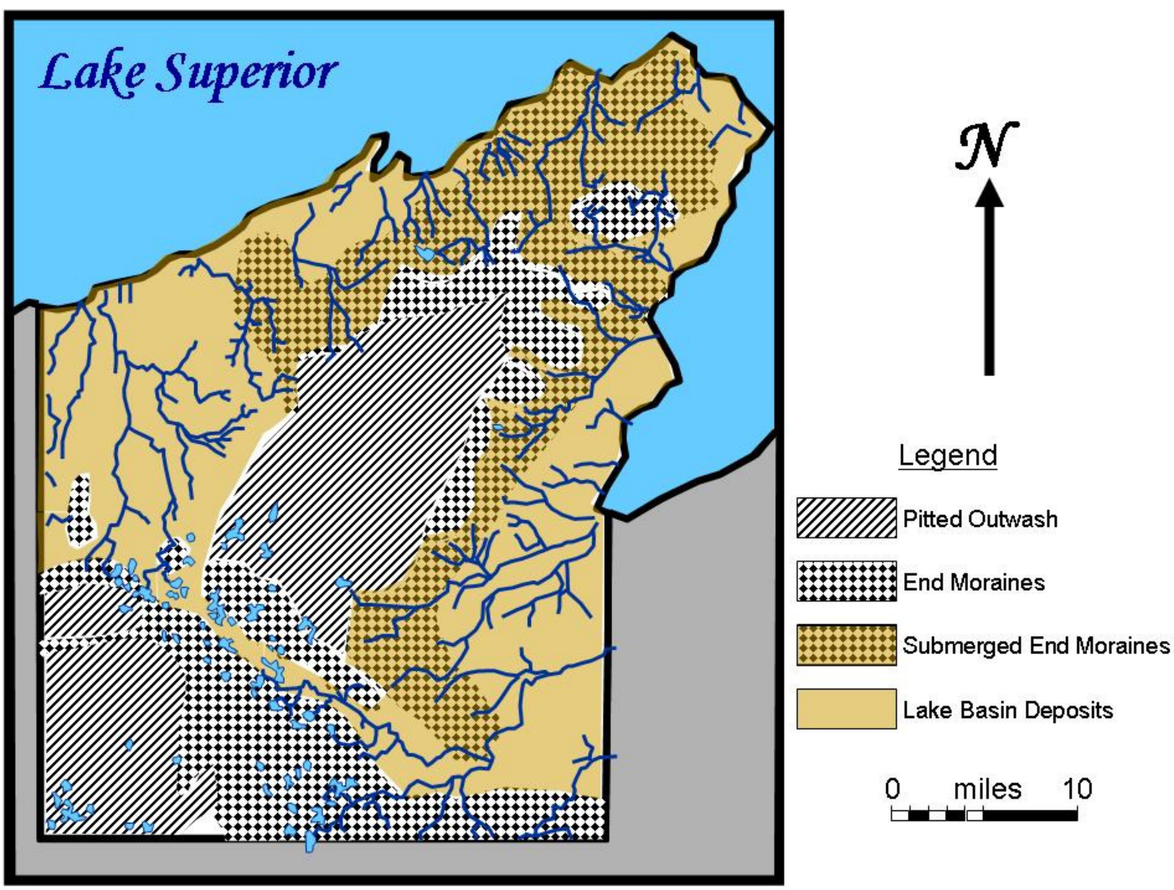

Figure 5: Glacial deposits in northern Bayfield County.

As the glacier receded northeast of the St. Mary's River, the lake level dropped below its current elevation. As the earth's surface slowly rebounded from the massive weight of the glacier, Lake Superior reached its present level about 6,000 years ago. Bayfield County's soils developed on the deposits remaining above the lake's waters (Figure 5).[5]

Soils and Streams

The deposits from the last glaciation influence critical characteristics of Lake Superior tributary streams. The sandy outwash deposits in the Barrens allow snow melt and rain to percolate rapidly into a massive groundwater reservoir along the backbone of the Bayfield Peninsula. This reservoir provides steady flows of cool groundwater to the headwaters. The headwaters emerge at the transition from the outwash sands and end moraines to the clay plain. The clays that were deposited on the bed of the former glacial lake are only slightly permeable to rainfall and are highly erodible. As the tributary streams flowed across the former lake bed, they cut steep ravines through the clay. The clay soils, though weakly permeable to water flow, holds water much better than outwash sands or end moraines. Because of their high water holding capacity, the clays are suitable for agriculture so long as the erodible ravine slopes and drainages remain well vegetated. Wetlands that formed in shallow depressions in the clay plain capture runoff water, like a sponge holds water, and release it slowly to tributary streams. The wetlands capture sediment and release clean water to the streams.

