Salmon Trout River Watershed Management Plan

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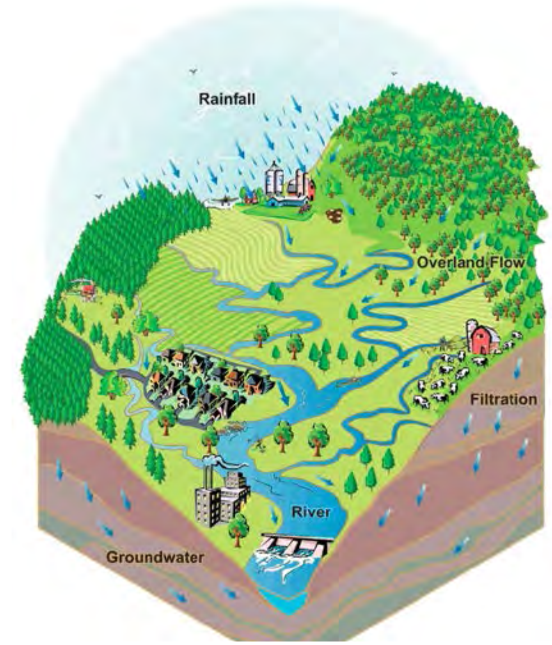
1.0 INTRODUCTION

1.1 Salmon Trout River Watershed Setting

People live, work, and recreate in areas of land known as "Watersheds." A watershed is best described as an area of land where surface water drains to a common location such as a stream, river, or lake. The source of groundwater recharge to streams, rivers, and lakes is also considered part of a watershed. Despite the simple definition for a watershed, they are complex systems with interaction between natural elements such as climate, surface water, groundwater, vegetation, and wildlife as well as human interactions. Agriculture, mineral exploration, timber harvesting and urban development produce polluted stormwater runoff, increase impervious surfaces thereby altering stormwater flows, and degrade or fragment natural areas. Other common names given to watersheds, depending on size, include basins, sub-basins, subwatersheds, and Subwatershed Management Units (SMUs).

The Salmon Trout River watershed (12 Digit HUC: 040201050401) is in Michigan's Upper Peninsula in Marquette county (see locator map below). It is named for the Salmon Trout River that drains into Lake Superior in the northern portion of the watershed. The watershed is oblong and oriented south-north and drains into Lake Superior. Many small tributary streams in the watershed drain approximately 49.6 square miles (31,760 acres) of land surface. Municipalities found in the watershed include Powell Township, Michigamme Township, and Champion Township.

Prior to European settlement, the Salmon Trout River watershed was ecologically intact, with clean water and a diversity of plant and wildlife populations. The steep topography was dominated by sugar maple-hemlock forests, hemlock-yellow birch, jack pine-red pine, and mixed conifer swamp communities, which were preserved by the cool moist climate along Lake Superior. During these times most of the water that fell as precipitation was absorbed in these forested and wetland communities or flowed over the exposed bedrock surfaces into the rivers. This portion of the Upper Peninsula was inhabited by the Ojibwe (Chippewa) Indian tribe until 1842 when the Treaty of La Pointe ceded the lands to the settlers and forced the Ojibwe from the region.



Hypothetical watershed setting (Source: USEPA)

The steep topography and dense forests of the region limited the landscape changes typically seen following European settlement in the mid-1800s. There were relatively few areas farmed, and the relatively few wetlands were in narrow floodplains, protecting them from drainage and filling. However, many ecological impacts were not eliminated. Drastic changes resulted from the rapid growth of the timber industry and early settlers cleared land in order to build their homes, use wood for fuel, and to sell to sawmills. Iron ore was discovered in the region around this time as well, bringing the Industrial Revolution to the area along with the ecological impacts brought by mining. The majority of the watershed remains forested with residential units scattered throughout, and a large portion of the watershed owned by the Huron Mountain Club.

"Traditional" development and landscape change in watersheds brings negative impacts to the environment. Impervious surfaces greatly reduce the ability of precipitation to infiltrate into the ground and instead cause stormwater runoff to quickly reach streams and tributaries resulting in down cutting, widening, and bank erosion causing sediment and nutrient loading downstream. Meanwhile, invasive species established in adjacent floodplain wetlands are causing loss of wildlife habitat and reduced floodplain function. In addition, nutrients from residential lawn fertilizers negatively impact the watersheds. Additionally, discharged water from various sources that is not properly filtered is referred to as "non-point source pollution" and another source of degradation. Resource production activities such as mineral exploration and timber harvesting, can also pollute the watershed with sediment, contaminated groundwater, and the runoff of byproducts and other pollutants associated with these activities.

According to Michigan Department of Environment, Great Lakes and Energy (EGLE)'s Water Quality and Pollution Control in Michigan 2020 Sections 303(d), 305(b), and 314 Integrated Report (EGLE, 2020), Salmon Trout River, Clear Creek, East Branch Salmon Trout River, East Branch Snake Creek, Snake Creek and West Branch Salmon Trout River are all fully supporting the use designations for agriculture, navigation, and industrial water supply. Salmon Trout River is fully supporting for fish consumption and cold-water fishery while the remaining streams were not assessed for the fish consumption or cold water fishery use designations. Salmon Trout River is not supporting of other indigenous aquatic life and wildlife due to mercury in the water column, however it was delisted when Total Maximum Daily Load (TMDL) was approved by the EPA in 2018. The remaining streams in the watershed are all fully supporting of the other indigenous aquatic life and wildlife designated use. None of the streams in the watershed were assessed for the total body contact recreation, partial body contact recreation, and warm water fishery use designations. Additionally, the lakes within the Salmon Trout River watershed were assessed only for the navigation, agriculture, and industrial water supply uses and all are fully supporting for these uses. Use designations for all waterbodies in the Salmon Trout River watershed are summarized in Section 4.0 (EGLE, 2020).


Lake Superior
Whitefish Bay
Lake Michigan
Lake Huron
Study Area
Cook County
Keweenaw County
Houghton County
Ontonagon County
Ashland County
Baraga County
Marquette County
Alger County
Luce County
Chippewa County
Sault Ste. Marie
Gogebic County
Ottawa National Forest
Iron County
Vilas County
Dickinson County
Hiawatha National Forest
Schoolcraft County
Mackinac County
Delta County
Oneida County
Nicolet National Forest
Florence County
Price County
Forest County
Menominee County
Marinette County
Langlade County
Oconto County
Door County
Leelanau County
Charlevoix County
Emmet County
Cheboygan County
Presque Isle County
Alpena County
Otsego County
Location Map
Lake Superior
Lake Superior Watershed
Study Area
Michigan
NE Lake Michigan Watershed
NW Lake Michigan Watershed
Wisconsin
0 12.5 25 50 Miles
Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
LEGEND
Salmon Trout River Watershed
State Boundary
County Boundary
Salmon Trout River Watershed
Watershed Locator Map
Coordinate System: NAD_1983_StatePlane_Michigan_North_FIPS_2111_Feet
Data Source(s): ESRI, USDA-NRCS, USGS, EPA

Noteworthy- Watershed at a Glance

- The Salmon Trout River watershed lies in an area covered by the most recent glacial event - the Late Wisconsin Glaciation.
- Sugar Maple-Hemlock forests covered the majority of the watershed during European settlement in the 1830s.
- The climate is cool to mild; Lake Superior reduces heat of summer and buffers the cold of winter.
- Tributaries in the watershed drain 49.6 square miles of land in Marquette County, Michigan.
- The dominant land uses/land cover in 2015 includes forested land, timber production, and residential land.
- Municipalities include Powell Township, Michigamme Township, and Champion Township.
- The watershed area is known for its steep, forested, topography beloved by outdoor enthusiasts.
- The Lundin Eagle Mine is a nickel and copper mine situated in the southern end of the watershed.
- The population of the watershed in 2017 is estimated to be around 425 and is expected to remain stable.
- Water quality in tributaries is impacted by mercury, total nitrogen, and total phosphorus. Sampling data, however, was limited.
- There are 65.80 miles of streams within the watershed, mostly unnamed tributaries.
- There were 925 acres of wetlands prior to European settlement.
- Open space parcels comprise approximately 30,822 acres or 97% of the watershed.
- "Important Natural Areas" as defined by MDNR do not occur within the watershed.
- Kirtland's Warbler, a federally endangered bird species, has been sighted recently in the watershed.
- Shallow and deep groundwater aquifers provide the water supply for many private users and municipalities.

1.2 Project Scope & Purpose

The Superior Watershed Partnership and Land Conservancy is a 501(c)(3) is an award-winning Great Lakes nonprofit organization that has set national records for pollution prevention and implements innovative, science-based programs that achieves documented, measurable results. SWP hired Applied Ecological Services, Inc. (AES) to undergo a watershed planning effort and produce a comprehensive "Watershed-Based Plan" for the Salmon Trout River watershed that meets requirements as defined by the United States Environmental Protection Agency (USEPA).

Ultimately, the intent is to develop and implement a Watershed-Based Plan designed to achieve water quality standards/criteria. The watershed planning process is a collaborative effort involving voluntary stakeholders with the primary scope to restore impaired waters and protect unimpaired waters by developing an ecologically-based management plan for the Salmon Trout River watershed that focuses on improving water quality by protecting green infrastructure, creating protection policies, implementing ecological restoration, and educating the public. Another important outcome is to improve the quality of life for people in the watershed for current and future generations.

The primary purpose of this plan is to spark interest and give stakeholders a better understanding of the Salmon Trout River watershed to promote and initiate plan recommendations that will accomplish the goals and objectives of this plan. This plan was produced via a comprehensive watershed planning approach that involved input from SWP and analysis of complex watershed issues by watershed planners, ecologists, GIS specialists, water quality specialists, and environmental engineers. In addition, ideas and recommendations in this plan are designed to be updated through adaptive management that will strengthen the plan over time as additional information becomes available.

1.3 USEPA Watershed-Based Plan Requirements

In March 2008, the United States Environmental Protection Agency (USEPA) released watershed protection guidance entitled "Non-point Source Program and Grant Guidelines for States and Territories." The document was created to ensure that Section 319 funded projects make progress towards restoring waters impaired by non-point source pollution. Applied Ecological Services, Inc. consulted USEPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" (USEPA 2008) to create this watershed plan. Having a Watershed-Based Plan will allow Salmon Trout River watershed stakeholders to access 319 Grant funding and other funding for watershed improvement projects recommended in this plan. Under USEPA guidance, "Nine Elements" are required in order for a plan to be considered a Watershed-Based Plan.

Noteworthy- USEPA Nine Elements

Element A: Identification of the causes and sources or groups of similar sources of pollution that will need to be controlled to achieve the pollutant load reductions estimated in the watershed-based plan;

Element B: Estimate of the pollutant load reductions expected following implementation of the management measures described under Element C below;

Element C: Description of the BMPs (non-point source management measures) that are expected to be implemented to achieve the load reductions estimated under Element B above and an identification of the critical areas in which those measures will be needed to implement;

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement the plan;

Element E: Public information/education component that will be implemented to enhance public understanding of the project and encourage early and continued participation in selecting, designing, and implementing/maintaining non-point source management measures that will be implemented;

Element F: Schedule for implementing the activities and non-point source management measures the plan; identified in this plan that is reasonably expeditious;

Element G: Description of interim, measurable milestones for determining whether non-point source management measures or other control actions are being implemented;

Element H: Set of environmental or administrative criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards;

Element I: Monitoring component to evaluate the effectiveness of the implementation efforts over time.

1.4 Using the Watershed-Based Plan

The information provided in this Watershed-Based Plan is prepared so that it can be easily used as a tool by any stakeholder including elected officials, federal/state/county/municipal staff, and the general public to identify and take actions related to watershed issues and opportunities. The pages below summarize what the user can expect to find in each major "Section" of the Watershed-Based Plan.

Section 3.0: Watershed Resource Inventory
An inventory of the characteristics, problems, and opportunities in the Salmon Trout River watershed is examined in Section 3.0. Resulting analysis of the inventory data can help develop a Management Measures Action Plan. Inventory results also help identify causes and sources of watershed impairment as required under USEPA's *Element A*.

Section 4.0: Water Quality & Pollutant Modeling Assessment
This section includes a detailed summary of physical, chemical, and biological data available for the Salmon Trout River watershed. Water quality data combined with pollutant loading data provides information that sets the stage for developing pollutant reduction targets and identifying "Critical Areas."

<u>Watershed Resource Inventory Topics Included in the Plan</u>

- 3.1 Geology, History & Climate
- 3.2 Pre-European Settlement Landscape to Present Landscape
- 3.3 Topography, Watershed Boundary, & Subwatershed Management Units
- 3.4 Hydric Soils, Soil Erodibility, & Hydrologic Soil Groups
- 3.5 Jurisdictions, Roles, & Protections
- 3.6 Existing Policies and Ordinances Review
- 3.7 Demographics
- 3.8 Transportation Network
- 3.9 Existing Land Use/Future Land Use
- 3.10 Impervious Cover Impacts
- 3.11 Open Space Inventory and Prioritization
- 3.12 Green Infrastructure Network
- 3.13 Important Natural Areas
    - *3.13.1 Natural Resource Management*
- 3.14 Watershed Drainage System
    - *3.14.1 Salmon Trout River*
    - *3.14.2 Salmon Trout River Tributary Streams*
    - *3.14.3 Streambank Erosion*
    - *3.14.4 Riparian Area Condition*
    - *3.14.5 Designated Trout Streams*
    - *3.14.6 Wetlands and Potential Wetland Restoration Sites*
    - *3.14.7 Floodplain*
- 3.15 Groundwater Aquifers and Recharge, Contamination Potential, and Water Supply

1.5 Prior Studies & Projects

This planning document is an updated version of the Salmon Trout River Watershed Management Plan approved in 2007. Since the initial plan came out, much work has been done to implement previously identified restoration projects and to continue to gather information for the Salmon Trout River watershed. The Superior Watershed Partnership, with assistance from partners, continues to evaluate environmental conditions.

Superior Watershed Partnership has a legacy of water quality improvement implementations and monitoring efforts in the Salmon Trout River watershed. Since 1999, the Superior Watershed Partnership and other partners have implemented a number of corrective actions and management strategies. On the ground restoration projects consisted of improvements to 11 crossings since the Salmon Trout WMP was created in 2007, and 14 road/stream crossings were replaced, including 8 crossings of the Northwestern Road that were identified as significant sources of sedimentation to the Salmon Trout River and its tributaries prior to 2007. In addition, a variety of means were used to inform and educate landowners, stakeholders, and the public about watershed issues and implementation progress. Public information and education efforts focused on land use management practices, conservation planning tools, and other methods to preserve and protect water quality and natural resources in the Salmon Trout River watershed. A brief summary of projects completed along with other strategies implemented is provided.

A comprehensive three-year study, entitled Lake Superior: Urban and Rural Watershed Restoration, was prepared for the Model Forest Policy Program (MFPP) and Superior Watershed Partnership. The study identified aspects of the Salmon Trout River watershed that could benefit from improved land management, including from riparian restoration, streamside and wellhead protection zones, and protection from the effects of metals and gravel mining (Hall, Margaret & Thaler, T. 2018). This collaborative project included social surveys, ecosystem services analysis, and curriculum development.

The watershed continues to be an ecological and community asset and provides a number of ecosystem services through the inherent capabilities of the landscape. A 2018 ecosystems services analysis by Key-Log Economics provided an assessment of Salmon Trout watershed ecosystem services which include aesthetics, climate regulation, air quality, cultural, passive use, energy resources, protection from extreme events, food, biodiversity, raw materials, medicine, recreation, soil formation, erosion control, waste assimilation, water supply, and pollination (Phillips 2018).

Table 1 Salmon Trout River Watershed Implementation Progress 1999-2019.

1999
• Watershed-wide inventory of road crossings and erosion sites begins.
2000
• With the help of 10 Marquette area youth, erosion control and storm water improvements were completed at nine road/stream crossings of the Northwestern Road. • Water quality monitoring begins at seven sites with funding from EGLE. • Completed a natural features inventory for the Lake Superior coastline including portions of the Salmon Trout River watershed.

2001

- Water quality monitoring was expanded to twelve sites and continues through 2005.
- Worked with Longyear Realty Corporation to replace failing culverts at two road/stream crossings of the Northwestern Road. This included installation of clear span bridges and storm water diversions at crossings of the Main Branch and a main tributary of the East Branch of the Salmon Trout River.
- Worked with Longyear Realty Corporation to improve a series of logging road crossings of seasonal streams and drainages in the vicinity of Murphy's Creek, one of the only tributaries of the lower Salmon Trout River. This included installation of culverts, storm water diversions, and bank stabilization (riprap and vegetative plantings) at 10 crossing sites.

2002

- Clear span bridges were installed at two additional crossings of tributaries of the East Branch of the Salmon Trout River by the Northwestern Road with funding from the U.S. Fish and Wildlife Service.
- Worked with the Natural Resources Conservation Service to install a 150-foot-long storm water diversion ditch along a steep approach of the Triple A Road near the crossing of the Main Branch of the Salmon Trout River. The entire crossing, along with the approach ditches was replaced in 2004 by the landowner, who had recently acquired the land.
- Hosted a public riparian buffer workshop targeting waterfront landowners with information on stream bank protection and restoration practices.

2003

- Installed an aluminum arch culvert and storm water diversions at a crossing of the West Branch of the Salmon Trout River by Northwestern Road.
- Develop land use planning guide and CD for Marquette County including a resource inventory (GIS maps) for the Salmon Trout River watershed.
- Developed a model riparian buffer ordinance for area townships and other local units of government.

2004

- Installed a sediment trap on the Main Branch of the Salmon Trout River, upstream of the lower dam. The project was coordinated with and approved by MDNR Fisheries and had previously been recommended by MDNR and the U.S. Fish and Wildlife Service following a 1998 survey of the watershed.
- Provided support to the Presque Isle Power Plant (City of Marquette) for a variance to install a mercury abatement facility, which resulted in a 90% reduction in mercury emissions.
- Hosted a public workshop on working forest conservation easements with emphasis on riparian property owners (over 100 in attendance).
- Mailing completed to riparian property owners with information on conservation easements and overview of watershed protection practices for landowners.

2005

- Much of the watershed was photographed during a low altitude aerial survey conducted for development of the Superior Watershed Partnership "Shoreline Viewer" land use planning project www.superiorwatersheds.org/aerial.php.

2006
• Plans implemented to further reduce sedimentation in priority areas and begin implementation of other plan recommendations.
2007
• Bottomless arch installed on East Branch at NW Road reducing an estimated 73 tons of sediment and restoring 5 stream miles
2010
• Bottomless half pipe installed on a tributary to the East Branch at NW Road reducing an estimated 16 tons of sediment and restoring 1 stream mile • Another bottomless half pipe was installed on a tributary to the East Branch at NW Road reducing an estimated 88 tons of sediment and restoring 4 stream miles
2012
• A box culvert was installed on Clear Creek – at Blind M-35 reducing an estimated 10 tons of sediment and restoring 2 stream miles • A bottomless half pipe was installed on a tributary to the Main Branch at NW Road reducing an estimated 5 tons of sediment and restoring 1.8 stream miles • An additional bottomless half pipe was installed on a tributary to the Main Branch reducing an estimated 5 tons of sediment and restoring 1.8 stream miles • A bottomless half pipe was installed on Iron Creek reducing an estimated 5 tons of sediment and restoring 1.5 stream miles • A bottomless half pipe was installed on a tributary to the Main Branch reducing an estimated 16 tons of sediment and restoring 1.1 stream miles • A bottomless arch was installed on the Main Branch reducing an estimated 5 tons of sediment and restoring 1.5 stream miles

2019
• A bottomless half pipe was installed on a tributary to the East Branch at a private road reducing an estimated 10 tons of sediment and restoring 1.8 stream miles • An additional bottomless half pipe was installed on a tributary to the East Branch at a private road reducing an estimated 10 tons of sediment and restoring 1.8 stream miles

2.0 MISSION, GOALS, AND OBJECTIVES

2.1 Superior Watershed Partnership

The Superior Watershed Partnership and Land Conservancy is a 501(c)(3), award-winning, Great Lakes nonprofit organization that has set national records for pollution prevention and implements innovative, science-based programs that achieve documented, measurable results. The Superior Watershed Partnership implements a variety of conservation and public education projects including:

- Great Lakes habitat protection and restoration
- Community pollution prevention
- Climate change adaptation planning and implementation
- Invasive species removal and prevention
- Water quality and stormwater management
- Native plant restoration
- Land protection
- Youth programs and public education
- Alternative energy and energy conservation
- UP community assistance

The Superior Watersheds Partnership also provides technical, educational, and monitoring assistance on a variety of Great Lakes protection initiatives with emphasis on Lake Superior, Lake Michigan, and Lake Huron. The Superior Watershed Partnership has received numerous state and national awards and has been recognized by Michigan's Governor Granholm, the US Environmental Protection Agency, Environment Canada and the Lake Superior Bi-national Program as a leader in watershed protection for the Lake Superior Basin and the headwaters region of the Great Lakes ecosystem.

2.2 Goals and Objectives

The main goal of the Salmon Trout River Watershed-Based Plan is to promote and facilitate coordinated, collaborative action among stakeholders in order to improve and protect water quality and preserve the unique nature of the watershed. The watershed inventory and analysis identified and prioritized the causes and sources of pollution affecting or having the potential to affect water quality and designated and desired uses in the watershed. The following goals and management objectives provide guidance for implementation of actions that will reduce these affects and provide a basis for protection from further impacts.

The following goals and management objectives were developed in 2007 as strategies to address threats to water quality and designated and desired uses in the Salmon Trout River watershed (Table 2). They provide a basis for protection of significant natural resources and reflect the desires of the stakeholders for the future state of the watershed. Goals and objectives for the watershed have not changed since 2007.

Table 2 Goals of the Salmon Trout River watershed management plan: Threatened designated or desired uses and pollutants addressed.

Goals	Threatened Designated or Desired Uses Addressed	Pollutants Addressed
1. Protect the integrity of aquatic and terrestrial ecosystems within the watershed.	Designated Uses: Coldwater fishery Other indigenous aquatic life and wildlife Public water supply Desired Uses: Protect coaster brook trout Limit development to areas outside the riparian corridor Promote sound land use practices	All
2. Protect and improve the quality of water in order to support all designated and desired uses.	Designated Uses: Coldwater fishery Other indigenous aquatic life and wildlife Public water supply Desired Uses: Protect coaster brook trout Limit development to areas outside the riparian corridor Promote sound land use practices	All
3. Establish and promote information and education programs that support watershed planning goals, objectives, tasks, and increase stewardship.	Designated Uses: Coldwater fishery Other indigenous aquatic life and wildlife Public water supply Desired Uses: Protect coaster brook trout Limit development to areas outside the riparian corridor Promote sound land use practices	All

Goal #1
Protect the integrity of aquatic and terrestrial ecosystems within the watershed

Designated Uses Addressed:
Coldwater fishery, other indigenous aquatic life and wildlife, and public water supply

Desired Uses Addressed:
Protect coaster brook trout, limit development to areas outside the riparian corridor, and promote sound land use practices

Pollutants Addressed:
All

Objective 1:
Assist local units of government with master planning and zoning ordinances to protect water quality and sensitive areas

- Prevent the establishment of new sulfide-based mining operations and closely monitor and strive to prevent negative environmental impacts as a result of mines already established
- Provide guidance and tools for planning, ordinance development, and zoning enforcement
- Encourage the use of effective riparian buffers
- Encourage the use of land use restrictions in areas sensitive to environmental degradation
- Encourage appropriate provisions for water quality and sensitive areas in the approval process for new development or redevelopment

Objective 2:
Protect and restore desirable habitat areas for fish and aquatic organisms in the Salmon Trout River and its tributaries including critical habitat for coaster brook trout and preserve the biodiversity of aquatic communities

- Reduce sedimentation from priority sources
- Improve passage for fish and aquatic organisms (road/stream crossings)
- Improve habitat for coaster brook trout in the lower Salmon Trout River (reduce sedimentation)
- Promote proper riparian land use practices including the use of buffers (reduce sedimentation, protect sensitive areas)
- Support efforts to improve and maintain naturally reproducing native fish populations

Goal #2
Protect and improve the quality of water in order to support all designated and desired uses

Designated Uses Addressed:
Coldwater fishery, other indigenous aquatic life and wildlife, and public water supply

Desired Uses Addressed:
Protect coaster brook trout, limit development to areas outside the riparian corridor, and promote sound land use practices

Pollutants Addressed:
All

Objective 1:
Control and/or minimize sediment input to the Salmon Trout River and its tributaries from the following sources:
- Road/stream crossings
- Land use practices
- Recreational access
- Development

Objective 2:
Promote voluntary arrangements and regulatory incentives to help prevent degradation of natural resources and water quality
- Avoid development that encroaches on sensitive or biologically important areas
- Preserve high quality natural communities
- Protect critical riparian areas
- Properly manage working lands (forest lands)

Objective 3:
Discourage land use practices that have the potential to negatively impact water quality
- Eliminate and/or minimize risks for surface and groundwater contamination by acid mine drainage, heavy metals, nutrients, and toxins through improved zoning and increased landowner education and stewardship
- Discourage development in sensitive areas (riparian corridors, wetlands, and areas with unsuitable soils, slope, etc.) through improved zoning and increased landowner education and stewardship

Goal #3 **Establish and promote information and education programs that support watershed planning goals, objectives, and tasks and increase stewardship**
Designated Uses Addressed: Coldwater fishery, other indigenous aquatic life and wildlife, and public water supply **Desired Uses Addressed:** Protect coaster brook trout, limit development to areas outside the riparian corridor, and promote sound land use practices **Pollutants Addressed:** All

Objective 1:
Regularly inform local landowners and the public about watershed, activities, study findings, and opportunities for involvement

- Use social surveys to identify what information should be sent to landowners and the public
- Use tactical and targeted outreach and communications plan that is tailored to specific user groups
- Use multiple mediums to communicate information, connect with, and inform landowners

Objective 2:
Involve citizens, public agencies, stakeholders, and landowners in implementation of the watershed management plan through meetings and workshops with individuals or groups

- Form and/or maintain local and regional partnerships and identify shared goals and objectives
- Where applicable, use and share place-based curriculum *Resource Management for Resilience* developed for educators in collaboration with the Model Forest Policy Program in 2018.
- Connect with the community to form citizen science opportunities for gathering data and providing meaningful hands-on experiences

Objective 3:
Provide focused information to residents, visitors, local governments, and other target audiences on priority topics

- Use strategic and informative signage to inform the public about projects, biologically important areas, sensitive areas, and watershed concerns in publicly accessible areas
- Address watershed concerns and goals with focused communication campaigns through a variety of print and digital mediums
- Participate in regular communication with local governmental decision makers
- Provide detailed watershed information to landowners, land managers and local governmental decision makers

3.0 WATERSHED RESOURCE INVENTORY

3.1 Geologic History & Climate

The terrain of the Midwestern United States was created over thousands of years as glaciers advanced and retreated during the Pleistocene Era or “Ice Age.” Dr. Randall Schaetzl’s “Geography of Michigan and the Great Lakes Region,” observes that far earlier than that, more than a billion years ago, volcanic activity along the Lake Superior Syncline lead to the formation of the Lake Superior basin and the deposition of the volcanic Pre-Cambrian geology that makes up the Keweenaw Peninsula, as well as forming the post-volcanic Cambrian and Ordovician sedimentary rock which makes up the bedrock of the watershed area. The area of the Upper Peninsula of Michigan where the Salmon Trout River watershed now lies was covered by the most recent glacial event known as the Late Wisconsin Glaciation that began approximately 30,000 years ago and ended around 9,500 years ago (Figure 1). This area was largely covered by the Superior lobe. The terrain of the Upper Peninsula was some of the last to experience deglaciation, with the Marquette re-advance occurring circa 10,000 years ago burying exposed areas such as the Gribben Lake forest bed.

Figure 1- Lobes and Sublobes of the Laurentide Ice Sheet

Around 9,500 years ago, the earth’s temperature warmed and the ice slowly retreated leaving behind moraines and glacial ridges where it stood for long periods of time, some of which contribute to the topography in the watershed region.

Figure 2- Moraines of Michigan and Surrounding States

The composition of the soil in Salmon Trout watershed is also a remnant of the ancient ice movement. Above the bedrock and sedimentary deposits, is a thin layer of poorly-sorted deposits left behind from the glaciers, consisting of largely mineral soils.

A combination of the thin mineral soils and somewhat tundra-like environment led to coniferous forest being the first ecological community to colonize after the glaciers retreated. As temperatures continued to rise, cool moist deciduous forests dominated by aspen and birch developed along Lake Superior coastal areas and beech, sugar maple, hemlock forests developed more inland. Jack pine-red pine forests, and hemlock-white pine forests, as well as small patches of mixed conifer swamp were also part of the landscape.

Climate

The Marquette, MI area climate can be described as temperate with cold winters and warm summers where great variation in temperature, precipitation, and wind can occur on a daily basis. Surges of polar air moving southward or tropical air moving northward causes daily and seasonal temperature fluctuations. The action between these two air masses fosters the development of low-pressure centers that generally move eastward and frequently pass over the study area, resulting in abundant rainfall. Prevailing winds are generally from the west, but are more persistent and blow from a northerly direction during winter. Lake Superior significantly influences the study area as it reduces the heat of summer and buffers (warms) the cold of winter by several degrees on average.

The Weather Channel website (www.weather.com) provides an excellent summary of climate statistics including monthly averages and records for most locations in the Upper Peninsula. Data for Marquette was selected to represent the climate and weather patterns experienced in Salmon Trout River watershed (Figure 3). The winter months are cold averaging highs around

30° F while winter lows are around 17° F. Summers are warm with average highs around 71° F and summer lows around 56° F. The highest recorded temperature was 104° F in July 1977 while the lowest temperature was -33° F in February 1861.

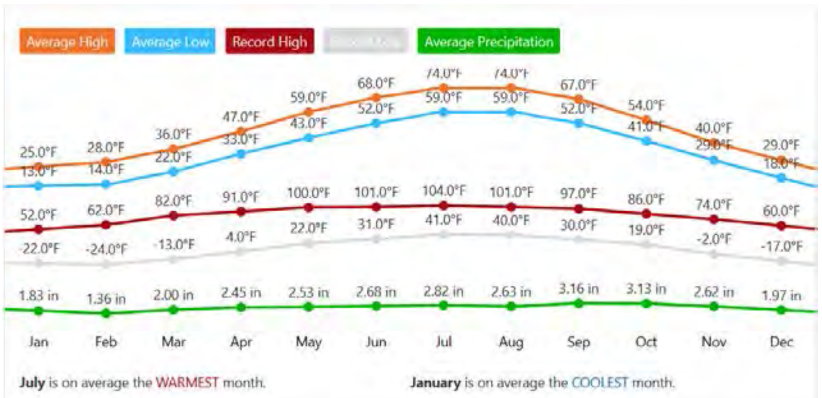


Figure 3- Regional Climate Trends

With a climate impacted by its northern latitude and proximity to Lake Superior, the Salmon Trout River watershed consists of an average rainfall around 29 inches and snowfall around 119 inches. According to data collected in Marquette, the most precipitation on average occurs in September and October (3.2 inches) while January receives the least amount of precipitation with 1.3 inches on average.

According to Great Lakes Integrated Sciences and Assessments (GLISA) Michigan's climate is changing. On average, Michigan has become warmer and wetter over the past 60 years. Future projections for Michigan created by GLISA along with University of Michigan and Michigan State University suggest this trend will continue and increase considerably. By the latter half of the century, regional annual average temperatures are likely to warm by 5.5-6 ° F and precipitation increase by 2-4 inches.

Climate Change

The variable effects of climate change are altering Northern Michigan forests and other ecosystems and can be attributed to changes in important cultural, economic, and environmental factors. In Michigan, the four heaviest rain events per year contain 35% more water than they did 50 years ago (US EPA 2016). These heavy rains lead to increased sedimentation, nitrates, phosphates, *E. coli*, and other pollutants entering waterways leading to beach closings and algae blooms. In addition, northern forest compositions are changing. In particular, the Upper Peninsula of Michigan may see declining paper birch, quaking aspen, balsam fir, and black spruce populations and increasing populations of oak, hickory, and pine trees (US EPA 2016). Furthermore, the central and eastern regions of the Upper Peninsula are projected to experience more extreme temperature changes than other parts of Michigan (GLISA 2014). The Climate Change Response Framework conducted a series of vulnerability assessments for the north-woods region supported by 19 science and management experts from across the area aka the "Northwoods Framework." The experts agreed that current and anticipated climatic changes suggest the following main points for the Laurentian Mixed Forest Province of Northern Wisconsin and the Western Upper Peninsula (including Marquette County): 1). Increased precipitation 2). Increased daily maximum temperatures, particularly in winter 3). Potential increase in mean annual temperature of 2 to 9 °F for the region 4). The most vulnerable forest communities in the assessment area include upland spruce-fir, lowland conifers, aspen-birch, lowland-riparian hardwoods, and red pine forests (Janowiak et al. 2014).

Projected climate trends anticipated for the next 100 years were determined using downscaled global climate model data. The suggested management implications in the Northwoods Framework report include (summarized) 1). Following state and federal guidance to protect and support wildlife, and specifically rare, threatened, and endangered species. 2). Replace water infrastructure such as culverts, bridges, and shoreline roads following 100-year flood plans. Use hydrologic modeling where possible to identify high runoff zones. 3). Prioritize the preservation of stream margins, as reduced shading could cause the effects of warming temperatures to compound with severe consequences for fish populations and other aquatic life. 4). Adapt fire and fuel policies specific to land use in particular regions to address ecosystem and human health concerns exacerbated by drought conditions. 5). Adapt forest harvest and management practices for anticipated changes in tree species diversity related to heat-stress and tolerance levels. 6). Adapt forest harvest and management practices for shorter seasons of frozen ground and reduced harvest windows. 7). Manage forests using strategies for increasing carbon storage with enhanced regeneration, competition control, fertilization, and superior stock (Janowiak 2012). 8). Manage forests for non-timber products such as food, medicine, and craft. In addition, protect cultural, archeological and historical resources. 9). Plan for increased infrastructure maintenance on trails, campsites, structures and hazard tree removal in wilderness areas due to increased storm events. 10). Plan to shift tourist and local recreational focus from winter-sports to warmer-weather activities. 11). Plan, adapt, and inform the public about regional increases in human diseases and vectors of transmission. 12). Plan, adapt to challenges and plant a variety of highly tolerant species at urban and community forest sites (Janowiak et al. 2014).

3.2 Pre-European Settlement Landscape Compared to Present Landscape

According to Michigan State University's "Michigan History," the Ojibwe (or Chippewa) peoples called this region home for many centuries before the arrival of European settlers. These people primarily hunted and fished in the region, subsisting themselves with the natural environment. This made them key allies to the French fur traders, until the decline of the fur trade and transfer of lands from French to British and eventually American ownership led to them being driven from the region around 1640. The final removal of the Ojibwe peoples from their native lands came with the signing of the Treaty of La Pointe in 1842, ceding the copper and iron rich lands. This treaty paved the way for European settlement in the area that began with surveys of the land. The original public land surveyors that worked for the office of U.S. Surveyor General in the early and mid-1800s mapped and described natural and man-made features and vegetation communities while creating the township, range, and section ("Rectangular Survey System") for mapping and sale of western public lands of the United States (Daly & Lutes et. al., 2011). Ecologists know by interpreting survey notes and hand drawn Federal Township Plats of Michigan (1833-1866) and from documents written by the earliest settlers in the area that a complex interaction existed between several ecological communities including coniferous and deciduous forests, and wetlands prior to European settlement in the 1830s (Figures 4 & 5). Circa 1800 pre-European settlement vegetation mapping indicates forested upland areas dominated the watershed. The area was primarily covered by sugar maple-hemlock forest, with it comprising 19,120 acres (60%) of the community. Other common communities such as hemlock-yellow birch (9%), hemlock-red pine (6%), hemlock-white pine (5%), and exposed bedrock (5%) were also present. The few lowland areas that existed largely consisted of mixed conifer swamp (5%), with other areas being muskeg/bog (2%) or shrub swamp/emergent marsh (1%). These wetland areas were largely concentrated near the outlet of the Salmon Trout River, along with a small sliver of sand dune community.

With most European settlement occurring around nearby Marquette, the Salmon Trout River watershed remained largely untouched. The earliest, available aerial photography of the watershed, is from 1953 (Figure 7). The early tracks of today's roads are visible, but outside of that the land is minimally, visibly impacted.

Figure 7 shows a 2015 aerial photograph of the Salmon Trout River watershed. Throughout the majority of the watershed, the condition of the land has changed minimally. The clearest changes have occurred in the south west portion of the watershed, where the topography is relatively flat. Evident in the photograph are the parcels that have been logged, as well as the Eagle Mine which began operation in 2014. Isolated residential parcels occur sporadically throughout the region. Otherwise, the majority of the watershed remains heavily forested.

Figure 4 Salmon Trout River corridor

Ecological conditions throughout the watershed present opportunities for implementing watershed protections and ecological restoration to improve the condition of the Salmon Trout River watershed. Present day knowledge of how pre-European settlement ecological communities formed and evolved provides a general template for developing present day natural area restoration and management plans and projects. One of the primary goals of this watershed plan is to identify, protect, restore, and manage remaining natural areas.

