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DEPARTMENT OF NATURAL RESOURCES

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Tahquamenon River Assessment

James R. Waybrant

and

Troy G. Zorn

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EXECUTIVE SUMMARY

This is one in a series of river assessments being prepared by the Michigan Department of Natural Resources (MDNR), Fisheries Division for Michigan rivers. This report describes the physical and biological characteristics of the Tahquamenon River, discusses how human activities have influenced the river, and serves as an information database for managing the river's future.

River assessments are intended to provide a comprehensive reference for citizens and agency personnel who need information about a river. By pulling together and synthesizing existing information, river assessments show the intertwined relations between rivers, watershed landscapes, biological communities, and humans. This assessment shows the influence of humans on the Tahquamenon River, and is intended to increase public concern for the river. We hope it will encourage citizens to become more actively involved in decision-making processes that provide sustainable benefits to the river and its users. To help achieve this, assessments identify problem areas within a river system and identify potential opportunities for alleviating them. Assessments also identify the types of information needed to better understand, manage, and protect the river.

This document consists of four parts: an introduction, a river assessment, management options, and public comments (with our responses). The river assessment is the nucleus of the report. It provides a description of the Tahquamenon River and its watershed in twelve sections: geography, history, geology and hydrology, soils and land use patterns, channel morphology, dams and barriers, water quality, special jurisdictions, biological communities, fishery management, recreational use, and citizen involvement.

The management options section of the report identifies a variety of actions that could be taken to protect, restore, rehabilitate, or better understand the Tahquamenon River. These management options are categorized and follow the main sections of the river assessment. They are intended to provide a foundation for public discussion, setting priorities, and planning the future of the Tahquamenon River watershed.

The Tahquamenon River drains a modest watershed of 790 square miles, mostly in Luce County. A few tributaries originate in northwest Mackinac County and western Chippewa County. Its mainstem flows 87 mi generally eastward to drain into Lake Superior in western Whitefish Bay. For simplicity of discussion, the mainstem is divided into five segments, each having distinct characteristics of size, channel shape, flow characteristics, channel gradient, and water quality. Those segments are named, from headwaters to Lake Superior: Upper River, Dollarville, Marsh Drainage, Middle River, and Lower River. A sixth segment discusses the East Branch Tahquamenon River separately due to its fishery values, land ownership, and Natural and Scenic designation.

Although Native Americans resided around the perimeter of the watershed, they were not able to live along much of the mainstem, due to an extensive contiguous marsh system. Even so, the mainstem was an important canoe route from the Fox River system to the west, extending east to Lake Superior. Early Europeans likewise generally stayed out of the watershed's interior, following native travel routes along the perimeter. It was only when lumbermen arrived that humans penetrated the watershed in large numbers. When the lumber era ended, the river again became quite isolated from human activity. Current river-related activities include hunting, trapping, and pleasure boating. The majority of water users, however, are anglers. Various fish surveys and angler comments suggest that they are targeting good fisheries throughout the watershed.

The Tahquamenon River and most tributaries originate in coarse glacial till or outwash materials, flowing down relatively steep gradients. Those streams that have been surveyed support good brook trout populations. Roughly one-half of the watershed, however, is comprised of a large wetland complex located in the center of the watershed and following the mainstem. All large tributaries flow into the wetland several miles from the mainstem, and both their gradient and velocity virtually disappear at the same point. The wetland complex acts to moderate discharge fluctuations during the summer and fall by absorbing and then slowly releasing water from rainfall events. Snowmelt flooding, however, produces an unusually large flood event, when compared with streams in the Lower Peninsula. Much of the Tahquamenon River watershed receives considerable lake effect snowfall due to its proximity to Lake Superior, and the marsh snowmelt event usually releases all the accumulated snow within a 2-week time period.

Headwater soils are predominantly sand and poorly consolidated. Past logging practices, some improperly designed road crossings, and other riparian land uses around 1900 accelerated erosion into the streams. For example, some straight-line dredging occurred 120 years ago to remove the sharp stream bends and facilitate log transport. Other streams were cleared of "debris" for the same reason. Even so, little evidence remains of this environmentally heavy-handed logging, and stream and riparian habitats within this watershed are surprisingly natural. Decades of natural healing have produced streams that meander, vegetated banks, and woody debris within the stream channel. Sand bedload is the most significant remaining evidence of the extensive land and timber management effort, as many lower gradient stream sections still suffer from excessive sand sediment load, pools filled in with sand, and subsequent declines in aquatic invertebrate communities. Despite the sand, however, most fish communities appear well balanced with good species diversity, likely owing to the healthy riparian community and contributions of terrestrial invertebrates, leaf litter as nutrient sources for periphyton and invertebrates. Large instream wood structure provides a stable surface for periphyton and invertebrate colonization. A current road-crossing inventory found very little erosion from any of the present road crossings. As the local population increases, there will be a desire to develop many more river or streamside areas. Education, vigilance, and funding will be needed to keep erosion at the lower, more natural levels, and to minimize sedimentation due to human activity in the riparian corridor.

The Tahquamenon River watershed is very natural; forests and wetlands comprise about 90% of the watershed. Little evidence of previous logging-related habitat destruction remains. Even so, the forest type changed after the last pine complexes were lumbered almost 100 years ago. The intervening time has allowed the forest to stabilize into a mixture of upland and conifers, upland and lowland hardwoods, wetlands, and marshes. The distribution of wetlands corresponds closely to occurrences of lacustrine deposits of clay, silt, sand, and gravel. As a result, urban development is restricted or impossible in many of the wetland areas, which serve to further maintain the natural condition. Further stream protection is provided by the riparian forests, which stabilize streambanks, shade stream channels, help control surface runoff, and provide periodic large woody material to the stream channel that is used as habitat by aquatic organisms. Several smaller tributaries were recently surveyed by Michigan Department of Environmental Quality (MDEQ) to quantify habitat quality and the aquatic invertebrate community. All streams were judged acceptable. Researchers, however, documented an increase in quality and diversity of the aquatic invertebrate community in a range from downstream to upstream, and from the east side of the watershed to the west.

The Tahquamenon River has a unique gradient profile. Although its average gradient is 3.2 ft/mi, the majority of the river has almost 0 ft/mi gradient. The 12-mi Upper River segment contains an average gradient of 12 ft/mi, and the best trout fishing waters here average 14 ft/mi for 7.3 mi. The highest slope in the Dollarville segment occurs mostly in the upstream portion, and the gradient slowly lessens as the river flows off glacial outwash and onto organic deposits. It averages 2.8 ft/mi for the first 7.4 mi of the segment, and only 0.9 ft/mi for the last 11.5 mi. The highest gradient of the Marsh Drainage segment exists immediately downstream from the Dollarville Dam. The river drops 3 ft at the dam, and then another 4 ft through about 3 mi to the M-123 Bridge (1.3 ft/mi). The river then averages 0.15 ft/mi through the next 13 mi to the downstream boundary of the segment at the Sage River mouth. The Middle River segment averages only 0.09 ft/mi. The river through the Upper and Lower falls complex drops about 96 ft. Below the Lower Falls downstream rapids area, the river averages 0.25 ft/mi through the last 16 mi to Lake Superior. Most tributaries follow a similar gradient pattern, with headwater areas containing gradients of 10–36 ft/mi, while the main branches contain considerably lower gradients. The lower gradients are generally due to the huge marsh complex that each stream flows through to join with the Tahquamenon River.

There are only seven dams in the Tahquamenon River watershed. Three were built and maintained by MDNR, Fisheries Division, and the ponds are managed as brook trout fisheries. Two additional small dams are privately owned. They each impound 4 acres. Fish surveys have shown brook trout populations at sites downstream from each dam. The 61-acre Halfway Lake and its lake level control dam are privately owned, and situated in the headwaters of Auger Creek. Dollarville Dam impounds 1,100 acres and was cooperatively built by local residents, state, and federal authorities.

Water quality in the watershed is generally good, primarily due to the lack of human development within the basin. There are only two point source discharges permitted in the watershed, the Newberry Wastewater Treatment Plant and the Tahquamenon Falls State Park. MDEQ, Water Bureau, monitors the effluents. Agriculture is rare in the watershed. Despite minimal local pollution, air transport brings pollutants such as mercury into the watershed from outside sources. As a result, the Tahquamenon River watershed is included in the statewide general fish consumption advisory for large predator fish based on mercury bioaccumulation.

Headwater and tributary high gradient stream temperatures provide acceptable thermal regimes for brook trout. The lower gradient tributary sections warm as they flow into the large wetland that encompasses most of the Tahquamenon River mainstem, producing temperatures that are only marginal for trout. The mainstem from County Road 415 north of McMillan downstream to Lake Superior is classified for coolwater species including muskellunge, northern pike, walleye, and yellow perch. A recent thermal study found that coolwater sport fish species have adequate coolwater refuge in lower segments along the river’s mainstem, as high summer water temperatures fall quickly with increasing depth in the several deep holes.

Jurisdiction over the river generally belongs to the State of Michigan. Sport fishing regulations, consumption advisories, fish stocking protocols, chemical discharges, and habitat manipulations are all determined or approved by the various entities of state government. In addition, local units of government influence the river through construction and maintenance of road crossings. The Tahquamenon Falls State Park is a special use area managed by the MDNR, Parks and Recreation Division. The upstream half of the East Branch Tahquamenon River lies within United States Forest Service (USFS) ownership. That portion of the river that flows through USFS property has been designated as a Wild and Scenic River. The section extending from the headwaters in section 5, T45N, R05W downstream about 11 mi to section 20, T46N, R06W was designated “recreational” for its exceptional brook trout fishing, while the small remaining section within USFS ownership west of section 20 was designated “wild.” The existing wild brook trout population was recognized in the designation as an outstanding value of the river that must be preserved.

The Tahquamenon Falls have existed since the early period of glacial retreat. Thus, they have continually provided a migration barrier for fish coming in from Lake Superior. With only a few rare human-caused exceptions, the species diversity is representative of an earlier era of geologic time. There are no carp, sea lamprey, alewives, smelt or other introduced species in the mainstem upstream of the Upper Falls. Hulbert Lake has always been a private lake, and therefore subject to private stocking. It was historically stocked with lake trout, smelt, ciscoes, and green sunfish. Those species are found nowhere else in the upper river. Fisheries Division has over the last 120 years stocked brown trout, rainbow trout and splake, in addition to species already present in the watershed. Native American legend associated lake sturgeon with the lower Tahquamenon River, but no Fisheries Division survey on record has documented any sturgeon in the river.

The Upper River segment is designated as first quality trout water. The segment characteristics are relatively high stream gradient, excellent large woody structure, and an abundance of exposed rock cobble and gravel. Considerable habitat enhancement work conducted in recent years has protected eroding banks, exposed rock and gravel beds, and scoured the sand bedload to produce deeper holding waters. The new fish community reflects a traditional brook trout – mottled sculpin species complex, with large numbers of wild brook trout.

The Dollarville, Marsh Drainage, and Middle River segments all support excellent fisheries for northern muskellunge, northern pike, walleye, and yellow perch. Concurrent with somewhat warmer annual temperatures in recent years, angler input and survey results indicate increases in the number of both smallmouth and largemouth bass. The Lower River segment supports excellent seasonal fisheries for walleye, steelhead, and yellow perch, with good summer catches of northern pike, northern muskellunge, and smallmouth bass.

A variety of amphibians, reptiles, birds, mammals and plants occur within the watershed. Several are threatened or endangered. The number of bird species either inhabiting or passing through the watershed is striking. Much of the migratory traffic consists of birds moving to Whitefish Point, Chippewa County. It is a common concentration area for migratory species flying north into Ontario in the spring, or back south again in the fall. Purple loosestrife, Eurasian milfoil, and zebra mussels are the only aquatic pest species documented in the watershed. Purple loosestrife has been identified along several road and wetland margins, while Eurasian milfoil and zebra mussels have each been documented in only one lake in this watershed.

Angling is by far the most popular riverine activity. The number of kayakers and canoeists are increasing, generally targeting the Marsh Drainage segment as McPhee’s Landing is the only public access between Newberry and the Upper Falls. Their trips are generally day trips for fishing or wildlife viewing, as there are no acceptable campsites within the marsh complex. Almost all of the shoreline acceptable for camping further downstream in the Middle River segment is privately owned.

A watershed council would provide a mechanism for people of diverse interests to work together to protect and preserve existing resources. Such a multi-agency forum for exchange of information, ideas, visions, and goals does not currently exist.

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Michigan Department of Natural Resources
Fisheries Special Report 45, 2008

TAHQUAMENON RIVER ASSESSMENT

James R. Waybrant

Michigan Department of Natural Resources, Newberry Operations Service Center,
5100 State Highway M-123, Newberry, Michigan 49868

Troy G. Zorn

Michigan Department of Natural Resources, Marquette Fisheries Research Station,
484 Cherry Creek Road, Marquette, Michigan 49855

INTRODUCTION

This river assessment is one of a series of documents being prepared by the Michigan Department of Natural Resources, Fisheries Division, for rivers in Michigan. We have approached this assessment from an ecosystem perspective, as we believe that fish communities and fisheries must be viewed as parts of a complex ecosystem. Our approach is consistent with the mission of the Michigan Department of Natural Resources, Fisheries Division, namely to "protect and enhance the public trust in populations and habitat of fishes and other forms of aquatic life, and promote optimum use of these resources for benefit of the people of Michigan".

As stated in the Fisheries Division Strategic Plan, our aim is to develop a better understanding of the structure and functions of various aquatic ecosystems, to appreciate their history, and to understand changes to systems. Using this knowledge, we will identify opportunities that provide and protect sustainable aquatic benefits while maintaining, and at times rehabilitating, system structures or processes.

Healthy aquatic ecosystems have communities that are resilient to disturbance, are stable through time, and provide many important environmental functions. As system structures and processes are altered in watersheds, overall complexity decreases. This results in a simplified ecosystem that is less able to adapt to additional change. All of Michigan's rivers have lost some complexity due to human alterations in the channel and on surrounding land. Therefore, each assessment focuses on ecosystem maintenance and rehabilitation. Maintenance involves either slowing or preventing losses of ecosystem structures and processes. Rehabilitation is putting back some of the original structures or processes.

River assessments are based on ten guiding principles in the Fisheries Division Strategic Plan. These are: 1) recognize the limits on productivity in the ecosystem; 2) preserve and rehabilitate fish habitat; 3) preserve native species; 4) recognize naturalized species; 5) enhance natural reproduction of native and desirable naturalized fishes; 6) prevent the unintentional introduction of invasive species; 7) protect and enhance threatened and endangered species; 8) acknowledge the role of stocked fish; 9) adopt the genetic stock concept, that is protecting the genetic variation of fish stocks; and 10) recognize that fisheries are an important cultural heritage.

River assessments provide an organized approach to identifying opportunities and solving problems. They provide a mechanism for public involvement in management decisions, allowing citizens to learn, participate, and help direct decisions. They also provide an organized reference for Fisheries Division personnel, other agencies, and citizens who need information about a particular aspect of the river system.

The nucleus of each assessment is a description of the river and its watershed, using a standard list of important ecosystem components. These include:

Geography–a brief description of the location of the river and its watershed; a general overview of the river from its headwaters to its mouth, including topography. This section sets the scene.

History–a description of the river as seen by early settlers and a history of human uses and modifications of the river and watershed.

Geology–a description of both the surficial and bedrock geology of the area.

Hydrology–patterns of water flow, over and through a landscape. This is the key to the character of a river. River flows reflect watershed conditions and influence temperature regimes and habitat characteristics.

Soils and Land Use Patterns–soils and land use in combination with climate determine much of the hydrology and thus the channel form of a river. Changes in land use often drive change in river habitats.

Channel Morphology–the shape of a river channel: width, depth, and sinuosity. River channels are often thought of as fixed, apart from changes made by people. However, river channels are dynamic, constantly changing as they are worked on by the unending, powerful flow of water. Diversity of channel form affects habitat available to fish and other aquatic life.

Dams and Barriers–affect almost all river ecosystem functions and processes, including flow patterns, water temperature, sediment transport, animal drift and migration, and recreational opportunities.

Water Quality–includes temperature, and dissolved or suspended materials. Temperature and a variety of chemical constituents can affect aquatic life and river uses. Degraded water quality may be reflected in simplified biological communities, restrictions on river use, and reduced fishery productivity. Water quality problems may be due to point-source discharges (permitted or illegal) or to nonpoint-source runoff.

Special Jurisdictions–stewardship and regulatory responsibilities under which a river is managed.

Biological Communities–species present historically and today, in and near the river; we focus on fishes, however associated mussels, mammals and birds, key invertebrate animals, special concern, threatened and endangered species, and pest species are described where possible. This component is the foundation for the rest of the assessment. Maintenance of biodiversity is an important goal of natural resource management. Species occurrence, extirpation, and distribution are important clues to the character and location of habitat problems.

Fishery Management–goals are to provide diverse and sustainable game fish populations. Methods include management of fish habitat and fish populations.

Recreational Use–types and patterns of use. A healthy river system provides abundant opportunities for diverse recreational activities along its mainstem and tributaries.

Citizen Involvement–an important indication of public views of the river. Issues that citizens are involved in may indicate opportunities and problems that the Fisheries Division or other agencies should address.

Throughout this assessment we use data and shape files downloaded from the Michigan Geographic Data Library, maintained by the Michigan Center for Geographic Information (MDNR 2004). These data provide measures of watershed surface area for numerous categories (e.g., soil types, land use, surficial geology), measures of distance (e.g., stream lengths), and creation of associated figures. We used Arc View GIS 3.2a or Arc GIS (Environmental Systems Research Institute, Inc.; Copyright) to display and analyze these data, and create the landscape figures presented in this report. Unless otherwise referenced, all such measures and associated figures reported within the sections of this report were derived from these data.

Management options follow the river assessment sections of this report, and list alternative actions that will protect, rehabilitate, and enhance the integrity of the river system. These options are intended to provide a foundation for discussion, setting priorities, and planning the future of the river system. Identified options are consistent with the mission statement of Fisheries Division.

Copies of the draft assessment were distributed for public review beginning September 2007. One public meeting was held September 20, 2007 at the Tahquamenon Area School Library in Newberry. Written comments were received through November 16, 2007. Comments were either incorporated into this assessment or responded to in the Public Comment and Response section.

A fisheries management plan will now be written. This plan will identify options chosen by Fisheries Division, based on our analysis and comments received. In general, a Fisheries Division management plan will focus on a shorter time, include options within the authority of Fisheries Division, and be adaptive.

Individuals who review this assessment and wish to comment should do so in writing to:

Michigan Department of Natural Resources
Fisheries Division, Eastern Lake Superior Management Unit
Newberry Operations Service Center
5100 South M-123
Newberry, Michigan 49868

Comments received will be considered in preparing future updates of the Tahquamenon River Assessment.

RIVER ASSESSMENT

Geography

The Tahquamenon River watershed is located in the north central portion of the Eastern Upper Peninsula (Figure 1). The river originates from the three Tahquamenon Lakes which occur about 0.5 mi east of the border between Alger and Schoolcraft counties at an elevation of 880 ft. From there, the river flows 87 mi to Lake Superior, draining a 790-square-mile watershed. Its path is generally south for 10 mi, east for 42 mi, north for 14 mi, and then after the Upper Falls, it meanders with wide curves and high banks easterly 21 mi to Lake Superior.

Newberry is the center of human activity within the watershed, with government offices, the only high school system, good shopping, many churches, and a population of 2,200. Even so, Newberry is very isolated within this portion of the Upper Peninsula, as evidenced by the distance to the four closest cities. St. Ignace lies 69 mi southeast, Sault Ste. Marie 67 mi east, Marquette 105 mi west, and Manistique 61 mi southwest.

Sixty-seven named tributaries (376 total miles) flow directly or indirectly into the Tahquamenon River. For clarity, the most significant 42 are shown (Figure 2). The East Branch Tahquamenon River, Hendrie River, Sage River, and Murphy Creek are the largest tributary systems, each with several tributaries of their own. In addition, there are numerous small, unnamed streams that are marsh drainages or small spring-fed creeks.

Baker (2006) identified 5 distinct valley segments for the Tahquamenon River and 21 for its tributaries. Valley segments are long stretches of a stream that are relatively uniform in size, channel shape, flow characteristics, channel gradient, and water quality. Those features generally change (and valley segment boundaries occur) at distinct points along a river, such as boundaries of geological landforms over which it flows (e.g., moraines or former lake beds), major stream confluences, or major changes in gradient. For simplicity, segments delineated in this assessment will generally follow Baker's segments, but will use geographic features for boundaries. Discussion will center on five valley segments of the mainstem, plus the East Branch Tahquamenon River as a separate segment. The mainstem is divided into the following segments: Upper River, Dollarville, Marsh Drainage, Middle River, and Lower River (Figure 3).

Upper River Segment

The Upper River segment is the headwater portion of the Tahquamenon River and the area of highest gradient as the river flows across glacial outwash deposits. Total length of this segment is 10.4 mi. In profile, the mainstem drainage emerges from a series of steep rolling sand hills, dropping quickly to the three Tahquamenon Lakes. The Tahquamenon Lakes collate drainage from smaller basins higher in elevation, and the river originates from the central lake. After flowing under County Road 422 (Figure 4), the stream falls in a series of gravel riffles and sand-bottomed pools for about 10 mi to County Road 442. Just west of County Road 442, the stream flattens out into a small swampy "spreads," consisting of braided channel morphology fringed with tag alder and cedar. The river pinches back together at County Road 442, and then opens up again into a spreads flowage. No streams join the Tahquamenon through this section. Water in this section is cold, designated for trout, with a stable annual flow.

Dollarville Segment

The river in this 18.8 mi long segment flows across a former glacial lakebed mostly made up of clay and silt, and is dominated by marsh in the upper section and the Dollarville Flooding in the downstream section. The river flows east from County Road 442 across an extension of the marsh and swamp forest that ended the Upper River segment. It is highly braided through this marsh, and is commonly referred to as “The Spreads.” The bottom substrate consists of sand and silt and is littered with windfalls of cedar and spruce trees. Though the stream is hard to follow in this area, there is a main course that follows the low sandy hills along County Road 442 for a half mile and then dips generally southward for about 3 mi. The river then flows east for about 10 mi to Dollarville Flooding, receiving Kings, Syphon, and East creeks, all of which are designated trout streams. Silver Creek, a designated trout stream, enters at the western end of Dollarville Flooding influence. Teaspoon Creek, which is designated trout water in the upper reaches, enters within the flooding. The deepest water in Dollarville Flooding can be found in the old riverbed. The river here is well vegetated with a variety of aquatic vegetation, and fringed with small islands vegetated with willow, alder, marsh grass, and northern lowland conifers.

Marsh Drainage Segment

The Marsh Drainage segment begins immediately downstream from the Dollarville Flooding, extending 17 mi to the confluence with the Sage River. From Dollarville, the river winds a serpentine path to M-123, about 3 mi downstream. The river is a relatively fast moving, shallow stream until it gets about halfway to M-123. At the halfway mark, the river opens into Spider Bay, which consists of three large, deep bayous surrounded by grass, cattails, and some brush. The river then flows slower and deeper as it goes under M-123 and winds its way through a narrow serpentine channel inundated with downed trees downstream to McPhee’s Landing.

Below McPhee’s Landing, downstream to the mouth of the Sage River, the Tahquamenon River flows through low marshland vegetated with alder, dense brush, cattails, and sedges. However, 5 mi downstream from McPhee’s Landing, large trees start appearing on some low sandy hills which emerge from the swamp.

Middle River Segment

The Middle River segment begins where the river’s size increases at its confluence with the Sage River and continues 21 mi downstream to the Upper Falls. This segment is straighter, wider, and deeper than the upstream segments. Gradient is almost nonexistent. Vegetation consists of hardwood forests on the higher banks, and aspen, lowland conifers, and tag alder in the flood plain. Many small, spring-fed streams with high gradients enter along the river’s eastern bank as the river flows north, while those joining from its western bank have considerably lower gradient. The river averages about 200 ft wide, with normal depths ranging from 15 to 25 ft. There are many deeper holes down to 65 ft, usually at the mouth of a tributary stream or in a bend, but sometimes in unexpected locations. The only boat access within this zone is Slater’s Landing, a private fee-paid site just upstream of the mainstem on the East Branch Tahquamenon River. Where the river again comes near M-123, about 1 mi upstream of the Upper Falls, it bends eastward through a deep hole, thought to be the deepest spot on the river. Early field notes (Anderson, 1976, unpublished data) put the depth about 65 ft, which is similar to a deep hole immediately upstream from Joy Island. From M-123, the river’s velocity picks up as it widens and becomes shallower in its approach to the Upper Falls.

Hendrie River.–The Hendrie River is the largest sub-watershed of the Middle River segment. Originating in the east portion of the watershed, it flows quickly out of a small area of coarse glacial till and into the huge low gradient marsh complex of peat and muck soils (Figure 5) surrounding the Middle River and joining with the main Tahquamenon River marsh. For that reason, the mainstem has little gradient, with most of the gradient in the upstream reach. The rest of the mainstem winds a serpentine, sluggish path through the marsh. Naugle Creek, a small tributary to the headwater area of the mainstem, has a relatively high gradient. Neither Naugle Creek nor the mainstem, however, are classified as trout water. No water temperatures have been recorded in those waters. The Soo Line

Railroad runs southeasterly through the watershed, roughly paralleling the mainstem of the Hendrie. It is used for delineation between trout and non-trout waters. As a result, the West Branch, South Branch, and McLeod's Ditch are designated as trout water, while the rest of the watershed is not. West and South Branches both originate in forested areas of elevated peat and muck over limestone in Mackinac County (Figure 5), and then flow through some coarse glacial till en route to the main low gradient marsh complex. Headwaters are forested that portion of the watershed is inundated with beaver dams.

Sage River.–The second largest sub-watershed in the Middle River segment is the Sage River. Most headwaters originate in uplands of coarse glacial till (Figure 5). Those headwater sections are of relatively high gradient, such as First Creek. The East and West Branches are of lower gradient. Once into the huge marsh complex of peat and muck (Figure 5), gradients decrease significantly. The main Sage River has very low gradient, while the Big Ditch has somewhat higher gradient. The headwaters drain forested lands and are inundated with beaver dams. The West Branch in the marsh is very convoluted. During the early logging era, loggers excavated a straight channel from roughly where Third Creek enters the West Branch, extending downstream to the Tahquamenon River. The Big Ditch is an east–west offshoot of the main ditch.

Lower River Segment

This segment begins at the Upper Falls, where the river drops 49 ft off a sandstone escarpment. From this spot to about 1 mi above the Lower Falls, the river is about 100 to 150 ft wide, relatively shallow, and flowing over bedrock. It is bordered by steep wooded banks 80 to 100 ft high, and vegetated with northern hardwoods, hemlock, and white pine. About 1 mi above the Lower Falls, the river bottom becomes an even shallower sandstone ledge, over which the river flows until it drops about 20 ft over the Lower Falls. Total elevation change within the 1.5 mi surrounding the Lower Falls is roughly 45 ft, similar in height to the single drop at the Upper Falls. After a series of shallow rocky rapids for about 0.25 mi below the falls the river heads in a southeasterly direction over a mostly sand and silt bottom 16.3 mi to Lake Superior. Only 16.5 mi of river below the Lower Falls can be accessed by Great Lakes fish. The deepest water of this segment is found in a big bend just upstream from the mouth, adjacent to a large grassy island about 100 yd west of the M-123 Bridge.

East Branch Tahquamenon River

The East Branch Tahquamenon River basin lies in the east-central portion of the Tahquamenon River watershed. It is a major coldwater tributary, extending 23.5 mi and receiving several small tributary streams. Hulbert, a village of perhaps 200 residents, lies 1 mi south of the river in the lower section, while the small villages of Strongs and Eckerman are on the East Branch in the upper section of the river. Despite the presence of these small villages, riparian development is limited due to extensive riparian wetlands and USFS land ownership.

History

General

The Tahquamenon River had its origins with the retreat of the last great glacial lobe about 9,500 years ago (Farrand 1988). Current theory of the Holocene period says that the watershed as we know it was submerged under Lake Nipissing until about 4,000 years ago (McKee 1966; Farrand 1988). At that time, the water level of glacial Lake Nipissing declined, leaving us Lake Superior, Lake Huron, and St. Mary's River Rapids of today. The sandstone sills in what are now the St. Marys and Tahquamenon Rivers were rising due to the earth's crustal rebound, and the Lake Huron water level was falling due to erosion at the Port Huron outlet (Farrand 1988). However, new studies using optically stimulated luminescence dating, ground penetrating radar, examination of stratigraphy, and analyses of digital elevation models and surficial soils maps are generating some radically different theories (Loope et al. 2004, Loope et al. 2005, Loope et al. 2006). Results from all study parameters support the hypothesis that beginning prior to 10,000 cal yr BP, large floods of water from the Superior Basin (Lake Minong) flowed south through the Tahquamenon River watershed. The large discharge then flowed west across the Lake Michigan-Lake Superior watershed divide located just west of McMillan, into the present Manistique River watershed. A detailed elevation map indicates the general flow, as well as a large "eroded area" where the theorized river turned from south to west (Figure 6). Shallow sand dunes north of the Upper Falls were theoretically formed when the Lake Minong water level fell too low to continue discharging into the Tahquamenon basin. In addition, optical ages of dunes within the Tahquamenon River basin suggest that a Holocene lake ("Lake Bergquist") existed south of the present Tahquamenon Falls. Data suggest that Lake Bergquist was impounded and persisted for up to 1,000 years after the initial withdrawal of Lake Minong from the area. Data also suggest that Lake Bergquist was breached sometime after 9,500 cal yr BP. Lake Minong then receded, possibly with the opening of the St. Marys River drainage system. Drainage from coarse-textured moraines and outwash deposits flowed in a reverse direction, generally east and north to Lake Nipissing, circa 5,000 cal yr BP, and then in more recent times to Lake Superior. The intriguing result of such marked changes in flow patterns is that Lake Bergquist apparently still exists as a series of deepwater habitats, with holes up to 65 ft deep in the river channel, extending 17 mi upstream from the Upper Falls (see **Fishery Management**, *Middle River Segment*, *Mainstem*).

With the exception of upper reaches of the river and its tributaries, the Tahquamenon River drains a very flat watershed comprised mostly of peat lands and sandy deposits from the old Lake Nipissing glacial lakebed (Farrand and Bell 1982). The sandstone escarpment forming the Upper Falls prevented further downcutting by the channel, thus limiting further natural drainage of the basin and impounding upstream water into a series of swamps connected by the drainage network (Taylor 1991). Poor drainage, combined with cool temperatures and a high ratio of precipitation to potential evapotranspiration during the growing season, favors occurrence of wet coniferous forests, swamps, and bogs (Albert et al.1986). Much of the watershed was – and still is – uninhabited due to the large amounts of these habitats (Figure 5). A human track remains very rare in many square miles of the watershed (Taylor 1991).

Upland areas of the watershed have long been occupied by Native American tribes, although the only permanent village was near the mouth of the river (Hinsdale 1931). The inhabitants of the Tahquamenon watershed were from the Ojibwa nation, now called Chippewa (Taylor 1976). Estimated dates from artifacts go back 2,000 years (Taylor 1976). The sparse Tahquamenon Chippewa population did much traveling to and trading at the Sault Ste. Marie village, and made contact with the Jesuits in 1671 (Taylor 1991). Father Claude Jean Allouez, a Jesuit priest, found seven different tribes living together in a small village at what is now Sault Ste. Marie in 1664 (Nute 1944).

In sharp contrast to permanent villages established by tribes in Lower Michigan, the Chippewa showed little dependence on agriculture. Their subsistence centered on hunting and fishing activities. In either case, entire family units were involved (Fitting 1970). Henry Rowe Schoolcraft (1833) described springtime nomadic migrations.

> Late in March, the Chippewa's crust-moon, winter camps were generally abandoned in favor of groves of hard maple. In what was perhaps the happiest time of the year, families flocked to the present location of Newberry, to points on the south bank of the river below the Lower Falls, and principally, to bluffs overlooking the southern shore of the bay. Tapping trees and collecting the sweet sap, boiling it down to different consistencies, filling birch-bark containers, the "makoks," with the brown, nourishing sugar – these were the tasks of a festive month.

Nomadic by environmental necessity, the Tahquamenon natives often used their ancient trails (Taylor 1991), though such trails were very rare within the Tahquamenon River watershed due to the swampy conditions. Hinsdale's map (Hinsdale 1931) showed few trails within the watershed. A main pathway to the interior of the peninsula led from Sault Ste. Marie southwest to the Tahquamenon near the mouth of the Hendrie River, and a trail still detectable in the 1920s led from the west end of Hulbert Lake south to Big Carp Lake near the present village of Trout Lake. Another trail connected the river with the Manistique Lakes to the southwest, and there was a well-used portage between the East Branch Fox River and the Upper Tahquamenon River near King's Creek.

Henry Wadsworth Longfellow used the Tahquamenon River as a literary backdrop for his long poem, *The Song of Hiawatha*, portraying the legendary Indian hero, Hiawatha, and the beautiful maiden, Minnehaha. The Indian agent Henry Schoolcraft, who married the granddaughter of noted Chippewa chief Waub-o-jeeg, recorded and organized a monumental collection of Indian mythology, language, and customs; the *Song of Hiawatha* drew heavily from that collection (B. Mead, Assistant State Archaeologist, personal communication). Longfellow took several English and French attempts at spelling the native river name, "Otahquamenaw, Otikwaminag, Tacquimenon, and Tackwymenon," and others, and finally adopted Tahquamenaw in his writing. To make it fit his meter, Longfellow pronounced it Tah-qua-*me*-naw (Taylor 1991). Current pronunciation is Tah-*qua(kwa)*-menon. The word "Tahquamenon" literally means "our woman" in Ojibwe. There is an Ojibwe legend about a woman who was in love with a man she could not be with, and she ended up throwing herself over the falls. To this day, it is believed that her ghost, wearing a white buckskin dress can still be seen around the falls (N. Wright, personal communication, Bay Mills Indian Community, History Department). The *Song of Hiawatha* incorporated many adventures from the Chippewa figure Manabozho (B. Mead, Assistant State Archaeologist, personal communication), but Longfellow apparently liked the name Hiawatha (actually an Iroquoian figure) better for his verse. Also, it was for good reason that Longfellow had Hiawatha swallowed by a huge lake sturgeon. Lake sturgeon spearing was a dominant activity in the lower Tahquamenon River and many native legends attributed magical powers to the lake sturgeon (Taylor 1991). The Bay Mills Indian Community, History Department, maintains a website containing the history of the Bay Mills Indian Community (see References). They can also be contacted about many of the legends (N. Wright, personal communication, Bay Mills Indian Community, History Department).

Tahquamenon native chiefs were very prestigious throughout the Upper Great Lakes region (Taylor 1991). In particular, Chief Shingabawossin, his name meaning "Image Stone," was the most important figure after 1800. He was the leading chief of the Upper Peninsula before his death in 1828, "A tall, majestic, and graceful person," according to Schoolcraft. He traveled to what are now the states of Minnesota and Wisconsin to attend treaty hearings, and his advice to young warriors was, "Live in peace and follow the chase." His influence and concerns were reflected in many of the treaties signed after his death (Taylor 1991).

Photo 1.–Portrait of Chief Shingabawossin (Taylor 1991). Photo reprinted with permission from Mrs. Carol Taylor.

The Tahquamenon area retained much of its solitude into the 1830s. Access to the river was always poor, as extensive marshes made walking to open water very difficult in all but a few rare spots. From the 1830s into the 1860s, however, the native trails gradually became broader and more defined by increased European traffic (Taylor 1991). Even so, Europeans were not attracted by the land as much as by the timber. In late 1800s, many loggers and lumbermen used the river in one way or another to assist in the promotion of their fortunes or ill fortunes (Anderson 1982). Many local names refer to the loggers of that time.

In an effort to facilitate log floatation and passage, the Detroit, Mackinac and Marquette (DM&M) Railroad Company created the Tahquamenon River Improvement Company in 1882 (Barnett 1990). The Improvement Company cleared the Upper River segment of all obstructions upstream to the Alger County line in 1883. That early stream modification, however, is no longer evident as natural hydrologic processes in the last century have restored the streambank and instream woody structure back to a more natural configuration. Even so, the major ecological problem in this area is excessive sand bedload in lower gradient streams where sand has not moved enough to expose the underlying gravel and rock. The excess sand was presumably caused by early stream work and logging practices.

The next paragraphs are a brief history of the landmarks along the river, moving from headwaters to the mouth (Figure 1), taken from Anderson (1982). The County Road 422 Bridge, known locally as the "High Fill", is one of several logging railroad crossings associated with Danaher, who lumbered in the area during 1895–1903. E.C. Underwood's fur farm (muskrats) was situated on the south shoreline of Dollarville Flooding, near the tracks of the Duluth, South Shore, and Atlantic Railway Company (DSS&A), successor of the DM&M Railroad Company, and now the Soo Line Railroad. The "ghost town" of Dollarville was once a thriving lumbering metropolis named for Robert Dollar, who was later an associate in the Dollar Steamship Company. He ran the American Lumber Company Sawmill in about 1882. This sawmill was then taken over and operated by Danaher and Malendi until closing in 1903. Remnants of the railroad trestles, booms, and building foundations are still evident in Dollarville, which at that time was larger than Newberry. Chamberlain's Mill, a modern day small-dimension sawmill, is located at the M-123 river crossing, 1.5 mi north of Newberry. The Underwood Shingle Mill and Potash Plant, run by Mr. Clausen was on the opposite side of the bridge, where Newberry's sewage disposal plant is now located. It is not known if this Underwood is the same person who operated the fur farm on Dollarville Flooding. The pilings from the Newberry Lumber and Charcoal Co. railroad trestle are still evident at this location.

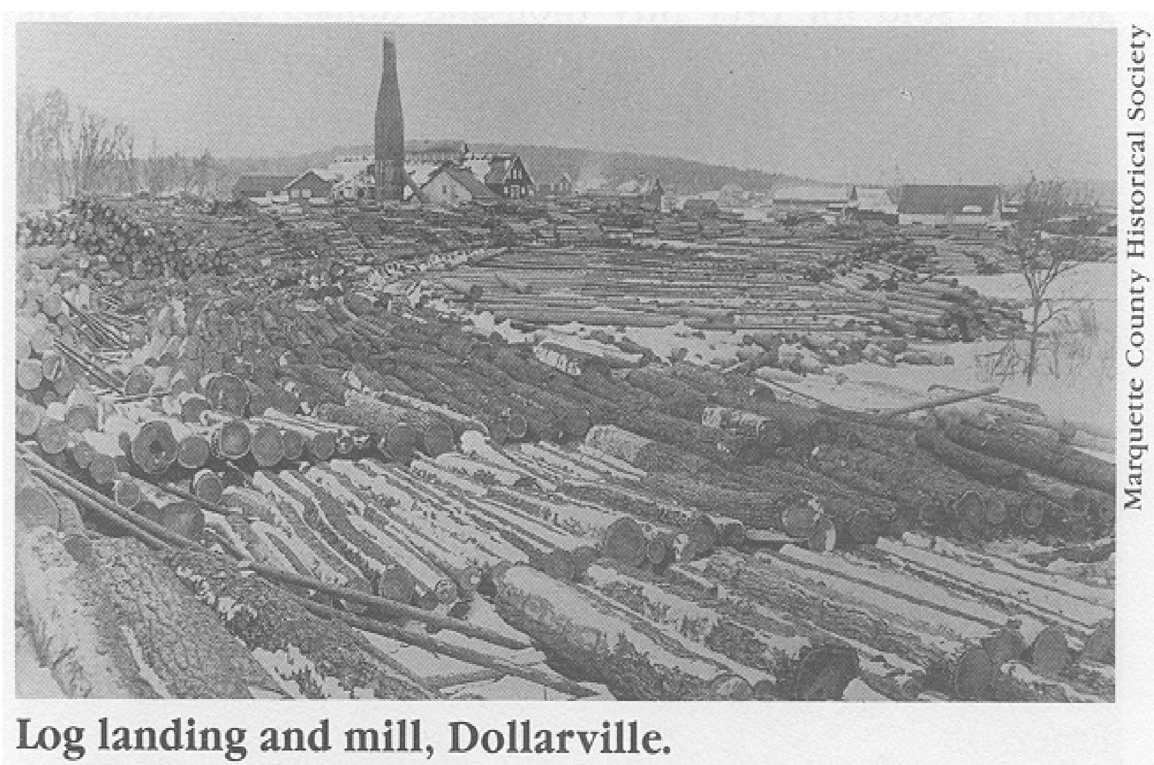

Photo 2.–Log landing and mill, Dollarville, c. 1890s (Taylor 1991); reprinted with permission from Mrs. Carol Taylor.

Photo 3.–Giant birch burl used as flagpole base in Dollarville, c. 1890s (Taylor 1991); reprinted with permission from Mrs. Carol Taylor.

Continuing the downstream history (Anderson 1982), Cummings and McPhee in 1903 had a logging camp and log banking ground at the present site of McPhee's Landing, 6 mi downriver from Newberry (Figure 1). Timber from this point was floated downstream to either Lake Superior or Hunter's sawmill. Deadman's Farm, about 5 mi below McPhee's, is a well-known landmark on an isolated high spot in the Tahquamenon swamp where a trapper-farmer, remnant of the post-logging era, was supposedly murdered and his furs stolen. Hunter's sawmill is now the upstream terminus of Hugh and Chris Stewarts' *Betty B* riverboat trips and the Toonerville Trolley from Soo Junction, which is the junction where the previous DSS&A joined the Soo Line Railroad. Slater's Landing at the mouth of the East Branch Tahquamenon River was the beginning of the *Tom Sawyer* riverboat trip, a business no longer operating. McNearney's farm, about 3 mi below the mouth of the East Branch, was the headquarters camp of Dawson Timber Company during 1872–79, where timbers were hewn square and then rafted downriver. Square-hewn logs were easier to transport to England, the first major market for Tahquamenon lumber. All of the early lumbermen squared their timber for shipment, but it meant leaving up to one-half of each tree on the ground as waste (Taylor 1991). Con Culhane's logging railroad grade crossed the river about 3.5 mi below McNearney's farm in about 1897. Parts of the trestle and approach grade are still in evidence. Closer to the falls, the first project completed by the Tahquamenon River Improvement Company was blasting a channel in the riverbed above the Upper Falls during 1882–83. The channel was 0.5 mi long, up to 4 ft deep and about 80 ft wide. The new channel also eliminated a 2 ft waterfall upstream of the Upper Falls. The blasting project resulted in permanent modification of the river channel.

Despite the new logging channel, the Upper Falls remained a barrier to log movement and was the most dangerous site on the river to work logs. During the logging days, a logger named Morett built a floating bridge at the top of the falls to prevent loss of stray barges and keep errant loggers from taking "Hiawatha's Plunge" (Anderson 1982). Even so, the Upper Falls caused considerable problems for the loggers. The following text and photographs from Hulbert (1949), describe an Upper Falls logjam in 1904. Mrs. Carol Taylor has the actual photographs used in the book, and they are included with her permission.

> The sun was shining gloriously. The leaping, roaring water flashed and sparkled and gleamed as it pitched over the ledge and dropped out of sight in its own mist and spray. Far below me the brown logs circled endlessly, the gorge lay like a great gash in the green woods, flooded with the white, foam-covered water. The man on the brink seemed posing for a sculptor, now standing erect on the outermost log, now stepping back and bracing himself as he hauled in on the line. The foreman passed up and down, using the pile as a stairway between the upper rapids and the whirlpool, and the three men went about their business quietly and deliberately—neither reckless nor anxious—as if in such a place as

this the risking of one's life became a mere matter of course. And over it all, filling the bright spring morning with its splendid music was the thundering voice of the falls.

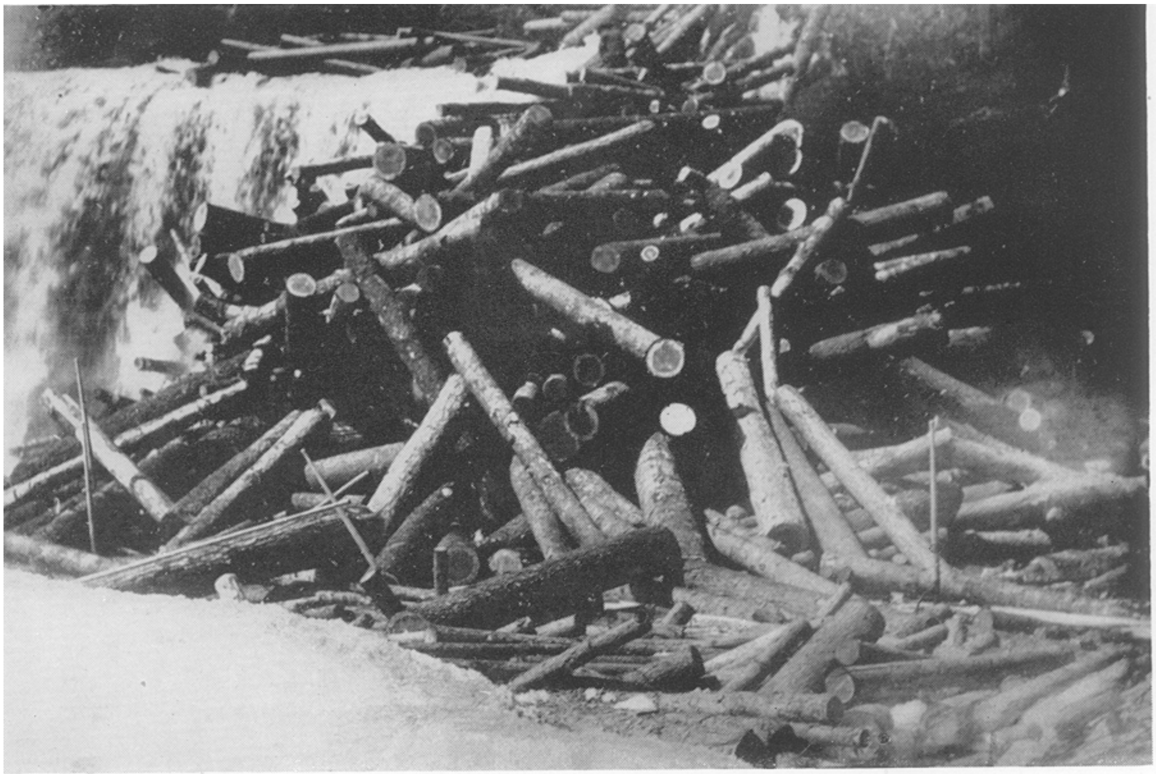

Photo 4a.–Upper Falls logjam, 1904; reprinted with permission from Mrs. Carol Taylor.

Photo 4b.–Upper Falls logjam, 1904; reprinted with permission from Mrs. Carol Taylor.

> The Lower Falls also caused problems for log movement. To help ease the jams, Culhane diked one of the two channels of the Lower Falls to facilitate better log passage over the other fall (Anderson 1982). However, his later Culhane Railroad Grade ended at the “Whitehouse” landing about 5.5 mi below the Lower Falls (Taylor 1991). The railroad neatly bypassed the problem-filled section of the river containing both the Upper and Lower falls, which today appears entirely natural. The Whitehouse Landing was not only Culhane’s home, but also the site of his crew quarters, storehouses, blacksmith shop, other shops, and barns. Further downstream, a channel was dredged by Alanso Cheeseborough to cut off the big bend above the mouth of the river, evidently so he could use the cutoff bend as a log booming/storage area (Taylor 1991). That south channel remains evident today near the M-123 crossing. Cheeseborough’s sawmill at the mouth of the river burned down within a year, so he moved it to a more protected site in Whitefish Bay several miles south of the mouth, at what is now called Emerson. The sawmill was managed by his sons after his death in 1887 (Taylor 1991). To facilitate boat loading, they dredged a channel from the open bay into their docks, and to facilitate log movement to their docks, they dredged a deep channel along the shoreline from the river to the mill. Sand movement has filled in the shoreline channel during the past century, and very little remains at Emerson today except for dock pilings.

Anderson (1982) described lumbering on the East Branch Tahquamenon River (Figure 1). Logs were driven on the East Branch as early as 1890. Cornelius Bennett had a lumber and shingle mill on the river just north of Seewhy with a spur railroad to the DSS&A, now named the Soo Line, prior to World War I. There was also a long corduroy logging road which crossed the East Branch about 1 mi northeast of Hulbert (Taylor, personal library of pictures, notes and letters). Dick Hulbert, for whom the town and lake of Hulbert were named, had a log rollway on the East Branch near the mouth of Big Beaver Creek in 1890. Much of the East Branch was channelized during the logging area, but little evidence still exists except for a continuing sand bedload. The stream during the last century has regained the natural sinuosity it had prior to the lumbering era.

The Hendrie River, which flows into the Tahquamenon about 1 mi upstream from the East Branch (Figure 1), was used in the logging era by the D.N. McLeod Lumber Company from 1905–15 (Anderson 1982). In addition to lumbering interests, McLeod also had visions of land promotion after the logging era, since the black mud flats in the Tahquamenon flood plain were noted for their ability to produce bumper crops of celery, cabbage, and lettuce (Taylor 1991). For log movement and drainage reasons, he hired Carl McSweeney to dig a network of canals and ditches that straightened out the serpentine configurations of the Hendrie and Sage rivers, providing better drainage and more “judicious use” of water flow for log transport (Anderson 1982). The results of his efforts are still visible today, in the Big Ditch of the Sage River system and McLeod’s Ditch in the Hendrie River system. The ditches may have been desirable for log movement by the logging industry, but they could have been an ecological disaster if the local channel gradient was higher. A century after the dredging, the marshland has never drained, the original stream channels still exist concurrently with the ditches, and there has apparently been very little sediment erosion damage to the Tahquamenon River. The mouths of both the Sage and Hendrie rivers discharge into deep holes in the Tahquamenon which hold good numbers of muskellunge, northern pike, yellow perch, and walleyes. In 1883, Daniel Farrand Henry, the engineer hired by the Tahquamenon River Improvement Company, looked into deepening the Tahquamenon River to reclaim over 30 square miles of potentially valuable swampland (Barnett 1990). That effort never occurred.

The village of Newberry was platted and streets laid out in 1882 when the Vulcan Furnace Company was established (Taylor 1991). Newberry was then incorporated in 1885. The Furnace (Charcoal) Company employed up to 600 men and survived various owners and name changes until 1945. When it closed in 1945, it was known as the Newberry Lumber and Chemical Company, and it was the last plant in the Midwest to make charcoal iron (Taylor 1991). Charcoal iron is another name for pig iron, which is crudely smelted iron. Charcoal was used to heat the furnace hot enough to melt the ore and release the iron. Charcoal production was also the main reason for the second wave of lumbering throughout the watershed and surrounding area, as production of charcoal iron required hardwood, rather than the then-depleted pine (Taylor 1976). The demand for hardwood was enormous, as during one week in June 1886, 31,899 bushels of charcoal were required for the production of 329 tons of pig iron (Taylor 1991).

The eastern half of the village of Newberry was at one time a collection of celery farms in black muck up to 7 ft deep (Taylor 1991). Houses and village streets now cover those same muck fields. The lands north of the Tahquamenon River are not well suited to farming, and in 1976, only one dairy farm was in operation (Taylor 1976). Taylor (1976) also described how total farm acreage increased from 8,440 in 1890 to 25,707 in 1930. Since then, many farms have become inactive. Dr. George F. Deasy said in 1950, "Celery, sheep, beef cattle, peas, swine, orchards, barley, sunflowers, rye, wheat, corn, alfalfa and fur farming were all hopefully tried but without success," (Taylor 1976). Either the short 120-day growing season, the long harsh winters, the cool night temperatures all summer (Anonymous 2004), the erratic weather with occasional snow and frost in July and August, the long distances to move produce to market, or any combination of those factors have apparently limited agricultural success. Farming continues today in Luce County, with a significant portion concentrating on growing potatoes, but it is only of minor importance to the local economy.

The last extensive human influence in the watershed was the Civilian Conservation Corps (CCC) of the 1930s era. The CCC provided the labor force for an enormous reforestation effort in this watershed. Crews from camps Strongs and Newberry concentrated on reforestation, while the Paradise CCC camp built M-123 from Paradise to the Upper Falls (C. R. Waybrant, personal communication). Statewide, Michigan's 102,814 CCC participants—eighth highest among all states—occupied an average of 57 camps annually (State of Michigan 2004). Only five states had a higher average. More impressively, Michigan enrollees during the CCC era planted 484 million trees, more than twice as many as any other state. In addition, they spent 140,000 days fighting forest fires, stocking 156 million fish, and building 7,000 mi of truck trails, 504 bridges, and 222 buildings. They revitalized the Michigan State Park system, established Isle Royale National Park, and built campgrounds in Michigan's national forests. Total CCC expenditures in Michigan reached $95 million and enrollees sent over $20 million to their dependants (State of Michigan 2004).

Archaeology

The following archaeological information was supplied by Barbara Mead, Assistant State Archaeologist, through a personal communication. The Office of the State Archaeologist, Michigan Historical Center, has records for 109 archaeological sites that lie within the Tahquamenon River drainage. Only 2% of these are related to Native American occupation; the remainder date to the mid- to late-nineteenth century or early-twentieth century and are associated with European development of the region.

Archaeologists have examined only a small percentage of the lands within the drainage. Based on archaeological studies of other areas in the eastern Upper Peninsula, we would expect to find an average of 1.5 archaeological sites per square mile of the watershed.

Although early human settlement of the Upper Peninsula began about 8,000 years ago, the earliest sites found so far in the Tahquamenon area date to the last 2,000 years, during the Woodland period. The sites include small camps, a larger village near the mouth of the river, and quarries where chert was collected for making stone tools. Woodland peoples in the region lived in small, isolated family camps in the interior during the winter, and congregated in larger villages on the coast in warmer seasons to take advantage of fish runs and other lake resources. They made pottery, hunted moose and deer with bow and arrow, and had an advanced fishing technology. Fishing gear included spears, harpoons, gorges, fishhooks, ice fishing lures, gill nets, dipping nets, and weirs. Lake sturgeon, lake whitefish, and many other species were important foods that could be smoked and stored for winter use. Plant foods included berries, nuts, aquatic tubers, and a variety of greens and teas. More recently, Native American sites include places where fields were cleared and sugar bushes where maple sugar was collected and processed.

Most of the non-Native American sites in the Tahquamenon drainage are abandoned logging camps. Abandoned homesteads and recreational camps are also present. One of these was Deerfoot Lodge, a camp used by former governor Chase S. Osborn. Other sites include sawmills, logging dams, railroad-related structures, trails, and the logging town of Emerson with its boom house. Most recent sites are those associated with CCC camps and former fire towers.

Sites on state lands and the artifacts found there are the property of the State of Michigan. These resources are managed by the Michigan Historical Center in cooperation with the landholding agency. Those on National Forest lands are federal property. Permits from the appropriate agencies are necessary for any artifact collecting or archaeological study.

Geology

The physical setting of the Tahquamenon River watershed, in particular its geology, topography, and climate, play a key role in determining the watershed's settlement history, present land use, hydrology (streamflow characteristics), and biological communities. From a hydrological perspective, the climate determines the amount and timing of precipitation inflows to the watershed. The watershed's topography and surficial geology determine how water is routed from the landscape to the river, which in turn influence the frequency and severity of floods and droughts, geomorphic processes (e.g., channel erosion and sediment deposition), and conditions for biological communities.

Precipitation usually enters a river by one of two pathways, groundwater or surface runoff. The pathway used in a local area is determined by permeability of the landscape surface. Landscapes having coarse-textured material, such as sand or gravel, allow rainfall to readily infiltrate (or penetrate) the soil surface and travel underground toward the river, eventually entering the channel where it intersects the water table or at adjacent springs (Table 1). The slower delivery of water to the channel results in groundwater-dominated streams which have much more uniform flows year-round than streams more heavily influenced by surface runoff. Similarly, groundwater's stable temperature is cooler than ambient air and surface water temperatures in the summer and warmer than ambient air during the winter. Streams draining areas with finer-grained material such as clay and silt quickly become saturated (Table 1), which results in more rainfall and snowmelt flowing overland toward streams. Thus, streamflow levels of surface runoff-dominated streams respond much more to existing climate events such as storms, snowmelt periods, droughts, etc. Likewise, temperatures of streams dominated by surface runoff also more closely mimic ambient air temperatures, than do temperatures of groundwater-dominated streams.

The Tahquamenon River watershed contains a distinctive mix of natural landscapes due to its unique post-glacial history (Figure 5). Most rivers in Michigan continued to erode deeper channels as glacial lake levels receded and crustal rebound occurred (Berquist 1936). Down cutting of the Tahquamenon River's channel, however, essentially stopped (Figure 6) at locations where river met the sandstone escarpment at the Upper and Lower falls (Taylor 1991). Much of the area upstream, being flat from the former glacial lakebed, remained poorly drained and became an extensive complex of marshes and swamps connected by the river network. Over time, these wetland areas produced extensive deposits of peat and muck sediment. For example, soils of the eastern half of the Village of Newberry are black muck up to 7 ft deep, with sand and gravel underneath (Taylor 1991). Currently, about 40%

of the watershed is covered with peat and muck (Table 2). Almost 100% of the central portion of the watershed downstream to the Upper Falls is MDEQ designated wetland (Figure 7).) The porous soils of most tributary headwaters and the large central wetland area of this watershed contribute to the river's flow stability and water quality.

Almost all Tahquamenon River headwaters drain porous soils, producing relatively cool and stable flows. Flow and temperature conditions of the river remain in a relatively natural state, because nearly the entire watershed is well forested and shaded. Wetlands cover the extensive areas of low permeability soils (e.g., peat, muck, clay, and silt) in the watershed, limiting their effects on river flows (Figure 7). Small lakes and extensive marshes cover 47 percent of the watershed (Fitting, 1970), and almost every tributary flows through a wetland before entering the mainstem. These wetlands reduce flooding and augment low flows by storing water and slowly releasing it, and act as "living filters" to remove nutrients and some chemicals from precipitation runoff (Hynes 1970). Except for the village of Newberry, there are very few impervious surfaces in the whole watershed such as paved streets or shopping centers to modify river hydrology.

Bedrock Geology

The Upper Peninsula in the Tahquamenon River watershed area is composed of bedrock in roughly horizontal strips consisting of (south to north) Middle Silurian Niagaran limestone, Lower Silurian limestone, Ordovician sandstone, and Cambrian sandstone (Fitting 1970). Ordovician and Cambrian sandstones are found near the Upper and Lower falls complex, in the northern portion of the watershed.

Surface Geology

The most distinguishing feature of the Tahquamenon River watershed is the relatively flat topography and extensive deposits of clay, silt, sand, and gravel associated with glacial lakes that inundated the river during the most recent glacial retreat (Figure 5). Poor drainage in much of this area resulted in extensive wetlands and deposits of peat and muck in the watershed (Figure 7). Peat and muck deposits make up 40% of the watershed, the highest percentage for any watershed in Michigan (Farrand and Bell 1982). Coarse-textured end moraines and outwash deposits produced by the last advance and retreat of glacial ice in the eastern portion of Michigan's Upper Peninsula bound much of the watershed (Fitting 1970). These deposits most notably occur in the northwest and southeast portions of the watershed, where they feed groundwater to the Upper River and East Branch Tahquamenon River segments and tributaries.

Upper River Segment

Coarse-textured moraines and glacial outwash make up 87% of the catchment for this valley segment (Table 2). These deposits are very porous, allowing ready infiltration of rainfall and melting snow, and provide large quantities of cold groundwater to the Upper River segment (Figure 5). Such stable flows benefit fish populations and limit streambank erosion. Stable flows over millennia also have the ability to sift and move the fine sand present in glacial outwash. Over geologic time, such continuous sifting will remove much of the sand substrate, leaving behind a substrate of coarse gravel and rock. However, lack of high seasonal discharge also limits movement of recently eroded sand substrate in the stream. As a result, stream modifications and logging practices a century ago may still be partly responsible for sand deposits and bedload that exist today in this segment. The Upper River segment is inundated with sand substrate that severely limits the aquatic invertebrate community (Taft 1994). Sand deposits greater than 4 ft deep were found in portions of this segment (Taft 1994). The only stable aquatic habitat consists of submerged logs, which are covered with aquatic insects and periphyton. Banks are steep, and the floodplain is narrow.

Dollarville Segment

Below the Upper River segment, the entire river becomes increasingly influenced by the abundance of fine-textured deposits within its watershed. Here, peat and muck comprise 31% of the segment's catchment, with sand and gravel deposits from glacial lakes and moraines making up 68% (Table 2). The entire river corridor in Dollarville segment consists of wide marshy swamps of peat and muck (Figure 5). Coldwater tributaries entering in this segment drain coarse-textured end moraines in the north, and coarse-textured glacial till in the south.

Marsh Drainage Segment

The river in this segment flows across more lowland deposits (Figure 5). Peat and muck deposits make up 42% of the river's catchment, with coarser deposits contributing 57% of the total (Table 2). The Newberry area soils and the river corridor downstream about 6 mi are lacustrine sand and gravel. That soil type forms a 6 mi long ridge through which the river flows, and streambanks within this area range from 10–20 ft in height. Extensive peat and muck soils occur to both the north and south. Beyond this point, the river again flows through peat, muck, and lacustrine sand and gravel up to the mouth of the Sage River.

Middle River Segment

The Middle River segment begins in lacustrine peat and muck, but the majority of the segment flows through lacustrine sand and gravel (Figure 5). Several major tributaries enter in this segment. The Sage and Hendrie rivers, both cool low-gradient tributaries draining mostly lacustrine deposits, enter from the south (Figure 5). The East Branch Tahquamenon River enters from the east and drains coarse-textured deposits in its upper catchment and lacustrine clay and silt deposits in its lower catchment (Figure 5). Several small coldwater tributaries draining coarse-textured end moraines enter in the northern portion of this segment. The catchment at the endpoint of this valley segment consists of 41% peat and muck deposits, 23% lacustrine sand and gravel, 35% coarse-textured moraine and outwash deposits, and smaller percentages of other types (Table 2).

Hendrie River.–The Hendrie River drains a flat landscape dominated by extensive deposits of peat and muck, as well as lacustrine deposits ranging from gravel to clay. Roughly 78% of its catchment consists of these types of deposits, with the remainder being coarser tills scattered throughout the catchment (Table 2).

Sage River.–The Sage River also drains a flat landscape, one even more dominated by peat, muck, and lacustrine deposits, which combined make up about 88% of the river's catchment (Table 2). The upper reaches of the river's branches and most of its tributaries drain lacustrine sand and gravels, and may receive small amounts of groundwater. Shortly thereafter though, they drain increasing amounts of peat and muck deposits and become increasingly influenced by surface drainage.

Lower River Segment

Geologic composition of this segment differs little from the segment immediately upstream (Table 2). Sandstone outcrops and subsequent falls are the most prominent feature (Figure 5). The Lower River segment begins where the river flows over a sandstone escarpment and drops 49 ft at the Upper Falls. The river continues flowing over bedrock for a couple miles, pouring over the Lower Falls and its associated rapids downstream, before resuming its course over lacustrine sand and gravel deposits further downstream. Streambanks between the Upper and Lower falls are coarse-textured end moraines, while the banks from the Lower Falls to Lake Superior are lacustrine clay and silt. Consequently, the river substrate from the Lower Falls to Lake Superior consists of sand, clay, and silt.

East Branch Tahquamenon River

The headwaters of the East Branch Tahquamenon River almost entirely drain coarse-textured end moraines and glacial outwash of sand and gravel (Figure 5). The river becomes less groundwater-driven further downstream, as its middle third flows through peat and muck, while the bottom third flows through lacustrine clay and silt. Fifty-eight percent of this tributary's catchment consists of coarse-textured moraine and outwash deposits (Table 2).

Hydrology

Climate

Climate within this watershed is generally quite uniform, though proximity to Lake Superior influences local climatic conditions. When the wind passes over the water surface and its temperature is sufficiently different from the local land surface, "lake effect" changes such as greater snow or rainfall, more clouds, and milder temperatures occur. Summer lake effect weather produces a locally milder and cloudier climate. The clouds cause cooler summer temperatures, which decrease the growing degree-days (total annual degrees above 50°F). The resulting average growing degree day value (1,550°F-days) and potential evapotranspiration from May to September (460 mm) are among the lowest in the state, second only to those found in the Keweenaw peninsula (Albert 1986). This, combined with a relatively wet climate makes more precipitation available as streamflow. In contrast, proximity to Lake Superior in the fall produces milder weather and extends the annual growing days (number of days when the temperature does not drop below 32°F). As a result, although Newberry is centrally located within the peninsula, its growing season is long for the northern latitude, averaging 114 days (Albert 1986). Average monthly high temperatures in Newberry are above 60°F during May through September, and above 70°F during June through August (Anonymous, 2004).

Data from Newberry and Whitefish Point weather stations (Anonymous 2004) describe the watershed. Average annual high temperature at Newberry is about 50°F, average low is 31.5°F, and average annual precipitation is about 33 inches (Anonymous, 2004). Weather stations at Whitefish Point on Lake Superior, Grand Marais on Lake Superior, and Newberry have recorded averages, maximum and minimum snowfall data for 1951–80. Snowfall averages 130 inches at Whitefish Point, 143 inches at Grand Marais, and 108 inches at Newberry during that period (Anonymous, 2004). Recent winters have exceeded the average, with the minimum annual snowfall in Newberry during 1991 through 2004 about 170 inches, and with historic record snowfalls set in 1999 and then broken in 2004, both over 190 inches (Luce County Airport weather station). Thus, snowfall can be considerable. Albert (1986) agrees, noting that snow depth in this watershed can rival that in the Keweenaw Peninsula. Snowfall in this watershed often increases considerably from south to north in this portion of the Upper Peninsula due to lake effect snows from prevailing north or northwest winds (Albert 1986).

Annual Stream Flows

There is only one active USGS gauging station in the watershed, located just upstream from the Upper Falls. For the years 1953–2003, the mean annual flow is 908 ft^3/s from a catchment of 790 mi^2 (Table 3). A USGS gauging station monitored flows at M-123 north of Newberry for 1934–36 (Table 3). The mean annual flow was 225 ft^3/s from a catchment of 200 mi^2. Seasonally high flows typically occur in April and May, while low flows usually occur in July and August.

Annual stream flow data can be analyzed for trends over time in a number of ways. Using the Index of Hydrologic Alteration (The Nature Conservancy 2005), we looked for annual trends in 65 parameters computed from mean daily streamflows for the Tahquamenon River at Paradise from

1953–2005. In general, there were no significant trends in streamflow conditions, with a few exceptions that may be related to climate warming. We found that average March flows were increasing and the date of peak runoff is earlier, both indicative of shorter winters. We also found that September low flows have become lower over time, most notably in the last 15 years. Further analyses of these data by discrete time periods may reveal finer-scale trends.

Seasonal Flow Stability

Streamflow conditions in rivers vary naturally among seasons; higher flows are important for channel-forming processes and lower flows support stable fish communities during the summer season and overwintering periods. Seasonal flow stability in Michigan rivers is relatively high due to permeable glacial drift deposits that cover most watersheds. The importance of this stability has been discussed by previous authors.

> The flow stability of a stream is the variability in its discharge over periods of years, months, days or hours. The frequency, timing, and magnitude of high flows determine stream channel characteristics, and are related to a river's water quality, temperature, and aquatic community," (Poff and Ward 1989). In Michigan, streams with more variable flow regimes tend to have more actively changing stream channels, warmer summer temperatures, fewer coldwater fishes, and greater year-to-year variation in fish reproductive success. Fishes in Michigan streams are adapted to streamflow conditions that are relatively stable on a daily, seasonal, and annual basis. In general, streams that have stable flows tend to have more fishes with specialized feeding habits, such as feeding on benthic invertebrates, other fishes, or surface insects (Poff and Allan 1995). Fishes acclimated to streams with stable flows are generally also less tolerant of silt and turbidity, and more commonly associated with coarser substrates than fish species more common in hydrologically variable streams. The stability, timing, and volume of streamflows have been shown to influence the reproductive success of warm-, cool-, and coldwater fishes (Starrett 1951; Coon 1987; Strange et al. 1992; Bovee et al. 1994; Nuhfer et al. 1994). Increased flow stability has been positively related to fish abundance, growth, survival, and reproduction (Coon 1987; Seelbach 1986). Habitat suitability studies have documented the importance of flow stability to many fishes, including pink salmon (Raleigh and Nelson 1985), largemouth bass (Stuber et al. 1982b), smallmouth bass (Edwards et al. 1983), walleye (McMahon and Nelson 1984), brook trout (Raleigh 1982), chinook salmon (Raleigh et al. 1986a), and brown trout (Raleigh et al. 1986b). Incorporating the need to maintain stable flows in land use plans will help support the balanced and diverse fish communities in Michigan streams (Richards 1990). [Zorn and Sendek 2001].