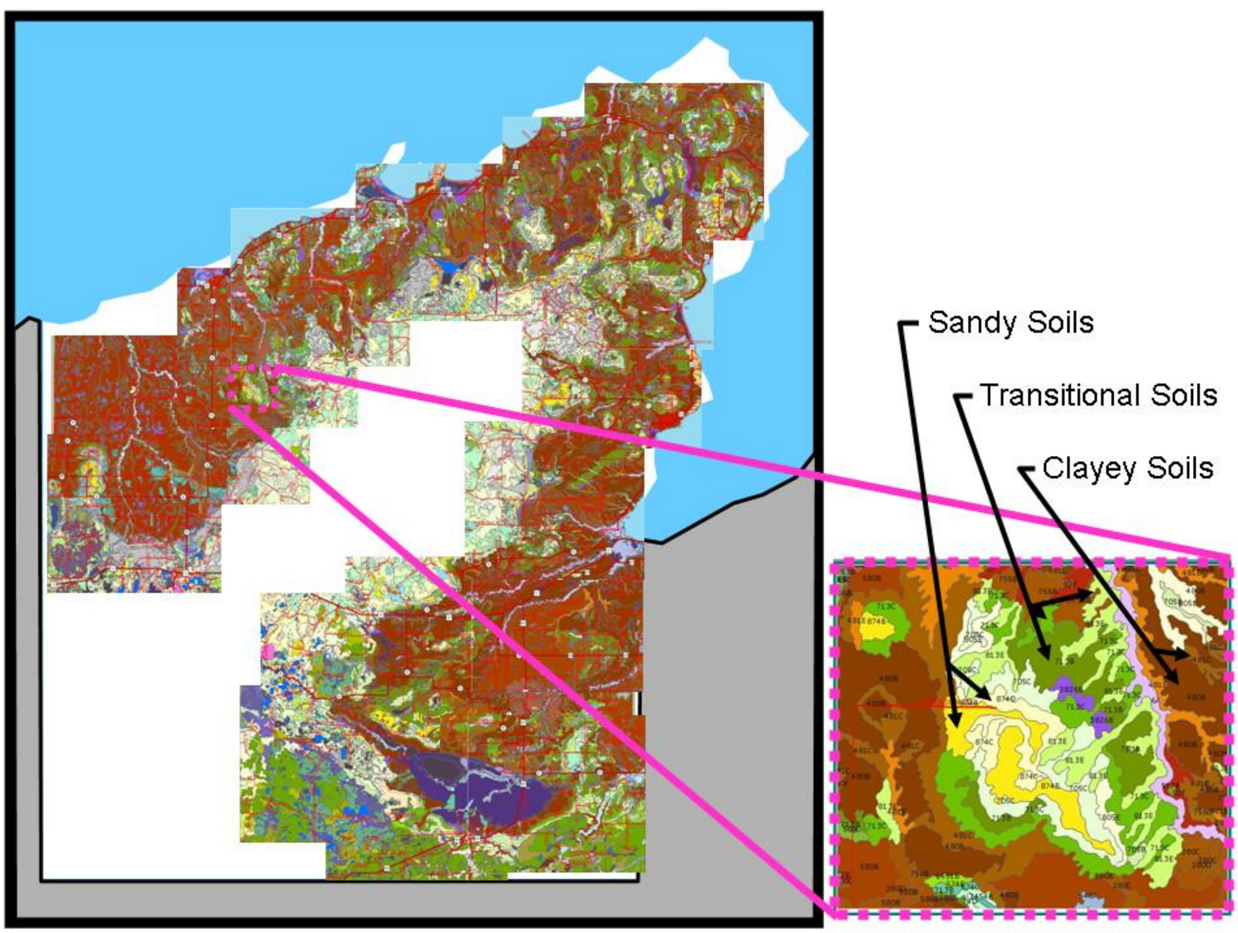

Figure 6: Transitional soils occur between sandy soils (light colors on soils map) and the clay plain (brown colors).

When clay is saturated with water, it is very soft and slippery – like toothpaste. Saturated clays occur throughout the clay plain during spring snowmelt and throughout the year in transitional soil areas where groundwater seeps form the headwaters of streams. When transitional soils are disturbed, massive amounts of clay, sand and silt slump into streams. Trout spawning habitat is disturbed when sand and silt from slumps bury the gravelly stream bottoms where the fish deposit their eggs. As excessive amounts of silt and sand flow downstream, they build up at the mouths of tributary streams and block the normal interactions of organisms between coastal wetlands and Lake Superior. These wetlands provide critical habitat for many water birds and juvenile fish. As a result it is critical to prevent disturbance of clay slopes and of the soils that form the transition from the sandy regions to the clay plain. On the county soil map (Figure 6) these soils are shown as the green areas between the light colors (sandy soils) and the brown colors (clay soils).[6]

Figure 7 shows the relationship between transitional soils and Lake Superior tributary streams in the county. Many streams originate from seeps in transitional soils. There also are a number of smaller intermittent streams that flow to the lake from transitional soils that overlie end moraines buried under clay. These smaller streams do not appear in the figure.