Figure 5- Federal Township Plat of Area Near Powell Township

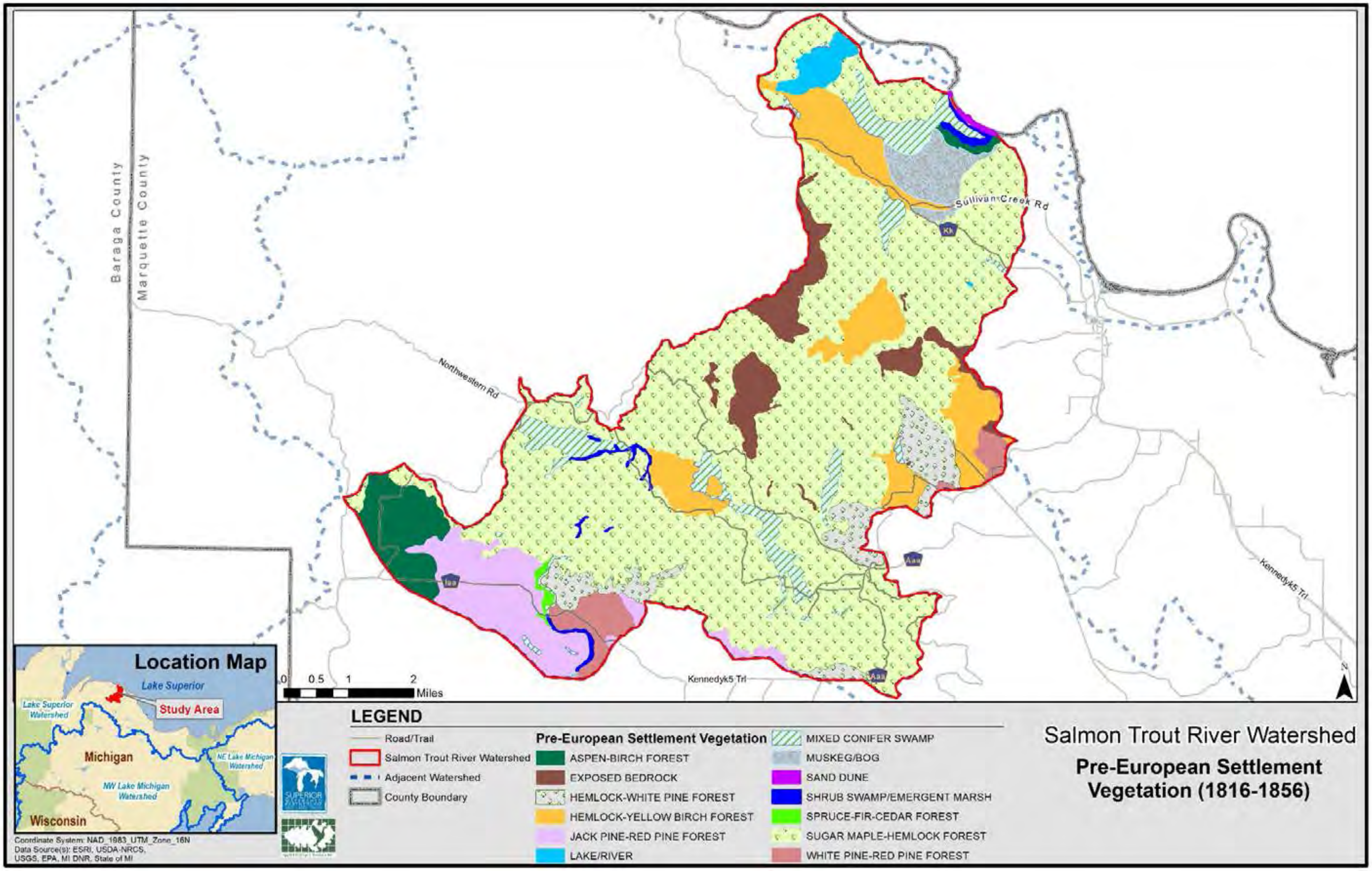


Figure 6- Pre-European settlement vegetation

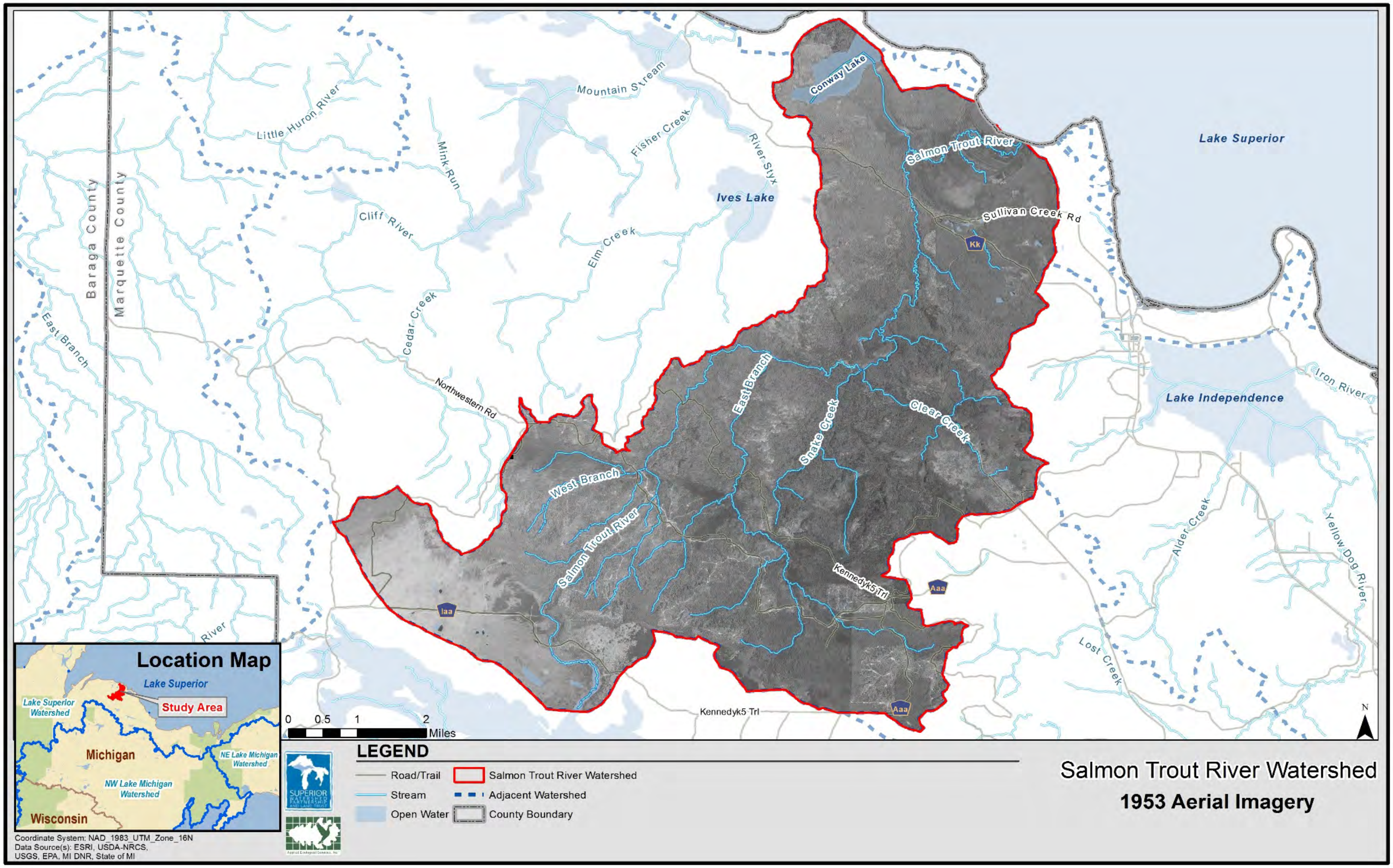


Figure 7- 1953 Aerial Imagery

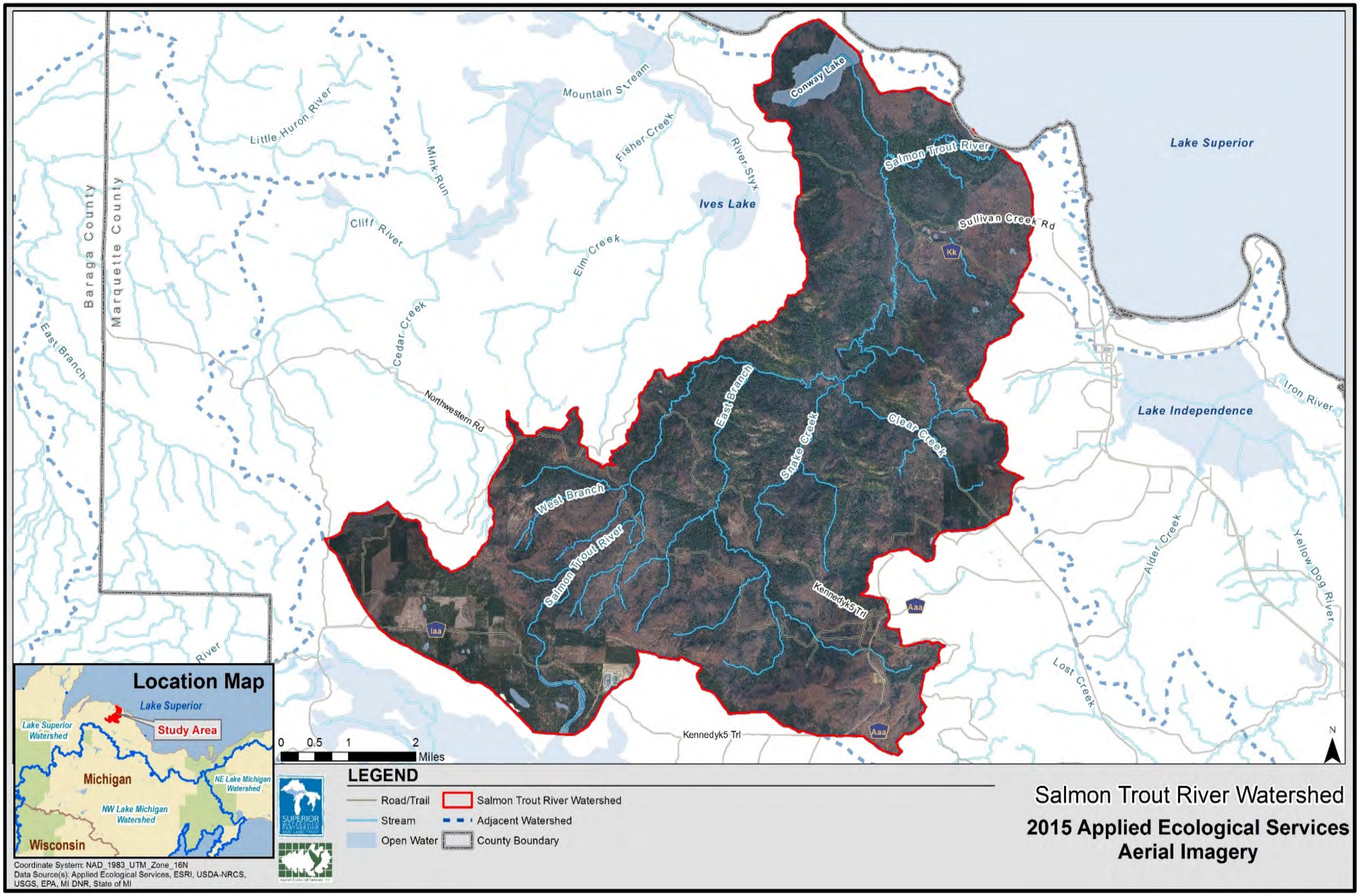


Figure 8- 2015 Aerial Imagery

3.3 Topography, Watershed Boundary, & Subwatershed Management Units

Topography & Watershed Boundary

The topography of the Salmon Trout River watershed is best described in terms of the upper and lower watersheds. The upper watershed consists of the area from the base of the Lower Falls upstream to the headwaters and includes the Main Branch of the Salmon Trout River, several main tributaries, and numerous smaller streams. Most of these streams originate south of the Huron Mountains at the northern base of the Yellow Dog Plains. Tributaries of the upper watershed are characterized by high gradient reaches that descend rapidly. The Main Branch of the Salmon Trout River, for example, descends approximately 690 meters from its headwaters to the Lower Falls, an average of 86.25 meters per mile. Due to its steep gradient, this reach can transport large quantities of sediment but is also highly vulnerable to erosion. Similarly, the East Branch descends approximately 410 feet with an average gradient of 53 feet per mile.

The lower Salmon Trout River watershed is quite different. The lower watershed includes the area downstream from the Lower Falls to Lake Superior. At this point, all of the major tributaries have been consolidated into one river course and the stream gradient levels out dramatically to approximately 6 feet per mile. Such a low gradient in this reach makes the task of transporting sediments from the upper watershed difficult. This reach also includes the entire distribution of spawning and nursery habitat for coaster brook trout. Coaster brook trout habitat is usually located in lower-river and river mouth areas (White 1940; Vladykov 1942; Slade 1994) with nearshore, lacustrine and estuarine settings often being used where suitable conditions exist (Scott and Crossman 1973; Weed 1934). This includes areas consisting of loose, silt-free gravel or coarse sand over strong groundwater seepage. As such, it is critical to minimize sediment from upstream sources before it reaches the slow-moving water of the lower watershed. Fortunately, naturally occurring large, woody debris are common in the stream channel of this reach. This debris causes scouring of bed sediments, exposing substrate suitable for coaster brook trout.

The Salmon Trout River watershed boundary used in this study is sourced from the United States Geologic Survey (USGS) database. The watershed boundary and available elevation data from Michigan Open GIS database was then input into a GIS model (ArcSWAT) that generated a Digital Elevation Model (DEM) of the watershed (Figure 9).

The Salmon-Trout River watershed is 31,760 acres or 49.6 square miles in size. The entire watershed drains from south to north and eventually to Lake Superior. Elevation within the watershed ranges from a high of 471 meters above mean sea level (AMSL) to a low of 183 meters AMSL along the Lake Superior coast for a total relief of 288 meters (Figure 9). The highest point is found on the western edge of the watershed, where there is a concentration of steep topography.

An interesting feature is the large, relatively flat lowland in the northern portion of the watershed generally at the outfall of the Salmon Trout River. According to the original public land survey conducted in the mid-1800s, this lowland is surrounded by 40-foot cliffs and consists of dunes on the coast with the inland portions consisting of muskeg and swamps filled with cedar, tamarack, alder and black ash. The ecosystem persists through today exhibiting the same communities as it did when initially surveyed.

Subwatershed Management Units (SMUs)

The Center for Watershed Protection (CWP) is a leading watershed planning agency and has defined watershed and subwatershed sizes appropriate to meet watershed planning goals. In 1998, the CWP released the "Rapid Watershed Planning Handbook" (CWP 1998) as a guide to be used by watershed planners when addressing issues within urbanizing watersheds. The CWP defines a watershed as an area of land that drains anywhere from 10 to 100 square miles. Broad assessments of conditions such as soils, wetlands, and water quality are generally evaluated at the watershed level and provide some information about overall conditions. The Salmon Trout River watershed is about 50 square miles and therefore this plan allows for a detailed look at watershed characteristics, problem areas, and management opportunities. However, an even more detailed look at smaller drainage areas must be completed to find site specific problem areas or "Critical Areas" that require immediate attention.

A watershed can be divided into subwatersheds called Subwatershed Management Units (SMUs) to address issues at a smaller scale. The Salmon Trout River watershed was delineated into 29 SMUs using a Digital Elevation Model (DEM) (Table 3; Figure 9). All SMUs drain into Lake Superior through the outlet in SMU 29. Information obtained at the SMU scale allows for detailed analysis and better recommendations for site specific "Management Measures" otherwise known as Best Management Practices (BMPs). Delineation into SMUs also allows for better identification of areas contributing to water quality problems as summarized in Section 4.0.

SMU #	Subwatershed/ Creek Names	Total Acres	Total Square Miles
SMU 1	Unnamed Creek	786.2	1.2
SMU 2	Unnamed Creek	1,185.7	1.9
SMU 3	Main Branch Salmon Trout River	1,271.6	2.0
SMU 4	Main Branch Salmon Trout River	719.4	1.1
SMU 5	Iron Creek	1,169.0	1.8
SMU 6	West Branch Salmon Trout River	1,507.9	2.4
SMU 7	Salmon Trout River	1,013.1	1.6
SMU 8	East Branch Salmon Trout River	1,159.7	1.8
SMU 9	East Branch Salmon Trout River	1,461.4	2.3
SMU 10	East Branch Salmon Trout River	2,085.5	3.3
SMU 11	East Branch Salmon Trout River	1,826.5	2.9
SMU 12	Salmon Trout River	1,285.5	2.0
SMU 13	East Branch Salmon Trout River	939.6	1.5
SMU 14	Snake Creek	1,488.2	2.3
SMU 15	Clear Creek	900.4	1.4
SMU 16	Clear Creek	987.4	1.5
SMU 17	Salmon Trout River	737.2	1.2
SMU18	Snake Creek	1,122.6	1.8
SMU19	Clear Creek	621.9	1.0
SMU 20	Clear Creek	604.9	0.9
SMU 21	Unnamed Creek	624.0	1.0
SMU 22	Spring Creek/ Main Branch Salmon Trout River	1,590.0	2.5
SMU 23	Murphy's Creek	2,034.6	3.2
SMU 24	Main Branch Salmon Trout River	670.0	1.0
SMU 25	Main Branch Salmon Trout River	696.2	1.1
SMU 26	Conway Lake	1,186.6	1.9
SMU 27	Conway Creek	813.8	1.3
SMU 28	Sullivan Creek	516.2	0.8
SMU 29	STR Mouth/ Sullivan Creek	754.6	1.2
Totals		**31,759.7**	**49.6**

Table 3 Subwatershed Management Unit (SMU) acreage

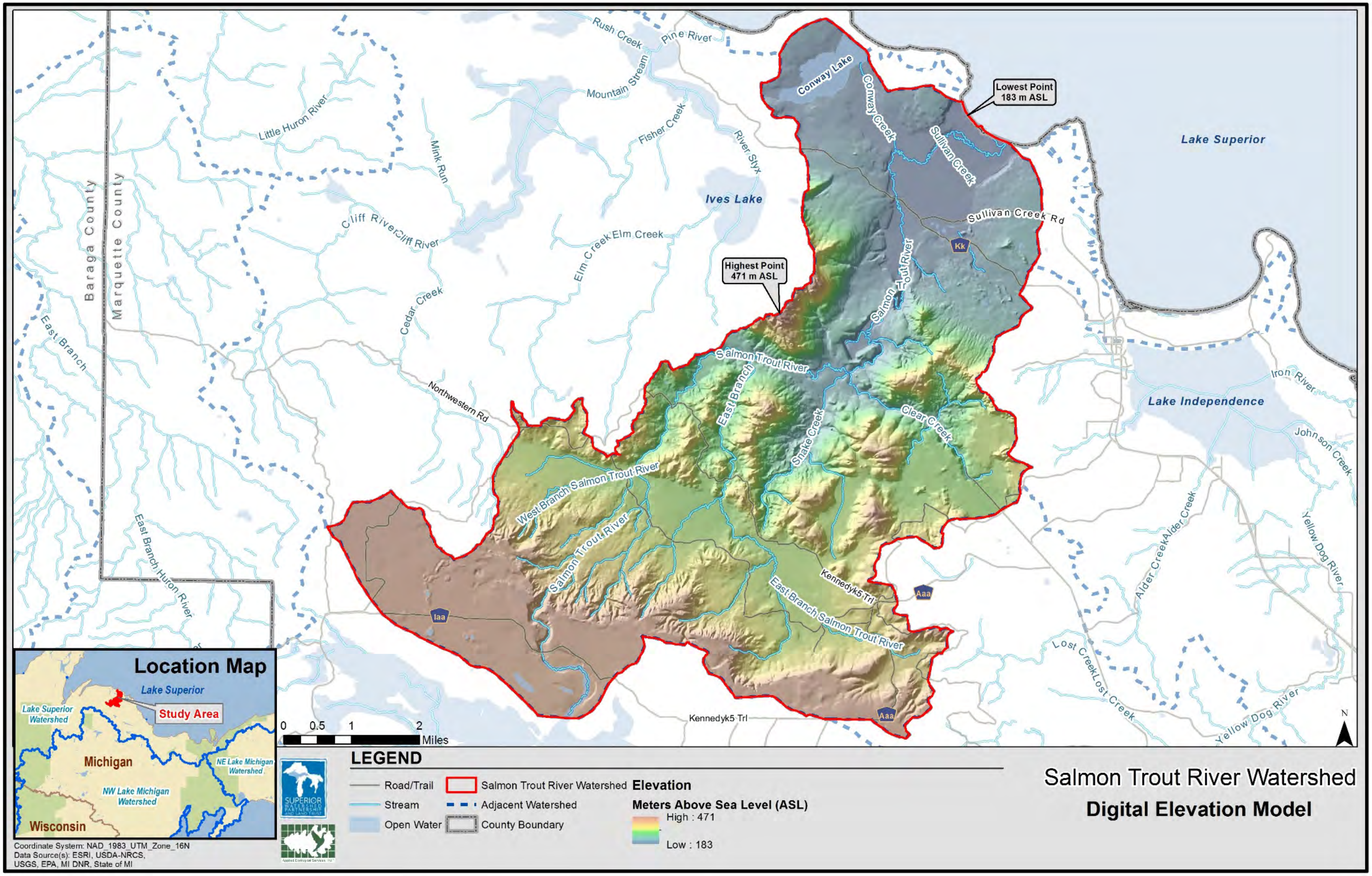


Figure 9- Digital Elevation Model

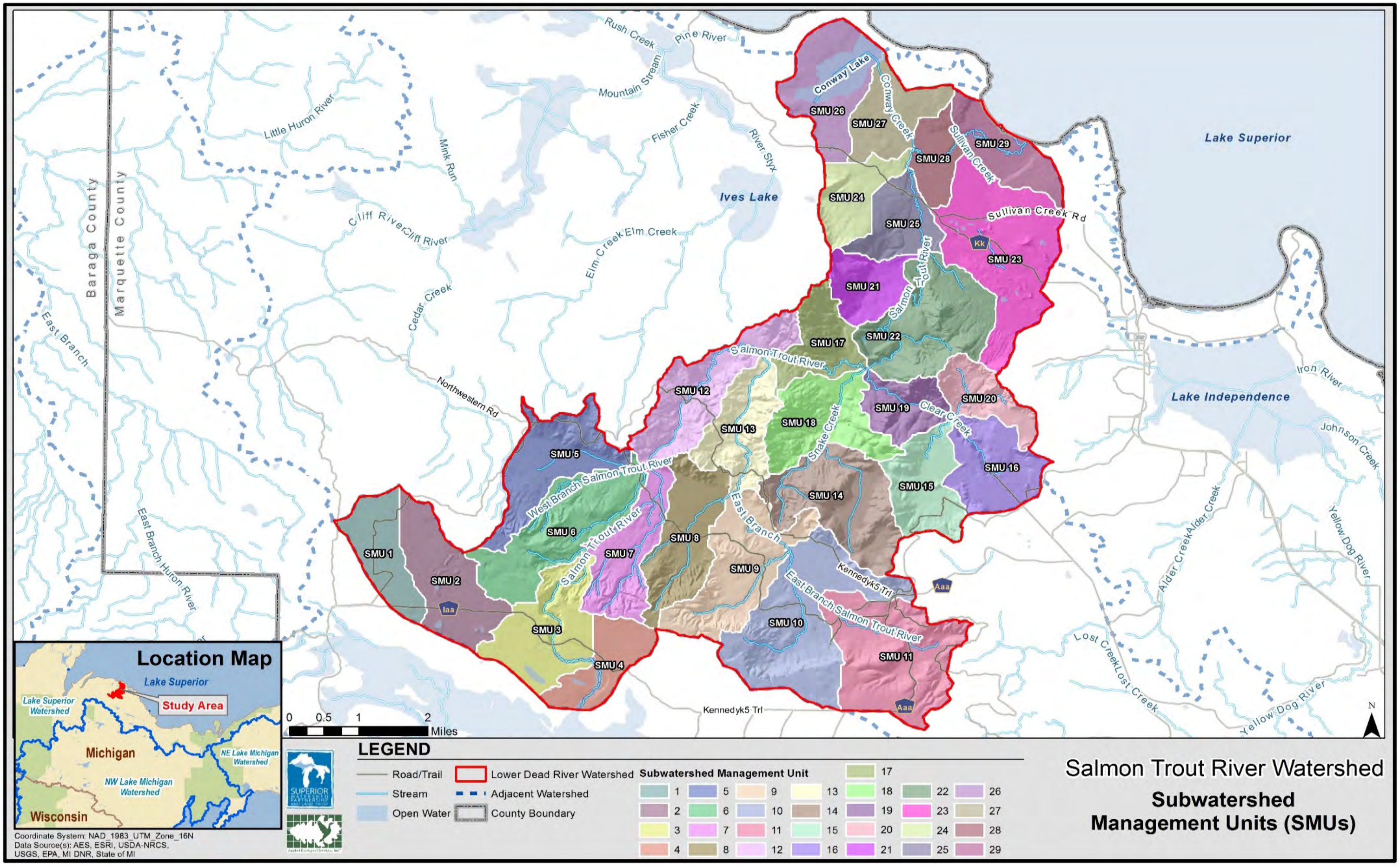


Figure 10- Subwatershed Management Units

3.4 Hydric Soils, Soil Erodibility, & Hydrologic Soil Groups

Soils

The U.S. Department of Agriculture Natural Resources Conservation Service Soil Survey Geographic (SSURGO) database for Marquette County, Michigan was used to identify soil types within the boundary of the Salmon Trout River watershed. This dataset was used to identify hydric soils, hydrologic soil groups, and soil erodibility.

Hydric Soils

Wetland or "Hydric Soils" generally form over poorly drained clay material associated with wet prairies, marshes, and other wetlands and from accumulated organic matter from decomposing surface vegetation. Hydric soils are important because they indicate the presence of existing wetlands or drained wetlands where restoration may be possible. There has not been significant wetland loss in the western Upper Peninsula primarily due to not many wetlands existing in the first place. This is largely due to the steep topography, especially around riparian systems, where water doesn't stand long enough to develop a significant organic layer.

Hydric soils comprise 2,258 acres or 7.1% of the watershed. Most of these soils are located on the relatively flat headwater areas around the regional tributaries and at the mouth of the Salmon Trout River at the northern end of the watershed. Early vegetation mapping suggests this area was bogs and mixed conifers. Much of this bog area exists to this day.

1,446 acres or 4.6% of the watershed is comprised of partially hydric soils which exhibit some, but not all, of the characteristics of hydric soils. These soils are concentrated in the floodplain areas throughout the watershed and in the lowland areas near the mouth of the river adjacent to hydric soils. These soils likely did not support true wetland communities.

Approximately 28,055 acres (88.3%) are not hydric, largely due to the steep topography and well-drained soils within the region.

Table 4- Acreage of Hydric, Partially Hydric, and Non-Hydric Soils

Soil	Total Area (acres)	Percentage of Watershed
Hydric Soil	2,258	7.1
Partially Hydric Soil	1,446	4.6
Non-Hydric Soil	28,055	88.3
Totals	**31,760**	**100.0**

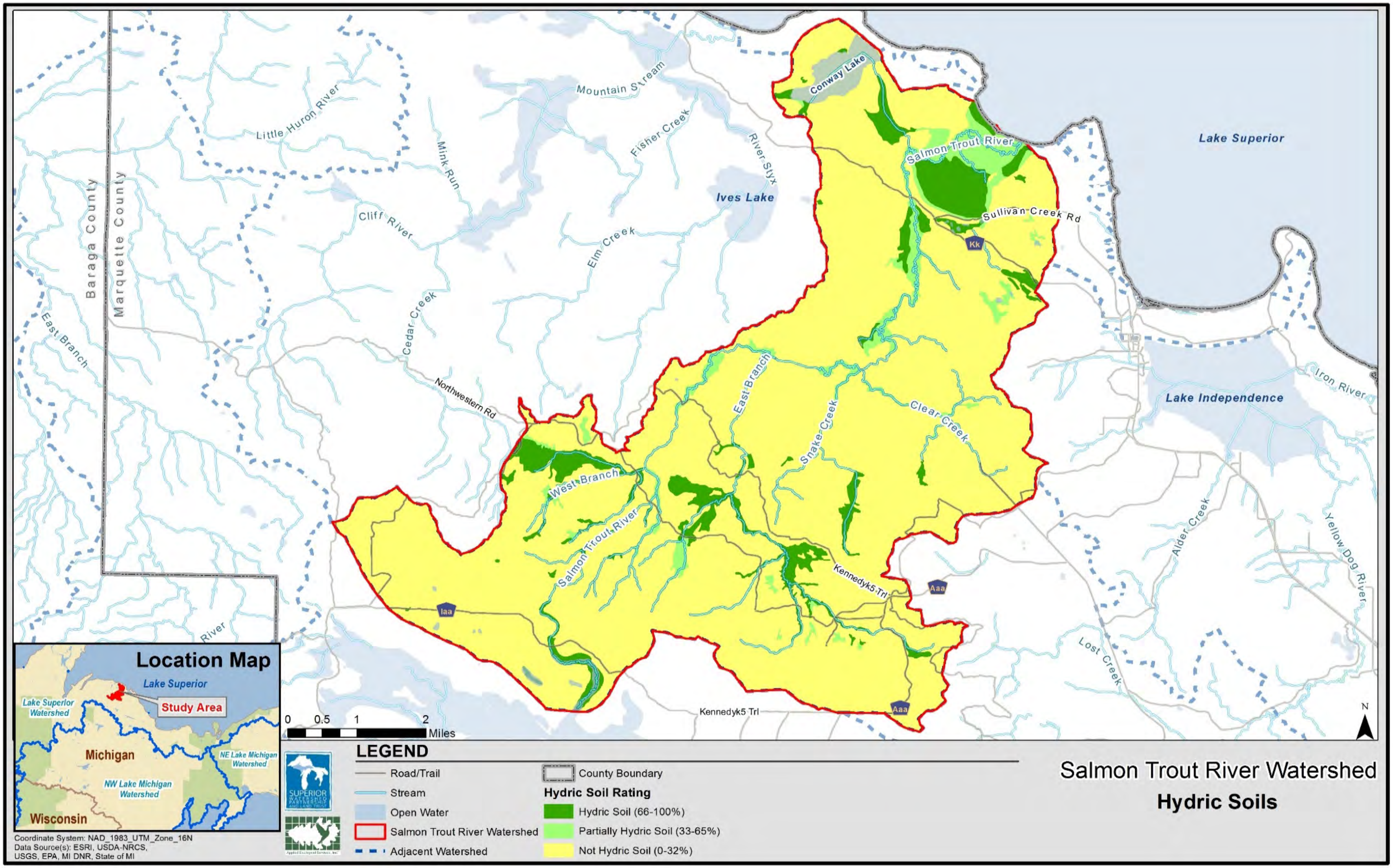


Figure 11- Hydric Soils

Soil Erodibility
Soil erosion is the process whereby soil is removed from its original location by flowing water, wave action, wind, and other factors. Sedimentation is the process that deposits eroded soils on other ground surfaces or in bodies of water such as streams and lakes. Soil erosion and sedimentation reduces water quality by increasing total suspended solids (TSS) in the water column and by carrying attached pollutants such as phosphorus, nitrogen, and hydrocarbons. When soils settle in streams and lakes, they often blanket rock, cobble, and sandy substrates needed by fish and aquatic macroinvertebrates for habitat, food, and reproduction.

A highly erodible soils map was created based on soil information provided by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) (Figure 11). Highly erodible soils have attributes that when located on slopes are susceptible to erosion. It is important to know the location of highly erodible soils because these areas have the highest potential to degrade water quality during timber harvesting, development, or flooding. Based on mapping, 13,181 acres or about 41.5% of the soils in the watershed are "Highly Erodible", 6,414 acres or 20.2% of soils are "Moderately Erodible", 11,807 (37.2%) acres are "Slightly Erodible", and the remaining 358 acres are not rated (Table 5).

Highly erodible areas are currently stabilized by existing land uses/cover. But land use, especially timber harvesting, can increase the risk of erosion, through the loss of land cover and exposure to increased truck traffic. These impacts on riparian systems can be mitigated as much as possible, by ensuring that best management practices prescribed through forestry management plans are followed (see section 3.13.1).

Table 5- Acreage of Severely Erodible, Moderately Erodible, and Slightly Erodible Soils

Soil Erodibility	Total Area (acres)	Percentage of Watershed
Severely Erodible	13,181	41.5
Moderately Erodible	6,414	20.2
Slightly Erodible	11,807	37.2
Not Rated	358	1.1
Totals	**31,760**	**100.0**

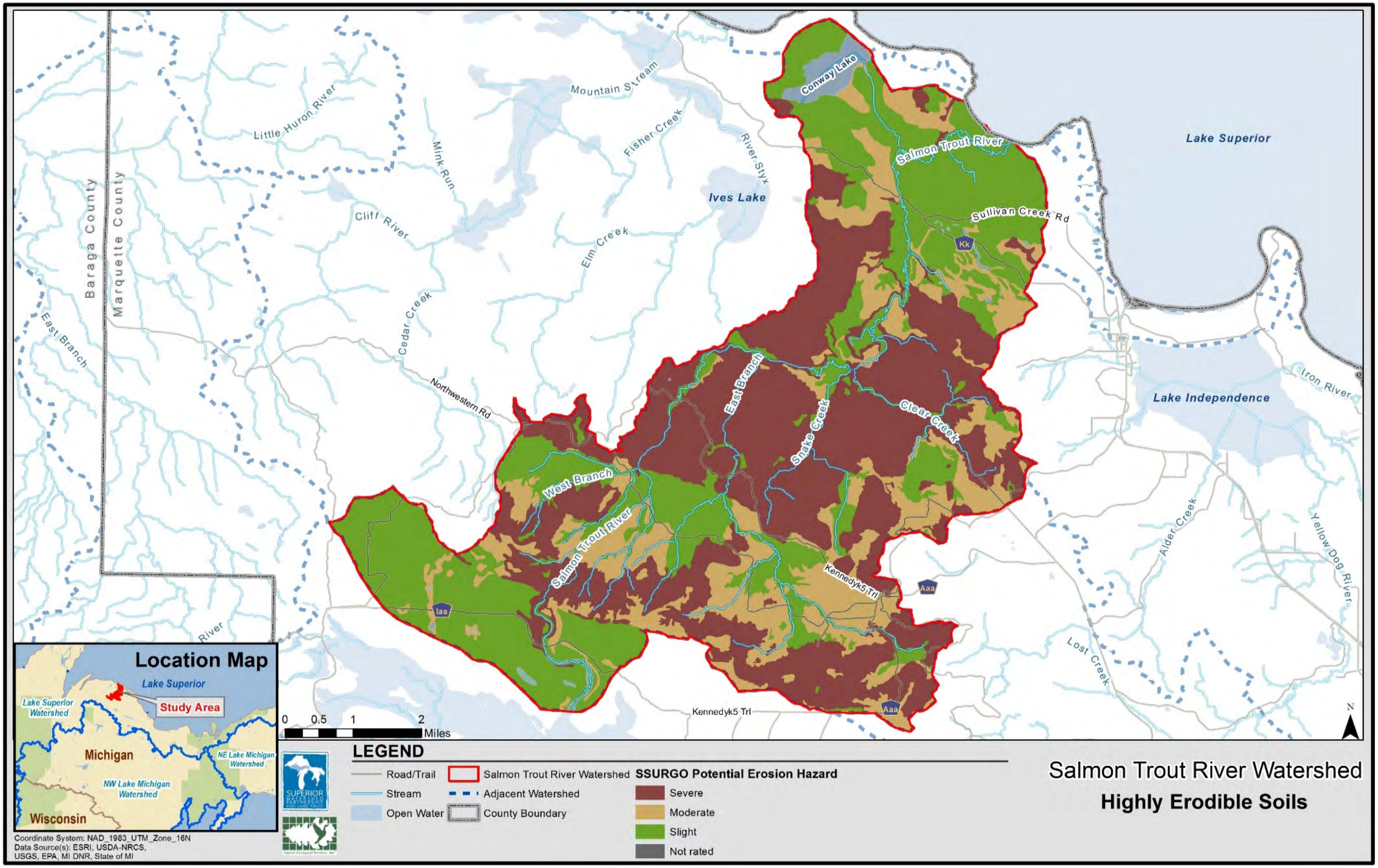


Figure 12- Highly Erodible Soils

Hydrologic Soil Groups

Soils also exhibit different infiltration capabilities and have been classified to fit what are known as "Hydrologic Soil Groups" (HSGs). HSGs are based on a soil's infiltration and transmission (permeability) rates and are used by engineers and planners to estimate stormwater runoff potential. Knowing how a soil will hold water ultimately affects the type and location of recommended infiltration management measures such as wetland restorations and detention basins. More importantly however is the link between hydrologic soil groups and groundwater recharge areas. Groundwater recharge is discussed in detail in Section 3.14.

HSG's are classified into four primary categories; A, B, C, and D, and three dual classes, A/D, B/D, and C/D. Figure 12 depicts the location of each HSG in the watershed. The HSG categories and their corresponding soil texture, drainage description, runoff potential, infiltration rate, and transmission rate are shown in Table 7 while Table 6 summarizes the acreage and percent of each HSG. Group A and A/D soils are dominant throughout the watershed at about 61% (19,286 ac) coverage and are found in most upland areas. Group B and B/D soils together make up another 4,169 acres or 13% of the watershed. Group C and C/D soils combine for 3,190 acres (10.1%). Group D soils comprise 4,758 acres or another 15% of the watershed, and generally line up with the location of hydric soils in the watershed.

Table 6- Hydrologic Soil Group Acreages

Hydrologic Soil Group	Area (acres)	Percent of Watershed
A	16,754	52.8
A/D	2,532	8.0
B	1,125	3.5
B/D	3,044	9.6
C	3,098	9.8
C/D	92	0.3
D	4,758	15.0
Unclassified	358	1.1
Totals	**31,760**	**100.0**

Table 7 - Description of Hydrologic Soil Groups

HSG	Soil Texture	Drainage Description	Runoff Potential	Infiltration Rate	Transmission Rate
A	Sand, Loamy Sand, or Sandy Loam	Well to Excessively Drained	Low	High	High
B	Silt Loam or Loam	Moderately Well to Well Drained	Moderate	Moderate	Moderate
C	Sandy Clay Loam	Somewhat Poorly Drained	High	Low	Low
D	Clay Loam, Silty Clay Loam, Sandy Clay Loam, Silty Clay, or Clay	Poorly Drained	High	Very Low	Very Low

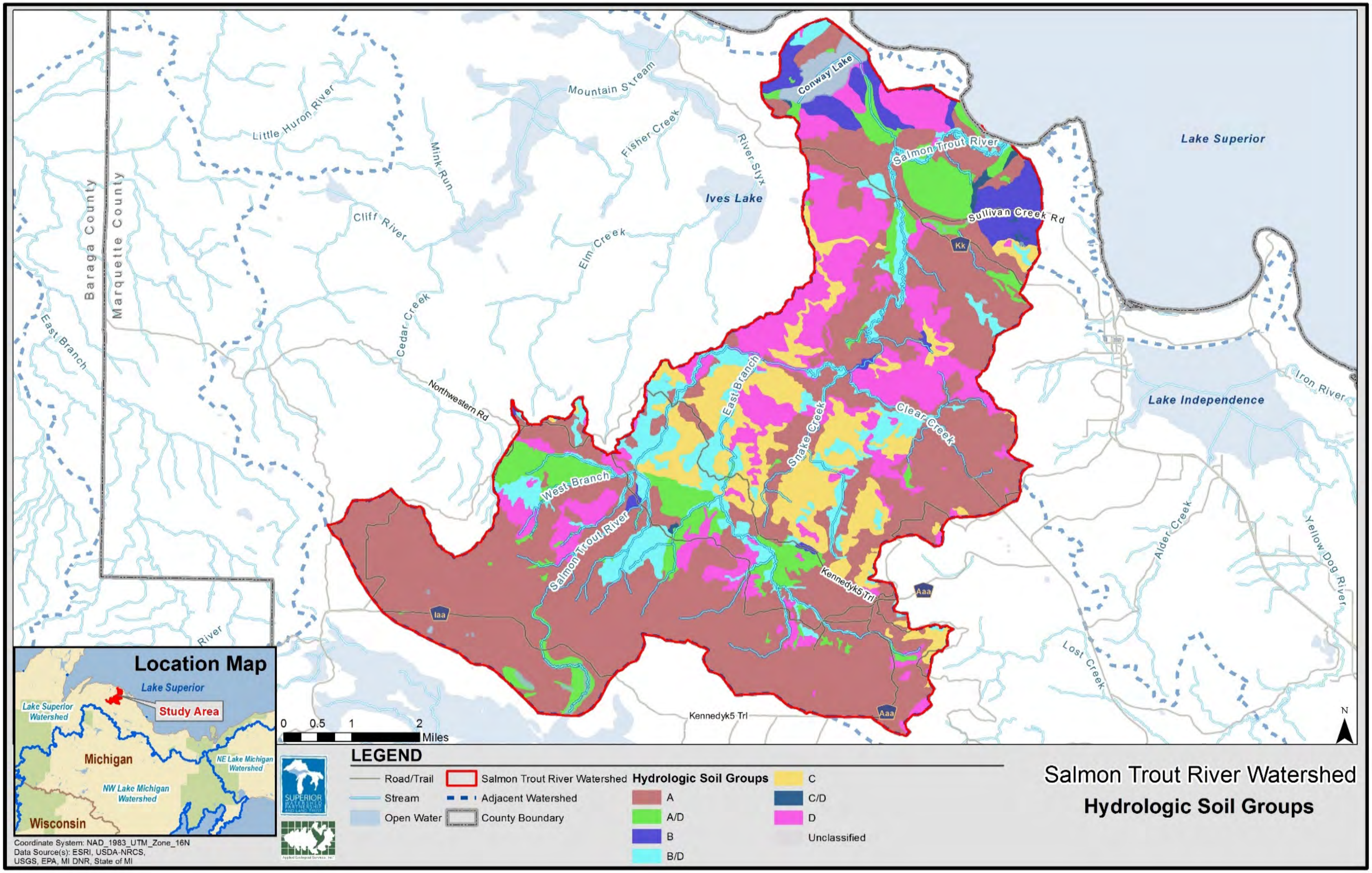


Figure 13- Hydrologic Soil Groups

3.5 Jurisdictions, Roles & Protections

The Salmon Trout River watershed is in Marquette County and spans three townships (Table 8, Figure 14). The largest municipality (by acreage) is Powell Township which makes up 22,668 acres (71.4%) of the area within the northern portion of the watershed boundaries. Michigamme Township (5,164 ac, 16.3%) and Champion Township (3,928 ac, 12.4%) make up the remaining acreage of the watershed. There are no large federally owned nature/forest preserves or parks in the watershed. Multiple parcels within Gwinn State Forest Area are within the boundaries of the watershed (1695.7 ac) as well as a portion of the Huron Mountain Club (3,614 ac.)

Table 8-County and municipal jurisdictions

Jurisdiction	Area (acres)	% of Watershed
County	**31,760**	**100**
Marquette	31,760	100
Townships	**31,760**	**100**
Champion Township	3,928	12.4%
Michigamme Township	5,164	16.3%
Powell Township	22,668	71.3%

Source: State of MI

Jurisdictional Roles and Protections

Water quality and land protection throughout the United States are protected to some degree under federal, state, and/or local law.

Water Quality Protection

At the federal level, the Clean Water Act (CWA) is the strongest tool in protecting water resources. Within the state of Michigan, the authority to administer the provisions of the CWA has been delegated to the Michigan Department of Environment, Great Lakes, and Energy (EGLE). Section 402 of the CWA establishes the National Pollution Discharge Elimination System (NPDES), while Section 319 Nonpoint Source Management Program was created in order to further support state and local nonpoint pollutant source efforts not addressed by NPDES permits. Section 319 permits states to receive grant money towards activities such as technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of nonpoint pollutant source implementation projects. Section 303 of the CWA requires states to catalogue impaired waters, prioritize them, and calculate Total Maximum Daily Loads (TMDLs) of pollutants a waterbody can receive and still safely meet the water quality standards.

The Safe Drinking Water Act also plays a role in protecting surface and groundwater resources. In Michigan, the Wellhead Protection Program includes both mandatory and voluntary initiatives aimed at protecting groundwater resources. As such, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) oversees protection of around 10,000 non-community and 1,400 community water supplies.

In 1985, the Michigan Legislature created the Office of the Great Lakes under the Great Lakes Protection Act, which is now part of the Michigan Department of Environment, Great Lakes and Energy (EGLE). The Office houses the Areas of Concern Program, Costal Management Program, and the Great Lakes Coordination Program with a mission of collaborating with groups locally and federally to protect and restore the Great Lakes. In 2016 Michigan released the Michigan Water Strategy, a 30-year vision for the protection, restoration, and sustainable management of Michigan's water resources (MDNR 2016).

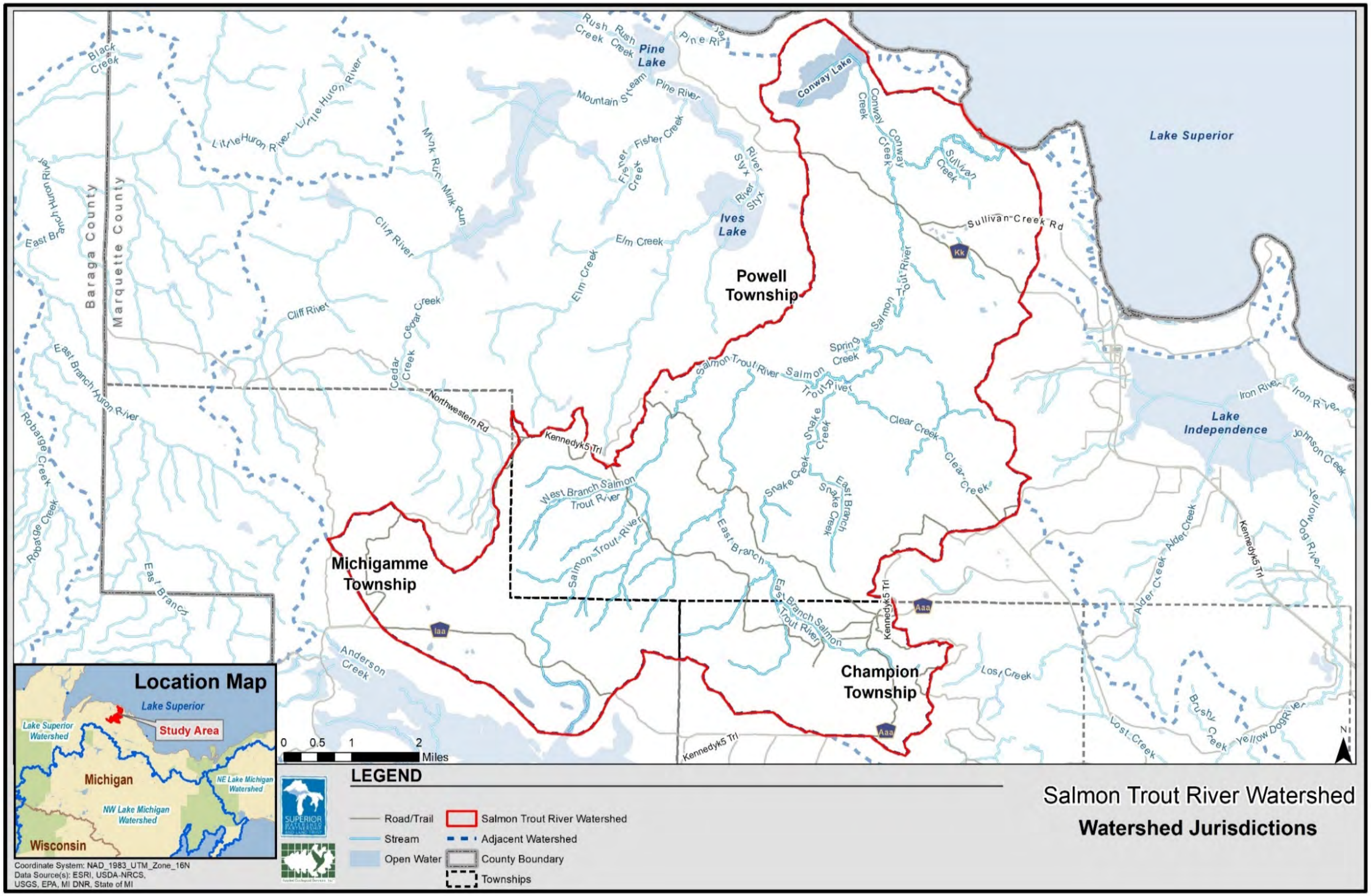


Figure 14- Watershed Jurisdictions

Additionally, Michigan is part of three interstate compact agreements that also have jurisdiction over Lake Michigan. The first is the Great Lakes Basin Compact which established the Great Lakes Commission and gave it the authority to research and make recommendations regarding water use and development in the Great Lakes. The Council of Great Lakes Governors established the Great Lake Protection Fund to finance projects used to protect and restore the Great Lakes. Finally, the Great Lakes Charter, signed by the Council of Great Lakes Governors, regulates water transfers out of the Great Lakes Drainage basin in excess of 100,000 gallons per day.