Flow stability can be assessed in a number of ways. We used two simple measures for assessing that of the Tahquamenon River. The 10:90% exceedence flow ratio (10:90 ratio) provides an index of a stream's flow stability that is useful for comparing streams. The 10% exceedence flow is the discharge exceeded by the river 10% of the time and represents typical spring flows. The 90% exceedence flow is the discharge exceeded 90% of the time and represents summer or winter drought flow (base flow) conditions. Seasonal flow stability decreases with increasing values of this ratio. Another useful measure, low-flow yield (LFY; 90% exceedence flow divided by the site's catchment area), provides an index of a stream's groundwater inflows, seasonal flow stability, temperature characteristics, summer current velocity, and other physical conditions important to aquatic biota (Zorn et al. 1997).

The 10:90 ratio calculated from 50 years of data at the Upper Falls USGS gauge was 6.34 (Table 4). Such a value would classify the river as "fair", putting it on par with other warmwater rivers (e.g., Huron River in southeast Michigan), not as stable as agricultural rivers draining coarse geologic deposits (e.g., Kalamazoo River), and not as flashy as urban-influenced rivers draining fine-textured, lacustrine deposits (e.g., Clinton River) (Table 4). Seasonal flows are less stable than those found in the upper portion of the Manistique River, an adjacent watershed. The 10:90 ratio, calculated from 2 years of data on the river at M-123, north of Newberry was 3.33 (Table 4). Seasonal flow stability here is quite high relative to similar-sized streams in Michigan with USGS gage data and puts the Tahquamenon in the company of other Michigan trout streams, such as the Sturgeon River, which drains into the Cheboygan River. Soil types of the Upper River segment consist almost completely of high porosity coarse material (Table 2), similar to those of the Au Sable River which has a 10:90 ratio of about 2 (Zorn and Sendek 2001).

Low-flow yield provides a measure of groundwater loading to streams, and indexes a stream's flow stability, temperature characteristics, velocity conditions, and other physical conditions important to aquatic biota (Zorn et al. 1998). The LFY for the Tahquamenon River near the Upper Falls was 0.38 and an estimated LFY for the river at Newberry is 0.58 (Table 4). These values are quite high relative to similar-sized Michigan streams with USGS gage data (Table 4), putting the upper river in the company of high-quality trout streams like the Sturgeon (Cheboygan River drainage), Au Sable, and Manistee rivers (Zorn and Sendek 2001). The lower river's LFY puts it on par with stable warmwater rivers like the Manistique and Kalamazoo Rivers, but well behind highly groundwater-fed rivers like the Au Sable and Manistee Rivers (Zorn and Sendek 2001). The decrease in LFY values between the upstream and downstream gage sites reflects the increased contribution of low permeability geology to the river's catchment as further downstream (see **Geology**). Nevertheless, LFY values for the river are impressive, especially considering that 45% of the watershed is covered with geologic types having low permeability (Table 1).

In summary, flow conditions in the Tahquamenon River provide an interesting contrast to those of other more-studied Michigan streams due to the unique combination of climate, geology, and land use that occurs in the watershed. The watershed receives considerable snowfall during winter which, due to the area's cold climate, tends to become stockpiled until the spring thaw. This results in substantial spring runoff and high peak flows during a 2–3 week period when soils are still frozen or saturated (Figure 8). As a result, we see seasonal flow conditions typical of a fair–good quality warmwater river. However, daily stability of flows in the Tahquamenon is likely greater than that of these warmwater rivers (or than its 10:90 ratio may indicate) due to a near absence of urban and agricultural land uses (see **Soils and Land Use**). Flood events during the remainder of the year are not so extreme. In addition, coarse-textured geologic deposits, common in many headwater areas of the watershed and abundant wetlands provide a steady release of groundwater to the river, often producing summer conditions more typical of a cold–cool stream, a good portion of which is suitable for trout. Thus, we see a river with considerable seasonal variation in flow, relatively high inflows of groundwater during the summer, and one whose flow stability statistics (e.g., LFY and 10:90 ratio) differ somewhat from the typical pattern seen among other Michigan rivers (Table 4).

Photo 5.–Auger River mouth, May 2004

Photo 6.–Sage River mouth May 2004

Connected Marshes

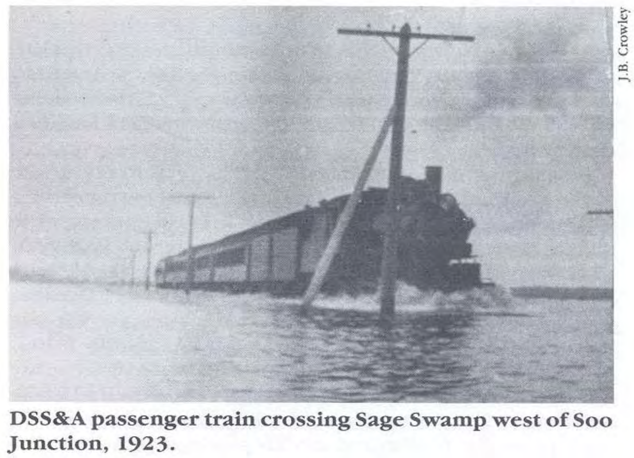

Photo 7.–DSS&A passenger train crossing Sage Swamp west of Soo Junction, 1923, c. 1890s (Taylor 1991); reprinted with permission from Mrs. Carol Taylor.

Channel gradients in the Marsh and Middle River segments and their major tributaries near the mainstem are very low. As a result, these areas are basically connected marshes, which flood during the spring snowmelt season (Taylor 1991). Spring floods produce considerable open water in those marshes. In effect, the marshes in the spring become a huge connected lake, inundated with brush. Even lower stretches of several tributaries produce lake-like open water extending upstream several miles. Despite the high discharge volume, seasonal lakes are very serene, displaying little visible water current. The picture of a train crossing the Sage Swamp in 1923 showed a rare, but not isolated event (Taylor 1991). Records show that May and June 1960 produced an equal amount of flooding, with water levels rising 2 ft. above the tracks in the same spot (MDNR, Fisheries Division, files, Newberry Office).

Soils and Land Use

Soils and Stream Crossings

Soils in the headwaters of the mainstem and many major tributaries are predominantly coarse-textured sands and gravels associated with glacial moraines and outwash features (Figure 5). Clay, silts, and sands from the former glacial lakebed predominate in lower elevations of the watershed. Many streams were cleaned out, straightened, and ditches were dug to facilitate log movement (see **History**). Even small streams were used for log movement, because the high, snowmelt-influenced flows in spring (Figure 8) reduced the need to build dams for managed water surges. These activities contributed large amounts of sand into streams, much of which may still be slowly moving downstream with each spring flood (Taft 1994). In addition, some tributary and headwater road crossings contribute a minor amount of erosion sediment to the streambed. The lower Tahquamenon River with its combination of 40% fine-textured peat and muck and 52% coarse-textured outwash, till, and moraine deposits demonstrates an intermediate hydrology with high, snowmelt influenced spring flows, but also with reasonably stable base flows.

A substrate sampling survey was conducted August 22–23, 2005 (Waybrant, in press). Sites were determined by studying the locations where walleye were found during April (see **Fishery Management**, *Middle River Segment*), such that 4 sites were located in the Marsh Drainage segment and 14 in the Middle River segment (Figure 9). Multiple sites along a cross-section of the river were sampled at each location, from the shallow macrophyte-inundated shelves along each bank out into the deeper main channel. Sediment type was roughly determined by visual observation and manual manipulation. The types were markedly similar throughout the section of river mainstem (Table 5). Silt, clay, peat, mud, and a minor component of sand were the only materials sampled.

Sediment sampling results were somewhat surprising. The surficial soils map (Farrand and Bell 1982) implied good potential for some areas of relatively coarse substrate material (Figure 5). The 10 river miles upstream from the sampling locations show about 6 mi of lacustrine sand and gravel, then about 4 mi of peat and mud. The center of the sampling area again consists of lacustrine sand and gravel, while for the remaining roughly 4 mi, surficial soils consist of lacustrine clay and silt. Despite the apparent abundance of lacustrine sand and gravel, however, coarse substrate material was found in only two samples, and at only one of the 15 sites. All other samples consisted of primarily silt, peat, and mud, with some occasional sand or clay components.

Water current has the ability to move fine-grained material, while leaving behind the heavier, coarser particles (Hynes 1970). A table contained in his book (Table 6) gives approximate critical current velocity required to move the various sediment types. Fine sand requires generally 20 cm/sec to remain mobile in the water column, while coarse sand requires 30–50 cm/sec, and fine gravel 60 cm/sec. All of the samples contained silt, mud, and clay, including those taken within the mapped areas of lacustrine sand and gravel. That consistency throughout the sampling area implies very low current flow, even during the annual spring flood events. With enough current velocity, annual flooding would have been sufficient to keep coarse soils exposed as that velocity pushes finer grained materials further downstream. That calculation is also consistent with visual observation during the 2005 peak flood event. Floodwaters were deeper, with waters extending out into flood plains of marsh or treed wetlands, but the river current seemed relatively unaffected by the increased discharge volume. The Tahquamenon River through the extensive marsh area between McPhee's Landing and the mouth of the Auger River appeared to have almost no current while the waters became a mile-wide lake, inundated with partially submerged shrubbery. The lack of visible current velocity at various discharge rates add credence to the theory that the Holocene Lake Bergquist never disappeared (see **History**, *General*), but exists today within the river channel extending from the Upper Falls southward about 17 mi.

Eighty-two road and railroad stream crossings occur in the Tahquamenon River watershed (Table 7). This is a low number compared to the hundreds or thousands that occur in other watersheds (Zorn and Sendek 2001, Wesley and Duffy 1999). Many crossings are on small gravel roads or two-track forest roads. Both the Sage and Hendrie river headwaters are inundated with beaver dams, which trap and retain sediment in upper portions of the watershed. A visual survey in 2005 showed that most trout stream tributaries have only one or two crossings, typically with low road approach gradients and one or more culverts. Low road approach gradients minimize water sheet flow down the road from rain or flood events and subsequent deposition of sand into the river. For that reason, active erosion is minor at most crossings. Michigan highway crossings total 21, with minimal active erosion at those bridges and culverts. The Soo Line Railroad has nine crossings, all well maintained. Major county roads contribute 21 crossings, most of which are also well maintained. Recent basinwide culvert inspections prior to this report revealed no serious problems such as perched, undersized, or collapsed culverts. The few crossings that are causing minor sand erosion are not causing any significant damage to the receiving habitat.

Removal of remaining historic excess sedimentation and prevention of new sedimentation in streams is an important management issue in the watershed, particularly for trout streams. Sand sediment adversely affects aquatic insects and fishes in coldwater streams by smothering gravel and cobble habitats critical for reproduction and survival of many fish and invertebrate species, and filling in pools used by larger fish (Alexander and Hansen 1983; Alexander and Hansen 1986). This results in habitats that are less diverse and less desirable for many fishes (Alexander et al. 1995). Trout streams in the Tahquamenon River system are generally located in the headwaters. The higher gradient of these headwater reaches generally moves sediment downstream to low gradient reaches nearer the mainstem. However, once sand sediment enters these streams, it may remain for many years (Taft 1994).

The geologic and hydrologic characteristics of the Tahquamenon River watershed, especially the huge central marsh and wetland area, tend to protect it from excessive human development. Even so, there is potential for human development in various headwater areas. Such development is occurring, but very few private road-stream crossings have thus far been constructed. However, there is a potential for more road-stream crossings, which will probably be for private development rather than resulting from expansion of the county road system.

Land Use

The Tahquamenon River watershed is very natural, with a landscape mixture of upland conifers and hardwoods, lowland conifers and hardwoods, wetlands, and marshes. Designated wetlands (actual or potential) make up roughly half of this 505,600-acre watershed (Figure 10). The distribution of wetlands corresponds closely to occurrences of lacustrine deposits of clay, silt, sand, and gravel (Figures 5 and 7). Forest and wetland land use types combined make up over 90% of the catchments of all river segments and major tributaries (Table 8). Urban development is restricted or impossible in many of the wetland areas, which serve to further maintain the watershed's natural condition. The occasional areas of agricultural, urbanized, and feral rangelands all tend to lie along a major county road or highway (Figure 10.) Much of the rangeland (4%) is from abandoned farms, either slowly reverting to a forest type or maintained as openings for wildlife considerations. Similar land use and land cover patterns occur for riparian zones with natural land-cover types being dominant. These data have been summarized and are available for all Michigan streams (Fisheries Division records, unpublished data).

The Tahquamenon River watershed contains considerable acreages of publicly owned lands, either state- or federally-owned. Publicly owned lands comprise almost 375,000 (or 74%) of the 505,600 acres, with roughly 270,000 belonging to the State of Michigan and the remainder to the Hiawatha National Forest (Figure 11). Much of the state land is wetland with considerable wildlife value but relatively limited forest management potential. Lands located in coarse-soil tributary headwater areas (Figure 5) are actively managed for forest diversity and wildlife. Forests are also managed within the national forest.

Land use in the Tahquamenon River watershed is not expected to change dramatically in the near future. The population of Luce County, which contains much of the watershed, is expected to remain stable or decline slightly between 1990 and 2020 (Michigan Society of Planning Officials 1995). Numbers of second homes were expected to increase 1–40% in the county during this period, one of only four counties north of Saginaw with such a low rate of change (Michigan Society of Planning Officials 1995). However, improperly planned development and associated infrastructure (e.g., road crossings) can cause significant localized damage to river resources. Proper zoning and vigilance are needed to prevent such damage and are highlighted in Michigan's Wildlife Action Plan (Eagle et al. 2005).

Channel Morphology

Channel Gradient

River gradient, together with flow volume, is one of the main controlling influences on the structure of river habitat. Changes in river gradient influence the river's power and ability to do work (such as channel shaping), leading to changes in current velocity, depth, width, channel meandering, and sediment transport (Knighton 1984). In the previously glaciated Midwest, high stream gradients often occur where streams cut through end moraine deposits. When high gradient streams cut through coarse-textured glacial deposits, stream channels often receive high inflows of groundwater (Wiley et al. 1997). Thus, stream gradient is related to other important variables such as stream temperature, current velocity, bottom substrate, and flow stability, and is especially important to fishes (Zorn et al. 1998). Gradient has also been used to describe habitat requirements of cool- and warm-water fish species including smallmouth bass (Trautman 1942; Trautman 1981; Edwards et al. 1983), largemouth bass (Stuber et al. 1982b), northern pike (Inskip 1982), white sucker (Twomey et al. 1984), black crappie (Edwards et al. 1982), blacknose dace (Trial et al. 1983), and creek chub (McMahon 1982).

Gradient is often measured as elevation change in feet per river mile. As the character of the landscape changes along a river's course, some portions of a river drop more steeply than others. These areas of different gradient create a variety of stream channel habitats for fish and other aquatic life. Typical channel patterns in relation to gradient (G. Whelan, MDNR, Fisheries Division, unpublished data) are shown below. In these descriptions, hydraulic diversity refers to the variety of water velocities and depths found in the river. The best river habitat offers a wide array of depths and velocities to support various life stages of different species. Fish and other aquatic life are typically most diverse and productive in those parts of a river with gradient between 10 and 69.9 ft per mi (G. Whelan, MDNR, Fisheries Division, unpublished data; Trautman 1942). Such gradients are rare in Michigan because of our low relief landscape. Most natural high-gradient stream reaches in the state became sites for current dams.

Gradient class	Value (ft/mi)	Channel characteristics
Low	0–2.9	Mostly run habitat with low hydraulic diversity.
Medium	3–4.9	Some riffles with modest hydraulic diversity.
High	5–9.9	Riffle-pool sequences with good hydraulic diversity.
Very High	10–69.9	Well established regular riffle-pool sequences with excellent hydraulic diversity.
	70–149.9	Chute and pool habitats with only fair hydraulic diversity.
	>150	Falls and rapids with poor hydraulic diversity.

The Tahquamenon River flows through almost stair-step changes in elevation on its way to Lake Superior (Figure 12). From its headwaters, the river drops about 167 ft in 18 mi, then drops only 12 ft during the next 49 mi. Through the Upper Falls and Lower Falls, including the rapids downstream of the Lower Falls, it drops 96 ft in roughly 4 mi. From below those Lower Falls rapids, it then drops only 4 ft during the next 16 mi to Lake Superior. Named tributaries, the amount of designated trout water in each, and their average gradients are shown in Table 8. Gradients for many streams are misleading, because there is very little drop once tributaries enter the huge marsh/wetland area that surrounds most of the mainstem. Because of that flat wetland, headwaters contain higher gradients than the average for the whole length of stream.

Upper River Segment

This segment has high gradient, but limited habitat quality (Figure 12). From the central Tahquamenon Lake, the river drops 35 ft in 3.1 mi until it reaches County Road 421. The river then falls 111 ft in the next 7.3 mi as it flows downstream to County Road 442. Despite the relatively high gradient of the reach (average of 14.0 ft/mi), substrates until recently were often inundated with deep sand and hydraulic diversity was limited. Large woody debris was often the only solid substrate for colonization by periphyton and aquatic invertebrates. The Upper River segment is approximately 30 ft wide and 1–5 ft deep. Since 2001, however, the instream habitat has undergone significant change (see **Fishery Management**, *Upper River Segment*).

Dollarville Segment

Moderate gradient occurs in the upper half of the segment, but the gradient then decreases downstream (Figure 12). From County Road 442, the river drops 21 ft through the next 7.4 mi to County Road 415, north of McMillan, winding through a flat marshy area. Downstream from County

Road 415, the stream levels off for the following 11.5 mi, dropping only 1 ft throughout that distance. Substrate is mostly sand and hydraulic diversity is limited because of the low gradient (average 1.2 ft/mi) character of the segment. The drop occurs close to the County Road 415 Bridge, as the rest of the segment hydrology is dominated by the Dollarville Impoundment, which is maintained with a 3-ft head dam. Small, high gradient, trout quality tributaries all flatten out as they flow into the expansive marsh perimeter of the Tahquamenon River.

Marsh Drainage Segment

This segment is also characterized as low gradient, having an average of 0.5 ft/mi (Figure 12). Most gradient occurs within the first 3 mi downstream from the Dollarville Dam, dropping 3 ft at the dam and another 4 ft en route to M-123. Some of the substrate is sand, but some gravel substrate is kept exposed due to the current. The river deepens from M-123 downstream and the gradient drops only 1 ft in the next 7 mi downstream to McPhee's Landing and 1 ft during the following 6 mi to the Sage River. The river is relatively shallow with sand and silt substrate throughout most of this segment and littered with downed trees and submerged logs. Width is approximately 50 ft with 1–10 ft depth below the Dollarville Dam, and it remains about 50 to 70 ft wide and 3–12 ft deep downstream through the marsh to the Sage. Spring snowmelt flooding expands the width of the river in this area to over 1 mi, with the surface inundated with flooded marsh vegetation.

Middle River Segment

The Middle River segment has a very low gradient (<0.1 ft/mi), with a drop of about 2 ft in 21.4 mi. At the mouth of the Sage River, the Tahquamenon widens to over 100 ft, with occasional depths to 25 ft or deeper. From the Sage River to the Upper Falls, the river averages about 200 ft wide, with normal depths ranging from 15 to 25 ft. There are holes up to 65 ft deep, usually at the mouth of a tributary stream or in a bend, but sometimes in unexpected areas. Substrate is mostly sand and silt throughout the segment. The sediment sampling effort discussed previously (Waybrant, in press) included eleven sites within this river segment. Similar to those sites in the Marsh Drainage segment, silt, clay, peat, mud and a very minor component of sand were the only materials sampled.

Hendrie River.–The main branch of the Hendrie River has a gradient of 6.4 ft/mi, although most of the gradient is in the headwaters (Table 9). Almost 90% of its length lies in the low-gradient extensive marsh system of the Tahquamenon River watershed (Figure 7). Headwater tributaries are higher gradient. The tributaries southwest of the railroad grade are designated trout streams. McLeod Ditch is an artificial canal that cuts through the marsh from the South Branch, across the West Branch, and then rejoins the main branch. Although of low gradient, it is a designated trout stream.

Sage River.–The Sage River main branch has an average gradient of 2.0 ft/mi, but similar to the Hendrie River, most gradient occurs in the headwaters (Figure 7). Also similar to the Hendrie River watershed, headwater tributaries are higher gradient and designated trout streams. Tributaries with the highest gradients are First and Third Creeks, tributaries to the West Branch, which have gradients of 25.4 and 36.0 ft/mi.

Lower River Segment

The Upper Falls begin the Lower River segment, with a drop of 49 ft (Figure 12). The river then falls another 2 ft over sandstone bedrock during the next 3.3 mi. At 0.6 mi above the Lower Falls, the river bottom becomes an even shallower sandstone ledge with slightly higher gradient, over which the river flows until it drops over the Lower Falls. This drop is about 20 ft over a two-step cataract west of the island and a one-step fall east of the island. A series of shallow rocky rapids below these falls ends in a quiet pool about 12 ft deep. Total elevation change within the 1.5 mi surrounding the Lower Falls is roughly 45 ft, similar in height to the single drop at the Upper Falls. The river then drops about 4 ft during the next 16 mi to Lake Superior, over a sand and silty bottom. Despite thick shoreline forest vegetation, the river below the falls is generally free of debris except along the immediate shoreline. The width of the river varies from 150 to 200 ft wide and from 3 to 20 ft deep (Anderson 1982).

East Branch Tahquamenon River

Gradients within the East Branch Tahquamenon River watershed are relatively high for the generally flat landscape of the eastern Upper Peninsula. As with other major tributaries, headwaters contain the highest gradient, while all major tributaries flow into the huge marsh that comprises the center of the Tahquamenon River watershed (Table 9). The East Branch mainstem is about 23 mi long, with 8.5 ft/mi average gradient. Creek 14 and Kleins Creek have considerably less gradient than Grants or Rileys Creeks and Creek 8. However, Kleins, Rileys, and Grants creeks have apparently been adversely affected by the old railroad grade that extends from Hulbert east to Eckerman. Immediately south of the grade, these creeks flow slowly through large wetland marshes filled with many dead trees, resembling old beaver dam impoundments. Flows are very low. In June 2006, Grants Creek discharged less than 1 cfs under the railroad grade, while Rileys Creek was less than 2 cfs on the same day. Both creeks were very turbid with suspended clay.

Other Tributaries

Most tributary streams flow from coarse-textured glacial geology, and provide high or very high gradient, coldwater habitat (Table 9). For example, 23 of the tributaries that support designated trout regulations have gradients greater than 20 ft/mi. In addition, several other streams also have high gradients, but are so small that they are not designated trout waters.

Channel Cross Sections

The characterization of habitat by gradient presented above assumes normal channel cross sections for such gradients. However, a variety of factors can cause channel cross sections to deviate from these characterizations. For example, unstable flows acting upon a stream channel whose bed is more resistant to erosion than its banks will often cause the channel to be overly wide and shallow, lacking large woody debris and structure (Heede 1980). Similarly, historic activities such as log driving increased bank erosion (see **History**). Overly narrow channels may result from dredging and channelization activities, or simply the existence of streambanks (natural or human-made) that are highly resistant to erosion. Sediment erosion and deposition associated with improper placement of bridges and culverts will also alter the channel form. Detailed observations of channel cross sections can be used to identify where significant channel changes may have occurred.

Only two channel width measurement sites were documented for the Tahquamenon River, one at the M-123 Bridge north of Newberry and one at the gauging station upstream from the Upper Falls. Channel widths were measured by USGS during stream discharge studies and compared to predicted width values for the same discharge. Expected width and range in width were calculated for the average monthly flow at these sites (Table 3) using relations developed in other studies (Leopold and Maddock 1953; Leopold and Wolman 1957) and commonly applied to Michigan rivers by previous river assessment authors (e.g., Zorn and Sendek 2001). At M-123, the actual average width was 89 ft, while predicted width was 82 ft, well within the 95% confidence interval. At the Upper Falls gauging station, actual average width was 161 ft, while predicted width was 164 ft, again well within the 95% confidence interval. The two widths imply no obvious human effects to channel widths at either site. No other information exists for channel cross-sections, but the natural condition of the Tahquamenon River watershed implies that any other measurements would also fall within the desired range.

Instream and Riparian Habitat Conditions

Conditions within the river's channel (e.g., depth, substrate, woody cover, etc.) are important in determining which aquatic species will flourish within the river system. Diverse aquatic assemblages are typically associated with habitats that are equally diverse. Thus, understanding the existing resource and protecting it are critical to sustaining aquatic communities in the river and providing the basis for future management.

Riparian habitats are an ecologically important component of the river system (Large and Potts 1994). Shoreline habitats are important for flora and fauna, and are areas of high biological diversity and productivity. They also regulate river ecosystem dynamics by controlling surface runoff, regulating sub-surface flows, and providing and structure in the water column, such as large woody structure. Deciduous leaves and other riparian organic matter provide the majority of nutrients annually available within the riverine habitat. In addition, terrestrial invertebrates provide a large component of the fish diet during summer months, when aquatic invertebrate biomass is generally at its lowest (Nakano and Murakami 2001). Floodplain habitats influence movement and migration of animals, and provide a variety of microhabitats which further enhance the aesthetic and recreational value of the river. For those reasons, protection of riparian habitat should remain a high priority. Much of the riparian corridor of the Tahquamenon River system is publicly owned and protected, but a significant portion of the mainstem's shoreline downstream from the Sage River confluence is privately owned (Figure 11).

Upper River Segment

Sand dominates most of the Upper River segment. In several spots (Taft 1994), a wooden net handle could be pushed deeply into the sand before encountering solid substrate. The handle at that depth encountered an irregular hard surface, similar to rock rubble or coarse gravel. The sand had filled any deep holes and widened the stream, such that many areas were 40–50 ft wide with less than 1 ft depth. Flow velocities were consistent throughout the cross-section, implying almost laminar flow with little turbulence. In other areas, water was being directed into actively eroding banks by naturally fallen large woody structure.

Fisheries Division conducted a multi-year effort from 1999 through 2001 (MDNR, Fisheries Division, files, Newberry Office) to enhance stream habitat in about 11 mi of this section. This effort was almost entirely directed at some removal and much modification of placement of instream woody structure. Visual survey during and following the work showed some surprisingly rapid habitat changes. In some instances, removal of one downed tree resulted in new flows scouring a channel more than 2 ft depth within 1 hour. In other instances, banks that had been actively eroding were isolated from the new stream channel by the next morning. Modifying placement of instream materials to narrow the existing channel several times exposed gravel substrate within 24 hours. In addition, scoured sand was redeposited by water currents into backwater areas, effectively narrowing and deepening the channel. Judicious removal or modification of large woody debris allowed scouring of deep holding water underneath that structure and increased habitat diversity in the channel. Above all else, the effort was designed to be as inconspicuous as possible.

A 2005 visual survey (Fisheries Division files) of the previous work site showed good habitat retention. A full 90% of the main channel in the 4 mi furthest upstream contained cobble rock and gravel. Abundant woody structure had water-scoured holes underneath, and most sand banks were vegetated near the water level. However, over 30 new problem areas were documented. Some recently fallen trees were again directing current into erodible banks, while others were capturing branches with their lower limbs, forming large logjams. Shoreline observations while walking the river showed hundreds of still-vertical, dead or dying conifers. Most are leaning toward the river. Those observations imply that this stream section will require maintenance.

Dollarville Segment

The Dollarville segment contains the most sinuous reaches of the mainstem. Launching at County Road 415 north of McMillan and heading downstream, one can boat through several sharp corners and straights, but an opening in the marsh vegetation will show that the bridge is still close by. The shoreline is vegetated with marsh brush and tag alder, mixed occasionally with shallow off-channel bayous filled with various broad leaved pondweeds and lined with cattails. The low-gradient, stable nature of the river and its tributaries, and extensive conifer swamps and marshes surrounding the mainstem and lower tributary reaches, result in little transport or addition of large woody structure to the segment. These conifer swamps also stain the colorless water from headwater areas, turning it brown with tannic acid by the time it reaches the mainstem. Although the mainstem water is clear, it is colored very brown.

The Dollarville Flooding (with only 3 ft of head) impounds the river upstream for almost 5 mi. However, the mainstem channel is relatively easy to spot until one gets within 0.5 mi of the dam. Much of the flooded area near the dam and outside the channel is weed-choked and shallow. Some very old large woody structure occurs in the main channel within 0.5 mi of the dam, in contrast to the sparse instream habitat further upstream.

Marsh Drainage Segment

The river during the first 2 mi below the Dollarville Dam winds through mature forest, with sharp turns, and occasionally, wide and shallow backwater areas. Scattered logs and downed trees occur in the channel, with more in the backwaters. In many areas, submerged aquatic plants anchor the sand immediately outside of the higher velocity channel. Backwaters are colonized by lily pads and various broad-leaved pondweeds.

Spider Bay, located about 1.5 mi downstream of Dollarville Dam, is a cloverleaf of three large, deep backwater bays connected with the mainstem. The bays are fringed with marsh grasses and brush. Spider Bay marks a dramatic change in river channel characteristics. The channel immediately downstream is wider, deeper, and with slower velocity than immediately upstream. Beyond Spider Bay there are no downstream sections of high velocity current until the Upper Falls in the Lower River segment.

The river between M-123 and McPhee's Landing winds through mostly forested lands. Banks are low and the channel is inundated with large woody structure, both extending from shore and submerged. The river is narrow as well, precluding any attempt at high-speed boating. That close quarter, almost claustrophobic sensation disappears below McPhee's Landing. Here, large woody structure diminishes and the river channel widens, becoming less sinuous as it enters a large marsh area. For several miles, large trees occur nowhere but on the distant horizon. The river is still winding, however, and darkly stained. The only way to determine depth is with a sounding line or sonar. Several large backwater bays exist, each inundated with submerged and floating leaved aquatic plants. Aquatic plant colonies lie along the main channel as well. Occasional beaver lodges also exist, constructed of flotsam and tag alder brush. Two large bayous exist along the south shoreline, each connected to the mainstem by a small channel.

At the east edge of the marsh, large mature oak live on the several, somewhat higher ridges, with soft maple, black ash, tag alder, and marsh brush in the floodplains. Large woody structure again becomes prevalent along the shorelines. Backwater areas and shallow portions of the river are completely vegetated. This is the furthest upstream observed occurrence of fern pondweed *Potamogeton robbinsii*, which forms a dense mat. The river also gradually widens with the confluence of the Auger and Sage Rivers.

Middle River Segment

Below the Sage River, the mainstem straightens somewhat into longer, sweeping bends as it widens. Water depths increase, with scattered unusually deep holes. One expects the deep holes to be located at tributary confluences where two flow regimes come together, but the deep holes also occur in unlikely areas such as along a straight section of river with no apparent cause for the erosion necessary to scour such deep holes. With the overall depth increase, submerged vegetation decreases. The decrease in vegetation may also be a function of the darkly stained water, which limits light penetration. Floodplain alternates with higher ridges vegetated with oak, maple, and ash.

Downstream from the Hendrie and East Branch Tahquamenon rivers, the channel averages about 200 ft wide. Average depth is 12 to 15 ft, and aquatic vegetation occurs only along the shoreline. However, large woody debris along the shoreline is still plentiful. The river in this segment is much more channelized, with few back bays and adjacent floodplains, and more continuously defined banks.

Hendrie River.–The Hendrie River is navigable for 3 or 4 mi upstream from the Tahquamenon River, with a width ranging from 25 to 75 ft. The shorelines are lined with downed timber, and the heavily forested banks range in height 5–15 ft. Further upstream, the river narrows and becomes very serpentine, with marsh vegetation and low banks. Upstream from M-28, however, the river is wide and deep enough for motorized boats to run about 0.5 mi. After that distance, the river again becomes narrow and often blocked by large woody debris. The East and West Branches are heavily vegetated and beaver ponds show up in aerial photos like beads on a necklace.

Sage River.–The Sage River is navigable for small motorized boats from the Tahquamenon River upstream to or slightly beyond the railroad bridges. Further upstream, narrowing widths and encroaching vegetation limit most boat movement. Similar to the Hendrie River, however, the East Branch Sage River immediately upstream from M-28 is open enough to allow some small boat movement, at least for a short distance. Also similar to the Hendrie River are the number of beaver ponds, which inundate the small headwater streams.

Lower River Segment

The river below the Upper Falls and its receiving pool is a shallow channel over scoured sandstone bedrock. Shorelines are of steep gradient, vegetated with white pine, hemlock, and northern hardwoods. An occasional toppled tree adds variety to otherwise uniform aquatic habitat. Very little aquatic vegetation is present.

The receiving pool below the Lower Falls is quite large and relatively deep. The outside of the bend is a steep bank 10–15 ft. high, while the inside bend is flat and vegetated with brush. That brush is completely inundated during spring floods. Below the adjacent rapids area, the river deepens again and opens back up. Most of the remaining distance to Lake Superior, the river contains only shoreline large woody structure and almost exclusively sand substrate. There are few deep holes, and none to rival those in the Middle River segment. Aquatic vegetation is generally limited to shallow shoreline areas. Just west of M-123, the bend bypassed by Alanso Cheeseborough’s dredged channel is very deep, vegetated along the outside perimeter with wetland conifers, white pine and hardwoods, and along the inside shoreline with marsh vegetation.

East Branch Tahquamenon River

Data describing this river habitat section is summarized from more a detailed description by Bassett (2005). The river upstream of Eckerman drains almost entirely coarse-textured glacial deposits and is groundwater-dominated. Gradient averages 17 ft/mi, substrates are mostly sand, woody structure is common, and banks are stable and forested with lowland conifers and deciduous trees. Stream widths and depths range 18–24 ft and 1.5–2 ft in much of the reach with pools up to 3–5 ft deep. Beaver dams between Strongs and Eckerman increased from 16 in 1992 to 22 in 2000 (Bassett 2005). From Eckerman downstream to the Tahquamenon River, the river flows across a flat landscape dominated by deposits of peat and muck and lacustrine silt and clay. Gradient is low to very low and the river's flow becomes more influenced by runoff, with the water level increasing by up to 3 ft in spring. About 95% of the substrate is sand or finer-sized particles. Pools 4–6 ft occur on most meander bends, and large woody debris is common. Riparian vegetation consists of deciduous shrubs mixed with lowland conifers, and streambanks are mostly stable. No beaver dams were documented on the mainstem, but aerial photos indicated that dams on tributaries increased from 20 in 1992 to 44 in 2000.

Slater's Landing is a large embayment in the East Branch, 0.25 mi upstream from the Tahquamenon River. It recently housed a large double-deck passenger boat that ferried tourists downstream to the Upper Falls and back. Although that business ended, people can still camp, launch their boat, and beach their boats in that embayment for a fee. The site is the only boat access into the Middle River segment downstream from McPhee's Landing. Channel width further upstream at the North Hulbert Road Bridge is about 40 ft. Medium sized boats with outboards can easily navigate from the embayment upstream 5 mi to the bridge and even further upstream. Water clarity is poor, due to both its dark stain and suspended clay particles.

Dams and Barriers

Two natural barriers in this system, Upper and Lower falls, are well known and cherished by Michigan citizens. The Upper Falls drop 49 ft, while the Lower Falls plunge 20 ft. An island splits the channel at the Lower Falls, producing a south fall with a single drop of 20 ft and a north fall which has two distinct steps.

Dams affect river ecosystems in a variety of ways, and are generally detrimental to coldwater systems (Ward and Stanford 1983). The rate at which water moves through the system affects water quality, instream productivity, dissolved oxygen levels, and temperature. Impounded, slow moving water absorbs more ambient heat (i.e., it warms faster in the summer and cools faster in the winter), and generally transports less sediment, woody debris, and other organic matter. Dams typically are built on high-gradient sections of stream, eliminating that rare habitat. In addition, dams block migration corridors for spawning fish and other aquatic biota. Dams also provide habitat for organisms not generally adapted for riverine environments.

The unusual surficial geology and gradient profile of the Tahquamenon River watershed dictated placement of dams generally in the higher-gradient, headwater areas of tributaries (Figure 13). Eighteen dams are shown in the MDEQ dam database, but only six dams are presently known to occur in the Tahquamenon River watershed, none of which generates hydropower (Table 10). Some dams in the database have been removed, some were watering holes dug into a pasture, while others were little more then large beaver dams. The most significant one is Dollarville Dam which has a 3-ft head and impounds several miles (1,100 acres estimated) of the mainstem near Newberry. Two dams are private dams high in the headwaters of trout streams; one is a lake-level control structure for a private lake, while three others form small MDNR-managed trout ponds.

The only major dam, the Dollarville Dam, exists in the mainstem about 2 mi west of Newberry. The original dam was located where the river gradient here was very low and the dam's head was only 3 ft. However, the extended upstream dam influence allowed early lumbermen to more easily float their logs to the sawmill at Dollarville. The original dam was a wooden structure, built in the early 1880s and maintained until 1924, when the millpond was no longer needed. It then gradually deteriorated, and washed out in 1928 (L. Anderson, MDNR, Fisheries Division, unpublished data). Beginning in 1948, Newberry residents, especially members of the Tahquamenon Area Sportsman Club, began an effort to restore the dam for fishing, waterfowl hunting, and trapping. The current dam of concrete and steel was subsequently built in 1971, a cooperative effort between local residents, and state and federal authorities. Once built, however, ownership and management authority was transferred to MDNR, Fisheries Division. The new dam has a head of 3 ft and holds back an estimated 1,100 acres of surface water, with depths of more than 12 ft. Dam construction and operation activities during the last several decades seem to be loosely associated with periods of elevated nutrient levels and lowered dissolved oxygen levels in the river immediately downstream from the dam (see **Water Quality**). Fisheries Division periodically lowers the flooding for extended time periods to reconsolidate the submerged soils, control aquatic vegetation, and for dam maintenance.

Dollarville Dam does not block fish migration, as the design includes an open channel between the gates. With only a 3-ft head, most fish can traverse the channel during low water and larger fish can even do so during flood stage (Waybrant, in press). Temperatures recorded during summer 2005 showed a 3°F increase in the 10 mi between the C.R. 415 Bridge and the Dollarville Dam, and a 1°F increase through the next 14 mi downstream to the mouth of the Sage River (Table 11). The flooding offers enhanced fishing access to the riverine fish community. Anglers can launch at the dam or at the Natalie State Forest Campground. In fact, Leland Anderson, retired MDNR, Fisheries Supervisor (personal communication) considered the Dollarville Flooding the best local fishing water for perch. In addition, the flooding is extensively used for waterfowling and trapping. Usage is very intense during fall hunting season. As a result, Fisheries Division plans periodic drawdowns for maintenance and soil re-compaction so that the flooding is at full pool in fall for hunters.

Brockies and Buckies dams are described together because of their similarities in age, construction, purpose, and location. Both dams were built by MDNR, Fisheries Division on unnamed streams that enter Silver Creek about 0.1 mi downstream from each pond. Brockies Dam was built in 1965 to replace a 1950 MDNR, Fisheries Division modification of a beaver dam. The 160 ft earth embankment has a structural height of 20 ft, with a head of 17 ft, and impounds about 4 acres. Buckies Dam was built in 1964 and lies in a valley adjacent to Brockies. Its earth embankment stretches 100 ft, impounds 6 acres, and has a structural height of 15 ft, with a head of 11 ft. A common access road splits at the top of an intermediate ridge to allow parking near each pond and walk-in access. Each path from the parking lots descends a steep hill, making retrieval of a carry-down canoe or kayak a considerable chore. Buckies Pond is scheduled to be drained and the area restored to stream conditions in 2007, due to poor returns from the stocking effort and new inspection costs for each dam owned by MDNR.

The Silver Creek Dam was completed for MDNR, Fisheries in 1962, and flooded in spring of 1963. The dam has a 250 ft earth embankment with a height of about 14 ft, and 11 ft of head. Maximum depth in the pond is about 8.5 ft. The “V”-shaped pond is about 15 acres and captures the headwater source for Silver Creek. Although the northern bays have steep banks, the central parking lot is relatively flat with 5–10 ft high banks.

Halfway Lake Dam is a lake-level control structure for Halfway Lake, a private lake with one riparian landowner who maintains a resort facility on the lake. The dam has a concrete spillway and raises the level of the lake 4 ft, increasing its area to 61 acres. There is no fish passage. Halfway Lake is one of the headwaters of the Auger River.

The remaining dam is privately owned. The George Wood Dam has a head of 5 ft and impounds 4 acres in the headwaters of Syphon Creek. This dam has existed for decades, and it does incorporate a fish passage structure.

Water Quality

General Water Quality—Point and Nonpoint Issues

Water quality in the Tahquamenon River watershed is good, owing primarily to the lack of human development within the basin. Water quality is influenced by point and nonpoint source flows and atmospheric deposition. Point source pollutants, from sources such as factories and wastewater treatment plants, reach the river from designated outfalls or discharge points. Point source discharges are regulated by National Pollution Discharge Elimination System (NPDES) permits. MDEQ, Water Division has federally regulated authority to administer the NPDES permit program in Michigan. There are two NPDES permitted point source discharges in the watershed, the Newberry Wastewater Treatment Plant (WWTP) and the MDNR, Tahquamenon Falls State Park wastewater sewage lagoon. The Newberry WWTP permit requires the treatment plant to submit periodic reports documenting the quality of their discharge, which totals 0.9 million gallons per day of municipal effluent. Both permits allow discharge to the Tahquamenon River. Non point source pollutants such as nutrients, sediments, and pesticides reach the river and its tributaries through runoff and erosion. Higher concentrations of some of these pollutants may enter the water via urban runoff, at poorly designed road-stream crossings, or from eroding streambanks. However, human riparian activity in this watershed is minimal. Road-stream crossings were inventoried in 2005 (see **Soils and Land Use**), and all were in good condition (Table 7).

Air transport contributes pollutants, such as mercury, to the watershed from sources outside the basin. Such pollutants may then be deposited in the watershed via precipitation and eventually show up in organisms in the river and Lake Superior. Mercury is the only source of fish consumption advisories in the river (Table 12).

Stream Classification and Water Temperature

Michigan Department of Natural Resources, Fisheries Division, classified streams throughout Michigan in 1967. The classification system is based on stream temperature and habitat quality, stream size, and riparian zone development (Figure 14). Classifications were developed for use in establishing water quality standards for Michigan streams, assessing stream recreation values, designating “wild and scenic” rivers, administering stream and riparian improvement and preservation, identifying dam and impoundment problems, administering fishing and boating access, and targeting fishing regulations, research planning, stream land acquisition.

The most atypical tributary in the classification system is the East Branch Tahquamenon River. The river is classified top quality cold water from the headwaters through USFS property and extending to the west side of T46N, R07W, Section 7, at the confluence with Riley’s Creek. However, as the clear, cold water flows west from Eckerman toward the North Hulbert Road Bridge, it first flows through about 7 mi of peat and muck soils, then finally through about 3 mi of lacustrine clay and silt. The 5-mi stretch of river downstream from Riley’s Creek to the North Hulbert Road Bridge is classified second quality cold water. Classification switches at the bridge to second quality warm water. At the North Hulbert Road Bridge, the water is turbid with clay, looking like coffee diluted with lots of cream. Many northern pike, muskellunge, and walleye have anecdotally been caught near the North Hulbert Road Bridge.

Temperature data were collected from five sites in the mainstem Tahquamenon River and six in select tributaries (Table 11). Some sites were measured in 2004, and the rest in 2005. Tahquamenon River sites were chosen to describe summer temperatures of each mainstem valley segment and to assess the thermal effects of the Dollarville Flooding (Figure 14). Tributaries were chosen to describe temperatures in an excellent brook trout stream (East Branch Tahquamenon River), marginal trout waters (Sixteen Creek and the East Branch Sage River at M-28), and streams designated as second quality warm waters. Temperature data was collected hourly via HOBO data loggers left in place between early June and mid October. Temperature data taken during 2005 do not typify “average” conditions due to the very warm, dry summer. Even so, they can shed light on the amount of groundwater influence in each stream. Those streams with significant groundwater influence will remain cool with minimal diurnal variation, while temperatures in those streams without the groundwater influence will fluctuate considerably due to solar warming on hot, sunny days and heat loss during the cooler nights.

Wehrly et al. (1999) described a thermal classification system for Lower Michigan that utilized July temperatures. Classification is based on average July temperature (i.e., cold, cool, and warm) and average weekly July weekly temperature range (i.e., stable, moderate, and extreme). Thus, temperature data collected from a site could be summarized and placed into one of the nine possible combinations of average and range in July weekly temperature. Wehrly et al. (1999) then used existing fish survey data for each stream to determine optimum thermal regimes for many fish species. Because of the close geographic proximity of the Upper and Lower Peninsulas, and because fish species from both peninsulas should have relatively similar thermal regime requirements, his data were used for analysis of the Tahquamenon River watershed temperature profiles (Figure 15).

Wehrly’s (1999) optimum thermal regimes for several game fishes were combined with data obtained at sites in the Tahquamenon River watershed to show site suitability for the species (Table 13). The identified regimes closely follow the current stream designations. For example, Auger Creek is a small creek officially designated as second quality warm water, but it was mapped as marginal to good for brook trout. Concurrently, however, it is also in the optimal thermal regime for northern pike, which target the trout for forage. The official designation of second quality warm water reduces the pressure to manage for trout in a system where pike would prey on the trout. Pike have free access to this creek from the Tahquamenon River mainstem, so they would be difficult to isolate from the stream. Portions of the Sage River, however, seem unsuited for their official designation. Data suggest the East Branch of the Sage at M-28, although designated trout water, is currently considered marginal for brook trout due to marginally warm mean July temperatures and excessive temperature variation. The increasing prevalence of beaver dams upstream have likely warmed the water and blocked spawning migrations, and anecdotal reports of reduced angler harvest occur for the area.

Thermal regime maps show that the Tahquamenon River mainstem downstream from the County Road 415 Bridge to Lake Superior has an optimum temperature profile for both northern pike and smallmouth bass. In addition, the unseasonably warm and dry summer, and warmer annual temperatures in recent years, might be warming the waters enough to allow largemouth bass populations to expand in the watershed, as largemouth have been anecdotally documented this summer as far downstream as the Hendrie River. In previous years, largemouth bass were seldom seen anywhere in the river system except Mud Lake, and the upper end of the Dollarville Flooding (see **Biological Communities**).

Existence of deep, cooler waters in the river from the Marsh Drainage segment to the mouth provide refuge during the heat of summer, likely benefiting coolwater sport fish species. During an exceptionally warm summer in 2005, the maximum recorded temperature immediately upstream from the Dollarville Dam was 86°F. Similar mid-August temperatures were observed further downstream as well, causing concern for the well-being and survival of the coolwater fish species. A subsequent vertical temperature profile was produced in the mainstem immediately upstream from the confluence with the Hendrie River (Table 14). Surface temperature was 79°F, and temperature was uniform to 5 ft. At 10 ft, temperature dropped to 73°, then 72° at 11 ft, 55°F at 15 ft, and 48°F at 20 ft.

A September 2006 limnological survey sampled temperature and dissolved oxygen concentrations in six deep holes located in the stretch from the Sage River downstream to near the Upper Falls (Figure 16).

Downstream from the Sage River, Site A with a depth of 25 ft showed no stratification (Table 15). Current velocity in that section of river, however, was easily discernable. Further downstream near the Betty B Landing, the river quickly widens to roughly double its former width, resulting in almost no visible current flow. That condition continues downstream to the Upper Falls. Site B, a 33-ft deep hole immediately upstream from the Hendrie River was the furthest upstream site showing stratification (Table 15). Temperature fell from 70°F at the surface to 63°F at 15 ft and 47°F at 20 ft. Similarly, dissolved oxygen concentration fell from 12.7 mg/l at the surface to 7.2 mg/l at 15 ft and 2.2 mg/l at 20 ft. Vertical limnological profiles for the other deep holes that were surveyed downstream from the Hendrie River showed similar stratification and oxygen depletion profiles (Table 15).

The vertical temperature profiles in the deep holes (Table 15) produced both excitement and questions. There are many shallow cross-sections in the Tahquamenon River, which suggest that all water has to mix as it flows up from the depths, over the bar, and then back into another deep hole. Since deeper water in some of those holes is anoxic, the deep waters apparently do not flow up and over the bars, but remain stationary. As unusual as it seems, the warmer surface waters in this relatively small river appear to pass over large pools of cool water without mixing. Also, because the several 18–25 ft deep holes between the Sage River and the Betty B landing showed no stratification, they will not provide thermal refuge for the sport fish during hot summers. Deep-water areas with a layer of oxygenated thermal refuge exist downstream from the Hendrie River, however, with many holes 22–48 ft (Figure 17). The deeper holes are unusual because they have a very irregular bottom contour. People with sonar equipment report there are several holes considerably deeper than we found that are extremely small and easily missed. Due to the distances involved, the Figure 17 resolution is only 0.5 mi. However, the deep holes averaged only 0.1–0.3 mi in length. Rather than use an average that would miss the depths of each hole, the deepest reading in the 0.5 mi section was recorded wherever there was a defined hole, or else the averaged depths of a uniform run was recorded if no deep hole was present. Although the figure may therefore be somewhat misleading, it still gives an accurate general profile for this stretch of river.

Since there are many similar or deeper holes in the mainstem (see **Geography**), they would appear to provide adequate coolwater refuge during periods of high water temperature. The deep holes, combined with many spring-fed streams, provide a variety of suitable temperatures for a variety of fish.

Agricultural Influences

Range-dependent agriculture is declining in the watershed. Visual evidence is seen in the several fenced feral pasturelands that are reverting to young forest or brush lands. Effects of grazing activity were most pronounced along reaches of Carlson Creek (Figure 10). Carlson Creek was one of several Eastern Upper Peninsula streams selected in the mid-1990s for renovation from livestock grazing damage (W.H. Taft, MDEQ, personal communication). The since discontinued cooperative program involved farmers, state and federal resource managers, the Luce County Conservation District, and the MSU Cooperative Extension Service. The program provided farmers with an 80% reduction in costs for fencing cattle out of streams and digging wells for alternative watering sites. Evidence documented by Strand (1996) and Strand and Merritt (1999) showed that within 1 year of cattle exclusion from Carlson Creek, the aquatic invertebrate community had begun to recover from its previously degraded condition. In addition, vegetation was beginning to cover raw eroding banks and to shade previously open shorelines.

The only other significant agricultural practice within the watershed is potato farming. Potato farms consist of several large, artificially irrigated fields that are well buffered from any nearby stream. Owners of a large potato farm between Newberry and McMillan, Walther Farm, applied for and received a permit to take irrigation water from East Lake, a 120-acre spring-fed lake. Further study by the farm owners showed the project was not worth the diversion effort. The current water supply for all local irrigation systems is from private wells.

Measures of Water Quality

Discharge of wastewater from the Newberry vicinity into the river has been a source of nutrients and toxic chemicals to the river, to varying degrees, over several decades. Eschmeyer (1946) studied water quality downstream from the M-123 Bridge in September. The cooler September water contained adequate dissolved oxygen, and he determined little significant impact from discharged wastes. At that time, two conduits delivered waste material from the City of Newberry and the State Hospital to a site immediately east of the bridge. A third conduit had delivered toxic material to the same site from the Newberry Lumber and Chemical Company until it went out of business in 1945. A follow-up study in July 1947 (Reynolds 1948), likewise found acceptable dissolved oxygen concentrations throughout the affected area. Odors were only present within the immediate vicinity of the outlets. However, local observers stated that fishing activity was seriously curtailed for a distance of about 17 mi downstream to Deadman's Farm. Reynolds also described no fish life in the first 4 mi downstream from the outfalls, with few deep holes and shallow, sand-choked channels. He concluded that his study showed no significant adverse effects from the domestic sewage discharges. However, a survey in 1960 (Fetterolf 1960) found that introduction of raw sewage from Newberry and the Newberry State Hospital into the Tahquamenon River caused radical changes in the bottom fauna population. The polluted situation extended downstream for at least 2.5 mi. Subsequently, the Newberry Wastewater Treatment Plant (WWTP) began operation in 1975 (Groundwater Education in Michigan Center 2005). A MDNR, Surface Water Quality Division (SWQD) survey in 1989 (Taft 1989) found no observed effects on the macroinvertebrate and fish communities due to effluent discharge from WWTP, as numbers and diversity of taxa were indicative of high stream quality.

Monitoring by MDEQ-SWQD in 1998 found out that the Newberry WWTP was out of compliance for all permit limits, including biological oxygen demand, total dissolved solids, and phosphorus (U.S. EPA 2005a). Subsequently, MDEQ-SWQD referred the treatment plant operation to MDEQ's 104(g)(1) Operations Training Unit (U.S. EPA 2005a). Plant inspection and operator training resulted in reduced pollutant discharge. In 1999, MDEQ-SWQD surveyed the river upstream and downstream of the WWTP outfall. Concentrations of chemical parameters were all below the Michigan Water Quality Standard (MWQS) for each chemical. Total phosphorus concentrations above and below the outfall were 0.017 and 0.02 mg/l, below the level specified in the WWTP's NPDES permit. No nuisance algae or aquatic macrophyte growth was observed.

Activities at Dollarville Dam appear to have influenced water quality of the river over the last several decades. Decomposition of dying vegetation associated with reconstruction and filling of the Dollarville Dam in 1970–72 may have contributed to reduced dissolved oxygen levels in the river upstream of the Newberry WWTP during 1970–73 (U.S. EPA 2005b). Nutrient enrichment (e.g., profuse growth of *Cladophora*) was observed in the river upstream of the Newberry WWTP in 1989 (Taft 1989), when Dollarville flooding was drawn down in early 1989 for dam repairs and reflooded in the summer (Fisheries Division, local files). Speculation was that the water level manipulation had released additional nutrients downstream of the dam. When MDNR, Fisheries Division drained the Dollarville Flooding for dam repair in 1993, USGS data sampling in mid-summer showed a serious dissolved oxygen deficit at the gauging station just upstream from the Upper Falls (USGS 2005). It is hard to believe that dam activities could have caused an oxygen deficit roughly 40 mi downstream, but the coincidence is intriguing. No other water quality data were available downstream of the dam during this period.

Taft (1994) surveyed one site in the upper portion of the Tahquamenon River mainstem in 1994. The survey was a qualitative biological survey, conducted according to Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers (MDEQ-SWQD 1997). The macroinvertebrate community was rated "Good." Although a variety of high quality insect types were collected, limited quantities of large woody structure and predominantly sand substrate within the study area reduced the total number of organisms in the river. The habitat rating was "poor," due to sand inundation.

Despite the poor habitat rating, the majority of streambanks received high scores for vegetative stability and cover type.

In 1999, MDEQ-SWQD surveyed nine sites within the Tahquamenon River watershed (Goodwin 2000). Sites were located on Syphon, Teaspoon, Murphy, Cheney, and Naugle creeks, West Branch Sage and Hendrie rivers, and sites in the mainstem above and below the Newberry WWTP outfall. Qualitative biological surveys were conducted at six of the sites, physical habitat observations were made at three sites, and water chemistry samples were taken at all nine sites. All surveyed macroinvertebrate communities rated “Acceptable.” In general, stations in the western portion of the drainage had higher combined percentages of mayflies and caddis flies. Habitat conditions rated either “Fair” or “Good,” depending on differences in scores in the substrate/cover, embeddedness, and velocity:depth ratios. Concentrations of chemical parameters were all below the Michigan Water Quality Standards (MWQS) for each chemical. Based on these surveys, the sampled reaches of the Tahquamenon River watershed met the biological integrity related requirements of the MWQS.

In 2002, Aiello (2004) found that the Tahquamenon River had the highest median total mercury concentration of all rivers sampled in Michigan that year. MWQS exceedence rate was 100%, with 4/4 samples over the MWQS. All other parameters were lower than the limits established for MWQS, and there are no watershed-specific Fish Consumption Advisories (see **Water Quality**, *General Water Quality—Point and Nonpoint Issues*, Fish Contaminant Monitoring).

In general, the primary nonpoint pollution issue in the watershed appears to be excessive sand sediment load. The sand is a product of the local geology, with its concentration in the river being exacerbated by historic logging of the watershed. Impacts from recent logging that did not include Best Management Practices (BMPs), construction, and road crossing activities appear to be very minor. Natural flushing of historic sediment from the system is hampered by extremely low channel gradients which occur in much of the river and its tributaries. However, sandy substrates are typical in many low gradient reaches of Michigan streams, and the presence of sand in many reaches of the Tahquamenon River system may be a natural phenomenon. Thus, some sandy reaches which MDEQ surveys rate as “poor” may not necessarily reflect human-induced impairments, but instead the physical setting of a reach (i.e., an extremely low gradient channel meandering through an extensive wetland). Holden (2005) stated that Procedure 51 was not designed to account for natural habitat features such as soft-bottom, sandy streams with few riffles, or streams flowing through wetland areas. For that reason, low Procedure 51 scores in this watershed are not necessarily an indication of human-caused habitat degradation.

Groundwater Contamination

Groundwater contamination sites within the watershed are relatively scarce (Schaefer, Environmental Quality Analyst, MDEQ-Remediation and Redevelopment Division, personal communication). Most documented contamination sites are concentrated within and near the village of Newberry. The most significant groundwater contamination site in the watershed is the former Charcoal Company, which closed its doors in 1945. Soils are currently being remediated by MDEQ. Identified contaminants at the Charcoal Company site include heavy metals and both volatile and semi-volatile chemicals. There is presently no evidence of a groundwater contamination plume extending toward the Tahquamenon River. However, anecdotal information suggests that when the mill was operating, surface drainage ditches extended from the plant north to the river. An old sawmill currently operating at the corner of Victory Street and Charles Road is listed for pentachlorophenol, a substance used to combat mold when drying milled green lumber. Documented groundwater contamination also occurs at county road commission road salt storage sites in the village of Newberry and Strongs. In addition, the Tahquamenon Falls State Park workshop is on the contamination list for several volatile and semi-volatile chemicals.

In addition to the sites mentioned above, there are several instances of leaking underground storage tanks (most in the Newberry vicinity) stemming from historic and current gasoline service stations. The site below the only downtown service station had produced a gasoline layer floating over the groundwater in the center of the village. The station was forced to close due to the cost of cleanup. Another business closed and MDEQ excavated most of the contaminated soils. In addition, the recent street remodeling effort in downtown Newberry uncovered three long-abandoned petroleum storage tanks under the street.

Fish Contaminant Monitoring

There are no Michigan Department of Community Health consumption advisories specific to any body of water within the Tahquamenon River watershed. Even so, there is a general advisory for many sport fish species, for inland lakes, reservoirs, and impoundments of the Lake Superior watershed due to mercury contamination of fish (Table 12). In general, it is recommended that consumption of all legal or acceptable sized fish should be limited to one meal per week for men and one meal per month for women and children.

Special Jurisdictions

Here we discuss special governmental jurisdictions within the watershed. Most notable land management jurisdictions are the U.S. Forest Service properties by Eckerman and Strongs, and the Tahquamenon Falls State Park. In addition to those areas, the State of Michigan owns and manages the Lake Superior State Forest properties.

U.S. Army Corps of Engineers

The United States Army Corps of Engineers, Detroit District, exercises navigation jurisdiction over the United States waters, across the entire Great Lakes water surface and bed to the Ordinary High Water Mark, which for Lake Superior, is 603.1 ft above Mean Water Sea Level at Rimouski, Quebec (Anonymous 2005a). Thus, the Tahquamenon River from the mouth upstream to the Whitehouse Landing falls under Corps of Engineers jurisdiction. The corps' authority is based on two laws (Anonymous 1985):

- Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) prohibits the obstruction or alteration of navigable waters of the United States without a permit from the Corps of Engineers.
- Section 404 of the Clean Water Act (33 U.S.C. 1344), Section 301 of this Act prohibits the discharge of dredged or fill materials into the waters of the United States without a permit from the Corps of Engineers.

Navigability

A navigable inland stream is:

(1) any stream declared navigable by the Michigan Supreme Court;

(2) any stream included within the navigable waters of the United States by the U.S. Army Corps of Engineers for the administration of the laws enacted by Congress for the protection and preservation of the navigable waters of the United States;

(3) any stream which floated logs during the lumbering days, or a stream of sufficient capacity for the floating of logs in the condition which it generally appears by nature, notwithstanding there may be times when it becomes too dry or shallow for that purpose;

(4) any stream having an average depth of about 1 ft, capacity of floatage during spring seasonal periods of high water limited to loose logs, ties and similar products used for fishing by the public for an extended period of time, and stocked with fish by the state;

(5) any stream which has been or is susceptible to navigation by boats for the purposes of commerce or travel; and

(6) all streams meandered by the General Land Office Survey in the mid 1800s (Anonymous 1993).

Log drives were a regular occurrence in the late 1800s and early 1900s, not only for the mainstem from County Road 421 to Lake Superior, but also on several of the larger tributary streams including the Sage and Hendrie rivers. In fact, both the Sage and Hendrie rivers have existing canals that were excavated through much of their length during the late 1800s to straighten the many bends and facilitate log movement. Even though the streams were very small, previous modification to allow log movement means that they are now considered navigable.

National Wild and Scenic River Designation

The East Branch Tahquamenon River was designated a National Wild and Scenic River on March 3, 1992 (Bassett, 2005). As part of that designation, the segment upstream from the center of section 20, T46N, R06W was designated “recreational” for fishing. The existing wild brook trout population was recognized as an outstanding value of the river that must be preserved. However, provision was made within the Act for management standards and guidelines that permit fish habitat enhancement activities to protect and enhance the outstanding resource values. The segment downstream from the center of section 20 was designated “wild,” to be left in pristine condition.

Federal Government

The USFS, Hiawatha National Forest was established in 1931 and encompasses East and West Units, collectively approximating about 880,000 acres of land. The East Unit includes the upper half of the East Branch Tahquamenon River watershed, the area most accessible to anglers. The Hiawatha Forest Plan is currently being revised, but activity is continuing based on the previous plan. Land outside of the river corridor is generally used for timber production and dispersed recreation including hunting, trapping, and fishing. The timber production area is dominated by pine plantations, emphasizing production of conifer sawlogs. The dispersed recreation area is dominated by lowland conifers. Another smaller portion of the watershed is used for hardwood saw log production and for both dispersed and developed recreation. Most of the river downstream from Forest Service property is privately owned and generally inaccessible to anglers. The Forest Service maintains the land in a natural state; there is only one campground, Three Lakes Campground, located south of Strongs. There are no USFS developed boat launches within the watershed.

State Government

The MDNR and MDEQ provide the primary state government influences on land management activities and special jurisdictions in the Tahquamenon River watershed. The MDNR is the primary landowner, owning 54% of lands within the watershed (see **Land Use**). Most of these lands are contained in the Lake Superior State Forest, which is managed by MDNR, Forest, Mineral and Fire

Management Division (FMFMD) for commercial and recreational uses. Species composition and growth rates of trees on 10% of state-owned forest lands are surveyed each year, with a decision then made concerning future management of those lands. This protocol results in assessment of the entire forest every 10 years. Wildlife Division is the co-manager of the forest, and Fisheries Division comments on management activities adjoining wetlands, lakes, and streams. Forest recreation programs are administered by MDNR and include campgrounds, pathways, water access, snowmobile trails, off-road vehicle (ORV) trails, state trailways, and a marine safety program. Two State Forest campgrounds exist within the watershed, one across the road from Bass Lake and the other at Natalie on the Dollarville Flooding. The boat launch on Bass Lake is maintained by FMFMD (Table 16).

The MDNR, Parks and Recreation Division manages the Upper and Lower units of Tahquamenon Falls State Park. The Upper Unit includes a campground at the Lower Falls, while the Lower Unit includes both campground and boat launch facility at the mouth of the river. Parks and Recreation Division also maintain 12 other boat access sites within the watershed, 4 on the Tahquamenon River mainstem, 1 on the East Branch Tahquamenon River at Eckerman, 4 on inland lakes, and 3 on small trout ponds (Table 16).

The MDNR, Law Enforcement Division enforces Michigan hunting, fishing, snowmobile, and ORV regulations. Law Division also works with Fisheries and Wildlife divisions, as well as various constituency groups to develop regulations that are biologically and legally protective of the resource.

The MDEQ is the lead regulatory agency for water quality protection in Michigan. Their charge is to protect and enhance Michigan’s environment and public health. On behalf of Michigan’s citizens, they administer programs to promote and ensure sound environmental stewardship and enforce laws that protect Michigan’s natural resources. They encourage voluntary actions to enhance our natural resources and the environment. They preserve biologically diverse, rare, sensitive, or endangered plants, animals, and ecosystems through identification, education, management, and public/private partnerships and initiatives. They advance environmental protection through innovation and improvements to regulations and programs (Anonymous 2005b). The MDEQ contains various divisions which focus on the protection of environmental quality (Table 17).

Biological Communities

Original Fish Communities

The glacial activity that shaped present-day Michigan and the Tahquamenon River watershed also played an important role in repopulating the area with numerous fish species. The Great Lakes region has 153 species of native fish. Periodic connections with glacier-free refugia during glacial retreats allowed aquatic organisms to recolonize the region. Three such areas of particular importance to the Great Lakes region were the Bering, Atlantic, and Mississippi refugia. The Great Lakes region was connected to the Bering drainage (refuge) by a lake and river system created along the face of the retreating Laurentide glacier. Current day Great Slave Lake and Great Bear Lake are also part of this system. Lake trout, Arctic grayling, and northern pike were some of the fish species that used the Bering refugia (Bailey and Smith 1981). The Atlantic refugia extended east from the northern Great Lakes region to the Atlantic Ocean. Fourteen species of fish populated the region solely from the Atlantic refugia. However, the primary source for repopulation of fish species came from the Mississippi refugia, which supplied 122 species of fish to the region (Bailey and Smith 1981).

Lake Superior appears less influenced by the Mississippi refugia, as its coldwater fishery is dominated by lake trout and coregonid species. In addition, Lake Superior has few species relative to adjacent Great Lakes, having 53 total species (native and exotic, living and extirpated) compared to lakes Michigan and Huron, which have 91 and 90 species (Bailey and Smith 1981). Even fewer species occur in the river upstream of the Upper and Lower falls, reflecting their function as a barrier to colonization (Appendix A and MDNR, Fisheries Division, files). With the exception of the barrier formed by these waterfalls, fish distribution and abundance throughout the watershed was determined by habitat and thermal suitability (Zorn 2002). In general, brook trout and other coldwater species inhabit the spring-fed stream headwaters and ponds, while coolwater species inhabit the warmer, low gradient main channels and larger, shallower lakes. No information exists to describe fish communities in the watershed prior to human settlement.

Even though Native American legend associated lake sturgeon with the lower Tahquamenon River, there are no documented occurrences. The lack of records is also surprising since there are historical notes of them in nearly all river assessments done to date. State Park development at the Lower Falls and near the mouth at Lake Superior has only marginally affected shoreline or instream habitat, and riparian development within the 17 mi to the Lower Falls is very sparse.

Factors Affecting Fish Communities

The logging effort from 1880 to 1940 (see **History**) cleared many streams of large woody debris, straightened bends by ditching new channels, and scoured bottom substrates. Even so, little evidence of such activity currently remains. Streams meander, most banks are vegetated, and woody debris again lies within the stream channel. Sand bedload is the most significant remaining evidence of historic logging activities.