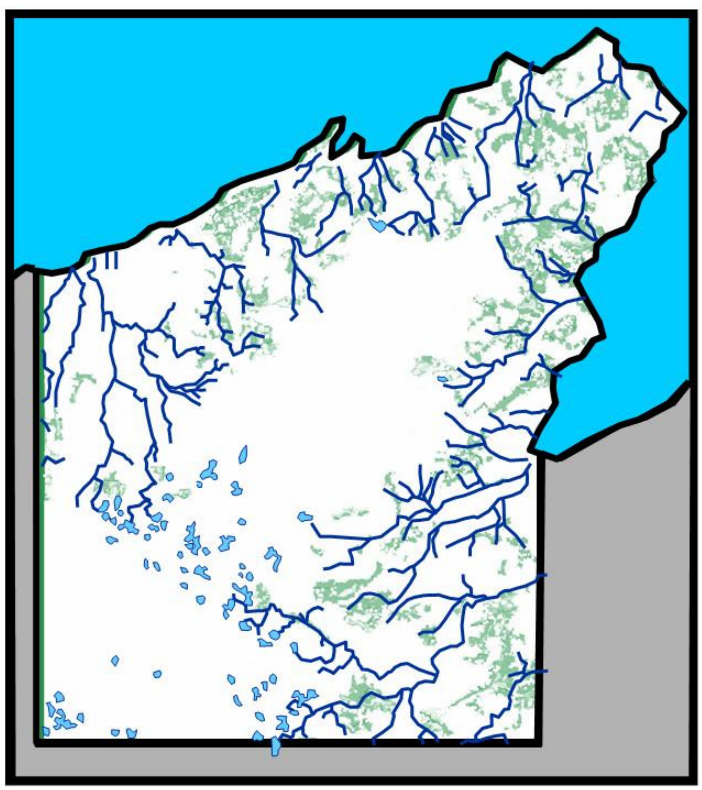

Figure 7: Transitional soils (shown above as green) often occur where groundwater flows to tributary streams.

The deep clays between the sandy uplands and Lake Superior are readily eroded by the steady flow of stream waters over them. On the county soils map these ravines are indicated by dark red and orange colors (Figure 8). The steams have cut steep ravines through the clay as they flow to the lake. These ravine slopes are susceptible to slumping from disturbance of overlying vegetation, changes in surface water flows (such as road ditches and culverts), or changes in upstream flows that can undercut ravine slopes. The many wetlands in the clay plain and the organic matter on the surface of woodland soils help to reduce the volume and speed of surface water flows and, thus, reduce the frequency of streams undercutting the banks of steep ravines.