The Michigan Coastal Management Program was established under the Federal Coastal Zone Management Act in 1978. It serves to protect Michigan's coastline by supporting healthy and productive coastal ecosystems and sustainable coastal communities.

Land Protection

The U.S. Fish and Wildlife Service (USFWS) and MI DNR protect various dedicated natural areas and threatened and endangered species. Local conservation groups such as the Superior Watershed Partnership and Yellow Dog Watershed Preserve also serve in a similar capacity by working to protect and restore natural areas, along with many other watershed groups and land conservancies throughout the state.

The Clean Water Act (CWA) Section 404 requires permits for discharge of fill material into Waters of the United States. In 48 states, permits are issued solely by the U.S. Army Corps of Engineers (Corps). Through a Memorandum of Agreement (MOA) with the Environmental Protection Agency (EPA), Michigan (EGLE) is one of two states that have assumed the authority of the 404 permitting program. Land development affecting water resources (rivers, streams, lakes, wetlands, and floodplains) is jointly regulated by the USACE and EGLE when "Waters of the U.S." are involved. These types of waters include any wetland or stream/river that is hydrologically connected to navigable waters. EGLE and USACE primarily regulates filling activities and requires buffers or wetland mitigation for developments that impact jurisdictional wetlands. The Salmon Trout River watershed falls within USACE's Detroit District of the Great Lakes & Ohio River Division, and EGLE's Marquette District Office.

Land development in the watershed is regulated by ordinances created by planning commissions at the county and municipal level (including townships.) Only townships who choose not to develop their own planning commission and set of ordinances fall under the county's zoning ordinances. In addition, Marquette County has drainage ordinances giving the county Drain Commissioner jurisdiction over all established drains in the county, new drain construction, maintenance of existing drains, and establishment of water management districts.

Beyond county-level regulations, each municipality has their own applicable regulations. Municipalities in the watershed may or may not provide additional watershed protection above and beyond existing local municipal codes. Most municipal codes provide ordinances covering businesses regulations, building regulations, zoning regulations, new subdivision regulations, stormwater management, streets, utilities, landscaping/restoration, tree removal, etc.

Municipal codes and ordinances include:

- *Powell Township*: Land development is regulated under zoning codes. Dedicated ordinances include Environmental Protection Strips, Mineral Extraction, Timber Harvest, High Risk Erosion Overlay Zones, and Planned Unit Development including Open Space Requirements.

- *Michigamme Township*: Zoning within Michigamme Township is regulated by a planning commission and zoning ordinances including: Waterfront Setback, Mineral Extraction, Open Space Preservation, and Timber Production.

- *Champion Township*: Zoning within Champion Township is regulated by a planning commission and zoning ordinances including: Mineral Extraction, Waterfront Development, and Timber Production.

Other governments and private entities with watershed jurisdictional or technical advisory roles include the Federal Emergency Management Agency (FEMA), the USDA's Natural Resources Conservation Service (NRCS), and Central Upper Peninsula Planning and Development Regional Commission (CUPPAD). County Boards are also important because they oversee decisions made by respective county governments and therefore have the power to override or alter policies and regulations.

Noteworthy- Stormwater Management Ordinances and Programs

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) oversees the implementation of the Municipal Separate Storm Sewer System (MS4) for urbanized areas in the state; defined by the US Census Bureau as consisting of 50,000 people or more. The NPDES program was initiated under the federal Clean Water Act to reduce pollutants to the nation's waters. This program requires permits for discharge of: 1) treated municipal effluent; 2) treated industrial effluent; and 3) stormwater from MS4's and construction sites.

As none of the municipalities within the Salmon Trout River watershed fall under the definition of "Urbanized Areas", they are not subject to the purview of the National Pollutant Discharge Elimination System (NPDES) requirements of being permitted under the MS4 program. As such, it is essential that local bodies, both public and private, cooperate to manage stormwater in such a way that protects the local populace from the effects of excess water volume and pollution.

Drainage regulations, such as those established by Marquette County, do a good job of laying the groundwork for stormwater management in rural areas. By identifying typical sources of flood risk and pollutant sources and seeking to mitigate these, regulations such as these balance development with natural resource protection. These regulations provide guidelines on the specifications for sewer drainage systems, construction stormwater management, and sizing of detention/retention facilities. Similar ordinances are established for the City of Marquette, the largest municipality in the region.

While these ordinances are useful for regulation in stormwater management, developing a long-term stormwater management program can provide an opportunity for local communities to reevaluate how best to make use of their water resources. This process is comprised of the following concepts:

1.) By adopting a long-term approach to planning, communities can provide for plan implementation that allows for the integration of selected projects within other community development plans such as capital improvement plans and master plans.
2.) Managing stormwater close to where precipitation falls, such as with retention or a similar hydrologically focused approach, has been shown to be an effective stormwater control method.
3.) Innovative technologies, including green infrastructure, are important tools that can generate many benefits ranging from improved air and water quality to cost savings to more community amenities. They also may be fundamental aspects of communities' plans for integrated solutions.
4.) The voluntary approach to long-term planning can be a useful part of the larger effort to comply with any Clean Water Act (CWA) requirements (e.g., over multiple permit cycles). For example, a regulated municipal separate storm sewer system (MS4) that has developed an initial plan may work with EPA and/or the state to consider how the plan can help satisfy the requirements of their permits.

USEPA, October 2016

Planning, Policy and Regulation

Planning, policy, and regulation are the foundation of watershed protection, because the process sets the minimum standards for development that occurs or is proposed to occur in the vicinity of water resources. It is hoped that recommendations from this watershed plan would be referenced in future comprehensive plans and implemented in ordinances. In many cases, municipal codes also lay the foundation for the types of trees that can be removed from sites as well as what types of plant communities and species that can be replanted. County stormwater ordinances are the primary preventative measure that can be used to standardize for the respective county the requirements that proposed developments must meet. Monitoring and enforcement of implemented municipal codes and county regulations falls in the hands of local municipalities or County agencies. It is up to these enforcing bodies to communicate effectively and discuss often the problems with how ordinance language is interpreted and amendments that may help clarify certain regulations.

Planning/zoning guidance provides another level of watershed and natural resource protection. Most planning and zoning guidance is in the form of local floodplain or zoning ordinances that regulate onsite land use practices to ensure adequate floodplain, wetland, stream, lake, pond, conservancy soil, and other natural resource protection. Zoning ordinances and overlay districts in particular define what type of development is allowed and where it can be located relative to natural resources. Other examples of planning/zoning forms of resource protection include riparian and wetland buffers, impervious area reduction, open space/greenway dedication, conservation easements and conservation and/or low-density development. For example, Powell, Michigamme and Champion Township Codes of Ordinances require the establishment of some form of environmental protection strip to protect water quality from the effects of development and erosion.

To improve the impact of planning/zoning guidance on water resource protection, there needs to be improved coordination and communication between county and local government. Watershed development regulations should be made very clear to local enforcement officers; local planners and zoning boards should consider revisions to local ordinances that address watershed, subwatershed, and/or site-specific natural resource issues. For example, communities with less impervious development now should revise their zoning ordinances sooner rather than later in order to adequately prevent the types of development that contribute to flooding, degrade wildlife habitat, and reduce water quality.

3.6 Existing Policies and Ordinance Review

Protection of natural resources during future growth is important for the future health of a watershed. To assess how future growth might further impact the watershed, an assessment of local municipal ordinances is recommended to determine how development is regulated in each municipality. In this way, potential improvements to local ordinances can be identified. As a future measure, it is recommended that municipal governments compare their local ordinances against model policies outlined by the Center for Watershed Protection (CWP)in a publication entitled "*Better Site Design: A Handbook for Changing Development Rules in Your Community*" (CWP 1998).

This assessment process begins by reviewing local municipal ordinances such as those for Powell Township, Michigamme Township, and Champion Township.

CWP's recommended ordinance review process involves assessments of three general categories including "Residential Streets & Parking Lots", "Lot Development" and "Conservation of Natural Areas". Various questions with point totals are examined under each category. The maximum score is 100. CWP also provides general rules based on scores. Scores between 60 and 80 suggest that it may be advisable to reform local development ordinances. Scores less than 60 generally mean that local ordinances are not environmentally friendly and serious reform may be needed. This assessment is meant to be a tool to local communities to help guide development of future ordinances.

Fortunately, the townships within the watershed are making good steps in preventing damage to natural resources by implementing zoning ordinances like environmental protection buffers, high risk erosion overlay Zones, and open space requirements. However, it is highly recommended that CWP review process be implemented to identify areas for improvement.

3.7 Demographics

Among other planning reports, the Central Upper Peninsula Planning and Development Regional Commission (CUPPAD) provides Upward 2025, an economic development strategy for Alger, Delta, Dickinson, Marquette, Menominee, and Schoolcraft Counties. The Regional Prosperity Initiative was developed by the State of Michigan and was implemented in 2014 for the areas within CUPPAD region. This was produced with the mission of encouraging regional collaboration in the application of public funds with the objective of cleaning up disparate service areas, reducing overlapping responsibilities, and enhancing public-private cooperation (CUPPAD, 2015).

In an area where populations are sparsely concentrated the presence of a regional planning body provides a window into demographic trends. Though the RPI 2025 plan does not provide projections for future changes in population, housing, and employment, it provides records of demographic trends in the region for the past century. Data from CUPPAD as well as 2017 American Community Survey data was used to assemble estimated total population, estimated total employed population, and estimated total housing units. This data is highly useful for predicting trends in where land use changes will be focused.

Table 9 includes 2017 American community survey results for estimated total population (Figure 15), estimated total employed population (Figure 16), and estimated total housing units (Figure 17). The data is generated by census block group, which is the most precise data available for the area. Block groups which are contacting the watershed boundary are included within the watershed boundary. As there is no reliable way to divide the block group into portions that are solely within the watershed, these estimates tend to overestimate the populations actually occurring within the watershed bounds.

On the regional level, CUPPAD's RPI 2025 plan data shows that since peaking in 1980 the Central Upper Peninsula region has seen a decline in overall population, with Marquette county experiencing modest growth of 0%-4.9% between 2000 and 2010.

For comparison, the Upper Peninsula as a whole has seen a similar trend with diminishing populations since 1980, while the general population of Michigan has largely continued to trend upward. By applying this trend to the watershed region, we can assume the Salmon Trout River Watershed area will experience population change in the range from stagnation to modest growth. As seen in Table 9 and Figure 15, the watershed population is around 425 people and at the smallest scale census block there is no distinct concentration in one area.

The housing units in the watershed area are also not clearly concentrated in any one area, with the estimated total housing units in 2017 being 1,003. Noting that the number of housing units exceeds the population in the watershed, it is hard to distinguish between houses with permanent residents, and housing units which are primarily camps. The general demographic trend in the region indicates that there will not be an increase in housing development in the coming years.

The total labor force in the Central Upper Peninsula has decreased in the past ten years as well, with the unemployment rate remaining relatively steady. This is an indication of the decrease in overall residents in the region and indicates that there won't be much industrial/commercial expansion within the watershed region in the upcoming years. The employed population in 2017 is estimated at 208 people spread throughout the watershed.

Table 9- Demographics

Data Category	
Estimated Total Population 2017	425
Estimated Total Employed Population 2017	208
Estimated Total Housing Units 2017	1,003

Source: American Community Survey 2017

Socioeconomic Status

Due to the sparse population within the watershed, it is difficult to classify socioeconomic status. The CUPPAD Upward 2025 economic development report and community profiles developed by Marquette County do provide some insight. The region within the Salmon Trout River Watershed has largely remained un-developed. Nearby townships offer amenities such as parks, shopping, conservation areas, libraries, and are in somewhat close proximity to interstate highway access.

Populations are largely moving away from the townships however, and populations in Michigamme and Powell townships peaked around the turn of the 20th century, and median ages in the area are 60.8 and 52.5 respectively. Marquette County is comprised of a mostly white population (>93%). The median household income in 2013 is about $45,622 which is about a 5.1% decrease from what it was in 2000. In Marquette County 2014, nearly 15.4% of the population is below poverty level, though that is roughly the same as the U.S. as a whole (CUPPAD 2015).

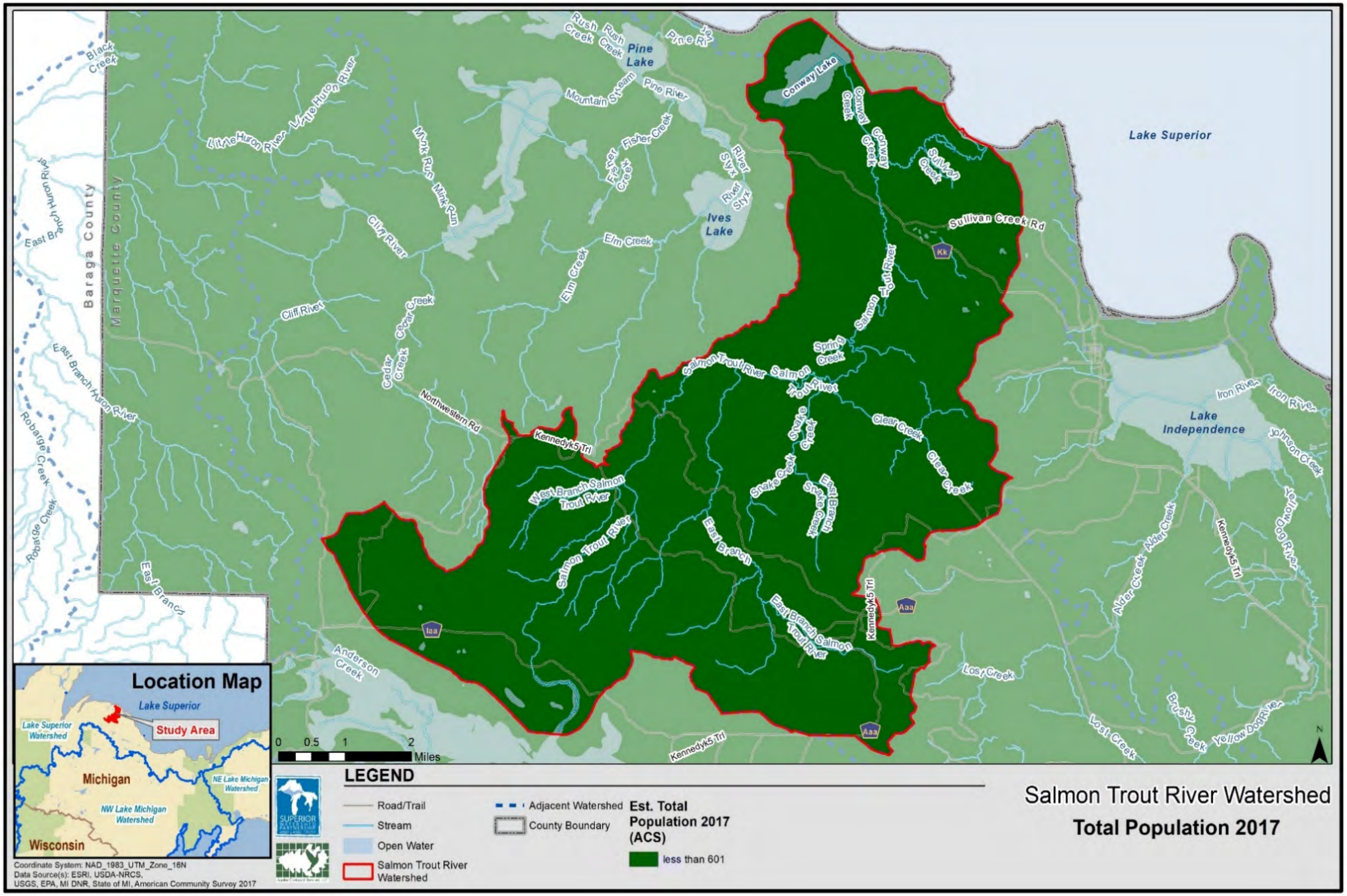


Figure 15 Total Population

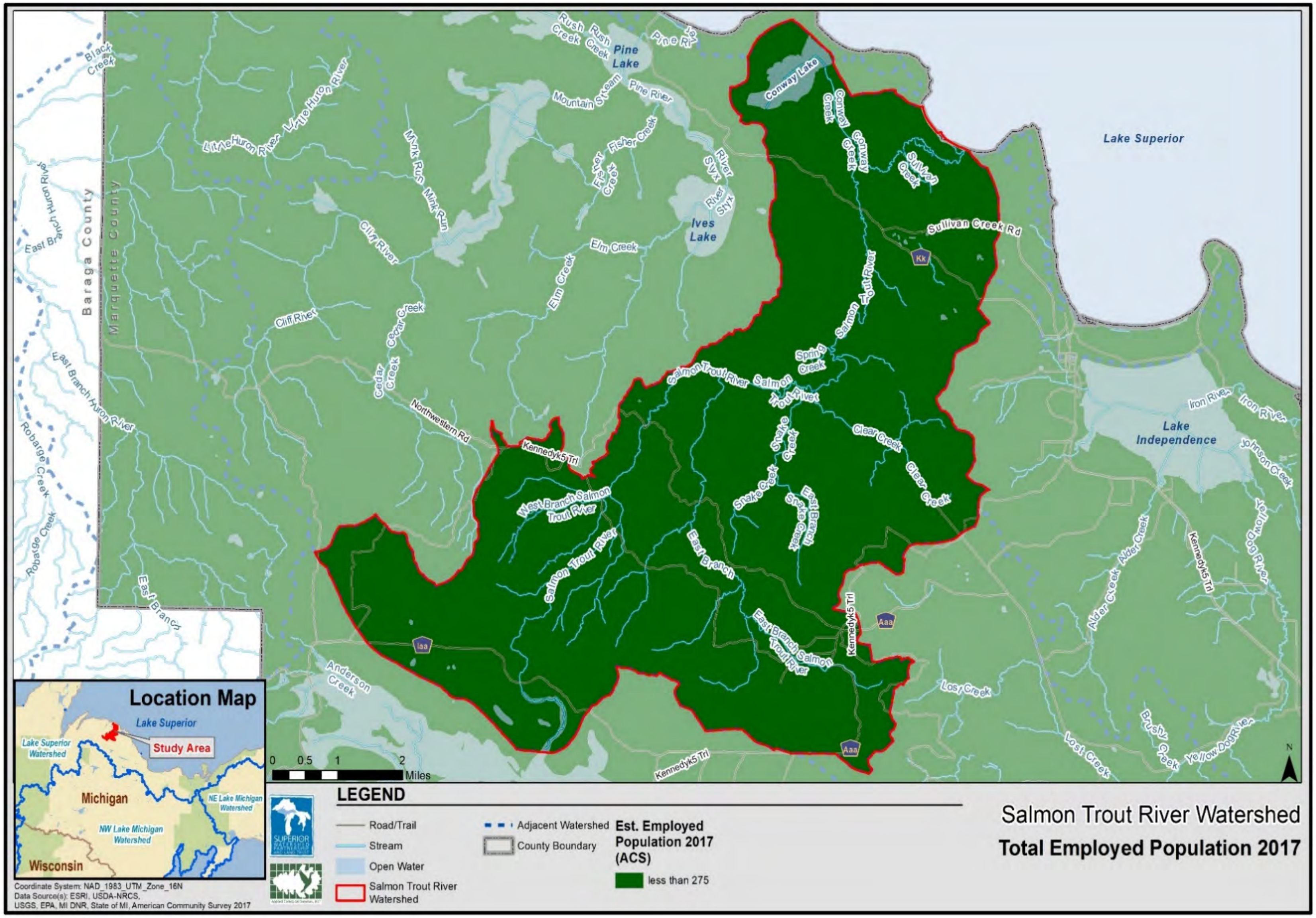


Figure 16 Total Employed Population

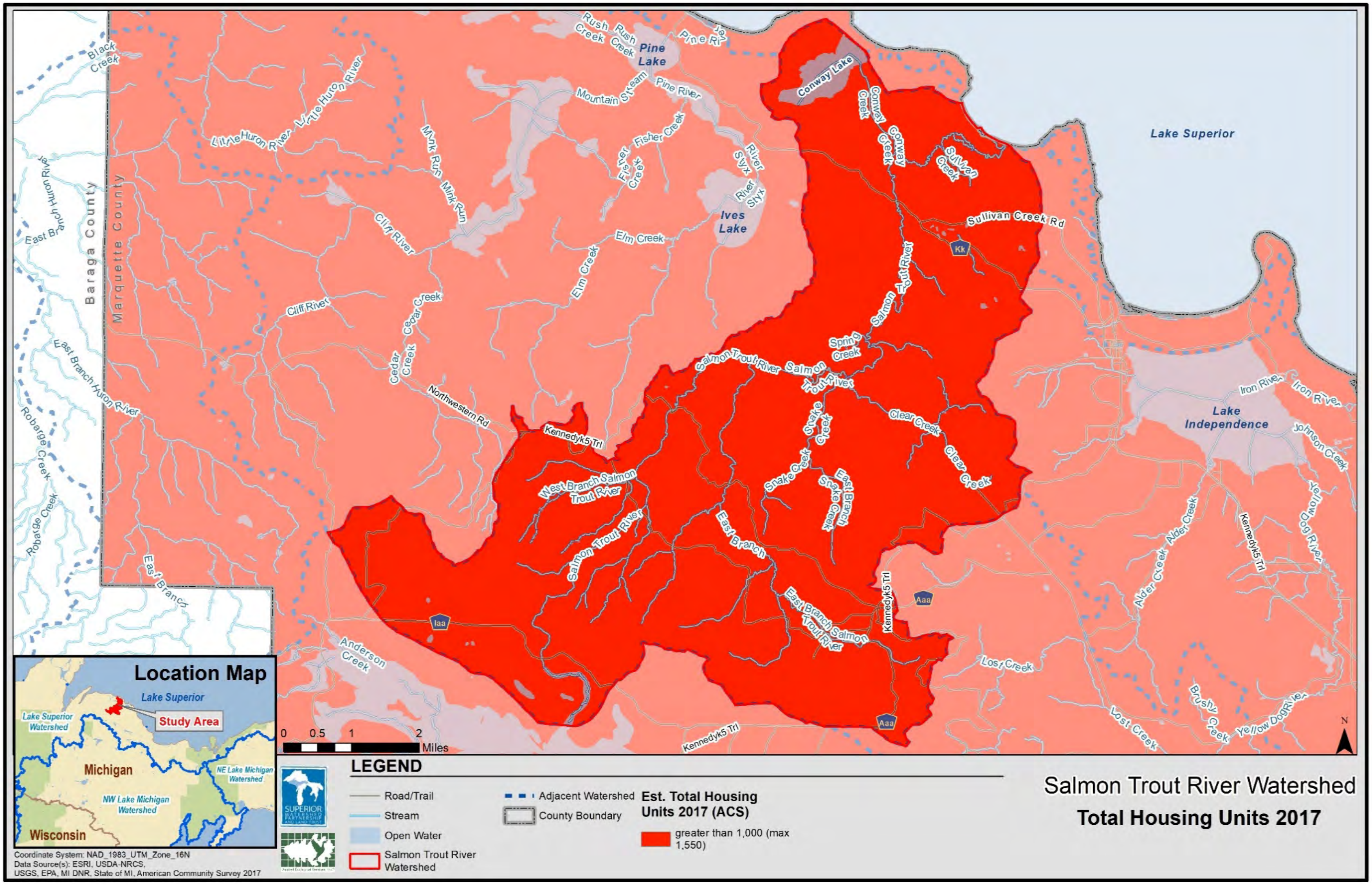


Figure 17 Total Housing Units

3.8 Transportation Network

Roads

Transportation is limited within the Salmon-Trout River watershed. It largely consists of a few seasonal back roads as well as secondary "two-track" roads; these provide access to otherwise remote areas. The Northwestern Road serves as the main artery to access the upper watershed landmass for logging, recreation, and private camps. With the exception of a portion of County Road KK leading to the Huron Mountain Club, all are gravel roads subject to erosion. Most are heavily traveled by logging trucks.

Railroads

There are no railways within the Salmon Trout River watershed.

Airports

There are no air fields, public or private, within the boundaries of the watershed.

Harbors

There are no harbors within the boundaries within the Salmon Trout River watershed.

Trails/Bike Paths

With beautiful natural scenery of forests and exciting topography, the Upper Peninsula is an area many consider a destination for exploration. With much of the area being privately held, there are few established trails which access the region. Cyclists can travel on established public roads, but there are no separate trails on or off road within the watershed. The same applies to hiking trails. People travel from all over to explore the Upper Peninsula via snowmobile. The Big Bay/550 Snowmobile Club trail covers 114 miles in the region. It heads due west from Big Bay and crosses the Salmon Trout River watershed with around 15 miles in the watershed itself.

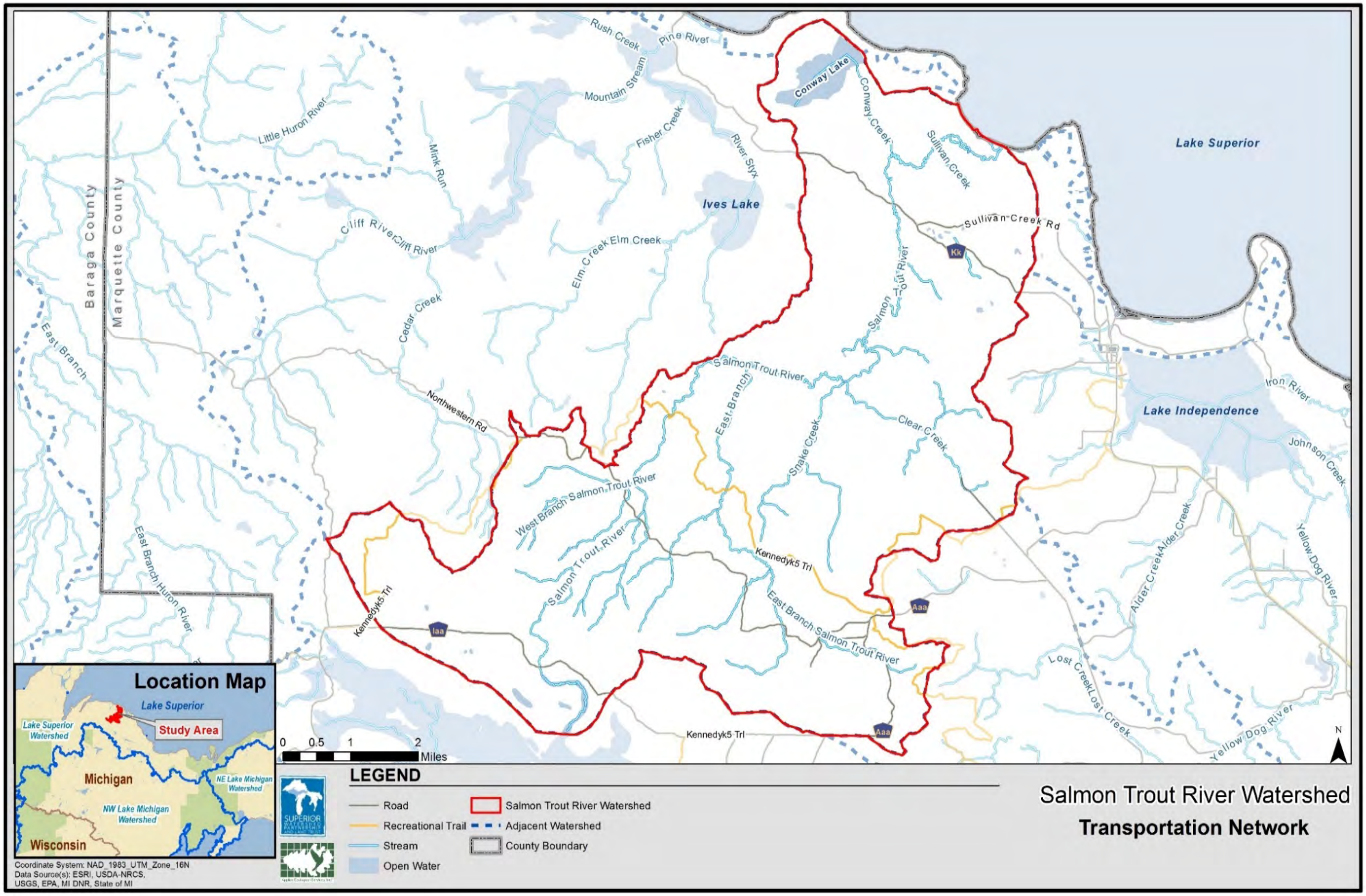


Figure 18- Transportation Network

3.9 Existing Land Use/Land Cover

2015 Land Use/Land Cover

Land use/land cover data was produced for Salmon Trout River watershed using a combination of sources. Marquette County zoning data, compiled from a number of local governments including various township zoning designations, served as the base layer and was then overlaid with 2015 land cover mapping to fill in gaps where data was missing. The 2015 land use/land cover data and map for Salmon Trout River watershed is included in Table 10 and depicted on Figure 19.

Table 10- 2015 Land use/Land cover classifications and acreage.

Land Use	Area (acres)	% of Watershed
Agricultural Production	48	0.2%
Conservation & Recreation	1,652	5.2%
Forested	16,118	50.8%
Residential	2,506	7.9%
Resource Production	169	0.5%
Timber Production	11,202	35.3%
Transportation	65	0.2%
Total	**31,760**	**100.0%**

Forested areas are the most abundant land use in the watershed and comprise 16,118 acres or 50.8% of the watershed. The forested lands are generally concentrated in the central portions of the watershed.

The Timber Production land use is the second largest land use within the watershed, covering 11,202 acres or 35.3% of the land base within the watershed. This is land designated as being part of an active forestry plan.

Residential land uses make up 7.9% of the watershed or 2, 506 acres and include various, predominantly low-density residential areas.

Conservation and Recreation areas comprise approximately another 5.2% or 1,652 acres of the watershed and the remaining acres are divided among the various remaining land use categories, such as agricultural production, resource production, and transportation.

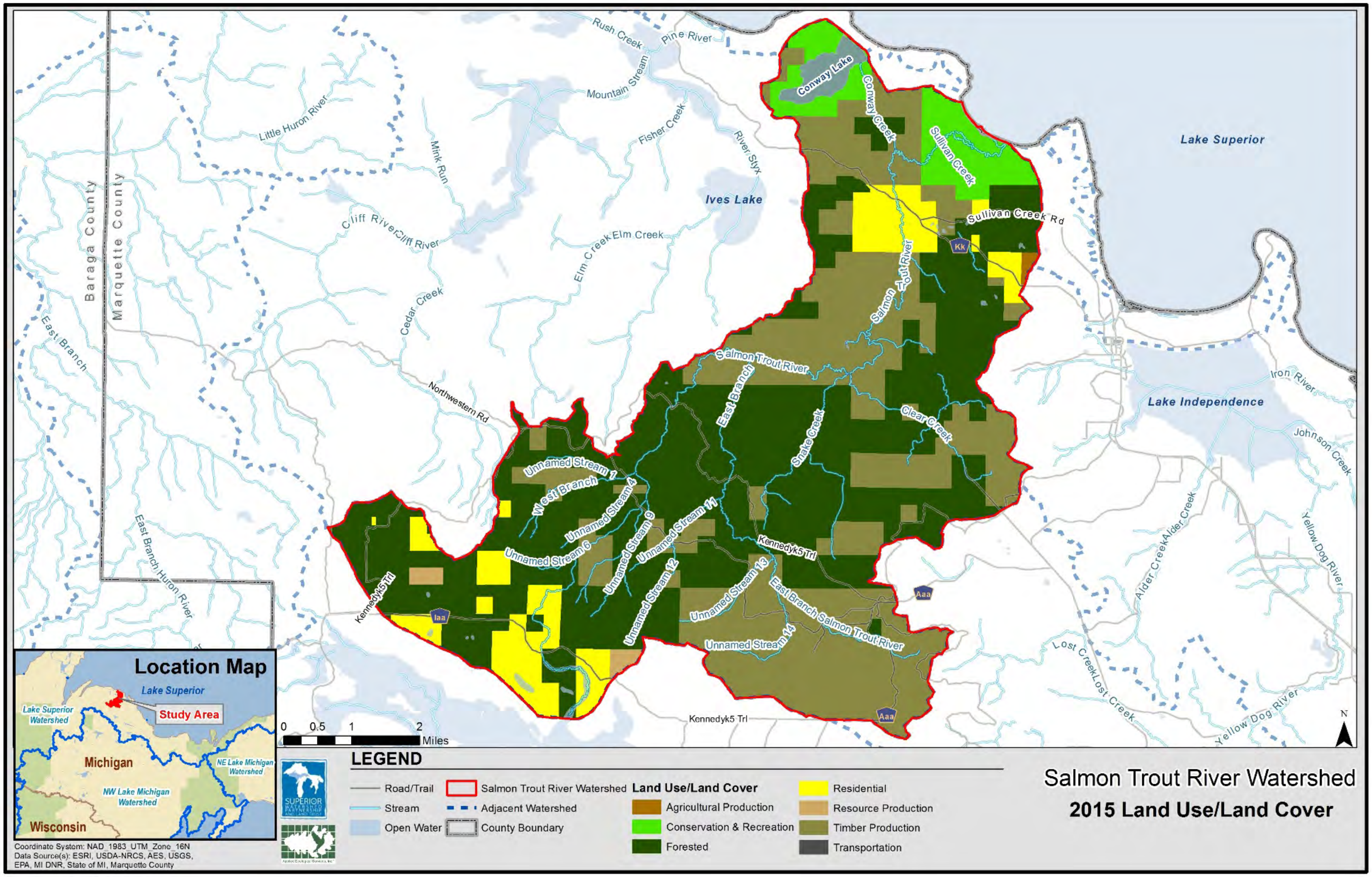


Figure 19- 2015 Land Use Land Cover

Noteworthy-Land Use/Land Cover Definitions:

Agricultural Production: Agricultural production district is intended to preserve for productivity and protect from other incompatible uses the lands which have suitable soil characteristics for the growing of crops and animals beneficial to humans and to allow forestry and mineral extraction where such resources exist and their removal will not interfere with the overall operation and productivity of adjoining agricultural land uses.

Conservation & Recreational: Established and maintained for recreational uses. The District is designed for areas with frontage on inland lakes and rivers, which because of their natural characteristics, accessibility, and high cost of providing public services, are suited for less intensive development than the Lake-Shore and River District and intended for recreational or seasonal development. Governmental services may not be provided on a year-round basis or may not be provided at all.

Forested: Land cover generally consisting of remnant or second growth forest.

Residential: A residential area is a land used in which housing predominates, as opposed to industrial and commercial areas, and includes single-family housing of varying density. Zoning for residential use may permit some services or work opportunities or may totally exclude business and industry.

Resource Production: This District is intended to provide for a variety of different uses which are resource based. The minimum performance standards are intended to provide flexible utilization of the Township's natural resources while preventing nuisance situations from arising. It provides for the conservation of minerals from wasteful use, and assures reclamation and restoration of a mining site after mining is phased out.

Timber Production: Timber Production, district is established to preserve and maintain for timber production purposes those lands which because of their soil, drainage, large tract ownership, potential mineral content, and other characteristics, are especially suited for timber productions and mining.

Transportation: Land use that includes railroads and associated stations, rail yards, linear transportation such as streets and highways, and airport transportation.

Future Land Use/Land Cover Predictions

Future land use predictions were not available for this watershed planning process, but population trends based on the Central Upper Peninsula Planning and Development (CUPPAD) Regional Commission's *Upward 2025: A Framework For Prosperity* (CUPPAD, 2016) show that the Central Upper Peninsula has been consistently losing population since the 1980's. This suggests, that it is unlikely that the land use/land cover of the Salmon Trout River watershed will change much in the immediate future, as their existing infrastructure can already support larger populations. Therefore, further examinations of future land use changes are unnecessary for this planning process.

3.10 Impervious Cover Impacts

Impervious cover is defined as surfaces of an urban landscape that prevent infiltration of precipitation (Scheuler 1994). Imperviousness is an indicator used to measure the impacts of urban land uses on water quality, hydrology and flows, flooding/depressional storage, and habitat related to streams (Figure 20). Based on studies and other background data, Scheuler (1994) and the Center for Watershed Protection (CWP) developed an Impervious Cover Model used to classify streams within subwatersheds into three quality categories: Sensitive, Impacted, and Non-Supporting (Table 11). In general, Sensitive subwatersheds have less than 10% impervious cover, stable stream channels, good habitat, good water quality, and diverse biological communities. Impacted subwatersheds have between 10% and 25% impervious cover, somewhat degraded streams, altered habitat, and decreasing water quality. Non-Supporting subwatersheds generally have greater than 25% impervious cover, highly degraded streams, degraded habitat, poor water quality, and poor-quality biological communities. In addition, runoff over impervious surfaces collects pollutants and warms the water before it enters a stream resulting in negative biological impacts.

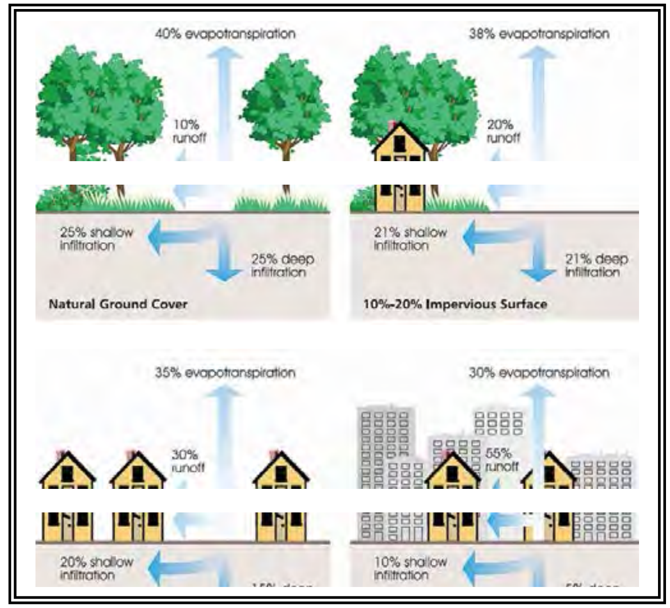


Figure 20- Relationship between impervious surfaces, evapotransporation, & infiltration. Source: The Federal Interagency Stream Restoration Working Group, 1998 (Rev. 2001).

The following paragraphs describe the implications of increasing impervious cover:

Water Quality Impacts

Imperviousness affects water quality in streams and lakes by increasing pollutant loads and water temperature. Impervious surfaces accumulate pollutants from the atmosphere, vehicles, roof surfaces, lawns and other diverse sources. During a storm event, pollutants such as nutrients (nitrogen and phosphorus), metals, oil/grease, and bacteria (*E. coli*) are delivered to streams and lakes. According to monitoring and modeling studies, increased imperviousness is directly related to increased urban pollutant loads (Schueler 1994). Furthermore, impervious surfaces can increase stormwater runoff temperature as much as 12 degrees compared to vegetated areas (Galli, 1990).

Water temperatures exceeding 90°F (32.2°C) can be lethal to aquatic fauna and can generally occur during hot summer months.

Hydrology and Flow Impacts

Higher impervious cover translates to greater runoff volumes thereby changing hydrology and flows in streams. If unmitigated, high runoff volumes can result in higher floodplain elevations (Schueler 1994). In fact, studies have shown that even relatively low percentages of imperviousness (5% to 10%) can cause peak discharge rates to increase by a factor of 5 to 10, even for small storm events. Impervious areas come in two forms: 1)

Category	% Impervious	Stream Condition within Subwatershed
Sensitive	<10%	Stable stream channels, excellent habitat, good water quality, and diverse biological communities
Impacted	>10% but <25%	Somewhat degraded stream channels, altered habitat, decreasing water quality, and fair-quality biological communities.
Non-Supporting	>25%	Highly degraded stream channels, degraded habitat, poor water quality, and poor-quality biological communities.

Table 11- Impervious category & corresponding stream condition via the Impervious Cover Model. Source: (Zielinski 2002).

disconnected and 2) directly connected. Disconnected impervious areas are represented primarily by rooftops, so long as the rooftop runoff does not get funneled to impervious driveways or a stormsewer system. Significant portions of runoff from disconnected surfaces usually infiltrate into soils more readily than directly connected impervious areas such as parking lots that typically end up as stormwater runoff directed to a stormsewer system that discharges directly to a waterbody.

Flooding and Depressional Storage Impacts

Flooding is an obvious consequence of increased flows resulting from increased impervious cover. As stated above, increased impervious cover leads to higher water levels, greater runoff volumes, and high floodplain elevations. Higher floodplain elevations usually result in more flood problem areas. Furthermore, as development increases, wetlands and other open space decrease. A loss of these areas results in increased flows because wetlands and open space typically soak up rainfall and release it slowly via groundwater discharge to streams and lakes. Detention basins can and do minimize flooding in highly impervious areas by regulating the discharge rate of stormwater runoff, but detention basins do not reduce the overall increase in runoff volume.

Habitat Impacts

A threshold in habitat quality exists at approximately 10% to 15% imperviousness (Booth and Reinelt 1993). When a stream receives more severe and frequent runoff volumes compared to historical conditions, channel dimensions often respond through the process of erosion by widening, downcutting, or both, thereby enlarging the channel to handle the increased flow. Channel instability leads to a cycle of streambank erosion and sedimentation resulting in physical habitat degradation (Schueler 1994). Streambank erosion is one of the leading causes of sediment suspension and deposition in streams leading to turbid conditions that may result in undesirable changes to aquatic life (Waters 1995). Sediment deposition alters habitat for aquatic plants and animals by filling interstitial spaces in substrates important to benthic macroinvertebrates and some fish species. Physical habitat degradation also occurs when high and frequent flows result in loss of riffle-pool complexes.

Impervious Cover Estimate, Erosion Hazard, & Vulnerability

In 1998, the Center for Watershed Protection (CWP) published the Rapid Watershed Planning Handbook. This document introduced rapid assessment methodologies for watershed planning. The CWP released the Watershed Vulnerability Analysis as a refinement of the techniques used in the Rapid Watershed Planning Handbook (Zielinski 2002). The vulnerability analysis focuses on existing and predicted impervious cover as the driving forces impacting potential stream quality within a watershed. It incorporates the Impervious Cover Model described at the beginning of this subsection to classify Subwatershed Management Units (SMUs). SMUs are defined and examined in more detail in Section 3.3.

AES used a modified Vulnerability Analysis to compare each SMU's vulnerability to land use or development changes across Salmon Trout River watershed. Three steps were used to generate a vulnerability ranking of each SMU. The results were used to make and rank recommendations in the Action Plan related to curbing the negative effects of predicted land use changes on the watershed. The three steps are listed below and described in detail on the following pages:

Step 1: Existing impervious cover classification of SMUs based on 2015 land use/land cover

Step 2: Soil Erosion Hazard score of SMUs based on NRCS soils data

Step 3: Vulnerability Ranking of SMUs based on current impervious cover and soil erosion hazard vulnerability factor

Step 1: Existing Impervious Cover Classification

Step 1 in the Vulnerability Analysis is an existing classification of each SMU based on 2015 land use/land cover and measured impervious cover. 2015 impervious cover was calculated by assigning an impervious cover percentage for each land use/land cover category based upon the United States Department of Agriculture's (USDA) Technical Release 55 (TR55) (USDA 1986). Highly developed land such as the general business district for example is estimated to have over 70% impervious cover while a typical medium density residential development exhibits around 25% impervious cover. Open space areas generally have less than 5% impervious cover. GIS analysis was used to estimate the percent impervious cover for each SMU in the watershed using 2015 land use/land cover data. Each SMU then received a classification (Sensitive, Impacted, or Non-Supporting) based on percent of existing impervious cover (Table 12; Figure 21).