Human access to this watershed has increased as a result of previous and continuing logging activity. Several local roads consist of sandy gravel placed over old cedar log ("corduroy") roads. Cedar branches and bark are continually being exposed on these roads by road commission maintenance grading activities. Forest logging roads reaching into previously untracked woods are kept open by continuous vehicular traffic. Off-road vehicles also use those two-track roads, but with their tremendous overland capability, they encroach even further into previously inaccessible areas. These roads introduce some sediment into waters. However, the large proportion of wetland and marsh prevents extensive road networks and serves to protect much of the watershed from significant adverse impact.

Dollarville Dam is the only dam in the watershed with a fish passage structure, which does not seem to significantly block fish migrations. In fact, two radio-tagged muskellunge swam upstream through the dam into the Flooding during spring 2005. Three other Fisheries Division-owned dams impound small stream headwaters to form brook trout ponds. Self-sustaining brook trout populations exist downstream from all three ponds. Little is known about the private dams in trout streams, but brook trout populations exist downstream from each. Halfway Lake Dam drains into a marsh headwater of Auger River, and no fishery exists immediately below the dam.

Humans have introduced nonnative plants (e.g., Eurasian milfoil, dandelion, Phragmites, trefoil, purple loosestrife, and autumn olive), birds (e.g., European starling and English sparrow), invertebrates (zebra mussels), and fish (e.g., brown trout and rainbow trout). No lake trout have been documented in the watershed other than in Hulbert Lake, where they were stocked. Hulbert Lake was also privately stocked with green sunfish, smelt, and lake herring. Some of the plants are adversely affecting small sections of the local ecology. Introduced and native fish appear to be co-existing in the watershed, and aquatic invasive species introduced into the Great Lakes have not accessed the majority of the watershed due to the barrier provided by the Upper and Lower falls.

In summary, the most significant impacts of humans in the watershed are sedimentation and channel changes associated with historic logging, previous removal of large woody debris, streambank erosion at access sites and road crossings, and elevated sand bedloads in streams. Much large woody debris has subsequently been naturally restored, so excessive sand bedload (from former heavily-eroding streambanks) seems to be the major negative impact that remains. On a much smaller scale, there is occasional minor erosion from the smaller road crossings.

Present Fish Communities

Fifty-two fish species have been documented by Fisheries Division personnel in the Tahquamenon River watershed (Table 18, Appendix A). None are recognized as being threatened or of special concern. The most obvious and significant factor affecting fish distribution in the watershed is the barrier formed by the combination of Upper and Lower falls. There are no carp, sea lamprey, alewives, smelt, or other introduced potamodromous species above the falls (Fisheries Division, files; Taylor 1954; Bailey et al. 2004). Despite being open to Lake Superior species, the river below the falls consists of very uniform habitat, with only a few small tributary streams. The result of migration blockage and fewer available downstream habitats is that there are 45 documented fish species above the falls and only 32 species below the falls (Table 19). In the course of targeted fish collection work, Fisheries Division personnel have noted observations of nontarget species.

The Upper River segment is classified as first quality trout water. Extensive habitat work (see **Fishery Management**) has produced a brook trout population while concurrently negating the need to stock trout. Fish communities in most coldwater streams throughout the watershed (i.e., second quality coldwater streams in Figure 14) are fairly similar to each other and typical of small trout streams in the Upper Peninsula. The species present usually include brook trout, blacknose dace, creek chub, Iowa darter, Johnny darter, and mottled sculpin. Brook trout are self-sustaining with the occasional occurrences of fish over 12 inches, but population densities are low relative to trout densities seen in more highly fed groundwater streams in the northern Lower Peninsula. Most of these streams have moderate gradients, groundwater inputs, and sand-gravel substrates in headwater reaches. Gradients abruptly flatten, however, as they approach the mainstem, transitioning the stream into emergent marshes with silt, peat, and clay bottom substrates, and water temperatures too warm for trout (Figure 6).

Coolwater stream fish communities generally exist within the mainstem and in the lower reaches of the larger tributaries. The species present usually include northern pike, northern muskellunge, walleye, smallmouth bass, yellow perch, rock bass, white suckers, brown bullheads, burbot, and various minnow species. There is no current fish stocking; all species are naturally reproduced and self sustaining.

Most lakes support warm- or cool-water fish communities (see **Fishery Management**), with the exception of the trout impoundments and Wolverine Lake. Largemouth bass are found in the lakes south of the mainstem, while smallmouth bass are generally found in the northern lakes. Yellow perch and rock bass are found in all of the lakes, while bluegills and pumpkinseeds are found in the lakes south of the mainstem. White suckers, brown bullheads, and various minnow species are also found in lakes uniformly across the watershed.

No salmonids other than brook trout were native to the Tahquamenon River upstream of the Upper Falls. However, rainbow trout were documented in early creel census data (Appendix B) from the Tahquamenon River in Luce County (1951–60) and Chippewa County, (1946–64), Grants Creek (1960–63), and the East Branch Tahquamenon River (1929–55). The Chippewa County records did not distinguish between the river above the falls or below, so the data could conceivably have come from the steelhead-spawning run from Lake Superior to the Lower Falls. All other waters, however, are above the Upper Falls. Even so, there is no historic documentation of rainbow trout stocking in the riverine system above the falls. Two possibilities exist concerning their presence above the falls: either the trout were misidentified by a conservation officer, or undocumented stockings occurred during the early part of the twentieth century. If the fish were stocked, however, no rainbow trout have been documented in the river or streams above the Upper Falls since the mid 1960s.

Northern muskellunge were likely native to the river above the falls, and both northern and Great Lakes muskellunge presently occur together below the lower falls. Their populations, however, have been bolstered by stocking in 1957 and in the 1980s. Although the two strains are easily identified from each other, both strains are generally combined into a single entry for “muskellunge.” Early creel census data (Appendix B) for the Tahquamenon River and the East Branch Tahquamenon River record catches of “grass pike” that were 36 and 38 inches long. Since the grass pickerel, *Esox americanus vermiculatus*, averages only 8 inches, with larger specimens up to 14 inches (Becker 1983), these fish were likely muskellunge that were misidentified. In addition, no grass pickerel have been documented in the Upper Peninsula (Bailey et al. 2004). The two areas where these historic creel surveys occurred (i.e., the Hendrie River near the confluence with the Tahquamenon River and the East Branch Tahquamenon River between the North Hulbert Road Bridge and the Tahquamenon River) currently support muskellunge.

Black bullhead may be present in the watershed as documented, but are rare, and none have been identified in recent years. Brown bullhead, however, are found in abundance. It is possible that workers during the first half of the twentieth century mistakenly identified brown bullheads as black.

Aquatic Invertebrates

The aquatic invertebrate community often provides a useful indicator of a stream site’s habitat and water quality because of each species’ distinct life cycle and habitat requirements (Merritt and Cummins 1996). Research has determined tolerances of various aquatic invertebrate species to temperature, sediment, nutrient loading, and water velocities. For that reason, presence or absence of any species helps to determine the ecological condition of the stream site.

The MDEQ, Great Lakes and Environmental Assessment Section (GLEAS) periodically conducts biological surveys as part of the nonpoint pollution surveillance program. These surveys followed GLEAS Procedure 51 survey methods (MDEQ-SWQD 1997). Procedure 51 is designed to assess the abundance and diversity of fish and macroinvertebrate communities, as well as shoreline and instream habitat.

Taft (1989) compared macroinvertebrate communities above and below the Newberry wastewater treatment plant, and found that both communities included two families of mayflies and four families of caddisflies. The total number of taxa at both sites was good to excellent. In contrast, Fetterolf (1960) found the downstream site heavily degraded, a condition that existed for approximately 2 mi below the plant (see **Water Quality**). The new results implied significant improvement in wastewater treatment, with no noticeable macroinvertebrate degradation.

A Procedure 51 survey at T46N, R12W, Section 15 in the Upper River segment (Taft 1994) was conducted to provide baseline information before initiation of a Fisheries Division, multi-year habitat enhancement project. The Upper River segment is designated as high quality trout water. The macroinvertebrate community rated “good,” consisting of stoneflies, mayflies, and caddisflies. Habitat, however, rated “poor,” due to limited quantities of large woody debris, lack of riffles and runs, and a preponderance of sand deposition (see **Channel Morphology**).

A Procedure 51 survey of several sites within the Tahquamenon River watershed (Goodwin 2000) found that all macroinvertebrate communities rated “acceptable.” Communities in the western portion of the watershed had higher combined percentages of mayflies and caddisflies, with lower amounts of embeddedness relative to the eastern sites. Habitat conditions rated either "fair" or "good," largely due to differences in scores for substrate/cover, embeddedness, and velocity:depth ratio.

Strand and Merritt (1999) studied Carlson Creek by surveying the macroinvertebrate community prior to and after fencing livestock away from the banks. Rapid regrowth of bank vegetation and concurrent changes in the aquatic macroinvertebrate community were striking. The authors concluded that, "The evidence is convincing that Carlson Creek invertebrate communities were altered by land clearing and decades of grazing in riparian habitat. Cattle exclusion apparently has started to reverse this trend and promises ultimately to satisfy the management objectives of limiting erosion and restoring brook trout habitat." Visual observation at the bridge on M-28 currently shows a well-healed stream, with a densely vegetated shoreline and floodplain.

Aquatic invertebrate survey data are lacking throughout the remainder of the watershed. A complete inventory of the river's aquatic invertebrate community is needed to further document any problem areas.

Amphibians and Reptiles

Targeted surveys for amphibians and reptiles are not done by MDNR, Fisheries Division, but occurrences are noted for surveys conducted for MDNR, Fisheries Division Status and Trends Program. Data on occurrences of rare species in the watershed are available through the Michigan Natural Features Inventory. Nine species of frogs and six species of salamanders (Harding and Holman 1992) are found within the Tahquamenon River watershed (Table 20). None are listed as endangered, threatened, or of special concern by the Michigan Natural Features Inventory (Anonymous 2005c). Five species of snakes (Holman et al. 1989) are found within this watershed (Table 20). Three turtle species have been documented (Table 20), of which the wood turtle is listed as being of "Special Concern" by the Michigan Natural Features Inventory (Anonymous 2005c). Wood turtles are found along rivers with sandy banks and nest on gently sloping sandbars (Harding and Holman 1990). Wood turtles are not protected under state endangered species legislation, but the species is protected by the Director's Order on regulations for the take of reptiles and amphibians.

Birds

There are 195 bird species associated with the Tahquamenon River watershed and the Lake Superior shoreline adjacent to the watershed (Table 21; Anonymous 2000 and 2005c, Brewer et al. 1991, Spieles et al. 2001, and Spieles, MDNR, Parks and Recreation Division, personal communication). Of those bird species, twelve are designated in Michigan as threatened, seven are designated for "Special Concern," and one is listed as endangered (Table 21). One, the bald eagle, is listed federally as threatened. Immediately north of this watershed, more than 300 bird species have been documented using the Whitefish Point migration (between the U.S. and Canada) corridor (Spieles et al. 2001).

Mammals

The Tahquamenon River watershed supports 46 mammal species (Baker 1983, K. Sitar, MDNR, Wildlife Division, personal communication, and Anonymous 2000b) (Table 22). Unquestionably, beaver are the mammal species with the greatest influence on the river system. Beaver are not the valuable fur-bearer that they were even 30 years ago, due to the decline in fur prices and concurrent decline in number of trappers (K. Sitar, MDNR, Wildlife Division, personal communication). Even so, beaver are a significant element in the Upper Peninsula ecosystem. Because of their ability to dam small streams, they build wetlands. Headwater streams, designated as trout water, are located in forests subject to extensive forest management through logging practices. Although mature riparian forests may attract an occasional beaver colony, stands of young trees in early successional forest stages provide much more attractive habitat (Baker 1983). In fact, beaver populations have prospered and increased throughout much of the watershed because riparian second-growth forests of aspen-birch-conifer stands followed lumbering and land-clearing activities (Baker 1983). Generally speaking, beaver build their dams at the site of highest stream gradient (Baker 1983). The high gradient reaches in Michigan streams often provide excellent trout spawning habitat because they consist of gravel and rock substrates that resist erosion, and therefore maintain high slopes and faster currents, and transport finer sediments downstream. The relationship between beaver and trout has been studied for many years. For example, Brandt (1935) found that not only do beaver dams flood spawning sites, they often also block fish migration to other suitable upstream spawning sites. Most importantly, beaver dams can increase stream warming downstream such that former trout streams become entirely unsuitable for salmonids. Thus, effects of increased forest logging and decreased trapping have increased beaver populations to the extent that they can and have significantly modified free-flowing headwater trout streams and reduced trout populations. For example, Bassett (2005) noted in the East Branch Tahquamenon River that beaver dams within the USFS owned parcel increased from 66 in 1992 to 120 in 2000. Concurrent with that increase in number of dams, fish surveys documented a significant decline in natural reproduction and population size of brook trout. Bassett (2005) documented standing crops at the Strongs site of 21.2 lbs/acre in 1995 and 19.3 lbs/acre in 2004. These numbers compare with 103.6 lbs/acre at the same site from surveys in 1977–83 (see **Fishery Management**, *East Branch Tahquamenon River*).

The gray wolf is currently listed as threatened by Michigan and as Endangered by the Federal government. Gray wolf numbers in the Eastern Upper Peninsula (EUP) and the Tahquamenon River watershed have been increasing annually, although the rate of increase appears to be slowing (K. Sitar, MDNR, Wildlife Division, personal communication). During early 2005, numbers in the EUP had increased to about 400. A subsequent U.S. Fish and Wildlife (USF&W) proposal to reduce their status from Endangered to Threatened was overruled in federal court. The gray wolf is still regulated under the federal Endangered Species Act (R. Ainsle, MDNR, Wildlife Division, personal communication).

Moose are naturally present in the watershed. Even so, moose were reintroduced into Michigan in 1986 and are designated as a mammal of “Special Concern” (Baker 1983, Anonymous 2000, Anonymous 2005c, and K. Sitar, MDNR, Wildlife Division, personal communication). The much-publicized 1986 Michigan reintroduction was conducted to “stock” the moose into the west-central portion of the Upper Peninsula. That effort should not have affected the local moose population; the potential for any of those moose to have wandered eastward into the EUP area is negligible (K. Sitar, MDNR, Wildlife Division, personal communication). However, the modest resident moose population in the EUP probably resulted from migration across the St. Marys River from Canada. Aerial estimates (K. Sitar, MDNR, Wildlife Division, personal communication) project about 100 moose in the EUP with the population appearing to be stable. Because of the extensive acceptable moose habitat and minimal human encroachment within the central Tahquamenon River watershed, there is potential in the watershed for roughly 33 resident moose (K. Sitar, MDNR, Wildlife Division, personal communication).

Fisher essentially disappeared in Michigan by 1928, apparently the result of habitat destruction through logging and farming practices, plus the unregulated harvest for their pelts (Baker 1983). Fishers were subsequently released in Gogebic County in 1961–63 (Baker 1983). Recently, fishers were released in and around the Tahquamenon River watershed (K. Sitar, MDNR, Wildlife Division, personal communication). In 1990, 34 were released in Luce County, generally within the Tahquamenon River watershed. More fisher were released in Mackinac County from 1988–89, and some also in Chippewa County in 1991. Fishers have now spread throughout the EUP, and numbers have increased substantially since the last introduction. The restored population is now large enough to support a trapping harvest season (K. Sitar, MDNR, Wildlife Division, personal communication).

Pine Marten were also reported extirpated in the 1920s (Baker 1983). A total of 99 were released in 1969 and 1970, in the Whitefish River area of Delta County. However, some were reported in Alger and Luce Counties in 1973 (Baker 1983). Other releases elsewhere in the Upper Peninsula continued throughout the 1970s and early 1980s. From 1988 to 1992, 27 pine marten were released in Schoolcraft and Mackinac counties. They are now relatively common in the Tahquamenon River watershed. Those efforts have successfully restored the pine marten into the EUP, and their population has increased enough to support a trapping harvest season (K. Sitar, MDNR, Wildlife Division, personal communication).

Other Natural Features of Concern

Michigan Natural Features Inventory (MNFI) (Anonymous 2005c) maintains a list of flora and fauna designated by the state as Endangered, Threatened, or of "Special Concern." The listings can be accessed by county or by watershed and sub-watershed. For the Tahquamenon River watershed, the MNFI listing includes 8 birds, 1 insect, 1 land snail, 11 plants, 4 ecological communities, and 1 geologic formation (Table 23). The table is divided into sub-watersheds. The watershed, however, is unique because of the extensive, unperturbed central wetlands surrounded by coarse glacial soils (see **Geology**). The most striking feature of the table is that the central portion of the watershed does not have any listings. That lack of listing may be because the extensive wetland habitats are well represented in other wetlands throughout the state and not unique, or because those habitats are so inaccessible to surveyors. The second feature of interest is that the area surrounding the Upper and Lower falls easily contains the most listed species (Table 23), possibly due to the number of microhabitats provided by the rock and the extensive humidity from the falls.

Aquatic Pests

The only known aquatic invasive species in the watershed are Eurasian milfoil and zebra mussel. Identified in East Lake in 1995 (MDNR, Fisheries Division, files), Eurasian milfoil has caused considerable boating and economic problems for riparians. Although treated with the chemical 2-4-D for several years in a row, the plant still exists in the lake. In addition, East Lake has an unimproved boat access site located near a large colony of the plant, further enhancing the potential for unintended introductions elsewhere. Zebra mussels were identified in Twin Lake in 2005. Warnings are posted at both lakes about transmittal to other lakes and so far, there is no evidence of any transference. Small colonies of purple loosestrife occur in isolated wetlands or roadside ditches, but none are known to occur along any stream or lake shoreline. Minimizing the rate of spread of aquatic invasive species is important to maintaining the ecological integrity of aquatic habitats and is also highlighted as a priority in Michigan's Wildlife Action Plan (Eagle et al. 2005).

Fishery Management

From the early 1900s through the 1980s, MDNR fisheries management focused primarily on development and maintenance of sport fish populations. Beginning in the late 1990s, however, emphasis shifted to more holistic management and naturally functioning systems. This evolution of philosophy mimics fisheries management changes that transpired through the twentieth century. Although there is some dispute between fisheries management in certain trout streams and beaver management (see **Biological Communities**, *Mammals*), the few comments external to the MDNR received so far are in favor of beaver control.

Early fisheries management in the Tahquamenon River watershed began in the 1920s with surveys to identify and document fish populations (Taylor 1954). Later in the 1930s, fish stocking in the Tahquamenon River watershed was one of the first management tools documented in local management unit files. Stocking resulted in numerous plants of walleye, bluegill, bass, and various species of trout (brook, rainbow, brown). Instream fisheries habitat management programs were introduced during the 1930s post-depression era by the Civilian Conservation Corps. From 1945 to 1964, the state was stocking legal-size trout into many local creeks and rivers (MDNR, Fisheries Division files). Fisheries management practices in the Eastern Upper Peninsula 1964–2000 incorporated fish stocking, habitat restoration, and research in day-to-day operations.

Beginning in the 1990s, fisheries management began to employ a more holistic ecosystem approach to managing fish populations. Specific management tools remained the same, but the emphasis was changed to encompass broader goals such as fish community balance rather than health of a single sport fish population. Management direction moved toward emphasis on issues such as watershed based dynamics, connectivity of rivers, forage and nongame species, reptiles and amphibians, and a departure from single-species lake management other than small trout lakes and a few high-quality trout streams. More attention was given to maintaining and protecting overall system functionality and a lessening of biological manipulation to develop sport fisheries. As a result, the number of lakes annually treated with chemicals to eradicate certain fish species has declined. Walleye, tiger muskellunge, and trout stockings have ceased in waters that showed poor returns to the creel. Although fisheries management on USFS land was originally a responsibility of the MDNR, management programs in federal lakes and streams were developed jointly by MDNR and the USFS during the last half of the 1990s. Public education, land acquisition, access improvement, and coordination with other governmental units have been instrumental parts of modern fisheries management. Current management efforts focus on fish stocking, habitat restoration, and establishing balanced predator-prey relationships within inland streams and lakes. Regularly scheduled surveys document resource status and management actions are determined based on survey results.

Recreational anglers fishing inland lakes generally target walleye, trout, northern pike, smallmouth and largemouth bass, yellow perch, and several species of panfish. Fisheries managers work to maintain acceptable populations of those species. Despite the efforts, however, a typical management problem arises when predators are overharvested in a lake. Lack of predators allows prey fish populations to proliferate, but because of limited available forage, they usually become stunted. The resulting fish community is one in which, for example, panfish are extremely numerous but very slow growing and averaging of only 3 to 5 inches. Management tools used to restore a balanced predator-prey relationship and balanced fish community structure include fish stocking, manual removal of the stunted prey species, chemical removal, instream fish barriers to prevent immigration of unwanted species, spawning habitat construction, and angling harvest regulations. Active management is defined as the use of any of those tools as opposed to passively relying on fishing regulations to protect the fishery.

The following descriptions of fisheries management efforts in the mainstem, tributaries, and lakes of each river segment utilize data taken from MDNR, Fisheries Division files at the Newberry Operations Service Center. Any data source other than those files will be referenced. Few lakes occur in the watershed, and they exist only in the Upper River, Dollarville, and East Branch Tahquamenon segments. However, many bodies of water within the watershed have no history of active management, such as fish surveys, removals, stocking, or habitat enhancement. Past local management history documents the difficulty of trying to manage small lakes for bass or pike, in combination with panfish. When anglers harvest too many large predators, the remaining panfish populations proliferate and then stunt, as described earlier. For that reason, several small lakes will be described that appear to have potential for a warm or coolwater fishery but are not under active management. In addition, many streams are of such low electrical conductivity that stream and backpack shockers are only minimally effective for surveys. Only those waters with survey data or with documented previous or current active management are discussed below. Standard Michigan fishing regulations apply to all waters in this watershed unless specifically mentioned otherwise. Any special regulation will be discussed under that water body.

Upper River Segment

Mainstem.–The Upper River segment is classified as top quality trout water, and has a long history of active management. The most recent management effort has been habitat enhancement. This segment is quite isolated, with only two road crossings. One road crossing exists near the upstream end at County Road 421, and the other forms the downstream boundary of the segment at County Road 442. The river mainstem through this segment is managed for a coolwater fish community, and specifically for brook trout. A visual survey in 1959 described abundant brook trout and substrate of sand, gravel, and rubble with fair cover. Electrofishing surveys in 1960 also described good brook trout populations, plus some mottled sculpin, blacknose dace and American brook lamprey. A subsequent electrofishing survey in 1968 at County Road 421 found no brook trout, but captured blacknose dace, central mudminnow, Johnny darter, mottled sculpin, and brook stickleback. Supplemental brook trout stocking began in 1983 and continued until 1998 (Table 24).

A late July 1991 survey was conducted again at County Road 421. Only 16 brook trout were captured, of which two were legal size. The trout were also growing about one in slower than the state average rate. Brook trout comprised 72% of the fish community biomass, as it shared the river with panfish, shiners and a northern hog sucker. Because of previous concerns about the trout population and fishery, MDNR in 1993 asked the MDEQ–SWQD to survey this water. Subsequently, Taft (1994) rated the fish community "good," but with reduced density. Only 26 brook trout were captured, with none of legal size, and 24 were either 4 inches or smaller. The habitat rated "poor," or severely impaired, due to lack of available cover, lack of riffles or runs, and deep sand deposition. In one area, the depth of soft sand was greater than 4 ft in the stream channel. Even so, the streambanks received high scores for stability, vegetative cover, and cover type. Despite the poor substrate rating, some spawning habitat existed further upstream that allowed some natural reproduction. Taft's conclusion, however, was that the trout fishery could be enhanced by the addition of sand traps, instream large woody debris exposed above the sand, and other stable cover.

Following Taft's recommendation, a 1998 electrofishing survey was conducted prior to beginning an extensive stream enhancement effort. That survey documented combined 408 brook trout in two sites of 1,000 and 500 linear ft of stream. However, less than 5% were legal size, and their weight totaled 13.5 lbs. That weight comprised only 68% of the fish community biomass. Seven other species were captured, including burbot, creek chub, common shiner, largemouth bass, longnose dace, log perch, central mudminnow, pumpkinseed sunfish, mottled sculpin, and brook stickleback. Trout were still growing slowly, at 1.2 inches slower than the state average rate. Although the Upper River was still receiving 2,000 yearling brook trout annually, they were not showing up in the survey. Size frequency analysis indicated that over 95% of the captured trout were naturally reproduced. In addition, age 1+ trout were almost nonexistent in the survey. Sand had filled in almost all deep holes, and the only substrate available for aquatic invertebrate colonization was partially buried large woody debris. Survey catch results and habitat assessment results showed strong indication that the adults left this portion of the river to find areas with more suitable holding waters and denser forage base.

MDNR Fisheries personnel conducted a stream habitat enhancement effort from 1999–2001 that covered an 11 mi reach. Instream trees were manipulated to move the current away from raw eroding banks, channel the flow to scour sand away from gravel substrate, and allow sand redeposition into backwater areas. Jams were analyzed and modified to allow better flow and minimize formation of new logjams. In addition, logs were placed to allow stream scouring of instream holes to support larger trout. In several instances, modified current flows scoured over 2 ft of vertical sand within 24 hours. Several raw, eroding banks became separated from the river by up to 30 ft, also within 24 hours. Anglers began telling about better fishing success and more fishing enjoyment from the Upper River. MMDNR, Fisheries Division also ceased stocking brook trout in 1999 because of the large number of naturally-produced trout observed during the 1998 survey.

A 2003 follow-up electrofishing survey was conducted at the same 1,000 ft stream site as in 1998 and found 964 brook trout, of which 3% were legal size. Their weight totaled 32 lbs, and they comprised 96% of the fish community biomass. In addition to the greater number captured, their growth rates more closely resembled the state average. Only four other species were captured, of which mottled sculpin comprised about 4% of the catch biomass. Species diversity was truncated compared with the 1998 survey. A final, 2005 survey at the same site produced 573 brook trout, weighing 27 lbs, with 8% legal size, while other species were not captured or documented. In addition, the acceptable trout numbers were in spite of increasing angling pressure (and positive angler comments) that is resulting from the previous habitat work. A late summer visual survey entailed walking the riverbed for about 11 mi, traversing the area, which had undergone habitat enhancement work. The upper 4 mi, which had previously been dominated by loose and shifting sand substrate, were 90–95% gravel and rock rubble throughout the main channel. Lower reaches were also showing exposed gravel and rock, although not in the same percentage. This water has not been stocked since 1998, and the trout fishery is not only self-sustaining, but apparently still improving.

Tributaries.–There are no surveyed or managed streams within this segment.

Lakes.–There are many small pothole lakes and marshes in the Upper River segment, but most of them are privately owned with no public access. None of these lakes have been surveyed by MDNR, Fisheries Division. Little is known about their limnology or fish community structures. Larger named lakes including Marsh, Perch, Whitney, Grass, Long, Fur Farm and Lost lakes are entirely private, as are Grass Slough and the Hanes lakes. Several others are generally private but surrounded by Commercial Forest Reserve (CFR) lands. Those lands are taxed at a lower than normal rate in exchange for owners allowing public access for hunting and fishing. The lakes discussed below, listed alphabetically within the segment, have survey or management documentation in MDNR, Fisheries Division files. Only Belle Lakes I and II, however, are actively managed. Even so, the lakes are passively managed with the standard Michigan fishing regulations.

Belle Lakes are three lakes in section 9. Belle Lake I has been extensively managed through the last 50 years, and is currently stocked annually with splake, and walleyes are stocked on an alternate year basis (Table 24). This lake is a relatively large, clear lake of 107 acres and maximum depth of 78 ft. Vegetation is sparse except in the northern bay. Access is through CFR land. The original creel survey in 1953 found that fishing was poor, but had been better in the 1940s. Today, anglers target walleyes, northern pike, yellow perch, splake, and smallmouth bass. Angling pressure is limited, however, by a poor quality boat launch. Either anglers access the lake via the driveway to the single cabin on the east side, or else down a steep road through deep sand and onto a sandy beach. Growth rates of all species were acceptable during the 2002 netting survey. Large fish were abundant, with 50% of the northern pike, 70% of the smallmouth bass, and 24% of the walleyes of legal size. In addition, 24% of the yellow perch were acceptable at 7+ in. Other fish species netted included white sucker, pumpkinseed sunfish, rock bass, and spottail shiner.

Belle Lake II is 25 acres with 17 ft maximum depth, and is generally managed with Belle Lake I. Belle Lake I drains into Belle Lake II via a small stream channel that is wide and deep enough to allow careful passage of aluminum fishing boats. For that reason, anglers also target Belle Lake II from the access site in Belle Lake I. Belle Lake II contains more large woody debris along the shorelines and more aquatic plant growth than Belle Lake I. There are a couple of cabins along the western shoreline. The aquatic vegetation attracts both smallmouth bass and panfish, which has historically provided a good fishery. In addition, walleyes recently stocked into Belle Lake I have migrated into Belle Lake II as well, and many anglers target them in this smaller lake. Belle Lake II drains into Belle Lake III.

Belle Lake III is a small lake, 12 acres and only 5 ft deep. Aquatic vegetation is common. Historic records imply that this lake periodically dries up. Fish from Belle Lake II repopulate it when the lake again holds water. In fact, this lake was completely dry during the summer months from 1955–58. The only survey recorded for Belle Lake III, conducted in 1953, found abundant yellow perch, common rock bass, and a few pumpkinseed sunfish.

Bennett Spring and Grass Lake are small ponds included here as examples of fishery management activity during the mid-1900s. Bennett Spring, in section 17, is the headwater of a small tributary that flows through Grass Lake and Grass Slough, entering the Tahquamenon River through Long Lake. It is 3 acres in size and 12 ft deep. It was stocked with brook trout through the 1960s, but stocking was discontinued due to poor survival. Grass Lake, also in section 17, is about 5 acres, with 10-ft depth. Shoreline cover consists of aquatic vegetation, some fallen trees, and an overhanging bog mat. Similar to Bennett Spring, it was stocked with trout in the 1960s, but stocking was discontinued in 1965 due to poor survival. A study was conducted in 1962 with the plan to impound Grass Lake with a 150-ft long berm. An 8-ft head at the impoundment was projected to impound 25 acres. Although study results implied good feasibility, the project was never implemented; there is no explanation in the file. These lakes were only surveyed by angling; there are no data relating to a netting survey.

A small unnamed lake is located in section 8, just north of County Road 421 and just west of the Tahquamenon River. It is about 7 acres and 32 ft deep, with a pH of 5.6 in August 1997. The low pH precludes active management for all but a few species. The lake's littoral zone is narrow and contains a large number of fallen trees. The 1997 survey found an almost single-species fish community consisting of stunted perch. The lake subsequently received one stocking of 30 juvenile northern pike, even though it is not known whether the pike can survive such a low pH. It has not been surveyed since 1997.

Frank's Lake is another small pothole lake, located in section 5, in which no management is anticipated. It is about 15 acres, with many fallen trees lying in the narrow littoral zone. Dissolved oxygen in 1958 declined to 3.5 mg/l at 25 ft, with a maximum depth of 40 ft. A 1975 survey found 3 largemouth bass, 1 pumpkinseed sunfish, and 17 yellow perch. The perch were growing well above state average rate. Brown trout had been stocked from 1958–68, with several large specimens captured by anglers. None, however, were captured during the 1975 survey. The lake has not been surveyed since 1975.

Long Lake (in section 21), part of the Tahquamenon River mainstem, is a shallow, heavily-vegetated lake with limited management potential. It encompasses 50 acres with a maximum depth of 10 ft. Shorelines are gradual except for a sharper contour along the northeast shoreline. At least 80% of the surface is inundated with aquatic plants by August of each year. Although many brook trout were stocked between 1950 and 1980, none were captured during the 1982 survey. The fish community in 1982 consisted of northern pike, yellow perch, rock bass, white suckers, and a few brown bullheads. The lake has not been surveyed since 1982.

Tek Lake has an unfortunate combination of poor access and low pH, which dictates that it will remain a low priority for active management. Tek Lake is a pothole lake located in section 6, just west of the Tahquamenon Lakes, which marks the actual beginning of the Tahquamenon River. There is only one cabin on the lake. Although only 12 acres, it is 55 ft deep, with a narrow littoral zone containing many fallen trees. During August 1969, dissolved oxygen fell below 4 mg/l at 25 ft, while pH was constant at 5.0. Dissolved oxygen concentrations lower than 5 mg/l indicates that the lake is unsuitable for trout. Access to the lake is poor, being mostly across private property to a small section of land in Commercial Forest Reserve (CFR) status. Even so, a 1997 Fisheries survey documented one 20-inch largemouth bass, three northern pike with only one of legal size, 26 small pumpkinseed sunfish, and 19 small yellow perch. The perch were growing almost 3 inches slower than state average.

The Tahquamenon Lakes in sections 6 and 7 together form the general headwaters, but Big Tahquamenon Lake is the actual source for the Tahquamenon River. These lakes are entirely natural, with no human influence. They are not scheduled for active management. The northern half of Big Tahquamenon Lake is up to 8 ft deep, with scattered milfoil and Potamogeton colonies and a fair amount of large woody debris. The southern half, however, is only 1–2 ft deep with a soft, flocculent bottom substrate. Despite the shallow water, however, there was no evidence of winterkill. A netting survey in 1997 found large numbers of suckers and yellow perch up to 11 inches. No predators were found. Although this lake would seem predestined for northern pike management, the fact that it lies immediately upstream from an excellent brook trout fishery precludes such management. This lake remains an esthetically wild and beautiful location with good perch fishing.

Dollarville Segment

Mainstem.–There are only two road crossings within this segment. The bridge at Co. Rd. 442 marks the upstream boundary, while the bridge at Co. Rd. 415 generally marks the downstream limit of water suitable for resident brook trout. Anglers report that many brook trout are caught in the upper “spreads” portion between Co. Rd. 415 and 442. Despite the reports, however, the trout water within this segment has never been surveyed. Access is only from either of the two road crossings, and angler reports of good fishing allowed survey efforts to be directed elsewhere. The rest of the mainstem will be described under the heading of Dollarville Flooding, since the flooding inundates or significantly influences the rest of the mainstem in this segment.

The Dollarville Flooding influence extends upstream almost to Mud Lake. The current flooding came into existence in 1972, and it has been drawn down for dam repairs several times since then (see **Dams and Barriers** and **Water Quality**). The flooding itself was previously surveyed by angling, and more recently by boom shocking while it was drawn down. The surveys found yellow perch, northern pike, muskellunge, walleyes, and smallmouth bass. This is a good fishery, dominated by anglers targeting perch. Because of its 3-ft head height, the flooding is quite shallow outside of the original river channel. Even so, the flooding covers roughly 1,100 acres. The flooding has never been mapped, and acreage was estimated with use of topographic maps. The public boat launch site at Natalie was established in 1950 by the Tahquamenon Area Sportsmen’s Club and improved by MDNR, Fisheries Division in 1951. At that time, the access site was only for the river itself, but at current full pool water levels it still provides a viable and well-used access.

Tributaries.–The following streams all flow into the Dollarville Flooding. Water in the flooding warms enough in summer months to be marginal or unacceptable for brook trout. In addition, the flooding supports northern pike, muskellunge, smallmouth bass, and occasional largemouth bass. The presence of those predators combined with warm summer water temperatures imply that the brook trout found in these creeks are generally isolated in their respective creeks. All these streams, listed alphabetically, are under Type 1 trout regulations.

Carlson Creek is an unstocked designated trout stream, flowing north from Kak’s Lake to Teaspoon Creek (Figure 2). However, biological surveys in 1989 and 1991 (Taft 1990, Taft 1992) found no brook trout. In 1992, Taft (1992) scored the stream’s habitat as poor (severely impaired) habitat where it flowed through a 700-acre pasture immediately north of M-28 that was subject to unrestrained grazing cattle. The site upstream from M-28 scored good (slightly impaired) being adversely affected by beaver activity. Strand and Merritt (1999) studied the effects of isolating pastured cattle from this stream and adjacent floodplain (see **Biological Communities,** *Aquatic Invertebrates*) and found that after 3 years of fencing out livestock, the streambanks were fully vegetated with overhanging grasses. The stream is not stocked and has not been surveyed recently.

East Creek is also an unstocked designated trout stream, flowing south to the mainstem, west of McMillan (Figure 2). A survey at County Road 442 in 1960 found fair habitat consisting of undercut banks, a few instream logs, but substrate consisting almost entirely of sand. Fish captured were brook trout, mudminnow, and mottled sculpin. This creek has not been surveyed since 1960. Even so, anecdotal stories tell of good trout catches.

King's Creek is an unstocked, designated trout stream lying in the southwest corner of the Tahquamenon River watershed, flowing north under M-28 to the mainstem (Figure 2). The stream is of marginal quality for brook trout. Surveyed in 1960, the fish community consisted of brook trout, burbot, blacknose dace, pearl dace, finescale dace, common shiner, blacknose shiner, brassy minnow, central mudminnow, brook stickleback, redbelly dace, and mottled sculpin. The creek was subsequently designated as a trout stream with a natural population. However, the 400 ft long survey site, described as having low swampy banks lined with tag alder, overhanging brush, deep pools and medium to abundant vegetation, has been for many years part of an extensive beaver dam marsh, with mud banks and extensive cattail colonies. A cursory backpack electrofishing effort at the south end of the marsh in 1996 produced minnows and dace and no other fish species. The creek is still designated Type 1 for trout, despite the treeless marsh and the several beaver dams between M-28 and the mainstem.

Silver Creek, an unstocked designated trout stream located northwest of Newberry (Figure 2), has over the years been the site of several stream enhancement projects conducted by the local high school. Its proximity to Newberry and easy access made it an ideal site for introducing environmental class students to stream ecology. The creek was surveyed at two sites in 1998, one of which was below Silver Creek Pond. The second site was adjacent to the only road crossing, in the locale of all the high school stream projects. Downstream from Silver Creek Pond, brook trout, mottled sculpins, and brook sticklebacks were found. Brook trout comprised 58% of the fish community biomass, and 48% were legal size. Trout were smaller at the second site. However, the road crossing allows considerable angler effort and harvest. Although brook trout comprised 49% of the biomass, none were legal. The crew, however, continued shocking further upstream and away from the road, but did not record their catch because they were outside of the designated site. With the extra effort, they again found good numbers of large brook trout.

Syphon Creek is a small, unstocked designated trout stream, flowing south to the mainstem, northwest of McMillan (Figure 2). A private dam which includes a fish ladder exists about 1.5 mi upstream from Co. Rd. 442. Syphon Creek was surveyed at Co. Rd. 442 in 1960. The substrate was defined as mostly sand, with a minor component of gravel. Cover included woody debris, undercut banks, brush, stumps, and shorelines of overhanging tag alder. Good numbers of brook trout were captured, as well as burbot, blacknose dace, and mottled sculpin. It was again surveyed in 2003. Although this is a small stream only 15 ft wide, the 500 ft survey documented 19 brook trout with 8 of legal size. Other species captured were brook stickleback and mottled sculpin. The habitat consisted of considerable small trees laying in the water, some very old habitat enhancement structures, some undercut banks, and a substrate consisting of silt and sand.

Teaspoon Creek, an annually-stocked designated trout stream near Newberry, begins in a surface water discharge from Twin Lake, south of M-28, and flows north under Co. Rd. 402, west under Co. Rd. 405, and then into the Dollarville Flooding (Figure 2). It was designated as a children's fishing area in 1947. That designation ended in the early 1970s in response to concerns about discrimination against adult anglers. Brook trout have been stocked annually since 1947, and brown trout were also stocked from 1949–54. Surveys in 1960 and 1968 found both brook and brown trout, plus mottled sculpin, yellow perch, burbot, creek chub, blacknose dace, common shiner, central mudminnow, and white suckers. A 1992 survey found 20 brook trout with 19 of legal size, plus very few rock bass, yellow perch and small white suckers. Trout growth rates were very high. A 1998 survey found 51 brook trout with 46 of legal size, plus some burbot, largemouth bass and pumpkinseed. The last survey in 2004 specifically targeted brook trout, and found 40 trout with 39 of legal size. No brown trout have been captured in surveys since 1968.

Lakes.–Lakes in this segment are listed alphabetically. There are no files for any other lake in this segment, other than those discussed below. All lakes except Twin Lake are managed with standard Michigan fishing regulations.

Bass Lake (Figure 1) is a 145 acre actively managed lake. Roughly half of the lake is deeper than 30 ft, and it reaches depths of 70 ft. The lake has a high ridge along the north side, and a contiguous marsh in the southwest shoreline. Shorelines are mostly sand, with an abundance of downed trees. Bass Lake has a long management history. A note to the file from Leland R. Anderson, District Fisheries Supervisor, in 1957 documented a 9-year creel census with good fisheries for bass, perch, and rainbow trout. Trout of various species have been stocked in the past, ending with splake. Beginning in 1981, surveys showed that trout survival was decreasing and perch were becoming overabundant and stunted. A manual perch removal was conducted in 1987, concurrent with initiation of a walleye stocking program, and the splake stocking program was eliminated in 1990. Walleye growth was and still is excellent, while perch have never recovered to the population numbers and condition they exhibited in the early 1970s. A comprehensive survey in 1991 showed that walleye, smallmouth bass, and northern pike comprised 63% of the total fish community biomass. The 2001 survey found that yellow perch comprised only 11% of the fish community biomass, while only 4% were acceptable at 7+ inches. In comparison, walleyes, smallmouth bass, and northern pike comprised 74% of the catch biomass. Yellow perch growth rates had improved to only 0.3 inches slower than state average rate. The other species, except walleyes, were all growing close to state averages, while walleyes were growing much faster than state average. Ages of captured walleyes showed that they were almost all from years in which there were no walleyes stocked, suggesting that natural reproduction supports the fishery. Walleye stocking ended in 2004, pending the results of the next comprehensive netting survey. Other fish species currently present in the lake include rock bass, pumpkinseed sunfish, golden shiner, blacknose dace, brown bullhead, and possibly a surviving splake.

Brockies Pond, a small MDNR managed 4-acre impoundment (see **Dams and Barriers**), has been stocked annually with brook trout since its construction in 1964. A survey in 2000 produced 24 brook trout, of which only three were legal size. Many worm containers and considerable trampled vegetation gave evidence of heavy angling pressure. Beginning in 2001, this pond was stocked with equal numbers of Assinica-strain and Nipigon-strain coaster brook trout. The stocking effort was part of a multi-water experiment to see how well the coaster brook trout will do in small trout ponds. A preliminary survey was conducted in 2004 to verify the presence of both strains in the pond. That survey produced 34 trout, but none with the fin clip used to identify the Nipigon strain. For reasons unknown at this time, it appears that Nipigon strain brook trout did not survive in Brockies Pond. However, six of the Assinica-strain trout were legal size, and growth rates were very good. The last comparative stocking occurred in 2005, and a comprehensive netting survey will be conducted in 2007 to conclude the study. Brockies Pond is scheduled for Assinica-strain brook trout, beginning in 2006.

Buckeye Lake, directly west of Bass Lake, is 102 acres with 25 ft maximum depth, and is not actively managed. Access is limited to traversing private property, but it was stocked during 1948–52 with rainbow trout, at which time the stocking was discontinued. Angler comments in the early 1970s described northern pike up to 20 lbs, yellow perch up to 2 lbs, and smallmouth bass at 6 lbs. The only netting survey was conducted in 1992. Rock bass were the dominant species, followed by yellow perch, pumpkinseed sunfish, and smallmouth bass. No northern pike were captured. At that time, the lake's water level was considerably lower than normal, due to drought conditions extending from 1988. The lake has not been surveyed since 1992.

Buckies Pond, a small MDNR-managed 6-acre impoundment (see **Dams and Barriers**), has been stocked annually with brook trout since its construction in 1964. A survey in 2000 produced only three brook trout. One, however, was 11 inches and two were 14 inches. Positive angler comments, the presence of many worm containers and considerable trampled vegetation gave evidence of heavy angling pressure. Beginning in 2001, this pond was stocked with only Nipigon coaster brook trout. The stocking effort is part of a multi-water experiment to see how well the coaster brook trout will do in small trout ponds. A preliminary survey was conducted in 2004 to verify that the experiment was still viable. Despite using several nets and electrofishing, no brook trout were found. The lake was stocked again in 2005. Recent poor stocking returns and increased inspection costs dictated a scheduled removal project in 2007, which will restore the stream back to free-flowing conditions.

East Lake (Figure 1) is an actively managed natural lake of 122 acres and about 22 ft maximum depth. It was stocked by MDNR, Fisheries Division with smallmouth bass and bluegill during 1922–27. It was also stocked once with walleyes in 1922, largemouth bass in 1928, and brook trout in 1940. J. N. Lowe, in Newberry local files, described the fish community as consisting of yellow perch and smallmouth bass. There were no northern pike in the lake. A subsequent survey in 1953 found yellow perch, blacknose shiner, and Iowa darter. Despite the stocking and survey activity, the lake had no public access until 1988, when a parcel was bought by MDNR. The access site currently is an unimproved shoreline without a courtesy pier, capable of supporting the launch of small trailered boats. A 1988 survey documented extreme inundation with dense aquatic plant colonies and a resulting fish community dominated by stunted bluegills. In response to the stunted bluegill population, a manual removal was conducted in 1992, and walleye were stocked to act as predation control on the remaining bluegill. Another netting survey in 1995 identified the problem aquatic plant as Eurasian milfoil *Myriophyllum spicatum,* an exotic nuisance species. All fish species at that time were growing very slowly. Chemical treatments with 2-4-D to control the milfoil began in 1997 and continued on a reduced basis for the next several years. A 1999 visual survey of the Eurasian milfoil colonies showed much reduced and scattered colonies. A 2000 survey found few bluegills, an excellent largemouth bass population, a very large northern pike population, and a large rock bass population with good average size. Fishing regulations were changed in 2002 to set a "no minimum size" standard for northern pike. Fishing on East Lake is currently good for northern pike, largemouth bass, rock bass, and bluegill.

Goose Lake, 52 acres with 27 ft maximum depth, has very poor public access and is not actively managed by stocking. When surveyed in 1969, the catch included northern pike, yellow perch, pumpkinseed sunfish, and brown bullheads. It was again surveyed in 1992, with similar results. The 1992 survey, however, also found rock bass and white suckers. The growth rate for northern pike was very good, while yellow perch were growing quite slowly. Length-frequencies of captured pike and yellow perch implied significant fishing pressure, despite the poor boat access.

Kak's Lake (Figure 1), with 60 acres and 22 ft maximum depth, has been actively managed in the past. It historically supported dense aquatic plant growth. Surveys from earliest records show the presence of northern pike, largemouth bass, yellow perch, rock bass, bluegill, pumpkinseed sunfish, brown bullhead, white sucker, and golden shiner. Growth data in 1951, 1953, 1968, and 1969 showed the panfish all growing slowly, while northern pike were growing faster than state average. In an attempt to thin the panfish for faster growth, tiger muskellunge were stocked in 1969 and 1973. Results in 1974 showed good growth and survival of tiger muskellunge, concurrent with better growth rates of panfish, and increased harvest of largemouth bass and northern pike. A 1990 survey described only a modest but balanced fishery, with relatively few predators and relatively sparse panfish. The last survey in 1999 showed a fish community with good species balance, providing good numbers and sizes of panfish, largemouth bass, and northern pike. Likewise, growth rates were good for bluegill and northern pike, and acceptable for largemouth bass and yellow perch. There is currently no active management by stocking or other species manipulation on this lake.

Mud Lake, a 153-acre lake connected to the river, lies about 2.5 river miles downstream from the County Road 415 Bridge north of McMillan (Figure 1). Its depth is very shallow, with the only area deeper than 4 ft being the channel leading to the river. Mud Lake supports a winter ice fishery for perch, muskellunge, and northern pike, with occasional boaters entering during spring and fall months to fish for muskellunge as well. An August 1970 netting survey captured northern pike, smallmouth bass, yellow perch, rock bass, pumpkinseed sunfish, brown bullheads, and white suckers. Although many largemouth bass were anecdotally observed in Mud Lake during 1956–57, a 1997 boom shocking survey finally added largemouth bass to the official species list. Although the northern pike were growing faster than state average rate, both the largemouth and smallmouth bass were growing slower. Mud Lake is also reputed to be a spawning area for muskellunge.

Murray Lake is 92 acres, with 15 ft maximum depth, but has limited management potential due to lack of public access. It was surveyed in 1955. Subsequently, MDNR stocked largemouth bass, bluntnose minnows, and northern pike between 1955 and 1962. There has been no other survey since.

Peanut Lake, 18 acres and 25 ft maximum depth, has a long management history because it historically provided a brook trout fishery. The completely vegetated sand shoreline contains a moderate amount of downed trees. Prior to 1951, this lake produced very good brook trout fishing throughout the year. During 1951, however, bluegills and largemouth bass began to appear in anglers' creels. To return the lake to a brook trout lake, Fisheries Division conducted a chemical reclamation with rotenone in 1957. Similar circumstances forced more reclamations in 1971, 1984, 1991, and 1997. The 1997 treatment was conducted on November 12, immediately before "first ice." The lake was checked on November 14, and was about a third iced over. The late-season treatment was for the purpose of maintaining active rotenone in the lake for much of the winter, maximizing the chance for a complete removal. Even so, a follow-up survey in 2000 using only two fine-mesh nets captured over 500 small perch, plus 4 larger perch. At that time, Fisheries Division stopped actively managing this lake with chemical reclamations because they were not cost-effective. Each reclamation required 110 gal of Nusyn-Noxfish rotenone, which then cost $32/gal. Annual stocking of trout also was terminated due to poor survival of trout stocked into an existing perch population.

Active management of Peanut Lake resumed in 2003 with the stocking of "advanced yearling splake," in response to Rumsey and LaMarre's (1994) findings that stocking splake into a small lake full of stunted yellow perch reduced the perch population by about 40% in just a couple of years. For that protocol, larger splake are culled several times during their year at the hatchery, and each time the largest are separated and fed more than normal. The intent is to provide the largest possible yearling splake. As splake attain 12 inches in size, their food preference generally switches from invertebrates to fish (Peanut Lake netting survey, unpublished data). Stocking "advanced yearling splake" at 11–12 inches means that they are entering the lake as piscivores, capable of eating small perch. However, stocking of such large fish required a change in fishing regulations. Therefore, Peanut Lake is now managed as a Type E trout lake, which allows all-year fishing, all types of baits. Minimum sizes for brook trout and splake are now 15 inches. This is a new experimental management effort; the fish community should begin to stabilize and produce an excellent trout fishery by 2008.

Silver Creek Pond, a 15-acre MDNR-managed trout impoundment (see **Dams and Barriers**), has been stocked annually with various strains of brook trout since it was constructed in 1963. Surveys in 1983 and 1988 showed fluctuating numbers of brook trout, but a good fishery. Beaver activity forced a partial drawdown and excavation around the pond standpipe in both 1992 and 1993. Even so, a 1994 survey found 33 brook trout with 20 of legal size. The 2000 survey found 46 brook trout with 27 legal size. Silver Creek Pond is a very nice trout pond, and is expected to remain so in the future. It is currently stocked with Assinica-strain brook trout.

Syphon Lake, 5 acres and 55 ft depth, is a trout lake northwest of McMillan. Dissolved oxygen concentration in 1947 fell from 8.6 mg/l at 15 ft down to 4.2 mg/l at 20 ft, leaving the lower 35 ft depth uninhabitable for brook trout. Even so, MDNR, Fisheries Division determined that this could be a trout lake because of the good plankton, cool water, and excellent shoreline habitat. The lake was chemically reclaimed in 1959 and trout stocking commenced. The records do not indicate any reason for the 12-year time lag between the oxygen survey and subsequent trout management. Syphon Lake was officially designated a trout lake in 1978. A 1983 survey found 11 brook trout, one of which was of legal size. Then, a 1987 survey again found 11 brook trout, with none legal. The 1993 survey was much more extensive, but no brook trout were caught. Shorelines, however, showed angler traffic, and hatchery truck drivers verified that they had stocked the correct lake. A follow-up survey in 1994 found 14 brook trout, of which 11 were legal size. The survey also caught an 8-inch yellow perch. The last survey was conducted in 2000, and described a modest trout fishery. Six brook trout were caught, with four legal size. Many sticklebacks were also caught. Zooplankton samples showed a dense community consisting of amphipods, copepods, and some daphnia. Syphon Lake is still stocked annually with Assinica-strain brook trout.

Twin Lake is a relatively small managed lake consisting of two distinct basins (Figure 1). The west basin, which has the public boat launch, is 72 acres and 75 ft maximum depth, while the east basin is 31 acres and 25 ft maximum depth. The west basin has several areas of shallow shoreline inundated with bulrushes, followed by sharp drop-offs, while the east basin has generally sharper drop-offs from shore, covered by submerged large woody structure. Until 1960, the fish community consisted of northern pike, smallmouth bass, yellow perch, bluegill, pumpkinseed, minnows, white suckers, and an occasional brook trout. Public access was obtained in 1967. Brown trout were stocked in 1968, and then splake stocking commenced in 1973, ending in 1998. A 1968 survey found white suckers dominating the fish community, followed by yellow perch, panfish, and rock bass. Two brook trout, one brown trout, and one largemouth bass were also captured. A one-year creel census in 1975 showed anglers catching perch, bluegills, rock bass, one brown trout, two splake, one northern pike, and one largemouth bass. Manual removals in 1982, 1985, and 1986 targeted white suckers, yellow perch, and brown bullheads. A 1988 survey found low numbers and small sizes of largemouth bass, which had previously been the dominant predator in the lake. Concurrently, there were large numbers of white suckers and brown bullheads. Those results precipitated a regulation change for largemouth bass, to 18-inch minimum size limit and one fish per day. A 1993 survey found no largemouth bass larger than 7 inches, slow growing panfish and yellow perch, and no splake. The last survey was 1999. At that time, all panfish, perch, and small largemouth bass were growing very slowly. In addition, splake were not surviving well. The conclusion was that the yearling splake were competing for the same forage as mature panfish and immature bass, so a decision was made to cease splake stocking. Also, the growth curve for largemouth bass showed that their growth roughly leveled off at 5 years, a factor that statistically precludes catching legal bass at 18 inches. However, no change was made in the largemouth bass fishing regulations because some larger fish were occasionally being caught. A vertical oxygen profile in 2000 found that dissolved oxygen virtually disappeared at a depth of around 13 ft. That finding verified the earlier decision to stop stocking splake. Management currently consists of the largemouth bass special regulation of 18-inch minimum size limit and one fish per day.

Wolverine Lake is a managed natural pothole lake of 8 acres and 22 ft maximum depth, located in sand country northwest of Newberry. Access is via a narrow sandy two-track road. It was first mapped in 1970, and has been stocked with rainbow trout annually since that time. All surveys since then have documented good rainbow trout populations, with sizes ranging to over 20 inches. In 1994, a survey found two female yellow perch, a cause for potential concern. Extra nets of various mesh sizes were used in a 2000 survey, expressly to define the extent of the expected perch population, but no perch were captured. At present, annual rainbow trout stocking is the only management activity.

Youngs Lake is a 7-acre pothole lake, with 37 ft maximum depth, that is routinely stocked with trout. A 1946 survey found yellow perch and brown bullheads. Subsequently, in 1948 it was chemically reclaimed and stocked with brook trout. Brook trout management has continued since then, and all the surveys have found good growth and survival. Surveys in 1982 and 1985 found a few perch and white suckers, but subsequent surveys in 1988 and 1994 found only brook trout and sticklebacks. The latest survey, in 2000, found brook trout, blacknose dace, and sticklebacks. Concurrent zooplankton samples showed excellent lake fertility and plankton density. This lake is stocked annually with Assinica-strain brook trout.

Marsh Drainage Segment

Mainstem.–The Marsh Drainage segment begins immediately below the Dollarville Dam and extends downstream to the mouth of the Sage River (Figure 3). This segment of the Tahquamenon River has only one mainstem road crossing, M-123 north of Newberry. It had an early reputation for northern muskellunge, walleye, northern pike, and yellow perch. However, the earliest records in this segment showed concerns with pollution by raw sewage from the village of Newberry and the State Hospital, in 1946 and 1947. A decision was made in 1948 to manage the river from County Road 415 north of McMillan to the east border of Luce County for warmwater fish species. Walleye fry were stocked in 1941, and largemouth bass were stocked in 1950, 1951, and 1953, to help establish the warmwater fishery. Northern muskellunge were stocked in 1957. No survey records exist prior to the stocking years, but a 17 lb., 43-inch wild muskellunge was caught below Dollarville Dam in 1959. Therefore, the 1957 stocking was apparently just a supplement to the existing population. The fish community in 1970 consisted of northern muskellunge, northern pike, smallmouth bass, largemouth bass, walleye, yellow perch, rock bass, white suckers, and various minnow species.

Another round of stocking began in 1980 (Table 24), basically to supplement existing fish populations. The only exception was stocking tiger muskellunge during 1980, 1981, and 1983. Northern muskellunge were stocked in 1982, 1985, 1987, and 1989. Walleyes were stocked annually during 1987–92, and yellow perch were stocked in 1987. There have been no other fish stocked in this segment since that time. The 2005 fish community structure from Dollarville Dam downstream to Lake Superior was determined by analysis of a comprehensive boom shocking survey in July 2005 (Table 25). The fish community at that time consisted of naturally reproduced populations of abundant northern pike, yellow perch, northern muskellunge and walleye, and occasional smallmouth and largemouth bass. White suckers, brown bullhead, and minnow species were very abundant.

The upper portion of the Marsh Drainage segment consists of the stretch between M-123 and the Dollarville Flooding. Spring fishing is good immediately below the dam for yellow perch. If the snowmelt flood stage remains until opening day, the area is also good for northern pike and muskellunge. Roughly half way between the Dollarville Dam and M-123 lie the three lobes of Spider Bay. Depth is 15–20 ft, and northern muskellunge, northern pike and yellow perch are present in good numbers. The next six river miles from M-123 to McPhee’s Landing is through a narrow, winding channel inundated with downed trees. Some anglers target this area successfully for northern muskellunge, northern pike, and walleye. There is less angler traffic, however, probably due to difficulty maneuvering larger boats.

The lower portion of the Marsh Drainage segment, from McPhee’s Landing to the Sage River mouth, is subject to extensive snowmelt flooding (see **Geology and Hydrology**). Because pike and muskellunge generally spawn over flooded vegetation, there was interest in identifying specific locations where the river's muskellunge and walleye spawned, and their potential use of the flooded marshes. MDNR, Fisheries Division subsequently began a radio-tagging study of walleye and northern muskellunge to determine the extent to which fish moved out of the main channel into the flooded marsh vegetation during the spawning period (Waybrant, in press). Surprisingly, spring 2005 tracking results indicated that the fish did not appear to leave the main channel (Figures 18 and 19). Muskellunge, however, generally took up residence adjacent to the several flooded marsh areas, and could have moved in and out during the night. A subsequent survey of sediment type through the area frequented by implanted walleyes during April and May found that the bottom consisted of mainly silt, with decreasing amounts of peat, clay and some very rare sand (Waybrant, in press). Anglers successfully target northern muskellunge and walleye through this section.

Tributaries.–Fisheries Division has local files on only four streams in this segment. At least a portion of each stream is regulated under Type 1 trout regulations. They are listed alphabetically.

Auger River (Figure 2) was surveyed in 1960, one year after a one-time MDNR brook trout stocking. Bottom substrate was silty sand, and the only cover was provided by aquatic vegetation and overhanging tag alder branches. Fish species collected were brook trout, white sucker, burbot, blacknose dace, pearl dace, redbelly dace, blacknose shiner, central mudminnow, Johnny darter, blackside darter, Iowa darter, brook stickleback, and mottled sculpin. Stocking ceased after the single plant. Although one occasionally hears about someone catching brook trout from this stream, access is very difficult through open marsh country, and the section upstream from M-123 is full of beaver dams. Limited angler access and limited potential precludes active fishery management. July water temperature in 2004 averaged only 65°F at the Charcoal Grade, with just two short-duration spikes above 70°F. Despite that cold temperature, the Auger is designated as Type 1 trout water only upstream from M-123. It is designated as warm water downstream from M-123, past the temperature logger recording site to the Tahquamenon River.

Otto Brandt Creek, just north of the Tahquamenon River on M-123 (Figure 2), carries a water quality classification of top quality cold water and is a designated Type 1 trout stream, but is very small. The portion west of M-123 is also very susceptible to beaver damming activity. There is at present an active beaver dam between M-123 and the Charcoal Grade Road. Substrate in the lower section of this small stream is excellent, consisting of coarse rock cobble and gravel. Because of its small size, this designated trout stream is not actively managed other than through protection supported by MDEQ regulations and Best Management Practices for land use on state-owned lands.

Sixteen Creek (Figure 2) is a Type 1 designated trout stream, but is not actively managed by stocking or other protocols. The only survey (1960) found only burbot and mudminnows. Even so, water temperatures during July 2004 were well suited to trout, averaging in the low 60°s F and never higher than 70°F.

Thirty-nine (39) Creek is a small creek that drains the fields and forestland just east of Newberry (Figure 2). It was stocked with brook trout during 1950–60. A 1960 fish survey documented 1 brook trout, 17 burbot, and 6 mottled sculpin. Apparently the capture of only one brook trout ended the stocking program in 1961. An angling survey in 1964 captured seven brook trout despite cessation of the stocking program. Although 39 Creek is designated as Type 1 trout water, no active management has occurred since 1960.

Lakes.–Halfway Lake is a private lake halfway between Newberry and Lake Superior at Muskellunge State Park. There is one permanent residence, which includes a resort with several cabins. It is the headwaters of one branch of the Auger River. At about 60 acres, this lake was apparently an emergent brushy marsh of about 3-ft depth before construction of a lake-level control structure. Sonar readings show a uniform depth of about 7 ft, with few fluctuations. It did, however, show occasional blank readings. The blank spots were assumed by the owner to be transponder signals sent through gaps in the submerged vegetation into either open water or soft flocculent material beneath that layer of submerged vegetation. Shoreline large woody debris abounds. The private owner has stocked pike, walleye, and rainbow trout over the years. Pike are now reproducing in the lake. However, both rainbow trout and walleye can survive but apparently not reproduce; they have to be stocked occasionally. Because it is considered a private lake, the owner for many years did not enforce any fish regulations. When the fish community collapsed due to angling overharvest, the owner learned that he had to protect such a small fish community to ensure future fishing, which he has now done. The current fish community consists of northern pike, yellow perch, and an occasional walleye.

There are no files for any other lake in this segment.

Middle River Segment

Mainstem.–There are no mainstem road crossings within this segment. This river segment supports a fish community that is basically identical to the one described for the Marsh Drainage segment. Habitat is somewhat changed, with a wider, deeper, and straighter channel. The shorelines downstream to the Hendrie River until recently were relatively wide, shallow shelves inundated with submergent aquatic plants. Downstream from the Hendrie, shallow shoreline widths vary and channel width increases to an average of about 200 ft. Large woody debris provides shoreline habitat. As in the Marsh Drainage segment, the present fish community consists of naturally reproduced populations of abundant northern pike and yellow perch, common northern muskellunge and walleye, and occasional smallmouth bass (Table 25). White suckers, brown bullhead, and minnow species are very abundant. Largemouth bass were not seen during boom shocking, but anglers reported seeing this species downstream almost to the Hendrie River.

There are many documented deepwater areas in the Middle River segment, beginning at the mouth of the Sage River. July and August 2005 were very warm and dry months. Surface water temperatures in July and early August were consistently in the 80s°F (Fisheries Division survey files), raising concern for the well-being of coolwater fish species. For that reason, a summer vertical temperature profiles were analyzed in 2005 and 2006 (see **Water Quality**). Water temperatures in deep holes downstream from the Betty B Landing stratified, as did dissolved oxygen with the deeper waters becoming anoxic. Even so, each deep hole contained a stratified depth layer consisting of cooler water and adequate dissolved oxygen.

Together, these holes provide an abundance of coolwater refuge areas within the mainstem. The four most sought-after sport fish are walleye, muskellunge, northern pike, and yellow perch. None of the species survive well in water that warms over 80°F (Becker 1983). Preferred temperature range for yellow perch was 68–70°F, 55–74°F for walleye, 55–74°F for northern pike, and 70–80°F for muskellunge. Coolwater sport fish are apparently well protected from dangerously high water temperatures during unusually warm summers.

Recent activities in this portion of the watershed suggested a need to better understand behavior and habitat use of resident muskellunge and walleye populations in the river. The MDNR recently went through a multi-divisional state land consolidation exercise, during which the divisions together studied state land boundaries, trying to determine which parcels to keep or sell. During that effort in Newberry, local personnel became aware of the large proportion of private land ownership along the Tahquamenon River between Newberry and the Upper Falls. Riparian land owners are either building roads to the riverbank or floating building materials downstream to their sites to build cabins and cottages. Historical precedent in other large river systems shows that private riparians tend to “clean up” their shorelines for various reasons. That process almost invariably results in removal of aquatic vegetation and large woody debris, dredging for boat access, or hardening of the shoreline to prevent further bank erosion. Although MDEQ permits would be required for any shoreline work, there is insufficient local information regarding critical spawning and nursery habitat for abundant game species such as walleye *Sander vitreus* and muskellunge *Esox masquinongy* in this river. For that reason, it is currently difficult to evaluate a permit proposal in terms of potential damage to critical habitat.

A radio-tracking study of muskellunge and walleye in the river was conducted from October 2004 until November 2005 (Waybrant, in press) to determine the location and characteristics of spawning habitat for walleye and muskellunge. The study was intended to identify critical Tahquamenon River shoreline and instream habitats for these species and provide scientifically-defensible data for use in habitat protection efforts. Seven muskellunge and 13 walleyes were implanted with transmitters. Tracking efforts during April and May accounted for 12 of 29 total efforts; fish were tracked seven times during April and five times during May. Documented walleye and muskellunge locations during that time period were separated by species, collated, and mapped for both months (Figures 18 and 19). The resulting locations were considered to be close to spawning sites. The spring of 2005 was unusual with temperatures fluctuating through the preferred range of spawning temperatures for walleye (Table 26). Contrary to expectations, walleye did not congregate at a few specific sites along the river (Figure 18). There were no tributary streams with rock, coarse gravel, or even merely solid substrate within the range of walleye spring locations. If the fish were moving to "typical" spawning habitat types, then most fish would have had to swim several miles in the mainstem and then upstream several miles into small tributaries to find coarse substrates. They would also have to make the spawning trip quickly and then just as quickly return to their normal location in the mainstem. Becker (1983) claimed that males will remain in the spawning area for 3–4 weeks, while females remain adjacent to the spawning area and then enter the location, spawn, and leave within one day. We did not observe such activity in the Tahquamenon River. The implication from the tracking data is that the Tahquamenon walleye did not spawn in gravelly reaches of smaller tributaries.

Photo 8.–Wild rice in the Tahquamenon River near the Sage River confluence, July 2005

There is precedent for walleye to spawn in flooded marshes. Becker (1983) and Priegel (1970) described walleye use of flooded marsh areas adjacent to the Wolf and Fox rivers. These tributaries to Lake Winnebago watered 13 major spawning marshes located 33–97 mi upstream from the lake. One of the most significant environmental characteristics was the presence of inlets and outlets which provided continuous water flow over the marsh areas during the period of high water levels. Flowing water provided good aeration of the eggs and an escape route of walleye fry to the river. A significant vegetative change has occurred on the Tahquamenon River from Dollarville Flooding downstream to immediately upstream from the Hendrie River. However, the most striking change is located between the mouths of the Auger and Hendrie rivers. Open water channel width has recently been halved by dense emergent colonies of wild rice *Zizania aquatica* on both sides of the river, identified by Dr. Janice M. Glime, botany professor at Michigan Technological University. Second hand stories report deer standing in the shallow shoreline waters, foraging on the plant, as well as much foraging by waterfowl. This plant and the unusual narrowing of the open water channel had not been observed during the annual surveys that lasted from 1993 to 2001. The wild rice colonies extend about 7–10 mi and provide excellent shelter for young fish. Boom shocking surveys in 2005 drew forage fish, young game fish, and mature walleye from those dense emergent wild rice colonies. The 30–75 ft wide shallow waters and dense wild rice colonies along both sides of the river provide modest, protected currents of flowing water, which may approximate the Wisconsin flooded marshes. The unusual temperature fluctuations during April and early May (Table 26) may have forced the walleye into a correspondingly unusual spawning migration pattern. Even so, the only occurrences of coarse gravel or rock rubble habitat lie in small tributaries, several miles upstream from their mouths. There was no discernable migration toward the mouths of those tributaries. Because the tracking locations during the spawning period do not indicate any other acceptable conclusion, it may be assumed that walleye are spawning in the vegetated banks along the river.