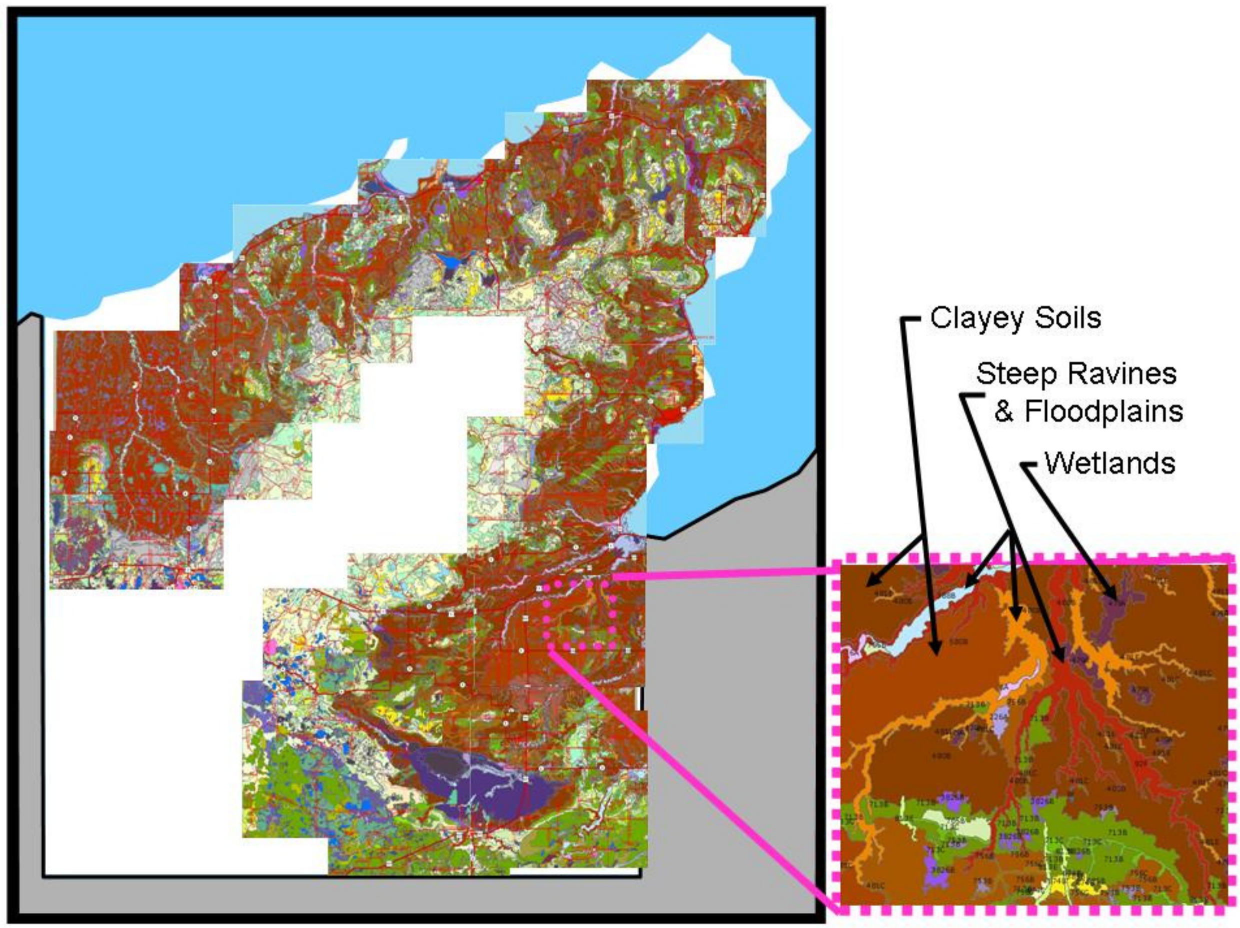

Figure 8: Steep ravines (shown in dark red and orange) occur where streams cross the clay plain.

Implications for Future Land Use

Each of the major soil regions of northern Bayfield County contributes to the quality and character of the many trout streams that flow to Lake Superior. The outwash sands and moraines rapidly absorb precipitation and runoff waters into the massive groundwater reservoir that provides base flows to the streams and drinking water for the entire area. These areas, most of which already are in public ownership, should be identified as "wellhead protection zones" to prevent long-term contamination of drinking water supplies.

Sensitive areas that are subject to severe gully erosion slumping of clay slopes are generally unsuited for development unless proper safeguards are in place. Upstream changes in the watershed that cause changes in drainage or increased flows of runoff waters can erode the base of steep slopes and carve deep ruts in the clay plain. The best practice for ravine slopes is permanent forest cover with a substantial organic surface layer on the soil. Any development upstream of steep slopes should maintain or restore natural volumes and rates of runoff flow such that steep slopes downstream will not be undercut. Upstream development should be designed to prevent concentration of surface flows into ditches and to promote slow and steady flows of surface water toward waterways.

The layered sand and clay soils in transitional areas often contain seeps at the headwaters of streams. These areas tend to be seasonably wet and are subject to cave-ins. These areas generally are not suited for septic drain fields. Roads in these areas are subject to break-up and contain unstable wet zones. Because of their sensitivity, any development on these areas will require careful analysis and special protective measures prior to any disturbances that involve construction or alteration of vegetation

References

[1] Water map source: Bayfield County Land Records Department. 2009. http://www.bayfieldcounty.org; accessed January. Washburn, Wisconsin.

[2] Figure taken from: Lawrence Martin. 1965.The physical geography of Wisconsin. University of Wisconsin Press: Madison, Wisconsin.

[3] Figure taken from: Gene L. LaBerge. 1994. Geology of the Lake Superior region. Geoscience Press: Tucson, Arizona.

[4] Figure taken from Martin *op. cit.*

[5] Figure adapted from United States Department of Agriculture, Soil Conservation Service. 1961. Reconnaissance soil survey: Bayfield County, Wisconsin. Series 1939, Number 30. In cooperation with Wisconsin Geological and Natural History Survey, University of Wisconsin Agricultural Experiment Station and Wisconsin Department of Agriculture. U.S. Government Printing Office: Washington, D.C.

[6] Soils map downloaded from Bayfield County Land Records Department, *op. cit*. Soils data obtained from United States Department of Agriculture, Natural Resources Conservation Service.