To summarize, all SMUs, except for one (SMU 4) were classified as Sensitive. SMU 4 was classified as Impacted based on 2015 impervious cover estimates. No SMUs were classified as Non-Supporting in the Salmon Trout watershed. SMU 4 lies in the south-central portion of the watershed and has, relatively speaking, the most impervious cover in the watershed. The Eagle Mine site is within SMU 4 and the surface facilities account for the impervious cover percentage. Eagle Mine has implemented storm water management measures that essentially prohibit storm water falling inside of the perimeter berm from leaving the site at all according to Michigan EGLE. In this instance, the implemented storm water control measures accomplish the statements in the last paragraph of section 3.10.

Table 12- 2015 impervious cover, soils erosion hazard, and vulnerability by Subwatershed Management Unit.

SMU #	Subwatershed/ Creek Names	Step 1: Existing Impervious %	Existing (2015) Impervious Classification	Step 2: Soil Erodibility Score	Soil Erodibility Hazard Classification	Vulnerability Factor	Step 3: Vulnerability Ranking
SMU1	Unnamed Creek	0.5%	Sensitive	1.0	Slight	0.01	Low
SMU2	Unnamed Creek	6.0%	Sensitive	1.1	Slight	0.07	Moderate
SMU3	Main Branch Salmon Trout River	3.0%	Sensitive	1.6	Moderate	0.05	Moderate
SMU4	Main Branch Salmon Trout River	11.5%	Impacted	1.1	Slight	0.13	High
SMU5	Iron Creek	0.5%	Sensitive	2.0	Moderate	0.01	Low
SMU6	West Branch Salmon Trout River	0.6%	Sensitive	2.0	Moderate	0.01	Low
SMU7	Salmon Trout River	0.1%	Sensitive	2.1	Moderate	0.00	Low
SMU8	East Branch Salmon Trout River	0.1%	Sensitive	1.9	Moderate	0.00	Low
SMU9	East Branch Salmon Trout River	0.2%	Sensitive	2.2	Moderate	0.00	Low
SMU10	East Branch Salmon Trout River	0.2%	Sensitive	2.2	Moderate	0.00	Low
SMU11	East Branch Salmon Trout River	0.5%	Sensitive	2.5	Severe	0.01	Low
SMU12	Salmon Trout River	0.0%	Sensitive	2.8	Severe	0.00	Low
SMU13	East Branch Salmon Trout River	0.0%	Sensitive	2.9	Severe	0.00	Low
SMU14	Snake Creek	0.0%	Sensitive	2.7	Severe	0.00	Low
SMU15	Clear Creek	0.0%	Sensitive	2.2	Moderate	0.00	Low
SMU16	Clear Creek	0.2%	Sensitive	2.4	Moderate	0.00	Low
SMU17	Salmon Trout River	0.0%	Sensitive	2.6	Severe	0.00	Low
SMU18	Snake Creek	0.0%	Sensitive	2.8	Severe	0.00	Low
SMU19	Clear Creek	0.0%	Sensitive	2.9	Severe	0.00	Low
SMU20	Clear Creek	0.0%	Sensitive	2.6	Severe	0.00	Low
SMU21	Unnamed Creek	0.0%	Sensitive	2.3	Moderate	0.00	Low
SMU22	Spring Creek/ Main Branch Salmon Trout River	0.0%	Sensitive	2.3	Moderate	0.00	Low
SMU23	Murphy's Creek	1.7%	Sensitive	0.5	Slight	0.01	Low
SMU24	Main Branch Salmon Trout River	0.3%	Sensitive	2.2	Moderate	0.01	Low
SMU25	Main Branch Salmon Trout River	4.1%	Sensitive	2.0	Moderate	0.08	Moderate
SMU26	Conway Lake	2.2%	Sensitive	1.1	Slight	0.02	Moderate
SMU27	Conway Creek	0.9%	Sensitive	0.7	Slight	0.01	Low
SMU28	Sullivan Creek	2.4%	Sensitive	1.1	Slight	0.03	Moderate
SMU29	STR Mouth/ Sullivan Creek	4.5%	Sensitive	1.1	Slight	0.05	Moderate

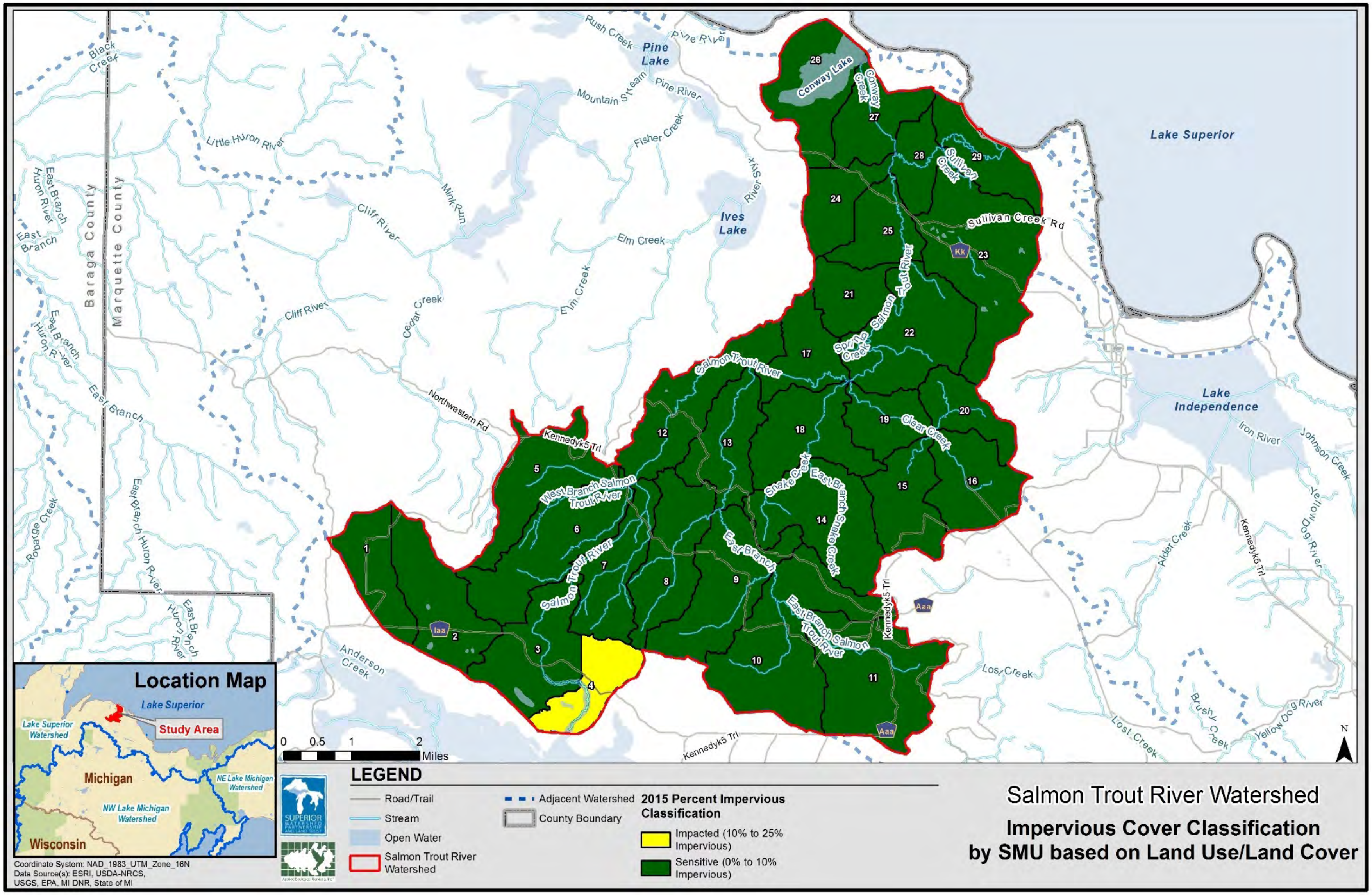


Figure 21- Impervious Cover Classification by SMU based on Land Use/Land Cover

Step 2: Erosion Hazard Score by SMU

The soil erosion hazard of each SMU was calculated based on the NRCS soils data available for the watershed and were classified as either Slight, Moderate, or Severe. Table 12 and Figure 22 summarize and depict soil erosion hazard classifications for each SMU. This step identifies SMUs that are most vulnerable to soil erosion if projects or development occurs in these areas in the future. SMUs 1, 2, 4, 23, and 26-29 have only a slight erosion hazard. Thirteen SMUs in the watershed have a moderate erosion hazard, including SMUs 3, 5-10, 15, 16, 21, 22, 24, and 25. Finally, the remaining 8 SMUs (SMUs 11-14 and 17-20) were categorized as being a severe erosion hazard.

Step 3: Vulnerability Ranking

The vulnerability of each SMU to erosion where land use changes might occur was determined by multiplying the percent impervious cover by the soil erosion hazard score for each SMU to determine the vulnerability factor of each SMU. The resulting vulnerability factors ranged from 0 to 0.13.

The vulnerability factors were then ranked for each SMU and categorized as Low, Medium, or High:

Low = a vulnerability factor of 0 to 0.01

Moderate = a vulnerability factor > 0.01 to 0.08

High = a vulnerability factor of > 0.08 to 0.13

The vulnerability analysis resulted in 1 High, 6 Moderate, and 22 Low ranked SMUs (Table 12; Figure 22). SMU 4 is ranked as highly vulnerable to land use changes or projects because these are areas that would be susceptible to erosion, and where the impervious cover classification is high. Future projects or development in this SMU need to take precautions to protect against increasing impervious cover or development and ensure that soils are protected from erosion during construction, development, and through the mining reclamation process when the operation ends. As mentioned, Eagle Mine has implemented storm water management measures at its surface facilities, which are effectively managing impervious surface runoff according to Michigan EGLE. Stormwater BMPs should remain in place through the full life of the mine and restoration process.

SMUs 2, 3, 25, 26, 28, and 29 are ranked as moderately vulnerable to land use changes. The remaining SMUs have a low vulnerability to land use changes and development. The results of this analysis clearly point to the potential negative impacts of traditional development. It will be important to consider developing the areas that are highly susceptible to development using Conservation/Low Impact Development standards that incorporate the most effective and reliable Stormwater Treatment Train practices whereby stormwater is routed through various water quality and infiltration Management Measures prior to being released from the development site.

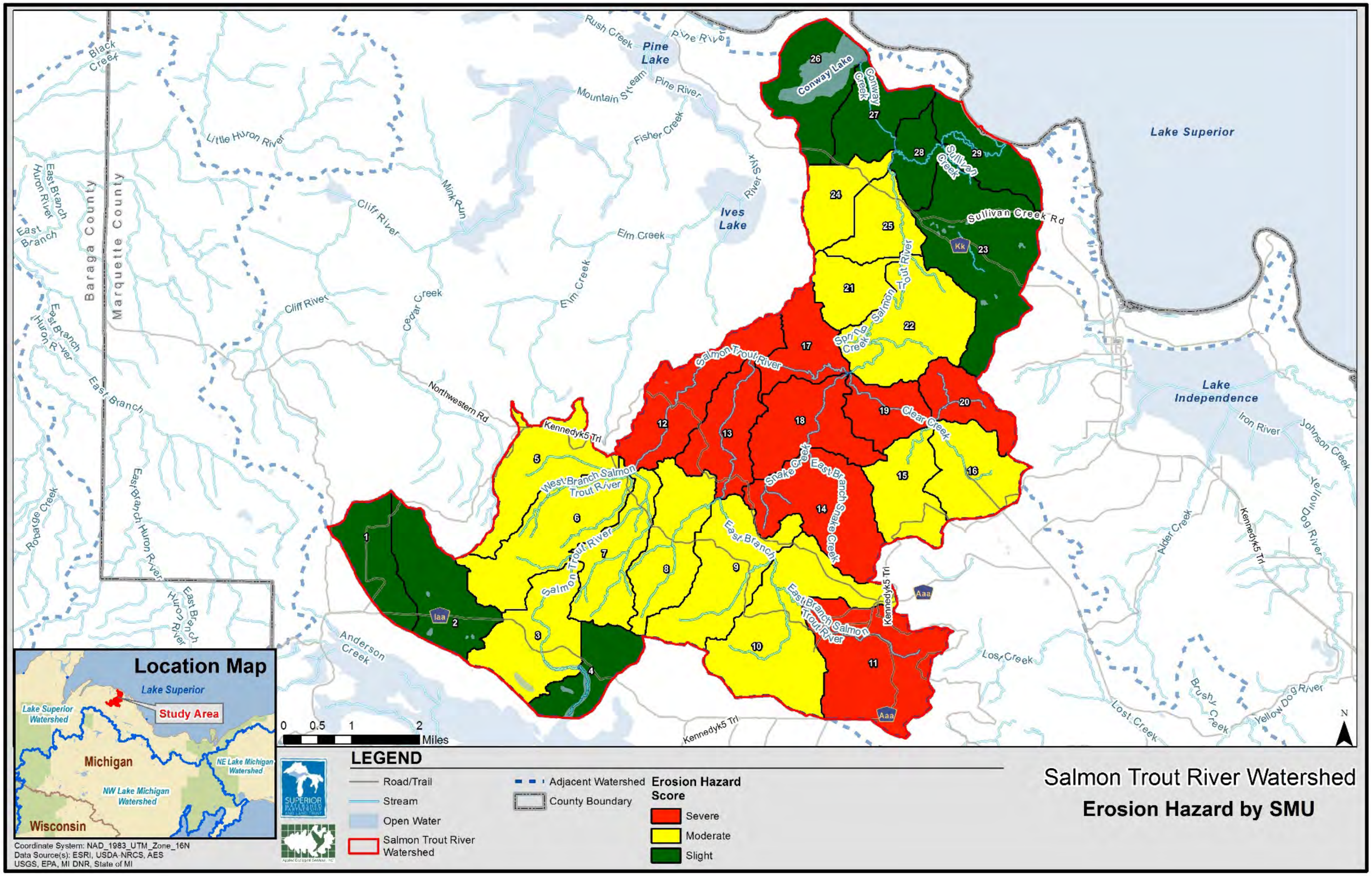


Figure 22- Erosion Hazard by SMU

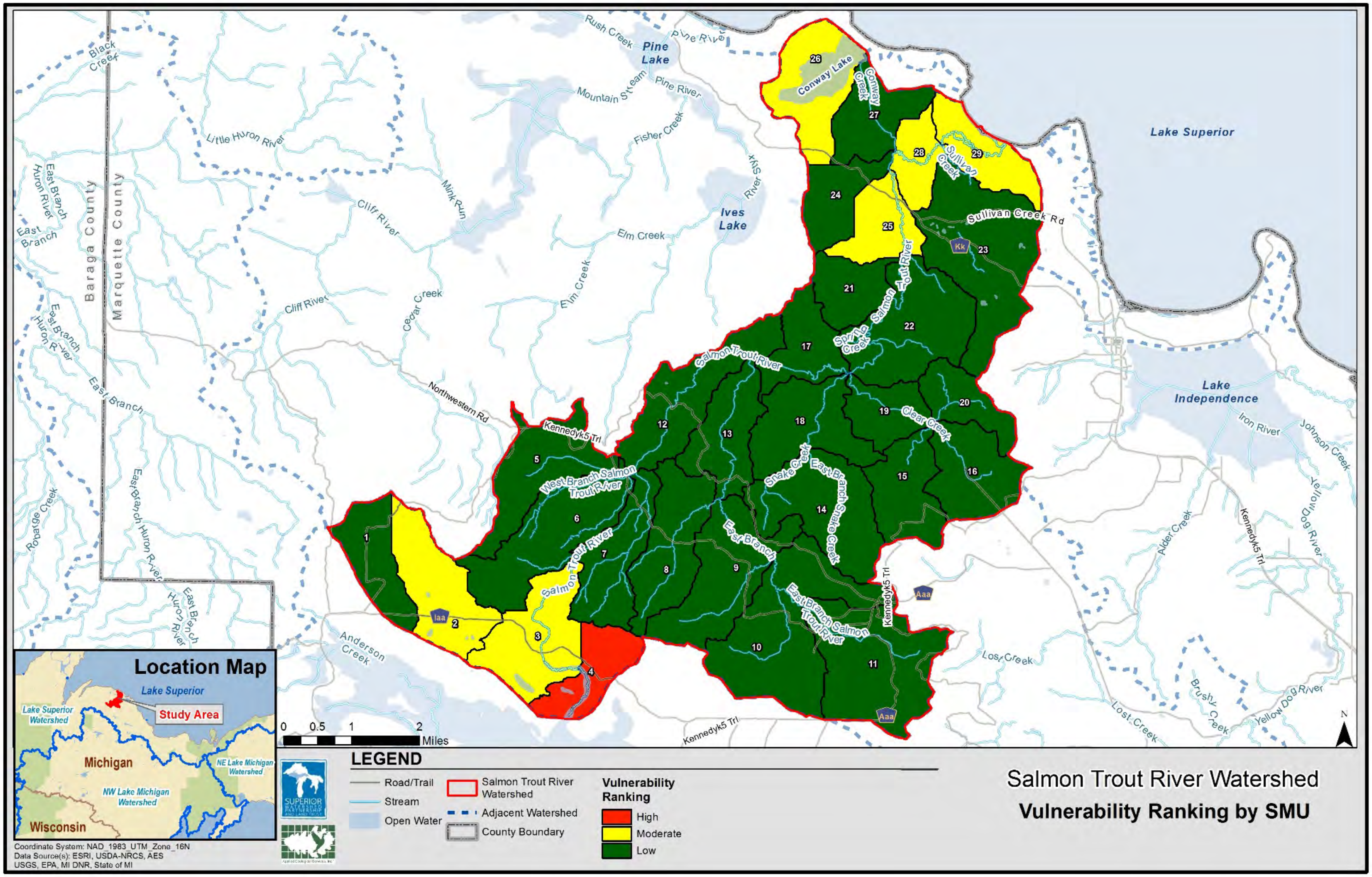


Figure 23- Vulnerability Ranking by SMU

3.11 Open Space Inventory, Prioritization, & Green Infrastructure Network

A Green Infrastructure Network is a connected system of *Hubs* and linking *Corridors*. Hubs generally consist of the largest and least fragmented areas. Corridors are generally formed by smaller private/unprotected parcels along swales and streams. Corridors are extremely important because they provide biological conduits between hubs. However, not all parcels forming corridors are ideal green infrastructure until residents, businesses, industries, and farmers embrace the idea of naturalizing stream corridors. Unique to the Salmon Trout River watershed, are very undeveloped riparian corridors. The main branches of these rivers are still currently wooded, diverse and have limited development impacts and encroachments.

General depiction of a green infrastructure network.

Source: greeninfrastructure.net

A major component of watershed planning includes an examination of open space to determine how it best fits into a "Green Infrastructure Network". Green infrastructure is best defined as an interconnected network of natural areas and other open space that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife (Benedict 2006). Natural features such as stream corridors, wetlands, floodplain, woodlands, and grassland are the primary components of green infrastructure. Working lands such as farms parks/ball fields, school grounds, detention basins, and large residential parcels can also be considered green infrastructure components. A three-step process was used to create a parcel-based Green Infrastructure Network for the Salmon Trout River watershed:

Step 1: All parcels of land in the watershed were categorized as open space, partially open space, or developed.

Step 2: All open and partially open parcels were prioritized based on a set of criteria important to green infrastructure.

Step 3: Prioritized open and partially open parcels and some developed but linking parcels were combined to form a Green Infrastructure Network.

For this watershed plan, an "open space" parcel is generally defined as any parcel that is not developed such as a protected natural area or forested lands. "Partially open" parcels have been developed to some extent, but the parcels still offer potential green infrastructure opportunities. Examples of partially open parcels include some school grounds and residential lots generally greater than two acres with minimal development. Parcels that are mostly built out such as medium and high-density residential development, transportation, and commercial/retail areas are considered "developed". Public versus private and protected versus unprotected status of open and partially open space parcels are other important green infrastructure attributes that are discussed in more detail below.

Open, Partially Open, & Developed Parcels

Step 1 in creating a Green Infrastructure Network was completed by categorizing all parcels in the watershed as "open", "partially open", or "developed" as described above. Figures 23 and 24 summarize and depict Step 1 results. Open space parcels comprise approximately 30,822 acres or 97% of the watershed. Partially open parcels make up another 772 acres or 2% of the watershed. Developed parcels account for the remaining 166 acres or 1% of the watershed. Most open and partially open parcels are located on forested land, private conservation areas, and large residential lots.

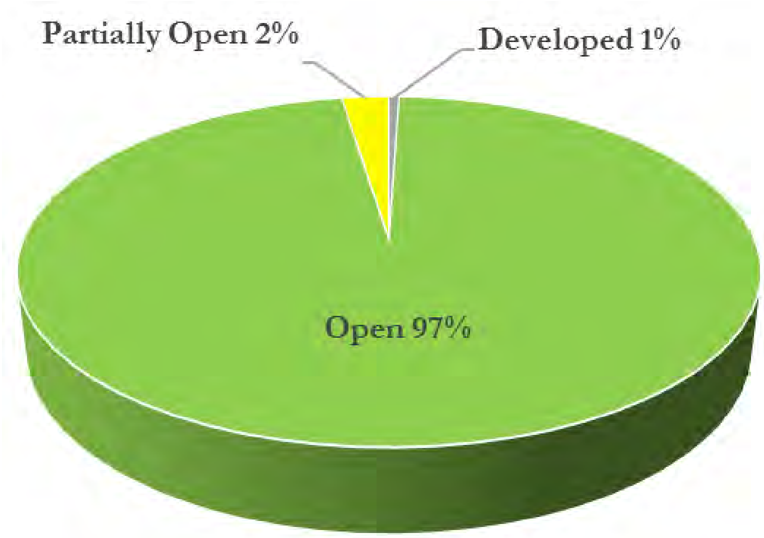


Figure 24- Distribution of open, partially open, and developed

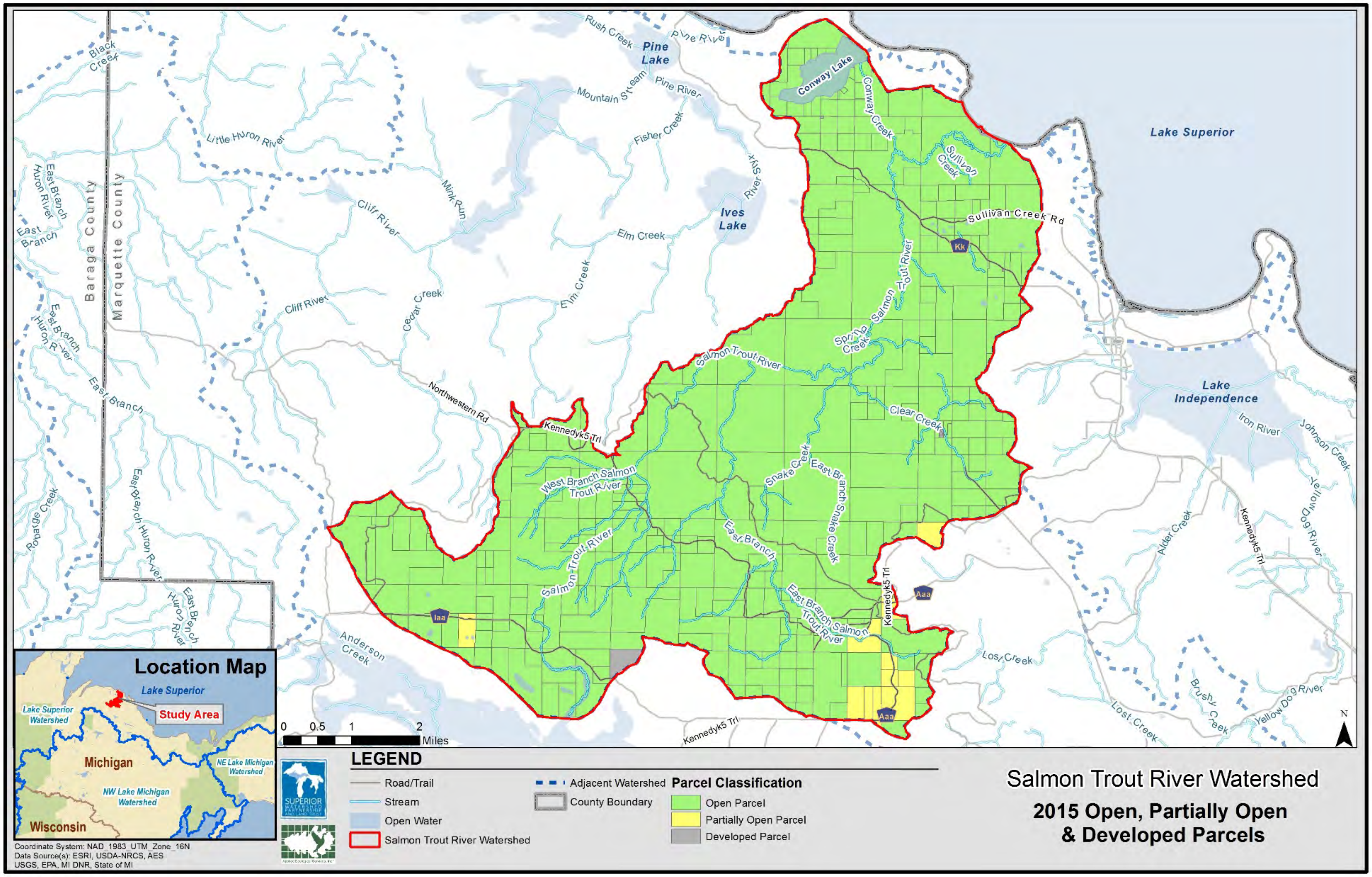


Figure 25- 2015 Open, Partially Open, and Developed Parcel

Public/Private Ownership of Open and Partially Open Parcels

The public or private ownership of each open and partially open parcel was determined from available parcel data. Developed parcels are not included in this summary. Publicly owned parcels generally include those owned by state, county, municipal government, school districts, and park districts. Public open and partially open parcels account for 5% and 0% of the open and partially open acreage, respectively (Figures 26 & 27). Private ownership types include privately owned conservation areas, large lot residential areas, etc. Private open parcels comprise 92% of the open and partially open acreage whereas private partially open parcels comprise 2% (Figures 26 & 28). Public open and partially open parcels are mostly owned by MDNR and the County.

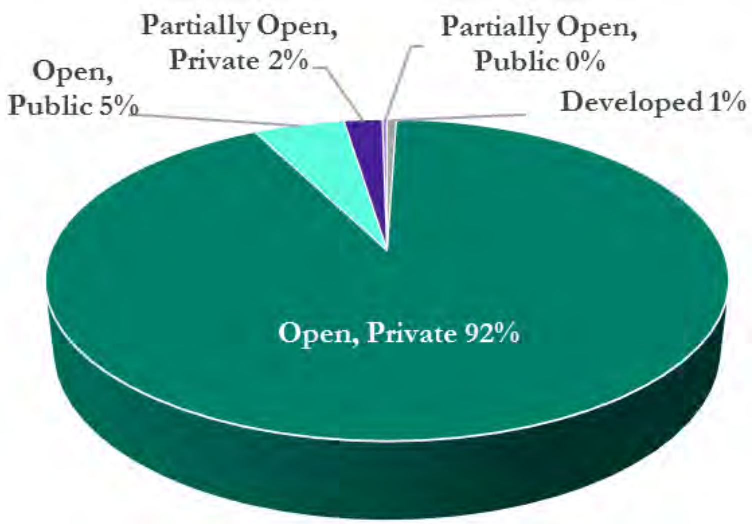


Figure 26- Distribution of private and public open and partially open parcels.

Protected Status of Open and Partially Open Parcels

Preservation of open space is critical to maintaining and expanding green infrastructure and is an important component of sustaining water quality, hydrological processes, ecological function, and the general quality of life for both wildlife and people. Without preservation, open space can be converted to other less desirable land uses in the future. Protected open and partially open parcels account for 15% of the open space acreage in the watershed, partially protected open space accounts for about 2%, partially open and partially protected is roughly 2%, while unprotected open and partially open parcels account for the remaining 80% of the watershed (Figures 27 & 29). Much of the unprotected open space in the watershed is forested land owned by timber companies.

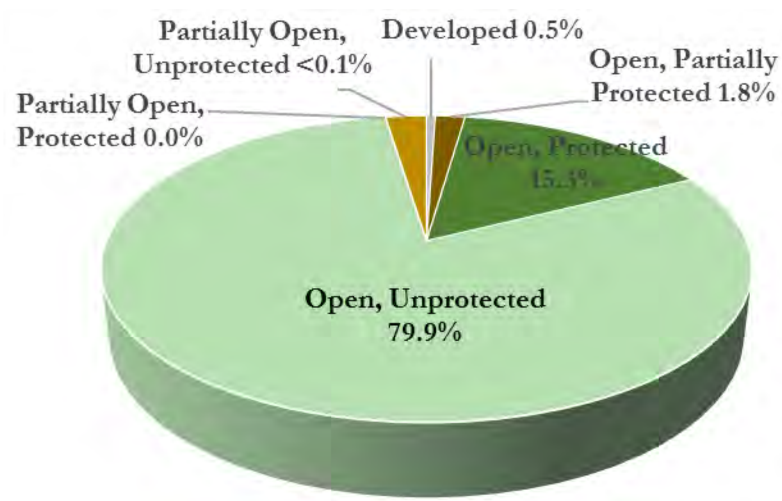


Figure 27- Distribution of protected and unprotected open and partially open parcels

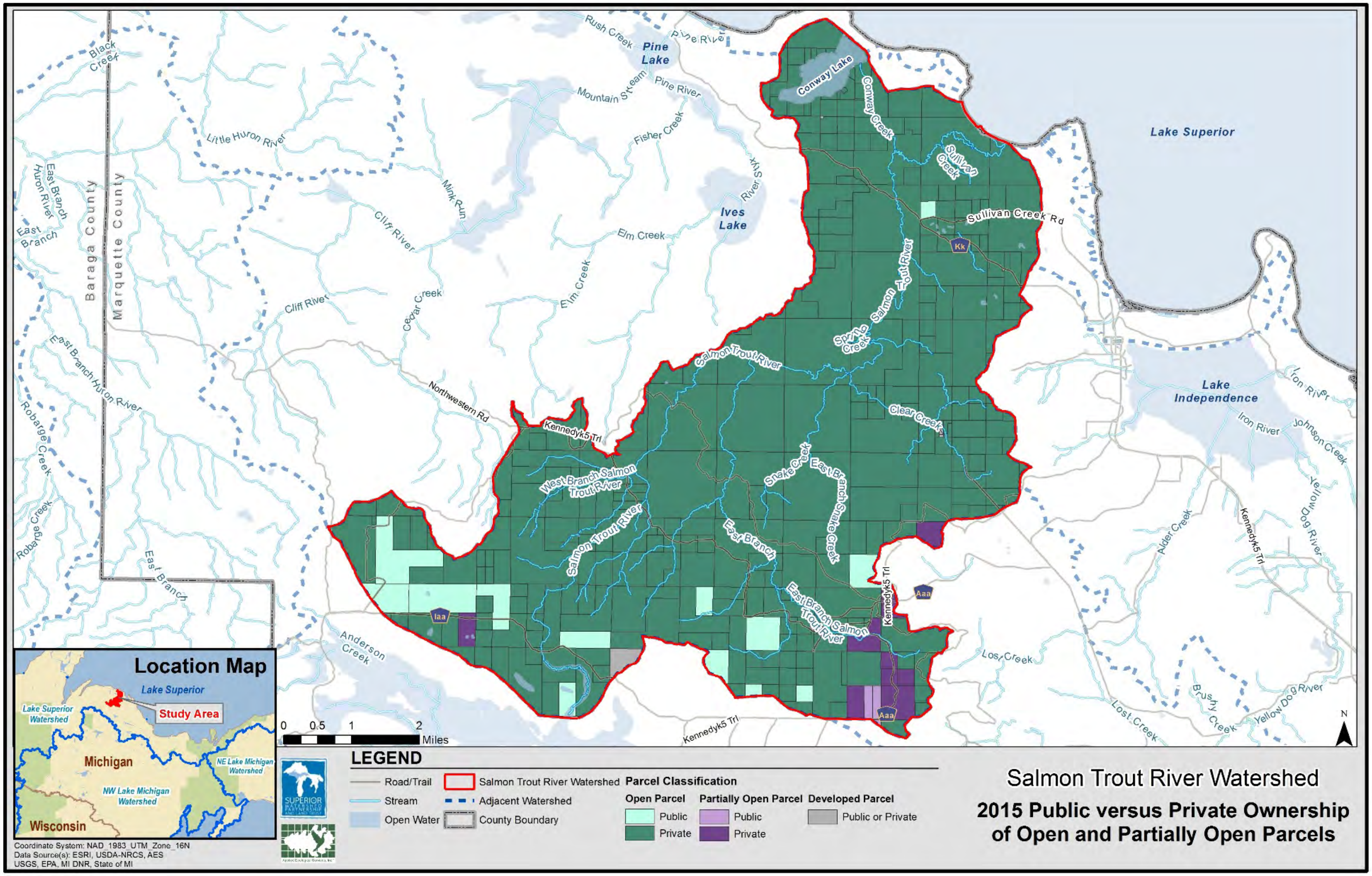


Figure 28- 2015 Public versus Private Ownership of Open and Partially Open Parcels

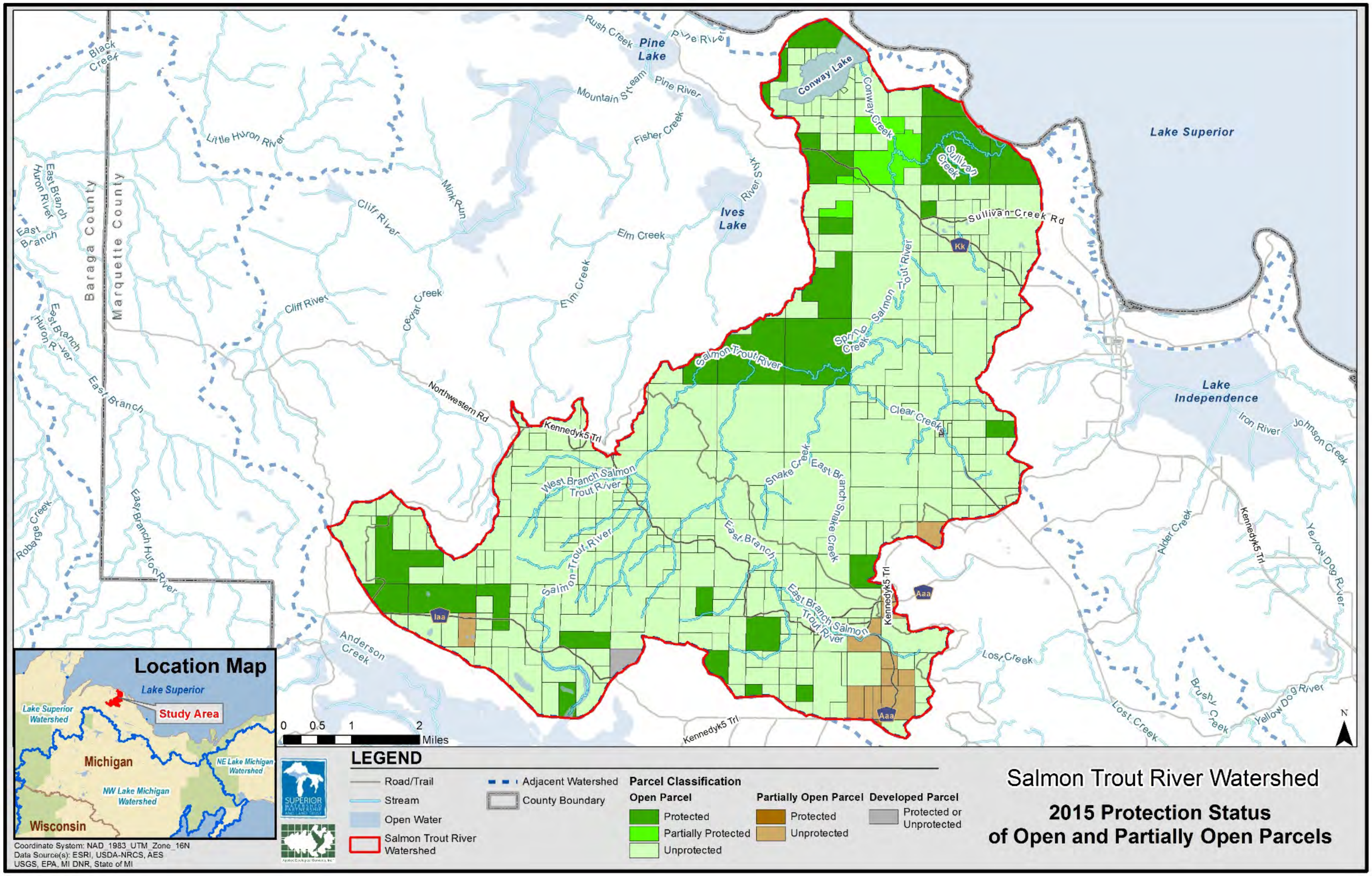


Figure 29- 2015 Protection Status of Open and Partially Open Parcels

Open Space Parcel Prioritization
Step 2 in creating a Green Infrastructure Network for Salmon Trout River watershed was completed by prioritizing open and partially open parcels. For this step, nine prioritization criteria important to green infrastructure were examined via a GIS analysis (Table 13). If an open or partially open parcel met a criterion it received one point. If the parcel did not meet that criterion, it did not receive a point. This process was repeated for each open and partially open parcel and for all criteria. The prioritization process was not completed for developed parcels. The total points received for each parcel were summed to determine parcel importance for developing the Green Infrastructure Network; parcels with the highest number of points are more important to green infrastructure than parcels that met fewer criteria.

The combined possible total of points any one parcel can accumulate is 9 (9 of 9 total criteria met). The highest total value received by a parcel in the weighting process was 7 (having met 7 of 9 criteria). After completion of the prioritization, parcels were categorized as "High Priority", "Medium Priority", or "Low Priority" for green infrastructure based on point totals. Parcels meeting 5-7 of the criteria are designated High Priority for inclusion into the Green Infrastructure Network while parcels meeting 3-4 criteria are designated Medium Priority. Parcels with a combined value of 0-2 are categorized as Low Priority but are not necessarily excluded from the Green Infrastructure Network based on their location or position as linking parcels.

Figure 30 depicts the results of the parcel prioritization. First, many of the High Priority green infrastructure parcels form the *hubs* of the Green Infrastructure Network for Salmon Trout River watershed. Many of the Medium Priority parcels are currently privately-owned lands along the stream corridors and necessary for protecting the Trout Streams in the watershed. Low Priority parcels are generally smaller isolated, private residential parcels.

Table 13- Criteria used to prioritize parcels for a Green Infrastructure Network

Green Infrastructure Criteria
1. Open/partially open parcels that include the FEMA 100-year floodplain
2. Open/partially open parcels within 0.25 miles of a headwater stream
3. Open/partially open parcels that include a wetland
4. Open/partially open parcels that include a Trout Stream of Trout Restoration Area
5. Open/partially open parcels that are within 100 feet of a stream or open water
6. Open/partially open parcels in a "Highly Vulnerable" Land Use/Land Cover SMU
7. Open/partially open parcels adjacent to or including private or public protected open space
8. Open/partially open parcels that include an existing or planned trail
9. Open/partially open parcels that include groundwater recharge areas with greater than 12"/yr potential

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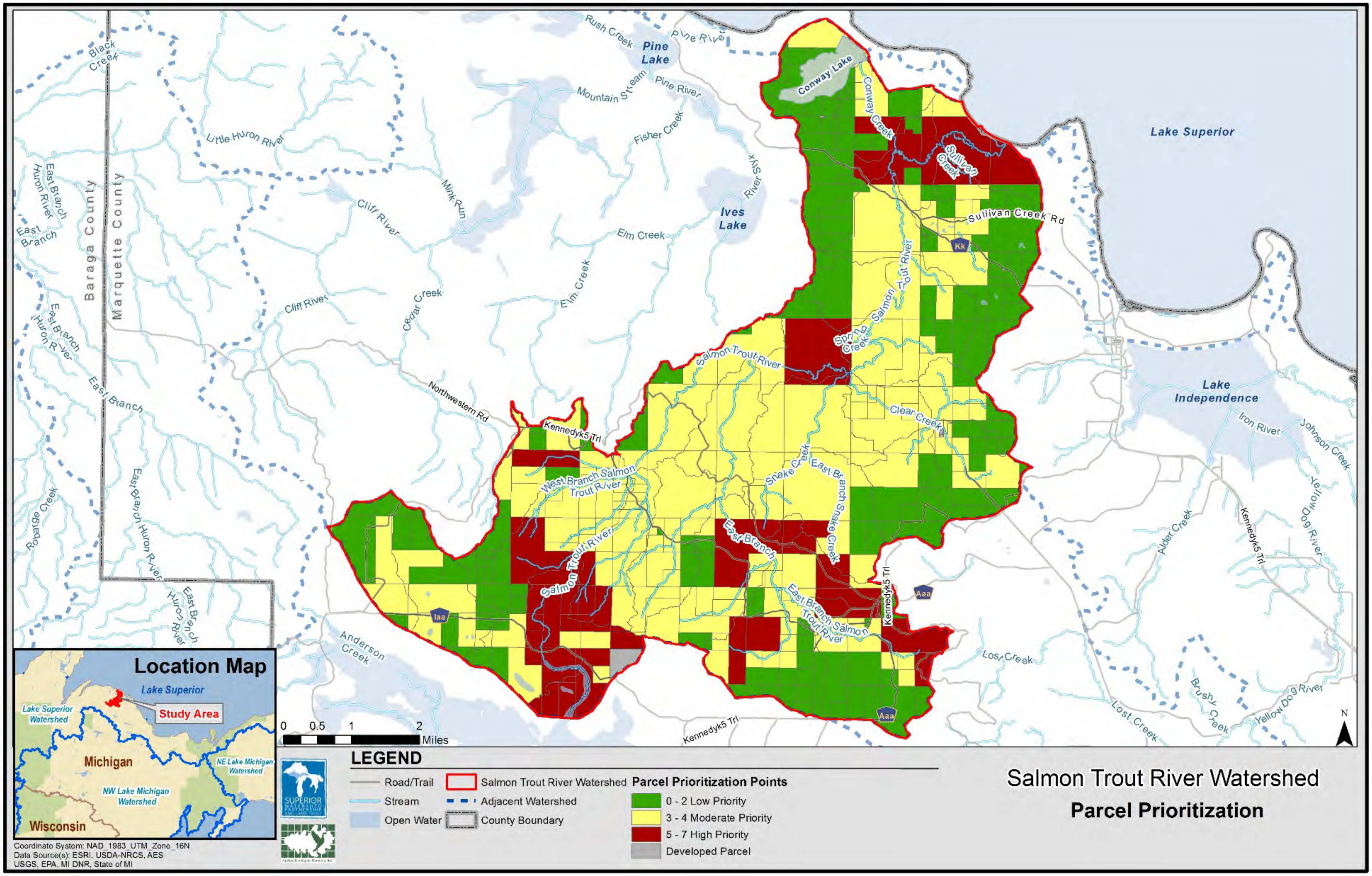

Figure 30- Parcel Prioritization

3.12 Green Infrastructure Network

The final step (Step 3) in creating a Green Infrastructure Network for Salmon Trout River watershed involves laying out the network by using prioritized open space results from Step 2 as the base layer that includes all High Priority, all Medium Priority parcels, and Low Priority or developed parcels along streams corridors and inland lakes if they provided *links*, expanded existing green infrastructure, or were simply isolated sites.