Temperatures were more stable through the muskellunge spawning range. Muskellunge were far more mobile during that time (Figure 19). Two fish migrated upstream to the Dollarville Flooding, immediately adjacent to an extensively vegetated shallow flat shoal. The largest came from about 25 mi downstream, stayed 2 days and then moved 10 mi back downstream. The second migrated 15 mi to enter the Flooding concurrently with the larger fish. It remained in the Flooding all summer and fall. One muskellunge spent most of May in the flooded marsh area downstream from McPhee’s Landing. Another moved upstream 1–2 mi into the Sage River flooded marsh for 2 days, then immediately back downstream about 8 mi. Two fish originally captured and implanted at Joy Island went over the Upper Falls during the winter. There is no way of knowing at this time why they undertook “Hiawatha’s Plunge.” There is potential that over-stress due to radio implantation so late in the fall caused weakness or disorientation, but there is no evidence, only conjecture. One fish did not move out of the plunge pool, while the second did not move more than 0.25 mi downstream from the basin immediately below the falls. The last muskellunge moved very little from the mainstem area near the mouth of the East Branch Tahquamenon River. There was no concentration of radio-tagged muskellunge in the Middle River section other than the two which had gone upstream into the Dollarville Flooding.

Muskellunge activity observations produced some surprising results. The two fish that entered Dollarville Flooding stationed themselves in the mainstem immediately adjacent to one of several shallow, permanently flooded marsh areas. Those two fish swam past many flooded marshy areas including several very extensive areas, to swim through the dam into the Flooding. A third fish entered the Sage River and was found almost 2 mi upstream adjacent to another shallow, flooded marsh area. The fourth fish swam upstream 15 mi during early May into an area of extensive flooded marsh vegetation downstream from McPhee’s Landing. The last muskellunge that did not go over the Upper Falls did not move out of the mainstem, nor was it near any significant flooded marsh area. It may have tried to spawn in the more marginal shoreline vegetation, or else possibly in flooded vegetation upstream in the East Branch Tahquamenon River. It was interesting that four of the five fish still in the Middle River section targeted various flooded marshy areas adjacent to the river. Their use of the flooded marshes was the expected result, but their extensive travel was not. Because so few fish were radio-tagged, there potentially may have been significant concentrations of spawning muskellunge at each of the sites.

Tracking results indicated that the flooded marsh vegetation is critical habitat for muskellunge and needs to be protected. Most of the extensive marsh habitat is already in state ownership, while the dense shoreline vegetation downstream is not. In contrast, much of the shoreline vegetation apparently targeted by spawning walleye is in private ownership. The shoreline is currently very natural with few riparian dwellings, so the potential habitat destruction is not on the immediate horizon. The potential exists, however, for piecemeal destruction during the next several decades that could conceivably remove enough walleye spawning habitat to adversely affect the riverine population and resultant fishery. Fisheries Division will have to remain vigilant to ensure that adequate spawning habitat remains in the future.

Tributaries.–Angling and survey access is difficult for many of the tributaries in this segment. Headwater areas are generally in areas without access roads, while the lower sections are within the huge wetland that surrounds the mainstem. In addition, some of the few headwater streams with adequate angler access are now inundated by beaver dams. Several of the trout streams, when viewed from aerial photographs, show a series of beaver dams that resemble beads on a necklace. For those reasons, scientific data of any kind are generally nonexistent for most of the streams. This segment's tributary list (Figure 2) includes: Baird Creek, Big Ditch, Callam Creek, Camp One Creek, First Creek, Gimlet Creek, Hendrie River, Hendrie River, South Branch, Hendrie River, West Branch, Linton Creek, Linton Creek, North Branch, Linton Creek, South Branch, Linton Creek, West Branch, McLeod Ditch, Murphy Creek, Murphy Creek, North Branch, Murphy Creek, West Branch, Naugle Creek, Sage River, Sage River, East Branch, Sage River, West Branch, Savage Creek, Schouts Creek, and Third Creek. However, only those streams for which data are available will be discussed alphabetically below.

Gimlet Creek is a small stream, not designated for trout. It was surveyed at the Charcoal Grade crossing in 1960. The site was 200 ft long, extending upstream from the culverts. Bottom substrate consisted of clay and silt, and the banks were lined with tag alders. The electrofishing survey found two fish: a Johnny darter and a blackside dace. That survey site is currently a large open meadow dominated by a shallow beaver pond with radiating channels. Water temperatures recording during the summer 2004 verified the warming influence of the beaver dam and meadow, as temperatures on several days warmed to over 75°F.

The Hendrie River mainstem at M-28 supported a coolwater fish community, based upon a 1948 survey. At that time, northern pike, burbot, Johnny darter, central mudminnow, and common shiner were documented at the M-28 Bridge. The stream was 20–30 ft wide, about 4 ft deep, with a soft mud bottom and dark brown stain. Shorelines were vegetated with tag alder. A 2004 boom shocking fish community survey extending 1,000 ft upstream from the M-28 Bridge found white sucker, northern pike, yellow perch, golden shiner, and mottled sculpin. The mainstem extends upstream south and easterly to M-123, through U.S. Forest Service property. A survey in 1997 was conducted by USFS personnel, at a site 3.6 mi west of M-123. The stream was only 9 ft wide and 0.8 ft deep. Bottom substrate was sand, and there was abundant woody debris. Fish species sampled included white sucker, burbot, blacknose dace, creek chub, finescale dace, common shiner, mottled sculpin, and central mudminnow. No trout were captured. The entire mainstem is considered a warmwater stream.

The Hendrie River, South Branch, a designated Type 1 trout water, was stocked with legal size brown trout during 1947–61. A 1960 survey described the instream substrate as predominantly sand, with low and marshy shorelines and dense tag alder growth. The fish collected during the study included one brown trout, white sucker, burbot, American brook lamprey, creek chub, blacknose dace, redbelly dace, central mudminnow, mottled sculpin, and brook stickleback. A 1988 survey found a good aquatic invertebrate community, tag alder bank vegetation, and abundant large woody debris. The fish documented were brook trout, mottled sculpin, creek chub, blacknose dace, central mudminnow, brook stickleback, and redbelly dace. Currently, beaver dams inundate this stretch of river, but no plans have yet been made to remove them. Even so, it is still designated for trout.

The Hendrie River, West Branch, is a designated Type 1 trout stream, but one of marginal quality for trout. It was stocked with legal size brown trout during 1947–54. A survey in 1960 found white suckers, American brook lamprey, blacknose dace, pearl dace, central mudminnow, mottled sculpin, and brook stickleback, but no brown or brook trout. The low banks were vegetated with tag alder, and the instream substrate was predominantly sand. Dense beds of aquatic vegetation provided most of the instream cover. This stream has not been surveyed since 1960. It is still a designated trout stream, although there is no active management planned for the future.

All three branches of the Linton Creek system have been designated trout streams since 1951, when they were initially stocked with brook trout. The brief file description from 1951 mentioned several small beaver ponds. Despite not being stocked or actively managed since 1951, they are currently designated as Type 1 trout streams, and angler comments describe good fishing success for brook trout. They have never been surveyed.

McLeod Ditch is a coolwater stream. South of M-28, it is designated as Type 1 trout water. It was stocked with both brook and brown trout in 1947. However, a subsequent visual check in 1948 showed the creek to be muddy, with no sign of angler traffic. It was never stocked again. A 1960 survey found bottom substrate consisting mostly of clay, with banks lined with tag alders. The only fish species captured were white sucker, burbot, blacknose dace, blackside darter, and mottled sculpin. It has not been surveyed since 1960.

The West Branch Murphy Creek is a small warmwater stream. Its only fisheries survey occurred in 1960. Bottom substrate was silty sand, and there were occasional deep holes. Dense tag alder growth hung over the shoreline, and a few logjams were located in the area. Fish collected included burbot, American brook lamprey, creek chub, blacknose dace, central mudminnow, Johnny darter, and blackside darter. No trout were captured.

Naugle Creek is a warmwater headwater tributary to the Hendrie River mainstem. It was surveyed in 1960. Water was light brown and turbid. Bottom substrate was mostly sand with some clay, and there were deep holes and woody debris. Shorelines were vegetated with dense overhanging tag alders. Fish observed during the survey were white sucker, burbot, American brook lamprey, blacknose dace, central mudminnow, Johnny darter, blackside darter, and mottled sculpin. No trout were captured. Naugle Creek, when observed by U.S. Forest Service personnel in 1997, was very turbid, and reddish brown in color. The water was too deep to survey, with bottom substrate of muck and sand. Several old beaver dams were observed in close proximity to the survey area.

The Sage River main branch is classified as warm water. It is delineated as extending generally from confluence of the Big Ditch and the West Branch downstream to the Tahquamenon River. It was designated for warmwater species management in 1961, even though it has never been surveyed.

Like the West Branch, the unstocked East Branch Sage River was stocked with brown trout during 1947–61. A 1960 survey described the instream substrate as sandy silt. Cover was fair, with large woody debris and overhanging tag alders. No trout were captured. The fish community described was composed of white sucker, burbot, American brook lamprey, blackside dace, and mottled sculpin. Further south, the East Branch headwater was stocked with brook trout in 1959, and has been designated for trout since then. Access to the headwater section is difficult, so a 1960 survey targeted an unnamed tributary at a county road crossing. Brook trout, redbelly dace, finescale dace, fathead minnow, central mudminnow, brook stickleback, and pearl dace were all captured. The East Branch has not been surveyed since 1960. The entire East Branch is a designated Type 1 trout stream.

The West Branch Sage River, an unstocked designated Type 1 trout stream, was stocked with brown trout during 1947–61. A 1960 survey found brown trout, white sucker, burbot, central mudminnow, Johnny darter, blackside darter, and mottled sculpin. The bottom substrate was mostly sand, and instream cover was poor, but the banks were lined with dense tag alder growth. An abundant population of burrowing mayflies was found in the silt banks. Brown trout were again stocked during the mid-1970s. An angler report in 1974 described catching large brook trout downstream as far as the mouth of the Big Ditch. Still another angler in 1974 described catching 58 large brook trout, but no brown trout, between M-28 and the Big Ditch. The stream has not been stocked since the mid-1970s, nor surveyed since 1960.

Third Creek is noteworthy because of its history. A small headwater tributary to the West Branch Sage River, it is a designated Type-1 trout stream. It was stocked in 1951 with brook trout. A 1960 survey found poor instream cover, and sand substrate. However, the survey captured good numbers of brook trout, plus finescale dace, central mudminnow, mottled sculpin, and brook stickleback. Subsequently, at the request of the Tahquamenon Area Sportsmen's Association, a dam was constructed in the mid-1960s near the Third Creek headwaters for trout management. The pond was annually stocked with brook trout, and stream stocking concurrently was stopped. A series of pond surveys verified good trout survival, and the pond was opened to all-year fishing in 1967–68. The fishing season was changed back to the standard trout season in 1989. The structure and embankments needed repair in 1991. Then, due to extent of repairs needed and increasingly poor trout survival, the dam was removed in 1993. The dam plus beaver dams downstream were impeding trout spawning migrations. It was felt that dam removal allowed some trout to access good spawning habitat upstream (and within) the section previously impounded. Even so, this stream has not been surveyed since the dam was removed.

Lakes.–There are no lakes within this segment.

Lower River Segment

Mainstem.–The Tahquamenon River mainstem between the Upper and Lower falls is stocked annually with brown trout (Table 23). The 4 mi of river encompass 103 acres, and the river flows over stepped sandstone bedrock. Fly fishers target this stretch, not only for the brown trout but also for smallmouth bass, northern pike, and an occasional northern muskellunge. Accessing this reach for a survey would entail carrying a stream shocking barge and equipment while hiking upstream from the Lower Falls or going down about 100 stair steps from the top of the bank at the Upper Falls. Consequently, the fish community has not yet been surveyed, nor has the contribution of stocked brown trout to the fishery. This reach is not designated as trout water.

The Tahquamenon River mainstem immediately below the Lower Falls provides the best angling success of the Lower River segment. The Lower Falls represent the upstream limit to migrations of Great Lakes and lower river fish. For that reason, anglers target the area just after spring flood stage for steelhead or yellow perch, while returning incidentally caught northern pike, walleye, smallmouth bass, and occasional Great Lakes muskellunge to the river. When their respective seasons open, anglers harvest the other species as well. A walleye tagging effort was conducted in the Lower Falls basin during late April 2001, during their spawning run. Concurrently with the tagging project, a population estimate was made. The spawning run that year consisted of an estimated 2,400 adults. Over 100 tagged walleyes were caught that same spring throughout the lower river from the May 15 season opening until mid-June. No tags were returned during the rest of the year. During the fall season, anglers target steelhead and Chinook salmon. The Tahquamenon Falls State Park subcontracts a canoe rental at the basin immediately below the Lower Falls, allowing recreational canoeing, access to an island pathway between the two lower falls, and canoe access for fishing the lower river.

The Tahquamenon River mainstem between the Lower Falls and the mouth contains surprisingly consistent instream habitat. There is little large woody debris, few deep holes, and the bottom is uniformly sandy silt. A series of boom shocking fish community surveys were conducted during 1993–2001 (Fisheries Division files), and again in 2005 (Table 24). Three sites below the Lower Falls were surveyed each year. Northern pike, muskellunge, smallmouth bass, walleye, and yellow perch were generally represented at each site. A creel census during the summer 2004 found heavy angling pressure and harvest during May and early June, targeting walleye. For the rest of the summer, however, there were very few anglers on the river. Lake trout previously stocked (Table 23) into the open water of Whitefish Bay were stocked in the mouth of the river in 1996, 1999, and 2000, as part of the tribal consent agreement. No subsequent lake trout catch or harvest within the river system has been either documented or described anecdotally.

Tributaries.–Cheney Creek, an unstocked designated Type 1 trout stream, is the only tributary of consequence in the Lower River segment. It was stocked with legal size brook trout during 1949 and 1950. Stocking was discontinued in 1951 due to concerns about poor angler access and road conditions. Its only survey occurred in 1960. Bottom substrate was sand with some silt, there was abundant woody debris and undercut banks, while the shoreline was lined with conifers and hardwood species. Species found at two combined sites included brook trout, American brook lamprey, central mudminnow, mottled sculpin, brook stickleback, burbot, Johnny darter, and trout perch. This stream has not been stocked, surveyed, or observed since 1964.

Lakes.–There are no lakes within this river segment.

East Branch Tahquamenon River

The East Branch Tahquamenon River's designated Type 2 trout water extends from the headwaters downstream to North Hulbert Road at the north end of T46N, R07W, Section 9. The portion within the U.S. Forest Service boundary is a popular trout fishery, known for producing large trout. This stream has not been stocked with brook trout since 1976, and the population is considered self-sustaining. In addition, no stream habitat improvement efforts have been made since the CCC era in the 1930s. A HOBO recording data logger in 1994 produced a thermograph showing 55°F average July water temperatures near Eckerman. At the same site, the 2005 average July temperature was 56°F, during an unusually warm and dry summer. The fish community was surveyed at several identical sites in 1995 and 2004 (Figure 20). Fish species sampled in 2004 (Table 27) included brook trout, burbot, white sucker, blacknose dace, common shiner, creek chub, mottled sculpin, brook stickleback, central mudminnow, brassy minnow, pearl dace, American brook lamprey, and northern redbelly dace (Bassett 2005).

Beaver effects have been an issue on the East Branch Tahquamenon River for some time. The 1991 survey was in response to angler complaints about increasing numbers of beaver dams, many of which were documented. The U.S. Forest Service produced Fishery Status Reports in cooperation with MDNR, Fisheries Division during 1981, 1996, and 2005. Conclusions were that the brook trout population has changed considerably since the late 1970s, with the most significant parameter being the increase in beaver dams and ponds. Aerial flights showed the number of dams increased from 66 in 1995 to 120 in 2004 (Bassett 2005). Carrying capacity for brook trout is currently much higher than the current standing crop (Table 28), implying that the beaver dams are blocking spawning migrations and/or covering spawning habitat (Bassett 2005). Efforts will commence in 2006–07 to remove dams. In addition, the work will entail installing spawning substrate in tributaries near the mainstem, in areas currently reachable by spawning brook trout from the mainstem. Despite the number of beaver dams, water temperature throughout the designated trout reach remains excellent for trout management.

The East Branch Tahquamenon River downstream from the North Hulbert Road Bridge to its mouth is very turbid, as the river flows over and drains clay deposits from a former glacial lakebed. The reach looks very much like coffee with lots of cream in it, similar to rivers such as the Munuscong and Charlotte, which drain lacustrine clay deposits in eastern Chippewa County. This stretch of the river is not designated trout water; and anglers report catching northern pike, muskellunge, and walleye upstream as far as the North Hulbert Road Bridge. This reach has never been surveyed.

Tributaries.–Tributaries to the East Branch Tahquamenon River are listed alphabetically. There are no Fisheries Division files for any other stream in this segment.

Big Beaver Creek, an unstocked designated Type 1 trout stream, was surveyed only in 1960. Bottom substrate was clay, woody debris was present in the channel, and banks were vegetated with tag alder. Fish species observed were brook trout, northern pike, burbot, central mudminnow, and mottled sculpin. It has never been stocked.

Little Beaver Creek is a small unstocked designated Type 1 trout stream whose sole survey was in 1960. Bottom substrate was clay and sand, woody debris were present, and the banks were vegetated with overhanging tag alder. Fish species captured were brook trout, burbot, and blackside darter.

Creek Number 14 is a small designated Type 1 trout stream. It was stocked with brook trout during 1947–61, except for 1948–49. The only survey conducted on it occurred in 1960. The stream substrate was silty sand, and the water was stained light brown and turbid. Abundant woody debris occurred in the channel, and the low swampy banks were lined with leatherleaf and cedar. Fish species collected were white sucker, redbelly dace, fathead minnow, central mudminnow, mottled sculpin, and brook stickleback. Stocking ceased in 1961 when survey results from 1960 found that the stream was marginal for trout. The only comment on record from that time is that there was poor trout survival. The trout designation, however, remains.

Klein's Creek is a small designated Type 1 trout tributary to Riley's Creek. It was stocked with brook trout during 1950–54. Stocking ceased when visual observation determined that it was too small to fish, had poor angling access, and little evidence of any angling pressure. It has never been surveyed.

Ward Creek, otherwise known as Creek Number 8, is a small Type 1 trout stream. It was stocked with brook trout annually in 1947–60. A 1960 survey found brook trout, burbot, American brook lamprey, and mottled sculpin. Bottom substrate was mostly silty sand, and some overhanging banks and woody debris provided cover for fish. The low swampy banks were vegetated with dense overhanging tag alder. It has not been surveyed since 1960.

Lakes.–Fisheries Division files exist for only four lakes within the East Branch Tahquamenon River. They are discussed alphabetically.

Hulbert Lake is a deep, 564-acre private lake south of the village of Hulbert (Figure 1). Because it has always been a private lake, it has never been surveyed or mapped by MDNR. The Hulbert Lake Lodge advertisement describes a fish community consisting of smallmouth bass, northern pike, yellow perch, and rock bass. Angler reports add bluegill, walleye, bullhead, and white sucker to the lake's fish community. In addition, the lake was privately stocked with green sunfish, smelt, lake herring, and fin-clipped lake trout (Hubbs 1932, P. Leazier, personal communication), none of which are indigenous to the Tahquamenon River watershed upstream from the Upper Falls. Since that time, every lake trout caught in the lake had been fin-clipped. Riparians subsequently concluded that there was no natural reproduction. That conclusion is supported by the complete absence of any rock or gravel in the lake. It is unknown whether the lake trout or any other fish species are currently stocked.

Walker Lake, on U.S. Forest Service property, is 16 acres, averages 6 to 8 ft in depth, and has firm sand shorelines with an organic substrate in deeper water. The lake has a well-used USFS campground on the north side. Boat access is limited to small carry-in boats and canoes. Since there are few public lakes in the area, there is considerable local pressure to provide a good fishery in this lake. For that reason, it has had a long history of attempted fisheries management, mostly by the USFS biologists with MDNR oversight. Some brush shelters were installed in 1948, and bluegills were stocked in 1949. Northern pike and spottail shiners were stocked in 1956. A survey in 1964 found filamentous algae covering shoreline areas. Fish species captured included abundant brown bullhead, abundant yellow perch, and one northern pike. A March 1980 limnological survey found dissolved oxygen at 2.5 mg/l and pH 4.5. The pH makes the lake marginal for fish management, as Schneider (1983) found that the only sport fish species expected to survive in pH lower than 5.0 were brook trout, yellow perch, bluegill, and lake herring. Despite acidic conditions, it was chemically reclaimed in 1981, and subsequently restocked with northern pike, rainbow trout, black crappie, and largemouth bass. A 1987 survey found only black crappie and yellow perch, most likely a result of the low pH. Walker Lake was subsequently limed in 1989, changing the pH from 4.5 to 6.95. However, a March 1990 dissolved oxygen concentration of only 2.27 mg/l (lethal to all but the most tolerant species of fish), and a follow-up survey in 1993 found only yellow perch. No chemical analyses were conducted at that time, following what appeared to be a partial winterkill situation. This lake has not been surveyed since 1993. Walker Lake is scheduled for an extensive netting, habitat, and water chemistry survey in 2006.

Williams Lake, at 22 acres and 9 ft maximum depth, also appears to occasionally experience fish winterkills. Access is for carry-in boats only. An attempted survey in 1964 was aborted because workers could not wade through shoreline muck to open water. A 1975 survey, when water levels were higher, found only yellow perch, which ranged in size from 5.4 to 13.2 inches. An angling survey in 1980 captured good numbers of yellow perch. U.S. Forest Service personnel conducted another survey in 2000. Again, they found only yellow perch, with sizes up to 15 inches. No active management is anticipated for this lake.

Whitmarsh Lake, at 10 acres with a relatively flat basin and 7 ft maximum depth, has limited management potential. Fish present during the August 1979 USFS survey were abundant brown bullhead, black crappie, and yellow perch. A dissolved oxygen check by USFS in March 1980 found the oxygen concentration was 1 mg/l. Winterkill must surely have occurred due to the limited available oxygen. A 2004 fish community survey also captured abundant brown bullhead, black crappie, and yellow perch. During the survey, 40 lbs/acre of bullheads and 8.7 lbs/acre of stunted yellow perch were removed. Only 1% of the yellow perch population was acceptable at 7+ inches, while 81% of the black crappies were acceptable at 7+ inches. Dissolved oxygen in early June 2004 was 10 mg/l in the water column, and 8 mg/l at the bottom, while pH ranged from 6.0 at the surface to 5.6 at the bottom. This lake is a good destination for small boat access, where one can catch good numbers of keeper, but not trophy, black crappies.

Recreational Use

Surficial soil types resulting from watershed's glacial history affect recreation in the watershed. Tahquamenon River access is very limited downstream from Newberry, and the huge marsh complex limits camping on state-owned lands. As a result, there are few boat access sites or campgrounds in this watershed (Table 16; Figure 21). Further downstream, where riverbanks are higher and the grounds drier, the riparian corridor is almost completely privately owned. The main tourist destination in the watershed is the Tahquamenon Falls State Park, which annually attracts 500,000 visitors. Most of the activity is sightseeing, but some visitors are birders, anglers, campers, cross-country skiers, snowmobilers, and hunters. Vacationing snowmobilers currently provide the greatest nonresident economic contribution to the local economy. Most people living within or near the watershed boundaries are environment-oriented. No matter what their individual occupations, most actively take advantage of the nearly pristine environment at their fingertips. Activities include hunting, fishing, boating, birding, hiking, camping, blueberry and morel harvesting, ATV riding, skiing, and snowmobiling.

Angling is by far the most popular riverine activity. Anglers in the Upper River segment and the East Branch Tahquamenon River target brook trout. Most anglers throughout the Marsh Drainage, Middle

River, and Lower River segments target walleyes, while the number targeting northern muskellunge is slowly increasing. Northern pike and yellow perch are mostly incidental catches, although an occasional angler will target them. Water fowling is seasonally intense, but an increasing number of people are finding value in the river's tranquility, isolation, and abundant wildlife. Numbers of canoeists and kayakers have been increasing in recent years. However, some jet-skiers have found an enjoyable challenge in the narrow, sinuous channel downstream from McPhee's Landing. Fortunately, all vessel traffic is still low enough that no accidents have been reported.

The Tahquamenon River is considered canoeable downstream from Kings Creek. At the confluence with Syphon Creek, the river picks up more depth and width, allowing use of powered boats downstream to the mouth at Lake Superior. The only boat launch upstream from Dollarville Flooding, however, is at the County Road 415 Bridge, north of McMillan. Dollarville Flooding is easily accessed for fishing, waterfowl hunting, and trapping. Public boat launch sites exist at Dollarville Dam for both upstream and downstream boat traffic. In addition, there is a public boat launch for the Dollarville Flooding at the Natalie State Forest Campground, about 1.5 mi west of the dam.

McPhee's Landing, the only public boat access in the Marsh Drainage segment other than at the Dollarville Dam, is located about 6 mi downstream from M-123. Anglers and recreational boaters generally head downstream, away from the narrow, sinuous upstream channel that is inundated with downed trees. Boaters from McPhee's Landing occasionally motor downstream to the Upper Falls for a picnic, returning the same day after a 60 mi journey. The narrow serpentine character of the marsh channel, however, makes high-speed boating a dangerous proposition. The occasional canoeists, kayakers, and jet-skiers generally plan to return to McPhee's Landing, as the current is slow enough to allow upstream paddling and retrieval access downstream is minimal.

The only boat access within the Middle River segment is at Slater's Landing, a private fee-paid site just upstream of the mainstem on the East Branch Tahquamenon River. Canoeists preferring a one-way trip can spot a vehicle at Slater's Landing, then canoe the 17 mi down from McPhee's Landing. However, the few who do so generally make the trip in one day due to lack of camping potential on state land. The Soo Junction railroad and Betty B Landing provide tourist excursion boat entry into the Middle River. Customers park about 2 mi north of M-28, then take a private, narrow-gauge train another 5 mi to the Betty B Landing at the river. The standard boat trip goes downstream to about 0.25 mi above the Upper Falls. Tourists disembark and walk to the Upper Falls on the south side, opposite the State Park viewing platform. After a picnic, they return to the Betty B Landing and then back to their vehicles via the railroad.

The single boat access site on the Lower River segment, located at the mouth between the M-123 Bridge and Lake Superior, is owned and maintained by the Tahquamenon Falls State Park. Boaters can go upstream to the Lower Falls during higher water, but are blocked about 0.5 mi below the Lower Falls during summer low flows. A rowboat and canoe rental exists at the Lower Falls, both for angling and for access to the island separating the two drops of the Lower Falls. Anglers catch smallmouth bass, perch, northern pike, and occasional walleye and muskellunge.

Resorts are rare within the watershed. There is a fishing resort located on the mainstem between Lake Superior and the Lower Falls, a resort on Halfway Lake, and a resort on Hulbert Lake. Both Halfway and Hulbert lakes are private, with no public boat launch facilities.

Public lakes included within this watershed are small, with no resort activity. Generally speaking, more pleasure boating occurs on the lakes with private homes than angling activity. However, most of the lakes without private homes are so small that they provide only angling opportunities.

Citizen Involvement

Citizen involvement in the Tahquamenon River watershed occurs through interaction with the various government agencies that manage water flows, water quality, animal populations, forest use, and recreation. The various government agencies include MDNR; USFS; USFWS; USDA; MDEQ; the Chippewa and Luce County road commissions and offices; and various township offices.

Nongovernmental organizations include the Two Heart Chapter of Trout Unlimited; Tahquamenon Area Sportsmens Club; Sault Area Sportsmens Club; Luce-West Mackinac Conservation District; and the Michigan State University Cooperative Extension Service. There are few issues of concern (see **Land Use**, **Biological Communities**, and **Fishery Management**).

As more people enter the local communities, potential for user conflict escalates. Even among anglers, historical conflicts existed between those targeting walleye and those targeting muskellunge in the mainstem. The future holds potential for disputes concerning fisheries management direction, land use zoning, harvest quotas, no-hunting zones, and ATV use of roads and trails.

A watershed council would provide a mechanism to allow people of diverse interests to work together, rather than argue from limited perspectives. If the council were established prior to any serious dispute, everyone would benefit from the development of shared vision and common goals concerning the whole watershed. It would be a forum for information exchange and dissemination of experiences, ideas, and proposals between individuals, communities, interest groups, and government agencies. Such a council does not currently exist.

MANAGEMENT OPTIONS

The Tahquamenon River is healthy relative to many other rivers in Michigan. Its thermal regime and water quality result in classification of top quality cold water in the headwaters and top quality warm water from the Dollarville Flooding downstream to The Upper Falls. Natural habitat and geological features, except for the Dollarville Flooding, determine water quality throughout the watershed.

Options follow the recommendations of Dewberry (1992), who outlined measures needed to protect and preserve the health of a river's ecosystem. Protection and restoration of headwater streams, riparian corridors, and floodplains are stressed in those recommendations. The overriding philosophy is that we must consider the river system as a whole, because many important elements of fish habitat are driven by whole system processes.

The following options are consistent with the mission statement of the MDNR, Fisheries Division. This mission is to protect and enhance public trust in populations and habitat of fishes and other forms of aquatic life, and promote optimum use of these resources for the benefit of the people of Michigan. In particular, the division seeks to protect and maintain healthy aquatic environments and fish communities, and rehabilitate those that are degraded; provide diverse angling opportunities, and maximize the values of those fisheries; and to foster and contribute to public and scientific understandings of fish, fishing, and fishery management.

There are several option categories. First are options to protect and preserve existing resources, second are options requiring additional surveys to gain needed data and understanding of processes, and third are opportunities for rehabilitation of degraded resources. Opportunities to improve an area or its resources, given its present status, are listed last. These options are not intended for MDNR action only, but could also be initiated by citizen groups and other agencies.

Geology and Hydrology

The Tahquamenon River has a relatively stable flow, with the seasonal exception of spring snowmelt runoff flooding. Although most headwater streams provide year-round uniform flow, the relatively impervious silt, peat, and clay soils under the huge central marsh system result in surface flow of snowmelt and some rainfall in many streams. In addition, because of its relatively far upstream location, the Dollarville Flooding has limited influence for downstream spring flood events. For that reason, the mainstem and watershed flow regime is almost entirely natural, not influenced by human activity.

Option: Protect natural hydrologic regimes of streams by protecting existing wetlands, flood plains, and upland areas that provide recharge to the water table.

Option: Protect future seasonal flow patterns of the river by requiring that all future development-related runoff be captured by infiltration basins.

Option: Protect natural seasonal flow patterns of the river by incorporating best management practices and requiring that no additional runoff enter the river from land development.

Option: Protect existing hydrologic conditions of lakes and natural lake outlets by prohibiting construction of new dams or lake-level control structures. This will ensure natural water level fluctuations needed to maintain wetlands in the lake and receiving stream, as well as provide spawning habitat for some fish species.

Option: Restore natural hydrologic regime of streams by removing the two private headwater dams if and when possible.

Option: Protect the mainstem and all existing streams from effects of shoreline modifications, land use changes, channelization, irrigation, construction of dams, and other activities that may disrupt the hydrologic cycle, by working with land managers, planners, and MDEQ staff on permit reviews.

Soils and Land Use Patterns

This watershed is very natural, with forest and wetland comprising over 90% of the total watershed. Even so, increasing shoreline development by private landowners and headwater stream crossings can adversely affect this system. Reducing sediment contributions from road-stream crossings involves both education and funding. Incorporation of Best Management Practices (BMPs) for road siting, construction, and maintenance requires training of workers and managers of private development companies. Topics for discussion should include ecological and economic effects of sediments on streams; how to properly site road-stream crossings; selection of crossing type and dimensions; recommended grades at crossing and approaches; and ways to minimize sediment delivery from grading and snowplowing. In addition, incorporation of some BMPs, such as those for bridge construction, will protect a stream and often save money in the long run. For that reason, it is critically important that land managers and environmentalist keep close track of all new development and road construction in the watershed.

Option: Protect the river by supporting efforts to establish zoning standards that minimize damage to aquatic resources in the watershed.

Option: Protect the river from excessive sedimentation by encouraging education of workers involved in private road siting, construction, and maintenance regarding use of best management practices (BMPs). Support cooperative funding in situation where local road commission budgets are inadequate for use of BMPs.

Option: Protect and maintain forested buffers along lakeshores and river/stream corridors to retain critical habitat and allow for natural wood deposition to the aquatic habitat.

Option: Rehabilitate or improve instream culverts or road stream crossings that are undersize, perched, misaligned, or otherwise placed incorrectly.

Option: Encourage use of permanent or temporary bridges to improve road stream crossings and discourage the use of culverts.

Option: Support cattle exclusion from creeks to protect riparian corridors.

Channel Morphology

The Tahquamenon River mainstem is a very low-gradient system, with unique “stair steps” at the Upper and Lower falls. Headwater reaches of most tributaries are higher gradient, stable, cold water systems with coarser soil types. Stream channels in the watershed are vulnerable to erosion resulting from inappropriate riparian activities. Habitat complexity, associated with woody habitats and coarse substrate, is limited at many sites.

Option: Protect diverse stream channel habitats by preventing removal of large woody material presently in the river.

Option: Protect channel morphology by using bridges or properly sized culverts at road-stream crossings.

Option: Protect riparian forests by educating riparian residents on how riparian zones influence water quality, stream temperatures, trophic conditions, channel morphology, bank erosion, and stability, and aquatic, terrestrial, and avian communities.

Option: Survey tributaries and upper portions of the mainstem to identify locations of excessive erosion or habitat degradation. Prioritize stream sections and habitat degradation locations to accomplish the greatest watershed benefit from limited funds or work projects

Option: Survey coldwater streams to identify where high beaver activity (or beaver dam density) adversely affects riparian habitats, stream channel morphology, downstream temperature conditions, and fish passage.

Option: Rehabilitate stream channel diversity where needed by removing excess streambed sediment load and controlling sediment contributions.

Option: Improve channel diversity by adding woody structure or habitat improvement structures where needed, and by modifying flow regimes to isolate eroding banks, scour soft material to expose gravel/rock substrate, scour deeper holes in sand-inundated stretches, and to provide diverse current velocities.

Water Quality

Water quality is good throughout the watershed. Current threats are minimal, consisting of occasional lumbering equipment petroleum product releases, minor erosion at a few sites, and the permitted discharge from the Newberry Wastewater Treatment Plant. Fish consumption advisories exist for migratory Lake Superior fishes that seasonably occur downstream of the Lower Falls. The local fish communities are under the statewide generic caution for mercury contamination due to atmospheric mercury deposition, which is locally uncontrollable. Water temperatures are altered in many tributary headwaters due to the presence of many beaver dams.

Option: Promote public stewardship of the watershed and support educational programs that protect and teach best management practices and prevent further degradation of aquatic resources.

Option: Protect and rehabilitate cold and coolwater thermal habitat areas and their biological communities.

Option: Rehabilitate coldwater reaches of streams by encouraging and promoting legal harvest of beaver in areas where damming hampers fish migration and degrades trout spawning habitat.

Option: Survey stream temperature conditions throughout the watershed to better assess potential of these waters to support different fish species.

Option: Survey thermal influence of human-made dams to determine their effect on downstream riverine systems.

Option: Survey stream temperature conditions throughout the watershed and develop stream classification designations based on the thermal characteristics of these waters.

Option: Survey dissolved oxygen levels in managed trout lakes to establish current data describing late winter minimum concentrations.

Option: Conduct limnological surveys on lakes and streams to establish current data describing alkalinity, dissolved oxygen, calcium carbonate, Secchi disk visibility, and thermocline.

Option: Protect water quality by developing regulatory rules requiring reporting of accidental spills or discharges to wetlands.

Option: Protect human health by supporting efforts to minimize chemical contamination of Lake Superior fishes.

Special Jurisdictions

While considerable state and federal forest ownership in the watershed affords much protection to its waters, other land management activities conducted by state, federal, or local units of government have potential for serious environmental degradation. The State of Michigan owns much of the central portion of the watershed, including the Tahquamenon Falls State Park, which extends from the Upper Falls downstream to Lake Superior, while the USFS owns much of the East Branch Tahquamenon River watershed. In addition, local road commissions have authority for road stream crossings, which can affect sedimentation rates and stream quality.

Option: Protect the river system by supporting cooperative planning and decision making among all involved levels of government and citizens.

Option: Protect the quality of wetlands, streams, and lakes through rigorous enforcement of Public Act 451, parts 301, Inland Lakes, and 303, Wetlands Protection.

Option: Protect riparian habitat by working with agencies to enact BMPs for logging and road stream crossing operations.

Option: Survey riparian areas after logging activities to assess and assure compliance with BMPs outlined in logging contracts.

Biological Communities

The Tahquamenon River mainstem is generally well protected from human-caused disturbances by the huge central wetland area and resultant loss of gradient as tributaries flow toward the mainstem. In addition, county and logging road stream crossings are well maintained and contribute little sediment to the system.

Option: Protect gravel habitats from sedimentation due to poorly constructed road stream crossings and land development by enforcing local soil and sedimentation codes. Implement nonpoint source best management practices at logging, road construction, and land development sites.

Option: Protect stream margin habitats, including flood plains and wetlands.

Option: Protect against transfer of aquatic nuisance species into the watershed. Maintain aquatic nuisance species information signage at all boat launch sites. Continue aquatic nuisance species public education discussion with media, schools, and sports group contacts.

Option: Evaluate fish communities on mainstem and major tributary valley segments that have not been surveyed within the last 10 years. Surveys should follow MDNR, Fisheries Division Status and Trends survey protocols.

Option: Rehabilitate the East Branch Tahquamenon River by working with the USFS personnel to remove beaver dams, reduce the beaver population, and place gravel spawning substrate within the accessible migratory path of the brook trout (as needed). Protect restored habitat by managing vegetation in riparian areas to promote forest types undesirable to beaver.

Option: Survey current distribution and status of flora and fauna throughout the river system to determine areas of habitat degradation.

Option: Survey river to identify areas where self-sustaining walleye and muskellunge populations reproduce.

Option: Protect key spawning and nursery habitats for walleye and muskellunge once identified.

Option: Survey aquatic invertebrate communities throughout the watershed to characterize overall stream health.

Option: Produce geographic information system databases showing identity and location of biological community distributions in the watershed.

Fishery Management

All waters in the Tahquamenon River watershed except the small ponds and impoundments managed for trout are generally self-sustaining. The diversity allows anglers to target large predators, panfish, or trout, and all within a short drive from Newberry. Management goals will be to protect and/or enhance the existing fisheries.

Option: Manage headwater tributaries for brook trout where appropriate habitat conditions exist.

Option: Survey muskellunge populations to identify spawning areas in need of protection.

Option: Rehabilitate beaver-impacted streams where potential occurs for restoring suitable habitat for brook trout by supporting beaver population control, beaver dam removal, and riparian vegetation management to discourage beaver.

Option: Protect headwater tributary habitats by protecting and appropriately managing riparian forests to discourage beaver populations.

Option: Survey the headwaters of the Sage and Hendrie rivers to determine feasibility of removing beaver dams, reducing the beaver population, and placing gravel spawning habitat within the accessible migratory path of the brook trout.

Option: Work with private landowners to remove the two current dams on cold headwater reaches of Syphon and East Creeks to allow fish passage.

Option: Remove the dam at Buckys Pond if the 2007 trout survey fails to document a fishable population.

Option: Be diligent in protecting headwater tributaries from any future instream dam construction.

Option: Survey all types of streams to assess beaver use and effects.

Option: Survey high-quality coldwater trout streams and mainstem and major tributary valley segments to collect baseline data on fish communities. Use Stream Status and Trends Protocols for fish and habitat surveys.

Option: Survey other streams in coordination with Wildlife Division where more aggressive control of beaver and their dams would restore trout habitat.

Option: Protect fish communities and improve ability to target fisheries management by initiating ecosystem-level monitoring of physical and biological characteristics of the lakes, ponds, mainstem, and tributaries throughout the watershed.

Option: Survey the percentage of wild versus hatchery reared walleye through the use of oxytetracycline analysis in the Lower River segment to determine stocking program effectiveness.

Option: Survey fish, habitat, and temperature at streams where no surveys have occurred in the last 10 years.

Option: Protect streams appropriately by revisiting the stream classification system as new knowledge of stream temperatures and biological communities are gained. For example, Rileys and Grants creeks in the East Branch Tahquamenon River watershed possibly should not be designated trout streams due their temperature regimes and low summer discharges.

Option: Protect coldwater reaches presently classified as cool or warm water by reclassifying them to cold water as new data become available. For example, the

Auger River should possibly be classified as cold water from M-123 to the Charcoal Grade.

Option: Survey fishery of the mainstem between Upper and Lower falls to assess the contribution of stocked brown trout to the fishery.

Option: Survey fishery of mainstem valley segments to document angler effort and catch.

Option: Survey to determine presence, location, and abundance of rare or endangered species, both flora and fauna.

Option: Restore sites of instream erosion by working with interested groups.

Option: Continue to manage streams, rivers, ponds, and lakes for the current diverse fisheries and fish communities.

Option: Determine what mechanism/obstacle has removed lake sturgeon from the Lower River segment and work to restore that population.

Recreational Use

Recreation activities within the Tahquamenon River watershed are very diverse. Perhaps the most critical component of the recreation spectrum is boating access to the mainstem of the river. Access to the Tahquamenon River is very limited between Dollarville Flooding and the Sage River, with limited potential for camping on state-owned lands. Access is also limited further downstream because the riparian corridor is almost completely privately owned. A result of that limitation is a large number of high-speed boaters driving up to 30 mi downstream to their favorite fishing spots, then returning back upriver to McPhee's Landing. Concurrently, however, the Marsh Drainage segment of the river is narrow and winding, with very little visibility around the next corner. Complicating the situation, an increasing number of canoeists and kayakers enjoy paddling through the large marsh downstream from McPhee’s Landing. Unfortunately, the number of close encounters between the two groups is increasing.

Option: Protect the watershed and fisheries communities by supporting efforts to minimize conflicts among user groups.

Option: Improve public access to the river in the Middle River segment.

Option: Improve public access to inland lakes in the watershed including Goose, Murray, and Buckeye lakes.

Option: Protect river habitat, boaters, and nonmotorized river users by establishing and encouraging voluntary compliance with safe boating speeds on portions of the river, such as the sinuous reach several miles upstream and downstream of McPhee’s Landing.

Option: Protect citizens at the long-abandoned Eckerman State Fish Hatchery facility by filling in the old raceways that exist across the river from the drive-in access site.

Citizen Involvement

Citizen involvement will become more critical in the watershed in the future. More people are reaching retirement age and planning to move to the Upper Peninsula, at least seasonally. Available land will become limited, new subdivision roads will become necessary, and landowners may begin encroaching into critical riparian wetlands. Examples of poorly designed and constructed subdivision roads already exist in other watersheds such as the East Branch Fox River. Citizen involvement in future watershed protection will be critical.

Option: Support development of a watershed council.

Option: Educate watershed citizens about the unique and special watershed characteristics.

Option: Protect watershed integrity by building public support through a network of citizen involvement groups.

Option: Protect the Tahquamenon River system by encouraging formation of a locally-driven, basinwide watershed council to direct watershed planning and management of the river system from a long-term, broad-based, community-oriented perspective.

Option: Protect the watershed by educating river users and property owners on sound watershed management.

Option: Protect the watershed by supporting efforts of special interest groups seeking funding to protect and improve the river system.

Option: Protect the watershed by continuing to work cooperatively with governmental and nongovernmental groups on common stewardship issues.

GLOSSARY

active management – use of management tools such as stocking, reclamation, partial removals, or habitat enhancement, as opposed to passively relying on fishing regulations to protect a fish population or community.

basin – a complete drainage including both land and water from which water flows to a central point

biodiversity – number and type of biological organisms in a system

biota – animal and plant life

benthic – associated with the bottom of a lake or stream – plants and animals living on, or associated with, the bottom of a water body

BMPs – best management practices used to protect water quality, generally from erosion; examples are buffer strips, location and design of roads, and proper design of road crossings of streams

boom shocking – use of a specially built boat that puts electricity into the water to stun fish in order for them to be collected and analyzed; almost all fish recover from the shock

catchment – the area of the earth's surface that drains to a particular location or stream

cfs – cubic feet per second; ft^3/s; a unit commonly used to express stream discharge, the amount of water flowing past a point each second; 1 cubic foot of water equals 7.48 gallons

channelization – conversion of a stream to a ditch; channelized streams are narrower, deeper, and straighter than natural channels; channelization may be done for navigation, flood control at that site, or to improve drainage for agricultural or other purposes

channel morphology – the structure and form of stream and river channels including width, depth, and bottom type (substrate)

coldwater fish species – term commonly applied to trout species although nongame species such as slimy and mottled sculpin also need and prefer colder waters

confluence – the joining or convergence of two streams

coniferous – cone-bearing, typically evergreen trees

coolwater fish species – usually used to refer to game fish in the perch or pike families; examples are walleye, yellow perch, northern pike, and muskellunge; maximum growth potential for walleye and pike occurs when temperatures are in the low- to mid-70s

coregonid – fish species in the whitefish family (e.g., lake whitefish, bloater, chub, Menominee, cisco, etc.)

deciduous – vegetation that sheds its foliage annually

discharge – common term used to refer to the volume of water flowing in, or discharged by a stream into another stream or water body; also referred to as streamflow discharge or stream discharge

diurnal – the daily twenty-four-hour cycle

drawdown – removal of stop logs, or opening of gates, resulting in the lowering of water levels in an impoundment

drought flow – water flow during a prolonged period of dry weather

electrofishing – the process of putting an electric current, either AC or DC, through water for the purpose of stunning and capturing fish

EUP – Eastern Upper Peninsula, the area generally includes Drummond Island on the east and extends west to Munising, then south to Manistique

evapotranspiration – loss of water from the soil by both evaporation and transpiration from growing plants

exceedence flow – a discharge amount that is exceeded by the stream for a given percentage of time. For example, for 90% of the year the stream's discharge is greater than its 90% exceedence flow value. Consequently, the 90% exceedence flow represents a stream's low (drought) flow

extirpation – to make extinct, eliminate completely

fauna – the animals of a specific region or time

flashy – streams and rivers characterized by rapid and substantial fluctuations in streamflow

flora – the vegetation (plants) of a specific region or time

flow regime – a term often used to describe the constancy or stability of stream discharge over periods ranging from days to years; discharge of streams with stable flow regimes does not fluctuate quickly or substantially through time whereas streams with unstable flow regimes are referred to as "flashy," see above definition

forage fish – term applied to small-bodied fish that can be eaten by piscivorous fish species such as walleye, pike, or bass

game fish – term applied to fishes that recreational anglers are most likely to seek to catch

glacial outwash – gravel and sand carried by running water from the melting ice of a glacier and laid down in stratified deposits

GLEAS – Great Lakes and Environmental Assessment Section

gradient – rate of decent of a stream, usually expressed in feet per mile

groundwater – water that is beneath the surface of the ground and is the source of a spring or well water; groundwater may also flow laterally to discharge into streams or lakes at lower elevations

growing degree-days – an annual equation that multiplies (the number of days with average temperatures between 50°F and 86°F) by (average daily temperature minus 50°F)

hydraulic diversity – the variability of water depths and velocities in a stream or river channel

hydrology – the study of water

impoundment – water of a river or stream system that has been held up by a dam creating an artificial lake or pond

indigenous – a species that is native to a particular area

invertebrates – animals without backbones

lacustrine deposits – deposits associated with former glacial lakes or lakes

lake-level control structure – a dam placed at the outlet of a lake to control the water level

large woody structure (debris) – larger trees, logs, and logjams at or beneath the surface of streams or lake waters

lotic – flowing water; for example lotic habitats are habitats present in flowing streams

low-flow yield (LFY) – defined in this document as 90% exceedence flow divided by catchment area and expressed as $ft^3/s/mi^2$; streams with high low-flow yields in Michigan are generally colder, have higher drought flows, and are more suitable for habitation by coldwater fish species

LWD – large woody debris; a term used to refer to larger woody material in a stream or lake that may provide instream fish cover or be colonized by fish-food organisms

macroinvertebrate – animals without a backbone that are visible to the naked eye

mainstem – primary branch of a river or stream

MDEQ – Michigan Department of Environmental Quality

MDNR – Michigan Department of Natural Resources

MNFI – Michigan Natural Features Inventory

moraine – a mass of rocks, gravel, sand, clay, and other material carried and deposited directly by a glacier

morphology – pertaining to form or structure of a river or organism

naturalized – animals or plants previously introduced into a region that have become permanently established, as if native

nonpoint source pollution – pollution including soil erosion that originates from diffuse sources, not from a single point

NPDES – National Pollution Discharge Elimination System

oxytetracycline (OTC) – an antibiotic that produces a mark on fish bony structure once it is submersed in the chemical; thus allowing for differentiation between stocked and wild fish

perched culvert – a culvert that blocks upstream movement of aquatic organisms by creating a significant drop between the culvert outlet and the downstream stream surface

periphyton – surface-dwelling algae that colonize stable underwater surfaces

permeability – the ability of a substance to allow passage of fluids; sands and gravels have high permeability for water because it moves readily through them

permeable – soils with coarse particles that allow passage of water

potamodromous – fish that migrate from fresh water lakes up fresh water streams to spawn; in the context of this report, it refers to fish that could migrate into the Tahquamenon River from Lake Superior

pothole lake – a small lake with no inlet or outlet

private stocking – fish stocking by private individuals; a permit from the Michigan Department of Natural Resources, Fisheries Division is required to legally stock fish into public waters of the state

recruitment – refers to natural reproduction of fishes in the context of this report

riparian – adjacent to or living on the bank of a river or other body of water; also refers to owner of stream or lakefront property

riverine – refers to a free-flowing condition, used in reference to river reaches

rotenone – a white, crystalline poisonous compound obtained from derris root; fisheries managers use it as a toxicant to kill undesired fish species; it is not toxic to other non-gill breathing aquatic organisms

run habitat – fast nonturbulent water

sedimentation – the deposition or accumulation of sediment

self-sustaining population – a fish population that remains at an acceptable level of abundance by naturally reproducing

sport fish – fish sought by anglers for sport and food

substrate – term referring to materials lying beneath the waters of a lake or stream; examples are clay, silt, sand, gravel, cobble, etc.

surficial – referring to something on or at the surface

tannic acid – somewhat acidic fluid deriving from decomposition of coniferous vegetation, usually from a coniferous marsh complex into a stream; similar to tea as it steeps from the tea leaves

temperature regime – phrase commonly used by fisheries biologists to describe the seasonal or daily pattern of temperature fluctuation (maximum, minimum, and average); for example, streams with cold temperature regimes are those where summer daily mean temperatures are usually colder than 68°F and maximum daily temperatures do not reach levels lethal or unduly stressful to coldwater fish species

till – unstratified, unsorted glacial deposits of clay, sand, boulders, and gravel

turbidity – suspended particles in the water that cause it to be less transparent

topography – the configuration of the earth's surface including its relief and the position of its natural features

USDA – United States Department of Agriculture

USFS – United States Forest Service

USFWS – United States Fish and Wildlife Service

USGS – United States Geological Survey

wadable – a stream that is shallow enough to be traversed by someone wearing chest waders

wetland – those areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support types of vegetation typically adapted to life in saturated soil; includes swamps, marshes, fens, and bogs

winterkill – mortality of fish resulting from depletion of dissolved oxygen from lakes as a result of extensive and long-term shading and ice cover on lakes during winter

PUBLIC COMMENT AND RESPONSE

A draft of this assessment was made available on the MDNR website in September 2007. Statewide MDNR press releases were subsequently issued, describing how citizens could access the draft, advertising the public meeting in Newberry, and stating how to send comments to the author.

A public meeting was held on September 20, 2007 at the Tahquamenon Area School Library. Twelve people attended and their comments were incorporated into this river assessment. Public comments were received until November 16, 2007. All comments received were considered, and similar comments were combined to avoid unnecessary duplication. Suggested changes were incorporated into the final document.

Comment: Several complimentary comments were received about this river assessment and the high level of detail in it.

> Response: Thank you!

Comment: "The rearing pond raceways at the old Eckerman State Fish Hatchery are still open, and the bulkheads could be dangerous. They should be filled in to protect people who cross the river on the foot bridge from the drive-in access site."

> Response: The old hatchery was shut down many decades ago. There have been no accidents that we are aware of in all this time. For that reason, the cost of material and permits, and heavy equipment activity to transport the fill material across the river to the raceways dictate that this activity will remain at a low priority until budgets improve. Even so, this work project will be placed in the stream file, and has also been incorporated into the Management Options section of this river assessment.

Comment: "Both the Soo Tribe and Bay Mills Indian Community have archives of historical myths and legends surrounding the Tahquamenon River. The word 'Tahquamenon' literally means 'Our Woman" in Ojibwe. There is an Ojibwe legend about a woman who was in love with a man she could not be with, and she ended up throwing herself over the falls. To this day, it is believed that her ghost can still be seen around the falls. She wears a white buckskin dress. Credit the Bay Mills Indian Community, History Department. People can contact either Kathy Lablanc or Nathan Wright at http:/www.baymills.org/history."

> Response: Thank you. This information has been added into the History section.

Comment: "The river is in excellent condition as it is. We do not want anything changed."

> Response: We agree with that assessment and will do everything in our power to maintain the unique character and ecology of this river system.

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FIGURES

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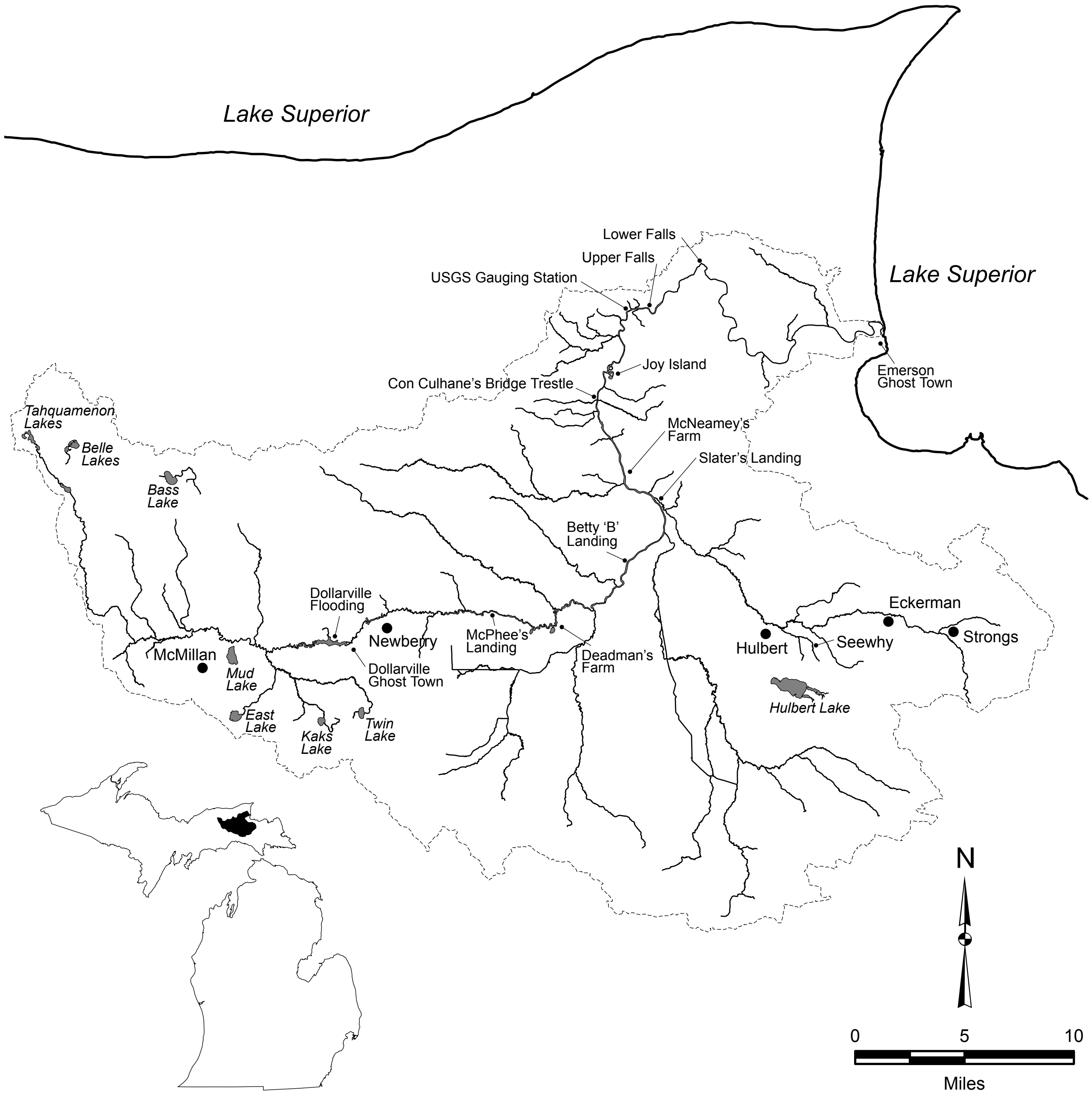
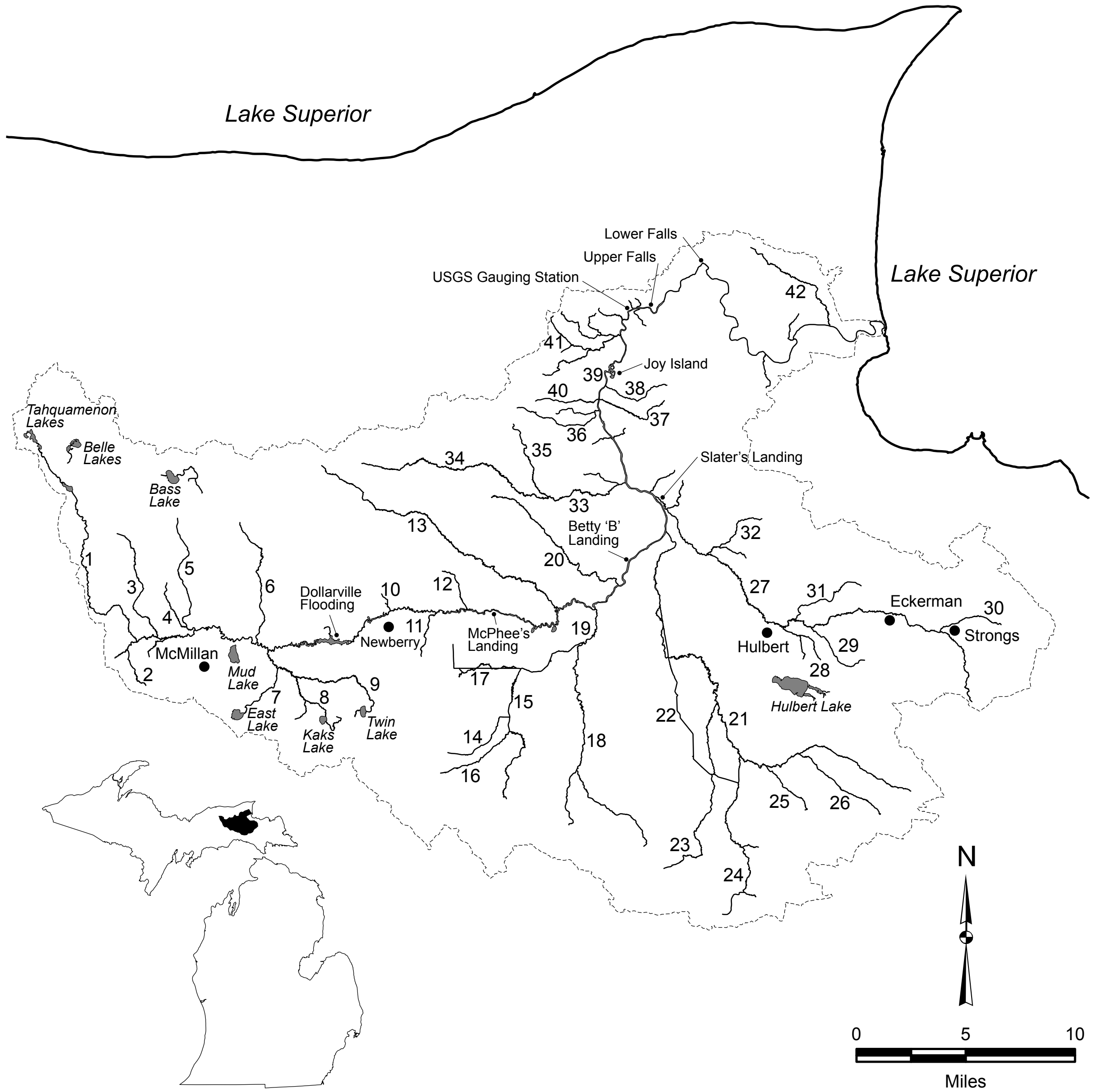
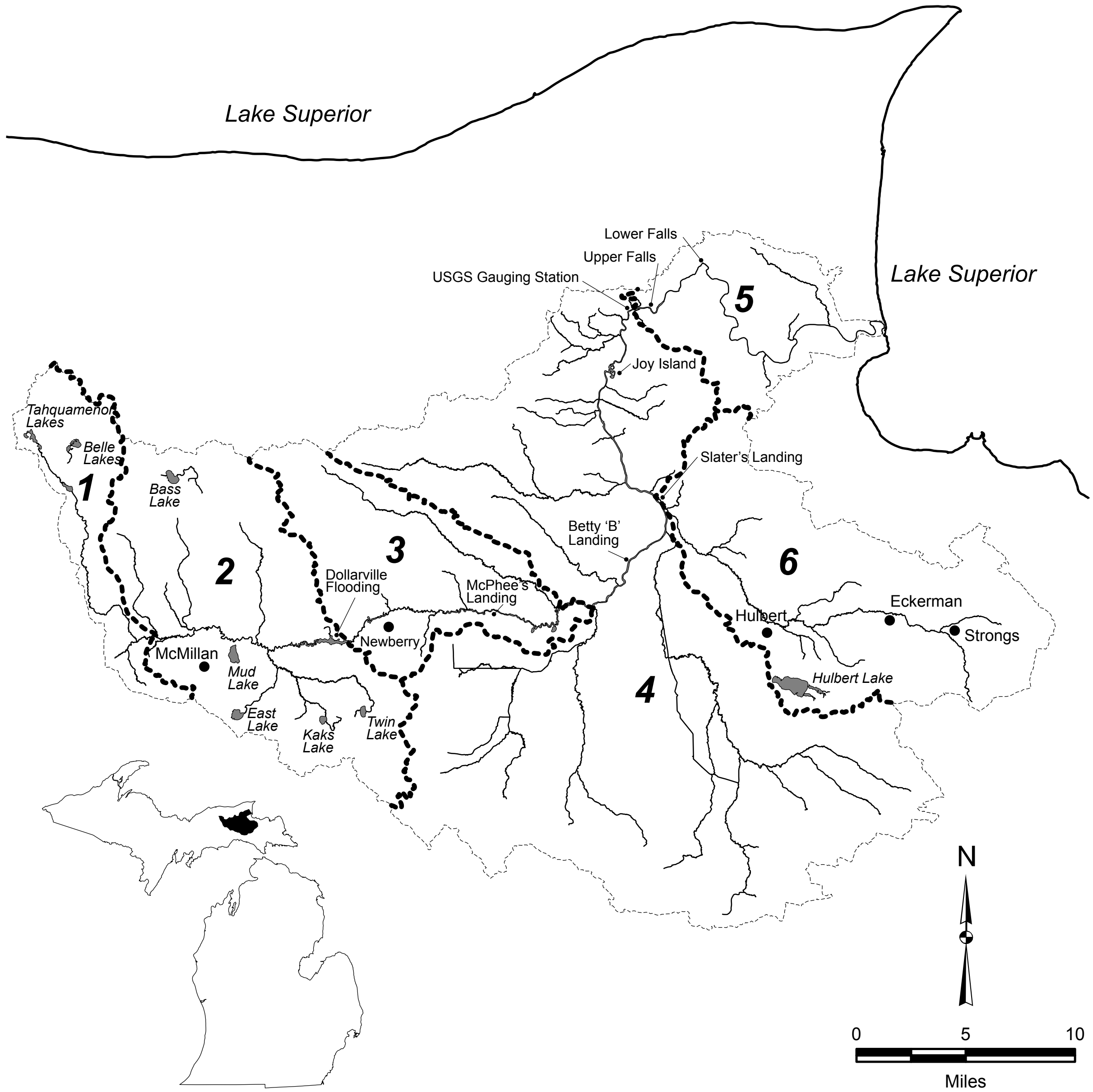


Figure 1.–The Tahquamenon River watershed.



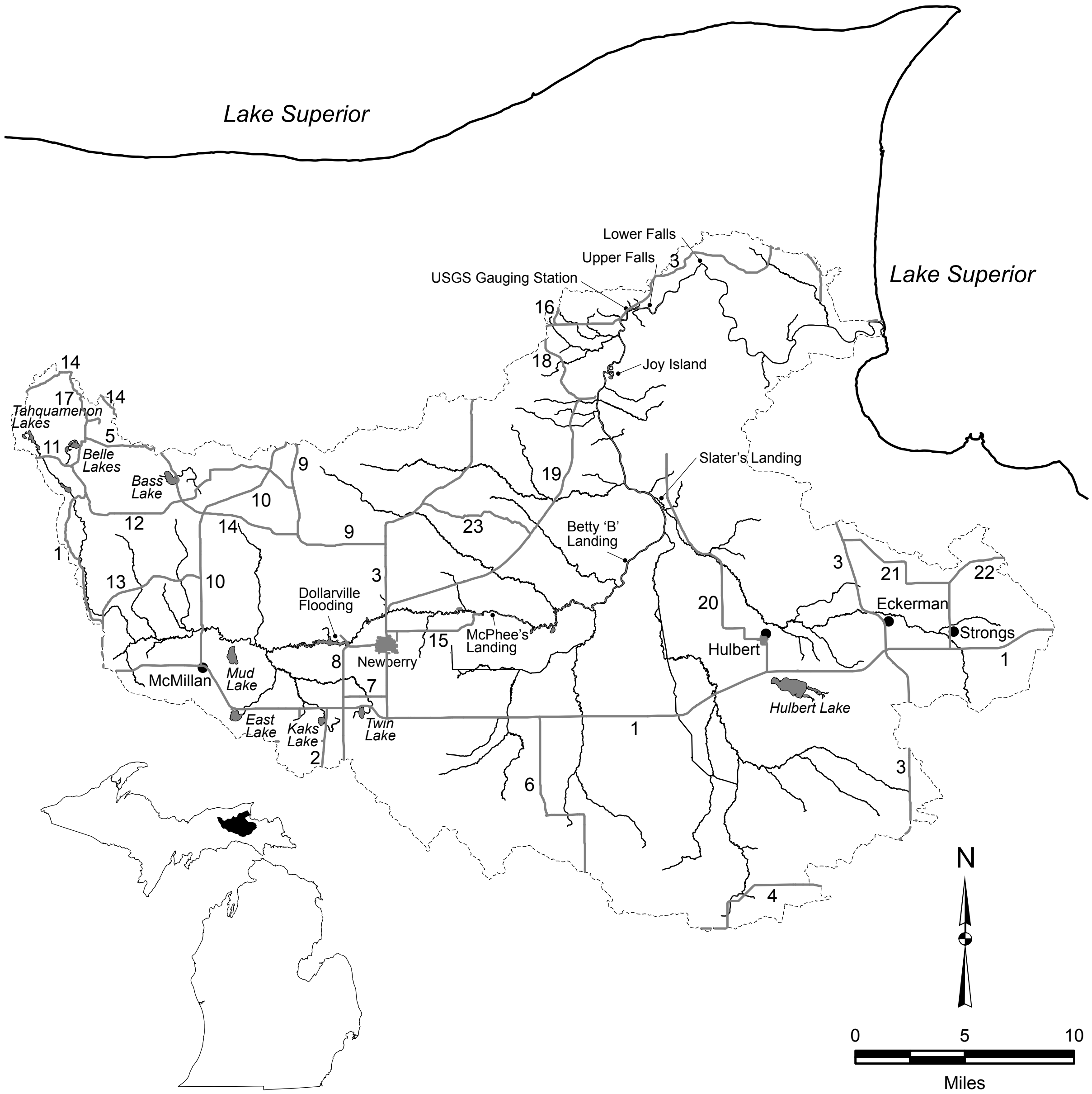
1 – Tahquamenon River
2 – Kings Creek
3 – Syphon Creek
4 – Red Creek
5 – East Creek
6 – Silver Creek
7 – East Lake Creek
8 – Carlson Drain
9 – Teaspoon Creek
10 – Otto Brandt Creek
11 – 39 Creek
12 – Sixteen Creek
13 – Auger River
14 – First Creek
15 – West Branch Sage River
16 – Third Creek
17 – Big Ditch
18 – East Branch Sage River
19 – Sage River
20 – Gimlet Creek
21 – Hendrie River
22 – McLeod Ditch
23 – West Branch Hendrie River
24 – South Branch Hendrie River
25 – Quinn Creek
26 – Naugle Creek
27 – East Branch Tahquamenon River
28 – Rileys Creek
29 – Grant Creek
30 – Creek #8
31 – Creek #14
32 – Big Beaver Creek
33 – Murphy Creek
34 – West Branch Murphy Creek
35 – North Branch Murphy Creek
36 – Baird Creek
37 – O'Keefe Creek
38 – Schouts Creek
39 – Linton Creek
40 – South Branch Linton Creek
41 – West Branch Linton Creek
42 – Cheney Creek

Figure 2.–Named tributaries to the Tahquamenon River. Names were taken from the United States Geological Survey (USGS) topographic maps and county maps produced by the Michigan Department of Natural Resources (MDNR) Engineering, Cartographic Services.