County and region-wide green infrastructure plans, where available, generally focus on natural features such as stream corridors, wetlands, floodplain, buffers, and other natural components. The Green Infrastructure Network created for Salmon Trout River watershed captures all the natural components and other green infrastructure such as private or recreational parks and large residential lots at the parcel level. Parcel level green infrastructure planning is important because land purchases, acquisitions, and land use changes almost always occur at the parcel level. A Green Infrastructure Network for Salmon Trout River watershed is illustrated on Figure 31. The total Green Infrastructure Network for Salmon Trout River watershed covers 21,997 acres. The majority of the network (17,658 acres; 80%) is unprotected, while 18% (3,868 acres) is protected and the remaining 2% (471 acres) is partially protected.

Perhaps the most important aspect of green infrastructure planning is that it helps communities identify and prioritize conservation opportunities and plan development in ways that optimize the use of land to meet the needs of people and nature (Benedict 2006). Green infrastructure planning provides a framework for future growth that identifies areas not suitable for development, areas suitable for development but that should incorporate conservation or low impact design standards, and areas that do not affect green infrastructure. The Action Plan section of this report includes various programmatic and site-specific green infrastructure recommendations.

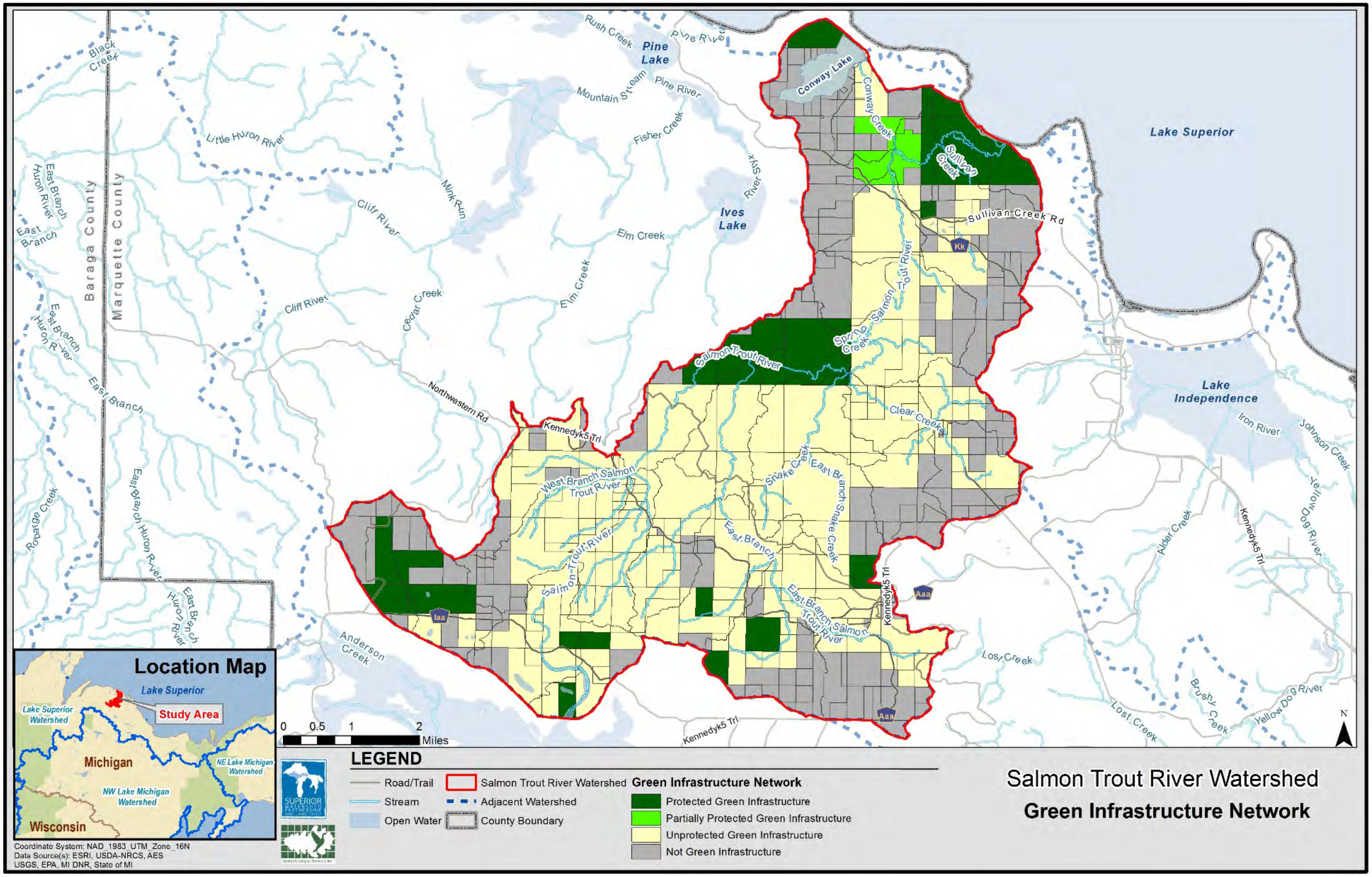

Figure 31- Green Infrastructure Network

3.13 Important Natural Areas

The Michigan Department of Natural Resources defines natural areas as: "Areas that have retained the best example of Michigan's native landscapes, ecosystems, natural communities or scenic qualities… Features used to identify natural areas include: size, uniqueness, pristine nature, aesthetic or scenic qualities, and outstanding opportunities for solitude or a primitive and unconfined type of recreation. To be legally dedicated, natural areas must also contain ecological, geological or other features of scientific, scenic or natural history value. Many areas also have populations of endangered and threatened species." (MDNR)

5,380 acres of property have at least some level of protection from development. These include the Bear Mountain Land Association (70.2 acres), multiple parcels within the Gwinn State Forest Area (1,695.7 acres), and portions of the Huron Mountain Club (3,614.5 acres).

The Bear Mountain Land Association is featured on the web as a put-and-take boar hunting facility. There is no indication from the association's web site that there are conservation goals beyond providing property for sport hunting.

The Huron Mountain Club has a very long legacy of conservation and contains some of the most pristine northwoods habitat in the country.

Table 14- Protected Properties

Protected Properties	Size (acres)	Description
Bear Mountain Land Association	70.2	Private Hunting Club
Gwinn State Forest Area	1,695.7	Public Conservation and Recreation
Huron Mountain Club	3,614.0	Private Conservation and Recreation

The Salmon Trout River watershed encompasses a unique diversity of terrestrial and aquatic ecosystems and an array of unusual geological features. The Huron Mountains, along and inland from the southern shore of Lake Superior, exhibit a stunning diversity of hemlock-northern hardwood forest ecosystems, including some of the oldest maple-hemlock forests in the Midwest, and terrestrial ecosystems ranging from rocky, dry, and exposed sites to forested swamps and marshes. Remaining old growth forests contain scattered individuals of very large size (Barnes et al. 1990).

Kirtland Warbler. Northern Express. 2019

Because of the area's remoteness and isolation, substantial tracts remain undeveloped and provide diverse and un-fragmented habitat for wildlife. This includes habitat for one of the rarest birds in North America, the federally endangered Kirtland's warbler, which was recently observed in the jack pine forests of the upper watershed. Only about 1400 specimens remain worldwide. They are primarily located in 10 Michigan Counties (4 in the Upper Peninsula) (Olson 2002). Other wildlife observed in the watershed includes, but is not limited to, whitetail deer, black bear, marten, fisher, and snowshoe hair, with an occasional moose, timber wolf, or lynx reported, along with numerous birds and waterfowl.

The Salmon Trout River, a cold-water trout stream, is home to the only known breeding population of the native coaster brook trout on Lake Superior's south shore. Coaster brook trout differ from other brook trout in that they spend part or all or their life cycle in a Great Lake. Historical catches of coaster brook trout in the Salmon Trout River during the late 1800s and early 1900s often exceeded 200 fish per day. Ongoing studies, sponsored by the Huron Mountain Wildlife Foundation, indicate the total spawning population is now fewer than 200 individuals each year. Many factors have been implicated in the reduction of coaster brook trout in the Great Lakes including over-exploitation (angling, commercial and tribal netting), logging effects, other habitat losses including loss of spawning areas, pollution, loss of genetic diversity, man-made barriers to migration, and competition with exotic salmonines (Newman et al. (ED) 2003).

US FWS fisheries biologist Harry Quinlan holding Lake Superior Coaster Brook Trout. Source: Trout Unlimited.

In February 2006, the Sierra Club Mackinac Chapter and the Huron Mountain Club filed a petition to the U.S. Fish and Wildlife Service to list the naturally spawning anadromous (fish that ascend rivers to spawn) coaster brook trout as an endangered species throughout its known historic range in the conterminous United States, and to designate "critical habitat" under the Endangered Species Act (16 U.S.C. Sec. 1531 et seq. (1973) as Amended). Since 1995, the Huron Mountain Club, owners of the land surrounding the entire reach of the Salmon Trout River used by coaster brook trout, has prohibited its members from killing coasters and supported closure of the river to fishing by the Michigan Department of Natural Resources during seasons when coasters are present, as well as the adoption of stricter take limits in Lake Superior. The Huron Mountain Club also encourages and supports academic research and long-term studies of coaster brook trout population dynamics and health in the Salmon Trout River.

Other state threatened, endangered, and special concern species with known occurrences in the Salmon Trout River watershed include; Calypso or Fairy-slipper (Threatened), Narrow-leaved Gentian (Threatened), Northern Gooseberry (Special Concern), spruce grouse (Special Concern), Common loon (Threatened), and Bald Eagle (Threatened, and federal status). State listed high quality natural communities found in the watershed include the Mesic Northern Forest, Rich Conifer Swamp, and Wooded Dune and Swale Complex ecosystems (MNFI 2006).

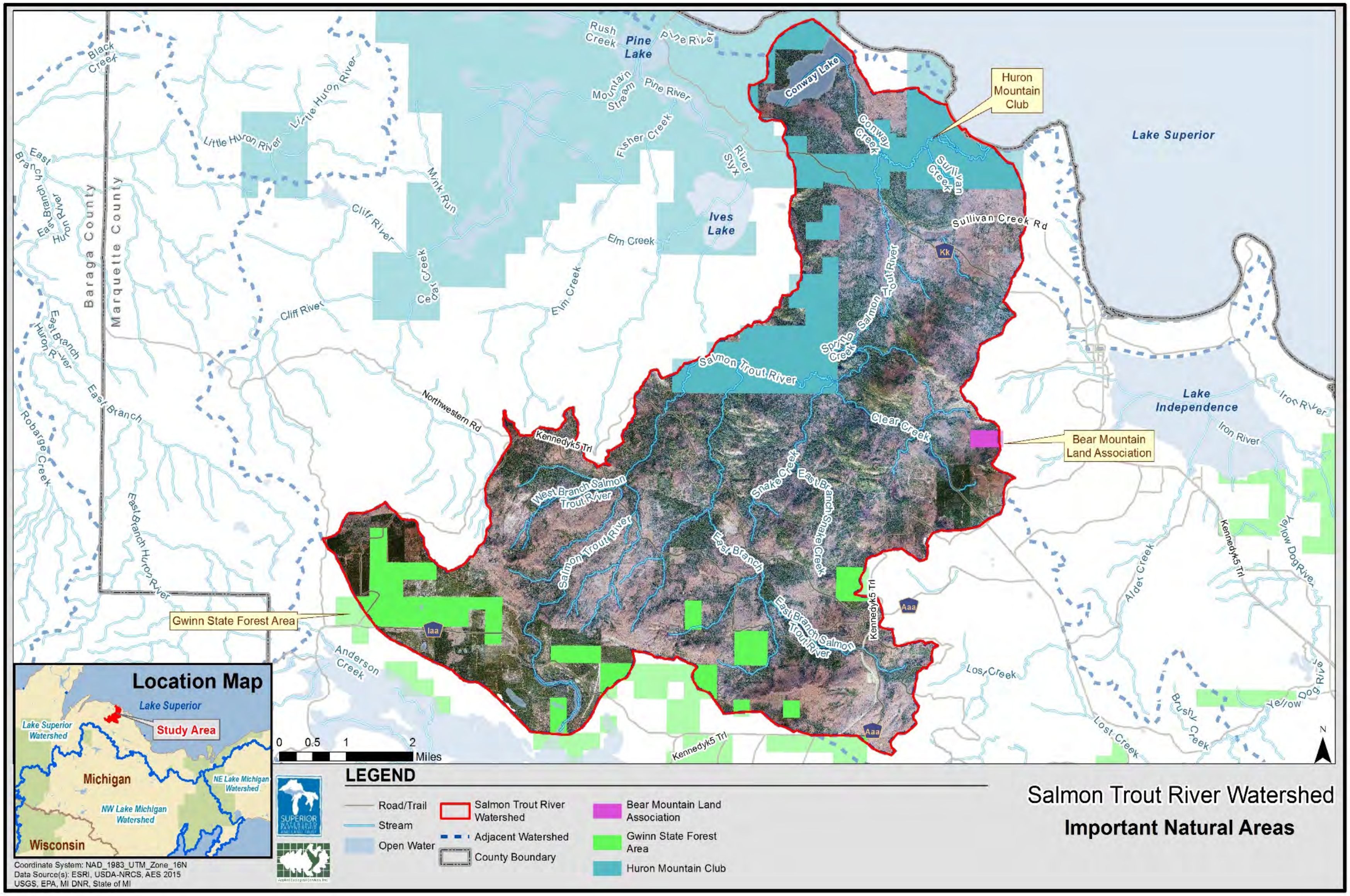
Salmon Trout River Watershed
Important Natural Areas
Location Map
Lake Superior
Study Area
Lake Superior Watershed
Michigan
NW Lake Michigan Watershed
NE Lake Michigan Watershed
Wisconsin
LEGEND
Road/Trail
Stream
Open Water
Salmon Trout River Watershed
Adjacent Watershed
County Boundary
Bear Mountain Land Association
Gwinn State Forest Area
Huron Mountain Club
Huron Mountain Club
Bear Mountain Land Association
Gwinn State Forest Area
Lake Superior
Lake Independence
Pine Lake
Ives Lake
Conway Lake
Baraga County
Marquette County
Salmon Trout River
West Branch Salmon Trout River
East Branch Salmon Trout River
East Branch Snake Creek
Snake Creek
Clear Creek
Spring Creek
Conway Creek
Sullivan Creek
Sullivan Creek Rd
Northwestern Rd
Kennedyk5 Trl
Anderson Creek
Cliff River
Little Huron River
Mink Run
Cedar Creek
Elm Creek
Fisher Creek
Pine River
Rush Creek
Mountain Stream
Iron River
Yellow Dog River
Alder Creek
Los Creek
Lost Creek
Brushy Creek
Black Creek
Robarge Creek
East Branch Huron River
0 0.5 1 2 Miles
N
Coordinate System: NAD_1983_UTM_Zone_16N
Data Source(s): ESRI, USDA-NRCS, AES 2015
USGS, EPA, MI DNR, State of MI

Figure 32- Important Natural Areas

3.13.1 Natural Resource Management

Forestry and Timber Harvesting

Land ownership in the Salmon Trout River watershed is comprised of corporate forest products producers, private land owners, the Huron Mountain Club, and the State of Michigan. Private parcels ranging in size from one acre to several hundred acres occupy approximately one quarter of the total watershed area. It is common for private landowners to manage their property for timber resources through the Commercial Forest Lands program through the MI DNR.

Logging has historically been the primary land use in the Salmon Trout River watershed due to the plentiful forests and proximity to railways and ports to transport goods. Logging has been identified as one component that has contributed to the sedimentation of the Salmon Trout River and its tributaries in the watershed. With the implementation of best management practices, timber harvesting has become more sustainable in recent years. However, the steep topography of the watershed and its highly erodible soils make implementation of practices difficult, and stream crossings tend to result in sediment contributions to the watershed. Other potential issues brought on by timber harvesting include reduction in forest shading contributing to rises in water temperature, changes in hydrology and flow patterns, and changes in water infiltration and evapotranspiration.

Through the Commercial Forest Lands program, private land owners can enroll their land into long-term timber production in exchange for property tax incentives. These lands must have a forestry management plan written by a registered forester or natural resources professional describing how the land will be managed.

Management practices on forest lands, by all owners, will help forests and watersheds to stay healthy and stable. The Michigan Department of Natural Resources defines a broad range of best management practices in: "Michigan Forestry Best Management Practices for Soil and Water Quality." These best management practices include:

- Pre-Harvest Planning: Allows for implementation of best management practices in appropriate site locations
- Riparian Management Zones: Provide shading, prevent sedimentation, habitat, and bank stabilization
- Stream Crossings: Provides guidance on staying within regulations and implementation of actions like portable bridges, and culvert sizing and placement
- Harvesting Operations: Prevention and mitigation of rutting, site location and water management of landings, and skid placement

- Site preparation, Reforestation, and Forest Protection: Guidance in prescribed burning, site reforestation, mechanical and chemical vegetation control, and establishment of crop trees
- Forest Road Planning: Proper control of grading, drainage management, knowledge of existing soil conditions, stream crossings, and closure practices prevent soil erosion
- Water Diversion Devices: Diverts water from roads and trails to prevent erosion

Mineral Rights and Exploration

In addition to commercial forestry, private landowners as well as the State are able to lease the mineral harvesting and exploration rights to their land. In the context defined by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), "mineral" and therefore "mineral rights" pertains to: fossil fuels (oil, natural gas, and coal), metals and metal-bearing ores, nonmetallic minerals and mineable rock products (limestone, gypsum, building stone, and salt), and may also include sand and gravel, peat, and marl. Mineral rights, similar to property rights, may be sold, transferred, or leased. They are distinct from "surface rights" and one can transfer "mineral rights" while maintaining "surface rights".

The owner of a parcels "mineral rights" may develop that parcel's mineral deposits or, alternatively, may lease these rights to a mineral development company. In this process, the land owner is generally paid a "bonus" when signing the lease along with royalties from any minerals extracted from the parcel.

This is applied to State-held public lands through the leasing nomination and bidding process. Interested parties have the opportunity to nominate state-owned parcels for leasing mineral rights, these leases are then auctioned. Interested parties may also apply for a direct lease. The State receives the revenue for these leases and has generated over $255 million in the last seven years which goes into the Michigan State Parks Endowment Fund and the Game and Fish Protection Trust Fund.

Whether the leased land is State or private owned, it is subject to regulation by the Michigan Department of Environment, Great Lakes, and Energy as leasing itself is not authorization to harvest minerals. The information on what land is leased and how as well as upcoming lease nominations is publicly available on the Michigan DNR "Managing Your Resources-Minerals" page.

At the time of writing, there are currently 57 active (40-acre parcel) mineral leases for development, and 3 active (40-acre parcel) mineral leases for development with restrictions within the Salmon Trout River watershed 12-HUC boundary. In the vicinity of the Lundin Eagle Mine on the Yellow Dog Plains, with surface facilities located at T50N-R29W Sections 11 and 12, there are a total of 100 active 40-acre mineral leases with 43 located within the adjacent Yellow Dog River watershed 12-HUC boundary. All of these are leased to Eagle Mine LLC. The mineral leases are a mixture of types including both metallic and non-metallic mineral leases.

3.14 Watershed Drainage System

Waterways such as streams and rivers are a barometer of the health of their watersheds. The story of waterways, as with so many natural resources, has been one of exploitation and lack of understanding. Few waterways throughout the world have escaped pollution, channel modifications, and increased flooding as a result of mismanagement of development in the watershed (Apfelbaum & Haney 2010). Fortunately, many waterways can be restored if stressors in the watershed can be mitigated.

Surveys in 2001, 2004, and 2006 on the Salmon Trout River and the major stream tributaries indicate a healthy fishery with an acceptable to excellent macro-invertebrate community and good habitat conditions (MISWIMS, 2019). This indicates that despite historical exploitation from over-fishing, logging, and other habitat destruction, the Salmon Trout River Watershed still maintains a relatively healthy ecosystem.

3.14.1 Salmon Trout River

Salmon Trout River

The Salmon Trout River is a 109,601.8 linear ft. (20.76 mi.) river running south to north in the Salmon Trout River Watershed and drains into Lake Superior. It consists of a natural channel with periodic pools and riffles and flows through wetland, forests, and old fields. In the south, the river is less than ten feet wide. It 25-50 feet where the main branch of the Salmon Trout River meets the east branch before decreasing to 10-25 feet. The average depth ranges from less than a foot to 3 feet. The riverbed is composed of sand, cobble, and boulders with high sand deposition. Instream cover includes undercut banks, overhanging vegetation, deep pools, aquatic plants, logs, and woody debris.

3.14.2 Salmon Trout River Tributary Streams

Tributary Streams

Thirty (30) streams totaling 237,817.9 linear feet or 45.04 miles are located within Salmon Trout watershed; all are tributary to Salmon Trout River (Table 15; Figure 33).

For this watershed plan, local tributary names are noted wherever possible. Of the 30 streams, the East Branch Salmon Trout River which flows south to north within the watershed, is the longest at approximately 109,601.8 linear feet or about 20.76 miles. Snake Creek and Clear Creek, the second and third longest streams in the watershed, are 17,955.4 linear feet (3.4 miles) and 16,918.4 linear feet (3.2 miles) and respectively. The remaining 27 streams account for 161,042.6 linear feet or 30.5 miles.

The streams within the watershed generally have natural channels. Evidence of beaver damage was also noted throughout the watershed.

Tributary Streams Inventory

No tributary stream inventory was completed. Descriptions of tributary streams were obtained from the Salmon Trout River Watershed Management Plan (2007).

Table 15- Stream Lengths

Primary Stream Names	Stream Length Assessed (ft)	Stream Length Assessed (mi)
Clear Creek	16,918.4	3.20
Conway Creek	7,968.7	1.51
East Branch Salmon Trout River	41,901.4	7.94
East Branch Snake Creek	11,334.9	2.15
Snake Creek	17,955.4	3.40
Spring Creek	2,326.0	0.44
Sullivan Creek	9,263.8	1.75
Iron Creek – aka Unnamed Stream 1	8,426.0	1.60
Trib. to West Br. STR – aka Unnamed Stream 2	2,826.6	0.54
Trib. to West Br. STR – aka Unnamed Stream 3	2,303.3	0.44
Trib. to West Br. STR – aka Unnamed Stream 4	9,339.7	1.77
Trib. to Main Br. STR – aka Unnamed Stream 5	2,137.1	0.40
Trib. to Main Br. STR – aka Unnamed Stream 6	5,185.5	0.98
Trib. to Main Br. STR – aka Unnamed Stream 7	1,524.7	0.29
Trib. to East Br. STR – aka Unnamed Stream 8	6,043.5	1.14
Trib. to Main Br. STR – aka Unnamed Stream 9	11,608.1	2.20
Trib. to Main Br. STR – aka Unnamed Stream 10	2,213.2	0.42
Trib. to East Br. STR – aka Unnamed Stream 11	10,815.9	2.05
Trib. to East Br. STR – aka Unnamed Stream 12	6,932.2	1.31
Trib. to East Br. STR – aka Unnamed Stream 13	10,690.0	2.02
Trib. to East Br. STR – aka Unnamed Stream 14	10,210.3	1.93
Trib. to Snake Creek – aka Unnamed Stream 15	2,390.4	0.45
Trib. to Clear Creek – aka Unnamed Stream 16	4,787.0	0.91
Trib. to Clear Creek – aka Unnamed Stream 17	2,931.3	0.56
Trib. to Clear Creek – aka Unnamed Stream 18	5,704.0	1.08
Unnamed Stream 19	5,990.7	1.13
Murphy's Creek – aka Unnamed Stream 20	4,802.6	0.91
Trib. to Main Branch STR at the river mouth – aka Unnamed Stream 21	2,385.2	0.45
Trib. to West Branch STR – aka Unnamed Stream 22	1,256.2	0.24
West Branch Salmon Trout River	9,646.0	1.83
Total	**347,419.7**	**65.80**

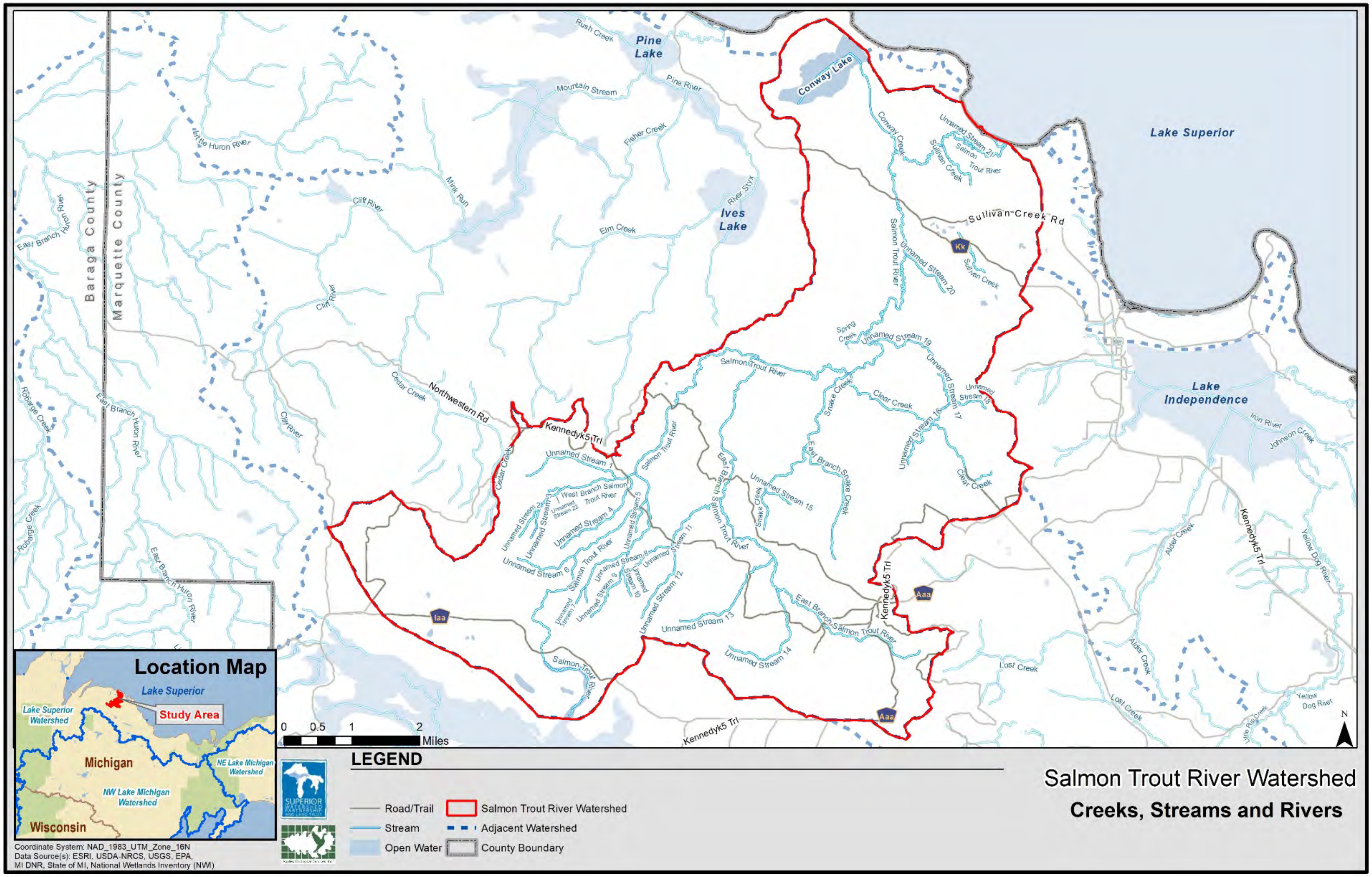

Figure 33- Creeks, Streams, and River

Clear Creek

Clear Creek is 16,9184 linear ft. (3.20 mi) long. The stream is centrally located in the Salmon Trout River watershed in Marquette County. Clear Creek flows northwest through forests with a wide riparian corridor and connects to Salmon Trout River. This medium to low flow stream is less than ten feet wide and averages 1-3 feet with natural channel and gravel and sand bed. The creek's undercut banks, overhanging vegetation, deep pools, logs, and woody debris provide instream cover for fauna species. Sand deposition is noted.

Conway Creek

Conway Creek is located in the north of the Salmon Trout Watershed and flows southeast for 7,968.7 linear ft (1.51 mi.) from Conway Lake to Salmon Trout River.

East Branch Salmon Trout River

The East Branch of the Salmon Trout River is located in the south-central region and flows for 41,901.4 linear ft. (7.94 mi.) through a wide riparian corridor comprised of wetlands, old field, and forest in a natural channel before meeting the main branch of the Salmon Trout River in the west-central region of the watershed. The river is 10-25 feet wide and 1-3 feet deep with a sandy bottom flow. Abundant aquatic vegetation and beaver activity is present.

East Branch Snake Creek

East Branch Snake Creek is east-centrally located in the Salmon Trout Watershed. It is 11,334.9 linear ft. (2.15 mi.) and flows northeast before joining with the Main Branch Salmon Trout River and Snake Creek.

Snake Creek

Snake Creek is centrally located in the Salmon Trout Watershed. It is 17,995.4 linear ft. (3.4 mi.) long. The natural channel flows north through a wide riparian corridor comprised of forest before flowing into the Salmon Trout River. The low to medium flow creek is 10-25 feet wide with the average depth ranges from less than a foot to three feet. The creek has a sand and gravel bottom with excess sedimentation at or near stream crossings.

Spring Creek

Spring Creek is centrally located in the Salmon Trout Watershed and flows northeast for 2,326 linear ft. (0.44 mi.) for emptying into the Salmon Trout River.

Sullivan Creek

Sullivan Creek us located in the northeastern region of the watershed and flows southwest for 9,263.8 linear ft. (1.75 mi.) before flowing into the Salmon Trout River.

West Branch Salmon Trout River

West Branch Salmon Trout River is located in the southwest of the Salmon Trout River Watershed where it flows east for 9,646.0 linear ft. (1.83 mi.) before meeting the main branch of the Salmon Trout River.

Iron Creek – aka Unnamed Stream 1

Unnamed Stream 1 is located in the southwest portion of the Salmon Trout River Watershed where it flows north for 8,426.0 linear ft. (1.6 mi.) before meeting the West Branch of the Salmon Trout River.

Tributary to West Branch Salmon Trout River – aka Unnamed Stream 2

Unnamed Stream 3 is located in the southwest portion of the Salmon Trout River Watershed where it flows north for 2,826.6 linear ft. (0.54 mi.) before meeting the West Branch of the Salmon Trout River.

Tributary to West Branch Salmon Trout River – aka Unnamed Stream 3

Unnamed Stream 3 is located in the southwest portion of the Salmon Trout River Watershed where it flows north for 2,303.3 linear ft. (0.44 mi.) before meeting the West Branch of the Salmon Trout River.

Tributary to West Branch Salmon Trout River – aka Unnamed Stream 4

Unnamed Stream 4 is located in the southwest portion of the Salmon Trout River Watershed where it flows northeast for 9,339.7 linear ft. (1.77 mi.) before meeting the West Branch of the Salmon Trout River.

Tributary to Main Branch Salmon Trout River – aka Unnamed Stream 5

Unnamed Stream 5 is located in the southwest portion of the Salmon Trout River Watershed where it flows north for 2,137.1 linear ft. (0.40 mi.) before meeting the main branch of the Salmon Trout River.

Tributary to Main Branch Salmon Trout River – aka Unnamed Stream 6

Unnamed Stream 6 is located in the southwest portion of the Salmon Trout River Watershed where it flows west for 5,185.5 linear ft. (0.98 mi.) before meeting the main branch of the Salmon Trout River

Tributary to Main Branch Salmon Trout River – aka Unnamed Stream 7

Unnamed Stream 7 is located in the southwest portion of the Salmon Trout River Watershed where it flows north for 1,524.7 linear ft. (0.29 mi.) before flowing into Unnamed Stream 8.

Tributary to East Branch Salmon Trout River – aka Unnamed Stream 8

Unnamed Stream 8 is located in the southwest portion of the Salmon Trout River Watershed where it flows northwest for 6,043.5 linear ft. (0.98 mi.) before emptying into Unnamed Stream 9.

Tributary to Main Branch Salmon Trout River – aka Unnamed Stream 9

Unnamed Stream 9 is located in the southwest portion of the Salmon Trout River Watershed where it flows northwest for 11,608.1 linear ft. (2.20 mi.) before meeting the main branch of the Salmon Trout River.

Tributary to Main Branch Salmon Trout River – aka Unnamed Stream 10

Unnamed Stream 10 is located in the southwest portion of the Salmon Trout River Watershed where it flows northeast for 2,213.2 linear ft. (0.42 mi) before flowing into Unnamed Streams 9 and 11.

Tributary to East Branch Salmon Trout River – aka Unnamed Stream 11

Unnamed Stream 11 is located in the south-central portion of the Salmon Trout River Watershed and flows from Unnamed Stream 10 to Unnamed Stream 12 for 10,815.9 linear ft. (2.05 mi.).

Tributary to East Branch Salmon Trout River – aka Unnamed Stream 12

Unnamed Stream 12 is located in the south-central portion of the Salmon Trout River Watershed where it flows northeast for 6,932.2 linear ft. (1.31 mi.) before meeting Unnamed Stream 11.

Tributary to East Branch Salmon Trout River – aka Unnamed Stream 13

Unnamed Stream 13 is located in the south-central portion of the Salmon Trout River Watershed where it flows northeast for 10,210.3 linear ft. (2.02 mi.) before meeting the East Branch of the Salmon Trout River.

Tributary to East Branch Salmon Trout River – aka Unnamed Stream 14

Unnamed Stream 14 is located in the southeast portion of the Salmon Trout River Watershed where it flows east and northwest for 10,210.3 linear ft. (1.93 mi.) before meeting the East Branch of the Salmon Trout River.

Tributary to Snake Creek – aka Unnamed Stream 15

Unnamed Stream 15 is located in the central portion of the Salmon Trout River Watershed where it flows west for 2,390.4 linear ft. (0.45 mi.) before flowing into Snake Creek.

Tributary to Clear Creek – aka Unnamed Stream 16

Unnamed Stream 16 is located in the east-central portion of the Salmon Trout River Watershed where it flows northeast for 4,787.0 linear ft. (0.91 mi.) flowing into Clear Creek.

Tributary to Clear Creek – aka Unnamed Stream 17

Unnamed Stream 17 is located in the east-central portion of the Salmon Trout River Watershed where it flows southeast for 2,931.3 linear ft. (0.56 mi.) before flowing into Unnamed Stream 18.

Tributary to Clear Creek – aka Unnamed Stream 18

Unnamed Stream 18 is located in the east-central portion of the Salmon Trout River Watershed where it flows southwest for 5,704.0 linear ft. (1.08 mi.) before flowing into Clear Creek.

Unnamed Stream 19

Unnamed Stream 19 is centrally located in the Salmon Trout River Watershed where it flows west for 5,990 linear ft. (1.13 mi.) before flowing into Snake Creek.

Murphy's Creek – aka Unnamed Stream 20

Unnamed Stream 20 is located in the northern region of the Salmon Trout River Watershed where it flows northwest for 4,802.6 linear ft. (0.91 mi.) before meeting the main branch of the Salmon Trout River.

Tributary to Main Branch Salmon Trout River at the river mouth – aka Unnamed Stream 21

Unnamed Stream 21 is located in the northern region of the Salmon Trout River Watershed where it splits from main branch of the Salmon Trout River and rejoins 2,385.2 linear ft. (0.45 mi.) upstream.

Tributary to West Branch Salmon Trout River – aka Unnamed Stream 22

Unnamed Stream 22 is located in the southwest portion of the Salmon Trout River Watershed where it flows east for 1,256.2 linear ft. (0.24 mi.) before meeting the West Branch of the Salmon Trout River.

3.14.3 Streambank Erosion

Unnatural streambank erosion generally results following an instability in flow rate or volume in the stream channel, human alteration such as channelization, or change in streambank vegetation. Resulting sediment transportation downstream can cause significant water quality problems. Streambank erosion is low on average throughout the watershed and the undercut banks are, in many locations, a natural geomorphic feature.

3.14.4 Riparian Area Condition

Riparian areas that are in good ecological condition buffer streams by filtering pollutants, providing beneficial wildlife habitat, and connecting green infrastructure. Riparian areas along the Salmon Trout River and its stream tributaries are wide and consists of predominately wetlands, forests, and shrub/old farm fields.

3.14.5 Designated Trout Streams

A Designated Trout Stream is a stream designated by the state to contain a significant population of trout or salmon. (DNR 2018). The Michigan Department of Natural Resources classifies Designated Trout Streams as Type 1 through 4, Gear Restricted, and Research Areas. There are approximately 1,400 Type 1 Designated Trout Streams in Michigan including most of the Salmon Trout River and its tributaries within the Salmon Trout River Watershed (Figure 34) These streams are high quality waters that support natural reproduction of wild trout and salmon species at or near carrying capacity (WiDNR 2017). The cold water, sand and gravel bottom streams of the Salmon Trout River Watershed is ideal habitat for various trout species such as brook trout, including the declining Coaster Brook Trout.

The Salmon Trout River is a designated research area from Lower Falls (T51N, R28W, Sec. 13) to Lake Superior. Research areas are under special fishing regulation by the Department of Natural Resources. Due to this designation, the research area on the Salmon Trout River is closed to fishing from August through April (MiDNR 2018) during the spawning and incubation periods of Coaster Brook Trout.

The Salmon Trout River Watershed is ranked 2nd out of 42 ranked subwatersheds for priority restoration by the Partnering for Watershed Restoration Group and the United States Fish and Wildlife (Figure 35) (PWR 2019). Prioritization was based on population status models, predicted future water temperatures, and field verification. The Salmon Trout River Watershed likely received high prioritization due to the presence of the last known breeding population of coaster brook trout on Lake Superior's southern coast. The spawning habitat within the watershed is currently imperiled due to the high levels of eroded sand from roads and other land use filling in the gravel beds historically used by the coaster brook trout. Restoration projects to restore the hatcheries include habitat restoration and the installation of sediment traps (Streamside 2017) to protect the area from further degradation.

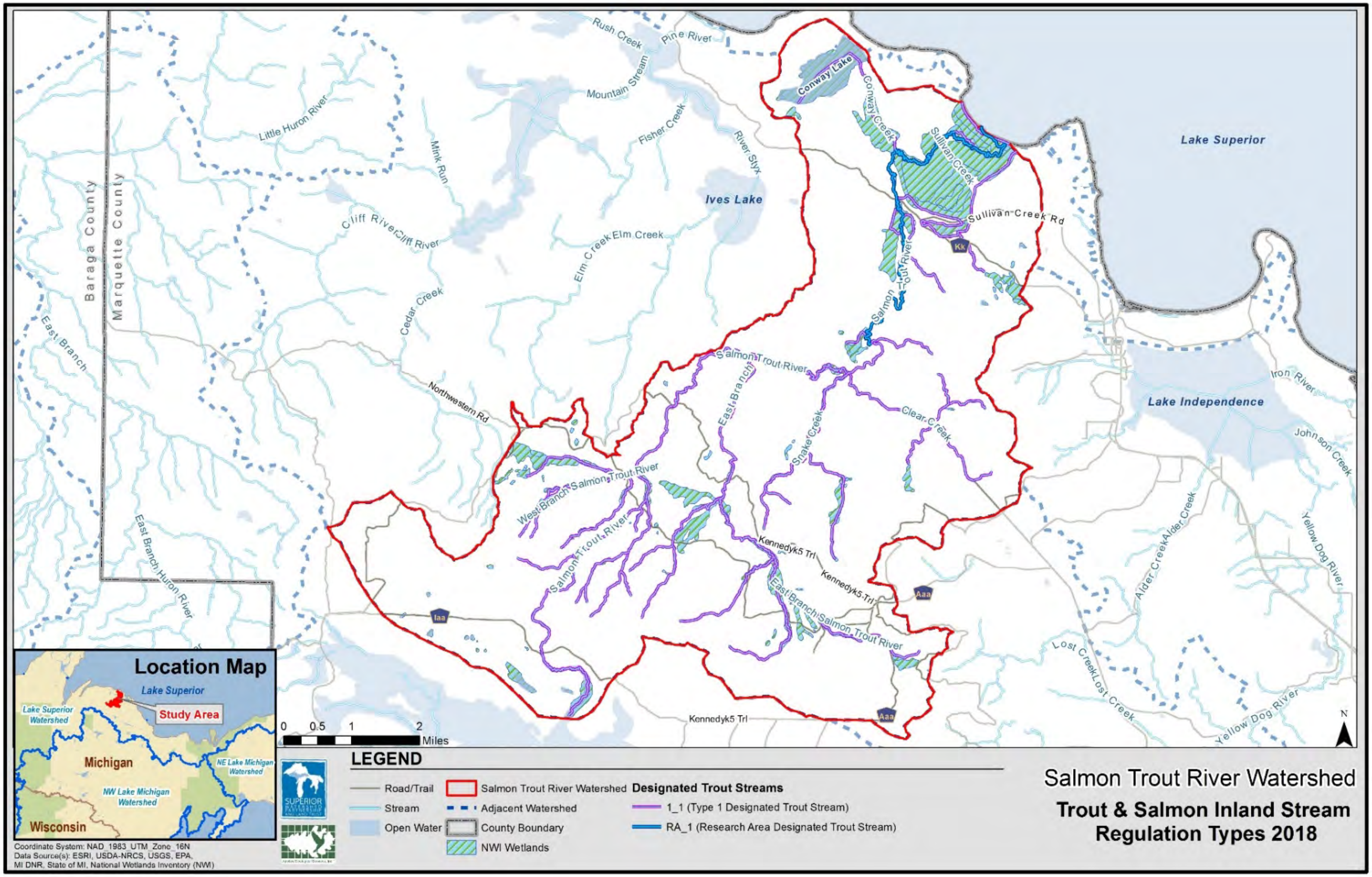

Figure 34- Trout and Salmon Inland Stream Regulation Types 2018

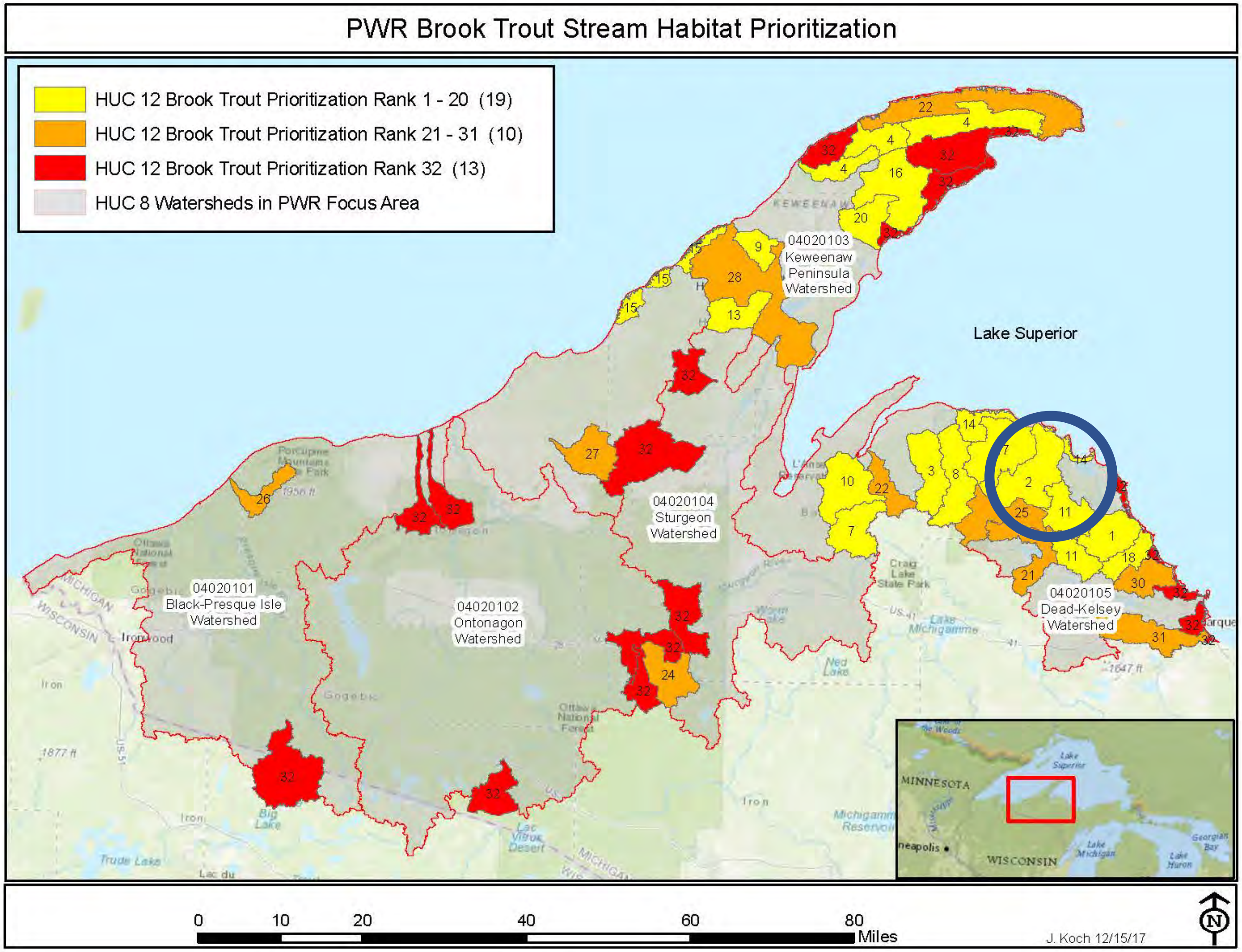

Figure 35- PWR Brook Trout Stream Habitat Prioritization (PWR, 2019)

3.14.6 Wetlands & Potential Wetland Restoration Sites
Wetlands are a critical part of the earth's hydrologic system, receiving water from snowmelt and rain, slowly releasing it from the land to recharge streams and lakes (Apfelbaum & Haney 2010). Functional wetlands do more for water quality improvement and flood reduction than any other natural resource. In addition, wetlands typically provide habitat for a wide variety of plant and animal species. They also provide some groundwater recharge capabilities and filter sediments and nutrients.