1 – Upper River Segment
2 – Dollarville Segment
3 – Marsh Drainage Segment
4 – Middle River Segment
5 – Lower River Segment
6 – East Branch Tahquamenon River

Figure 3.–Mainstem and East Branch valley segments of the Tahquamenon River.



1 – M-28
2 – M-117
3 – M-123
4 – H-40
5 – County Road 371
6 – County Road 373
7 – County Road 402
8 – County Road 405
9 – County Road 407
10 – County Road 415
11 – County Road 421
12 – County Road 422
13 – County Road 442
14 – County Road 455
15 – County Road 462
16 – County Road 500
17 – Belle Lake Road
18 – Camp 7 Road
19 – Charcoal Grade
20 – North Hulbert Road
21 – North Road
22 – Salt Point Road
23 – Skyline Road

Figure 4.–Major roads within the Tahquamenon River watershed.

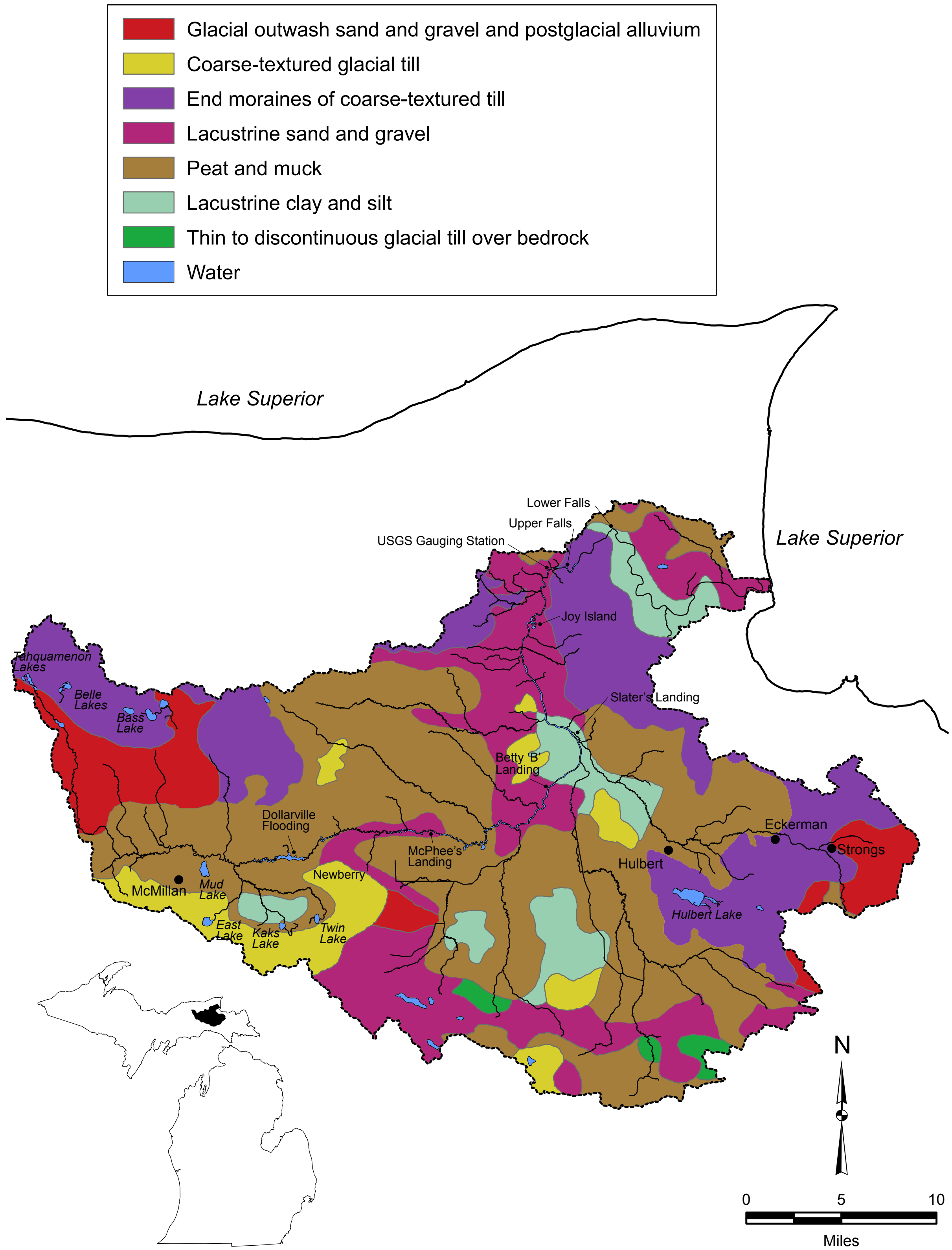


Figure 5.–Surface geology of the Tahquamenon River watershed. Data from Farrand and Bell (1982).

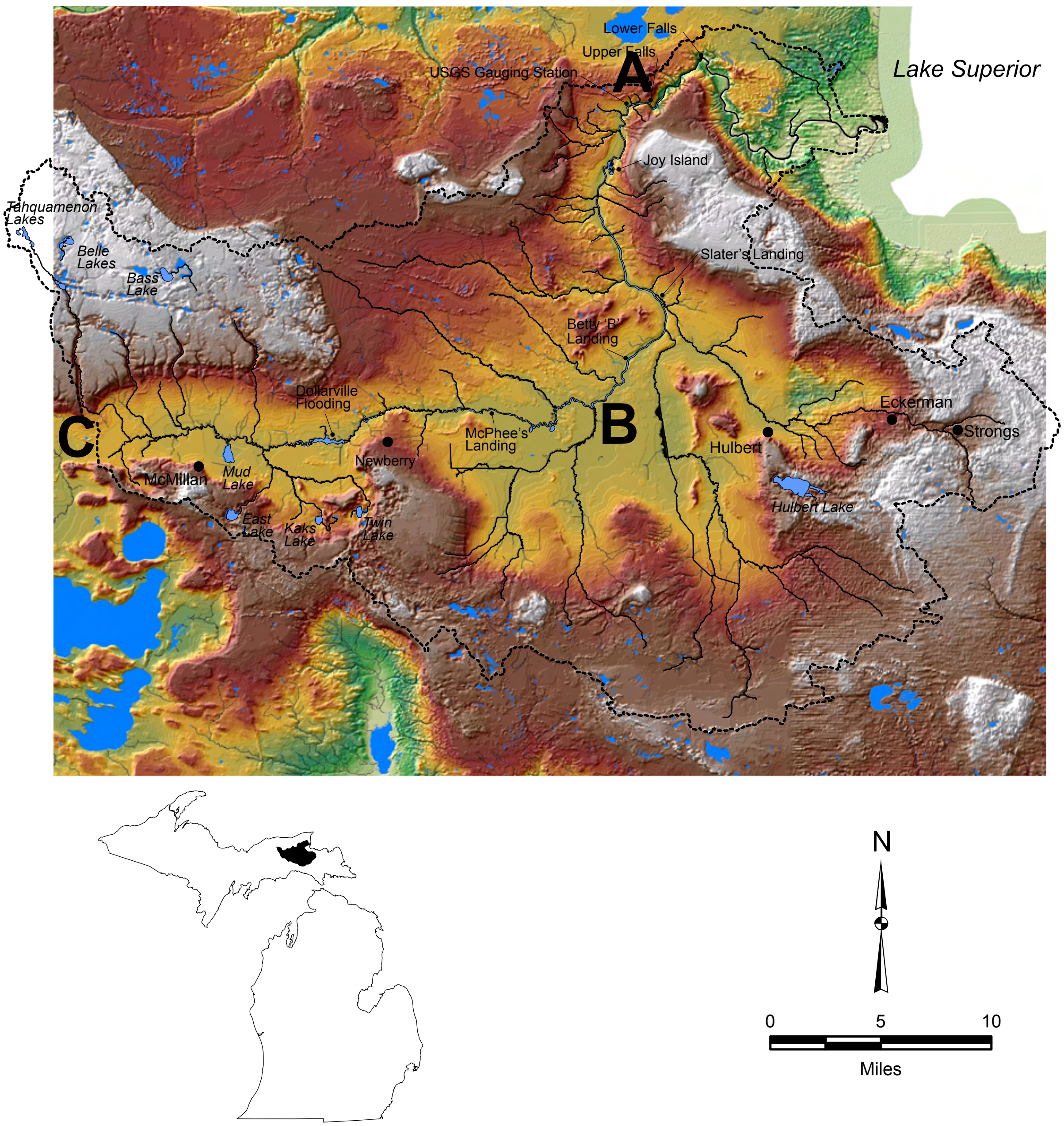


Figure 6.–Surface elevation map of the Tahquamenon River watershed and the local surrounding area. An arc connecting A, B, and C follows a former outlet of glacial Lake Minong (a precursor to Lake Superior). Sand dunes were formed around 10,000 years before present at Site A by glacial Lake Minong as a lower outlet (St. Mary's River) became available. Site B is hypothesized to be a 30-mile wide eddy as the drainageway turned westward toward C, eventually entering into present-day East Branch Fox and Manistique rivers. Site C shows the present divide between the Lake Michigan and Lake Superior watersheds. The horizontal striations along the right side of the picture are due to a data anomaly (Walt Loope, United States Geological Survey, Munising, unpublished data).

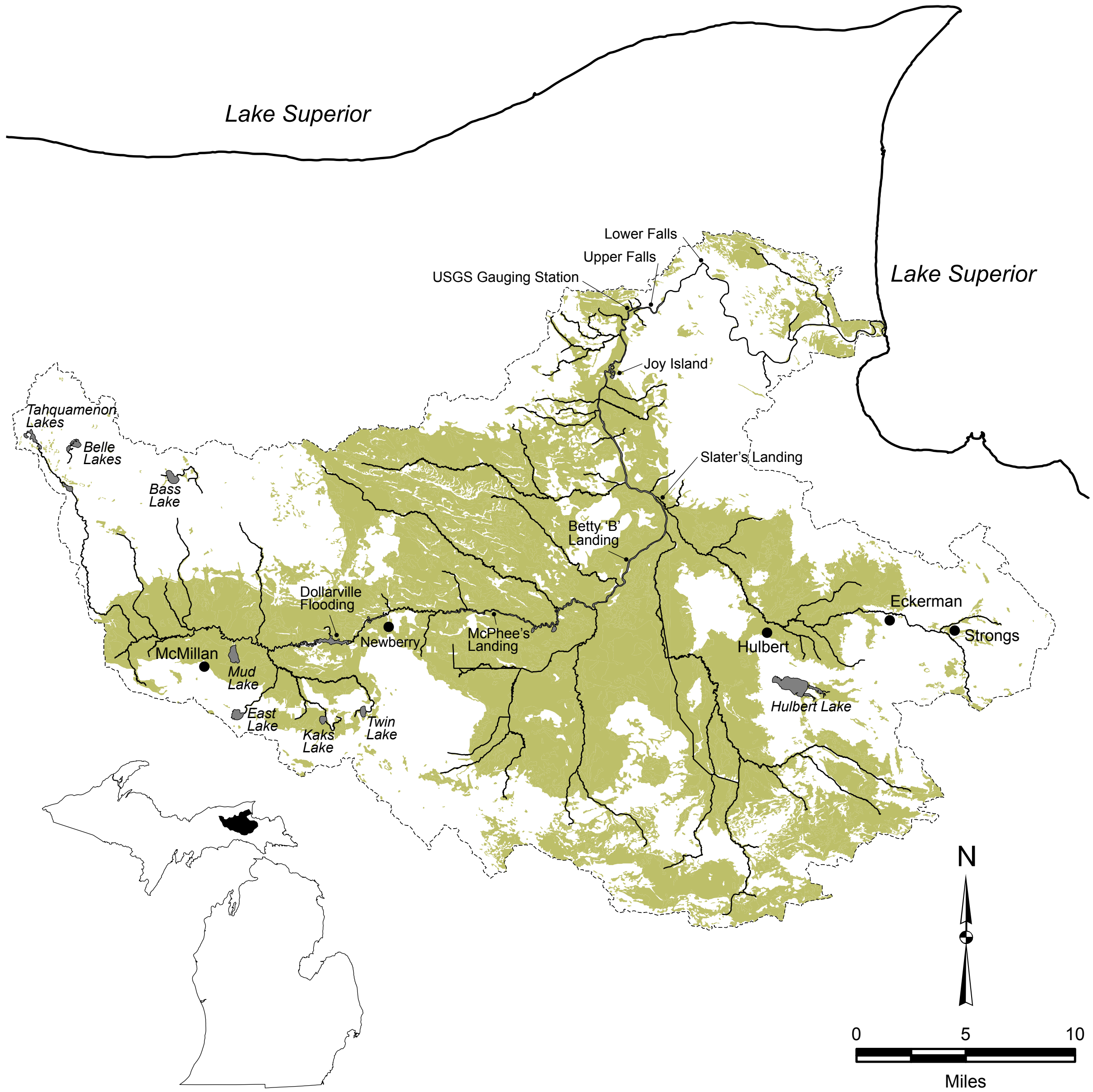


Figure 7.–Wetland composition of the Tahquamenon River watershed, as determined by the Michigan Department of Environmental Quality. Data is from the MDNR Spatial Information Resource Center, unpublished data, 2004.

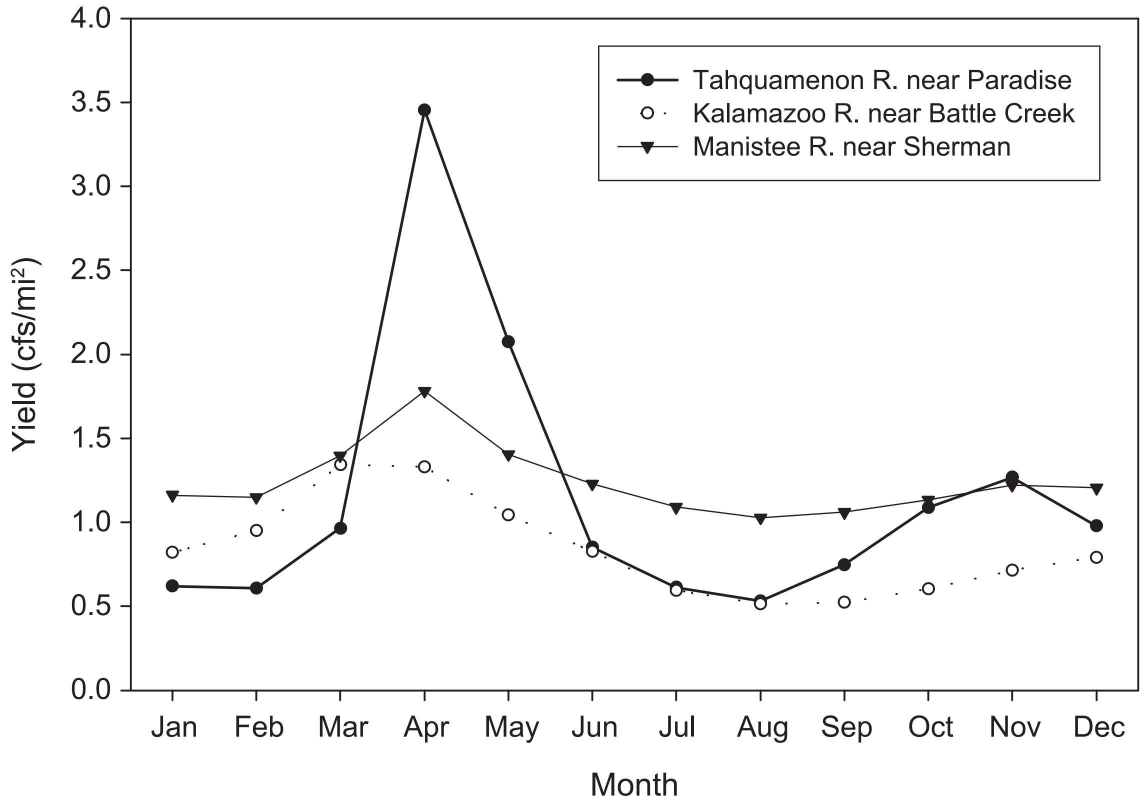


Figure 8.–Average monthly yield (mean monthly flow divided by catchment area) for the period of record at three similarly sized Michigan rivers with USGS gauges. Data from Blumer et al. (2004).

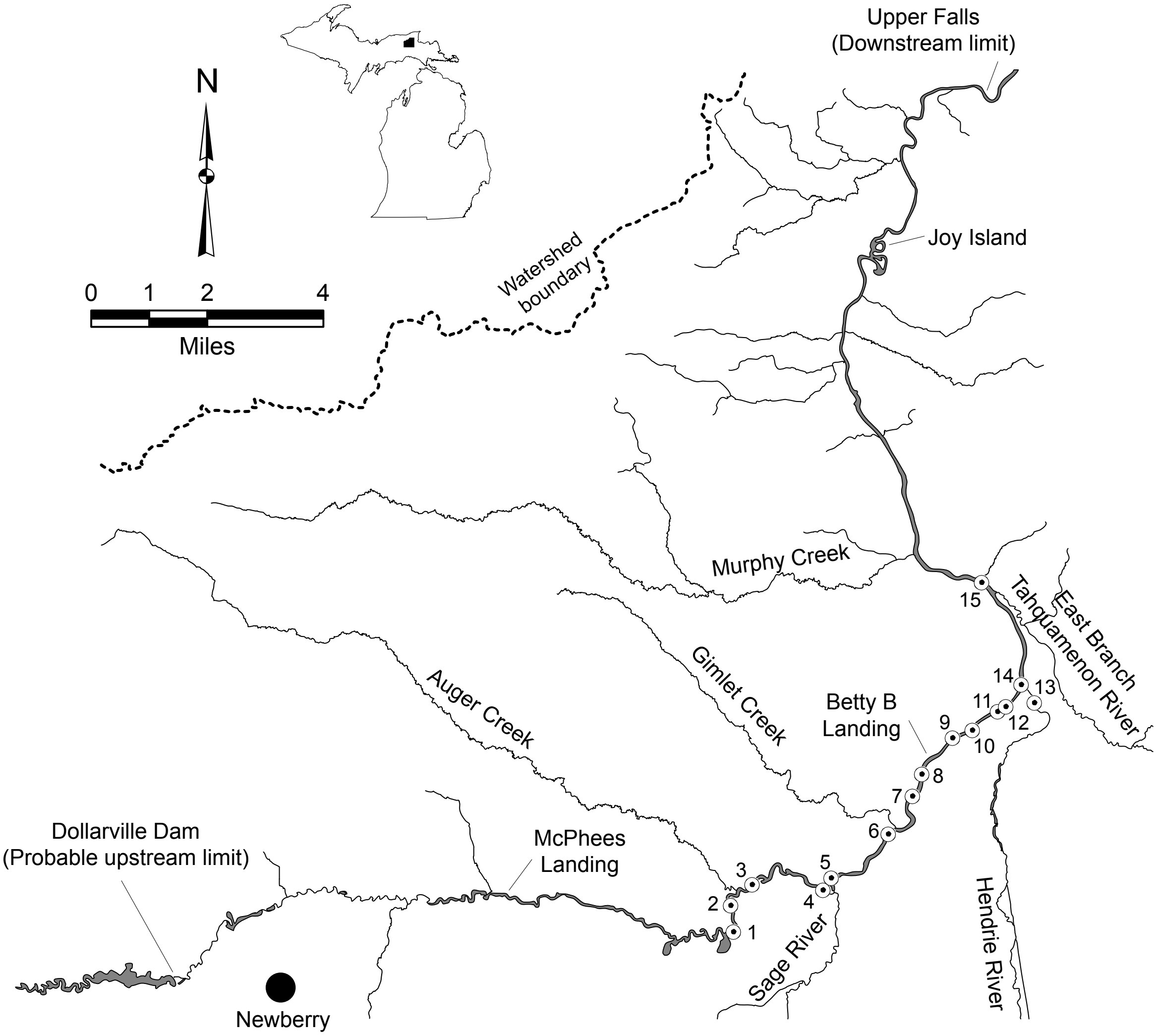


Figure 9.–Sediment sampling locations in the Tahquamenon River, August 22–23, 2005. Samples were taken with a Ponar dredge. Data summary (Table 5) from each site consists of multiple samples taken in cross-section.

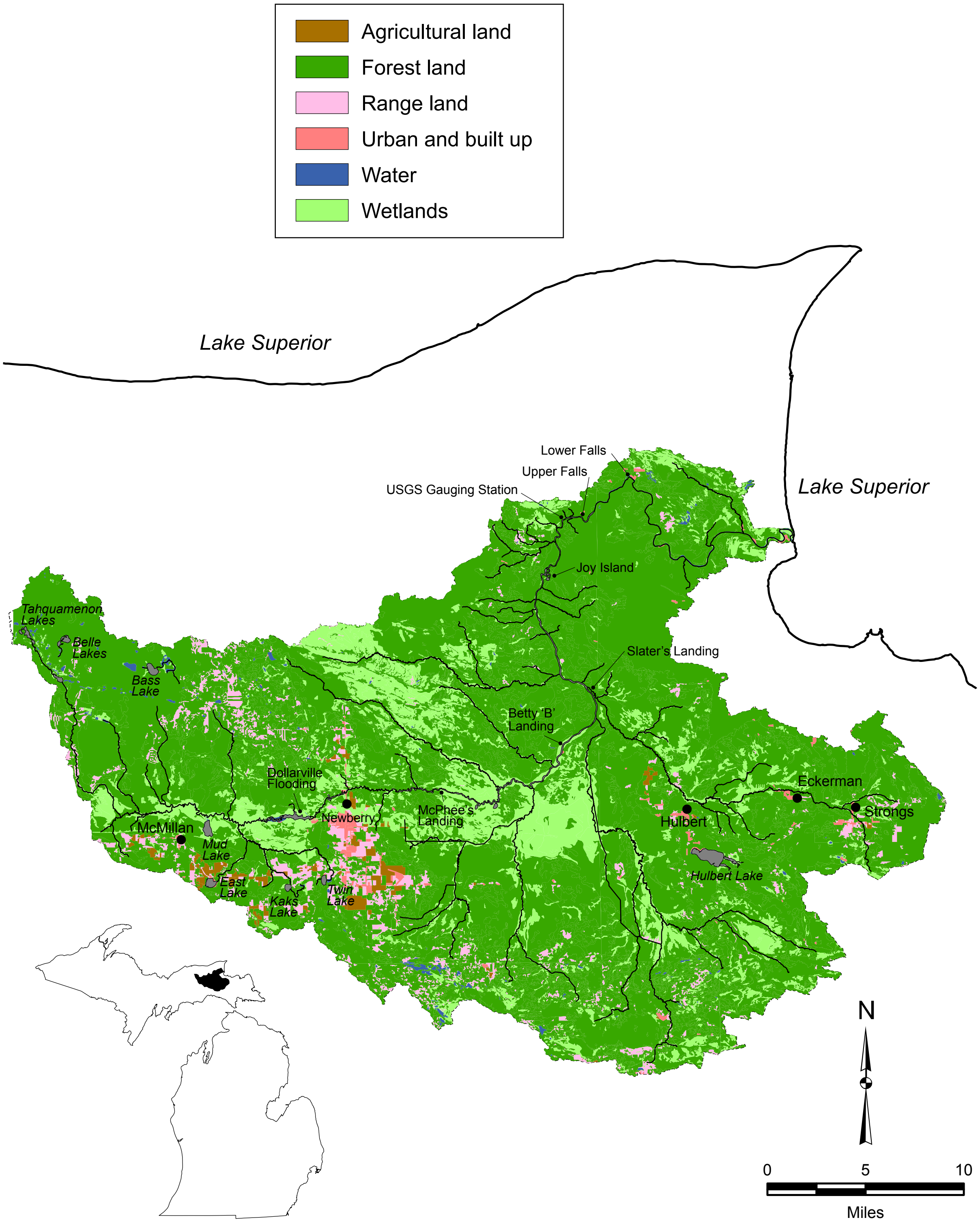


Figure 10.–Land type and use in the Tahquamenon River watershed. Data from MDNR Spatial Information Resource Center, unpublished data, 2004.

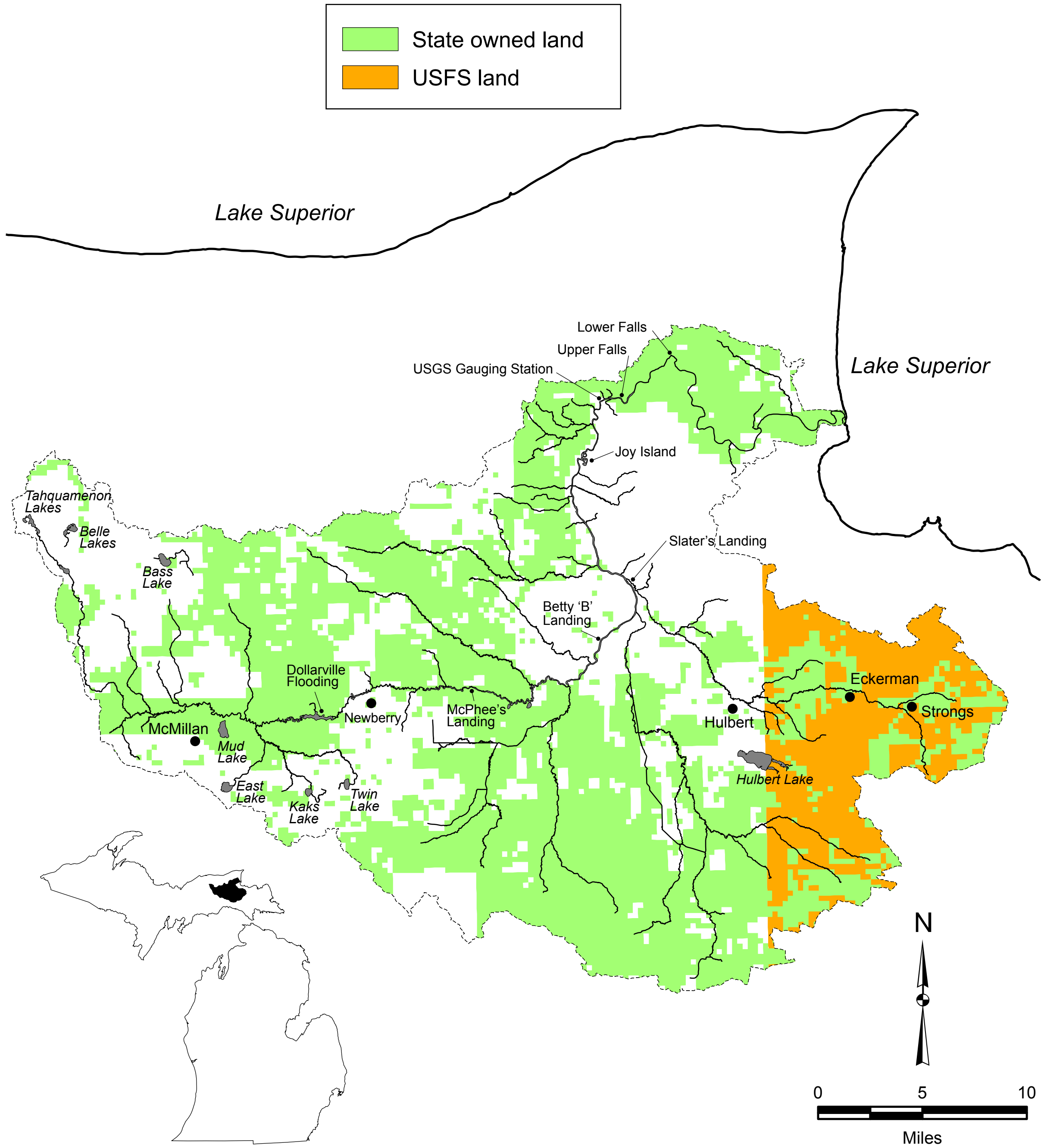


Figure 11.–Public land ownership in the Tahquamenon River watershed. State ownership is from the MDNR Spatial Information Resource Center, unpublished data, 2004. The UFS land ownership is from the U.S. Forest Service Office, Escanaba, Michigan, unpublished shapefile data, 2005.

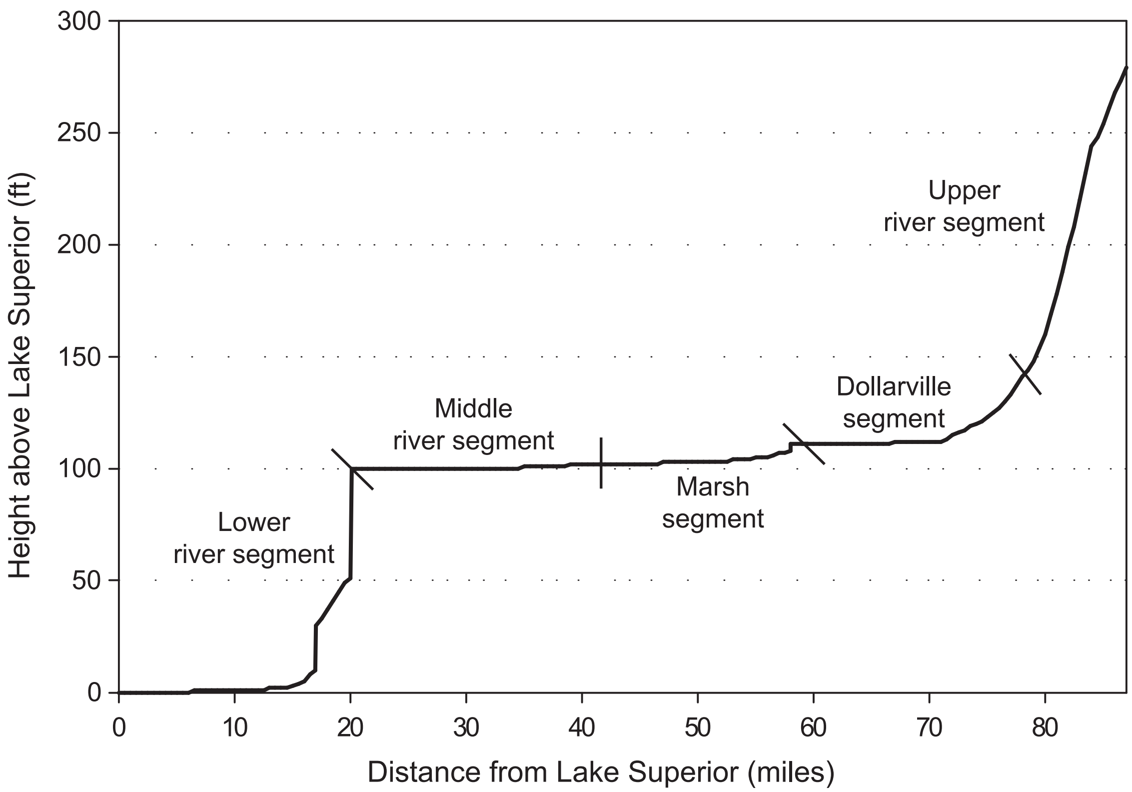


Figure 12.–Mainstem elevation changes from Lake Superior to headwaters. River segments are those described in the Tahquamenon River watershed assessment.

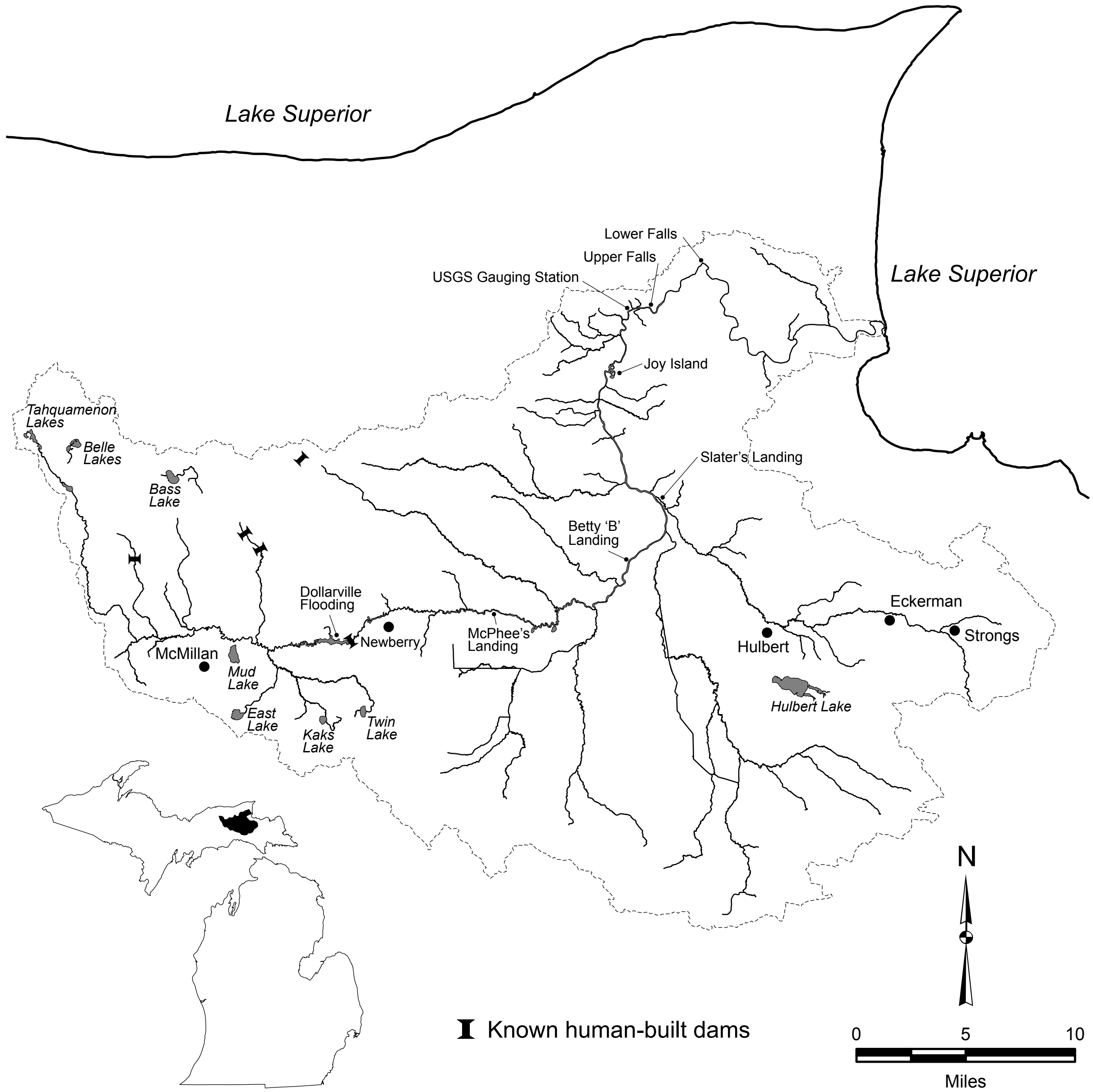


Figure 13.–Dams in the Tahquamenon River watershed (Department of Environmental Quality, Dam Safety Section), modified locally to eliminate earth-bermed, isolated ponds, July 2005.

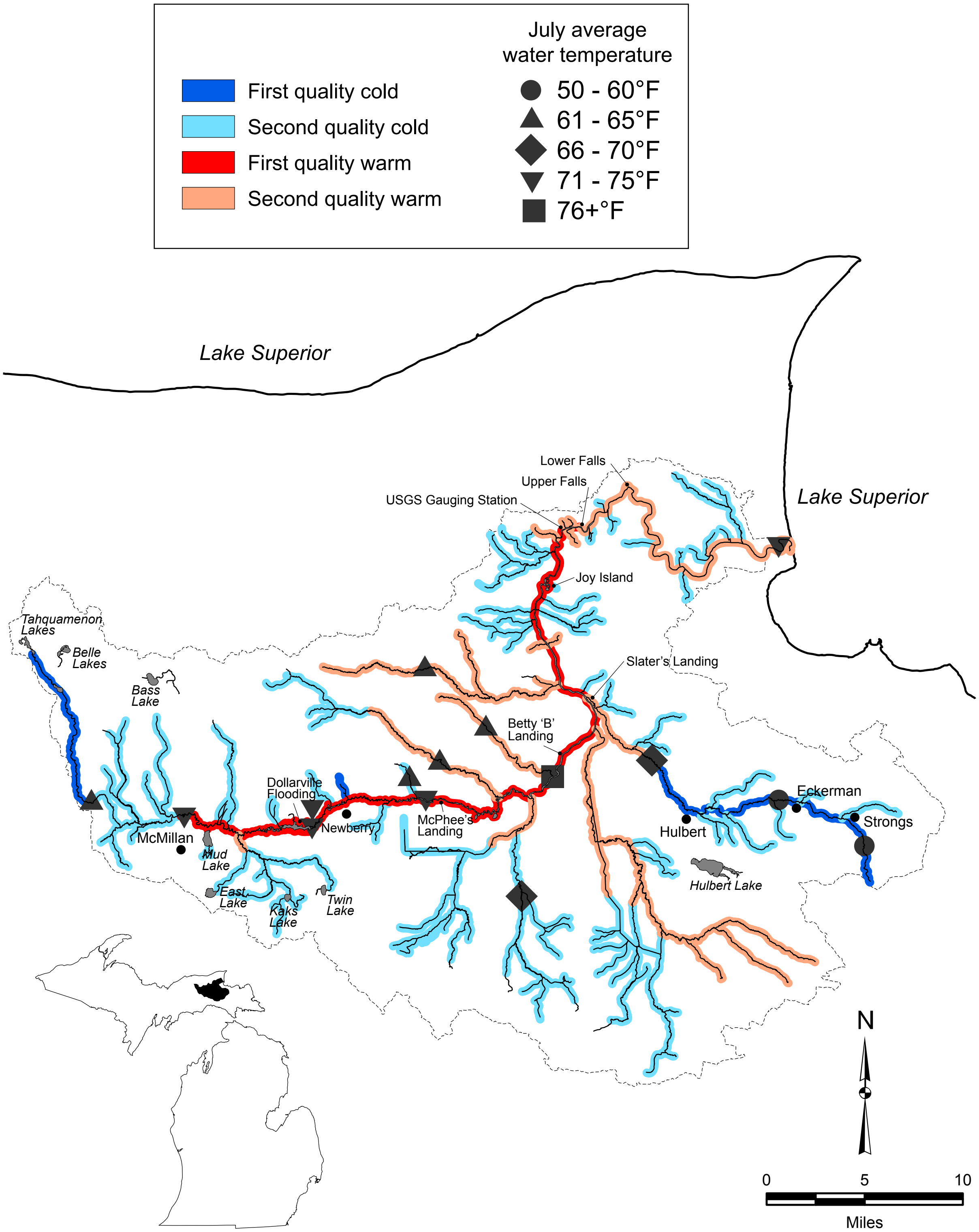
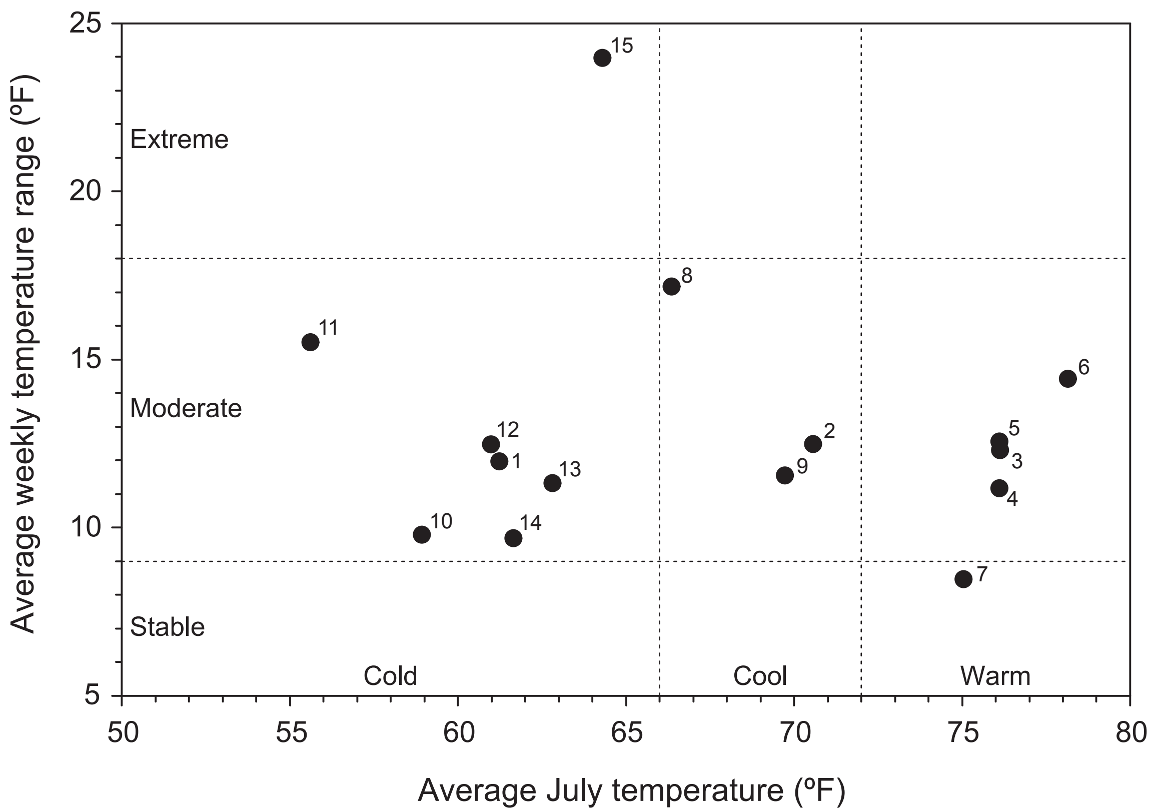


Figure 14.–Stream classification and temperature data logger locations during 2004 and 2005 for the Tahquamenon River watershed. Classes are defined in Anonymous (2000a).



1 – Tahquamenon River at County Road 442 Bridge
2 – Tahquamenon River at County Road 415 Bridge
3 – Tahquamenon River at Dollarville Dam, upstream side
4 – Tahquamenon River at Dollarville Dam, downstream side
5 – Tahquamenon River at McPhee's Landing
6 – Tahquamenon River about 2 miles downstream from Sage River confluence
7 – Tahquamenon River at mouth
8 – East Branch Sage River at M-28 Bridge
9 – East Branch Tahquamenon River at North Hulbert Road Bridge
10 – East Branch Tahquamenon River at old state hatchery site
11 – East Branch Tahquamenon River at Salt Point Road
12 – Sixteen Creek at Charcoal Grade Bridge
13 – Auger Creek at Charcoal Grade Bridge
14 – West Branch Murphy Creek at M-123 Bridge
15 – Gimlet Creek at Charcoal Grade culverts

Figure 15.–Temperature regime profiles for sites on the Tahquamenon River and selected tributaries. The calculations and format follow the classification system described in Wehrly et al. (1999).

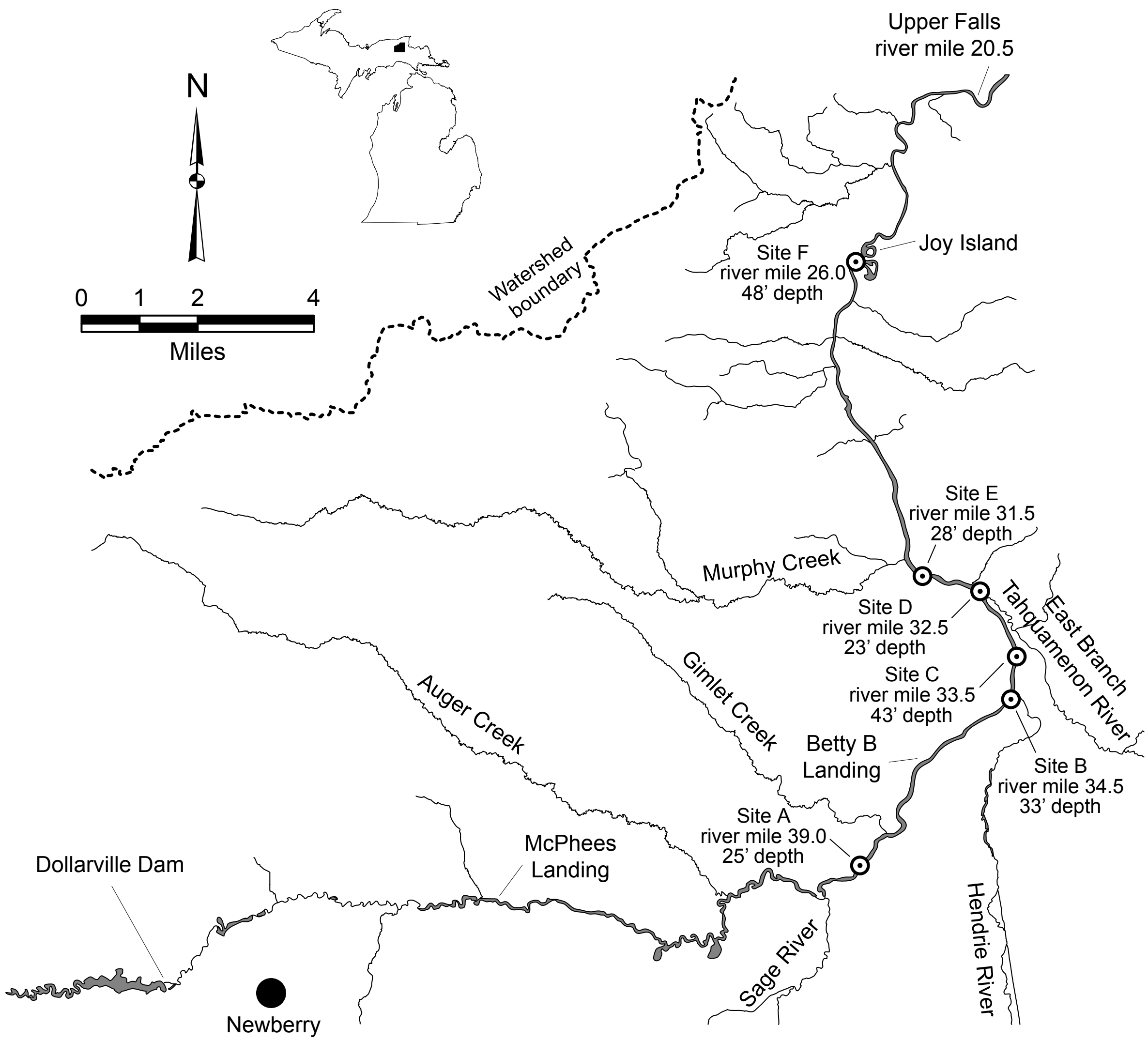


Figure 16.–Limnological vertical profile sites in the Tahquamenon River, September 1, 2006. Data from these sites are shown in Table 15.

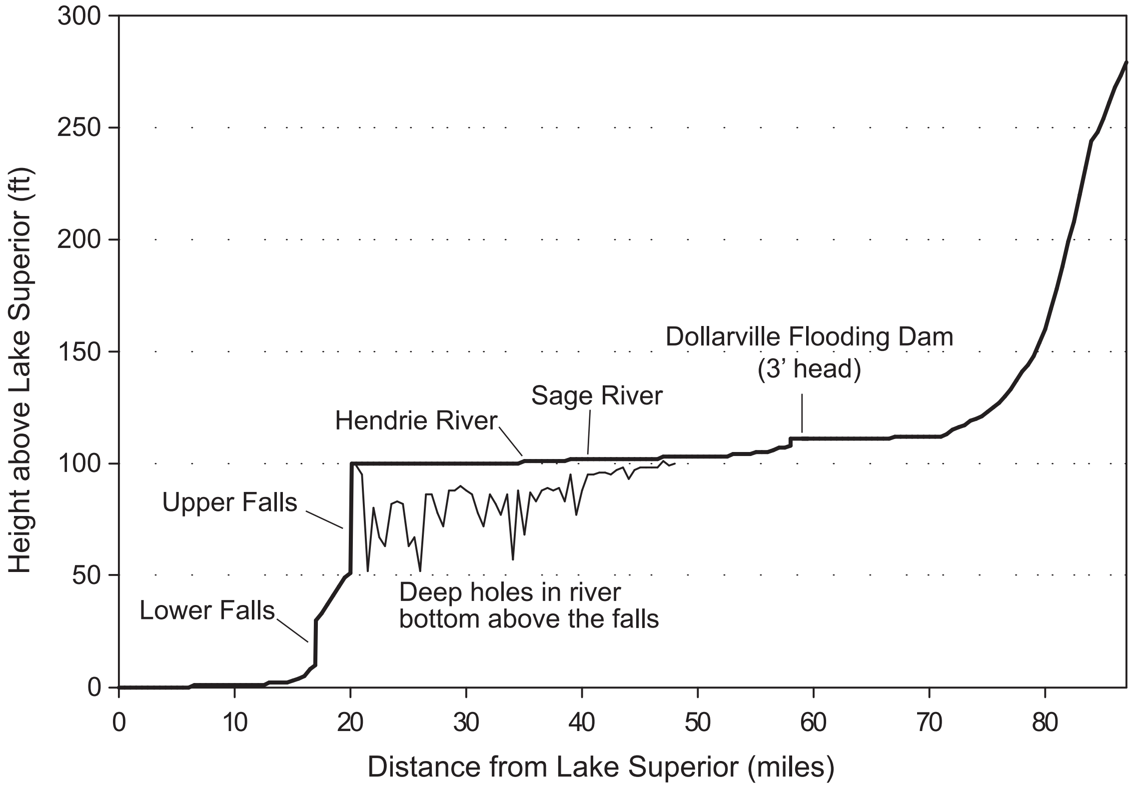


Figure 17.–Deep holes above the Upper Falls documented from survey data. Mainstem elevation changes from Lake Superior to headwaters. Elevation numbers are height above Lake Superior in feet. Most of the known holes are somewhat smaller than the 0.5 mi figure resolution. Also, some holes may be deeper, as there are several very small diameter deep spots that are easily missed during the sonar graphing effort.

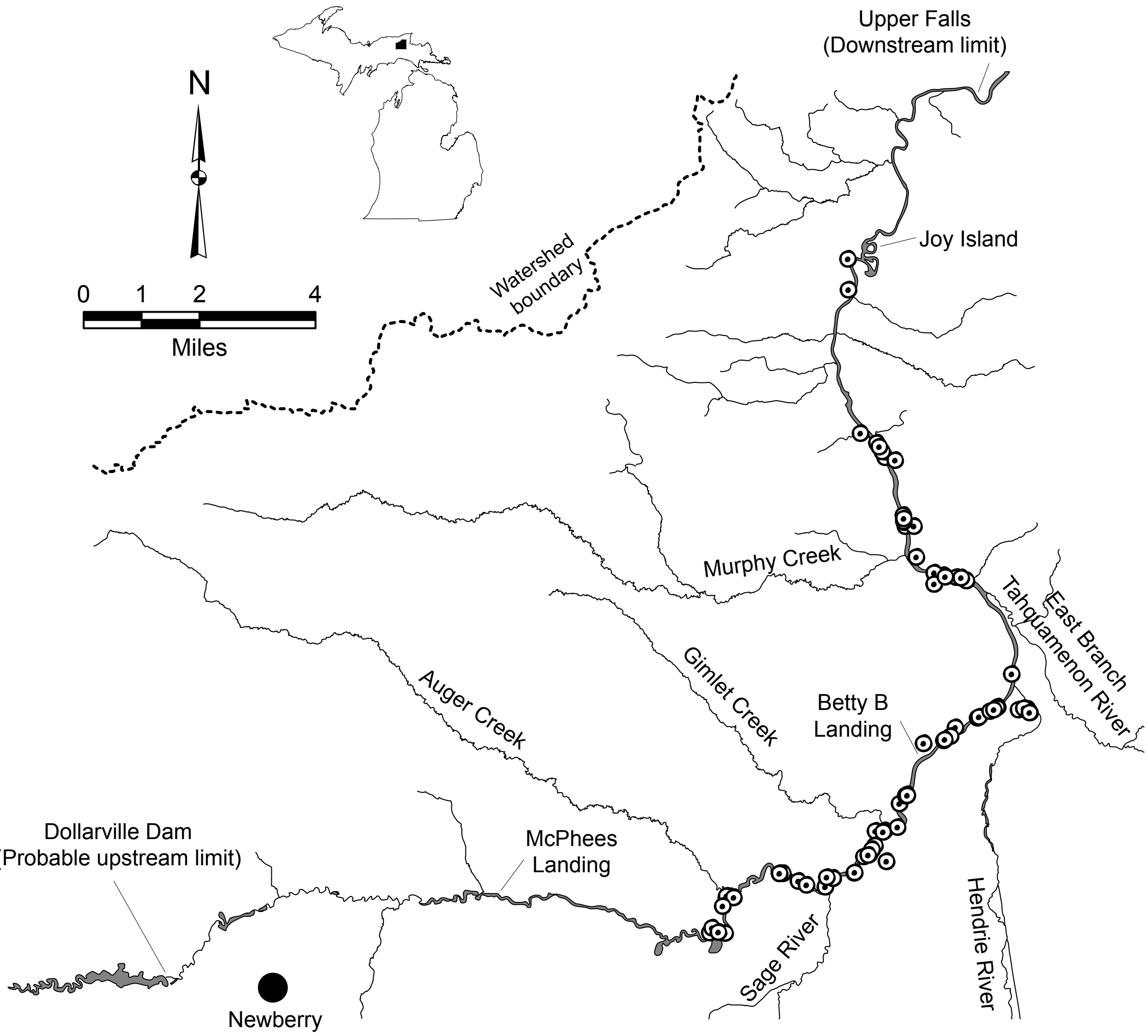


Figure 18.–Walleye locations observed by radio tracking in the Tahquamenon River, Middle River segment during April 2005. Data from 13 fish implanted with radio transmitters during October 2004.

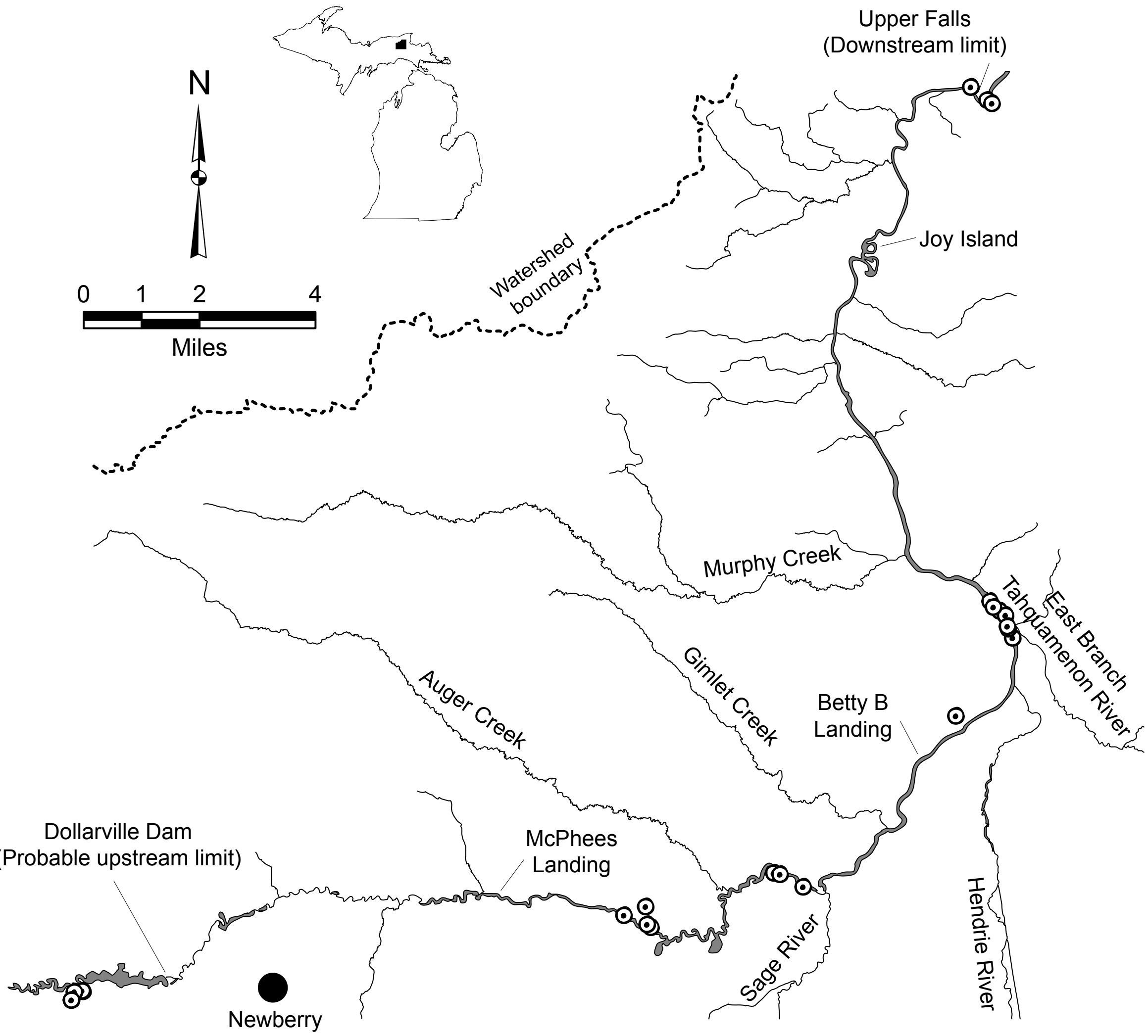


Figure 19.–Muskellunge locations observed by radio tracking in the Tahquamenon River, Middle River segment during May 2005. Data from seven fish implanted with radio transmitters during October 2004.

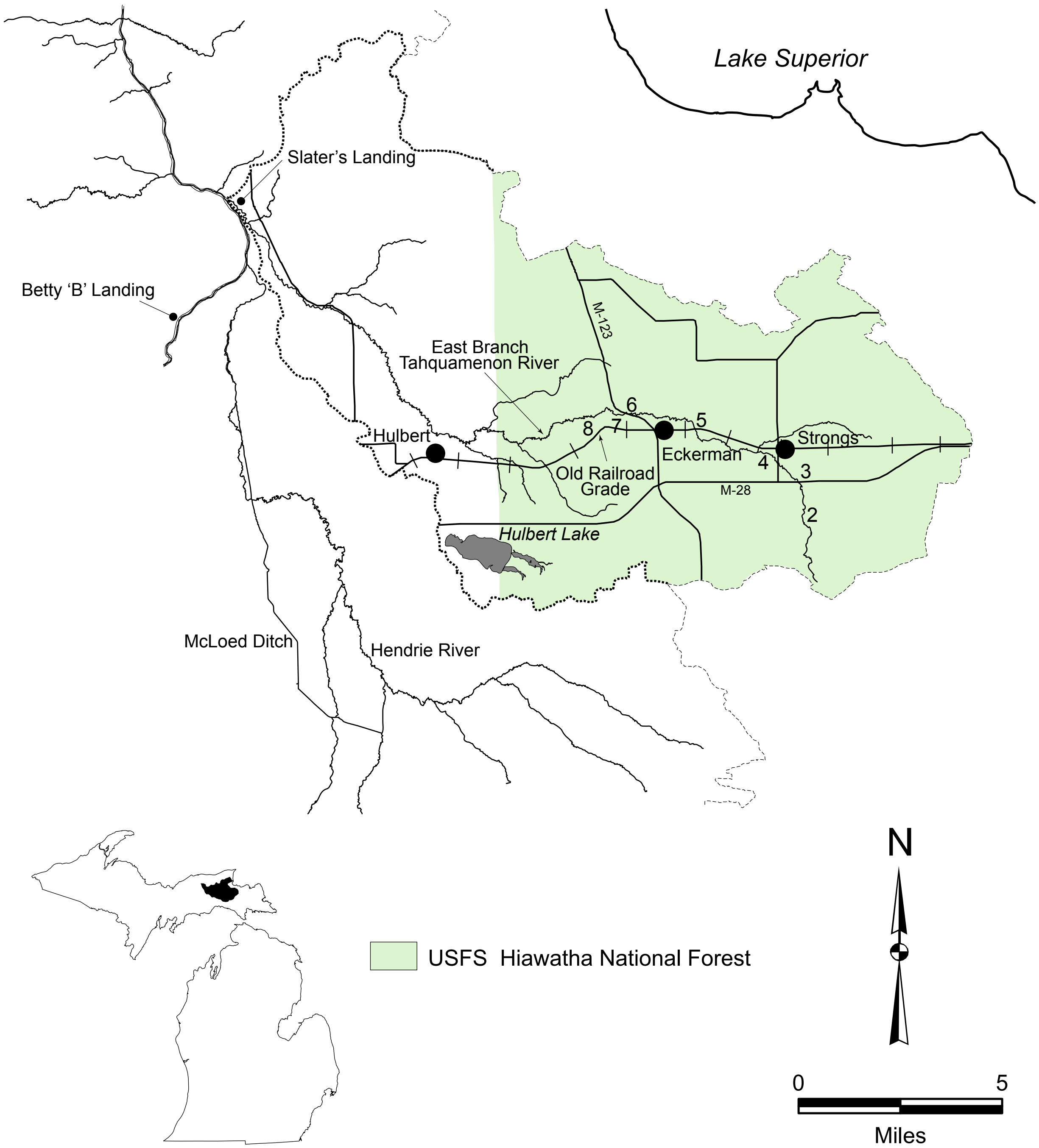


Figure 20.–Location of electrofishing inventory stations in the East Branch Tahquamenon River in 1995 and 2004 (Bassett 2005). There was no Site 1 sampled in 2004. Data from the 2004 survey occur in Table 25.

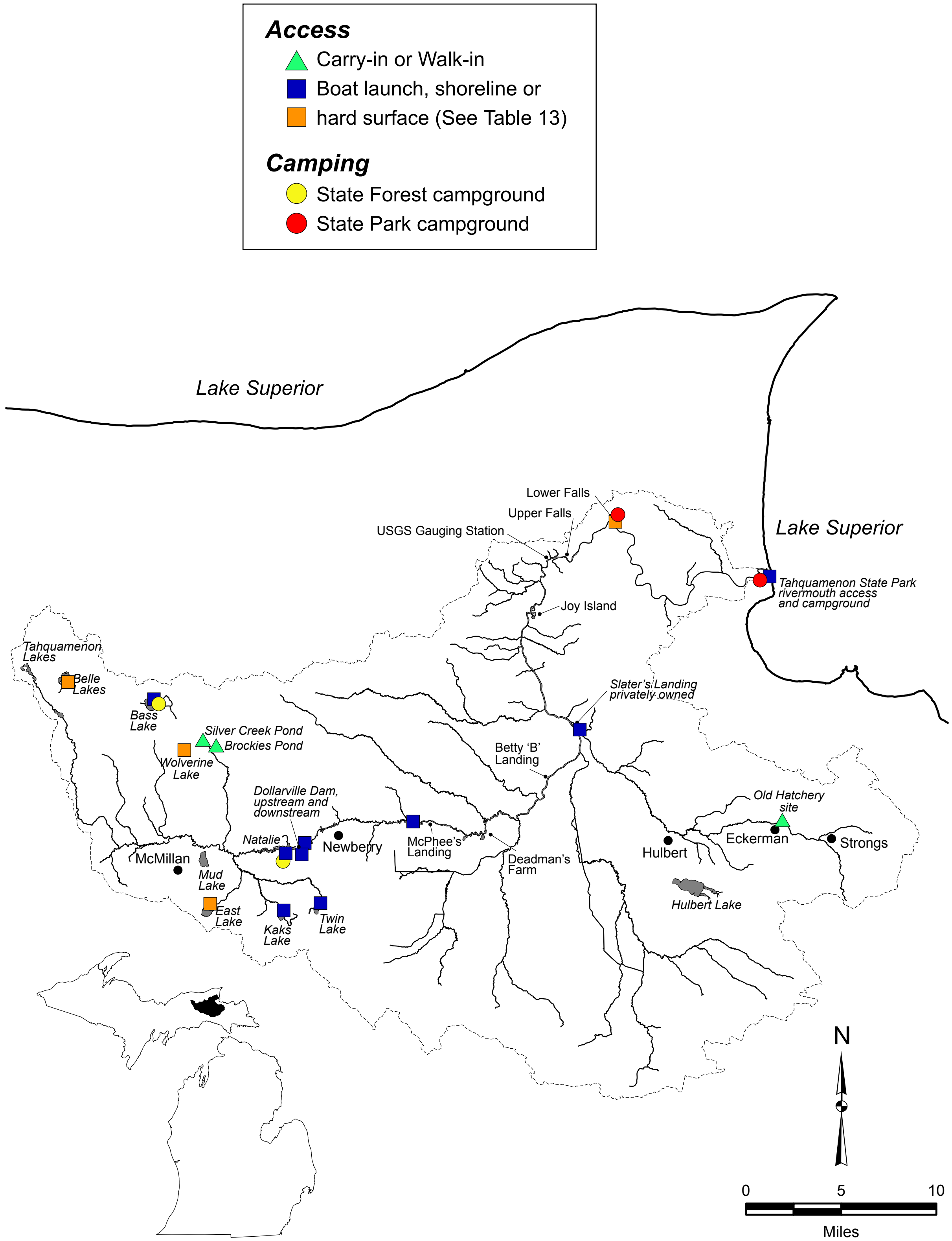


Figure 21.–Tahquamenon River watershed access sites and campgrounds.

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TABLES

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Table 1.–Percent of the Tahquamenon River watershed covered by various surficial materials and their permeability rates. Rates of permeability follow values given in Morris and Johnson (1967).