Pre-European Settlement Wetlands

Identification of historical wetland acreage is difficult, as the methods employed by surveyors in the 1800s were not consistent between surveyors as well as definitions of what constituted a wetland. By cross referencing historical surveys of vegetative cover, and locations of hydric soils within the region, there were approximately 925 acres of wetlands in the Salmon Trout River watershed prior to European settlement based on the most up to date hydric soils mapping provided by the USDA Natural Resources Conservation Service (NRCS).

Most existing wetlands in the Salmon Trout River watershed are concentrated along stream reaches towards the headwaters of the West Branch Salmon Trout, the Salmon Trout (main branch) and the East Branch Salmon Trout and its feeder creeks. They are relatively small and fragmented. This is primarily due to the geology of the region, with few small wetlands in upper reaches that are, by-in-large, disconnected from the river channel. The river carves thru granite bedrock and cascades toward Lake Superior in a very picturesque setting. Almost the entirety of wetlands in the Salmon Trout River are forested wetlands and over 19,000 acres lie within the property boundary of the exclusive Huron Mountain Club. Wetland forest types include black ash (*Fraxinus nigra*) and northern white-cedar (*Thuja occidentalis*) swamps that link together stream channels. Hemlock (*Tsuga canadensis*) and some aspen (*Populus tremuloides*) interspersed throughout the watershed. As an indicator of wetlands, hydric soils and partially hydric soils total 2,258 and 1,446 acres respectively and around 12% of the total area of the watershed (refer to Sec 3.4 for additional details), so with limited wetland soil profiles, wetland communities in this watershed were limited.

Around half of the Salmon Trout River's 20 miles lie within the exclusive Huron Mountain Club. Photo of Twin Falls on the East Branch of the Salmon Trout River (Image Courtesy Waterfalls of the Keweenaw Area, Online

National Wetlands Inventory

The US Fish and Wildlife Service USFWS is the principal Federal agency tasked with providing information to the public on the status and trends of our Nation's wetlands. The National Wetlands Inventory (NWI) relies on trained image analysts to identify and classify wetlands and deep-water habitats from aerial imagery. This online dataset National Wetlands Inventory is a publicly available resource that provides detailed information on the abundance, characteristics, and distribution of US wetlands.

The Salmon Trout River watershed has 3,167 acres of NWI (2,694 acres after surface water was backed out).

Table 16- Wetland Classifications

Wetland Category	Acres	Wetland Attributes
Pre-Euro Settlement Wetlands	925	Based on vegetation types and early records of topography
NWI Wetlands	2,694	Generally, all deep-water features within primary corridors and natural areas that are to be protected
PWR Sites	549	Potential Wetland Restoration sites >10AC (2 Categories, Hydric Soils and Pre-Settlement Wetland Overlay, see map and key)

Potential Wetland Restoration Sites

Wetland restoration projects are among the most beneficial in the context of improving watershed health. Wetlands are vitally important because they improve basic environmental functions such as storing floodwaters, increasing biodiversity, creating green infrastructure, and improving water quality. The wetland restoration process involves returning hydrology (water) and vegetation to soils that once supported wetlands but no longer do because of human impacts such as tile and ditch draining and/or filling. Potential wetland restoration sites were identified using a Geographic Information Systems (GIS) exercise whereby sites were selected that include at least 10 acres of drained hydric soils located on an open or partially open parcel where no wetlands currently exist.

The GIS exercise resulted in 22 sites meeting the above criteria in the Salmon Trout River watershed. Of the 22 sites, 4 are "High Potential", meaning they have hydric soils and 18 met the criteria for "Highest Potential" (hydric soils and pre-settlement overlay). Almost all the wetland restoration sites are located along the edge of the river or feeder creeks. It is important to note that a feasibility study beyond the scope of this project will need to be completed prior to the planning and implementation of any potential wetland restoration.

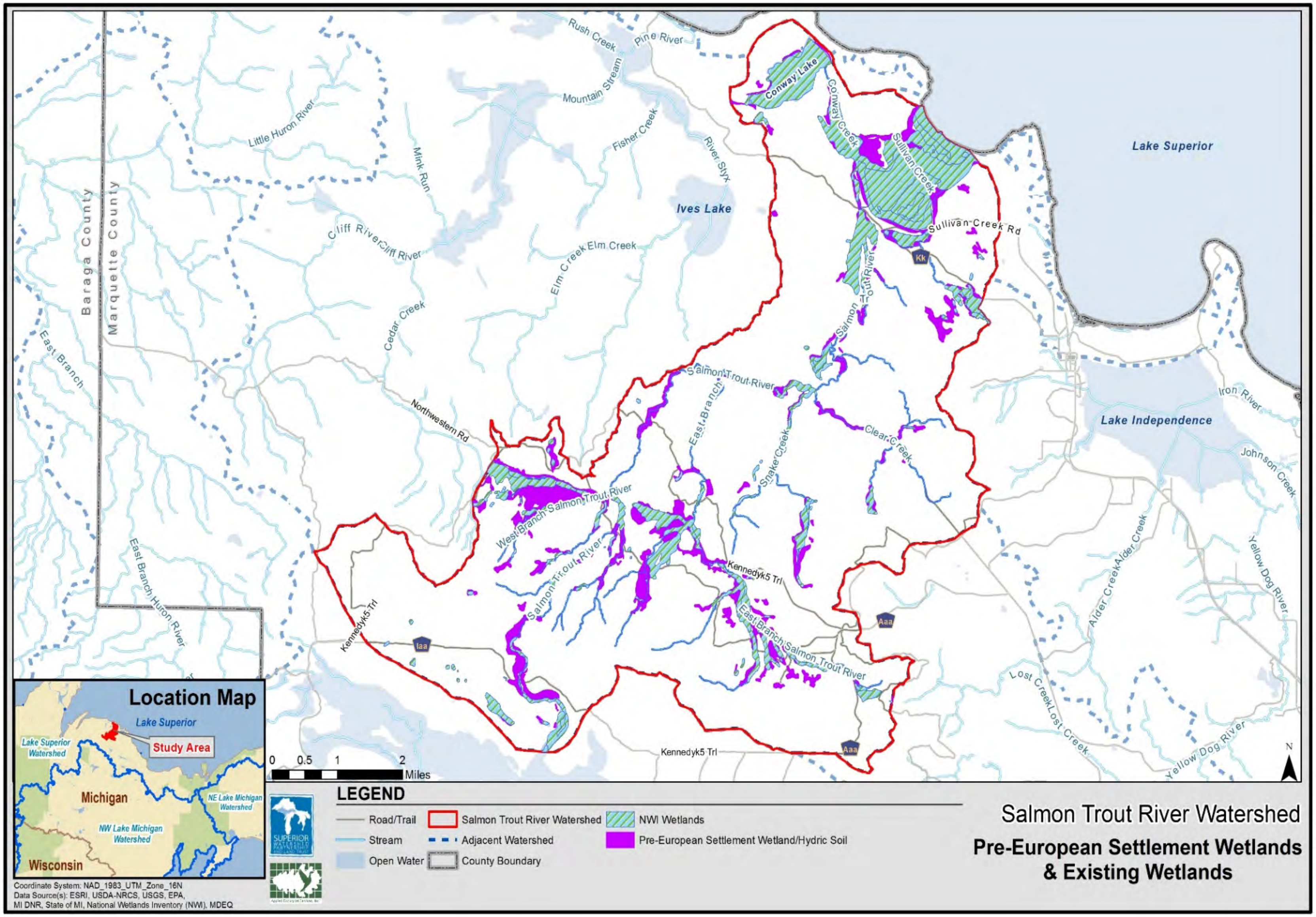
Salmon Trout River Watershed
Pre-European Settlement Wetlands & Existing Wetlands
LEGEND
Road/Trail
Stream
Open Water
Salmon Trout River Watershed
Adjacent Watershed
County Boundary
NWI Wetlands
Pre-European Settlement Wetland/Hydric Soil
Location Map
Lake Superior
Study Area
Lake Superior Watershed
Michigan
NW Lake Michigan Watershed
NE Lake Michigan Watershed
Wisconsin
0 0.5 1 2 Miles
Coordinate System: NAD_1983_UTM_Zone_16N
Data Source(s): ESRI, USDA-NRCS, USGS, EPA, MI DNR, State of MI, National Wetlands Inventory (NWI), MDEQ
Lake Superior
Lake Independence
Ives Lake
Conway Lake
Baraga County
Marquette County
Salmon Trout River
West Branch Salmon Trout River
East Branch Salmon Trout River
Sullivan Creek Rd
Kennedyk5 Trl
Northwestern Rd

Figure 36- Pre-European Settlement Wetlands and Existing Wetlands

3.14.7 Floodplain

FEMA 100-Year Floodplain

Functional floodplains along stream, river, and lake corridors perform a variety of green infrastructure benefits such as flood storage, water quality improvement, passive recreation, and wildlife habitat. The most important function however is the capacity of the floodplain to hold water following significant rain events to minimize flooding downstream. The 100-year floodplain is defined by the Federal Emergency Management Agency (FEMA) as the area that would be inundated during a flood event that has a one percent chance of occurring in any given year (100-year flood). 100-year floods can and do occur more frequently, however the 100-year flood has become the accepted national standard for floodplain regulatory and flood insurance purposes and was developed in part to guide floodplain development to lessen the damaging effects of floods.

The 100-year floodplain along streams also includes the floodway. The floodway is the portion of the stream or river channel that comprises the adjacent land areas that must be reserved to discharge the 100-year flood without increasing the water surface. Figure 37 depicts the 100-year floodplain and floodway in relation to a hypothetical stream channel.

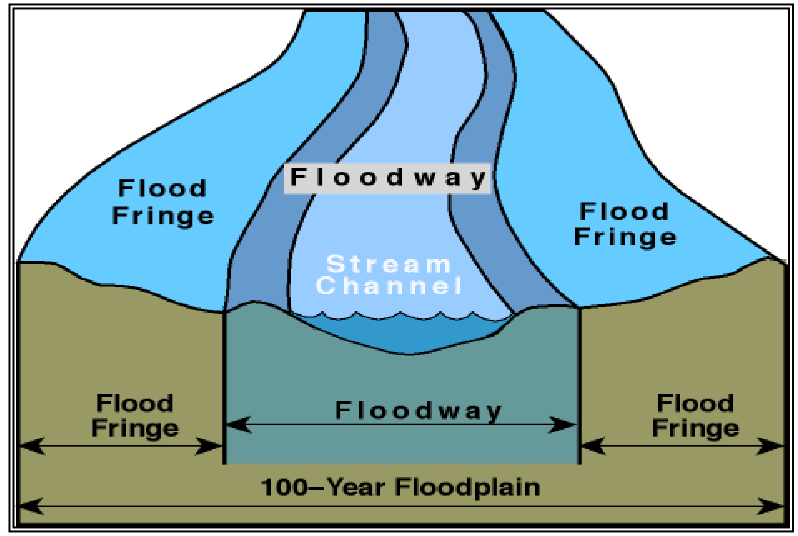

Figure 37- 100-year floodplain and floodway depiction along streams. (Source: Ozaukee County)

Figure 38 depicts the 100-year floodplain which occupies 763 acres or about 2% of the watershed. The most extensive floodplain areas are associated with flat low-land areas in the northern, downstream portion of the watershed. The large wetland area near the Salmon Trout River outlet is entirely within the floodplain.

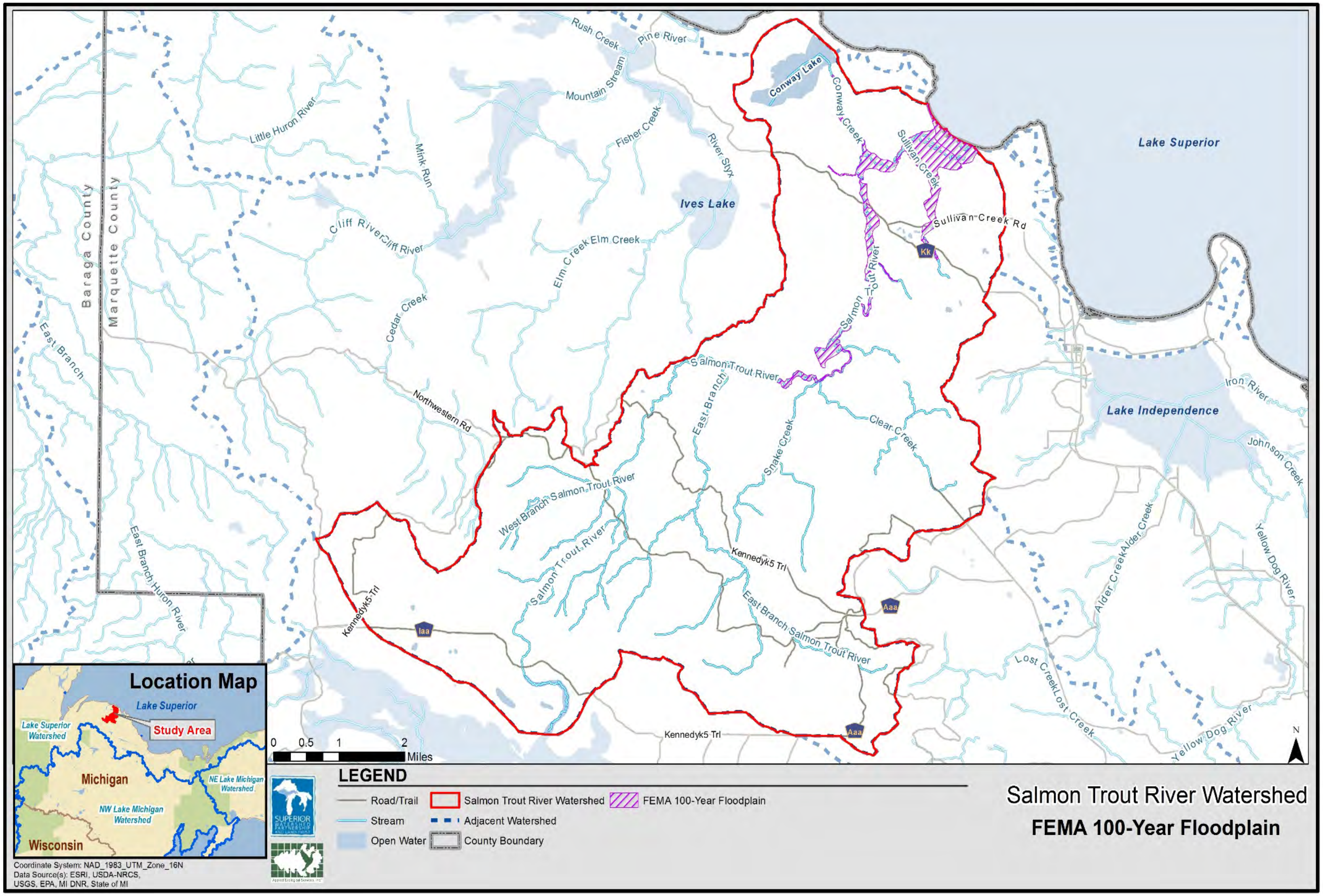
Salmon Trout River Watershed
FEMA 100-Year Floodplain
LEGEND
Road/Trail
Stream
Open Water
Salmon Trout River Watershed
Adjacent Watershed
County Boundary
FEMA 100-Year Floodplain
Location Map
Lake Superior
Study Area
Lake Superior Watershed
Michigan
NE Lake Michigan Watershed
NW Lake Michigan Watershed
Wisconsin
0 0.5 1 2 Miles
Coordinate System: NAD_1983_UTM_Zone_16N
Data Source(s): ESRI, USDA-NRCS, USGS, EPA, MI DNR, State of MI
Lake Superior
Lake Independence
Ives Lake
Conway Lake
Baraga County
Marquette County
Salmon Trout River
West Branch Salmon Trout River
East Branch Salmon Trout River
East Branch
Conway Creek
Sullivan Creek
Clear Creek
Snake Creek
Elm Creek
Cedar Creek
Cliff River
Little Huron River
Mink Run
Mountain Stream
Fisher Creek
Rush Creek
Pine River
River Styx
East Branch Huron River
Iron River
Johnson Creek
Yellow Dog River
Alder Creek
Lost Creek
Northwestern Rd
Sullivan Creek Rd
Kennedyk5 Trl

Figure 38- FEMA 100-Year Floodplain

3.15 Groundwater Aquifers & Recharge, Contamination Potential, & Water Supply

Groundwater Aquifers and Recharge

Groundwater is water that saturates small spaces between sand, gravel, silt, clay particles, or crevices in underground rocks. Groundwater is found in aquifers or underground formations that provide readily available quantities of water to wells, springs, or streams. Groundwater is important to the Great Lakes ecosystem because it provides a reservoir for storing water and slowly replenishing the lakes in the form of base flow in the tributaries.

Groundwater resources of Marquette County are divided between bedrock aquifers and those in glacial deposits. Depending on location within the county, wells range from less than 100 feet to reach bedrock aquifers in the northern and far southern parts, and up to 200 feet to draw water from glacial deposits in the central part of the county (USGS, 1992 and 1982).

Geology in the Salmon Trout River watershed consists of bedrock of Precambrian age, specifically, metamorphic formations in the eastern portion of the watershed and metasedimentary formations in the western portion. As mentioned in the geology section, the Upper Peninsula was glaciated multiple times, resulting in deposition ranging from nothing to over 400 feet. In the watershed, the quaternary geology includes glacial outwash-sand/gravel-postglacial alluvium, coarse-textured glacial till, and thin to discontinuous glacial till over bedrock.

Typically, these bedrock and quaternary geology formations have relatively low yields of groundwater due to their relative lack of storage capacity. The storage capacity and yield of the outwash and till quaternary geology is largely dependent on its thickness. The Precambrian bedrock aquifers have similar characteristics, and hold water in fractures and joints, with bedrock covered in glacial deposits having the most capacity. Groundwater in the area is typically high in iron and hardness.

In the region, the yield from aquifers is generally enough for private wells, which typically draw from small-diameter, shallow wells in glacial outwash (USGS, 1982).

Powell Township draws from one well with 20 feet of 8-inch screen set between 136’ to 156’ in the glacial deposits. Eight to nine hours of pumping draw 16,800 to 24,000 gallons. Also supplies the town of Big Bay.

With the dense, Precambrian bedrock layer acting predominantly as an aquitard, groundwater travels horizontally relatively easily through the glacially deposited quaternary layers. Similar to surface water, groundwater flows through the landscape eventually discharging to the lowest point; typically, a lake or river. Wells can affect this flow by lowering the local water level and creating a gradient where the well is the lowest point, rather than the typical body the groundwater would discharge to; this is called a cone of depression. A combination of water table drawdown due to groundwater withdrawal and hydrological droughts can result in decreasing recharge to streams, lakes, and wetlands.

Soil-water recharge estimates from the EGLE show recharge occurs mostly along the southwestern portion of Salmon Trout River watershed (Figure 39) where topography is relatively flat. These numbers are reported similar to precipitation, in inches per year (Table 17). The lower soil-water balance recharge values across the watershed generally relate to areas where steep topography forces water to move as overland flow, and low land area where water typically discharges rather than recharges.

Table 17- Annual Groundwater Recharge Area

Inches/Year	Acres	% of Watershed
10	5,852	18.4
11	8,766	27.6
12	11,961	37.7
13	5,180	16.3
Totals	**31,760**	**100**

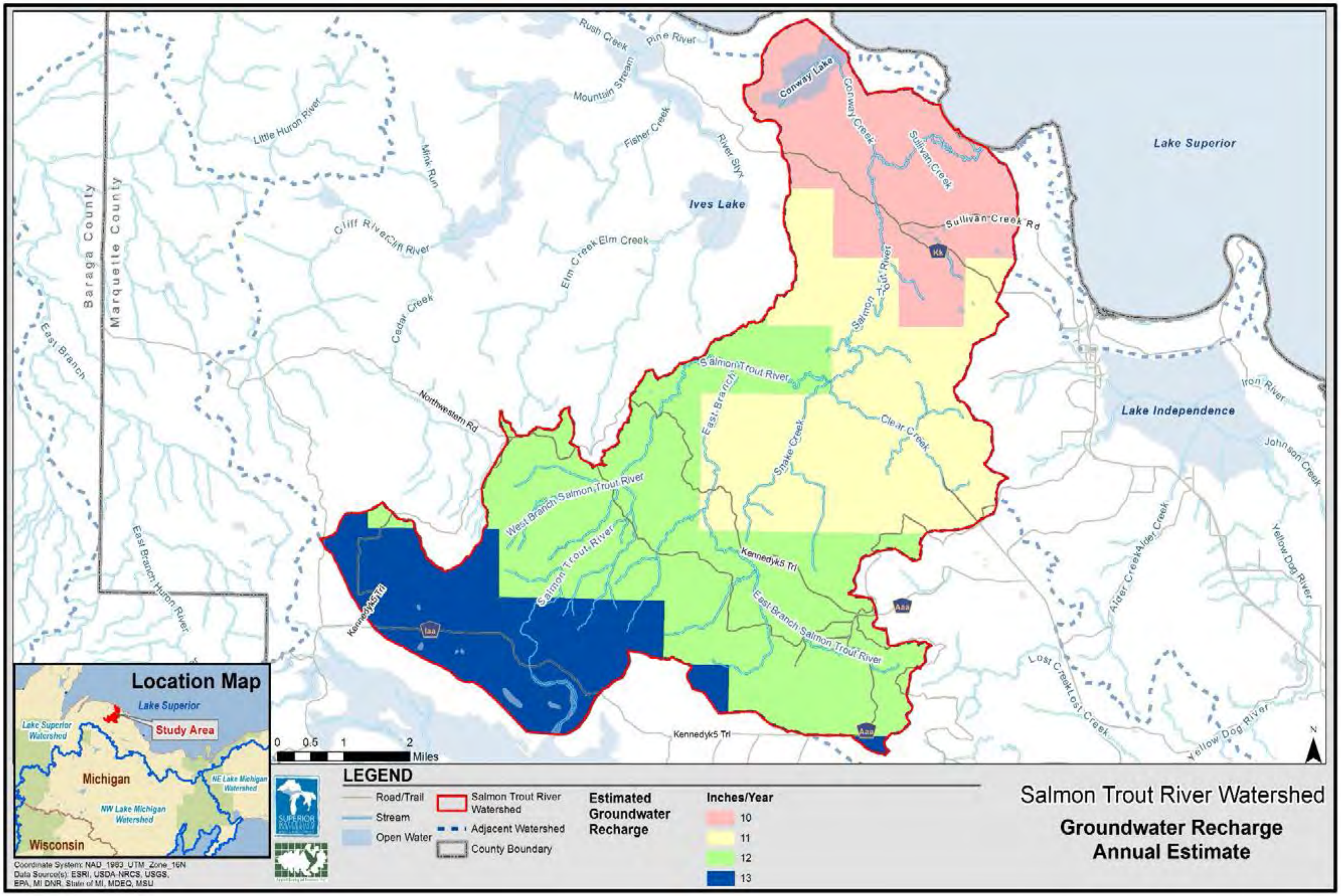

Figure 39- Groundwater Recharge Annual Estimate

Groundwater Contamination Potential

According to the US Geological Survey (USGS), unconsolidated and semi-consolidated sand and gravel aquifers, such as those found in the Salmon Trout River watershed, are particularly susceptible to contamination. Given municipalities and private residents draw drinking water from local wells, it is important that the groundwater is protected.

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) identifies areas which should be targeted for groundwater protection measures. These areas are referred to as Wellhead Protection Areas. Michigan's voluntary Wellhead Protection Program helps communities protect their drinking water by identifying the groundwater contributing area, identifying potential sources of contamination, and developing procedures to manage the area in order to minimize threats. The program includes steps to determine roles within the protection plan, wellhead protection area, potential sources of contamination, determining management plans to prevent contamination, contingency planning, assessing aquifer capacity for new development, and developing a public education program.

Though wellhead protection programs are excellent means of protecting community drinking water, there are still many private wells at risk of contamination. Housing located away from municipalities is typically not accessed by a water or wastewater distribution network, and therefore must incorporate private drinking water wells as well as septic systems. However, in a system where the aquifer is unconfined and composed of unconsolidated material, contaminants can easily travel into drinking water systems, and out of septic treatment systems. Therefore, it is important for communities to be aware of the potential contaminant sources for their drinking water. Some of those sources are: leaking storage tanks, superfund sites, oil and gas spills, hazardous water generators, groundwater discharges, agricultural operations, septic systems, landfills, industrial and manufacturing facilities, abandoned wells, and others.

One particular risk identified within the Salmon Trout River watershed, is that posed by the activities of the Eagle Mine situated at the southern end of the watershed. Metallic sulfide mining (aka hard rock mining) poses a significant threat to water quality as well as the designated uses discussed in Section 4.0. When the mineral or waste rock is brought to the surface during the mining process, oxidation creates sulfuric acid as a waste product, typically referred to as "acid mine drainage." This process is caused when acidifying compounds are released in the area though atmospheric emissions and through the drainage of acidic waters. The acidification of soils surrounding hard rock mining operations increases mobility of heavy metals into plant tissue, as well as through the soil. Surface soils in the vicinity of mines and smelters see elevated concentrations of copper, cadmium, lead, zinc, and nickel which is transported into waterways via erosion and percolation into groundwater (Dudka, 1997). As with any of the potential contaminant sources, public awareness, regulation, permitting, and monitoring are key to protecting environmental health.

Potential problem areas are places where naturally vulnerable areas overlap areas where potential contaminant sources are located. While practices like zoning regulations are effective at preventing the two from overlapping; it is very important that extra diligence is paid to this given the high hydraulic conductivity of the soils and the dependence local residents have on groundwater

Community Water Supply

Groundwater is an essential resource to the Upper Peninsula as underlying aquifers provide the drinking water supply for many people. According to an EGLE well inventory within Marquette County, since 2000 there have been over 2500 private water wells drilled. There is one active public water supply well located within the Salmon Trout River watershed (Table 18).

Table 18- Community Water Supply

WSSN	Name	Population	Source
00700	Powell Township	300	GW

4.0 WATER QUALITY ASSESSMENT

4.1 Point and Nonpoint Source Water Quality Pollutants

Water quality can be adversely affected by both point and nonpoint source pollutants. Point sources are identified as any discharge that comes from a pipe or permitted outfall, such as municipal and industrial discharges. Municipal and industrial discharges within Salmon Trout River watershed are regulated by Michigan's National Pollution Discharge Elimination System (NPDES) program and Industrial Pretreatment Program (IPP).

Table 19-NPDES permitted sites in Salmon Trout River watershed.

Permit Number	Site Name	City	Permit Category	Site Type
MIR111571	A Lindberg & Sons-Long Year	Big Bay	NPDES Construction Storm Water Notice of Coverage (NOC)	Construction Site

Michigan NPDES Permit Program

The Federal Water Pollution Control Act of 1948 established the first legislation aimed at addressing water pollution. Section 402 of the federal Clean Water Act established the National Pollutant Discharge Elimination System in 1972. This program regulates point source discharges of pollutants into United States waters and sets specific limits on discharges from point sources, establishes monitoring and reporting requirements, and establishes exceptions. The permitting program is designed to prevent storm water runoff from washing harmful pollutants into local surface waters such as streams, rivers, lakes or coastal waters. It also allows for the USEPA to authorize states to assume many of the permitting, administrative, and enforcement responsibilities of the program (USEPA 2012). In Michigan, the authority to administer the Federal Water Pollution Control Act was delegated to the Michigan Department of Environment, Great Lakes, and Energy. While the permitting process has evolved over time the Act has four main tenants:

1. *The discharge of pollutants to navigable waters is not a right.*
2. *A discharge permit is required to use public resources for waste disposal and limits the amount of pollutants that may be discharged.*
3. *Wastewater must be treated with the best treatment technology economically achievable - regardless of the condition of the receiving water.*
4. *Effluent limits must be based on treatment technology performance, but more stringent limits may be imposed if the technology-based limits do not prevent violations of water quality standards in the receiving water.* EGLE 2019

A National Pollutant Discharge Elimination System (NPDES) permit is required of anyone discharging waste or wastewater into surface waters in Michigan. Indirect discharges (those who discharge to a municipal treatment facility via a sanitary sewer) do not need an NPDES permit but may require a permit from the municipality under the Industrial Pretreatment Program (IPP). Goals of the Industrial Pretreatment Program include maintaining and restoring watershed quality, encouraging pollution prevention, prevention of poisonous gases forming in sanitary sewer systems, increased beneficial uses of sewage sludge, and helped communities to meet wastewater discharge standards (EGLE 2019).

NPDES Permit Sites

There is only one permitted NPDES site within the Salmon Trout River watershed (Table 19). It is a construction site permit held by A Lindberg & Sons – Long Year. There are no municipal permits within the watershed.

Nonpoint Source Pollutants

Nonpoint source pollutants are pollutants that enter a waterway from a source other than a pipe or permitted outfall. Historically these pollutants are the most difficult to control because tracking them back to their source is difficult. Nonpoint source pollutants can include, but are not limited to, illicit discharges into waterways, excess nutrients (such as nitrogen and phosphorus), oils and chemicals washed off of roadways (such as chlorides from deicing agents), and/or excess sediment (from construction sites or streambank destabilization). Most nonpoint source pollutants are monitored via physical-chemical water quality testing.

4.2 Water Quality Report, Designated Use, & Impairments

The Federal Clean Water Act requires Michigan and all other states to submit to the United States Environmental Protection Agency (USEPA) a biannual report of the quality of the state's surface and groundwater resources and an updated Section 303 (d) list. The *Water Quality and Pollution Control in Michigan 2020 Sections 303(d), 305(b), and 314 Integrated Report* was compiled by the Michigan Department of Environment, Great Lakes and Energy (EGLE) and is the most recent of these reports to be finalized. This report must also describe how Michigan assessed water quality and whether assessed waters meet or do not meet water quality standards specific to each "Designated Use" of a stream or lake as defined in the State of Michigan's Part 4 Rules of the Water Resources Protection Act (Act 451, Part 31). When a waterbody is determined through biological and/or physical-chemical sampling to be impaired, EGLE must list potential causes and sources for impairment in the 303 (d) impaired waters list (EGLE 2020).

Michigan's Water Quality Standards require that all designated uses of surface waters be protected, and those designated uses include: agriculture, navigation, industrial water supply, public water supply at the point of water intake, warmwater or cold water fish, other indigenous aquatic life and wildlife, fish consumption, partial body contact recreation, and total body contact recreation from May 1 to October 31 (EGLE, 2020). Each designated use is associated with particular water quality criteria and set the standards a waterbody must meet in order to protect the intended use.

According to EGLE's *Water Quality and Pollution Control in Michigan 2020 Sections 303(d), 305(b), and 314 Integrated Report* (EGLE, 2020), Salmon Trout River, Clear Creek, East Branch Salmon Trout River, East Branch Snake Creek, Snake Creek and West Branch Salmon Trout River are all fully supporting the use designations for agriculture, navigation, and industrial water supply. Salmon Trout River is fully supporting for fish consumption and cold-water fishery while the remaining streams were not assessed for the fish consumption or cold-water fishery use designations. Salmon Trout River is not supporting of other indigenous aquatic life and wildlife due to mercury in the water column, however it was delisted when Total Maximum Daily Load (TMDL) was approved by the EPA in 2018. The remaining streams in the watershed are all fully supporting of the other indigenous aquatic life and wildlife designated use. None of the streams in the watershed were assessed for the total body contact recreation, partial body contact recreation, and warm water fishery use designations. Additionally, the lakes within the Salmon Trout River watershed were assessed only for the navigation, agriculture, and industrial water supply uses and all are fully supporting for these uses. Use designations for all waterbodies in the Salmon Trout River watershed are summarized in Table 20 (EGLE 2020).

Table 20- Use designation assessments for the Salmon Trout River watershed

	USE DESIGNATIONS								
AUID/Waterbody	**Agriculture**	**Navigation**	**Industrial Water Supply**	**Other Indigenous Aquatic & Wildlife**	**Fish Consumption**	**Total Body Contact Recreation**	**Partial Body Contact Recreation**	**Warm Water Fishery**	**Cold Water Fishery**
040201050401-01/ Clear Creek, East Branch Salmon Trout River, East Branch Snake Creek, Salmon Trout River, Snake Creek and West Branch Salmon Trout River	**Full**	**Full**	**Full**	**Full**	**NA**	**NA**	**NA**	**NA**	**NA**
040201050401-02/ Salmon Trout River	**Full**	**Full**	**Full**	**TMDL Approved**	**Full**	**NA**	**NA**	**NA**	**Full**
040201050401-NAL/Lakes	**Full**	**Full**	**Full**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Abbreviations: Full - Fully Supporting, Not - Not Supporting, NA - Not Assessed, TMDL – Total Maximum Daily Load approved
Cells highlighted in green fully meet the use designation, cells highlighted in red do not meet the use designation, and all remaining uses were not assessed.

Table 21 Use designations of the Salmon Trout River

Designated Uses	Status
Coldwater Fishery	Threatened
Other Indigenous Aquatic Life and Wildlife Threatened	Threatened
Public Water Supply (groundwater)	Threatened

Desired Uses

The Salmon Trout River watershed Technical Advisory Group also identified a number of locally determined desired uses for the watershed. Desired uses are factors important to the watershed stakeholders. They reflect the way stakeholders want to use the watershed and their desire to maintain it for future generations. In the course of consultation with the Technical Advisory Group and stakeholders of the Salmon Trout River watershed, one overarching desired uses became apparent - the preservation of this unique natural watershed. Specific factors, important to the stakeholders were protecting critical habitat for coaster brook trout, limiting development to areas outside the riparian corridor, and promoting sustainable and environmentally sound land use management practices to provide long-term protection of water quality. Furthermore, the results of the ecosystem services valuation (ESV) assessment involving an April 2017 webinar/workshop and analysis by Key-Log Economics identified the highest ecosystem service values, in terms of their monetary value to humans, in the watershed (Phillips 2018).

Table 22: Highest ESV Categories by Value

1. Recreation
2. Food/Nutrition
3. Aesthetics
4. Protection from Extreme Events

4.3 Physical, Chemical, and Biological Water Quality Monitoring

In Michigan, EGLE manages a number of programs that collect and report physical, chemical, and biological, and habitat monitoring throughout the state in order to assess the health of streams and waterbodies and to determine water quality condition and/or impairment. Table 23 lists all known water quality data collected in the watershed from 2008 through 2018 while Figure 40 displays the location of each sample site where the data was collected. In general, the most recent data is analyzed and averaged so that recommendations and management strategies are based on the most current depiction of the water quality and biological conditions. All of the water quality monitoring was performed by USGS Michigan Water Science Center and tested for the same list of parameters, except where noted. The list of parameters includes alkalinity, aluminum, ammonia and ammonium, antimony, arsenic, barium, barometric pressure, beryllium, cadmium, calcium, carbon dioxide, chloride, chromium, cloud cover, cobalt, copper, detergent, fish kill, floating algae mat, floating debris, floating garbage, fluoride, gage height, gross-uranium, hardness, hydrogen ion, inorganic nitrogen, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, nitrate, nitrite, nitrogen (total), odor, oil and grease, organic carbon, organic nitrogen, orthophosphate, oxygen, pH, phosphorus, potassium, RBP high water mark, RBP stream width, selenium, silica, silver, sodium, specific conductance, stream flow, sulfate, suspended sediment concentration, suspended sediment, discharge, water temp, total dissolved solids, turbidity, vanadium, wind velocity, and zinc.

Table 23- List of water quality sample locations, dates, and parameters from 2008 to 2018.

Site ID	Organization	WQX Monitoring ID	Monitoring Location/Name	Monitoring Type	Date or Date Range	Water Quality and other Parameters
S01	USGS Michigan Water Science Center	USGS-04043237	SALMON TROUT RIVER AT TRIPLE A ROAD NR BIG BAY, MI	Stream	5/28/13 - 10/19/16	USGS list
S02	USGS Michigan Water Science Center	USGS-04043238	SALMON TROUT RIVER NEAR BIG BAY, MI	Stream	5/14/09 - 10/18/16	USGS list + bicarbonate, kjeldahl nitrogen
S03	USGS Michigan Water Science Center	USGS-040432383	TRIB TO SALMON TROUT RIVER NEAR DODGE CITY, MI	Stream	5/29/13 - 10/18/16	USGS list
S07	USGS Michigan Water Science Center	USGS-040432425	TRIB TO E BR SALMON TROUT RIVER NR DODGE CITY, MI	Stream	5/29/13 - 10/19/16	USGS list
S06	USGS Michigan Water Science Center	USGS-04043243	TRIB TO E BR SALMON TROUT R NEAR DODGE CITY, MI	Stream	5/29/13 - 10/19/16	USGS list
S04	USGS Michigan Water Science Center	USGS-040432437	TRIB TO E BR SALMON TROUT R NR DODGE CITY, MI	Stream	5/29/13 - 10/19/16	USGS list
S05	USGS Michigan Water Science Center	USGS-04043244	EAST BRANCH SALMON TROUT RIVER NEAR DODGE CITY, MI	Stream	5/14/2009	USGS list + bicarbonate, kjeldahl nitrogen
Sp08	USGS Michigan Water Science Center	USGS-464459087504201	STE-83-001	Spring	5/31/13 - 10/18/16	USGS list
Sp07	USGS Michigan Water Science Center	USGS-464526087513901	STE-67-002	Spring	5/31/13 - 10/18/16	USGS list
Sp02	USGS Michigan Water Science Center	USGS-464539087532301	STM-53-009	Spring	5/30/13 - 10/17/16	USGS list
Sp05	USGS Michigan Water Science Center	USGS-464541087523301	STE-51-005	Spring	5/30/13 - 10/17/16	USGS list
Sp01	USGS Michigan Water Science Center	USGS-464542087531101	STM-53-002	Spring	5/30/13 - 10/17/16	USGS list
Sp06	USGS Michigan Water Science Center	USGS-464543087523001	STE-51-023	Spring	5/30/13 - 10/17/16	USGS list
Sp04	USGS Michigan Water Science Center	USGS-464543087523201	STE-51-022	Spring	5/30/13 - 10/17/16	USGS list
Sp03	USGS Michigan Water Science Center	USGS-464545087522801	STE-51-024	Spring	5/30/13 - 10/17/16	USGS list

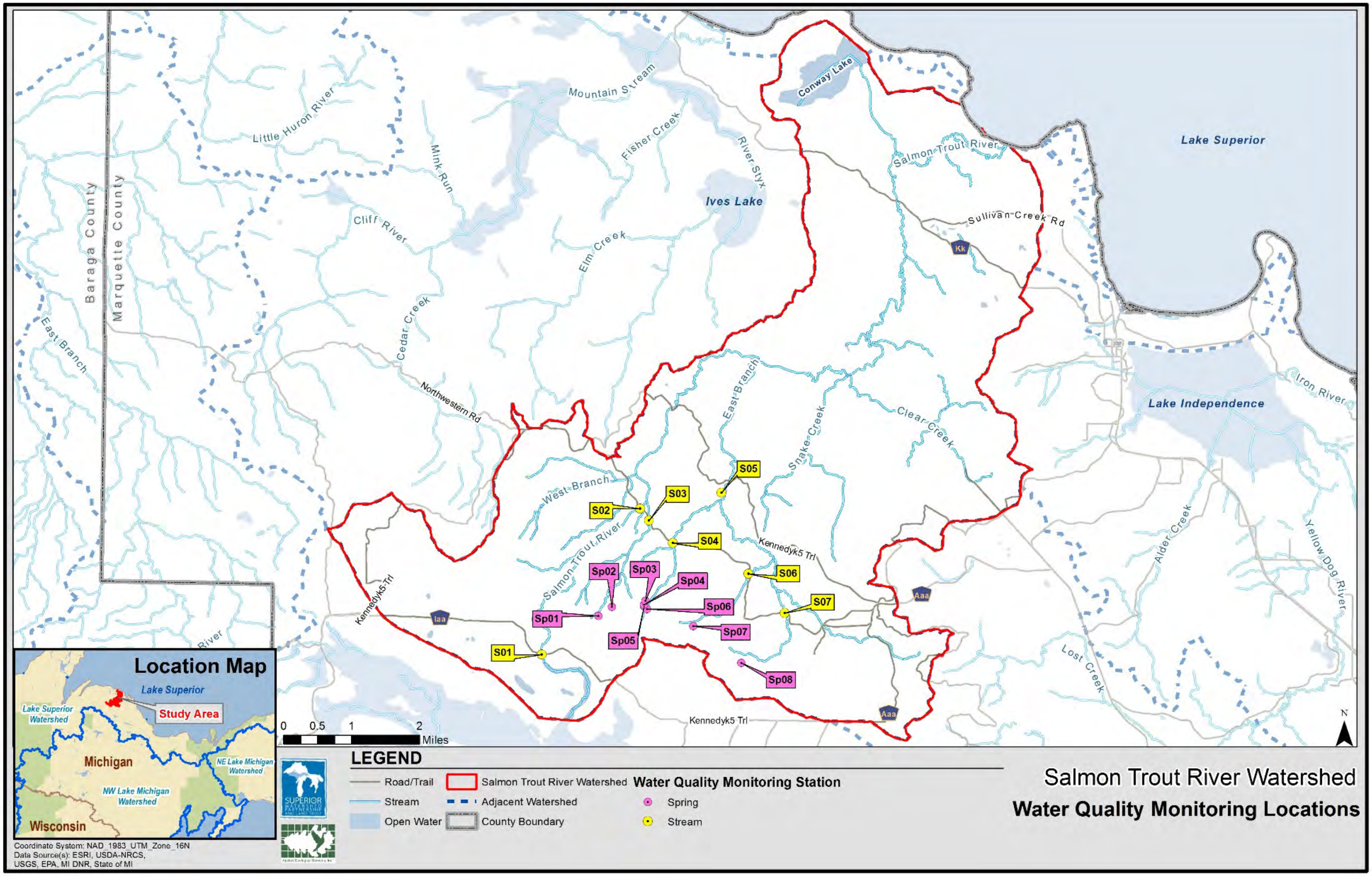

Figure 40- Water Quality Locations

Water Chemistry Monitoring

All streams within the Salmon Trout River watershed fully support their designated uses with one exception. Salmon Trout River is not supporting of other indigenous aquatic life and wildlife use designation due to mercury in the water column; however, the Salmon Trout River was delisted for impairment when a Total Maximum Daily Load (TMDL) was approved in 2018 to address this designated use.

Table 24 summarizes the USGS Michigan Water Science Center water quality sample results for Salmon Trout River watershed from 2008 to 2018 and also provides statistical and numerical guidelines for the various criteria. Michigan provides numeric guidelines within its administrative code for many physical and chemical characteristics within Act 451, Part 31 Water Quality Standards (Part 4 Rules); for this report water temperature, dissolved oxygen, pH, dissolved solids, chlorides, and mercury were summarized and held against Michigan's water quality standards. Michigan has not yet derived their own guidelines for nutrient criteria so USEPA's Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion VIII guidelines were utilized (USEPA, 2001).

Noteworthy- Numeric Water Quality Standards

USEPA has tasked states to establish *numeric* water quality standards for nutrients (phosphorus and nitrogen) in lakes and streams. To date, Michigan has not developed *numeric* standards for phosphorus and nitrogen in streams. *Numeric* criteria have been proposed by USEPA for nutrients based on a reference stream method for the Nutrient-Poor, Largely Glaciated Upper Midwest and Northeast Ecoregion (VIII) which includes Salmon Trout watershed.

While many physical and chemical criteria were sampled for, this report summarizes results only for water temperature, dissolved oxygen, pH, dissolved solids, chlorides, mercury, nitrogen, phosphorus, and dissolved solids. All other sample results for other sampled parameters fell within normal values. This report summarized results from stream water quality sampling Site S05 because it is the most downstream water quality sampling site within the watershed and Site S01 because it was the only stream sampling site for which mercury was detected.

Additionally, spring water quality sampling Site Sp06 results are provided as a reference but springs should not necessarily be held to the outlined stream guidelines since they are groundwater fed.

Table 24- Surface water sampling parameters, guidelines, and results for Salmon Trout watershed.

Parameter	**Statistical, Numerical, or General Use Guidelines**	**Site S01**	**Site S05**	**Site Sp06*****
Temp (F)	<74° F*	MAX 72	MAX 66	60
Dissolved Oxygen (DO)	>7.0 mg/l*	AVG 9.2	AVG 10	8.4
pH	>6.5 or <9.0*	AVG 7.4	AVG 7.6	7.1
Dissolved Solids	<500 mg/L*	AVG 45.8	AVG 73	52.9
Chlorides	<50 mg/L*	AVG 0.4	AVG 0.3	0.3
Total Nitrogen	<0.44 mg/L**	AVG 0.26	AVG 0.33	0.85
Total Phosphorus (TP)	<0.012 mg/L**	AVG 0.013	AVG 0.019	0.122
Mercury	0 ug/L*	AVG 0.005	AVG ND	0.0178

- (Previous page) Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines, cells in orange are for reference.

- Temperature listed as the maximum value available for each site.

* State of Michigan's Part 4 Rules, Water Quality Standards (of Part 31, Water Resources Protection, of Act 451 of 1994)

** Ambient Water Quality Criteria Recommendations Rivers and Streams in Nutrient Ecoregion VIII, USEPA 2001

** Spring results shown as reference, but should not necessarily be held to stream guidelines

Phosphorus exceeds the guidelines set forth in USEPA's Ambient Water Quality Criteria Recommendations Rivers and Streams in Nutrient Ecoregion VIII. Phosphorus exceeds the target, but the value is higher in the spring sample than the stream sample, indicating that the source might be groundwater or atmospheric deposition, rather than overland flow. Additionally, mercury was detected in samples at Site S01, resulting in not supporting the designated use of other indigenous aquatic life and wildlife and ultimately in the scheduling of a TMDL for the Salmon Trout River, and it was delisted when Total Maximum Daily Load (TMDL) was approved by the EPA in 2018. Mercury was also detected at one spring location suggesting that atmospheric deposition may be the source.

Nutrients such as phosphorus and nitrogen are a necessary component of plant growth and are therefore included in many fertilizers. Unfortunately, both have adverse effects on water quality, with phosphorus being particularly detrimental to aquatic systems in excess quantities. These nutrients are typically applied as fertilizer, either in an agricultural setting or by applicators or residents and the excess nutrients not absorbed by plants are then washed into waterways. Excess nutrients can cause algal blooms, accelerated plant growth, decreasing oxygen levels, and can lead to fish kills. Currently there is no Michigan state standard for nitrogen or phosphorus; however the USEPA's ambient water quality criteria recommend a concentration of less than 0.44 mg/L for nitrogen and less than 0.012 mg/L for phosphorus.

Mercury can be a source of environmental contamination when present in seed dressing fungicides, anti-slime fungicides in pulp and paper industries, by-products of burning coal, mine tailings, wastes from chlorine-alkali industries, and from atmospheric deposition. In 1994, the EPA settled a case with Copper Range Company in White Pine, Michigan (approximately 50 miles northwest of Watersmeet) due to airborne emissions of excessive amounts of mercury, some of which contaminated "water and surrounding landscape of the Lake Superior Basin (Brooks, 1993)." Whatever the source, mercury finds its way into water sources and can impair a stream or lake's biological community and, in extreme cases, its recreational potential. Most metals are acutely and chronically toxic to all forms of life and have the capacity to bioaccumulate in the food web. There is likely no point source of mercury in the watershed. Rather, atmospheric deposition (from global coal combustion) is a likely source and is not addressed in this planning effort. Again, a TMDL assessment and report was established to address mercury.

Community Environmental Monitoring Program
The Community Environmental Monitoring Program (CEMP), a periodic water sampling program of the Eagle Mine, began in 2012 and is implemented by the Superior Watershed Partnership in cooperation with the Keweenaw Bay Indian Community and the Community Foundation of Marquette County. The program will continue through the life of the mine (2025) under a new agreement. To date there have been no (0) state permit violations at Eagle Mine or Humboldt Mill, and more information about the program, results, and interactive site maps may be found at https://swpcemp.org/page/monitoring/.

Biological Monitoring
Biological data can also be used in conjunction with physical-chemical data to determine the health of a waterbody. Michigan utilizes the Great Lakes and Environmental Assessment Section (GLEAS) Procedure 51 protocols for sampling biological communities. This protocol uses a scaled scoring metric as follows (EGLE, 1996):

+1 = *Community performing better than the average condition found at the excellent sites;*

0 = *Community performing between the average condition and (minus) 2 standard deviations from the average condition found at the excellent site;*

-1 = *Community performing outside of (minus) 2 standard deviations from the average condition found at the excellent sites.*

According to EGLE, biological monitoring within Salmon Trout River watershed was conducted at three different sites in 2004 and 2006. Each site was rated for multiple taxa or populations of organisms; on average, all biological communities within the Salmon Trout watershed were rated between 0 and +1, more commonly at +1.

Additional biological monitoring was conducted through the Michigan Clean Water Corps (MiCorps) Volunteer Stream Monitoring Program (VSMP). MiCorps is a network of volunteer water quality monitoring programs in Michigan. It was created through Michigan Executive Order #2003-15 to assist the Department of Environment, Great Lakes, and Energy (EGLE) in collecting and sharing water quality data for use in water resources management and protection programs. MiCorps supports and trains volunteer monitoring organizations interested in monitoring the benthic macroinvertebrate communities in their streams and rivers. Yellow Dog Watershed Preserve (YDWP) conducts a number of macroinvertebrate surveys across six sites within the Salmon Trout River watershed following

MiCorps protocols and that data is made public. Data incorporated here is from 2012 through 2018.

Macroinvertebrate surveys taken during this time all resulted in total scores ranging from 34.4 to 63.7 or Good to Excellent, with a median score of 50.5 (Excellent).

4.4 Pollutant Loading Analysis

In 2016 and 2017, Superior Watershed Partnership conducted an erosion inventory and riparian restoration summary comparison of the Lower Dead River and Salmon Trout River Watersheds. Sixteen of the thirty Salmon Trout River Watershed sites were restored by implementing best management practices for erosion control on streambanks as demonstration sites for future BMP implementation. The EPA Spreadsheet Tool for Estimating Pollutant Loading (STEPL) was used for pollutant load reduction estimates. STEPL computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. Using STEPL and watershed-wide land use data, a watershed wide pollution load was calculated for Nitrogen (N), Phosphorus (P), Biological Oxygen Demand (BOD) and sediment based on current land use data (Table 25).

Table 25 Pollutant Load Reduction Estimates for Restored Sites

	N Load (no BMP)	**N Load (with BMP)**	**N Reduction**	**%N Reduction**	**P Load (no BMP)**	**P Load (with BMP)**	**P Reduction**	**%P Reduction**
Salmon Trout 2017	**lb/year**	**lb/year**	**lb/year**	**%**	**lb/year**	**lb/year**	**lb/year**	**%**
	6,381.6	6,376.8	4.9	0.1	1,978.4	1,976.6	1.9	<0.01
	BOD Load (no BMP)	**BOD (with BMP)**	**BOD Reduction**	**%BOD Reduction**	**Sediment Load (no BMP)**	**Sediment Load (with BMP)**	**Sediment Reduction**	**%Sediment Reduction**
Salmon Trout 2017	**lb/year**	**lb/year**	**lb/year**	**%**	**t/year**	**t/year**	**t/year**	**%**
	19,947.2	19,937.4	9.7	0.0	245.8	242.2	3.6	0.01

Priority Pollutant Ranking

The watershed pollutants were ranked and prioritized based on how they most affect or have the potential to affect water quality and the watershed's threatened designated uses (Table 26). Overall, sediment is the highest priority pollutant with known sources occurring from most land uses within the watershed.

Without implementation of corrective actions at degraded sites as well as implementation of improved zoning ordinances and improved land use practices, sedimentation problems will likely result in further degradation of water quality and designated and desired uses. Misaligned and perched culverts impact the watershed by altering the natural hydrologic flow, which threatens the coldwater fishery, other indigenous aquatic life/wildlife, and desired watershed uses.

Table 26- Priority ranking of pollutants in the Salmon Trout River Watershed

Pollutant	Priority Ranking
Sediment	1
Altered hydrologic flow	2
Acid mine drainage	3
Heavy metals	4
Nutrients	5
Toxins	6

The potential for impacts from acid mine drainage threatens designated and desired uses of the watershed should a leak occur in the wastewater containment or treatment facilities at Eagle Mine. Ongoing monitoring of the surface water, groundwater, and Eagle Mine facilities will continue through the life of the mine (2025).

The potential for impacts from heavy metals, nutrients (septic, residential fertilizer, etc.), and toxins also pose threats to water quality and designated uses in the Salmon Trout River watershed. Future water quality monitoring efforts should include periodic sampling for these pollutants. While each pollutant has a different effect on water quality and threatened designated uses, all are important and should be priorities for periodic monitoring.

Priority Source Ranking

Pollutants were also ranked by their sources in order to prioritize implementation of corrective actions (Table 27). Also, because pollutants are often interconnected with each other, implementing corrective actions at one source can often result in reductions of pollutants from other sources. In the Salmon Trout River Watershed, the causes of pollution include recreation activities, forest management practices, and development (Table 28). As the watershed contains some of Michigan's finest trout fishing, the river experiences frequent angling pressure during the fishing season. Although these activities are known to occur, there are no specific implementation sites to address them at this time. Pollutants related to these activities are best addressed through information campaigns, education, policy changes and partnership efforts.

Table 27- Priority Ranking of Sources of Pollutants in the Salmon Trout River Watershed

Pollutant	**Sources**	**Priority Ranking**
Sediment (k, p)	Road stream crossings (k) Streambank erosion (p) Forest management practices (p) Recreational activities (p) Mining (p) Development (p)	1 2 3 4 5
Altered hydrologic flow (k, p)	Channelization (k, p)	1
Acid mine drainage (p)	Sulfide-based mining (p)	1
Heavy metals (mercury and others) (p)	Mining (p) Atmospheric deposition (p)	1 2
Nutrients (p)	Septic systems (p) Residential fertilizer use (p)	1 2
Toxins (herbicides, pesticides, oils, gas, grease, salts/ chloride, etc.) (p)	Atmospheric deposition (p) Recreational activities (p)	1 2

k=known, p=potential

5.0 CAUSES/SOURCES OF IMPAIRMENT & REDUCTION TARGETS

5.1 Causes & Sources of Impairment

There are a number of pollutants in the Salmon Trout River watershed that adversely affect designated and desired uses or have the potential to (Table 28). The sources and causes of these pollutants were ascertained through scientific research reports, water quality monitoring data, road/stream crossing inventory data, field observations, land use analysis, and personal contact with watershed residents and experts. As discussed in previous sections of this plan, sediment is the greatest pollutant of concern in the Salmon Trout River watershed. Sand and sediment harm fish and other aquatic life by covering the natural stream substrate they rely upon. Excessive inputs of sediment also fill in stream channels, making them shallower and wider and more susceptible to changes in hydrologic flow and increases in water temperature. Unstable road/stream crossings are a significant source for tons of loose sediment which ultimately reaches surface waters of the Salmon Trout River and its tributaries each year. Much of this sediment is deposited in the low gradient reaches of the lower river where it degrades critical habitat for coaster brook trout. Furthermore, misaligned and perched culverts may cause altered hydrologic flow which disrupts the natural river course and can affect the riverine ecology.

While other sources such as forest management practices and recreational activities are currently contributing additional sediment to surface waters, these sources were either minor or not quantified due to unknown history of events. Mining and development have the potential to increase sediment loads as does any kind of excavation, earth moving, drainage, crossing, tunneling, or other activity in which soil is disturbed and transported to nearby streams.

The potential for sulfide-based mining poses a significant threat to water quality and designated and desired uses in the Salmon Trout River watershed. Some mines extract underground mineral deposits containing sulfur or sulfide. When the mineral or waste rock is brought to the surface and exposed to air, it oxidizes and creates sulfuric acid, commonly referred to as acid mine drainage. This acid can run off in rain or snow melt events and contaminate large areas of surface and ground water resulting in serious impacts to water quality and aquatic ecosystems. Contaminated groundwater also poses problems for private property owners that rely upon wells for their drinking water. This poses a risk to human health and often requires difficult and costly cleanup measures. Additional risks to water and air quality from sulfide-based mining include industrial site construction, truck traffic, heavy equipment operation, power generation, groundwater draw down and treatment, fuel storage and acid rock storage.

Heavy metals, nutrients, and toxins (herbicides, pesticides, oils, gas, grease, salts/chloride, etc.) often enter water bodies unnoticed via runoff, making them difficult to locate and quantify. The potential exists for these pollutants to contaminate both surface water and groundwater sources in the Salmon Trout River watershed due to current and anticipated future land uses. These pollutants have the potential to impact terrestrial and aquatic ecosystems as well as public health if the concentrations are high enough. Heavy metals, nutrients and toxins often attach to soil particles, thus linking them to sediment pollution. Mercury levels exceeding water quality standards were detected in the Salmon Trout River from the Northwestern Road upstream to CR AAA. Mercury contamination is a widespread problem in waterbodies across the Upper Peninsula of Michigan and should be monitored during future stream evaluations. Methods to determine the presence and extent of mercury and the other potential pollutants listed above were not employed during this project.

Table 28 Known and Potential Pollutants, Sources, and Causes in the Salmon Trout River Watershed

Threatened Designated Uses	Pollutants	Sources	Causes
Coldwater fishery Other indigenous aquatic life and wildlife	Sediment (k, p)	Road stream crossings (k)	Poor design/construction/maintenance (k) Lack of erosion controls (k) Steep approaches (k) Culverts not aligned to stream bed (k) Undersized culverts (k) Lack of crossing structure (k) Road grading operations (k)
		Streambank erosion (p)	Natural river dynamics (p) Sparse vegetative cover due to animal or human traffic (p) Concentrated runoff adjacent to the streambank (p) In-stream flow obstructions (log jams, failed bridge supports)(p) Ice jams or low probability floods (p) Unusually large or frequent wave action (p) Significant change in the hydrologic characteristics (land use)(p) Dredging, channelization (p)
		Forest management practices (p)	Removal of riparian vegetation (lack of riparian buffers) (p) Clearing by landowners (p) Equipment problems due to steep topography (p) Numerous crossings of small streams and drainage routes (p)
		Recreational activities (p)	Off Road Vehicle crossings of wetlands and streams (p)
		Mining (p)	Construction of industrial sites and roads (p)
		Development (p)	Removal of riparian vegetation (lack of riparian buffers) (p) Clearing by landowners (p) Construction of secondary access roads (p)

Threatened Designated Uses	Pollutants	Sources	Causes
Coldwater fishery Other indigenous aquatic life and wildlife	Altered hydrologic flow (k, p)	Channelization (k, p)	Crossing structure impacting natural hydrologic flow (k) Unsuitable sites/soils (p)
Coldwater fishery Other indigenous aquatic life and wildlife Public water supply (groundwater)	Acid mine drainage (p)	Sulfide-based mining (p)	Extraction of underground deposits containing sulfur or sulfide (p)
Coldwater fishery Other indigenous aquatic life and wildlife Public water supply (groundwater)	Heavy metals (mercury and others) (p)	Mining (p)	Extraction of underground deposits containing heavy metals (p)
		Atmospheric deposition (p)	Nearby coal fired power plants (p) Other industries (p) Forest fires (p) Use of burn barrels (p)
Coldwater fishery Other indigenous aquatic life and wildlife Public water supply (groundwater)	Nutrients (p)	Septic systems (p)	Poorly designed/maintained systems (p) Unsuitable sites/soils (p)
		Residential fertilizer use (p)	Improper application (amount, timing, frequency, location, method, chemical content) (p)

Threatened Designated Uses	**Pollutants**	**Sources**	**Causes**
Coldwater fishery Other indigenous aquatic life and wildlife Public water supply (groundwater)	Toxins (herbicides, pesticides, oils, gas, grease, salts/ chloride, etc.) (p)	Forest management practices (p)	Improper application (amount, timing, frequency, location, method, chemical content) (p) Hazardous waste spills from heavy equipment (p)
		Mining (p)	Hazardous waste spills from heavy equipment (p)
		Atmospheric deposition (p)	Use of burn barrels (p) Industries (p)

k=known, p=potential

5.2 Critical Areas, Management Measures & Estimated Impairment Reductions

Critical areas in the Salmon Trout River watershed are defined as the portions of the watershed that are most sensitive to environmental degradation and those areas having the most impact or potential to impact water quality and designated and desired uses. They include areas that may contribute the greatest amount of pollutants to the watershed, either now or in the future, and where preservation and restoration efforts will have the most profound results. Critical areas were identified through a detailed analysis concerning protection potential, current and future land uses, pollutant loading, and anticipated load reductions from particular Best Management Practices (BMPs). The goal of this analysis was to target specific strategies to those areas most in need of protection or restoration. It should be noted that these critical areas are by no means the only areas in need of protection and restoration efforts; they are simply those with the highest priority. Without implementation of the strategies outlined under the Goals and Objectives section of this management plan, the future negative impacts in critical areas of the Salmon Trout River watershed will be significant and the mitigation very costly.

The first goal addressed through the tasks and action plans outlined in this watershed planning process is to protect the integrity of aquatic and terrestrial ecosystems within the watershed. Critical areas with aquatic impacts to be addressed include road/stream crossings and adjacent streambank erosion sites located within the East Branch Salmon Trout River. subwatershed. In total, the annual erosion estimates for the East Branch Salmon Trout River and tributaries is 18.67 tons/year at nine sites. Other improvements to the crossings such as adjusting culvert elevations will help restore natural hydrologic flow. Implementing BMPs at the identified sites will address designated uses of the cold water fishery, indigenous aquatic life and wildlife, and the public water supply.

The second goal addressed through this planning process is to protect and improve the quality of water in order to support all designated and desired uses. Implementation of streambank stabilization and crossing BMPs will also reduce the loading of nitrogen, phosphorus, and biological oxygen demand (BOD5). Critical areas focus on the East Branch and Main Branch Salmon Trout River Watershed.

The third goal addressed through this watershed planning process is to establish and promote information and education programs that support watershed planning goals, objectives, tasks, and increase stewardship. Critical areas to focus the implementation of this goal are along the Northwestern Road corridor where privately-owned camps are congregated that may require the construction of new culverts and maintenance of existing crossings.

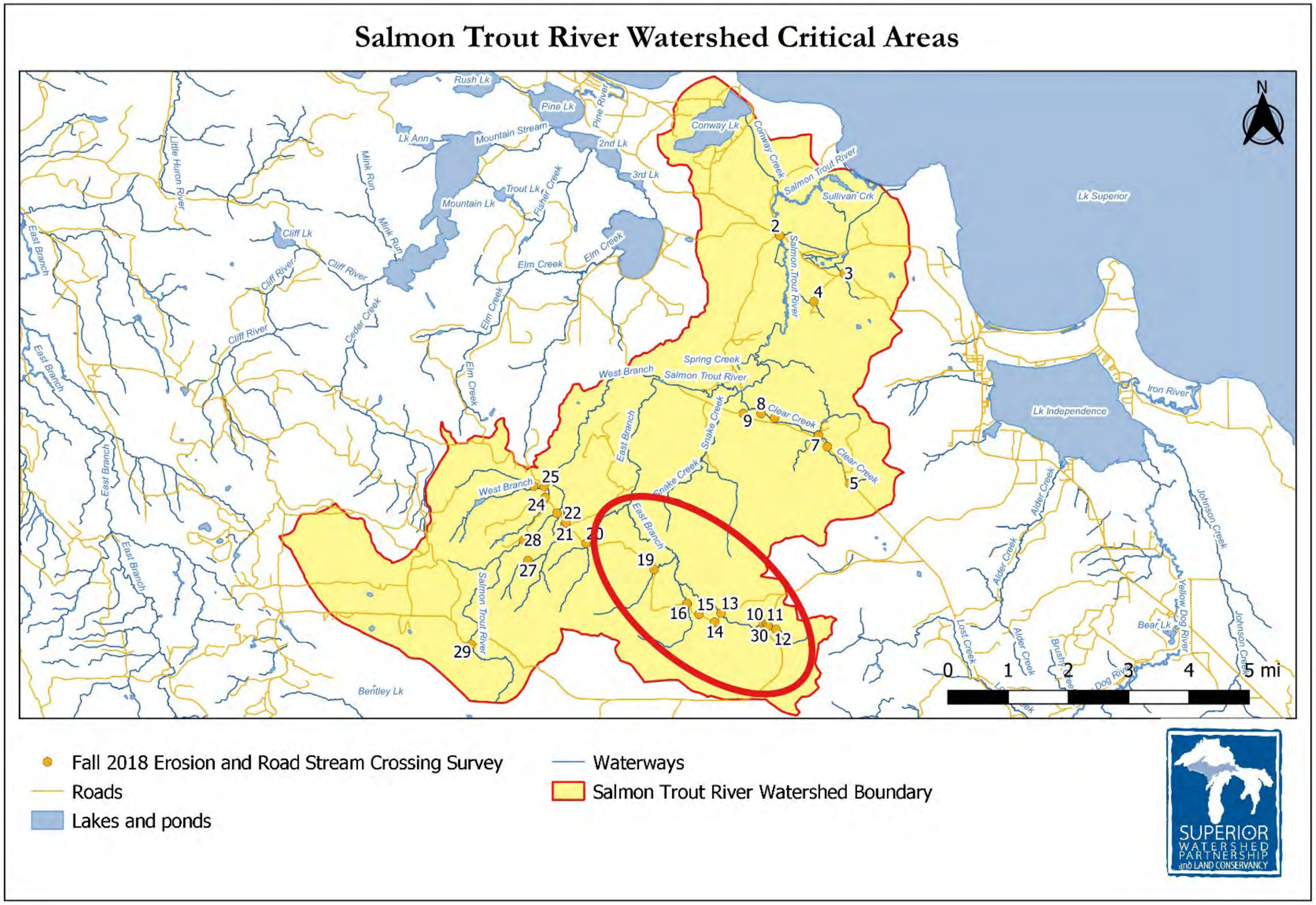

Figure 41 Salmon Trout River Watershed critical areas

5.3 Watershed Impairment Reduction Targets

In a fall 2018 assessment of streambank erosion by the SWP Great Lakes Conservation Corps, 21 sites were identified with a range of slight, moderate and severe erosion for a total of 240.5 feet of identified erosion caused by misaligned/undersized culverts or a lack of a crossing structure (Table 26, Figure 42). This streambank erosion inventory was estimated by measuring and quantifying eroding areas in the field, and the annual sediment loads were calculated using the Spreadsheet Tool for Estimating Pollutant Loads (STEPL). This is different from the modified vulnerability analysis used to compare subwatershed management unit (SMU) land use classifications (based on data from the National Land Cover Database (NLCD) which is derived from classifying Landsat satellite imagery with a 30-meter spatial resolution) and NRCS soils data. The former analysis resulted in impervious cover estimates, erosion hazard factors, and vulnerability rankings (Table 12, Figure 21).

Table 27 - 2018 Salmon Trout River Erosion Inventory Sites (not restored)

Priority Rank	SWP Site Number	Length (ft)	Height (ft)	Lateral Recession	Rate Range (ft/yr)	Rate (ft/yr)	BMP Efficiency (0-1)	Soil Textural Class	Soil Dry Weight (ton/ft^3)	Nutrient Correction Factor	Annual Load (ton)	STEPL Estimated Load Reduction (tons/yr)
1	30	30	25	Severe	0.3 - 0.5	0.5	0.95	Fine Sandy loam	0.05	0.85	18.75	17.81
2	4	12	9	Severe	0.3 - 0.5	0.3	0.95	Sands, Loamy sands	0.045	0.85	1.46	1.39
3	21	25	10	Moderate	0.06 - 0.2	0.1	0.95	Sandy clay	0.045	0.85	1.13	1.07
4	22	15	15	Moderate	0.06 - 0.2	0.1	0.95	Sandy clay	0.045	0.85	1.01	0.96
5	12	15	3	Severe	0.3 - 0.5	0.3	0.95	Fine Sandy loam	0.05	0.85	0.68	0.64
6	9	21.5	6	Moderate	0.06 - 0.2	0.1	0.95	Sandy clay	0.045	0.85	0.58	0.55
7	7	15	11	Slight	0.01 - 0.05	0.02	0.95	Sands, Loamy sands	0.055	0.85	0.18	0.17
8	13	8	1	Moderate	0.06 - 0.2	0.2	0.95	Fine Sandy loam	0.05	0.85	0.08	0.08

9	11	15	2	Slight	0.01 - 0.05	0.05	0.95	Fine Sandy loam	0.05	0.85	0.08	0.07
10	29	20	2	Slight	0.01 - 0.05	0.04	0.95	Sandy clay	0.045	0.85	0.07	0.07
11	10	10	1	Slight	0.01 - 0.05	0.05	0.95	Sands, Loamy sands	0.055	0.85	0.03	0.03
12	8	10	4	Slight	0.01 - 0.05	0.01	0.95	Sandy clay	0.045	0.85	0.02	0.02
13	31	5	3	Slight	0.01 - 0.05	0.02	0.95	Fine Sandy loam	0.05	0.85	0.02	0.01
14	20	10	1	Slight	0.01 - 0.05	0.03	0.95	Sandy clay	0.045	0.85	0.01	0.01
15	25	10	1	Slight	0.01 - 0.05	0.03	0.95	Sandy clay	0.045	0.85	0.01	0.01
16	28	5	1	Slight	0.01 - 0.05	0.04	0.95	Sandy clay	0.045	0.85	0.01	0.01
17	16	4	1	Slight	0.01 - 0.05	0.04	0.95	Fine Sandy loam	0.05	0.85	0.01	0.01
18	14	3	2	Slight	0.01 - 0.05	0.02	0.95	Sandy clay	0.045	0.85	0.01	0.01
19	15	4	0.5	Slight	0.01 - 0.05	0.04	0.95	Fine Sandy loam	0.05	0.85	<0.01	<0.01
20	24	2	1	Slight	0.01 - 0.05	0.01	0.95	Sandy clay	0.045	0.85	<0.01	<0.01
21	19	1	1	Slight	0.01 - 0.05	0.01	0.95	Loams, sandy clay loams	0.045	0.85	<0.01	<0.01
Total		240.5	100.5									22.91

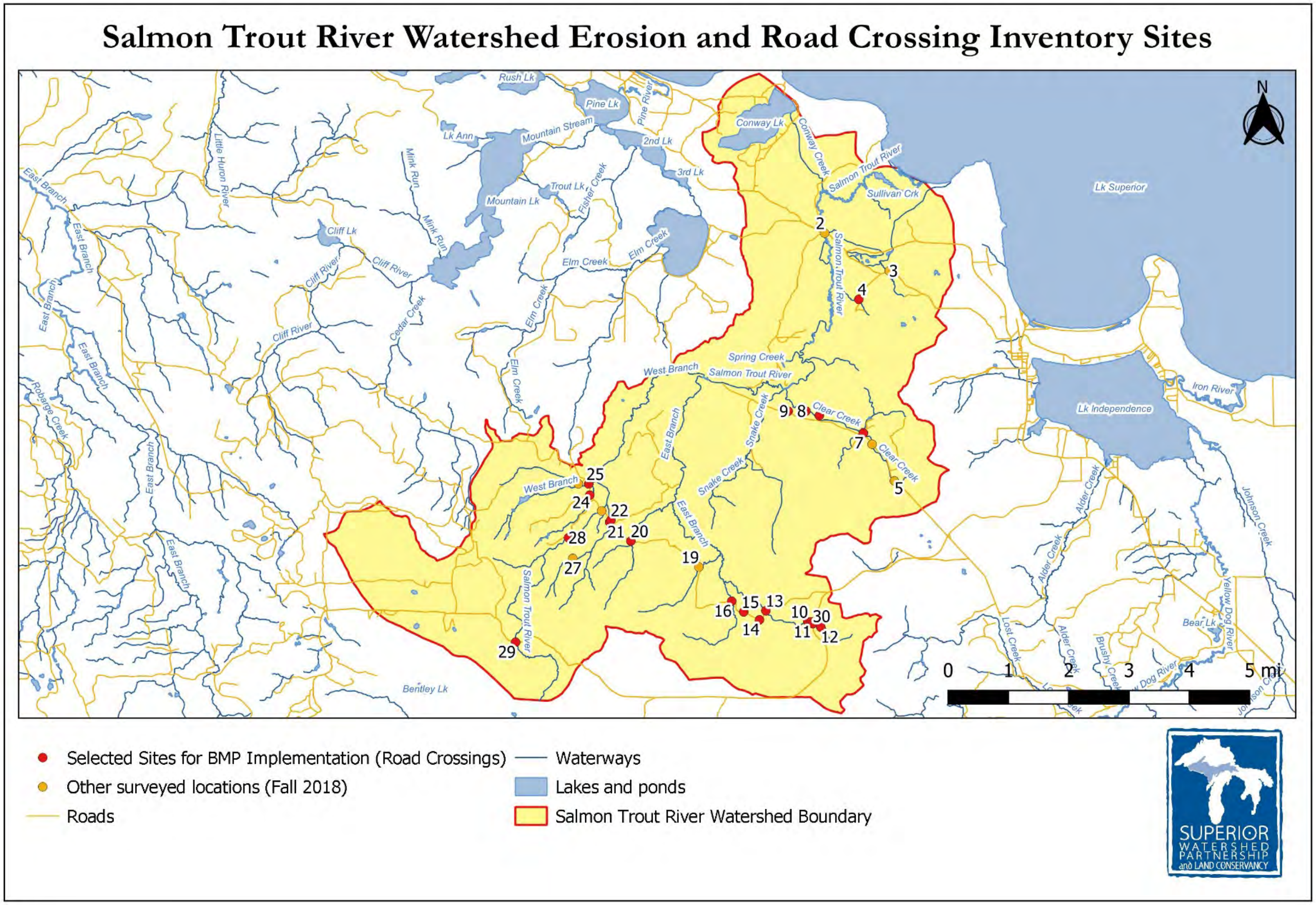

Figure 17 Salmon Trout River Watershed 2018 fall erosion and stream crossing survey

Pollution Load Reduction Estimates

In addition to sediment, STEPL also computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. Using STEPL and watershed-wide land use data, a watershed wide pollution load was calculated for Nitrogen (N), Phosphorus (P), Biological Oxygen Demand (BOD) and sediment based on current land use data (Table 30).

Table 28 Pollutant Load Reduction Estimates for the Erosion Inventory Sites (not restored)

	N Load (no BMP)	**N Load (with BMP)**	**N Reduction**	**%N Reduction**	**P Load (no BMP)**	**P Load (with BMP)**	**P Reduction**	**%P Reduction**
Salmon Trout Total	lb/year	lb/year	lb/year	%	lb/year	lb/year	lb/year	%
	4793.6	4762.4	31.2	0.7	1352.4	1340.4	12.0	0.9
	BOD (no BMP)	**BOD (with BMP)**	**BOD Reduction**	**%BOD Reduction**	**Sediment Load (no BMP)**	**Sediment Load (with BMP)**	**Sediment Reduction**	**%Sediment Reduction**
Salmon Trout Total	lb/year	lb/year	lb/year	%	t/year	t/year	t/year	%
	16439.1	16376.7	62.3	0.4	297.6	274.7	22.9	7.7

6.0 MANAGEMENT MEASURES ACTION PLAN

6.1 Programmatic Management Measures Action Plan

Starting in 2018, Applied Ecological Services conducted a comprehensive analysis comparing the watershed characteristics and management strategies between the Salmon Trout River watershed and the Lower Dead River watershed. The primary goal of the Lower Dead River Watershed and Salmon Trout River Watershed analyses was improving the approach to watershed planning, and identifying unique management measures to benefit the watershed health. In the analysis, comparison between an urban and rural watershed within the same region provided helpful context. The assessment results include an analysis of setbacks and a percentage of impervious surfaces. Overall, the Salmon Trout River watershed is 1.78% impervious and contains variable setbacks from aquatic areas primarily determined by sloping terrain. The percent of impervious surfaces is fairly low and suggests that a few key areas have a higher potential for impacts related to runoff.

AES identified parts of the Salmon Trout River watershed that have a higher ecological function score. A high ecological function score indicates that these regions within the watershed would benefit the overall watershed the most by implementing improved best management practices. Most of the areas with high ecological functions are adjacent to waterways, and some areas include water wells. Programmatic BMPs may address regional management concerns by implementing setback increases, creating ordinances, and conducting education and outreach. Individual BMPs are ranked based on ease and cost of implementation as follows: A, representing easy to implement at low cost; B, moderate to implement at moderate cost; and C, difficult to implement and more expensive (Table 31).

Table 31 Programmatic best management practices

BMP Number	Best Management Practices Descriptor	Residential target audience	Commercial target audience	Local Government target audience	Rank
1	Provide place-based education for educators	x		x	A
2	Green infrastructure strategies such as vegetation, soils, and natural processes to manage water flows rather than engineering water routes	x	x	x	B
3	Governmental planning toolkits and overlay ordinances to protect and preserve watershed characteristics			x	B/C
4	Encourage voluntary landowner assistance programs for conservation practices	x			A
5	Encourage the use of conservation easements	x	x	x	B

Task 1: Implement outreach and communication action plan

Implement a simplified, and tactical outreach and communication plan to increase awareness and provide education to specific target audiences within the Salmon Trout River watershed. Utilizing a variety of mediums, the outreach efforts will communicate watershed information such as hydrological concerns, ecological importance, pollutants, sources, causes, management practices and resources. Proposed steps are adapted from Upleaf Technology Services template (https://upleaf.com/nonprofit-resources/strategy-design/communication-plan-template); The Wallace Foundation "Workbook A: Creating a Communication Plan" (https://www.wallacefoundation.org/knowledge-center/Documents/Workbook-A-Communication.pdf); and a template provided by Convene, LLC, an independent consultant working with the Model Forest Policy Program:

Goals Accomplished:
Goal #3: Establish and promote information and education programs that support watershed planning goals, objectives, tasks, and increase stewardship.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium

Milestones:
Step 1: Define target audiences including Salmon Trout River landowners and local governmental decision makers, and establish goals of outreach to/communications with target audiences.

- Increase Decision Makers' (and Partners') awareness of the hydrological, ecological and economic importance (ecosystem services valuation) of maintaining the Salmon Trout Watershed's water quality not only to the immediate watershed but regionally.
- Increase Decision Makers' (and Partners') awareness of potential sources of water pollutants and conditions that can impact water quality especially those that may be exacerbated by changing climate conditions.
- Educate Decision Makers (and Partners) on policy options to protect the watershed's water quality.
- Use place-based education strategies to engage and provide experiential education.

Step 2: Align efforts with goals of outreach to communications with target audiences – See Section 7.0 on (*Lake Superior: Urban and Rural Watershed Restoration - MFPP 2018 Final Report page* 30) including:

- Increase landowners' awareness of the hydrological, ecological and economic importance (ecosystem services valuation) of maintaining the Salmon Trout Watershed's water quality not only to the immediate watershed but regionally.
- Increase landowners' awareness of potential sources of water pollutants and conditions that can impact water quality especially those that may be exacerbated by changing climate conditions.
- Increase landowners' awareness of management practices and potential support (e.g. cost-sharing, equipment-sharing opportunities, management tools, and labor resources (conservation corps) that could assist in implementing practices.

- Share success stories

Step 3: Use the key messages developed in the MFPP survey process.

- **Water Quality = Economic Value.** Protection of the Salmon Trout Watershed is crucial to protecting its fisheries, recreational activities, scenic beauty, and overall (economic) importance to the area.
- Stressors to the watershed include soil erosion from construction, street salt/sand, soil erosion from shorelines and/or streambanks; littering/illegal dumping of trash.
- Climate change will exacerbate stressors.

Step 4: Create a tactical outreach plan. How will you reach your audience? (Email, website, social media, in-person events, phone calls, traditional media: advertising, commercials, etc.)

- Critical to the Salmon Trout Strategy is working with the "Information Sources" identified as most trusted by survey respondents. The top four listed for the Salmon Trout are:
    - Soil and Water Conservation District;
    - Local Watershed Project;
    - University Extension;
    - Natural Resource Conservation Service

Measurements:

- Number of outreach actions completed
- Number of partners participating
- Number of public notices issued
- Number of new partnerships created

Task 2: Encourage voluntary landowner assistance programs for conservation practices

Work with Marquette County and local townships to develop and promote voluntary arrangements and regulatory incentives to preserve and protect water quality, sensitive or biologically important areas and high-quality natural communities. Topics include:

- Use existing governmental planning toolkits and overlay ordinances to protect and preserve watershed characteristics
- Avoid development that encroaches on sensitive or biologically important areas
- Preserve high quality natural communities (conservation easements, etc.)
- Protect critical riparian areas (avoid development, maintain appropriate riparian buffers and setbacks)
- Properly manage working lands (forest lands) and roads
- Install and maintain properly designed septic systems
- Minimize the number of access roads needed for land use practices such as timber harvest, private development, and recreation
- Avoid stream and wetland crossings when constructing new roads
- Encourage voluntary landowner assistance programs for conservation practices
- Encourage the use of conservation easements
- Green infrastructure strategies such as vegetation, soils, and natural processes to manage water flows rather than engineering water routes

Goals Accomplished:
Goal 1: Protect and improve the quality of water
Goal 2: Protect the integrity of aquatic and terrestrial ecosystems
Goal 3: Increase stewardship practices

Designated Uses Addressed:
Coldwater fishery, other aquatic life, public water supply

Desired Uses Addressed: All
Estimated Cost: $30,000
Timeline: 5 years
Priority: High

Milestones:

- Work with partners to develop and distribute information and education on voluntary landowner arrangements (Year 1)
- Work with Marquette County to develop and adopt incentive programs (Years 1-3)
- Work with landowners to improve land use management practices (Years 2-5)

Measurements:

- Number of landowners participating
- Number of volunteer/incentive programs adopted
- Number of acres protected
- Number of improved land use management practices

Potential Partners: Marquette County Planning and Development, Powell Township, Michigamme Township, and Champion Township, Superior Watershed Partnership, Natural Resources Conservation Service, and Marquette County Conservation District.

6.2 Site Specific Management Measures Action Plan

In the 2018 analysis, Applied Ecological Services identified areas in the Salmon Trout River Watershed that may benefit from the implementation of site-specific best management practices (BMPs) to reduce watershed pollutants and address sources and causes. Individual BMPs are ranked based on ease and cost of implementation as follows: A, representing easy to implement at low cost; B, moderate to implement at moderate cost; and C, difficult to implement and costlier (Table 32). Superior Watershed Partnership continues to monitor road/stream crossing and streambank conditions in the Salmon Trout River watershed. While many restoration projects have been implemented, ongoing monitoring, maintenance, and other site-specific structure replacements are needed. Table 34 identifies priority road/stream crossings in need of restoration and contributing to erosion. Additional BMP locations are outlined in Table 36.