Surficial material	Percent of watershed soils	Permeability (ft/day)·1000
High permeability soils	44.6	
Coarse Glacial till	8.1	98.4
End Moraines of coarse-textured glacial till	23.3	98.4
Glacial Outwash coarse texture	13.2	98.4
Medium permeability soils	12.0	
Lacustrine Sand and Gravel		32.8
Low permeability soils	42.7	
Peat and Muck	37.0	3.3
Lacustrine Clay and Silt	4.9	1.6
Thin to Discontinuous over Bedrock	0.8	0.0
Water	0.6	

Table 2.–Percent composition of surface geology types (Farrand and Bell 1982) for catchments measured at the downstream ends of Tahquamenon River valley segments and major tributaries (MDNR Fisheries Division files).

	Mainstem					Tributaries		
Geology type	Upper	Dollarville	Marsh drainage	Middle	Lower	East Br.	Sage	Hendrie
Water	0.8	0.9	0.6	0.5	0.4	0.9	0.6	0.1
Peat & muck	11.5	31.1	41.7	41.3	39.6	35.3	41.6	53.5
Lacustrine clay & silt	0.0	2.8	2.0	5.3	6.7	5.7	10.2	6.6
Lacustrine sand & gravel	0.0	2.5	4.2	17.3	18.1	0.1	35.9	17.8
Glacial outwash sand & gravel	33.5	22.8	16.2	8.0	7.5	12.4	4.0	1.2
Coarse-textured glacial till	9.4	15.9	13.4	6.9	6.4	1.5	5.1	6.3
End moraines of coarse-textured till	44.9	24.0	21.8	19.9	20.4	44.1	0.0	11.3
Thin till over bedrock	0.0	0.0	0.0	0.9	0.9	0.0	2.5	3.2
Catchment size (mi^2)	39	167	235	744	797	130	110	127

Table 3.–Average monthly Tahquamenon River discharges (cfs) at the USGS gauging stations, upstream of the Upper Falls (1953–2003) and at Newberry (1934–36).

Month	Upper Falls	Newberry
Jan	490	144
Feb	479	119
Mar	762	242
Apr	2,728	480
May	1,639	297
Jun	672	224
Jul	484	108
Aug	420	119
Sep	590	217
Oct	859	195
Nov	1,002	310
Dec	773	254
Average	908	225

Table 4.–Seasonal flow stability attributes for the Tahquamenon River and selected Michigan river catchments of similar size as calculated from USGS streamflow data. Low-flow yield (LFY) is calculated as 90% exceedence flow/mi^2/year, and the 10:90% exceedence flow ratio (10:90 ratio) is calculated as the 10% exceedence flow divided by the 90% exceedence flow. Qualitative ratings for the 10:90 ratio are: Very good–1.0–2.0; good–2.1–5.0; fair–5.1–10.0; and poor >10.0 (P. Seelbach, Michigan Department of Natural Resources, Fisheries Division, personal communication).

Watershed	Location	Size (mi^2)	LFY	10:90 ratio
Cass	Dehmel Road	841	0.06	25.12
Clinton	Moravian Drive	734	0.16	9.99
Huron	Willow Road	807	0.25	6.12
Kalamazoo	Raymond Road	824	0.35	4.30
Tahquamenon	Above Upper Falls	790	0.38	6.34
Manistique	UP–near Blaney	704	0.48	4.60
Manistee	M-37	857	0.95	1.75
Clinton, N. Br.	M59	199	0.04	45.64
Rouge	Spinoza Rd.	187	0.09	16.42
Battle Creek	Bellevue Cemetery	187	0.15	11.89
Black	UP–near Bessemer	200	0.15	19.62
Sturgeon	UP–near Foster City	237	0.18	9.31
St. Joseph	14 Mile Rd.	206	0.22	8.05
Flint, S. Br.	Columbiaville Rd.	221	0.22	7.64
Sturgeon	UP–near Nahma	183	0.36	6.00
Pine	UP–near Rudyard	184	0.38	6.58
Tahquamenon	M-123 (near Newberry)	200	0.58	3.33
Sturgeon	Wolverine	198	0.80	1.86

Table 5.–Sediment data taken with a standard Ponar dredge in the Tahquamenon River between Sage River and Murphy Creek, August 22–23, 2005. The Ponar sampled an area 9 in x 9 in. Samples were taken along a perpendicular transect at each location, generally from north to south or east to west. Sites at each location were determined visually for uniform spacing across the river. The sample from each site was analyzed in a wash bucket before moving to the next site.

Site	Description	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F
1	Downstream from Frenchmans Lake	100% silt	80% clay 15% silt 5% fiber	80% clay 10% sand 10% silt	80% clay 15% sand 3% silt 3% mussels	95% clay 5% mussels	95% silt 5% sand
2	Upstream from Auger River	100% silt	100% silt	95% silt 5% fiber	95% silt 5% fiber	85% peat 10% fiber 5% silt	
3	Downstream from Deadmans Farm	95% silt 5% fiber	90% silt 10% clay	80% silt 10% fibers 5% sand	95% silt 5% peat	90% silt 10% clay	
4	Upstream from Sage River	100% peat	90% peat 10% clay	85% silt 10% clay 5% peat	80% clay 20% sand	90% peat 10% silt	85% silt 15% peat
5	Downstream from Sage River	90% sand 10% silt	100% sand	100% sand	100% sand	100% sand	80% silt 10% sand 10% peat
6	Downstream from Green Knoll cabin	80% clay 10% peat 10% silt	60% sand 30% silt 10% clay	70% clay 20% sand 10% silt	90% sand 10% silt	90% sand 10% silt	80% sand 20% silt
7	Just above the Betty B Landing	70% silt 20% sand 10% mussels	75% silt 20% sand 5% mussels	60% sand 30% silt 10% clay	90% clay 5% silt 5% peat	95% silt 5% peat	80% silt 20% clay
8	Downstream from the Betty B	90% silt 10% peat	10% silt	90% clay 10% silt	80% clay 20% silt	90% clay 10% peat	100% silt

Table 5.–Continued.

Site	Description	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F
9	Crooked Tree Camp	60% silt 40% peat	100% silt	100% peat	100% peat	100% peat	100% peat
10	Upstream from Everglades Camp	80% peat 20% silt	80% silt 20% peat	70% clay 30% silt	70% clay 20% silt 10% sand	60% clay 30% peat 10% silt	
11	Everglades Camp	60% silt 20% peat 20% sand	60% silt 40% clay	60% clay 40% silt	80% silt 20% clay	80% silt 20% clay	
12	Rocky point up from Hendrie River	80% peat 10% sand 10% silt	80% silt 15% clay 5% small stone	80% silt 15% clay 5% small stone	80% silt 20% small mussels	85% gravel 15% 2–6” rock	
13	Hendrie River mouth	100% silt	85% silt 10% sand 5% clay	70% sand 25% silt 5% mussels	100% clay	100% clay	
14	Upstream in the Hendrie River	80% clay 20% sand	70% silt 15% clay 10% peat 5% sand				
15	Downstream from E. Br. Tahquamenon	100% clay	100% clay	60% silt 40% peat	75% coarse woody 25% silt	80% coarse woody 20% silt	100% silt

Table 6.–Critical mean current velocity of clear water required to initiate movement along a stream bed of various types of bottom deposit (Hynes 1972).

Type of bed	Velocity (cm/sec)
Sandy clay	30
Hard clay	60
Fine sand	20
Coarse sand	30–50
Fine gravel	60
Medium gravel	60–80
Coarse gravel	100–140
Angular stones	170

Table 7.–Road crossings in the Tahquamenon River watershed, from headwater to mouth. Missing data indicated by "–". Where a bridge is indicated, there will be no data for number of culverts.

Road name	Stream or river	Bridge (B) or culvert (C)	Number or type of culverts
CR 422	Tahquamenon River, W of Belle Lake area	C	1
CR 421	Tahquamenon River, Eagles Nest	B	
CR 442	Tahquamenon River, N of 421 junction	B	
CR 442	Syphon Creek	C	1
CR 442	East Creek	C	1
CR 413	Kings Creek	C	2 arch 57" x 38"
M-28	Kings Creek	C	box
Soo Line RR	Kings Creek	B	
Soo Line RR	Mud Creek	B	
CR 415	Tahquamenon River, N of McMillan	B	
M-28	East Lake Creek	C	1
M-28	Pete S Creek	C	1
M-28	Carlson Creek	C	box
M-117	McGraw Creek	C	–
M-28	Teaspoon Creek	B	
CR 363	Teaspoon Creek	B	
CR 402 (Foley Hill Rd)	Teaspoon Creek	C	1
Dollarville Rd	Teaspoon Creek	B	
CR 462	39 Creek	C	1
McLoed Truck Trail	W. Br. Sage River T45N, R09W, S29	C	1
McLoed Truck Trail	W. Br. Sage River T45N, R09W, S28	C	1
M-28	W. Br. Sage River	B	
M-28	E. Br. Sage River	B	
Norton Camp Rd	W. Br. Hendrie River	B	
Fibron Quarry Lane	S. Br. Hendrie River	C	1
Fibron Junction Rd	S. Br. Hendrie River	C	1
Fibron Junction Rd	Anguilm Creek	C	1
H-40 (Trout Lake Rd)	S. Br. Hendrie River	C	1
Camp 2 TT (USFS 3145)	Naugle Creek		road gated
Camp 2 TT (USFS 3145)	Hendrie River (Camp Two Creek)		road gated
M-123	Hendrie River	C	1
M-28	E. Br. Tahquamenon River	B	
Soo Line RR	E. Br. Tahquamenon River	B	
M-123	E. Br. Tahquamenon River	B	
M-123	Fourteen Creek	C	1 6 ft cement box
Soo Line RR	Grants Creek	–	
Soo Line RR	Riley S Creek	–	
Soo Line RR	Kleins Creek	–	
N. Hulbert R	E. Br. Tahquamenon River	B	
Soo Line RR	W. Br. Sage River	B	
Soo Line RR	E. Br. Sage River	B	
Soo Line RR	McLoed Ditch	B	
Soo Line RR	Hendrie River	B	
N. Hulbert Rd	Big Beaver Creek	C	1 6 ft corrugated
N. Hulbert Rd	Little Beaver Creek	C	1 6 ft corrugated
N. Hulbert Rd	Hiawatha Creek	C	1

Table 7.–Continued.

Road name	Stream or river	Bridge (B) or culvert (C)	Number or type of culverts
Unnamed Rd	O'Keefe Creek T48N, R08W, S36	C	1
Unnamed Rd	Shouts Creek T48N, R08W, S25	C	1
Unnamed Rd	Rose Creek T48N, R08W, S14	C	1
Unnamed Rd	Bowers Creek T48N, R07W, S23	C	1
Tahqua Rd	Cheney Creek	C	1 6 ft steel
Tahqua Rd	Lynch Creek	C	2 corrugated
M-123	Cheney Creek	C	1 + 1 (snowmobile trail on north side)
M-123	Wolf Creek	C	1 cement
M-123	Gage Creek	C	1 cement
M-123	Callum Creek	C	–
M-123	N. Br. Linton Creek	C	1 larch 72" x 44"
M-123	M. Br. Linton Creek	C	1 cement
M-123	S. Br. Linton Creek	C	1 cement
Halifax Rd	M. Br. Linton Creek T48N, R08W, S16	C	1
Halifax Rd	S. Br. Linton Creek T48N, R08W, S17/20	C	1
Halifax Rd	Linton Creek T48N, R08W, S20, East	C	2
Camp 7 Rd	Linton Creek T48N, R08W, S20, West	C	1
Halifax Rd	Linton Creek	C	1
Charcoal Grade	Baird Creek	C	1
Charcoal Grade	Penny Creek	C	2
Charcoal Grade	Savage Creek	B	
Charcoal Grade	Murphy Creek	B	
Murphy Creek Rd	N. Br. Murphy Creek T47N, R09W, S13	B	
Murphy Creek Rd	W. Br. Murphy Creek T47N, R09W, S15	B	
Charcoal Grade	Gimlet Creek	C	4
Unnamed Rd	Gimlet Creek T46N, R08W, S05 (upstream)		road gated
Unnamed Rd	Gimlet Creek T46N, R08W, S05 (downstream)		road gated
Charcoal Grade	Auger River	B	
Charcoal Grade	Sixteen Creek	B	
M-123	W. Br. Murphy Creek	B	
M-123	Auger River	B	
Silver Creek Rd	Silver Creek	B	
Camp Six Rd	Silver Creek	C	1
Charcoal Grade	Otto Brandt	B	
M-123	Tahquamenon River	B	

Table 8.–Percent composition of land use types for catchments measured at the downstream ends of Tahquamenon River valley segments and major tributaries.

	Mainstem					Tributaries		
Land use type	Upper	Dollarville	Marsh drainage	Middle	Lower	East Br.	Sage	Hendrie
Water	2.7	2.9	2.7	2.4	2.5	2.9	1.4	2.2
Urban	0.0	0.1	0.4	0.1	0.1	0.1	0.1	0.0
Barren	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Forest	68.1	53.1	45.6	45.0	46.2	59.2	31.7	38.5
Grassland	2.6	3.3	3.3	1.7	1.7	0.4	3.1	0.8
Agriculture, pasture, and recreational grass	1.0	3.5	3.2	1.5	1.4	0.6	2.0	0.3
Wetland	25.1	36.9	44.7	49.0	47.8	35.9	61.7	58.2

Table 9.–Tributary stream characteristics in the Tahquamenon River watershed, including length (mi), length of designated trout stream (mi), average gradient (ft/mi), source, elevation above Lake Superior level (ft), and mouth description.

Name of stream	Length (mi)	Trout (mi)	Gradient (ft/mi)	Source	Mouth elev. (ft)	Mouth description
39 Creek	2.5	2.5	21.4	Upland spring	704	Tahquamenon River
Anchard Creek	1.2	0	147.5	Upland spring	701	Tahquamenon River
Anguim Creek	1	1	1.0	Previous Fibron Pond	812	S Br. Hendrie River
Atwood Creek	0.9	0	36.7	Upland spring	702	Murphy Creek
Auger River	15	6.1	6.5	Cleveland Cliffs Lake	705	Tahquamenon River
Baird Creek	3.1	3.1	34.5	Marsh	702	Tahquamenon River
Basnau Creek	2.9	2.9	13.4	Marsh	704	Hendrie River
Big Beaver Creek	2.6	2.6	20.0	Marsh	706	E Br Tahquamenon R
Big Ditch	4.5	4.5	4.7	Marsh	705	West Br Sage River
Bowers Creek	1.8	1.8	82.2	Upland spring	602	Tahquamenon River
Callum Creek	1.4	0	31.4	Marsh	701	Tahquamenon River
Carlson Creek	2.6	2.6	3.1	Kaks Lake	717	Teaspoon Creek
Cheney Creek	5.7	5.7	18.4	Marsh	601	Tahquamenon River
Creek #14	4.4	4.4	8.2	Marsh	714	E Br Tahquamenon R
Creek #8	3.2	3.2	22.5	Upland spring	797	E Br Tahquamenon R
E Br. Sage River	13.7	13.7	9.5	Marsh	705	Sage River
E Br. Tahquamenon R	23.5	19.5	8.5	Marsh	702	Tahquamenon River
East Creek	4.6	4.6	21.1	Upland spring	713	Tahquamenon River
East Lake Creek	2.9	2.9	28.3	East Lake, Luce Co	714	Teaspoon Creek
First Creek	3.9	3.9	25.4	Upland spring	716	West Br Sage River
Freeman Creek E	0.8	0	47.5	Upland spring	702	Tahquamenon River
Freeman Creek W	1.9	0	12.6	Marsh	702	Tahquamenon River
Gage Creek	0.5	0	82.0	Upland spring	701	Tahquamenon River
Gimlet Creek	8.4	0	6.3	Marsh	704	Tahquamenon River
Grants Creek	2.9	2.9	29.0	Upland spring	716	E Br Tahquamenon R
Hendrie River	24.5	0	6.4	Upland spring	702	Tahquamenon River
Hiawatha Creek	1.6	1.6	30.0	Upland spring	702	Tahquamenon River
Kings Creek	2.1	2.1	9.0	Marsh	721	Tahquamenon River
Kleins Creek	1.7	1.7	6.5	Marsh	726	Rileys Creek

Table 9.–Continued.

Name of stream	Length (mi)	Trout (mi)	Gradient (ft/mi)	Source	Mouth elev. (ft)	Mouth description
Laketon Slough	1.4	1.4	2.9	Marsh	714	Tahquamenon River
Linton Creek	5.3	5.3	21.9	Marsh	701	Tahquamenon River
Little Beaver Creek	1.9	1.9	22.6	Upland spring	703	E Br. Tahquamenon R
Lynch Creek	1.6	1.6	18.1	Marsh	602	Tahquamenon River
Maye Creek	0.7	0.7	270.0	Big Spring	701	Tahquamenon River
McGraw Creek	1.4	1.4	17.1	Maki Lake	725	Kaks Lake
McLeod Ditch	9.8	6.8	3.4	S. Br. Hendrie	704	Hendrie River
Mid Br. Linton Creek	2.8	2.8	35.4	Marsh	708	N Br. Linton Creek
Murphy Creek	4.7	0	5.1	Confluence, W & N Brs	702	Tahquamenon River
N Br. Linton Creek	2.3	2.3	9.1	Marsh	723	Linton Creek
N Br. Murphy Creek	4.3	0	20.0	Upland spring	726	Murphy Creek
Naugle Creek	5	0	18.8	Marsh	755	Hendrie River
O'Keefe Creek	3.1	3.1	40.6	Upland spring	702	Tahquamenon River
Otto Brandt Creek	1.1	1.1	28.5	Marsh	704	Tahquamenon River
Penny Creek	2.1	0	24.8	Upland spring	701	Savage Creek
Petes Creek	1.2	1.2	20.0	Marsh	716	Carlson Creek
Popps Creek	5.3	5.3	27.9	Upland spring	701	Tahquamenon River
Quinn Creek	3.1	0	19.7	Marsh	741	Hendrie River
Red Creek	3.1	3.1	11.9	Marsh	713	East Creek
Riley Creek	1.4	1.4	12.1	Marsh	709	Big Beaver Creek
Rileys Creek	2	2	22.5	Riley Lake	713	E Br. Tahquamenon R
Rose Creek	1.1	0	136.4	Upland spring	701	Tahquamenon River
S Br. Hendrie River	9.2	9.2	13.8	Marsh	727	Hendrie River
S Br. Linton Creek	2.7	2.7	19.3	Upland spring	731	Linton Creek
Sage River	8.6	4.6	2.0	Marsh	704	Tahquamenon River
Savage Creek	3	3	36.3	Upland springs	701	Tahquamenon River
Schouts Creek	3.4	3.4	52.6	Upland spring	701	Tahquamenon River
Silver Creek	6.2	6.2	16.6	Silver Creek Pond	713	Tahquamenon River
Sixteen Creek	1.9	1.9	16.3	Marsh	705	Tahquamenon River
Syphon Creek	5.6	5.6	23.8	Turnbull Lake	718	Tahquamenon River

Table 9.–Continued.

Name of stream	Length (mi)	Trout (mi)	Gradient (ft/mi)	Source	Mouth elev. (ft)	Mouth description
Tahquamenon River	87.3	17.8	3.2	Middle Tahquamenon Lake	601	Lake Superior
Teaspoon Creek	6.1	4.9	2.0	Confluence, E & W Brs	712	Tahquamenon River
Third Creek	2.5	2.5	36.0	Marsh	713	W Br. Sage River
W Br. Hendrie River	10	10	12.7	Marsh	713	Hendrie River
W Br. Murphy Creek	10.4	0	6.0	Marsh	726	Murphy Creek
W Br. Sage River	7	7	14.3	Marsh	705	Sage River
W Br. Teaspoon Creek	1.1	1.1	0.9	Twin Lakes	724	Teaspoon Creek
Wolf Creek	0.7	0	62.9	Upland spring	701	Tahquamenon River

Table 10.–Dams in the Tahquamenon River watershed (Michigan Department of Environmental Quality, Dam Safety Section, unpublished data), modified to eliminate earth-bermed, isolated ponds, July 2005.

County/dam	River	Town	Range	Sec	Hazard	Owner	Head	Acres	Comment
Luce									
Dollarville Dam	Tahquamenon R	46N	10W	27	Low	State	3	1100	Concrete spillway
Brockies Pond Dam	Tributary to Silver Creek	46N	11W	1	Low	State	17	6	Level control structure
Buckies Pond Dam	Tributary to Silver Creek	46N	11W	1	Low	State	11	7	Level control structure
Silver Creek Pond Dam	Silver Creek	47N	11W	35	Low	State	11	15	Level control structure
Halfway Lake Dam	Tributary to Auger Creek	47N	10W	17	Low	Private	4	61	Lake-level control structure
George Wood Dam	Syphon Creek	46N	12E	01	Low	Private	4	4	Control and fish passage

Table 11.–Water temperatures (°F) for the Tahquamenon River and select tributaries during July 2004–06. Temperatures were generally recorded hourly with Onset Hobo Water Temp Pro temperature loggers. The summer of 2005 was unusually warm.

		Average weekly			
Sites	Year	Maximum	Minimum	Range	Mean
Tahquamenon River at CR 442	2005	66	55	12	61
Tahquamenon River at CR 415	2005	76	64	12	71
Tahquamenon River at Dollarville Dam, upstream side	2005	82	70	12	76
Tahquamenon River at Dollarville Dam, downstream side	2005	81	70	11	76
Tahquamenon River at McPhee's Landing	2005	82	70	13	76
Tahquamenon River downstream from Sage River [a]	2005	87	72	14	78
Tahquamenon River mouth	2005	79	71	8	75
Sage River at M-28	2005	74	57	17	66
E Br Tahquamenon River at N. Hulbert Rd	2005	75	64	12	70
E Br Tahquamenon River at old hatchery	2005	63	54	10	59
E Br Tahquamenon River at Salt Point Rd	2006	65	49	16	56
Sixteen Creek at Charcoal Grade	2004	67	55	12	61
Auger Creek at Charcoal Grade	2004	69	57	11	63
Murphy Creek at M-123	2004	66	57	10	62
Gimlet Creek at Charcoal Grade [b]	2004	76	52	24	64

[a] This temperature logger was potentially out of the water for a few days during the low water period.
[b] Logger was placed just downstream of a shallow beaver pond several acres in size.

Table 12.–Fish consumption advisories listed on the Michigan Department of Community Health website in July 2005 for lakes, impoundments, and streams in the Tahquamenon River watershed due to mercury (Michigan Department of Community Health 2004). No other advisories occur for the watershed and those listed below are subject to future change.

Species	Critical size [a] (inches)	Men (meals)	Women and Children (meals)
black crappie	≥8	1/week	1/month
largemouth bass	≥14	1/week	1/month
muskellunge	≥30	1/week	1/month
northern pike	≥22	1/week	1/month
rock bass	≥8	1/week	1/month
walleye	≥14	1/week	1/month
yellow perch	≥8	1/week	1/month

[a] Critical size means the advisory applies to this size fish or larger

Table 13.–Optimal temperature regimes (Fahrenheit) for several fish species in the Tahquamenon River and select tributaries. Optimal temperature regimes for each species and the calculation of the regimes were described by Wehrly et al. (1999). * = Designated Trout Stream. Opt = within the optimal temperature profile for the species. Marg. = marginal habitat, due either to average July temperature outside of the optimal range or else too great a temperature fluctuation, as defined by Wehrly et al. (1999).

	Brook trout		Brown trout		Northern pike		Smallmouth bass	
River location	Opt <63	Marg 63–68	Opt <64	Marg 64–68	Opt 66–79	Marg <66	Opt >73	Marg <72
1 Tahquamenon R. at Co. Rd. 422 Bridge *[a]	X							
2 Tahquamenon River at the Co. Rd. 415 Bridge *		X		X	X			X
3 Tahquamenon River at Dollarville Dam, upstream side					X		X	
4 Tahquamenon River at Dollarville Dam, downstream side					X		X	
5 Tahquamenon River at McPhee's Landing					X		X	
6 Tahquamenon River about two miles downstream from the Sage River confluence					X		X	
7 Tahquamenon River at the mouth					X		X	
8 Sage River East Branch at the M-28 Bridge *[b]		X			X			
9 E. Br. Tahquamenon River at the N. Hulbert Road Bridge		X		X	X			X
10 E. Br. Tahquamenon River at the old state hatchery site *	X		X					
11 E. Br. Tahquamenon River about ½ mile upstream from the M-28 Bridge *	X							
12 Sixteen Creek at the Charcoal Grade Bridge *	X		X			X		
13 Auger Creek at the Charcoal Grade Bridge			X		X			
14 Murphy Creek at the M-123 Bridge	X		X			X		
15 Gimlet Creek at the Charcoal Grade culverts								

[a] County Road 415 Bridge is the downstream limit of trout designation in the Tahquamenon River. A "spreads" exists about eight miles upstream, which serves to magnify diurnal temperature fluctuations.
[b] Many beaver dams exist throughout the upstream portion of the East Branch Sage River.

Table 14.–Water temperature vertical profile for the Tahquamenon River, August 19, 2005. The site was located 150 ft upstream from the confluence with the Hendrie River. Maximum depth at the site was 25 ft. Dissolved oxygen was not measured.

Depth (ft.)	°F
Surface (0)	78.7
1	
2	
3	
4	↓
5	78.6
6	
7	
8	
9	↓
10	73.4
11	71.6
12	65.5
13	62.1
14	58.7
15	55.4
16	
17	
18	
19	↓
20	48.1
21	
22	
23	
24	
(Bottom) 25	↓

Table 15.–Vertical limnological profiles taken September 1, 2006, from six deep holes in the Tahquamenon River, from the Sage River confluence downstream to the Upper Falls.

Depth	Temperature (F)	Specific conductance	Conductivity	Dissolved oxygen (%)	Dissolved oxygen (mg/L)	pH
Site A: About 1 mi downstream from Sage River; river mile 39.0, maximum depth 25 ft						
1	66	182	160	123	11.5	8.4
5	66	198	176	125	11.6	8.1
10	66	198	175	125	11.5	8.1
15	66	198	176	125	11.6	8.0
20	66	198	176	125	11.6	8.0
Site B: Just upstream from the Hendrie River; river mile 34.5; Maximum depth 33 ft						
1	70	202	187	142	12.7	7.9
6	68	202	183	136	12.3	7.9
10	67	208	186	128	11.7	7.9
15	63	215	184	75	7.2	7.9
20	47	192	130	19	2.2	8.2
25	46	189	126	6	0.7	8.2
29	46	196	130	3	0.4	8.3
Site C: Roughly 1/3 the distance downstream from the Hendrie to the E. Branch; river mile 33.5; maximum depth 43 ft						
1	70	205	190	150	13.3	8.2
10	67	213	190	132	12.2	8.2
15	51	176	128	10	1.1	8.4
20	45	177	117	8	1.0	8.5
30	45	180	118	10	1.2	8.5
Site D: About 0.25 mi below E. Branch confluence; river mile 32.5; maximum depth 23 ft						
0	69	208	191	147	13.2	8.1
9	65	205	179	139	13.0	8.2
15	45	255	168	17	2.1	8.3
21	44	283	185	7	0.8	8.2
Site E: About 0.25 mi upstream from Murphy Creek; river mile 31.5; maximum depth 28 ft						
1	69	208	191	154	13.8	8.1
10	63	201	172	126	12.1	8.2
15	61	202	168	84	8.2	8.1
19	61	206	170	23	2.3	8.0
Site F: At the sharp bend just upstream of Joy Island; river mile 26; maximum depth 48 ft						
1	71	207	193	159	14.0	7.8
10	67	209	186	143	13.2	7.9
15	45	139	92	48	5.8	7.8
20	44	140	91	39	4.7	7.9
25	44	138	90	39	4.7	7.9
30	44	138	90	41	5.0	8.1

Table 16.–Tahquamenon River watershed Public Boat Launch Directory. The Ramp Code number tells the type of launch ramp the site user can expect to find at the access site: 1) A hard-surfaced ramp with sufficient water depth and lake size to accommodate most trailerable boats; 2) A hard-surfaced ramp, in areas of limited water depth or lake size, where launching, retrieving, and use of larger boats may be difficult; 3) A gravel surfaced ramp; and 4) No actual ramp, the site is suitable only for carry-in canoes, kayaks and small aluminum boats. Administering codes: PRD = MDNR, Parks and Recreation Division, FMFMD = MDNR, Forest, Mineral and Fire Management Division (Anonymous 1995).

Site no.	Site name and water body	Location	Ramp code	Toilets	Parking	Administering division	Town	Range	Sec
48-3	Silver Creek Trout Pond	8 mi NW of Newberry	4	Yes	15	PRD	47N	11W	35
48-4	Kaks Lake	4 mi SW of Newberry	2	Yes	10	PRD	45N	10W	09
48-5	McPhee’s Landing, Tahquamenon River	5 mi ENE of Newberry	2	No	6	PRD	46N	09W	22
48-6	Natalie, Dollarville Flooding	2 mi W of Dollarville	1	Yes	10	PRD	46N	10W	29
48-8	Bass Lake, State Forest Campground	8 mi N of McMillan	1	Yes	5	FMFMD	47N	11W	17
48-9	Twin Lake	3 mi S of Newberry	1	Yes	14	PRD	45N	10W	10
48-14	East Lake	3 mi SE of McMillan	4	No	6	PRD	45N	11W	10
48-26	Brockie’s Pond	7 mi NW of Newberry	4	No	6	PRD	46N	11W	01
48-32	Dollarville Flooding above the dam, Tahquamenon River	Dollarville	1	Yes	8	PRD	46N	10W	27
----	Tahquamenon River, Below the Dollarville Dam	Dollarville	2	Yes	8	PRD	46N	10W	27
17-2	Old Eckerman Trout Pond, East Branch Tahquamenon River	Eckerman	4	Yes	10	PRD	46N	06W	22
17-11	Tahquamenon Falls State Park, River Mouth campground site	5 mi S of Paradise	1	Yes	11	PRD	48N	06W	14

Table 17.–Responsibilities of Michigan Department of Environmental Quality (MDEQ) divisions and offices pertinent to the Tahquamenon River watershed. Descriptions are from MDEQ website.

Office or division	Responsibilities
Air Quality Division (AQD)	Works with business and industry air pollution sources and with the general public to help maintain compliance with statutes that minimize adverse impacts on human health and the environment.
Environmental Science and Services Division (ESSD)	Oversees outreach and assistance services leading to the improvement in environmental quality, providing non-regulatory services related to all environmental programs administered by the MDEQ.
Land and Water Management Division (LWMD)	Responsible for land/water interface resources. The mission of the LWMD is to promote the best use of these resources for their social and economic benefits while protecting associated resource values, property rights, the environment, and public health and safety.
Remediation and Redevelopment Division (RRD)	Administers Part 201, Environmental Remediation; Part 213, Leaking Underground Storage Tanks; and portions of Part 215, Michigan Underground storage Tank Financial Assurance, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA).
Waste and Hazardous Materials Division (WHMD)	Administers prevention programs to protect the environment and the public’s health through proper management of hazardous products; solid, liquid, medical, and hazardous waste; and radioactive materials.
Water Bureau	Protects and enhances the quality of the state’s drinking water, surface water, and groundwater for the benefit of current and future generations.
Office of Civil Enforcement Coordination (OCEC)	Provides for policy development, coordination, and training to improve the MDEQs overall enforcement efforts.
Office of Geological Survey (OGS)	Responsible for geological resources. The mission of the OGS is to promote the best use of these resources for their social and economic benefits while protecting associated resource values, property rights, the environment, and public health and safety.
Office of Great Lakes (OGL)	Lead agency within state government to develop policies and programs to protect, enhance, and manage the Great Lakes ecosystem.

Table 18.–Fish species present in the Tahquamenon River watershed. None are recognized as endangered or threatened. MDNR, Fisheries Division, files, Taylor 1954, Bailey et. al. 2004. Introduction (I) or Native (N) designation is the best origin determination possible by perusing the existing files. Historical records indicate that the threatened lake sturgeon *Acipenser fulvescens* were at one time present in the lower river, but none have been documented in recent times. Two muskellunge forms, Great Lakes and northern, are present below the Lower Falls. Above the Upper Falls, only the northern form is present. Species are listed in taxonomic order. R = rare, C = common, O = occasional, A = abundant.

Common name	Scientific name	Occurrence	Origin
silver lamprey	*Ichthyomyzon unicuspis*	R	N
American brook lamprey	*Lampetra appendix*	C	N
sea lamprey	*Petromyzon marinus*	R	I
common carp	*Cyprinus carpio*	R	I
brassy minnow	*Hybognathus hankinsoni*	O	N
common shiner	*Luxilus cornutus*	A	N
northern pearl dace	*Margariscus nachtriebi*	A	N
golden shiner	*Notemigonus crysoleucas*	C	N
blackchin shiner	*Notropis heterodon*	O	N
blacknose shiner	*Notropis heterolepis*	C	N
spottail shiner	*Notropis hudsonius*	R	N
mimic shiner	*Notropis volucellus*	O	N
northern redbelly dace	*Phoxinus eos*	C	N
finescale dace	*Phoxinus neogaeus*	O	N
bluntnose minnow	*Pimephales notatus*	O	N
fathead minnow	*Pimephales promelas*	O	N
longnose dace	*Rhinichthys cataractae*	R	N
western blacknose dace	*Rhinichthys obtusus*	A	N
creek chub	*Semotilus atromaculatus*	C	N
longnose sucker	*Catostomus catostomus*	R	N
white sucker	*Catostomus commersonii*	A	N
silver redhorse	*Moxostoma anisurum*	R	N
black bullhead	*Ameiurus melas*	R	N
brown bullhead	*Ameiurus nebulosus*	C	N
northern pike	*Esox lucius*	C	N
muskellunge	*Esox masquinongy*	A	N
central mudminnow	*Umbra limi*	A	N
rainbow smelt	*Osmerus mordax*	R	I
cisco	*Coregonus artedi*	R	N
rainbow trout	*Oncorhynchus mykiss*	R	I
Chinook salmon	*Oncorhynchus tshawytscha*	R	I
brown trout	*Salmo trutta*	O	I
brook trout	*Salvelinus fontinalis*	A	N
splake	*Salvelinus fontinalis x S. namaycush*	R	I
lake trout	*Salvelinus namaycush*	R	N
trout-perch	*Percopsis omiscomaycus*	R	N
burbot	*Lota lota*	A	N
western banded killifish	*Fundulus diaphanous menona*	R	N
brook stickleback	*Culaea inconstans*	A	N
mottled sculpin	*Cottus bairdii*	A	N
rock bass	*Ambloplites rupestris*	C	N

Table 18.–Continued.

Common name	Scientific name	Occurrence	Origin
pumpkinseed	*Lepomis gibbosus*	C	N
bluegill	*Lepomis macrochirus*	O	N
smallmouth bass	*Micropterus dolomieu*	C	N
largemouth bass	*Micropterus salmoides*	O	I
black crappie	*Pomoxis nigromaculatus*	R	I
Iowa darter	*Etheostoma exile*	O	N
johnny darter	*Etheostoma nigrum*	C	N
yellow perch	*Perca flavescens*	A	N
northern logperch	*Percina caprodes semifasciata*	R	N
blackside darter	*Percina maculate*	C	N
walleye	*Sander vitreus*	C	N

Table 19.–Fish species above and below the Tahquamenon River Falls. An "*" = Not verified by historical documents but actually seen by MDNR personnel during non-collection surveys. "X" = verified. (MDNR, Fisheries Division, files, and Bailey et. al. 2004).

Species	Above the falls	Below the falls
Species found above and below the falls		
American brook lamprey	X	X
northern pearl dace	X	X
spottail shiner	*	*
mimic shiner	X	X
northern redbelly dace	X	X
finescale dace	X	X
longnose dace	X	X
creek chub	X	X
longnose sucker	X	*
white sucker	X	X
brown bullhead	*	*
northern pike	X	X
northern muskellunge	X	*
central mudminnow	X	X
rainbow smelt	X	*
brown trout	X	X
brook trout	X	X
burbot	X	X
brook stickleback	X	X
mottled sculpin	X	X
rock bass	X	X
smallmouth bass	X	X
johnny darter	X	X
yellow perch	X	X
walleye	X	X
Species found only above the falls		
brassy minnow	X	
common shiner	X	
golden shiner	X	
blackchin shiner	X	
blacknose shiner	X	
bluntnose minnow	X	
fathead minnow	X	
western blacknose dace	X	
black bullhead	X	
lake herring	X	
lake trout	X	
splake	X	
western banded killifish	X	
green sunfish	X	
pumpkinseed	X	
bluegill	X	
largemouth bass	X	

Table 19.–Continued.

Species	Above the falls	Below the falls
Iowa darter	X	
northern logperch	X	
blackside darter	X	
Species found only below the falls		
silver lamprey		X
sea lamprey		X
common carp		*
silver redhorse		*
Great Lakes muskellunge		*
rainbow trout		*
Chinook salmon		*
trout perch		X

Table 20.–Amphibian and reptile species found in the Tahquamenon River watershed. Data from Harding and Holman (1992), Holman et. al. (1989), and Harding and Holman (1990). Status symbol is Special Concern (SC). Species are listed in taxonomic order.

Common name	Scientific name	Status
mudpuppy	*Necturus maculosus maculosus*	
eastern newt (central subspecies)	*Notophthalmus viridescens*	
spotted salamander	*Ambystoma maculatum*	
blue-spotted salamander	*Ambystoma laterale*	
red-backed salamander	*Plethodon cinereus*	
four-toed salamander	*Hemidactylium scutatum*	
eastern American toad	*Bufo americanus americanus*	
northern spring peeper	*Pseudacris crucifer crucifer*	
gray tree frog	*Hyla versicolor*	
green frog	*Rana clamitans melanota*	
bullfrog	*Rana catesbeiana*	
northern leopard frog	*Rana pipiens*	
pickerel frog	*Rana palustris*	
mink frog	*Rana septentrionalis*	
wood frog	*Rana sylvatica*	
snapping turtle	*Chelydra serpentine*	
wood turtle	*Clemmys insculpta*	SC
painted turtle	*Chrysemys picta*	
northern water snake	*Nerodia sipedon sipedon*	
eastern garter snake	*Thamnophis sirtalis sirtalis*	
northern red-bellied snake	*Storeria occipitomaculata occipitomaculata*	
eastern smooth green snake	*Liochlorophis vernalis*	
northern ring-necked snake	*Diadophis punctatus edwardsi*	

Table 21.–Bird species associated with the Tahquamenon River watershed and the Lake Superior shoreline adjacent to the watershed. Data from Anonymous (2000), Brewer et. al. (1991), Spieles (2001) and Spieles (personal communication). Occurrence is delineated as: A = Abundant, species numerous; C = Common, likely to be seen in the correct habitat; U = Uncommon, present but hard to find; O = Occasional, seen only a few times during a season, such as migratory; and R = Rare, seen every 2–5 years. Status is the government listing as follows: Michigan status SC = Special Concern; T = Threatened; E = Endangered; Federal status LT = Listed as Threatened. Species are listed in taxonomic order.

Common name	Scientific name	Occurrence	Status
Common Loon	*Gavia immer*	A	T
Pied-billed Grebe	*Podilymbus podiceps*	A	
Double-crested Cormorant	*Phalacrocorax auritus*	A	
American Bittern	*Botaurus lentiginosus*	A	SC
Great Blue Heron	*Ardea herodias*	A	
Black-crowned Night Heron	*Nyticorax nyticorax*	O	SC
Turkey Vulture	*Cathartes aura*	C	
Canada Goose	*Branta canadensis*	C	
Mute Swan	*Cygnus olor*	O	
Trumpeter Swan	*Cygnus buccinator*	U	T
Tundra Swan	*Cygnus columbianus*	O	
Wood Duck	*Aix sponsa*	A	
Gadwall	*Anas strepera*	O	
American Wigeon	*Anas americana*	C	
Mallard	*Anas platyrhynchos*	A	
Blue-winged Teal	*Anas discors*	C	
Green-winged Teal	*Anas crecca*	C	
Northern Shoveler	*Anas clypeata*	O	
Northern Pintail	*Anas acuta*	U	
Canvasback	*Aythya valisineria*	O	
Red Head	*Aythya americana*	O	
Ring-necked Duck	*Athya Collaris*	A	
Greater Scaup	*Aythya marila*	C	
Lesser Scaup	*Aythya affinis*	C	
Bufflehead	*Bucephala albeola*	C	
Common Goldeneye	*Bucephala clangula*	C	
Hooded Merganser	*Lophodytes cucullatus*	C	
Common Merganser	*Mergus merganser*	C	
Red-breasted Merganser	*Mergus serrator*	C	
Osprey	*Pandion Haliaetus*	C	T
Bald Eagle	*Haliaeetus leucocephalus*	C	T, LT
Golden Eagle	*Aquila chrysaetos*	O	
Northern Harrier	*Circus cyaneus*	C	SC
Sharp-shinned Hawk	*Accipiter striatus*	U	
Cooper’s Hawk	*Accipiter cooperii*	U	SC
Northern Goshawk	*Accipiter gentilis*	O	SC
Red-shouldered Hawk	*Buteo lineatus*	O	T
Broad-winged Hawk	*Buteo platypterus*	C	
Red-tailed Hawk	*Buteo jamaicensis*	C	
Rough-legged Hawk	*Buteo lagopus*	U	

Table 21.–Continued.

Common name	Scientific name	Occurrence	Status
American Kestrel	*Falco sparverius*	C	
Merlin	*Falco columbarius*	C	T
Peregrine Falcon	*Falco peregrinus*	O	
Ruffed Grouse	*Bonasa umbellus*	A	
Spruce Grouse	*Dendragapus Canadensis*	C	T
Sharp-tailed Grouse	*Tympanuchus phaseanellus*	C	SC
Yellow Rail	*Coturnicops noveboracensis*	R	T
Virginia Rail	*Rallus limicola*	C	
Sora	*Porzana carolina*	C	
Sandhill Crane	*Grus canadensis*	A	
Black-bellied Plover	*Pluvialis squatarola*	O	
Lesser Golden Plover	*Pluvialis dominica*	O	
Semipalmated Plover	*Charadrius semiplamatus*	O	
Killdeer	*Charadrius vociferus*	C	
Greater Yellowlegs	*Tringa melanoleuca*	C	
Lesser Yellowlegs	*Tringa flavipes*	C	
Solitary Sandpiper	*Tringa solitaria*	C	
Spotted Sandpiper	*Actitis macularia*	C	
Semipalmated Sandpiper	*Calidris pusilla*	U	
Least Sandpiper	*Calidris minutilla*	U	
Common Snipe	*Gallinago gallinago*	C	
American Woodcock	*Scolopax minor*	C	
Bonaparte's Gull	*Larus Philadelphia*	O	
Ring-billed Gull	*Larus delawarensis*	C	
Herring Gull	*Larus argentatus*	C	
Caspian Tern	*Sterna caspia*	U	T
Common Tern	*Sterna hirundo*	C	T
Rock Dove	*Columba livia*	C	
Mourning Dove	*Zenaida macroura*	C	
Black-billed Cuckoo	*Coccyzus erythropthalmus*	U	
Great-horned Owl	*Bubo virginianus*	U	
Snowy Owl	*Nyctea scandiaca*	R	
Barred Owl	*Strix varia*	U	
Great Gray Owl	*Strix nebulosa*	O	
Long-eared Owl	*Asio otus*	O	T
Short-eared Owl	*Asio flammeus*	R	E
Boreal Owl	*Aegolius funereus*	R	
Northern Saw-whet Owl	*Aegolius acadicus*	U	
Common Nighthawk	*Chordeiles minor*	C	
Whip-poor-will	*Caprimulgus vociferous*	U	
Chimney Swift	*Chaetura pelagica*	C	
Ruby-throated Hummingbird	*Archilochus colubris*	C	
Belted Kingfisher	*Ceryle alcyon*	C	
Red-headed Woodpecker	*Melanerpes erythrocephalus*	O	
Yellow-bellied Sapsucker	*Sphyrapicus varius*	C	
Downy Woodpecker	*Picoides pubescens*	C	
Hairy Woodpecker	*Picoides villosus*	C	

Table 21.–Continued.

Common name	Scientific name	Occurrence	Status
Black-backed Woodpecker	*Picoides arcticus*	U	SC
Northern Flicker	*Colaptes auratus*	C	
Pileated Woodpecker	*Dryocopus pileatus*	C	
Olive-sided Flycatcher	*Contopus borealis*	U	
Eastern Wood Pewee	*Contopus virens*	C	
Yellow-bellied Flycatcher	*Empidonax flaviventris*	O	
Alder Flycatcher	*Empidonax alnorum*	C	
Least Flycatcher	*Empidonax minimus*	C	
Eastern Phoebe	*Sayornis phoebe*	C	
Great Crested Flycatcher	*Myiarchus crinitus*	C	
Eastern Kingbird	*Tyrannus tyrannus*	C	
Northern Shrike	*Lanius excubitor*	O	
Blue-headed Vireo	*Vireo solitarius*	C	
Philadelphia Vireo	*Vireo philadelphicus*	C	
Red-eyed Vireo	*Vireo olivaceus*	C	
Gray Jay	*Perisoreus canadensis*	U	
Blue Jay	*Cyanocitta cristata*	C	
American Crow	*Corvus brachyrhynchos*	C	
Common Raven	*Corvus corax*	C	
Horned Lark	*Eremophila alpestris*	R	
Tree Swallow	*Tachycineta bicolor*	A	
N. Rough-winged Swallow	*Stelgidopteryx serripennis*	C	
Bank Swallow	*Riparia riparia*	U	
Cliff Swallow	*Hirundo pyrrhonota*	C	
Barn Swallow	*Hirundo rustica*	C	
Black-capped Chickadee	*Parus atricapillus*	A	
Boreal Chickadee	*Parus hudsonicus*	O	
Red-breasted Nuthatch	*Sitta canadensis*	C	
White-breasted Nuthatch	*Sitta carolinensis*	C	
Brown Creeper	*Certhia Americana*	C	
Winter Wren	*Troglodytes troglodytes*	C	
Sedge Wren	*Cistothorus pletensis*	C	
Golden-crowned Kinglet	*Regulus satrapa*	C	
Ruby-crowned Kinglet	*Regulus calendula*	U	
Eastern Bluebird	*Sialia sialis*	O	
Veery	*Catharus fuscescens*	C	
Swainson’s Thrush	*Catharus ustulatus*	C	
Gray-cheeked Thrush	*Catharus minimus*	U	
Hermit Thrush	*Catharus guttatus*	C	
Wood Thrush	*Hylocichla mustelina*	C	
American Robin	*Turdus migratorius*	A	
Gray Catbird	*Dumetella carolinensis*	U	
Brown Thrasher	*Toxostoma rufum*	U	
European Starling	*Sturnus vulgaris*	A	
Bohemian Waxwing	*Bombycilla garrulus*	O	
Cedar Waxwing	*Bombycilla cedrorum*	A	
Golden-winged Warbler	*Vermivora chrysoptera*	R	

Table 21.–Continued.

Common name	Scientific name	Occurrence	Status
Tennessee Warbler	*Vermivora peregrina*	R	
Nashville Warbler	*Vermivora ruficapilla*	A	
Northern Parula	*Parula Americana*	C	
Yellow Warbler	*Dendroica petechia*	A	
Chestnut-sided Warbler	*Dendroica pensylvanica*	U	
Magnolia Warbler	*Dendroica magnolia*	C	
Cape May Warbler	*Dendroica tigrina*	O	
Black-throated Blue Warbler	*Dendroica caerulescens*	C	
Black-throated Green Warbler	*Dendroica virens*	C	
Yellow-rumped Warbler	*Dendroica coronata*	C	
Blackburnian Warbler	*Dendroica fusca*	C	
Pine Warbler	*Dendroica pinus*	C	
Palm Warbler	*Dendroica palmarum*	C	
Bay-breasted Warbler	*Dendroica castanea*	U	
Blackpoll Warbler	*Dendroica striata*	U	
Black-and-white Warbler	*Mniotilta varia*	C	
American Redstart	*Setophaga ruticilla*	C	
Ovenbird	*Seiurus aurocapillus*	C	
Northern Waterthrush	*Seiurus noveboracensis*	U	
Connecticut Warbler	*Oporornis formosus*	R	
Mourning Warbler	*Oporornis philadelphia*	O	
Common Yellowthroat	*Geothlypis trichas*	C	
Wilson’s Warbler	*Wilsonia pusilla*	O	
Canada Warbler	*Wilsonia Canadensis*	O	
Scarlet Tanager	*Piranga olivacea*	C	
Rufous-sided Towhee	*Pipilo erythrophthalmus*	O	
American Tree Sparrow	*Spizella arborea*	O	
Chipping Sparrow	*Spizella passerine*	C	
Clay-colored Sparrow	*Spizella pallida*	O	
Vesper Sparrow	*Pooecetes gramineus*	U	
Savannah Sparrow	*Passerculus sandwichensis*	C	
Le Conte’s Sparrow	*Ammodramus leconteii*	C	
Fox Sparrow	*Passerella iliaca*	O	
Song Sparrow	*Melospiza melodia*	C	
Lincoln’s Sparrow	*Melospiza lincolnii*	U	
Swamp Sparrow	*Melospiza georgiana*	C	
White-throated Sparrow	*Zonotrichia albicollis*	C	
White-crowned Sparrow	*Zonotrichia leucophrys*	O	
Dark-eyed Junco	*Junco hyemalis*	C	
Snow Bunting	*Plectrophenax nivalis*	O	
Northern Cardinal	*Cardinalis cardinalis*	O	
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	C	
Indigo Bunting	*Passerina cyanea*	C	
Bobolink	*Dolichonys oryzivorus*	C	
Red-winged Blackbird	*Agelaius phoeniceus*	A	
Eastern Meadowlark	*Sturnella magna*	O	
Rusty Blackbird	*Euphagus carolinus*	O	

Table 21.–Continued.

Common name	Scientific name	Occurrence	Status
Brewer's Blackbird	*Euphagus cyanocephalus*	U	
Common Grackle	*Quiscalus quisula*	A	
Brown-headed Cowbird	*Molothrus ater*	A	
Baltimore Oriole	*Icterus galbula*	U	
Pine Grosbeak	*Pinicola enucleator*	O	
Purple Finch	*Carpodacus purpureus*	O	
Red Crossbill	*Loxia curvirostra*	O	
White-winged Crossbill	*Loxia leucoptera*	O	
Common Redpoll	*Carduelis flammea*	U	
Hoary Redpoll	*Carduelis hornemanni*	R	
Pine Siskin	*Carduelis pinus*	U	
American Goldfinch	*Carduelis tristis*	C	
Evening Grosbeak	*Coccothraustes vespertinus*	C	T
House Sparrow	*Passer domesticus*	C	

Table 22.–Mammals of the Tahquamenon River watershed. Data from Baker (1983), Kristie Sitar, MDNR, Wildlife Division biologist, (personal communication), and Anonymous (2000). Occurrence codes: A = Abundant, species numerous; C = Common, likely to be seen in the suitable habitat; O = Occasional, seen only a few times during a season; and R = Rare, seen only every 2–5 years. State status rank: SC = Special Concern, T = Threatened, E = Endangered. Federal status rank: LE = Listed as Endangered. Species are listed in taxonomic order.

Common name	Scientific name	Occurrence	Status
Arctic shrew	*Sorex arcticus*	C	
masked shrew	*Sorex cinereus*	C	
pigmy shrew	*Sorex hoyi*	C	
water shrew	*Sorex palustris*	C	
northern short-tailed shrew	*Blarina brevicauda*	A	
star-nosed mole	*Condylura noctivagans*	C	
northern long-eared bat	*Myotis septentrionalis*		
little brown bat	*Myotis lucifugus*	C	
silver-haired bat	*Lasionycteris noctivagans*	O	
big brown bat	*Eptesicus fuscus*	C	
eastern red bat	*Lasiurus borealis*	O	
Keen’s bat	*Myotis keenii*	O	
hoary bat	*Lasiurus cinereus*	C	
snowshoe hare	*Lepus americanus*	C	
eastern chipmunk	*Tamias striatus*	A	
least chipmunk	*Tamias minimus*	C	
woodchuck	*Marmota monax*	C	
eastern gray squirrel	*Sciurus carolinensis*	C	
red squirrel	*Tamiasciurus hudsonicus*	A	
northern flying squirrel	*Glaucomys sabrinus*	O	
American beaver	*Castor Canadensis*	A	
southern red-backed vole	*Clethrionomys gapperi*	C	
meadow vole	*Microtus pennsylvanicus*	C	
muskrat	*Ondatra zibethicus*	A	
southern bog lemming	*Synaptomys cooperi*	O	
meadow jumping mouse	*Zapus hudsonius*	C	
woodland jumping mouse	*Napaeozapus insignis*	C	
American porcupine	*Erethizon dorsatum*	C	
coyote	*Canis latrans*	A	
gray wolf	*Canis lupus*	O	T, LE
red fox	*Vulpes vulpes*	C	
gray fox	*Urocyon cinereoargenteus*	O	
black bear	*Ursus americanus*	C	
raccoon	*Procyon lotor*	A	
American marten	*Martes martes*	C	
fisher	*Martes pennanti*	C	
ermine	*Mustela erminea*	O	
least weasel	*Mustela nivalis*	O	
long-tailed weasel	*Mustela frenata*	C	
mink	*Mustela vison*	C	
American badger	*Taxidea taxus*	O	

Table 22.–Continued.

Common name	Scientific name	Occurrence	Status
striped skunk	*Mephitis mephitis*	C	
northern river otter	*Lutra canadensis*	C	
bobcat	*Lynx rufus*	C	
white-tailed deer	*Odocoileus virginianus*	C	
moose	*Alces alces*	C	SC

Table 23.–Special features and rare species in the Tahquamenon River watershed. Species locations are: 1) Upper River and Dollarville segments; 2) Sage River; 3) Hendrie River; 4) East Branch Tahquamenon River; 5) Middle River segment; 6) Areas around Upper and Lower Tahquamenon Falls. State status SC = Special Concern, T = Threatened. Federal status LT = Listed as Threatened (Unpublished data from Michigan Natural Features Inventory, 2005).

Common name	Scientific name	Status	1	2	3	4	5	6
Birds								
Bald Eagle	*Haliaeetus leucocephalus*	T, LT	X	X		X		X
Osprey	*Pandion haliaetus*	T	X		X	X	X	X
Common Loon	*Gavial immer*	T	X				X	X
Red-shouldered Hawk	*Buteo lineatus*	T		X	X			
Merlin	*Falco columbarius*	T				X		
Northern Goshawk	*Accipiter gentiles*	SC						X
Spruce Grouse	*Falcipennis canadensis*	SC						X
Black-backed Woodpecker	*Picoides arcticus*	SC						X
Invertebrates								
friggia fritillary	*Borolia frigga*	SC	X				X	
land snail	*Vertigo elatior*	SC			X			
Plants								
goblin moonwort	*Botrychium mormo*	T		X	X			
satiny willow	*Salix pellita*	SC					X	
Farwell's water-milfoil	*Myriophyllum farwellii*	T						
fir clubmoss	*Huperzia selago*	SC			X			
Douglas's hawthorn	*Crataegis douglasii*	SC				X		X
autumnal water-starwort	*Callitriche hermaphroditica*	SC						X
alga pondweed	*Potamogeton confervoides*	SC			X			X
panicled screw-stem	*Bartonia paniculata*	T						X
blue wild-rye	*Elymus glaucus*	SC						X
northern prostrate clubmoss	*Lycopodium appressum*	SC						X
meadow-beauty	*Rhexia virginica*	SC						X
Special features								
great blue heron rookery	population feature		X				X	
mesic northern forest	community				X		X	
muskeg	community						X	
wooded dune / swale complex	community					X		
rich conifer swamp	community					X		X
Primary sedimentary structural feature	geological feature–upper and lower falls, rapids							X

Table 24.–Fish stocked in the Tahquamenon River, 1979 to 2006. Brown trout plants in the Lower River segment all occurred between the Upper and Lower Falls. SF = spring fingerling, FF = fall fingerling, Yr = yearling, Ad = adult.

Segment	Date	Species	Age	Length (in)	Number
Upper River	1979	brook trout	SF	3.8	3,900
	1980	brook trout	SF	2.0	1,900
	1981	brook trout	SF	2.0	3,900
		brook trout	FF	3.7	3,000
	1982	brook trout	SF	1.9	3,900
	1983	brook trout	FF	3.3	3,420
	1984	brook trout	FF	3.6	3,900
	1985	brook trout	SF	2.1	3,900
	1986	brook trout	SF	2.3	3,900
	1987	brook trout	SF	2.3	3,900
	1988	brook trout	Yr	6.5	1,000
	1990	brook trout	SF	1.7	3,900
	1991	brook trout	SF	2.3	3,900
	1992	brook trout	Yr	5.5	2,000
	1993	brook trout	Yr	7.3	2,000
	1994	brook trout	Yr	7.6	1,000
	1995	brook trout	Yr	7.9	2,000
	1996	brook trout	Yr	7.1	2,000
	1997	brook trout	Yr	7.6	1,700
	1998	brook trout	Yr	4.6	2,000
Dollarville	1979	largemouth bass	FF	2.4	15,000
	1980	tiger muskellunge	FF	6.9	1,686
	1981	tiger muskellunge	FF	6.9	1,600
	1982	muskellunge	Fry	0.6	66,710
	1983	tiger muskellunge	FF	7.4	600
	1985	muskellunge	FF	8.1	600
	1987	muskellunge	FF	5.9	1,200
	1988	walleye	SF	1.5	10,069
	1989	muskellunge	FF	9.2	266
		walleye	SF	2.2	2,151
	1990	walleye	SF	1.6	30,224
Marsh Drainage	1987	walleye	SF	1.8	1,632
		yellow perch	Ad	6.4	9,841
	1988	walleye	SF	2.0	12,539
	1990	walleye	SF	1.4	16,021
	1991	walleye	SF	2.3	2,968
	1992	walleye	SF	1.8	28,814
	1994	brook trout	Yr	7.6	1,000

Table 24.–Continued.

Segment	Date	Species	Age	Length (in)	Number
Lower River	1980	brown trout	Yr	6.7	2,850
	1984	brown trout	Yr	6.7	3,500
	1985	brown trout	Yr	7.1	3,200
	1986	brown trout	Yr	7.4	3,640
	1987	brown trout	Yr	7.7	4,132
	1988	brown trout	Yr	6.4	4,260
	1989	brown trout	SF	1.3	5,800
		brown trout	Yr	7.7	4,000
	1990	brown trout	Yr	7.1	5,000
	1991	brown trout	Yr	6.4	4,200
	1992	brown trout	Yr	6.7	5,000
	1993	brown trout	Yr	7.8	3,990
	1994	brown trout	Yr	6.9	4,360
	1995	brown trout	Yr	6.8	5,000
	1996	brown trout	Yr	7.4	3,920
		lake trout	FF	4.8	110,000
		walleye	SF	1.5	39,940
	1997	brown trout	Yr	7.5	3,600
		walleye	SF	2.2	30,457
	1998	brown trout	Yr	7.9	3,500
	1999	brown trout	Yr	3.8	3,990
		lake trout	FF	5.0	150,000
		walleye	SF	1.8	30,400
	2000	brown trout	Yr	4.8	5,000
		lake trout	FF	4.7	150,080
		walleye	SF	1.9	24,952
	2001	brown trout	Yr	4.8	4,160
		walleye	SF	1.6	32,395
	2002	brown trout	Yr	5.0	4,750
	2003	brown trout	Yr	5.1	5,000
		walleye	SF	1.7	28,885
	2004	brown trout	Yr	5.2	4,000
	2005	brown trout	Yr	7.1	3,500
		walleye	SF	1.6	10,772
	2006	brown trout	Yr	7.6	4,500

Table 25.–Electrofishing catch per hour (CPH) from July 2005 boomshocking surveys of the mainstem Tahquamenon River by site and river valley segment. All sites except the Dollarville Dam to M-123 site entailed boomshocking for 1 hour. The sites extended 1 mile, covering both sides of the river upstream and downstream ¼ mile from central site. The Dollarville Dam to M-123 site began at the dam and extended about 3 miles downstream to the M-123 Bridge. Sites with river names were centered at the confluence with the Tahquamenon River. An attempt was made this year to catch all fish observed while the boat was moving through the sample site.

Segment and site	Species	CPH	Lengths (in)
Marsh Drainage Segment			
Dollarville Dam to M-123 [a]	northern pike	35.8	9–26
	walleye	26.3	8–26
	burbot	22.1	5–8
	rock bass	16.3	3–11
	yellow perch	12.6	5–9
	white sucker	12.1	6–18
	creek chub	7.9	4–5
	pumpkinseed	3.2	3–4
	brown bullhead	2.1	6–8
	blackside darter	1.6	2–3
	common shiner	1.6	2–4
	golden shiner	1.6	3–5
	largemouth bass	1.1	12–14
	muskellunge	0.5	31
	smallmouth bass	0.5	8
	tiger muskellunge hybrid	0.5	19
McPhee’s Landing	rock bass	32	4–9
	northern pike	31	3–29
	walleye	30	9–25
	pumpkinseed	22	3–6
	yellow perch	17	6–10
	white sucker	11	7–16
	brown bullhead	1	5
Deadman’s Farm	northern pike	27	11–24
	walleye	20	9–23
	yellow perch	13	5–17
	white sucker	7	10–17
	rock bass	6	5–7
	muskellunge	1	4
Sage River mouth	walleye	37	6–22
	white sucker	29	7–17
	yellow perch	22	6–11
	rock bass	11	3–8
	northern pike	6	7–22
	muskellunge	2	31–31
	pumpkinseed	2	4–5

Table 25.–Continued.

Segment and site	Species	CPH	Lengths (in)
Middle River Segment			
Hendrie River	walleye	34	4–26
	yellow perch	22	5–10
	rock bass	21	2–10
	pumpkinseed	6	3–4
	golden shiner	1	6
	northern pike	1	6
E Br.Tahquamenon River	walleye	30	10–28
	muskellunge	2	8–41
	northern pike	2	12–19
	yellow perch	2	7–10
Murphy Creek	walleye	16	10–22
	yellow perch	14	5–11
	northern pike	4	14–21
	rock bass	4	5–7
	muskellunge	2	18–29
	trout-perch	1	4
Joy Island	walleye	18	6–23
	yellow perch	17	4–9
	muskellunge	7	18–32
	northern pike	7	11–24
	white sucker	1	15
	pumpkinseed	1	3
	rock bass	1	9
Lower River Segment			
Lower Falls pool	muskellunge	11	14–33
	walleye	9	7–16
	northern pike	8	19–23
	silver redhorse	7	8–24
	smallmouth bass	5	7–11
	yellow perch	5	5–8
Lower Falls Stairs	yellow perch	15	4–11
	smallmouth bass	4	6–11
	northern pike	3	19–24
	muskellunge	2	15–17
	walleye	2	3–10
Whitehouse Landing	muskellunge	4	10–23
	yellow perch	4	4–7
	northern pike	1	14
	walleye	1	14

[a] Dollarville Dam to M-123 Most of the unusual species were captured immediately downstream from the dam.

Table 26.–Walleye and muskellunge radio tracking dates in the Tahquamenon River with water temperature (Fahrenheit), discharge, and survey type. Daily discharge rate was from the USGS gauge near the Upper Falls in cubic feet per second (CFS).

Date	Water temperature	CFS	Survey type
10/21/2004	40	1020	boat
11/09/2004	36	1340	boat
11/10/2004	37	1280	boat
11/22/2004	34	1110	boat
12/15/2004		991	aerial
01/28/2005		471	aerial
03/29/2005		529	aerial
04/07/2005		3720	aerial
04/13/2005	45	3900	aerial
04/14/2005	48	3730	boat
04/18/2005	55.9	2840	boat
04/21/2005	54.3	2180	boat
04/26/2005	40.5	1490	boat
04/29/2005	42.7	1410	boat
05/02/2005	45	1260	boat
05/05/2005	42	1130	boat
05/09/2005	55	847	boat
05/17/2005		1070	aerial
05/26/2005	63.4	614	boat
06/01/2005	65.4	515	boat
06/07/2005	68		boat
06/29/2005	78	236	boat
07/22/2005	76.7	213	boat
09/23/2005	63.2	312	boat
10/06/2005	64		boat
10/08/2005	58		boat
10/18/2005	49.2	558	boat
11/01/2005	44.3	416	boat
11/03/2005	44.4	422	boat

Table 27.–Electrofishing survey results in catch per 1,000 linear feet for seven sampling sites in the East Branch Tahquamenon River, Chippewa County, July 2004 (Bassett 2005).

	Sampling site						
Species	2	3	4	5	6	7	8
brook trout	103	101	84	48	22	30	17
mottled sculpin	25	35	39	25	19	43	26
brook stickleback		10	1			1	2
brown bullhead			1				
northern brook lamprey			4		3	3	
northern redbelly dace			3		1		
central mudminnow			7			1	
blacknose dace				2	1	19	11
creek chub				2		3	1
common shiner					17		
pearl dace						6	
brassy minnow						1	

Table 28.–Brook trout population estimates and standing crop (lbs.) estimates (Station 4) in the East Branch Tahquamenon River at Strongs, Michigan , 1977–83, 1995, and 2004 (Bassett 2005).

Standing crop			Population estimates			
1977–83	1995	2004	Ages	1977–83	1995	2004
58.5	21.2	19.3	0	1426	781	455
			1–2	717	156	93
			3–4	70	0	11

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Tahquamenon River Assessment
Appendix

James R. Waybrant

and

Troy G. Zorn

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SPECIAL REPORT 45

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

Special Report 45 Appendix
February 2008

Tahquamenon River Assessment Appendix

James R. Waybrant
and
Troy G. Zorn

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Appendix A

Distribution Maps of Fish Species

Known present and past fish distributions in the Tahquamenon River watershed. Distribution maps were compiled from Bailey et al. (2004), Taylor (1954), and records at the Michigan Department of Natural Resources Newberry Operations Service Center and from the Michigan Department of Natural Resources Fish Collection System. No species found in the watershed is listed under Michigan's Endangered Species Act (Part 365, Endangered Species Protection, of the Natural Resource and Environmental Protection Act, Act 451 of the Public Acts of 1994). Historical records indicate that the threatened lake sturgeon Acipenser fulvescens were at one time present in the lower river, but none have been documented in recent times.

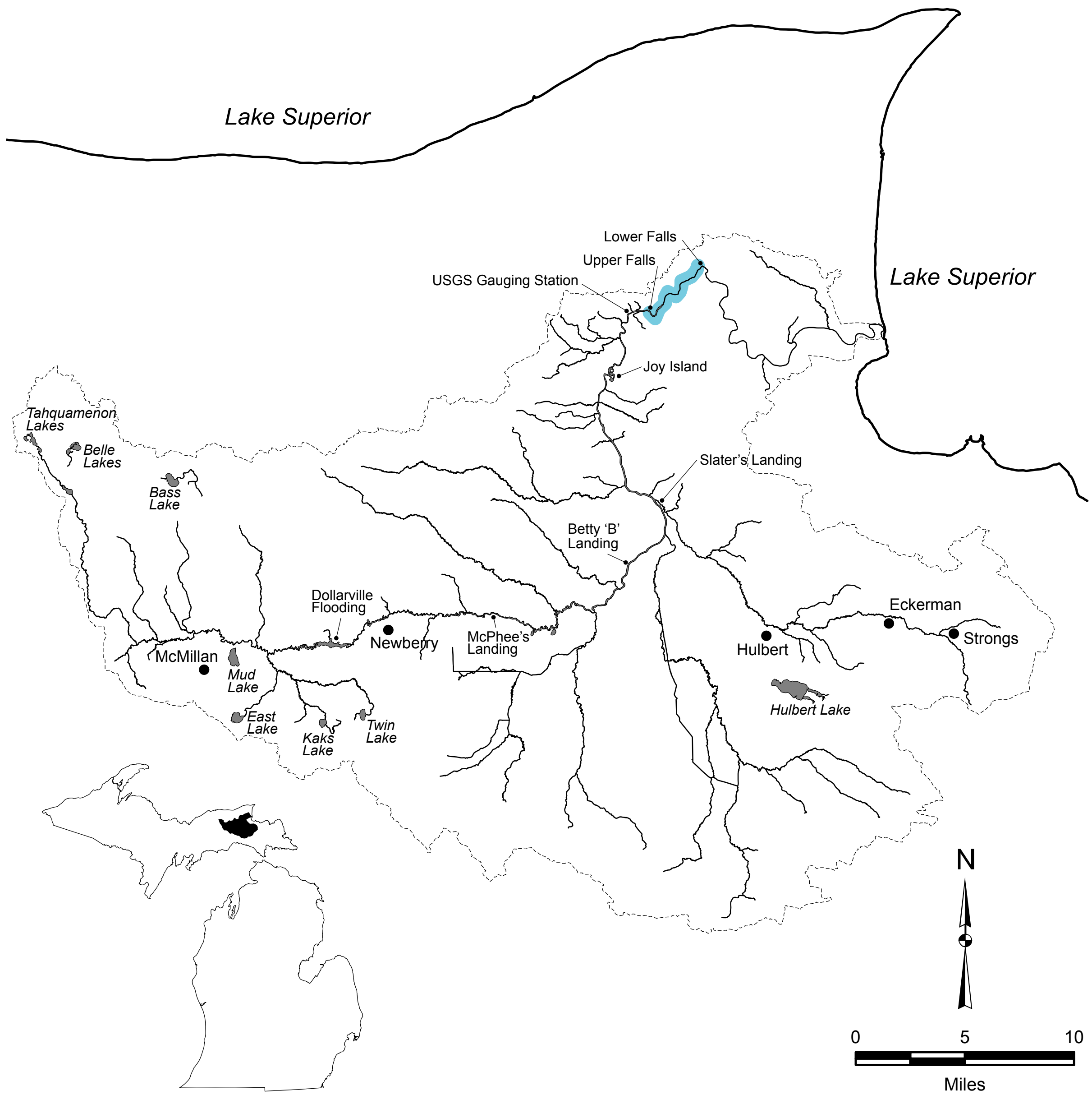
Habitat descriptions were compiled from the Fishes of Ohio (Trautman 1981), Freshwater Fishes of Canada (Scott and Crossman 1973), Fishes of Wisconsin (Becker 1983), Fishes of Missouri (Pflieger 1975), and Fishes of the Great Lakes Region (Hubbs and Lagler 1947).

APPENDIX A INDEX

Silver lamprey *Ichthyomyzon unicuspis*

Habitat**:**

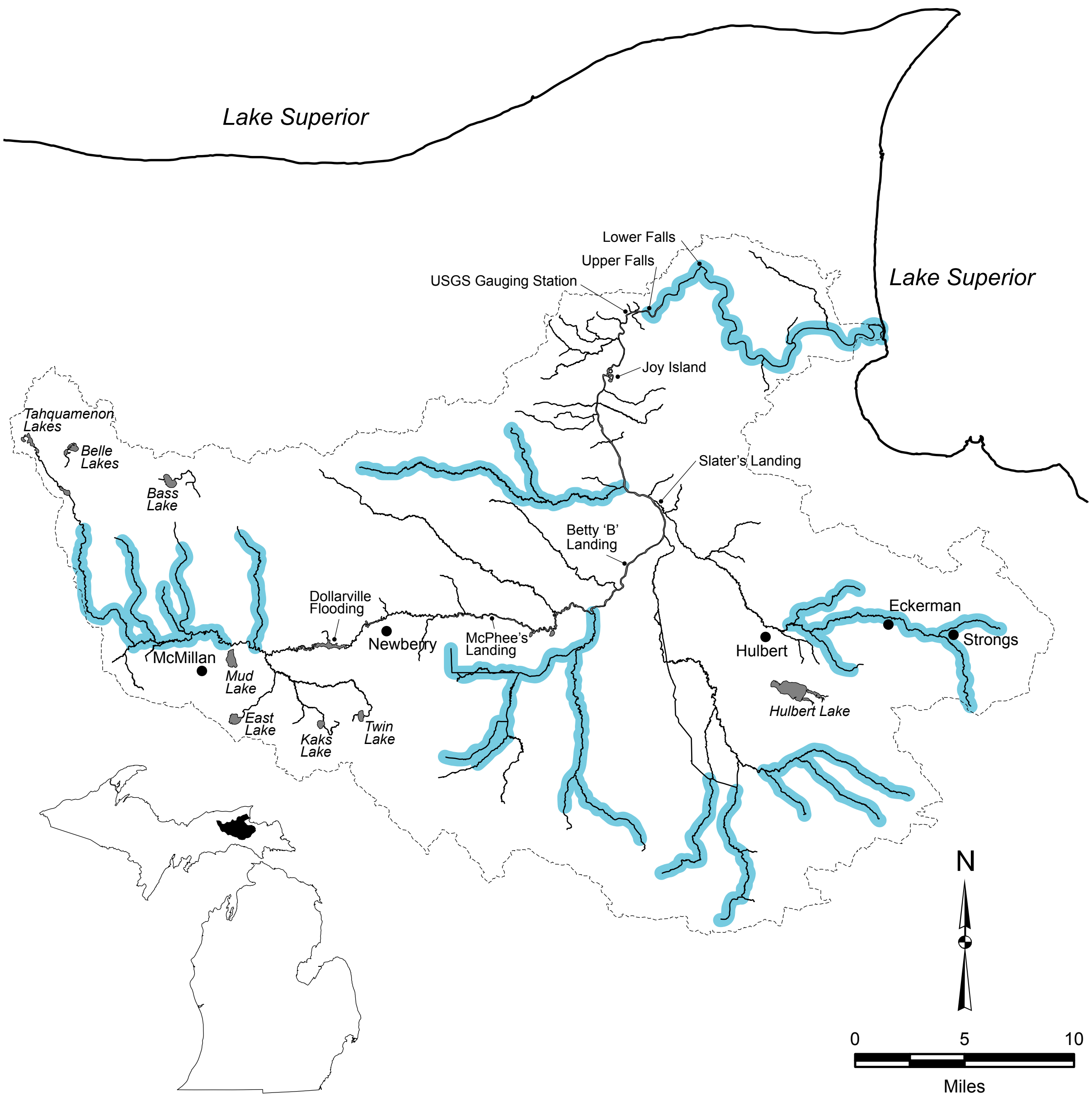
feeding	-	young: sand, muck, or organic debris substrate
	-	adults: clear river water with prey species
spawning	-	gravel and sand substrate
	-	moderate gradient
	-	moderate size stream
	-	cannot tolerate silt
	-	no dams
winter refuge	-	ammocetes burrow for 4 to 7 years in mud and silt at river margins



American brook lamprey *Lampetra appendix*

Habitat**:**

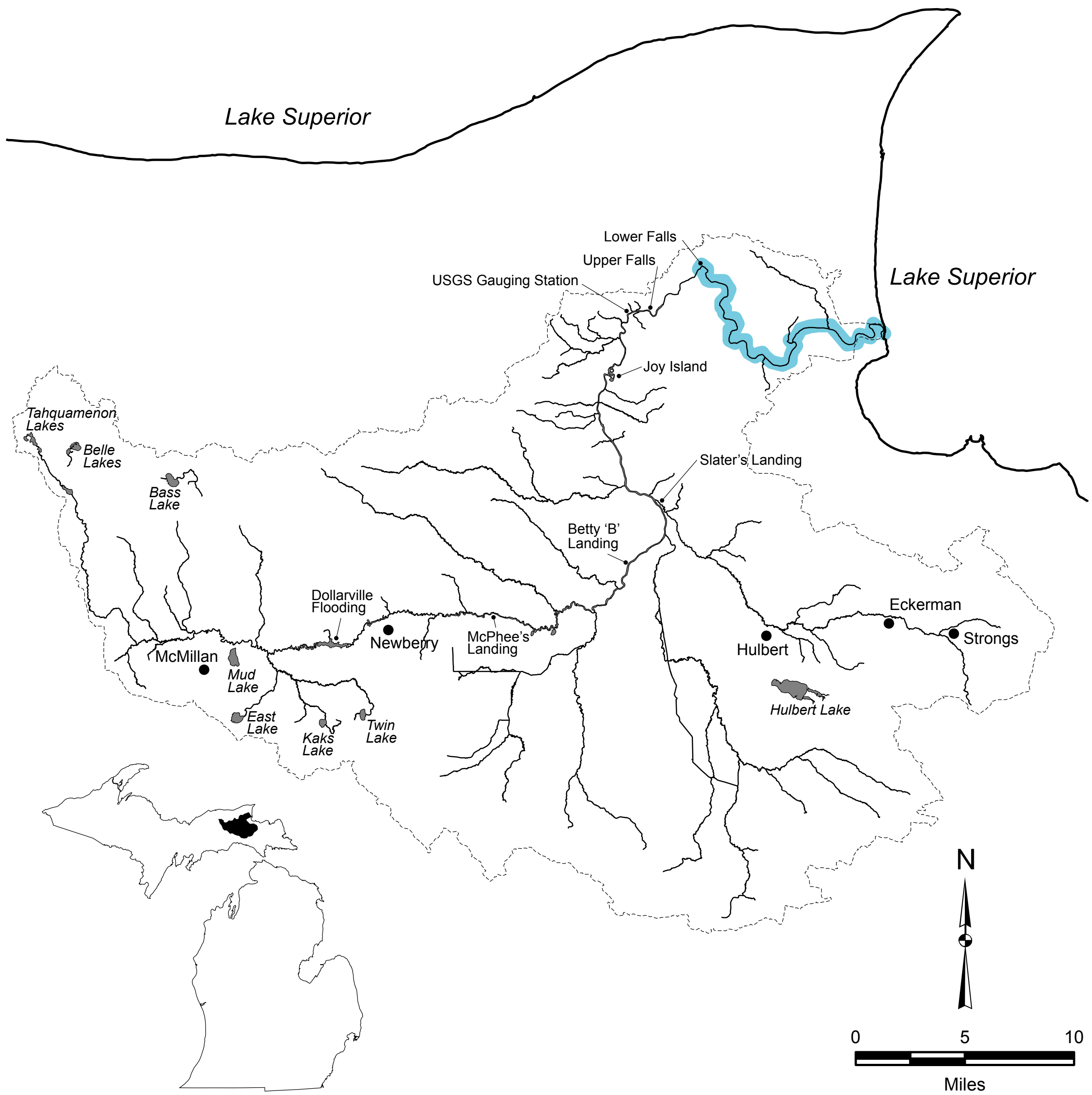
feeding	-	young: low gradient, substrate with bars and beds of mixed sand and organic debris
	-	clear cool stream water, sensitive to turbidity
spawning	-	clear, high gradient streams (>15 feet wide)
	-	cold water
	-	gravel substrate
winter refuge	-	sand or silt substrate for amnocetes



Sea lamprey *Petromyzon marinus*

Habitat**:**

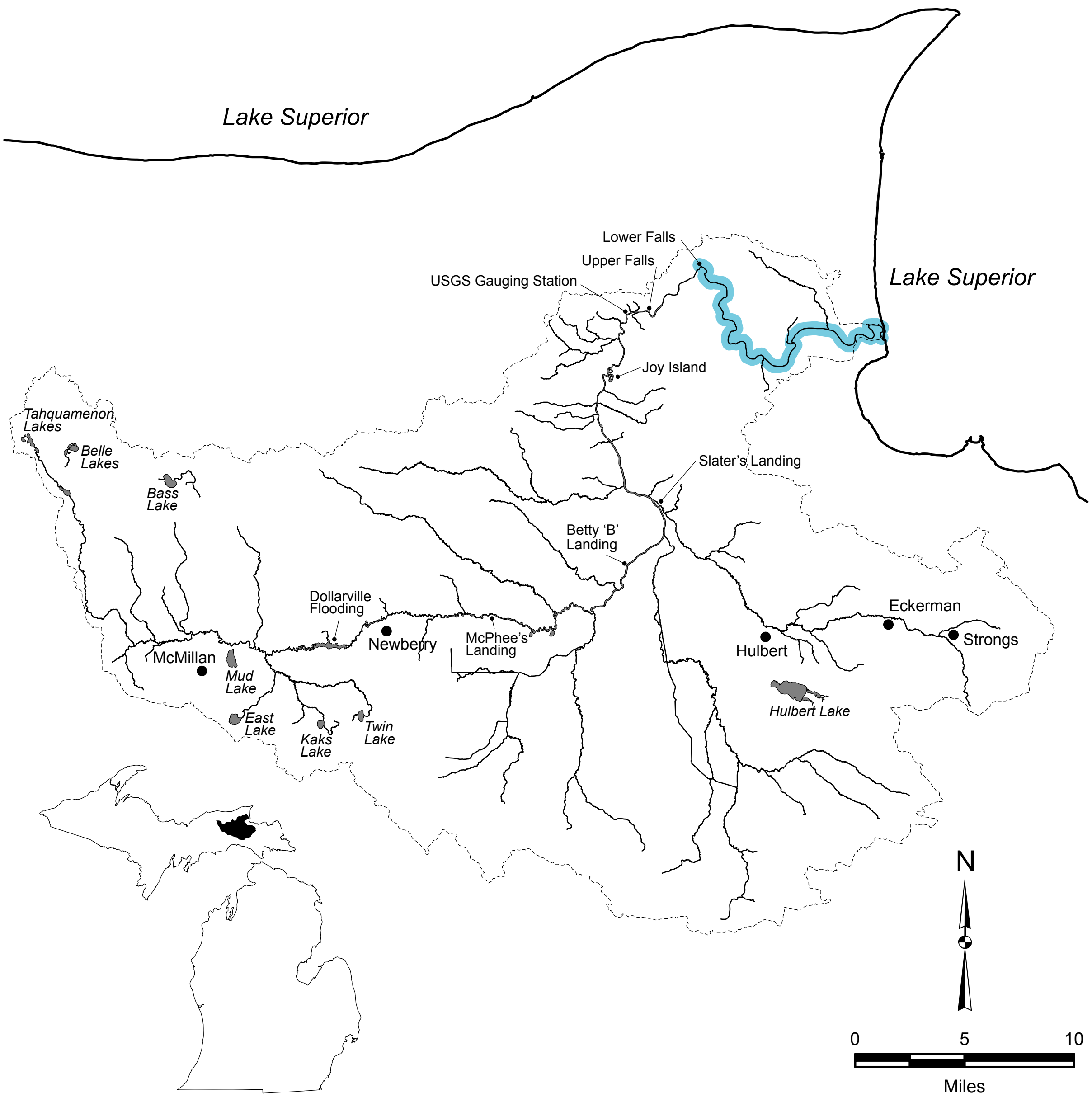
feeding	-	young: substrate with beds of sand mixed with organic debris
	-	cannot tolerate silt
	-	adults: clear cool water of Lake Superior
spawning	-	no dams
	-	riffles with sand and gravel substrates



Lake sturgeon *Acipenser fulvescens* – **threatened**

Habitat:

feeding	-	shoal areas of large rivers, lakes, and impoundments
	-	gravel, sand, rock substrates
spawning	-	in or before rapids, at the base of dams in rivers
	-	in 2-15 feet of water
	-	swift current
	-	rocky ledges or around rocky islands in Great Lakes

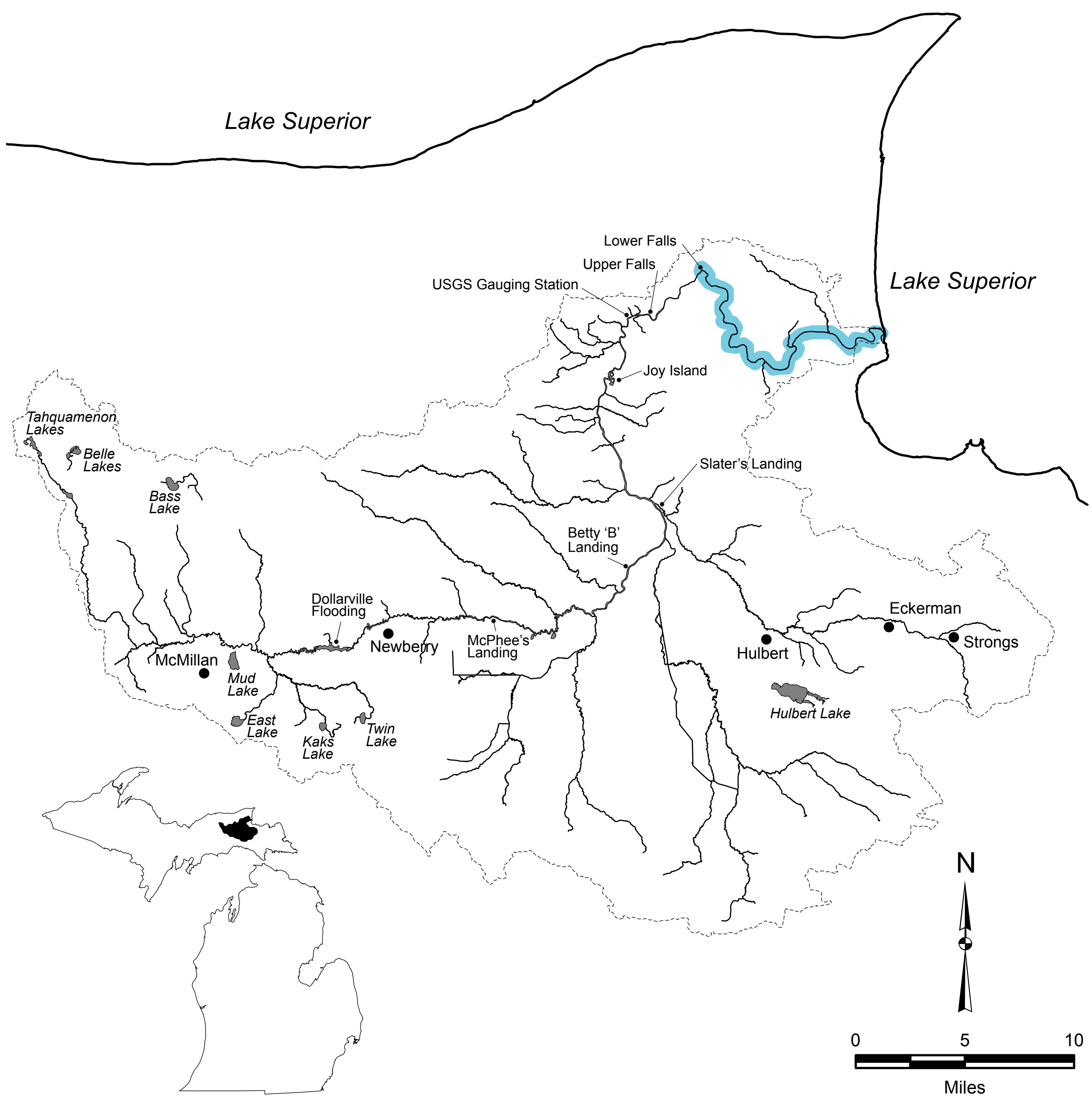


Common carp *Cyprinus carpio*

Habitat**:**

feeding - low gradient fertile streams, rivers, lakes, and impoundments
- abundance of aquatic vegetation or organic matter
- tolerant of all substrates and clear to turbid water

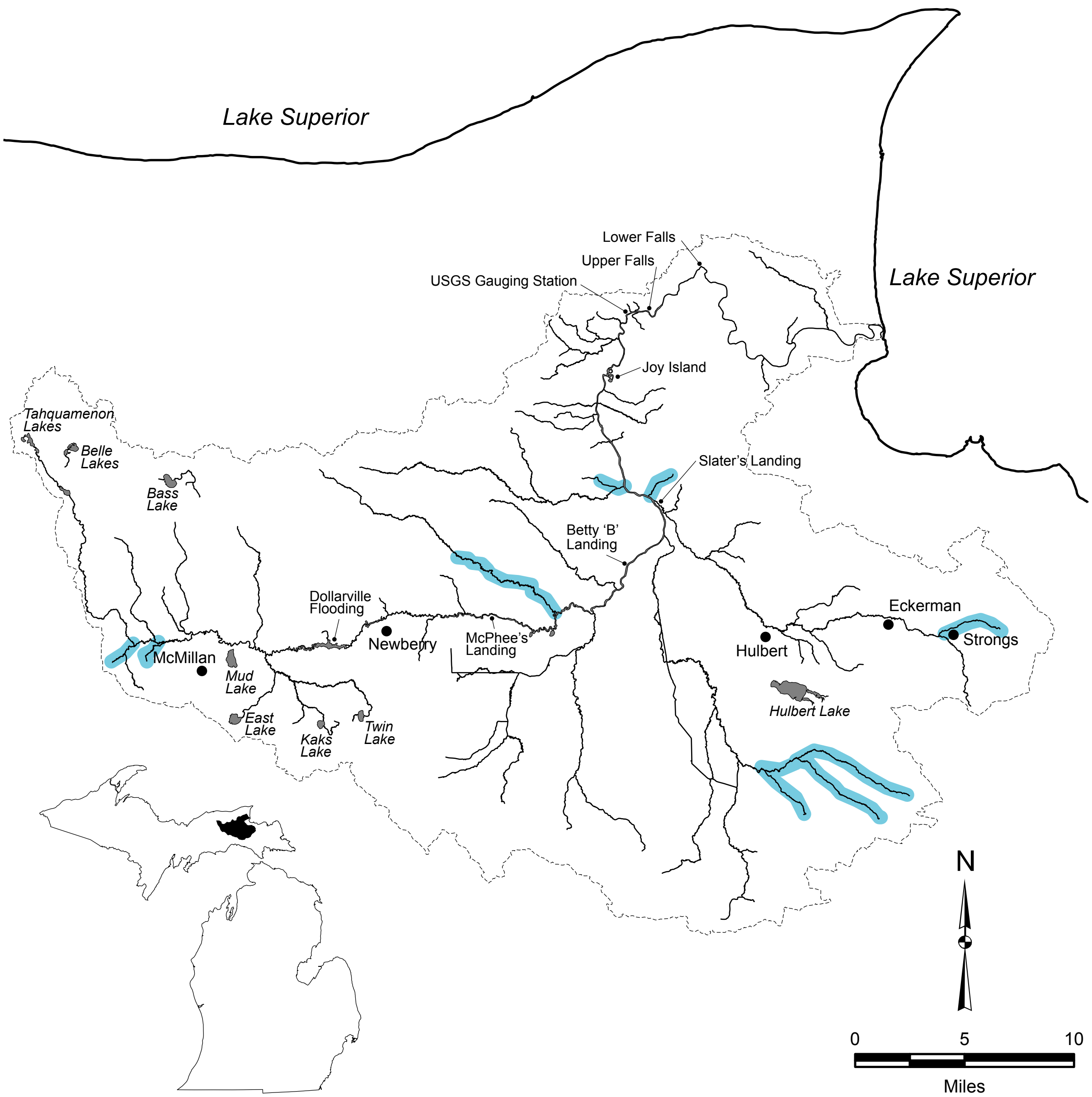
spawning - weedy or grassy shallows



Brassy minnow *Hybognathus hankinsoni*

Habitat**:**

feeding - cool acidic streams
- slow to moderate current
- sand or gravel substrate

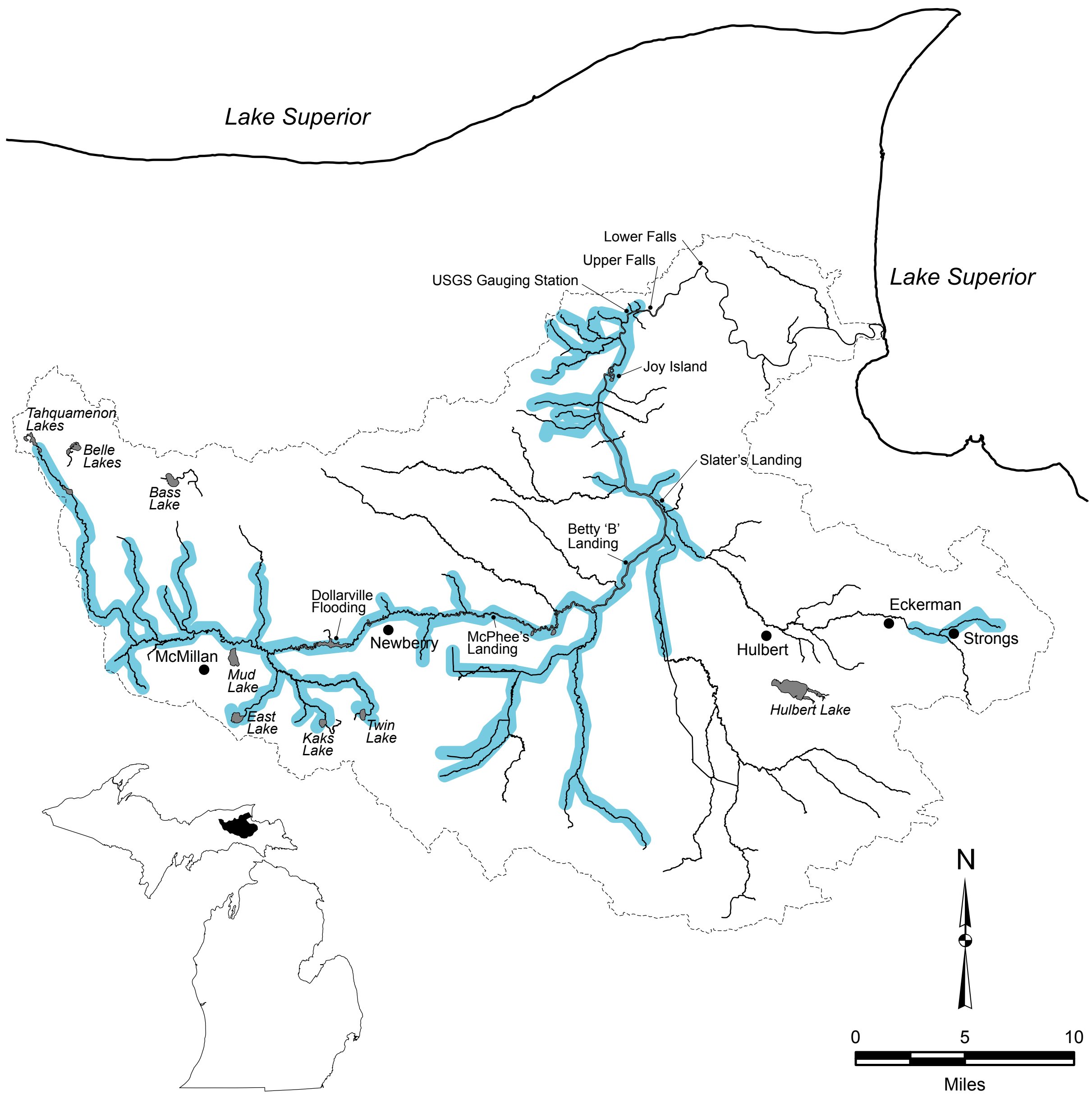


Common shiner *Luxilus cornutus*

Habitat**:**

feeding - small, clear, high-gradient streams and rivers, or shores of clear water lakes and impoundments
- gravel substrate
- can tolerate some submerged aquatic vegetation
- not very tolerant of turbidity or silted waters

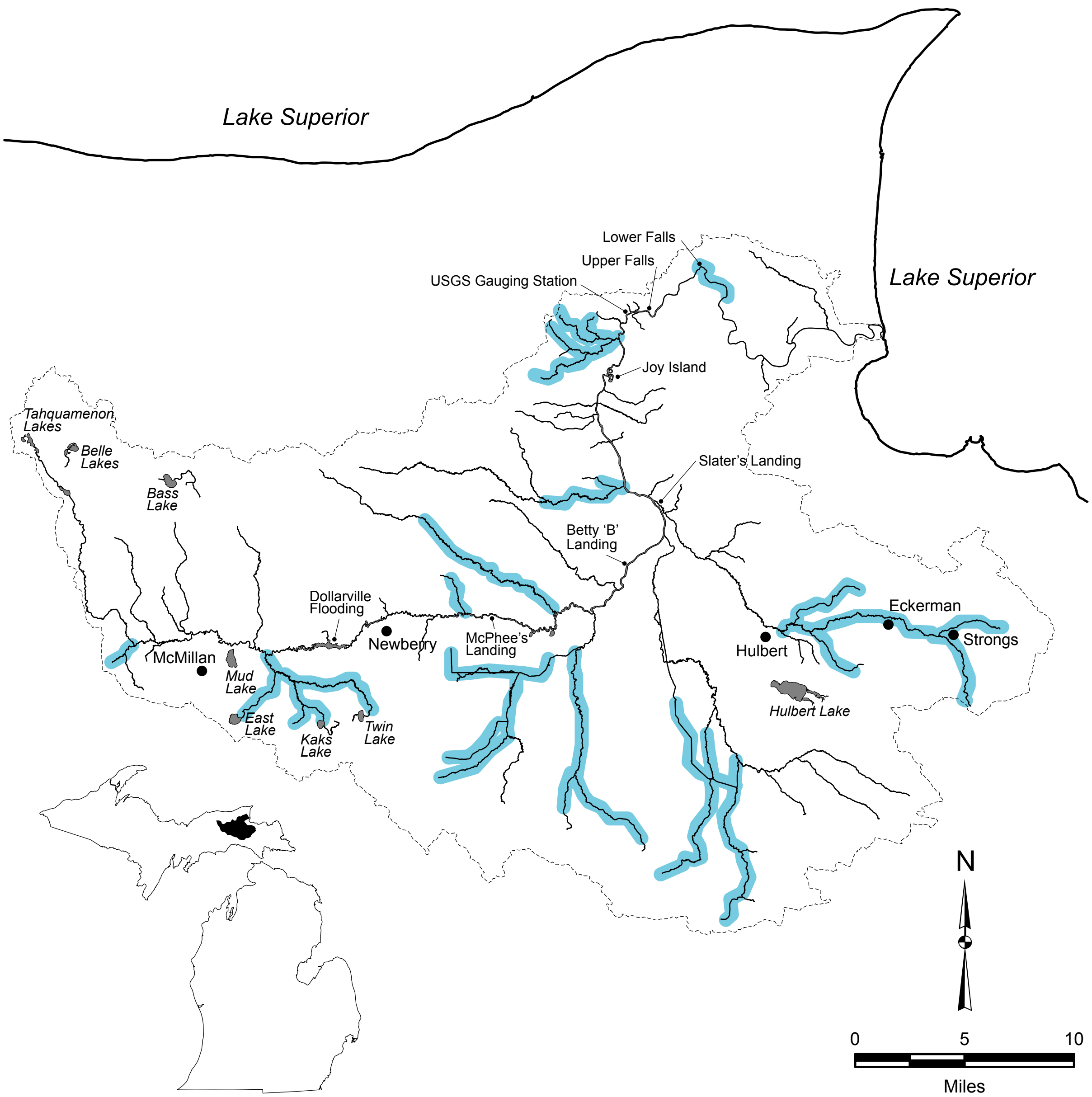
spawning - gravel nests of other fish, especially those at the head of a riffle



Northern pearl dace *Margariscus nachtriebi*

Habitat:

feeding	-	cool, neutral to acidic streams and lakes
	-	clear to slightly turbid water
spawning	-	males are territorial
	-	clear water, 18-24 inches deep
	-	sand or gravel substrate
	-	weak to moderate current

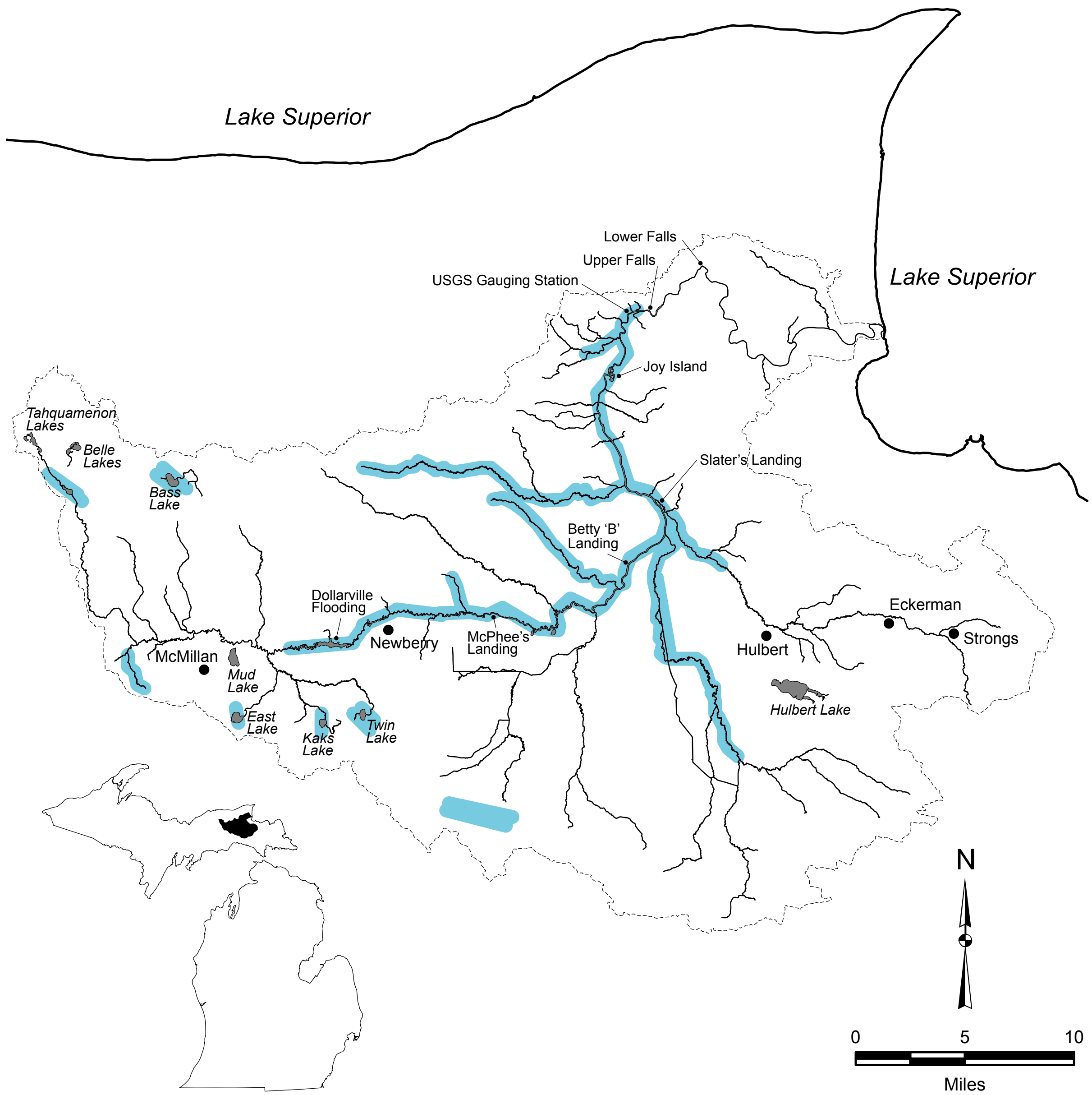


Golden shiner *Notemigonus crysoleucas*

Habitat:

feeding - lakes and impoundments and quiet pools of low gradient streams
- clear shallow water
- heavy vegetation

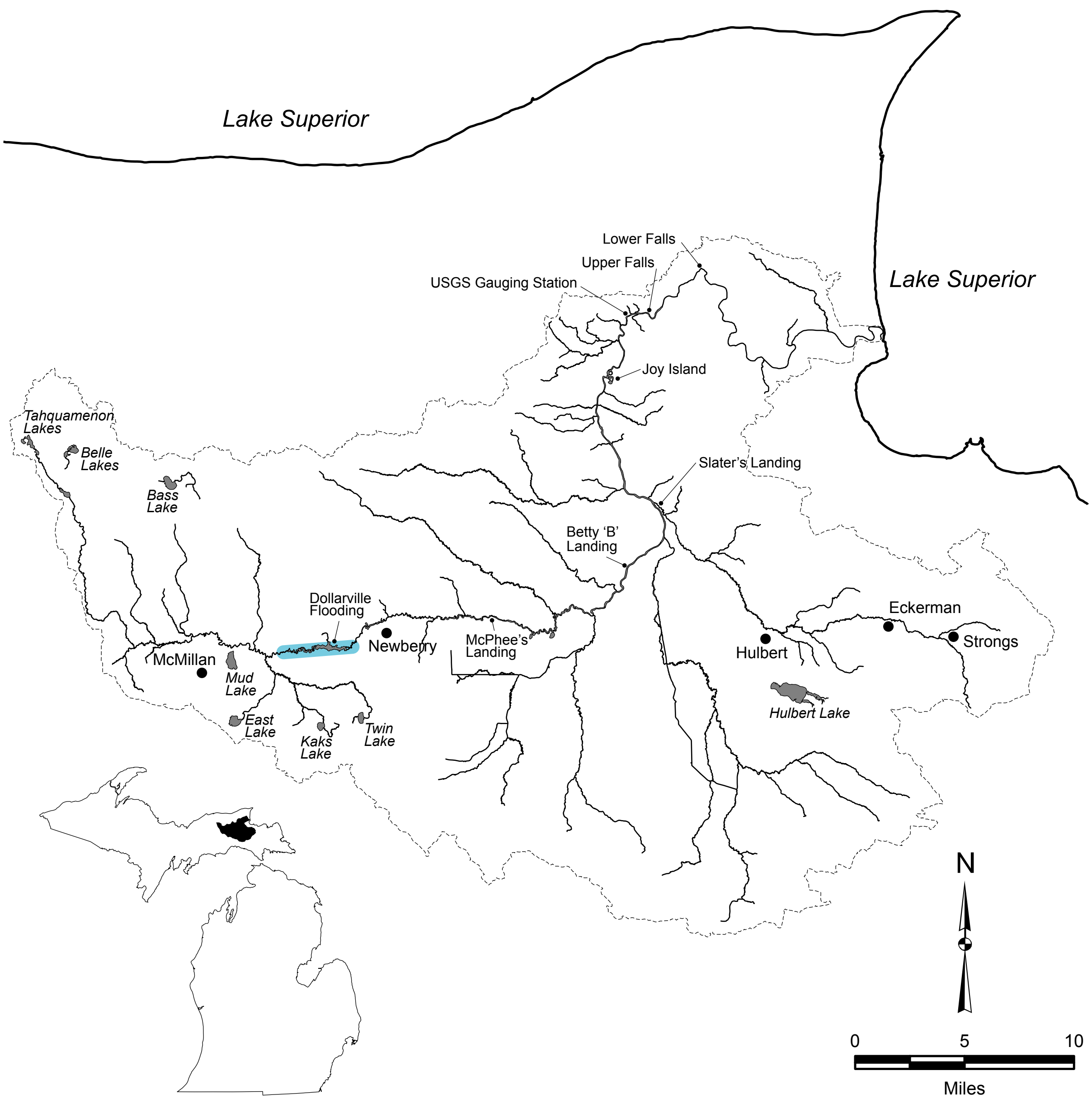
spawning - vegetation



Blackchin shiner *Notropis heterodon*

Habitat**:**

feeding - lakes, impoundments, and quiet pools in streams and rivers
- clear water
- clean sand, gravel, or organic debris substrate
- dense beds of submerged aquatic vegetation
- cannot tolerate turbidity, silt, or loss of aquatic vegetation

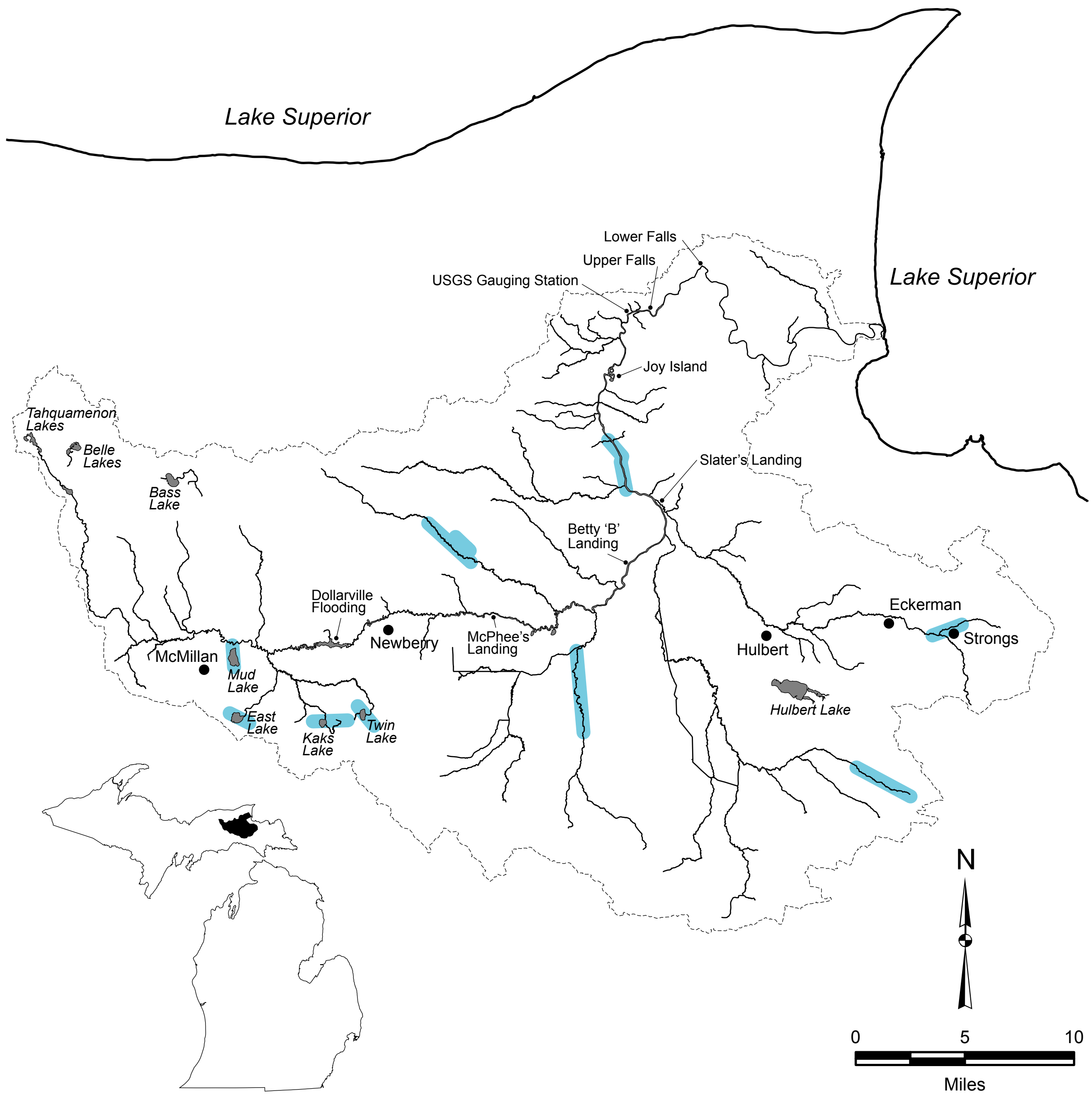


Blacknose shiner *Notropis heterolepis*

Habitat:

feeding - clear lakes, impoundments, and pools of small, clear, low-gradient streams
- aquatic vegetation
- clean sand, gravel, marl, muck, peat, or organic debris substrate
- cannot tolerate much turbidity, much siltation, or loss of aquatic vegetation

spawning - sandy substrate

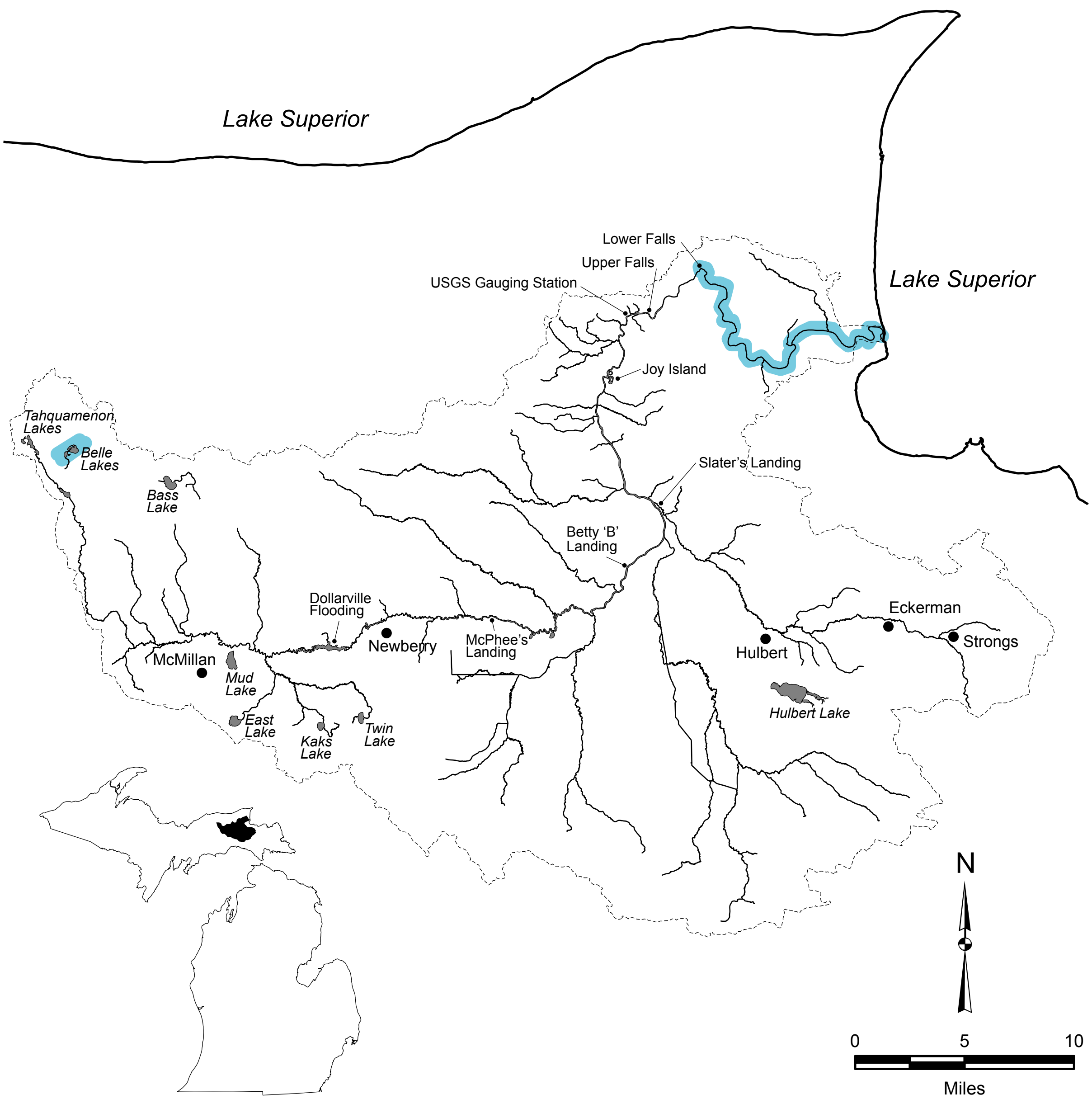


Spottail shiner *Notropis hudsonius*

Habitat**:**

feeding - large rivers, lakes, and impoundments
- firm sand and gravel substrate
- low current
- sparse to moderate vegetation
- avoids turbidity

spawning - over sandy shoals or gravelly riffles
- near the mouths of small streams

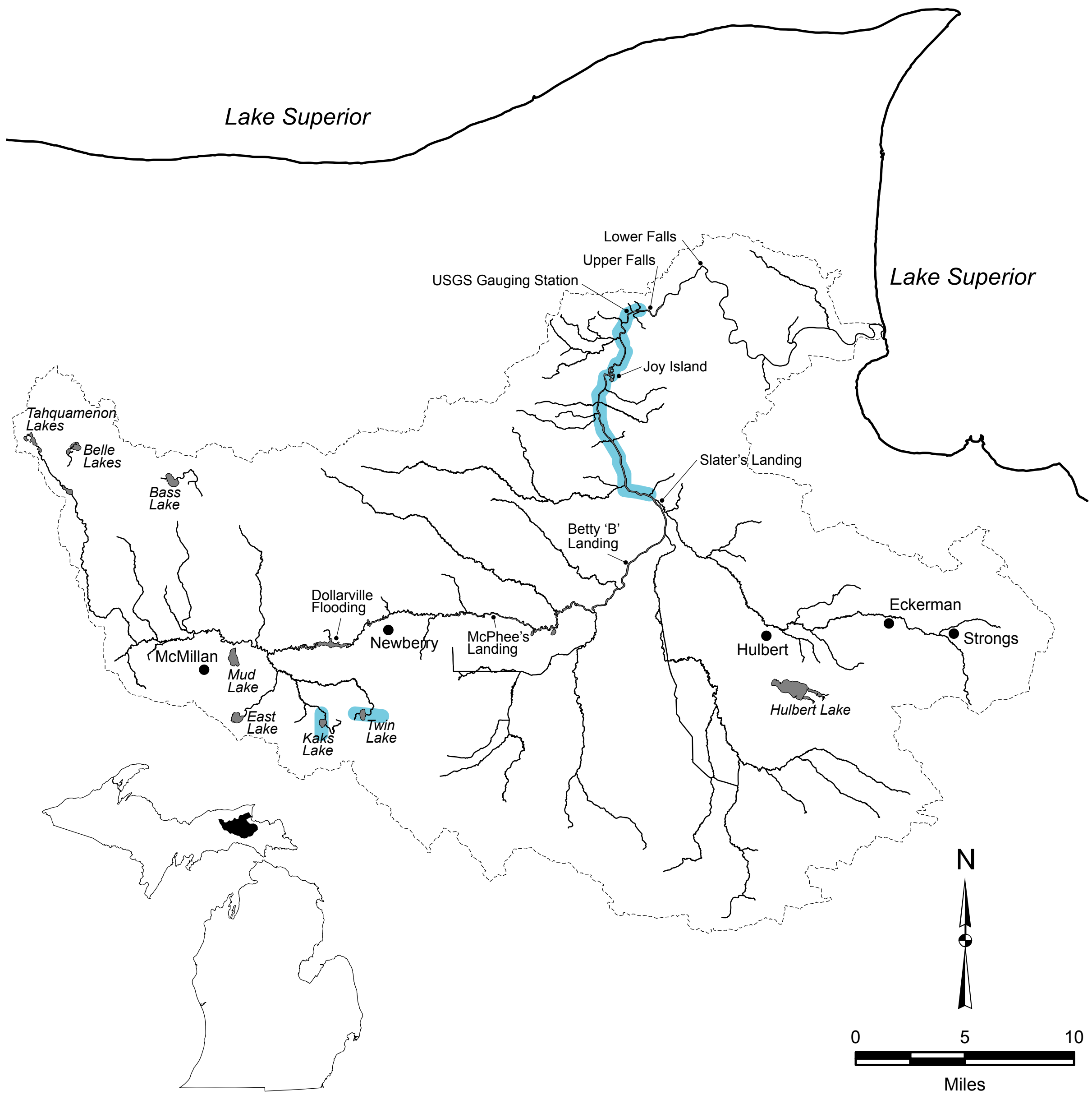


Mimic shiner *Notropis volucellus*

Habitat**:**

feeding - pools and backwater of streams, moderately weedy lakes and impoundments
- quiet or still water
- clear shallow water

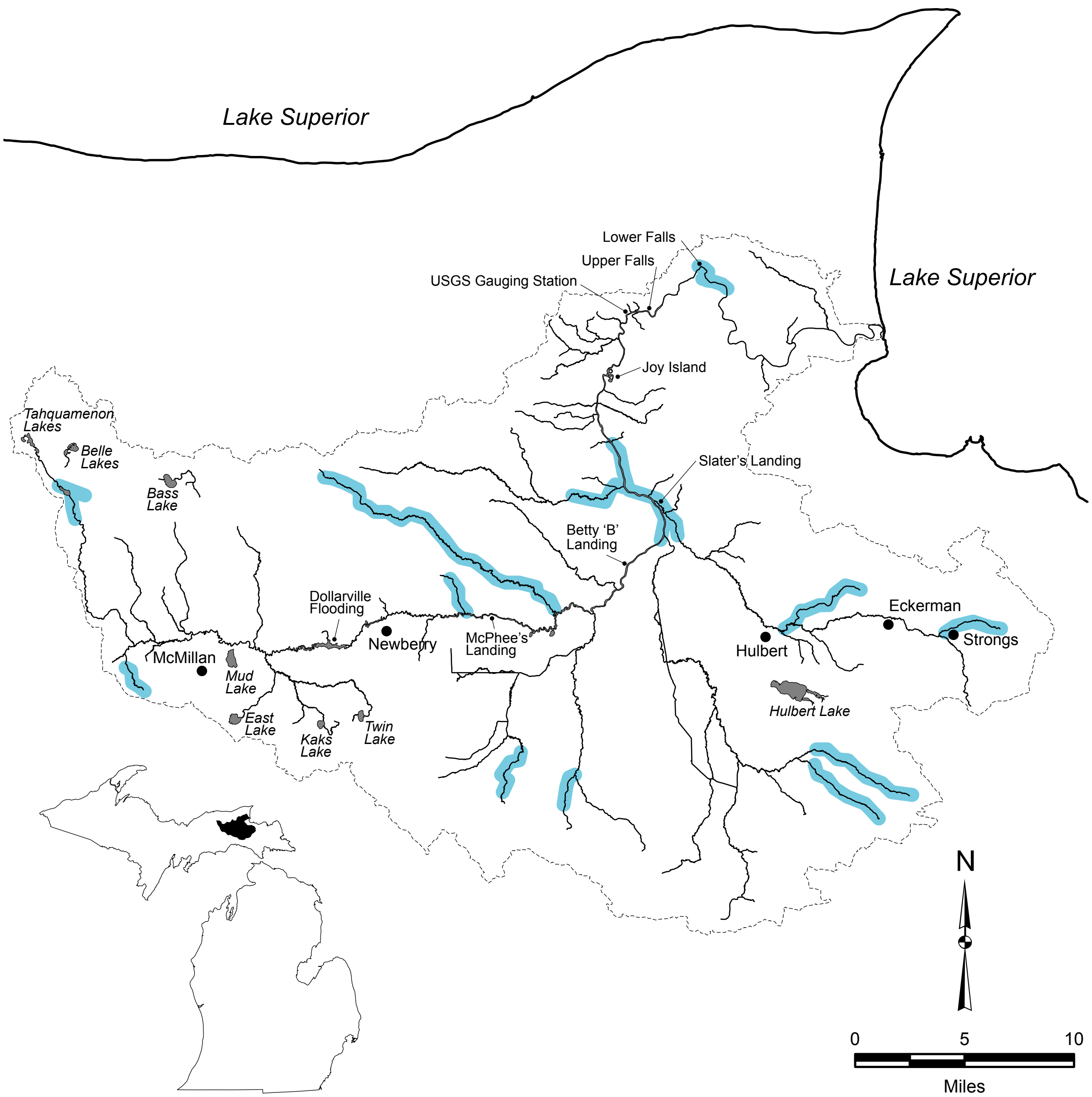
spawning - aquatic vegetation necessary



Northern redbelly dace *Phoxinus eos*

Habitat**:**

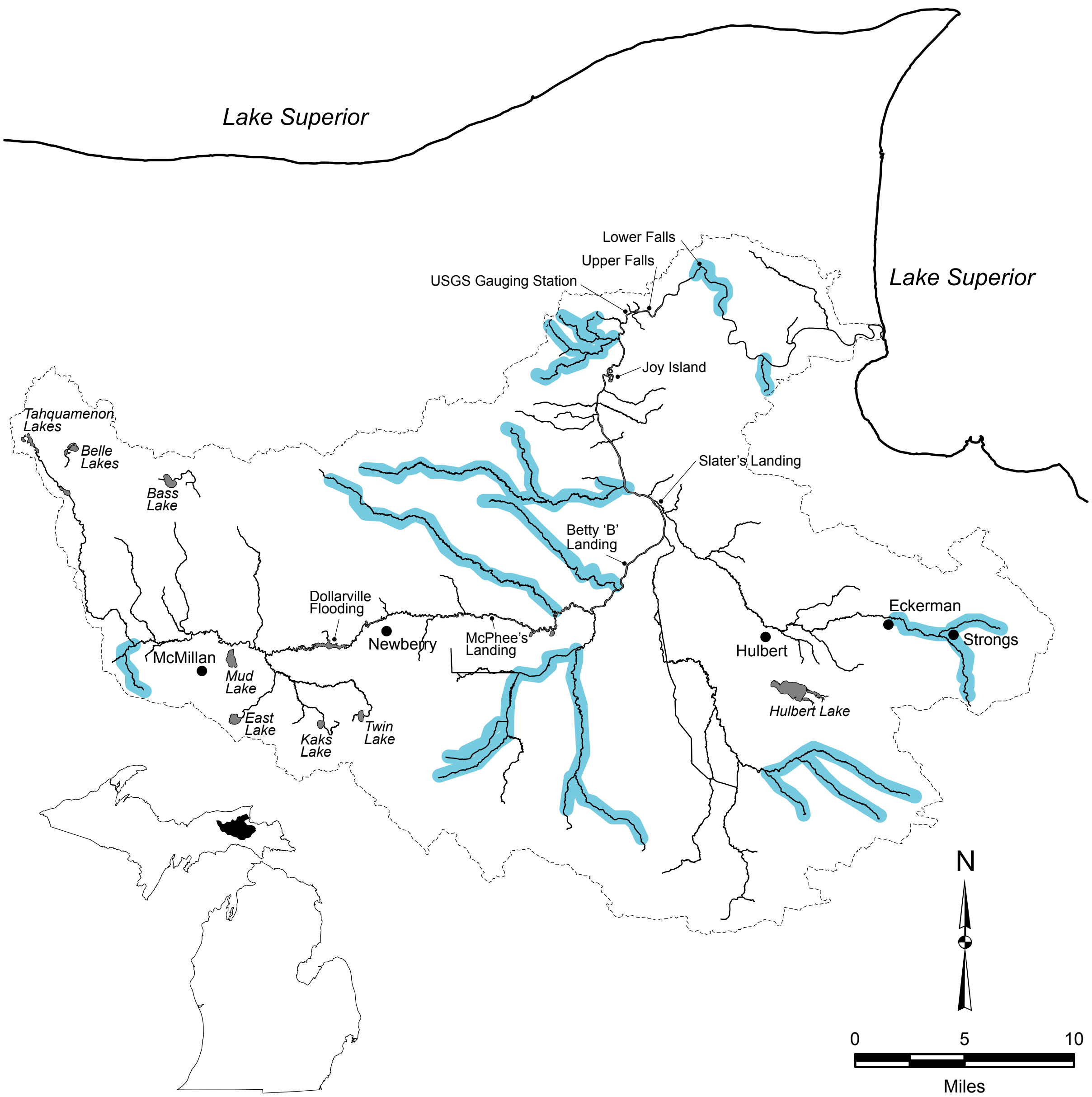
feeding	-	slow current
	-	in boggy lakes and streams
	-	detritus or silt substrate
	-	clear to slightly turbid water
spawning	-	filamentous algae needed for egg deposition



Finescale dace *Phoxinus neogaeus*

Habitat:

feeding - cool bog lakes and streams
- neutral to slightly acidic waters
- various substrates

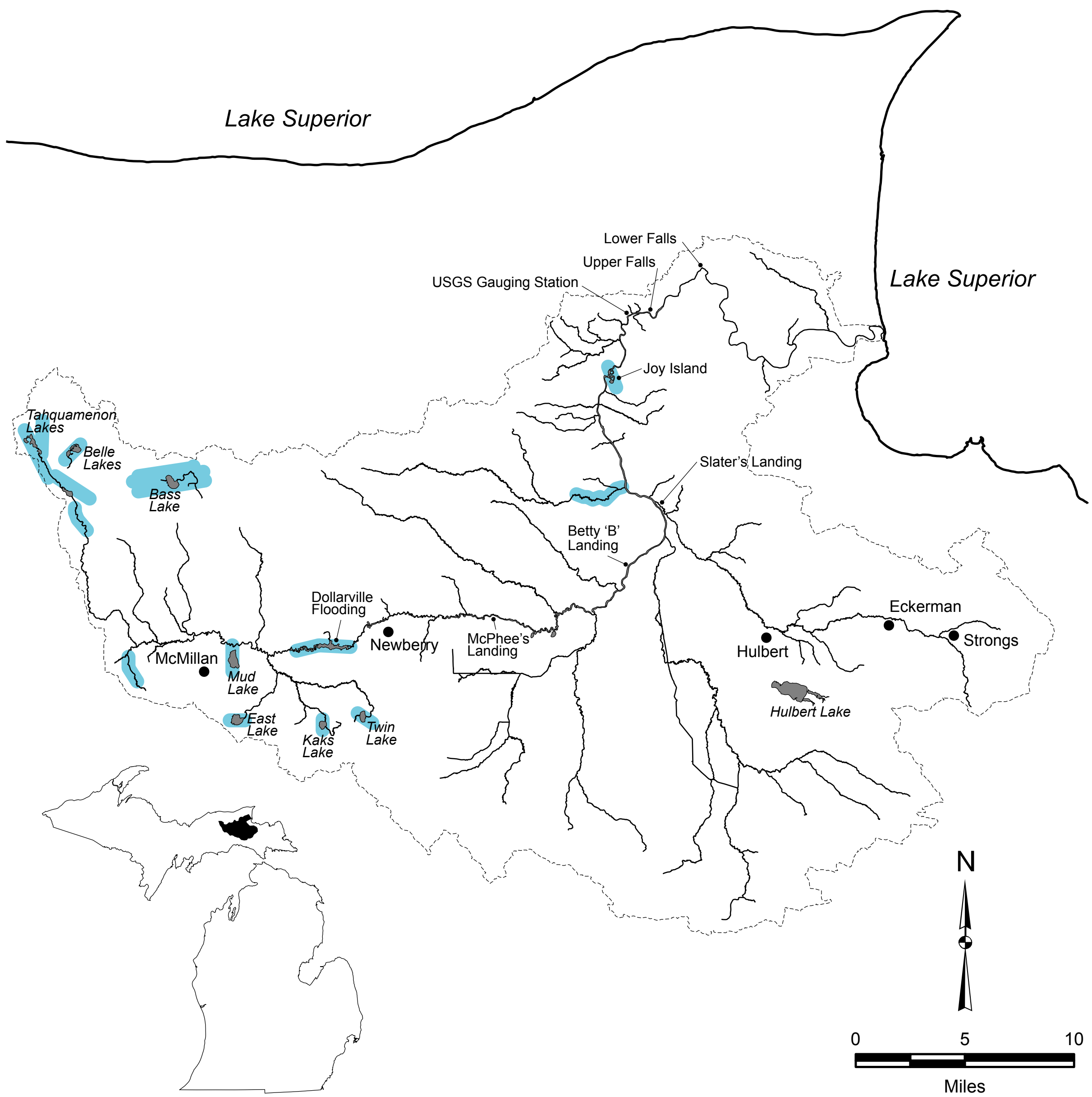


Bluntnose minnow *Pimephales notatus*

Habitat**:**

feeding - quiet pools and backwaters of medium to large streams, lakes, and impoundments
- clear warm water
- some aquatic vegetation
- firm substrates
- tolerates all gradients, turbidity, organic and inorganic pollutants

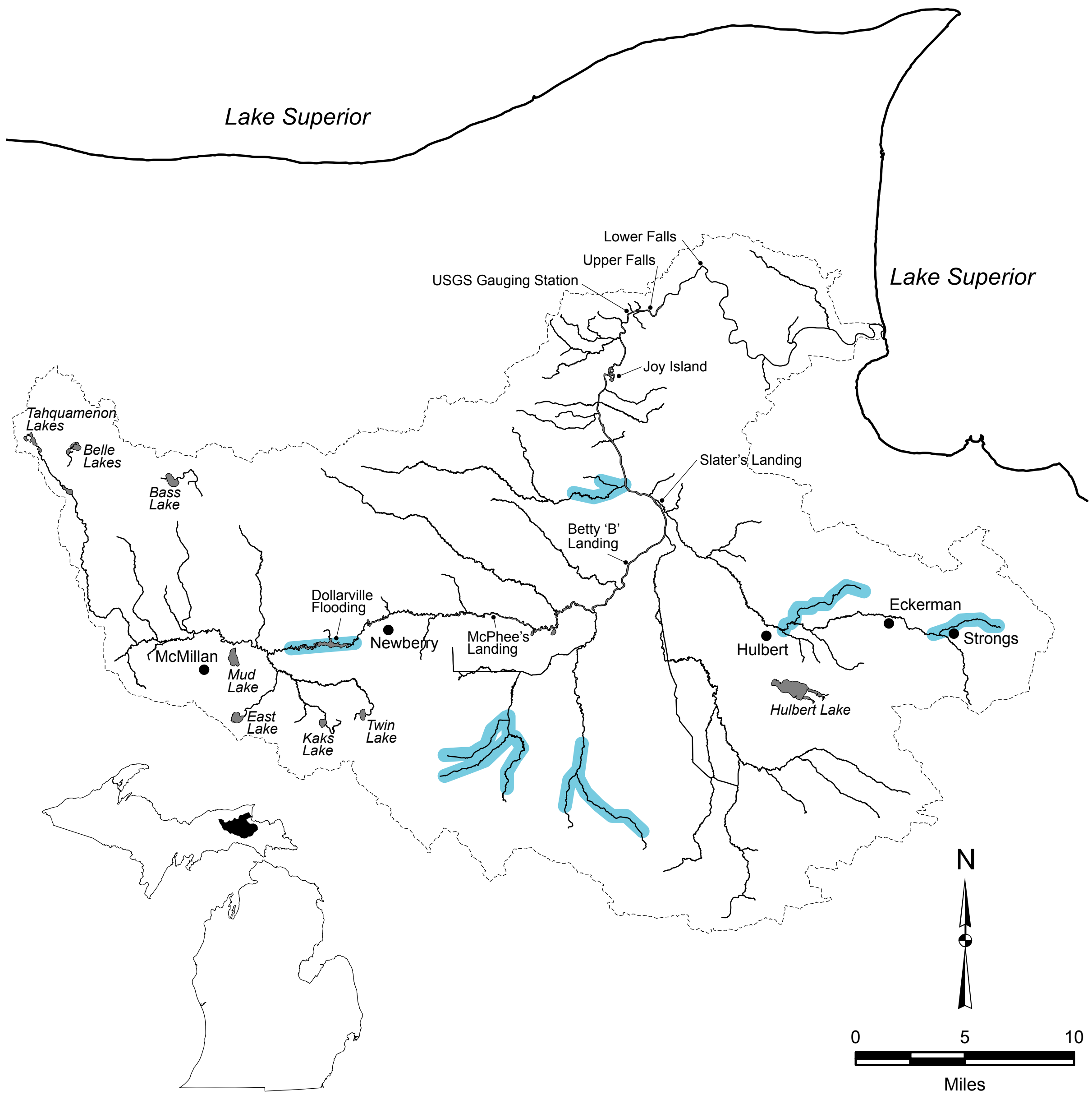
spawning - eggs deposited on the underside of flat stones or objects
- nests in sand or gravel substrate