Table 29 Best management practices (BMPs) by number

BMP Number	Best Management Practices Descriptor	Residential/ Commercial	Utility Easements	Quarry Sites	Forestry Sites	Rank
14	Stream stabilization using bioengineering needed	x				B
19	Culvert inlet elevation adjustment to ensure biological mobility in stream/drainageways	x	x		x	B/C
22	Alternative deicing strategy to reduce salt impacts to streams/biota	x			x	A/B
24	Road designs to minimize direct runoff into streams		x	x	x	C
25	Waterbar installation to divert road runoff regularly (and prevent concentrated high-volume flows) to biofilter and infiltration locations		x	x	x	B/C
26	Plant cover crops to eliminate bare soil in log staging /utility yards, areas/heavily impacted hauling roads, etc.		x	x	x	A
27	Regrade quarry locations and logging staging yards to internalize drainage and direct it to infiltration locations			x	x	B/C
28	Cover crop quarry locations and roadway cuts with annual cover crops and locally derived genetic stock native grasses, wildflowers		x	x	x	A

BMP Number	Best Management Practices Descriptor	Residential/ Commercial	Utility Easements	Quarry Sites	Forestry Sites	Rank
29	Mulch disturbed ground with clean straw applied at 2,000-3,000 lbs./acre and use crimper to crimp into substrates		x	x	x	A
30	Convert rutted, muddied roadways into water containment/management locations or regrade.		x	x	x	A/B
31	Minimize open working face to some efficient working area			x	x	A/B
32	Log yard and staging areas designed to totally internally drain with water collection, infiltration gallery				x	A/B
34	Focus revegetation on the use of diverse native planting of locally derived genetic stocks of species		x			A

Table 30 Possible BMPs not yet identified for current watershed implementation sites

BMP Number	Best Management Practices Descriptor	Residential/ Commercial	Utility Easements	Quarry Sites	Forestry Sites	Rank
1	Stormsewer inlet biofilters	x				B
2	Stormsewer inlet stenciling	x				A
3	Lawn/yard waste collection	x				A
4	Lawn fertilizer switch to slow release or organic	x				A
5	Lawn conversion to no-mow/low mow	x				A
6	Lawn conversion to native perennial wildflowers	x				B
7	Disconnect direct discharge from roof, driveway, sidewalk to stormsewer inlet and redirect to rain gardens	x				B
8	Create rain gardens to accept roof top drainage	x				A/B

BMP Number	Best Management Practices Descriptor	Residential/ Commercial	Utility Easements	Quarry Sites	Forestry Sites	Rank
9	Disconnect direct discharge from all impervious surfaces and redirect to rain gardens	x				A/B
10	Survey stream centerlines and edges of streams so that ordinance can be enforced (needed because of imprecision of mapped locations now available)	x				B
11	River access better definitions and safe water quality sensitive access needed	x				B/C
12	Invasive species management needed	x	x	x	x	A-C
13	Homeowner education needed about invasive species in their yards and how to manage them	x				A/B
15	Septic survey and subterranean wetland biofilters to ensure clean water prior to release	x				A/B
16	Parking lot infiltration galleries	x				B/C
17	Parking lot sunken biofilters	x				B/C
18	Parking lot retention	x	x			B/C
20	Waste/debris management (blown, wash off, and intentionally dumped) from parking lots	x	x			A
21	On parking lot water storage for rare events to reduce stream blow outs	x	x			A
23	Plowed snow stockpile locations with silt fence and water quality management	x		x		A
33	Focus vegetation clearance management of lines/infrastructure by doing LIDAR and Multispectral imaging mapping every 2-3 yrs to determine where woody		x			B

BMP Number	Best Management Practices Descriptor	Residential/ Commercial	Utility Easements	Quarry Sites	Forestry Sites	Rank
	vegetation management to meet clearance requirements may be necessary.					
35	Minimize forest fragmentation by revegetating cuts with diverse tree species to maintain landscape diversity and continuity		x			B
36	Culvert assessment and replacement to fit site characteristics	x				A

Selected Locations for Implementation of Best Management Practices

Figure 43 shows priority road/stream crossing locations for BMP implementation. Forestry sites, locations where the primary use of the road is for logging trucks, comprise the majority of locations where water quality would benefit from eliminating direct surface runoff.

Each location identified on Figure 43 corresponds with the point number in Table 34. The site description listed in Table 34 then corresponds to the BMP Number(s) in Table 32. These BMPs involve improving water quality by minimizing direct runoff by altering water flow to infiltration locations. The forestry sites BMPs vary widely throughout the watershed.

Table 31 Selected Locations for BMP Implementation

SWP Site Number	Description	BMP #	Pollutant	Priority Rank	STEPL Estimated Load Reduction (tons/yr)
30	Severe erosion at an East Branch Salmon Trout River crossing at Co Rd AAA. The stream meanders here with low vegetation. *AES notes - Bank stabilization failure, sedimentation/accumulation associated with road runoff per steep roadway (also known as AES survey site 17).*	14, 19, 22, 24-32, 34	Sediment, Altered hydrologic flow	1	17.81
4	Severe erosion at a crossing over Murphy's Creek on Pine Mountain Road.	14, 19, 34	Sediment, Altered hydrologic flow	2	1.39
21	Moderate erosion at a crossing over an unnamed tributary to the Main Branch Salmon Trout River on the Northwestern Rd near Dodge City. *AES notes - Plant species observed include young maple, hemlock, yellow birch, some rill erosion present at base of uplands (also known as AES survey site 31).*	14, 19, 22, 24-32 34	Sediment, Altered hydrologic flow	3	1.07
22	Moderate erosion at a crossing over an unnamed tributary to the Main Branch Salmon Trout River on the Northwestern Rd near Dodge City. Stream flow is quicker upstream where there is more erosion. The stream has a slower flow downstream of the culvert. *AES notes - Y-road with two crossings (also known as AES survey site 32)*	14, 19, 22, 24-32 34	Sediment, Altered hydrologic flow	4	0.96
12	Severe erosion at an East Branch Salmon Trout River / Old Co Rd AAA crossing. There is heavy vegetation and sediment build up at the site, and	14, 34	Sediment	5	0.64

	a large log blocking stream. A water/erosion net was installed on the top part of the bank/hillside. There are also tire tracks on the hillside. Some grass grew from GLCC seed planting in summer 2018.				
9	Moderate erosion at a culvert at an unnamed two-track over Snake Creek. *Note, this point is also known as 'SWP site new 8'*	14, 34	Sediment	6	0.55
7	Slight erosion on Clear Creek. There are some overhanging trees and heavy vegetation. The culvert is buried with sediment buildup, and the road is below the stream.	14, 34, 36	Sediment	7	0.17
13	Moderate erosion near the culvert at the East branch Salmon Trout/ Northwestern Road with natural water runoff (not going directly into the stream). There is abundant vegetation. Some seeds grew from GLCC planting in summer 2018. *AES notes - Small beaver dam upstream. Plant species observed include Alnus sp., tusec, Calamagrostis canadensis with Hypericum. The hydrology is stable with sand substrate (Also known as AES survey site 18).*	14, 19, 22, 24-32 34	Sediment, Altered hydrologic flow	8	0.08
11	Slight erosion at an East branch Salmon Trout River crossing at Co Rd AAA. There is good vegetation and good water flow. It is an open stream ford and there is no bridge or culvert present.	14, 34	Sediment	9	0.07
29	Slight erosion at the Main Branch Salmon Trout River crossing at Co Rd AAA near Eagle Mine. There is good vegetation and water flow. Some plants grew from seeds spread in summer. There is a beaver dam present with some sediment build-up upstream. *AES notes - First Salmon Trout point near mine. The headwater area contains species including Carex sp., Alnus sp, and Picea sp. Additionally, Fallopia sp. growing along road margins (Also known as AES survey site 16).*	14, 19, 22, 24-32 34	Sediment, Altered hydrologic flow	10	0.07
10	Slight erosion at an East Branch Salmon Trout River crossing over an Unnamed road. There is decent water flow and good vegetation. GLCC planted trees in the summer of 2018. The area is doing well. It is an open stream ford and there is no bridge or culvert present.	14, 34	Sediment	11	0.03
8	Slight erosion at a Clear Creek crossing. The culvert inlet is covered with rock, and there is some erosion at that location.	14, 34	Sediment	12	0.02
31	Slight erosion at a Blind M-35 / Clear Creek crossing. This is an older culvert and it is rocky upstream. There is abundant vegetation and the culvert is elevated with some erosion. New GLCC survey point in Fall 2018.	14, 19, 34	Sediment, Altered hydrologic flow	13	0.01
20	Slight erosion at a Northwestern Rd / Unnamed tributary to the East Branch Salmon Trout River crossing near Dodge City. The stream has	14, 34	Sediment	14	0.01

	good flow, some overhanging trees, and good vegetation. A low spot on the upstream side creates a sediment build up. Road grader created cut-outs for water to runoff.				
25	Slight erosion at the Northwestern Rd / West Branch Salmon Trout River crossing. There are some overhanging trees, and the stream has a rocky bottom. The stream has good water flow and a drainage area could be created with a road grader. *AES notes - Plant species observed include Alnus sp., and Calamagrostis canadensis. The stream is deeper at this location and has sand and silt substrate (Also known as AES survey site 35).*	14, 19, 22, 24-32 34	Sediment, Altered hydrologic flow	15	0.01
28	Slight erosion at a crossing over the Main Branch Salmon Trout River near Dodge City. There is good vegetation and stream flow, a rocky river bottom, and natural water cut-outs from the culvert downstream. The rock wall is stable.	14, 34	Sediment	16	0.01
16	Slight erosion at a crossing over an unnamed tributary to the East Branch Salmon Trout River at the Northwestern Road. Upstream there is a wetland area. Overall, it is a good stream crossing with continuous beaver dam build-up. *AES notes - Permit present to upgrade bridge. Upstream area of sediment deposition and accumulation with past channel migration (Also known as AES survey site 21).*	14, 19, 22, 24-32 34	Sediment	17	0.01
14	Slight erosion at a crossing over an unnamed tributary to the East Branch Salmon Trout River at the Northwestern Road. There is good water flow and the stream becomes deeper downstream. The rock wall is stable around culvert. *AES notes - Small stream with inline ponds used for trout. Hydrology is stable with sand substrate and tin clear water (Also known as AES survey site 19).*	14, 19, 22, 24-32, 34	Sediment, Altered hydrologic flow	18	0.01
15	Slight erosion at a crossing over an unnamed tributary to the East Branch Salmon Trout River at the Northwestern Road. The seeds spread in the summer of 2018 did not grow. Cut outs created by the summer crew are apparent. The river bottom is rocky. The crew raked leaves from the cutouts. *AES notes - Spawning brook trout at this location with European brome/quack grass on the bank. The hydrology is stable, Alnus sp. and calcan glowing on the bank, and the substrate is fine gravel/sand (Also known as AES survey site 20).*	14, 19, 22, 24-32, 34	Sediment, Altered hydrologic flow	19	<0.01
24	Slight erosion at a crossing over an unnamed tributary to the West Branch Salmon Trout River at the Northwestern Road near Dodge City. There is good vegetation, good stream flow, and stable rock banks. An	14, 19, 22, 24-32, 34	Sediment, Altered hydrologic flow	20	<0.01

	overflow culvert is located approximately 30ft away. Overall, it is a good stream crossing cut-out on all four sides of culvert. *AES notes - Upstream opening/wetland formal beaver pond, turtle eggs (Also known as AES survey site 34).*				
19	Slight erosion at a crossing over an unnamed tributary to the East Branch Salmon Trout River at the Northwestern Road. There is good flow and natural water cut-outs for water runoff. There is abundant overhang and decent vegetation. There is some buildup of sand on top of the rip rap.	14, 34	Sediment	21	<0.01

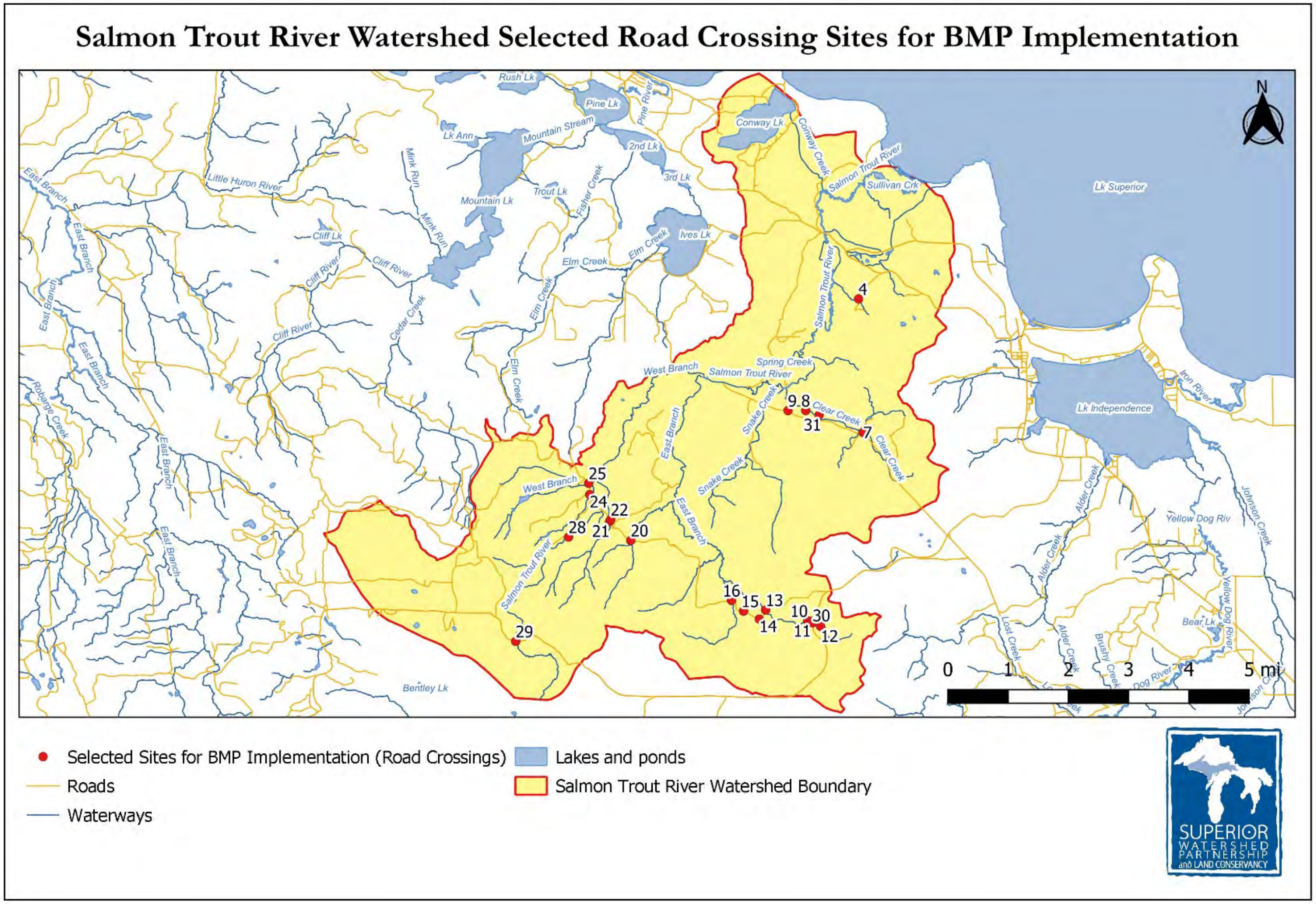

Figure 43 Salmon Trout River Watershed selected road crossing sites for BMP implementation

Figure 44 Salmon Trout River Erosion Site 30 on the East Branch Salmon Trout River

Task 3: Erosion and runoff: Restore riparian corridors and other sensitive areas

Use green infrastructure, road redesign, water bar installation, cover cropping, and mulching to minimize runoff and reduce the impacts of erosion in designated forested areas and near eroding crossings. Runoff may be diverted through improvements to road shape and water bar installation to divert runoff and to prevent concentrated flows. Cover crops may be installed where bare soil is exposed. Old quarry locations can be regraded or cover cropped.

Goals Accomplished:
Goal #1: Protect the integrity of aquatic and terrestrial ecosystems within the watershed.
Goal #2: Protect and improve the quality of water in order to support all designated and desired uses.

Estimated Cost: $177,500
Timeline: 3 years
Priority: High
Milestones:

- Coordinate project partners (Year 1)
- Conduct analysis and field verification of site data (Years 1-2)
- Conduct an inventory of road/stream crossings over private drives and logging roads (Years 1-2)
- Develop specific BMP recommendations and tools for each site (green infrastructure, road redesign, water bar installation, cover cropping, mulching, etc.) (Year 2).
- Implement restoration plans (Year 2-3).
- Pre and post BMP field evaluations (Year 1-10)

Measurements:

- Restoration of sensitive areas (number of acres improved)
- Number of partners participating
- Improved water quality (ratings of good or better at all monitoring sites by year 10)
- Improved habitat for brook trout (Year 5-10)

- Conduct pre- and post-BMP field evaluations (site condition evaluation and stream monitoring) (Years 1-10)
- Achieve 10% reduction in sediment load (Year 5)
- Achieve 25% reduction in sediment load (Year 10)

Potential Partners: Longyear Realty Corporation, Weyerhauser, The Nature Conservancy, Northern Michigan University, and Powell, Michigamme, and Champion Townships.

Table 32 Estimated Cost

Sub Watershed	Site Number	Estimated Cost	Brief Description of Work Needed	STEPL Estimated Load Reduction (tons/yr)
East Branch Salmon Trout River	30	$50,000	Erosion BMPs, culvert inlet adjustment	17.81
Murphy's Creek	4	$10,000	Erosion BMPs, culvert inlet adjustment	1.39
Main Branch Salmon Trout River	21	$10,000	Erosion BMPs, culvert inlet adjustment	1.07
Main Branch Salmon Trout River	22	$10,000	Erosion BMPs, culvert inlet adjustment	0.96
East Branch Salmon Trout River	12	$5,000	Erosion BMPs	0.64
Snake Creek	9	$5,000	Erosion BMPs	0.55
Clear Creek	7	$5,000	Erosion BMPs	0.17
East Branch Salmon Trout River	13	$10,000	Erosion BMPs, culvert inlet adjustment	0.08
East Branch Salmon Trout River	11	$5,000	Erosion BMPs	0.07
Main Branch Salmon Trout River	29	$10,000	Erosion BMPs, culvert inlet adjustment	0.07
East Branch Salmon Trout River	10	$5,000	Erosion BMPs	0.03
Clear Creek	8	$5,000	Erosion BMPs	0.02
Clear Creek	31	$10,000	Erosion BMPs, culvert inlet adjustment	0.01
East Branch Salmon Trout River	20	$5,000	Erosion BMPs	0.01
West Branch Salmon Trout River	25	$10,000	Erosion BMPs, culvert inlet adjustment	0.01
Main Branch Salmon Trout River	28	$5,000	Erosion BMPs	0.01
East Branch Salmon Trout River	16	$10,000	Erosion BMPs, culvert inlet adjustment	0.01
East Branch Salmon Trout River	14	$10,000	Erosion BMPs, culvert inlet adjustment	0.01
East Branch Salmon Trout River	15	$10,000	Erosion BMPs, culvert inlet adjustment	<0.01
West Branch Salmon Trout River	24	$10,000	Erosion BMPs, culvert inlet adjustment	<0.01
East Branch Salmon Trout River	19	$5,000	Erosion BMPs	<0.01
Total		$205,000		22.92

Task 4: Adjust culvert inlet elevations and maintain bridges to ensure biological integrity

Address culvert inlet elevation issues that may be leading to erosion, scour pool development or fish passage barriers. Where appropriate, culvert replacements may necessary.

Goals Accomplished:
Goal #1: Protect the integrity of aquatic and terrestrial ecosystems within the watershed.
Goal #2: Protect and improve the quality of water in order to support all designated and desired uses.

Estimated Cost: $140,000 *See above table*
Timeline: 3 years
Priority: High

Milestones:

- Coordinate project partners (Year 1)
- Conduct analysis and field verification of site data (Years 1-2)
- Quantify erosion at all Applied Ecological Services Sites *see table 36 below* (Years 1-2)
- Conduct an inventory of road/stream crossings over private drives and logging roads (Years 1-2)
- Develop specific BMP recommendations and tools for each site (culvert replacement, etc.) (Year 2).
- Implement restoration plans (Year 2-3).
- Pre and post BMP field evaluations (Year 1-10)

Measurements:

- Restoration of impacted streams (stream miles improved)
- Number of partners participating
- Improved water quality (ratings of good or better at all monitoring sites by year 10)
- Improved habitat for brook trout (Year 5-10)
- Conduct pre- and post-BMP field evaluations (site condition evaluation and stream monitoring) (Years 1-10)
- Achieve 10% reduction in sediment load (Year 5)
- Achieve 25% reduction in sediment load (Year 10)

Potential Partners: Longyear Realty Corporation, Weyerhauser, The Nature Conservancy, Northern Michigan University, and Powell, Michigamme, and Champion Townships.

Table 33 Applied Ecological Services BMP sites - Load calculations needed

Description	BMP #	Pollutant	Priority Rank
AES Site 22 notes: 30-40-year *Populus sp.* mixed with *Tsuga canadensis*	19, 22, 24-32	Sediment, Altered hydrologic flow	22
AES Site 23 notes: *Acer saccharum* and *Tsuga canadensis*	19, 22, 24-32	Sediment, Altered hydrologic flow	23
AES Site 24 notes: *Alnus sp.* and *Calamagrostis canadensis*	19, 22, 24-32	Sediment, Altered hydrologic flow	24
AES Site 25 notes: *Abies balsamea, Betula sp.,* and *Thuja sp.*	19, 22, 24-32	Sediment, Altered hydrologic flow	25
AES Site 26 notes: Stable w/ very little flowing left to right	19, 22, 24-32	Sediment, Altered hydrologic flow	26
AES Site 27 notes: Tree species include *Thuja occidentalis*, *Picea glauca, Pinus strobus,* understory *Acer saccharum*	19, 22, 24-32	Sediment, Altered hydrologic flow	27
AES Site 28 notes: *Abies balsamea, Betula sp., Acer saccharum* and small brookies observed	19, 22, 24-32	Sediment, Altered hydrologic flow	28
AES Site 29 notes: *Calamagrostis canadensis*, *Carex sp, Solidago sp., Picea glauca, Populus sp. Acer sp. Corylus cornuta*	19, 22, 24-32	Sediment, Altered hydrologic flow	29
AES Site 30 notes: *Betula sp, Acer saccharum, Tilia sp.* intermittent	19, 22, 24-32	Sediment, Altered hydrologic flow	30
AES Site 33 notes: Increase flow, larger brookies observed, USGS station. mostly *Alnus sp.,* some *Cornus sp.*	19, 22, 24-32	Sediment, Altered hydrologic flow	31
AES Site 36 notes: New logging area	19, 22, 24-32	Sediment, Altered hydrologic flow	32
AES Site 37 notes: Huron Mountain Club. Stable stream, sand substrate, few sprigs of *Phalaris arundinacea*, Water Access Issues	19, 22, 24-32	Sediment, Altered hydrologic flow	33
AES Site 38 notes: Monitor mining impacts and water outputs	19, 22, 24-32	Sediment, Altered hydrologic flow	34
AES Site 39 notes: Intense forest management strategies; implement appropriate BMPs especially on sloped areas and proximate to drainages	19, 22, 24-32	Sediment, Altered hydrologic flow	35

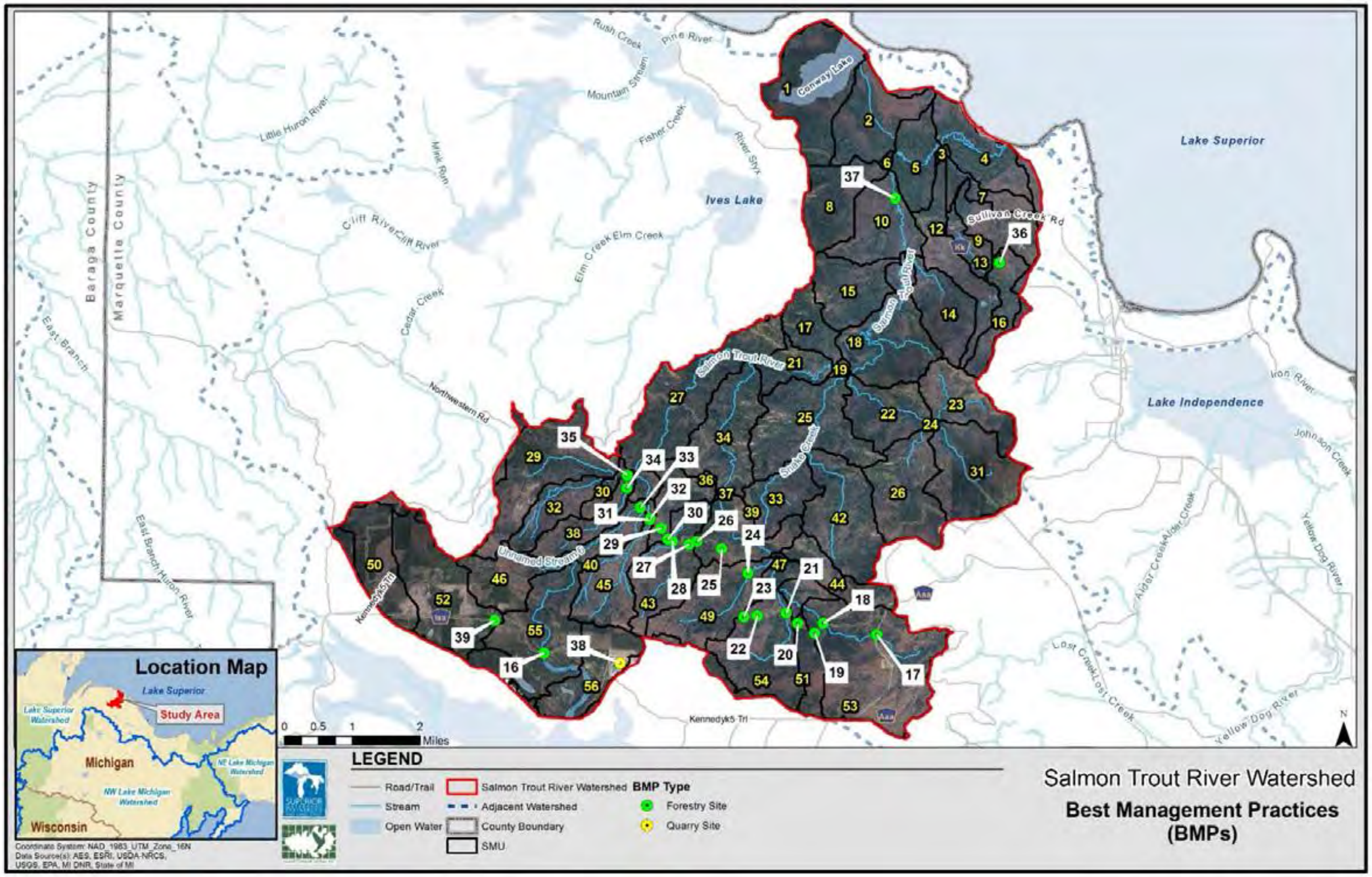

Figure 45 Salmon Trout River Sites identified by Applied Ecological Services

Task 5: Develop limited or local use hydraulic geometry curves that relate channel geometry characteristics with streamflow and basin characteristics to improve the design of channel restoration

The use of hydraulic geometry protocols is necessary to determine if there has been a shift in channel morphology in the Salmon Trout River. Michigan Technological University researchers have been studying coaster brook trout (*Salvelinus fontinalis*) habitat in the Salmon Trout River since 2002 and have noticed an aggradation of sand in the lower river reaches in recent years. The sand has inundated the spawning substrate and impacts natural coaster brook trout spawning habitat and threatens the cold water fishery designated use for this rare fish population. The use of hydraulic curve plots will help guide future management efforts to restore the channel morphology to stable conditions. The objective is to establish 20 sites/points, but fewer sites may be appropriate. In the future, the establishment of this limited use curve may be expanded to other watersheds and could lead to the development of a regional reference curve, which would be beneficial for BMP implementation work on a larger scale.

Goals Accomplished:
Goal #1: Protect the integrity of aquatic and terrestrial ecosystems within the watershed.
Goal #2: Protect and improve the quality of water in order to support all designated and desired uses.

Estimated Cost: $20,000
Timeline: 3 years

Priority: High

Milestones:
- Coordinate with project partners (Year 1)
- Develop/coordinate project plan, site selection criteria, landowner access permissions, and site reconnaissance (Years 1-2)
- Develop limited use curve plots of bank mean depth, width, and cross-sectional area versus drainage area. The plots will be developed using locally collected data from stable reference reaches with similar geographic, geologic, and climactic characteristics (similar soils, topography, land cover/uses, annual rainfall, and stream type) Implement field survey plans. (Year 2).
- Coordinate data collection, data storage, analysis, and dissemination with partners (Year 2-3).
- Compare to previously published hydraulic geometry/curves in adjacent areas (Year 3)

Measurements:
- Number of hydraulic geometry curve plots established
- Number of components collected per plot
- Number of partners participating

Potential Partners: Superior Watershed Partnership, Keweenaw Bay Indian Community, U.S. Fish and Wildlife Service, Michigan Department of Natural Resources, Michigan Technological University, Northern Michigan University, Huron Mountain Club, and other landowners.

Non-Native Invasive Species Management Plan

As a remote watershed with high quality aquatic and terrestrial habitats, the Salmon Trout River should remain protected from non-native and invasive species of regional priority. The state designates cooperative weed management areas, public-private partnerships, to identify, strategize, and manage species of regional concern to protect and restore native habitats. Partnership with the local cooperative weed management area, Lake 2 Lake CISMA, will be sought to address priority concerns. More information about Lake 2 Lake CISMA can be found here **www.michiganinvasives.org/l2lcisma**.

Goals Accomplished:
Goal #1: Protect the integrity of aquatic and terrestrial ecosystems within the watershed.

Timeline: 3 years

Priority: Medium
Estimated Cost: $5,000

Milestones:
- Coordinate project partners (Year 1)
- Conduct analysis and field verification of site data (Years 1-2)
- Develop specific BMP recommendations and tools for each site (Year 2).
- Implement restoration plans (Year 2-3).
- Pre and post BMP field evaluations (Year 1-10)

Measurements:
- Number of partners participating
- Conduct pre- and post-BMP field evaluations (Years 1-10)

Table 34 Locations where Non-Native Invasive Species (NNIS) management is needed

SWP Site Number	Description	NNIS regional priority species	BMP #	Priority Rank
29	Main Branch Salmon Trout River crossing at Co Rd AAA near Eagle Mine. *Fallopia sp. growing along road margins (also known as AES survey site 16).*	Yes	12	1
	AES Site 37 notes: Huron Mountain Club. Stable stream, sand substrate, few sprigs of *Phalaris arundinacea*, Water Access Issues	Yes	12	2
30	East Branch Salmon Trout River crossing at Co Rd AAA *(also known as AES survey site 17).*	No	12	3
21	crossing over an unnamed tributary to the Main Branch Salmon Trout River on the Northwestern Rd near Dodge City *(also known as AES survey site 31).*	No	12	4
22	crossing over an unnamed tributary to the Main Branch Salmon Trout River on the Northwestern Rd near Dodge City *(also known as AES survey site 32)*	No	12	5

13	East branch Salmon Trout/ Northwestern Road *(also known as AES survey site 18).*	No	12	6
25	Northwestern Rd / West Branch Salmon Trout River crossing *(also known as AES survey site 35).*	No	12	7
16	Crossing over an unnamed tributary to the East Branch Salmon Trout River at the Northwestern Road *(also known as AES survey site 21).*	No	12	8
14	Crossing over an unnamed tributary to the East Branch Salmon Trout River at the Northwestern Road *(also known as AES survey site 19).*	No	12	9
15	Crossing over an unnamed tributary to the East Branch Salmon Trout River at the Northwestern Road *(also known as AES survey site 20).*	No	12	10
24	Crossing over an unnamed tributary to the West Branch Salmon Trout River at the Northwestern Road near Dodge City *(also known as AES survey site 34).*	No	12	11
	AES Site 22 notes: 30-40-year *Populus sp.* mixed with *Tsuga canadensis*	No	12	12
	AES Site 23 notes: *Acer saccharum* and *Tsuga canadensis*	No	12	13
	AES Site 24 notes: *Alnus sp.* and *Calamagrostis canadensis*	No	12	14
	AES Site 25 notes: *Abies balsamea, Betula sp.,* and *Thuja sp.*	No	12	15
	AES Site 26 notes: Stable w/ very little flowing left to right	No	12	16
	AES Site 27 notes: *Thuja occidentalis*, *Picea glauca, Pinus strobus,* and *Acer saccharum*	No	12	17
	AES Site 28 notes: *Abies balsamea, Betula sp., Acer saccharum* and small brookies observed	No	12	18
	AES Site 29 notes: *Calamagrostis canadensis*, *Carex sp, Solidago sp., Picea glauca, Populus sp. Acer sp. Corylus cornuta*	No	12	19
	AES Site 30 notes: *Betula sp, Acer saccharum, Tilia sp.* intermittent	No	12	20
	AES Site 33 notes: Increase flow, larger brookies observed, USGS station. mostly *Alnus sp.,* some *Cornus sp.*	No	12	21
	AES Site 36 notes: New logging area	No	12	22
	AES Site 38 notes: Monitor mining impacts and water outputs	No	12	23

7.0 INFORMATION & EDUCATION PLAN

7.1 Social Survey

As a part of the *Lake Superior: Urban and Rural Watershed Restoration Project*, the Model Forest Policy Program (MFPP) assisted SWP with development of a social survey and analyzed the results collected in 2016. The survey data was collected from the Salmon Trout River watershed as well as the Lower Dead River watershed in the City and Township of Marquette, MI for urban and rural comparison. The survey was designed to 1.) Identify the watershed and conservation priorities and concerns of landowners, 2.) Inform policy development, and 3.) Improve land use planning and actions by local units of government and landowners. In addition, the survey results help to assess the social indicators of the region, which are helpful when developing plans to educate and promote watershed-based awareness.

The survey categories and their relative significance are based on the Great Lakes Regional Water Program - Social Indicators Data Management and Analysis (SIDMA); the survey was developed using "The Social Indicator Planning & Evaluation System (SIPES) for Nonpoint Source: A Handbook for Watershed Projects Management" ("Handbook") as a guide. The required guidelines allowed for minimal modification of survey questions. The Salmon Trout and Lower Dead survey forms are located at: https://superiorwatersheds.org/social-surveys. The survey was initially sent to 127 deliverable addresses within the Dead River watershed and 132 deliverable addresses within the Salmon Trout River watershed.

Observations from the Watershed Survey

Below highlights key (high-level) observations that stood out in reviewing the results. The full highlighted document is Reference B, "Lower Dead (Dead River) and Salmon Trout Survey - Use for Curriculum and Policy Development (2018)".

- Approximately 1/3 response rate; considered quite high.
- Basic **knowledge of hydrology by respondents is good**; **knowledge about impacts somewhat less so**.
- **Scenic beauty, boating and fish** stood out as important for people on both rivers. [The majority of respondents rated water quality in both rivers as good though the Lower Dead River was seen as less desirable for edible fish or fish habitat.]
- **Respondents value water quality** and its importance to their quality of life - less see connection to their business.

The survey results and analysis provided key insights into watershed curriculum development and education/outreach projects. The characteristics of the surveyed respondents are provided in Table 38.

Table 35 Survey Respondents Demographic Information

Demographic Information	Lower Dead	Salmon Trout
Gender	Male (73.0%); Female (27.0%)	Male (67.4%); Female (32.6%)
Age (Mean)	57.78 years	58.59 years
Highest Grade in School Top Two)	Post Graduate (34.2%); 4-year college degree (28.9%)	Post Graduate (31.0%); Some College (31.0%); and 4-Year College Degree (28.9%)
Total Household Income (Top Two)	$100,000 or more (33.3%); and $25,000 to $49,999 (27.3%)	$75,000 to $99,999 (30.3%); and $25,000 to $49,999 (24.2%) and $100,000 or more (24.2%)
Ethnicity	White/Caucasian (97.1%)	White/Caucasian (88.4%)
Media Source of Information (Top Three Out of Seven)	Newsletters/brochure/factsheet (62.2%); Internet (54.1%); and Workshops/ Demonstrations/Meetings (43.2%)	Newsletters/brochure/factsheet (65.9%); Internet (59.1%); and Conversations with Others (54.5%)
Regularly Read a Local Newspaper	No (64.9%); Yes (35.1%)	No (69.8%); Yes (30.2%)
Primary Residence	Yes (83.3%); No (16.2%)	Yes (34.9%); No (65.1%)
Best describes where you live.	In a town, village, or city (26.3%); In an isolated, rural, non-farm residence (28.9%); Rural subdivision or development (39.5%); On a farm (5.3%)	In a town, village, or city (4.7%); In an isolated, rural, non-farm residence (69.8%); Rural subdivision or development (30.2%); On a farm (9.3%)
In addition to your residence, which of the following do you own or manage?	An agricultural operation (5.4%); Forested land (32.4%); Rural recreational property (32.4%); None of these (51.4%)	An agricultural operation (4.7%); Forested land (69.8%); Rural recreational property (30.2%); None of these (9.3%)

8.0 PLAN IMPLEMENTATION

8.1 Plan Implementation Roles and Coordination/Responsibilities

The strategies for protection, restoration, and public involvement outlined under the goals and objectives of this watershed management plan will be implemented through a suite of recommendations or tasks. These tasks were developed based on the prioritization of watershed pollutants, sources, and causes, and critical areas of the watershed. A ten-year timeline was used as the schedule for implementation. Tasks that should be done in the short term were given a completion timeline of 3 years. Tasks that should be undertaken annually were given a timeline of "ongoing". Estimated costs for implementation tasks do not include staff oversight or administrative costs. A summary of implementation tasks and milestones is provided.

8.2 Implementation Schedule

Table 36 Implementation tasks and milestones

Task	Timeline (years)									
	1	2	3	4	5	6	7	8	9	10
Task 1: Implement outreach and communication action plan	X	X	X							
Define target audiences including Salmon Trout River landowners and local governmental decision makers, and establish goals of outreach to/communications with target audiences.	X									
Align efforts with goals of outreach to/communications with target audiences	X	X								
Use the key messages developed in the MFPP survey process.		X	X							
Create a tactical outreach plan. How will you reach your audience? (Email, website, social media, in-person events, phone calls, traditional media: advertising, commercials, etc.)		X	X							
Task 2: Encourage voluntary landowner assistance programs for conservation practices	X	X	X	X	X					
Work with partners to develop and distribute information and education on voluntary landowner arrangements (Year 1)	X									
Work with Marquette County to develop and adopt incentive programs (Years 1-3)	X	X	X							

Task	**Timeline (years)**									
	1	2	3	4	5	6	7	8	9	10
Work with landowners to improve land use management practices (Years 2-5)		X	X	X	X					
Task 3: Erosion and runoff: Restore riparian corridors and other sensitive areas	X	X	X		X					X
Coordinate project partners (Year 1)	X									
Conduct analysis and field verification of site data (Years 1-2)	X	X								
Develop specific BMP recommendations and tools for each site (green infrastructure, road redesign, water bar installation, cover cropping, mulching, etc.) (Year 2).		X								
Implement restoration plans (Year 2-3).		X	X							
Pre and post BMP field evaluations	X				X					X
Task 4: Adjust culvert inlet elevations and maintain bridges to ensure biological integrity	X	X	X		X					X
Coordinate project partners (Year 1)	X									
Conduct analysis and field verification of site data (Years 1-2)	X	X								
Develop specific BMP recommendations and tools for each site (culvert replacement, etc.) (Year 2).		X								
Quantify erosion at all Applied Ecological Services Sites *see table 36* (Years 1-2)	X	X								
Conduct an inventory of road/stream crossings over private drives and logging roads (Years 1-2)	X	X								
Implement restoration plans (Year 2-3).		X	X							
Pre and post BMP field evaluations (Year 1-10)	X				X					X
Task 5: Develop limited or local use hydraulic geometry curves that relate channel geometry characteristics with streamflow and basin characteristics to improve the design of channel restoration	X	X	X							
Coordinate with project partners (Year 1)	X									
Develop/coordinate project plan, site selection criteria, landowner access permissions, and site reconnaissance (Years 1-2)	X	X								

Task	Timeline (years)									
	1	2	3	4	5	6	7	8	9	10
Develop limited use curve plots of bank mean depth, width, and cross-sectional area versus drainage area. The plots will be developed using locally collected data from stable reference reaches with similar geographic, geologic, and climactic characteristics (similar soils, topography, land cover/uses, annual rainfall, and stream type) Implement field survey plans. (Year 2).		X								
Coordinate data collection, data storage, analysis, and dissemination with partners (Year 2-3).		X	X							
Compare to previously published hydraulic geometry/curves in adjacent areas (Year 3)			X							
Task 6: Implement NNIS BMPs	X	X	X	X	X	X	X	X	X	X
Coordinate project partners (Year 1)	X									
Conduct analysis and field verification of site data (Years 1-2)	X	X								
Develop specific BMP recommendations and tools for each site (Year 2).		X								
Implement restoration plans (Year 2-3).		X	X							
Pre and post BMP field evaluations (Year 1-10)	X	X	X	X	X	X	X	X	X	X

8.3 Funding Sources

Past projects and planning efforts within the Salmon Trout River watershed have been implemented through a variety of funding sources including:

- Longyear Realty Corporation
- U.S. Fish and Wildlife Service
- Natural Resources Conservation Service
- Michigan Department of Natural Resources – Fisheries
- Great Lakes Fish and Wildlife Restoration Act
- Great Lakes Restoration Initiative
- Michigan Department of Environment, Great Lakes, and Energy
- Federal Emergency Management Agency
- National Fish and Wildlife Foundation

Future funding could be sought from organizations on the previous list and expanded to include additional potential sources such as:

- Landscape Scale Restoration Grant Program
- NOAA Great Lakes Habitat Restoration Regional Partnership Grants
- NOAA Bay Watershed Education and Training (B-WET)
- Private foundations

9.0 MEASURING PLAN PROGRESS & SUCCESS

9.1 Water Quality Monitoring Plan & Evaluation Criteria

Continual evaluation provides information regarding the success of ongoing efforts to improve watershed characteristics. It allows for an assessment of the effectiveness and appropriateness of the original goals and objectives of this plan as tasks are implemented and conditions change over time. Evaluation also provides a feedback mechanism for periodically assessing the effectiveness of management practices and allows stakeholders to identify areas where program improvements are possible.

The measurements identified in relation to the goals and objectives of this plan provide helpful tools for local stakeholders to assess the effectiveness of their implementation projects or educational/outreach efforts. These measures however, are by no means exhaustive. Many other evaluation measures exist and local stakeholders must ensure evaluation programs and protocols meet local needs.

Evaluation programs typically include two types of measures: quantitative and qualitative. Quantitative attributes are those which it is possible to measure. Qualitative measures try to shed light on changes in attitudes, perceptions and knowledge levels. Examples of the two approaches as they related to the goals and objectives of the Salmon Trout River Watershed Management Plan are provided below.

Quantitative Measures

- Biological monitoring of surface waters (e.g. macroinvertebrate communities)
- Chemical monitoring or surface waters (e.g. temperature, dissolved oxygen)
- Stream flow monitoring (e.g. volume, velocity)
- Sediment monitoring (e.g. deposition, quantity)
- Number of buffer ordinances adopted by townships
- Number of acres protected (conservation easements)
- Educational workshop attendance levels
- Number of storm water Best Management Practices implemented
- Number of restoration projects completed

Qualitative Measures

- Workshop evaluation surveys
- Public opinion surveys (e.g. increased awareness of impacts of nonpoint source pollutants on aquatic habitats, etc.)
- Increased cooperation and networking between stakeholders and other entities
- Level of enthusiasm expressed about revising zoning ordinances and master plans
- Public confidence that groundwater is safe

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