Fathead minnow *Pimephales promelas*

Habitat**:**

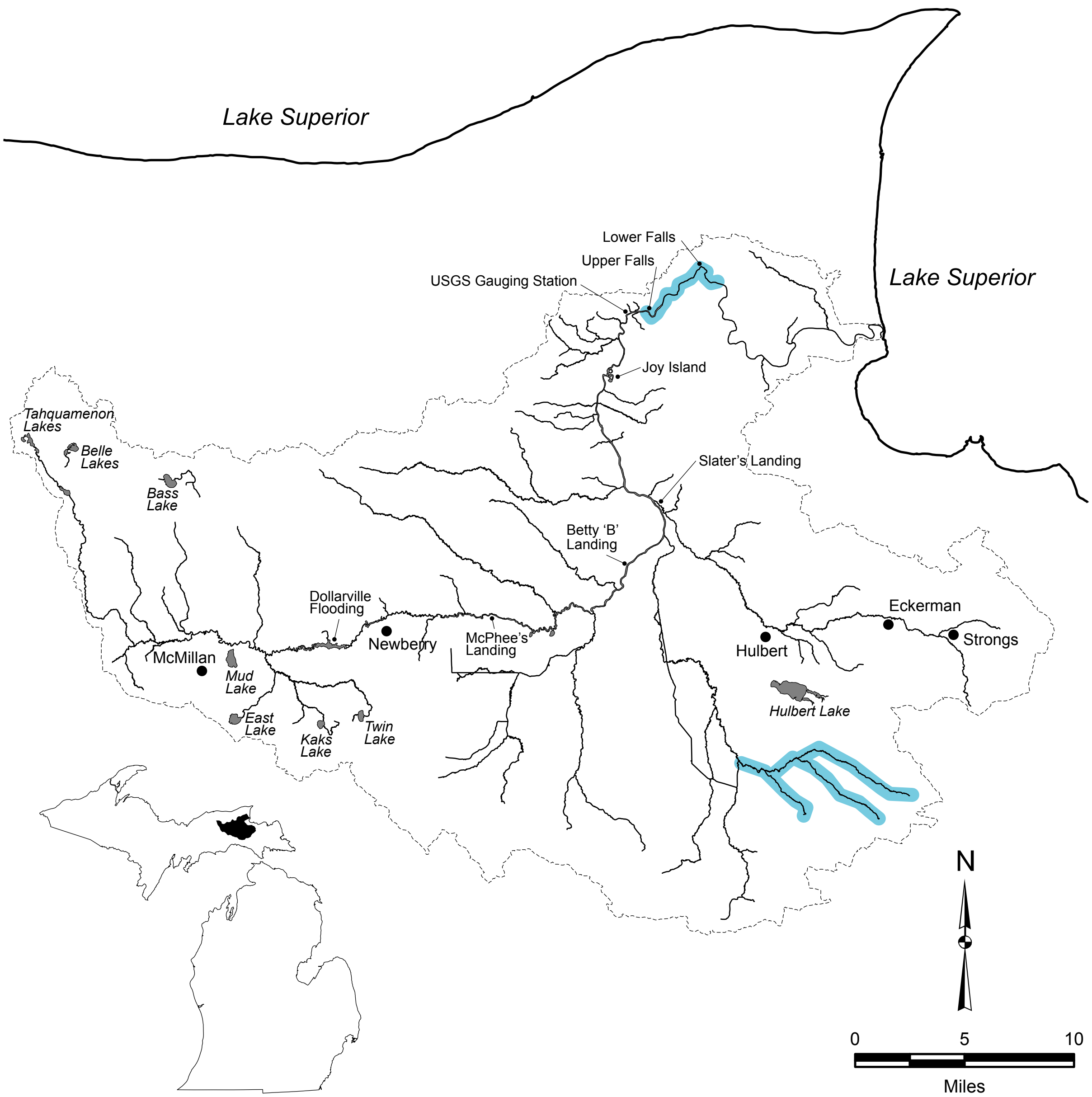
feeding	-	pools of small streams, lakes, and impoundments
	-	tolerant of turbidity, high temperatures, and low oxygen
spawning	-	on underside of objects in water 2 to 3 feet deep
	-	prefer sand, marl, or gravel substrate



Longnose dace *Rhinichthys cataractae*

Habitat**:**

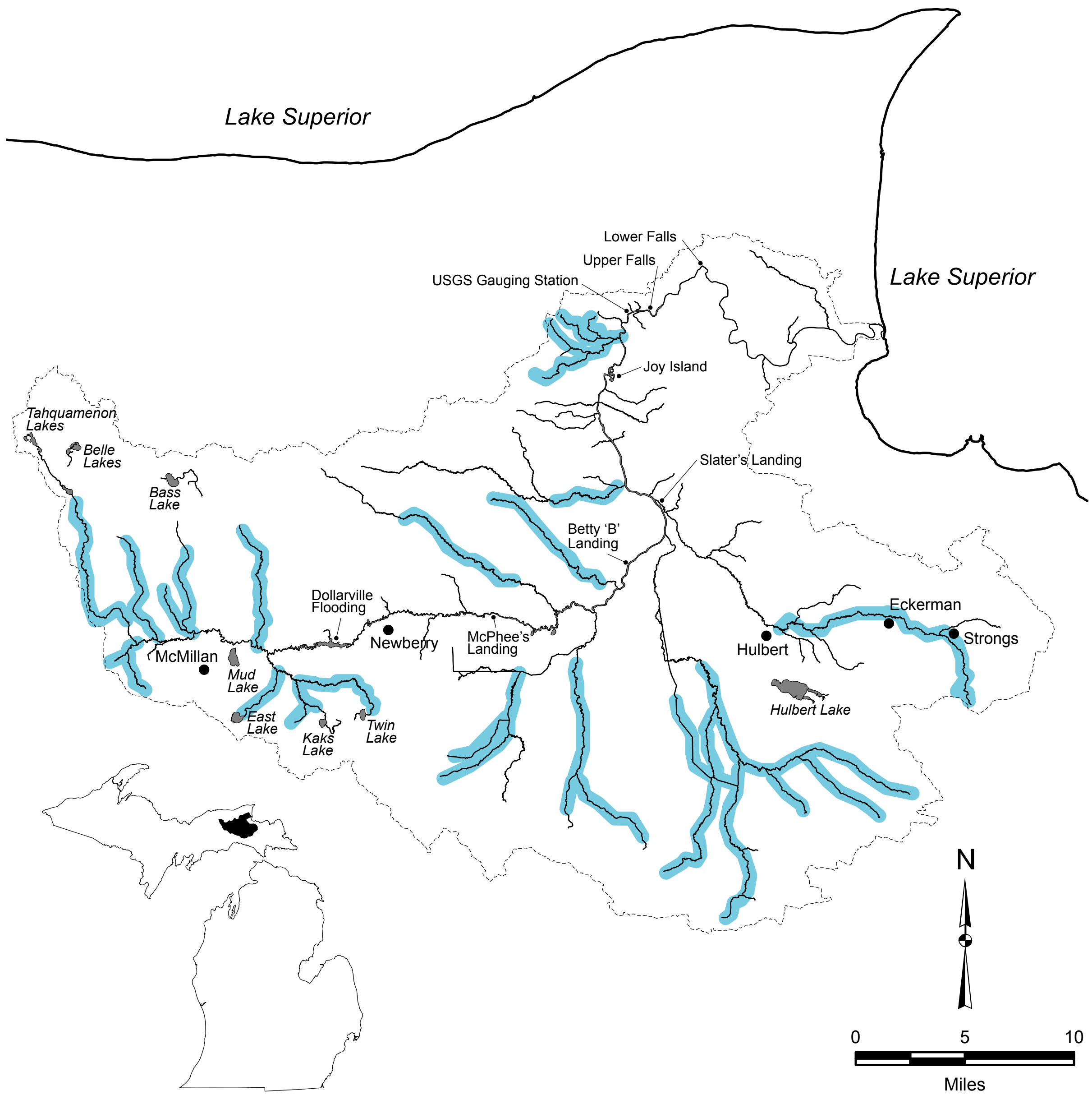
feeding - lakes and streams
- high gradient
- gravel or boulder substrate



Western blacknose dace *Rhinichthys obtusus*

Habitat:

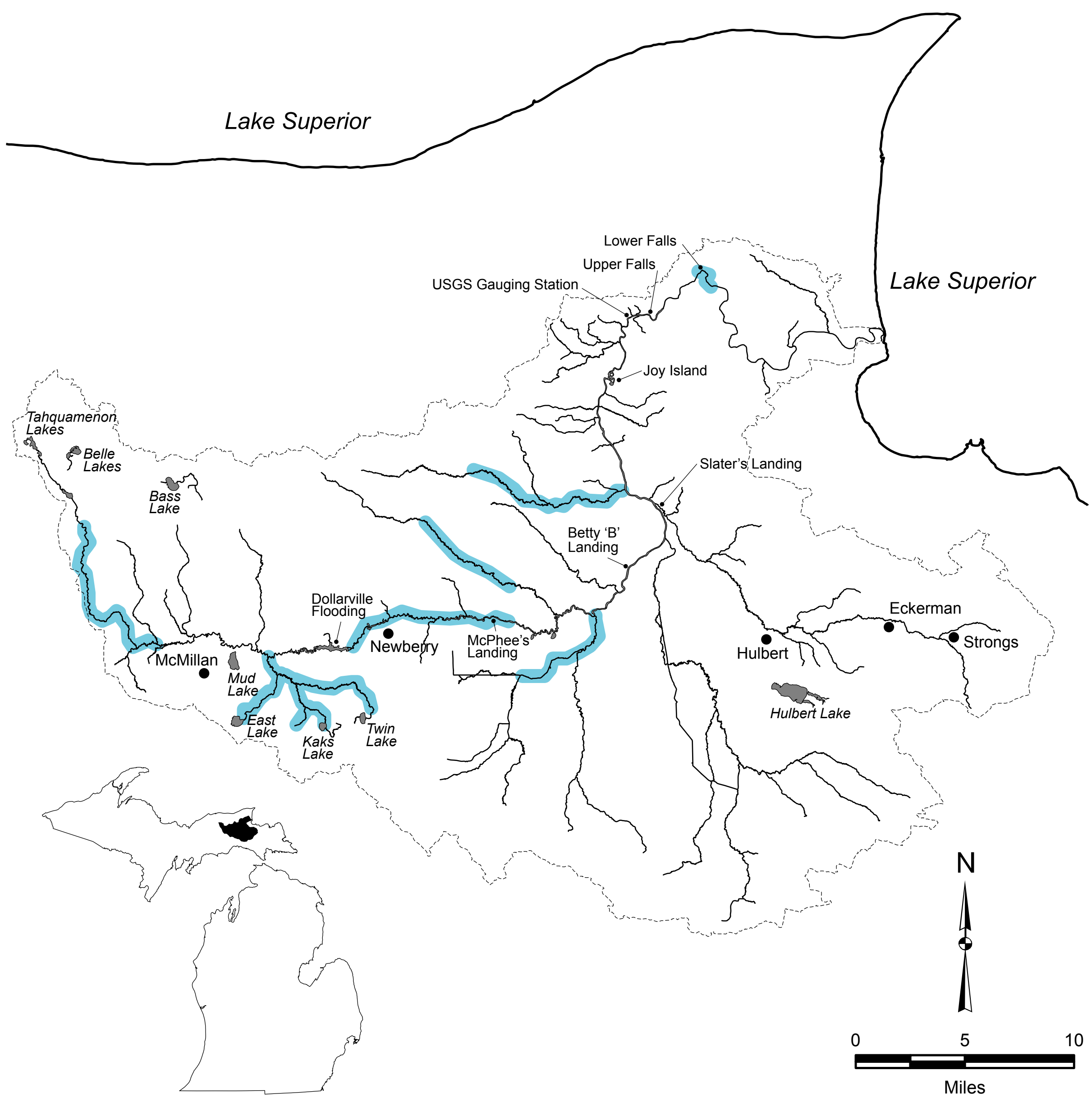
feeding	-	moderate to high gradient streams
	-	sand and gravel substrate
	-	clear cool water in pools with deep holes and undercut banks
	-	does not tolerate turbidity and silt well
spawning	-	riffles with gravel substrate and fast current
winter refuge	-	larger waters



Creek chub *Semotilus atromaculatus*

Habitat**:**

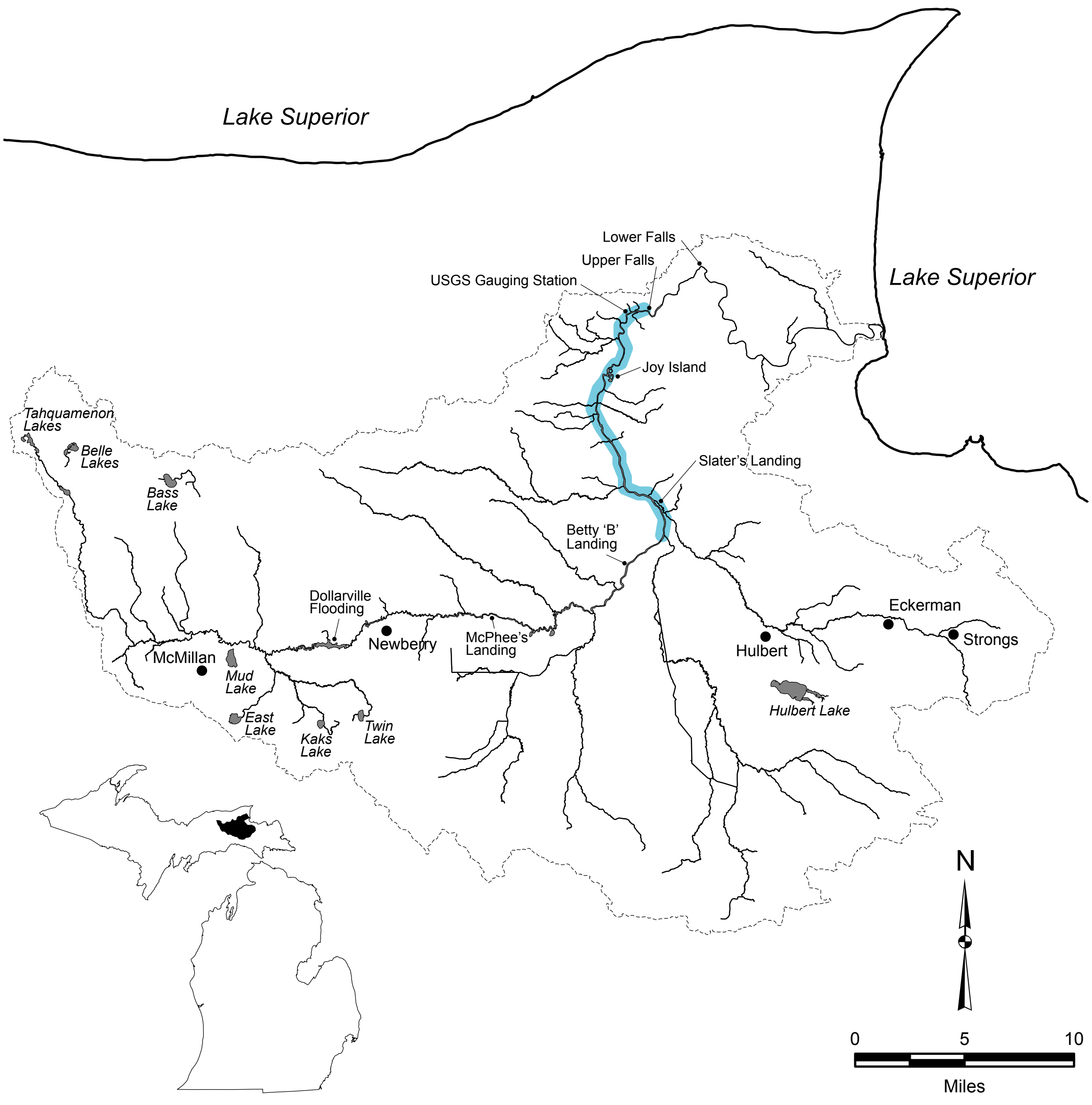
feeding	-	streams, rivers, or shore waters of lakes and impoundments
	-	can tolerate intermittent flows
	-	tolerates moderate turbidity
spawning	-	gravel nests
	-	low current
winter refuge	-	deeper pools and runs



Longnose sucker *Catostomus catostomus*

Habitat:

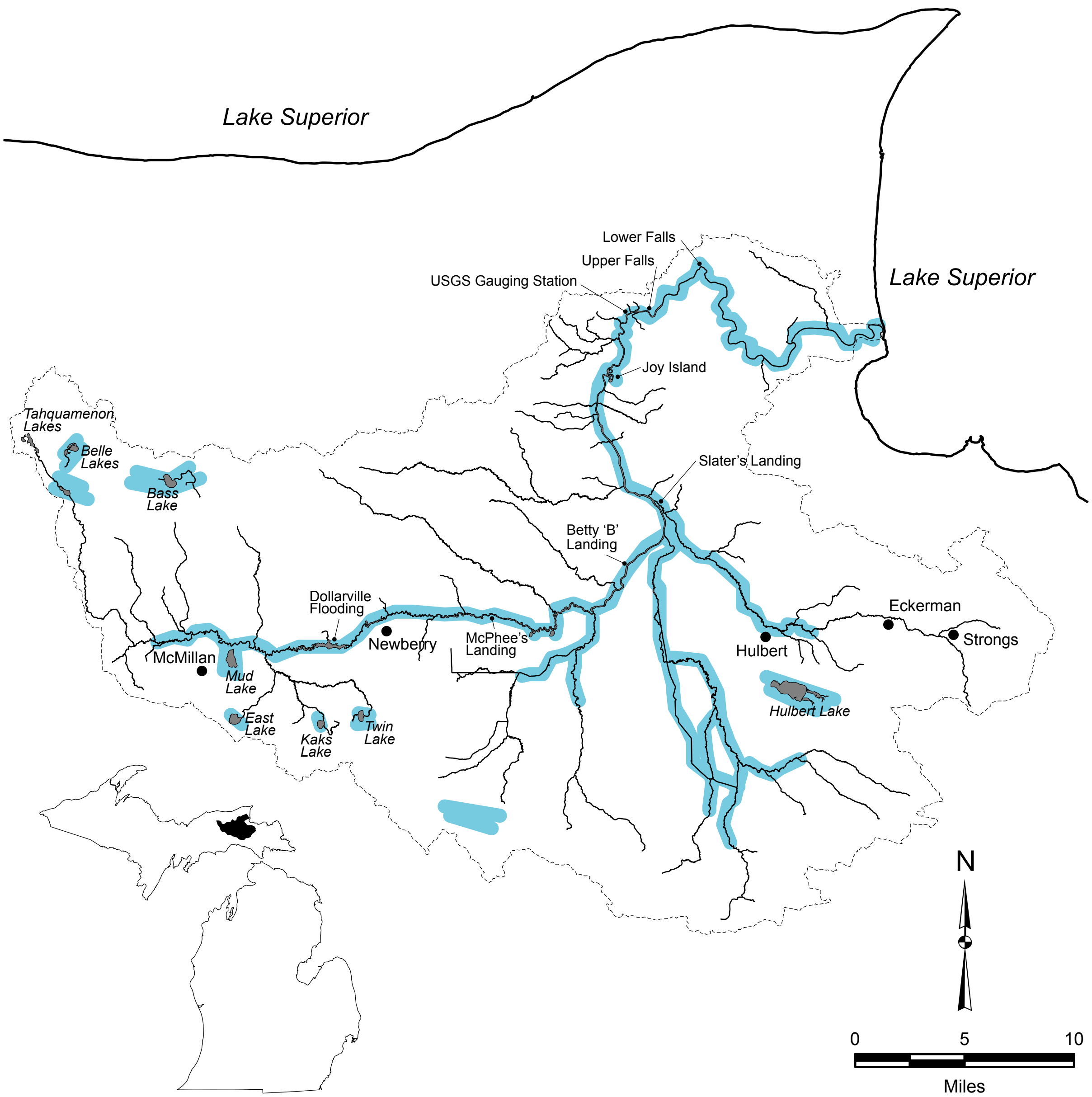
feeding	-	clear, cold rivers and lakes
spawning	-	in streams or lake shallows
	-	current
	-	gravel substrate



White sucker *Catostomus commersonii*

Habitat**:**

feeding	-	streams, rivers, lakes, and impoundments
	-	can inhabit highly turbid and polluted waters
spawning	-	quiet gravelly shallow areas of streams

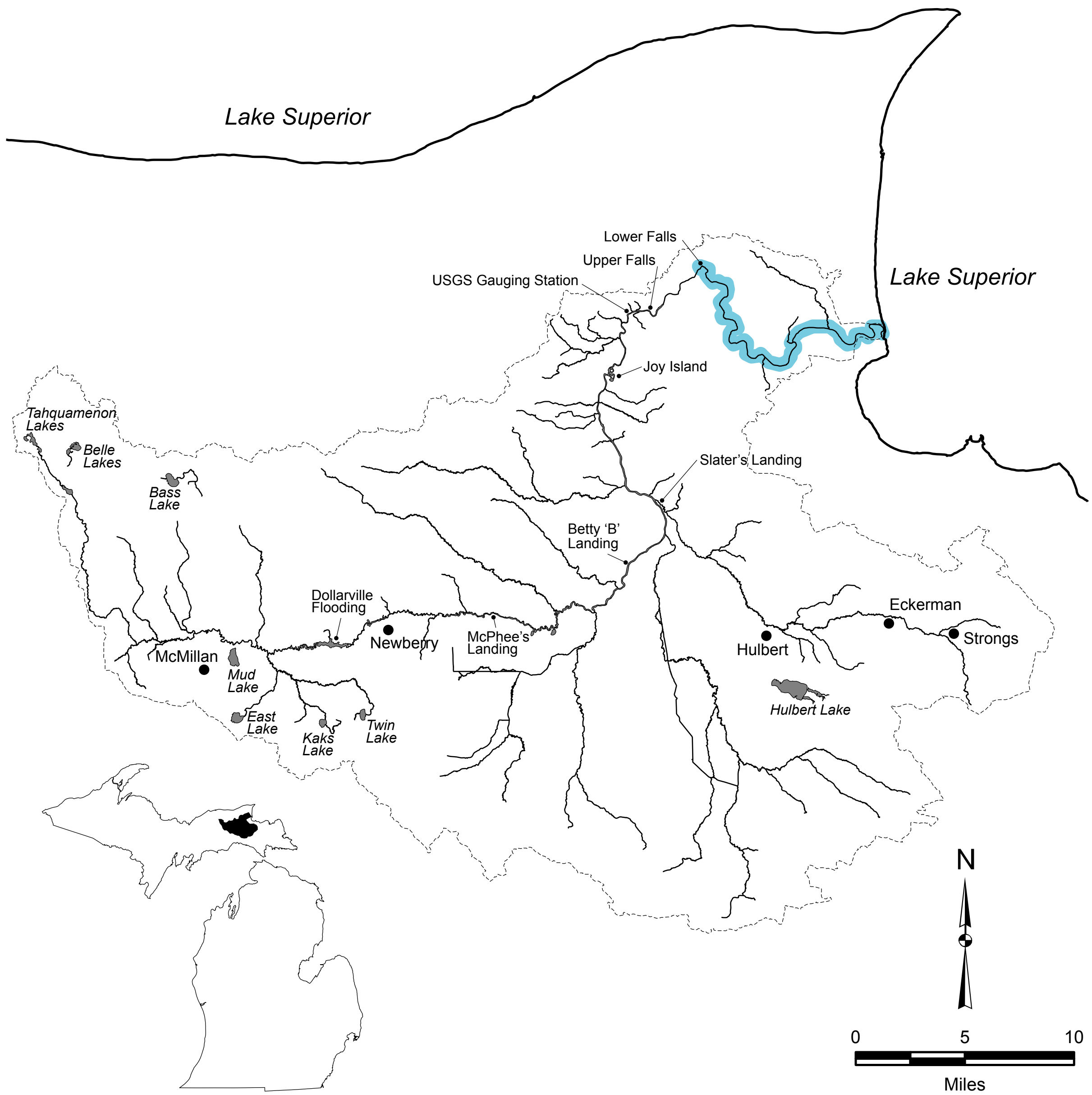


Silver redhorse *Moxostoma anisurum*

Habitat:

feeding - streams, rivers, lakes, and impoundments
- low current
- pollution and turbidity intolerant

spawning - swift current in rivers, do not spawn in tributaries
- males territorial
- gravel to rubble substrate

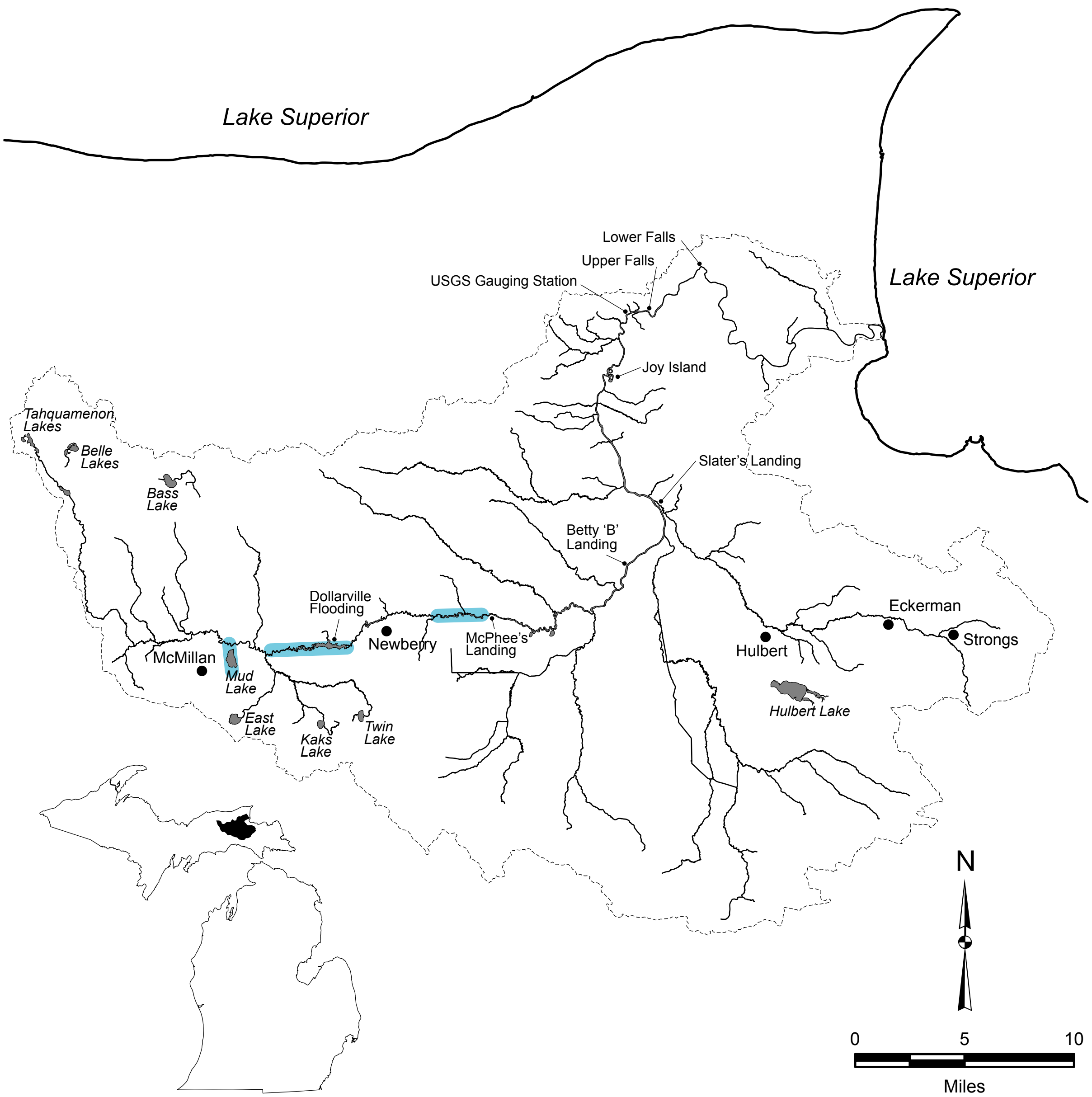


Black bullhead *Ameiurus melas*

Habitat:

feeding
- turbid water
- silt bottom
- low gradient small to medium streams, pools, and headwaters of large rivers; also in lakes and impoundments
- can tolerate very warm water and very low dissolved oxygen

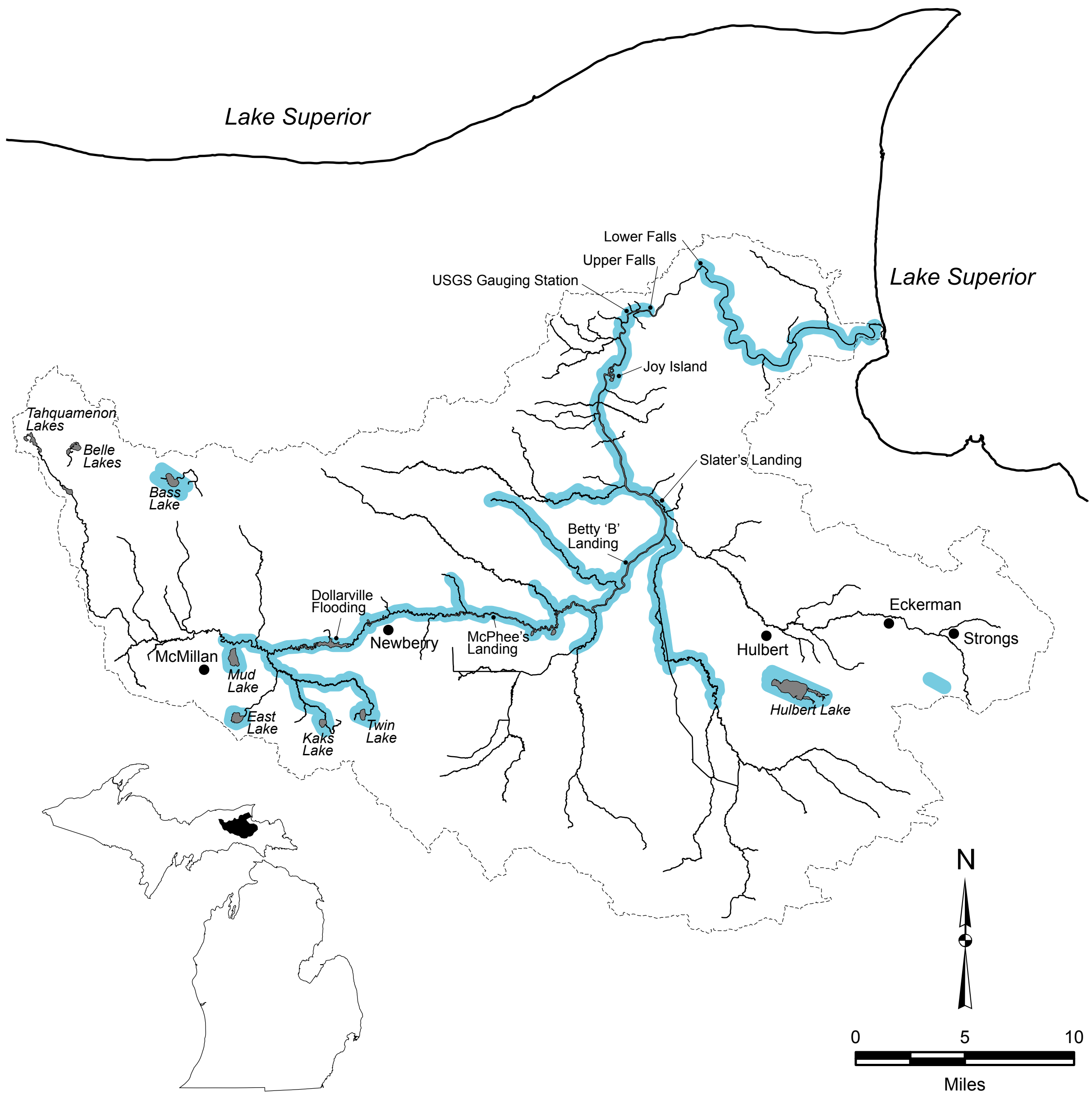
spawning
- nest in moderate to heavy vegetation or woody debris and under overhanging banks



Brown bullhead *Ameiurus nebulosus*

Habitat**:**

feeding	-	larger streams and rivers, lakes and impoundments
	-	clear cool water with little clayey silt
	-	moderate amounts of aquatic vegetation
	-	sand, gravel, or muck substrate
	-	not tolerant of turbid water
	-	tolerant of warm water and low oxygen
spawning	-	nest in mud or sand substrate among rooted aquatic vegetation usually near a stump, tree, or rock
winter refuge	-	in muddy bottoms

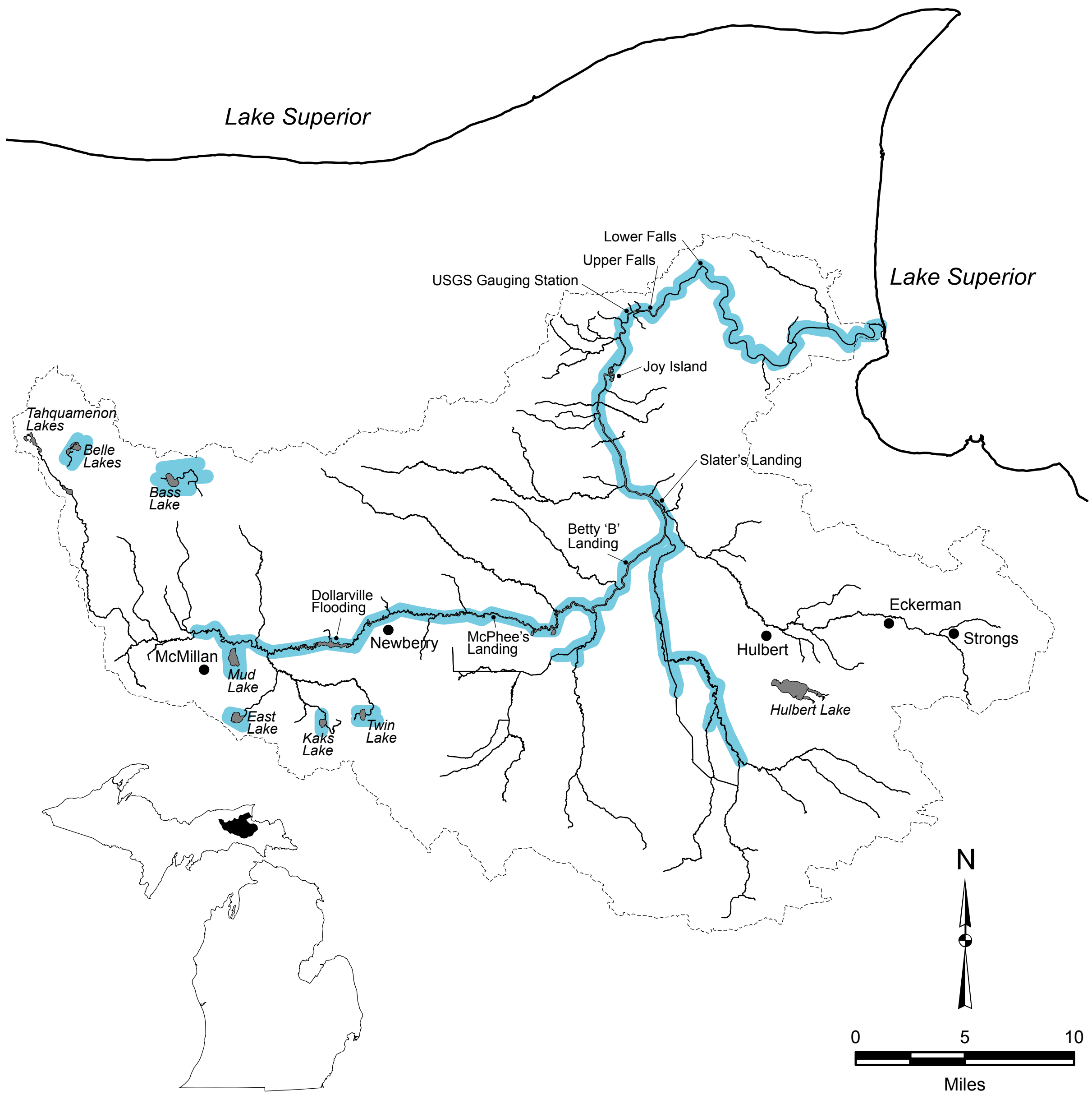


Northern pike *Esox lucius*

Habitat**:**

feeding - cool to moderately warm streams, rivers, lakes, and impoundments
- vegetation in slow to moderate current

spawning - submerged vegetation with slow current in shallow water

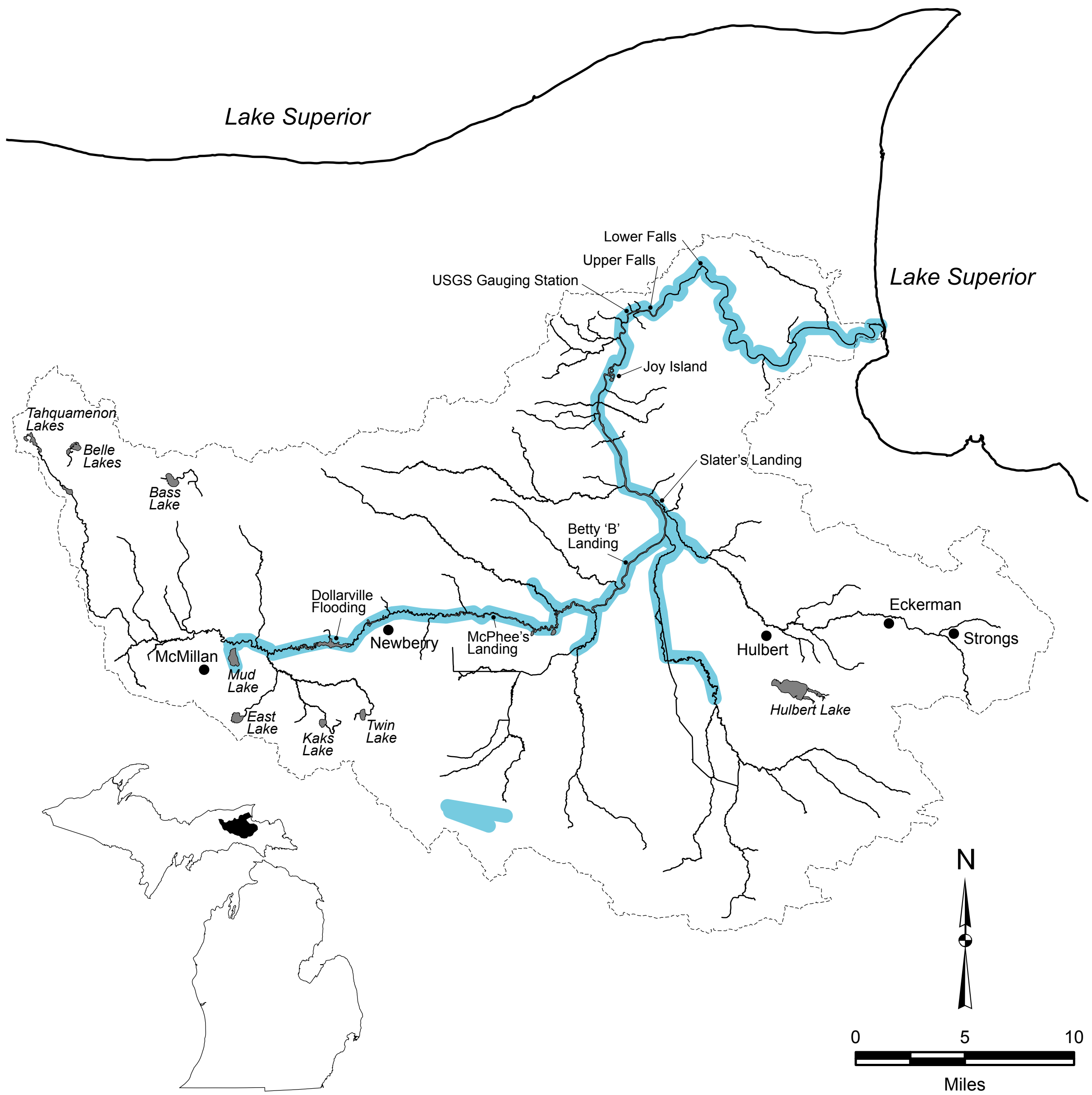


Muskellunge *Esox masquinongy*

Habitat:

feeding - warm, heavily vegetated lakes, stumpy weedy bays, and slow heavily vegetated medium to large rivers
- shallow cool water
- tolerant of low oxygen

spawning - clear shallow waters (15-20”) in heavily vegetated areas

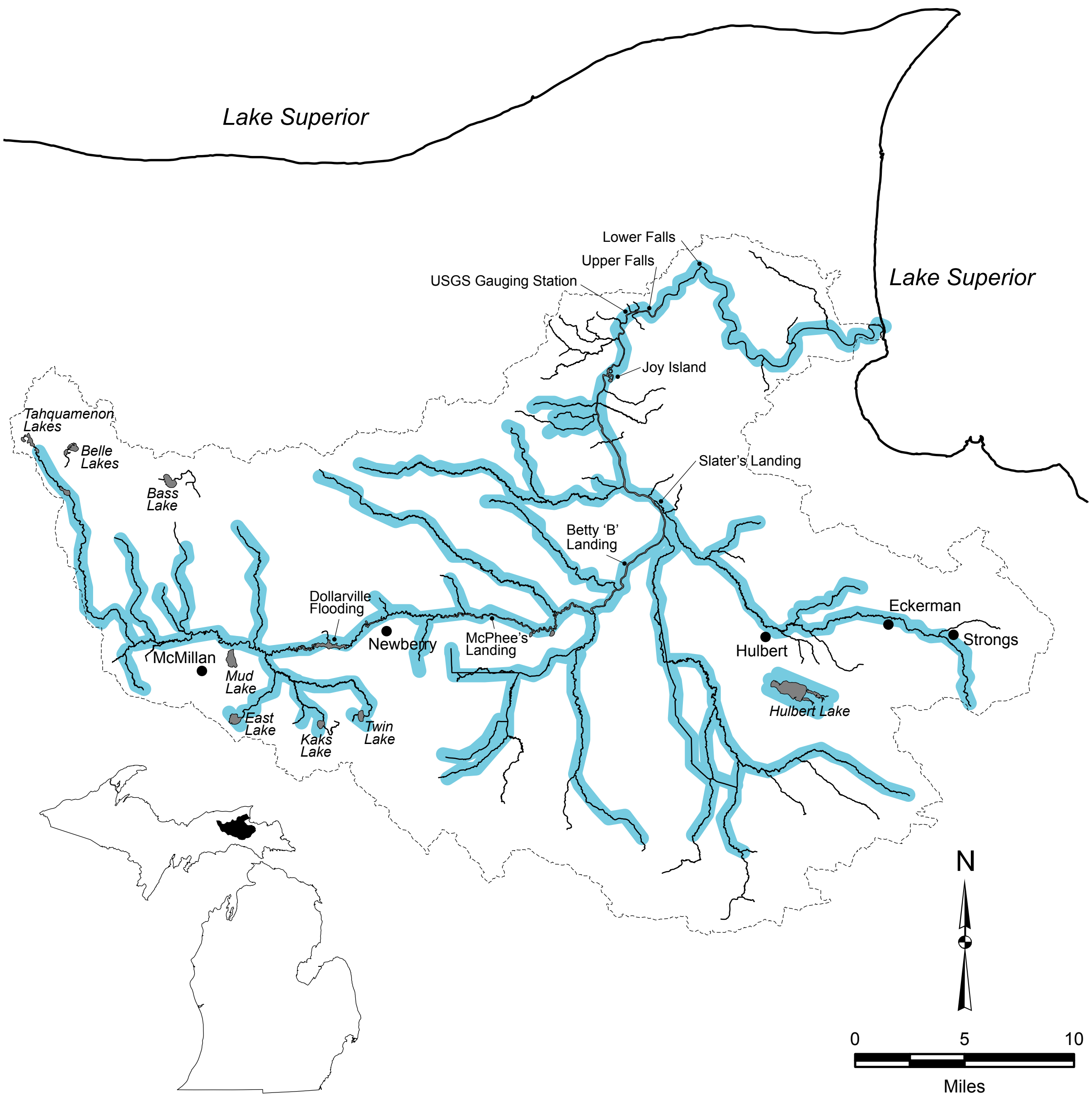


Central mudminnow *Umbra limi*

Habitat**:**

feeding - undisturbed clear, low-gradient streams or rivers and lakes and impoundments
- organic debris, muck, or peat substrates
- aquatic vegetation

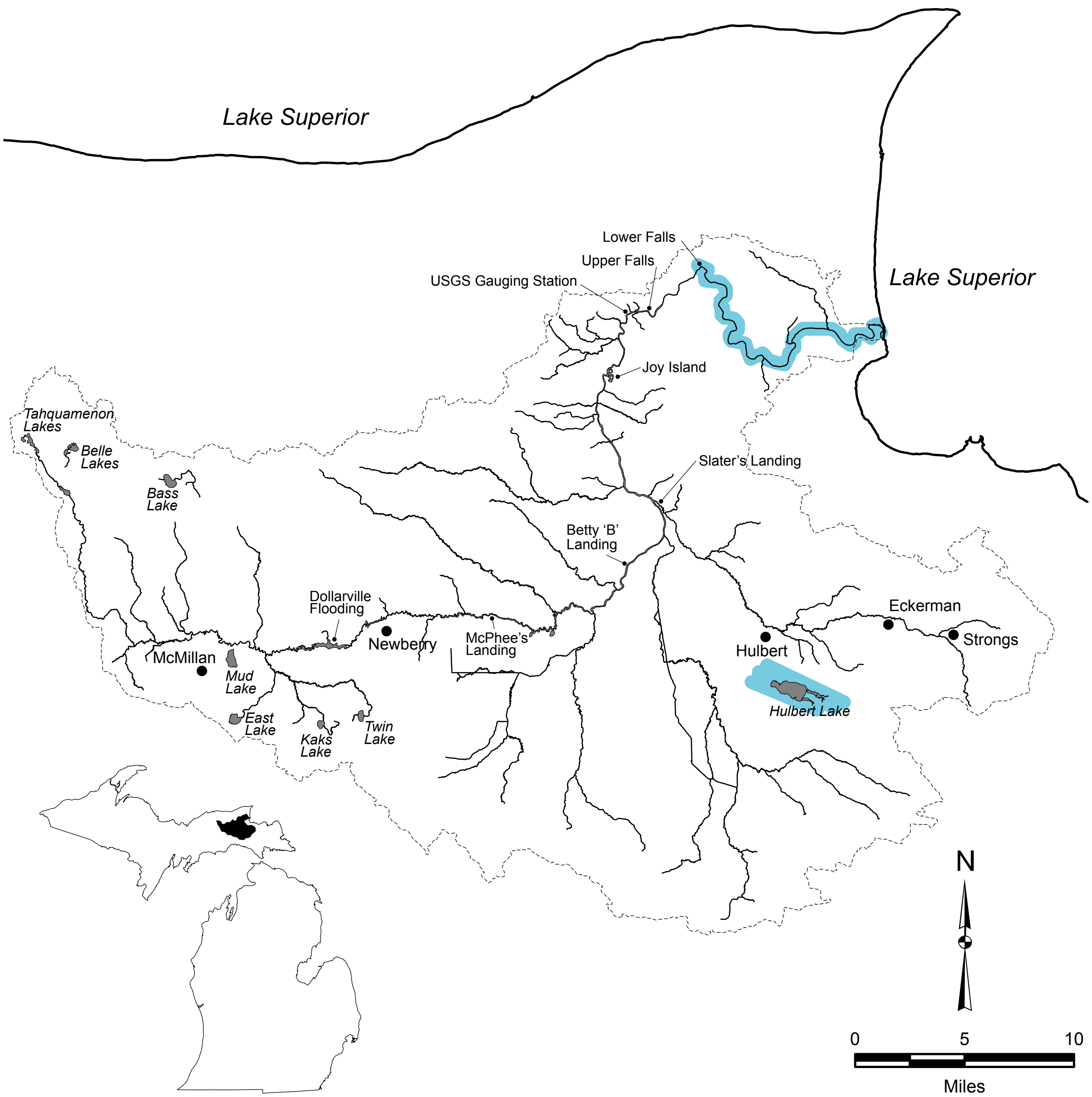
spawning - floodplain areas, on vegetation



Rainbow smelt *Osmerus mordax*

Habitat:

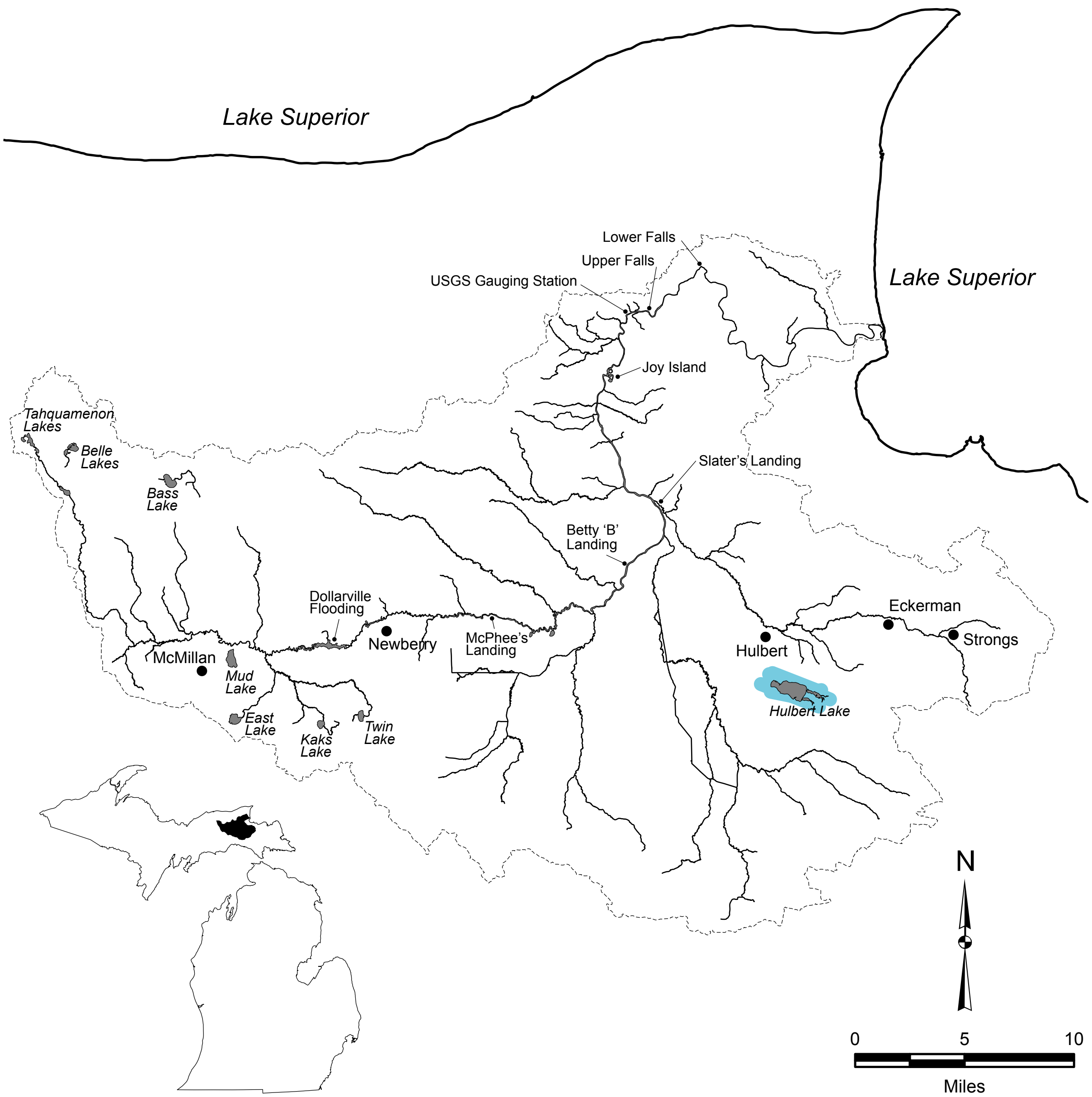
feeding	-	young: close inshore lake habitat along sand and gravel beaches\
	-	cold water
spawning	-	clear high-gradient streams or wave swept shoreline
	-	riffles with coarse sand or gravel substrate
winter refuge	-	midwaters of lakes or inshore coastal waters



Cisco {Lake herring} *Coregonus artedi* – **threatened**

Habitat:

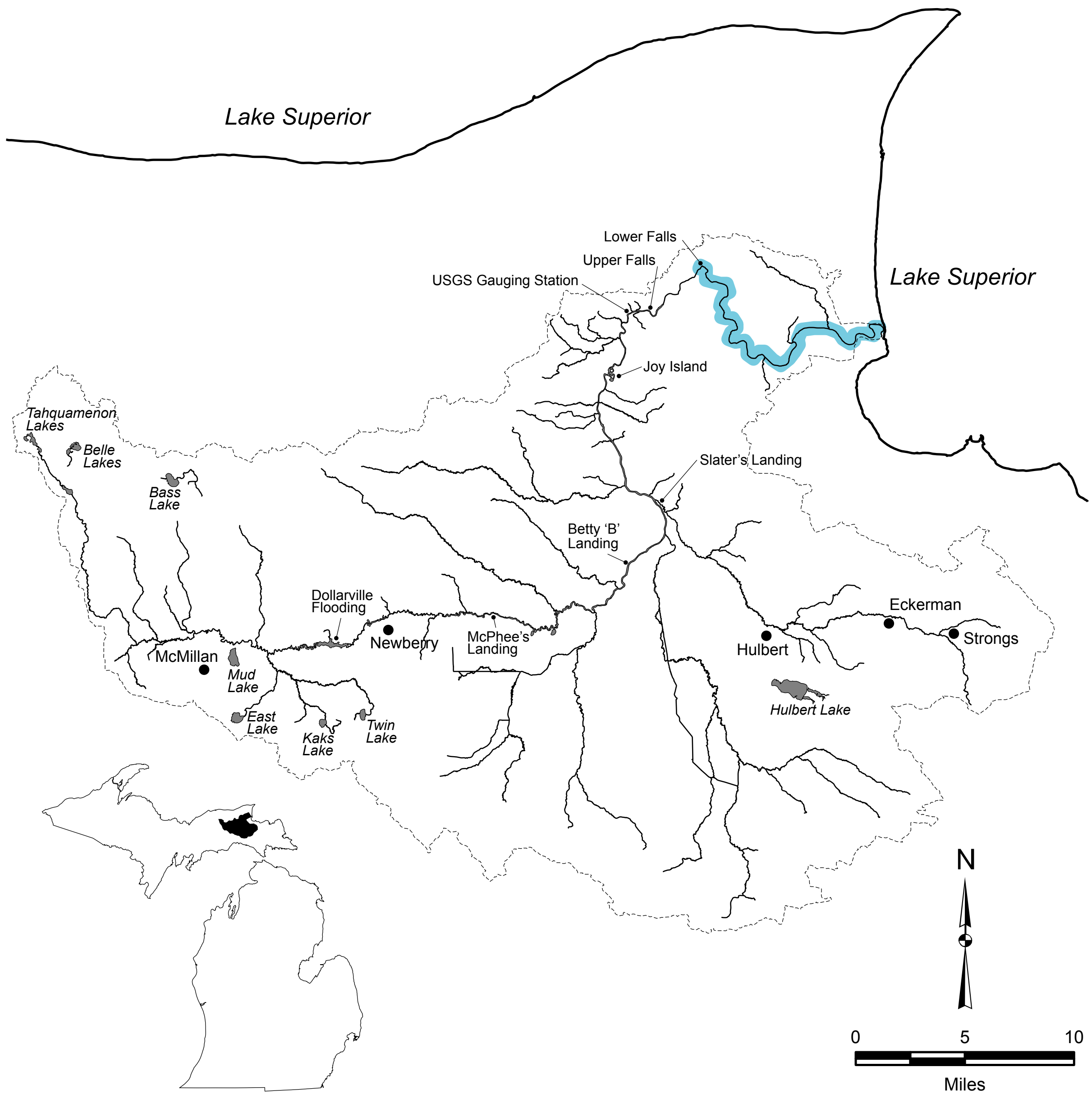
feeding	- deep cool lakes, preferably oligotrophic
spawning	- usually in lakes
	- 3 to 6 feet of water with no vegetation
	- often over gravel or stony substrate



Rainbow trout *Oncorhynchus mykiss*

Habitat**:**

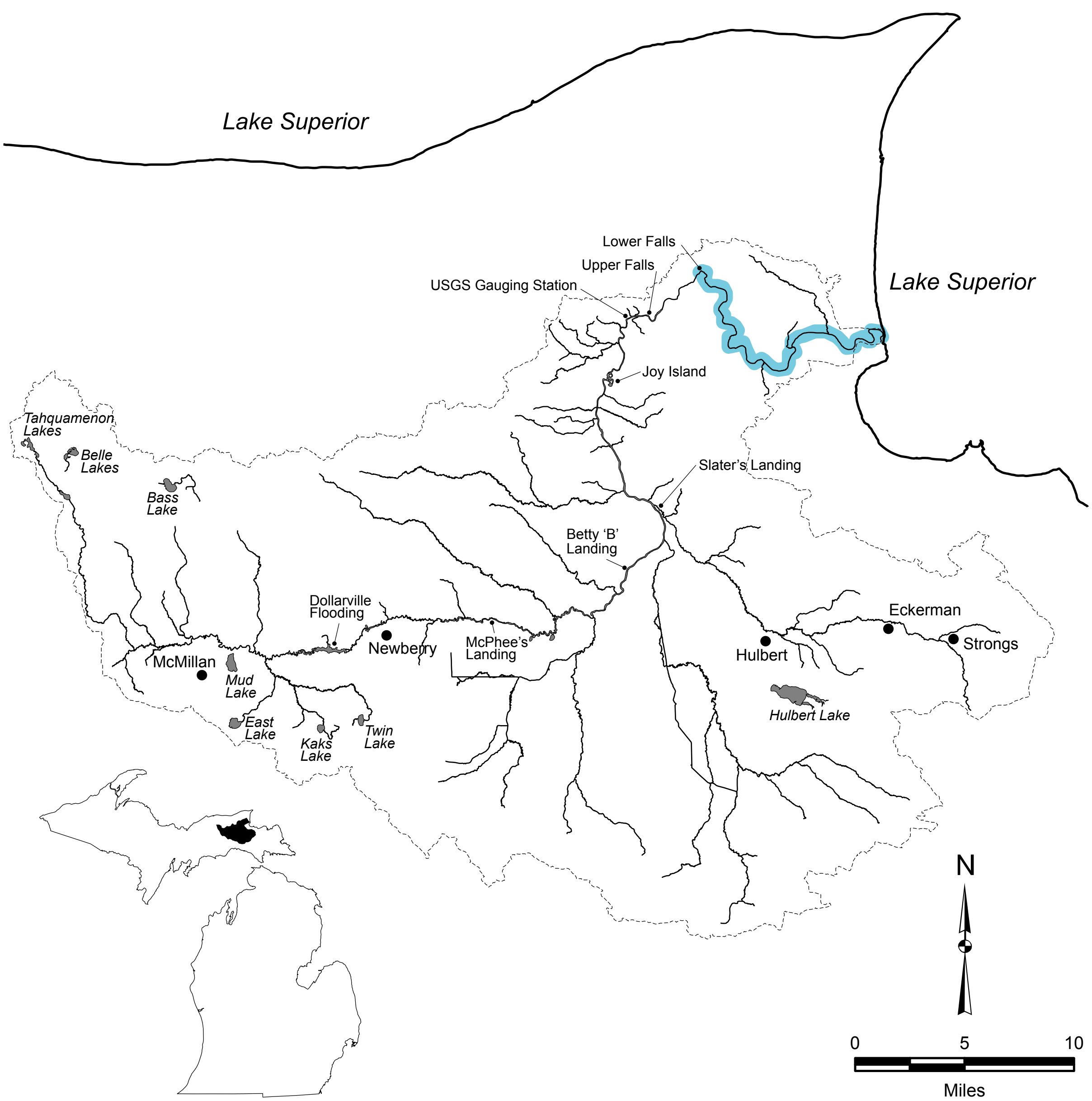
feeding	-	cold clear water of rivers and Lake Superior
	-	moderate current
spawning	-	gravelly riffles above a pool
	-	smaller tributaries



Chinook salmon *Oncorhynchus tshawytscha*

Habitat**:**

feeding	-	adults: Lake Superior
	-	young: shallow gravel substrate in cool streams, later into pools
spawning	-	gravelly substrate in cool streams

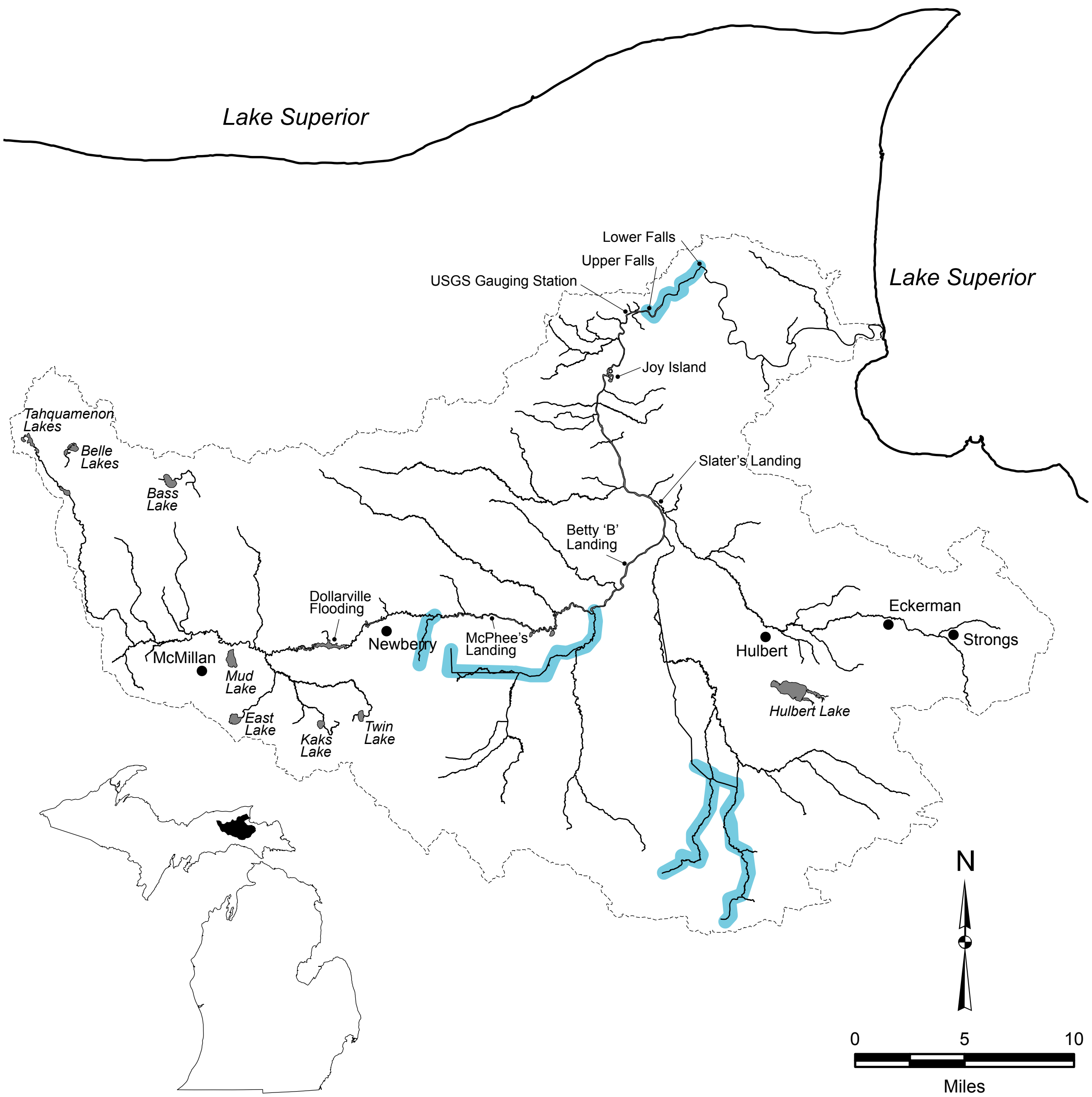


Brown trout *Salmo trutta*

Habitat**:**

feeding - cold, clear streams, rivers, and lakes (not >70°F)
- medium to swift current in streams
- does not tolerate silt well
- prefers few individuals and species around
- abundance of aquatic and land insects

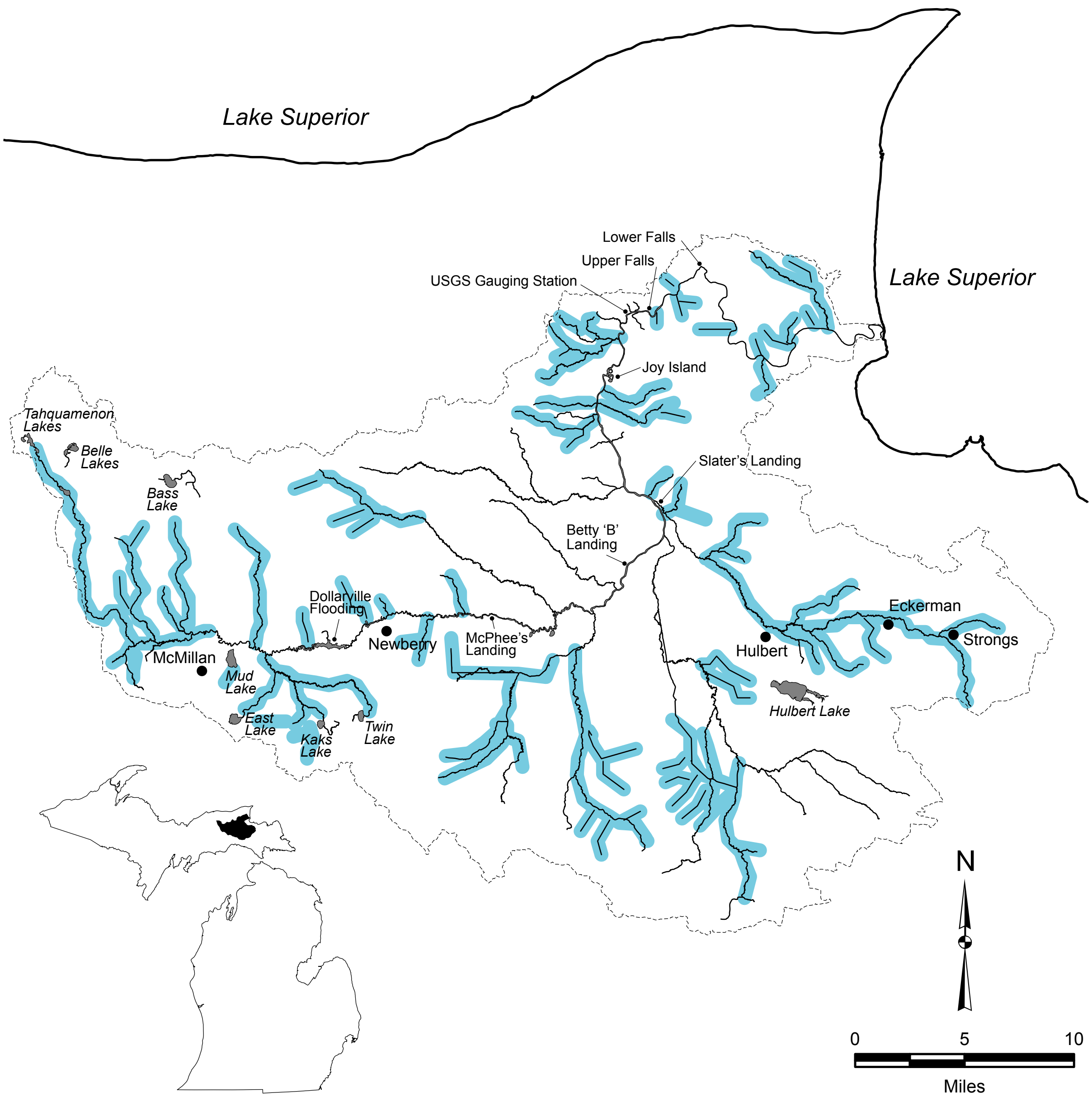
spawning - gravelly riffles; shallow headwater areas



Brook trout *Salvelinus fontinalis*

Habitat**:**

feeding	-	cold, clear streams, rivers, and lakes (not >65°F)
	-	low current
	-	well oxygenated water
spawning	-	gravelly riffles; shallow or headwater streams

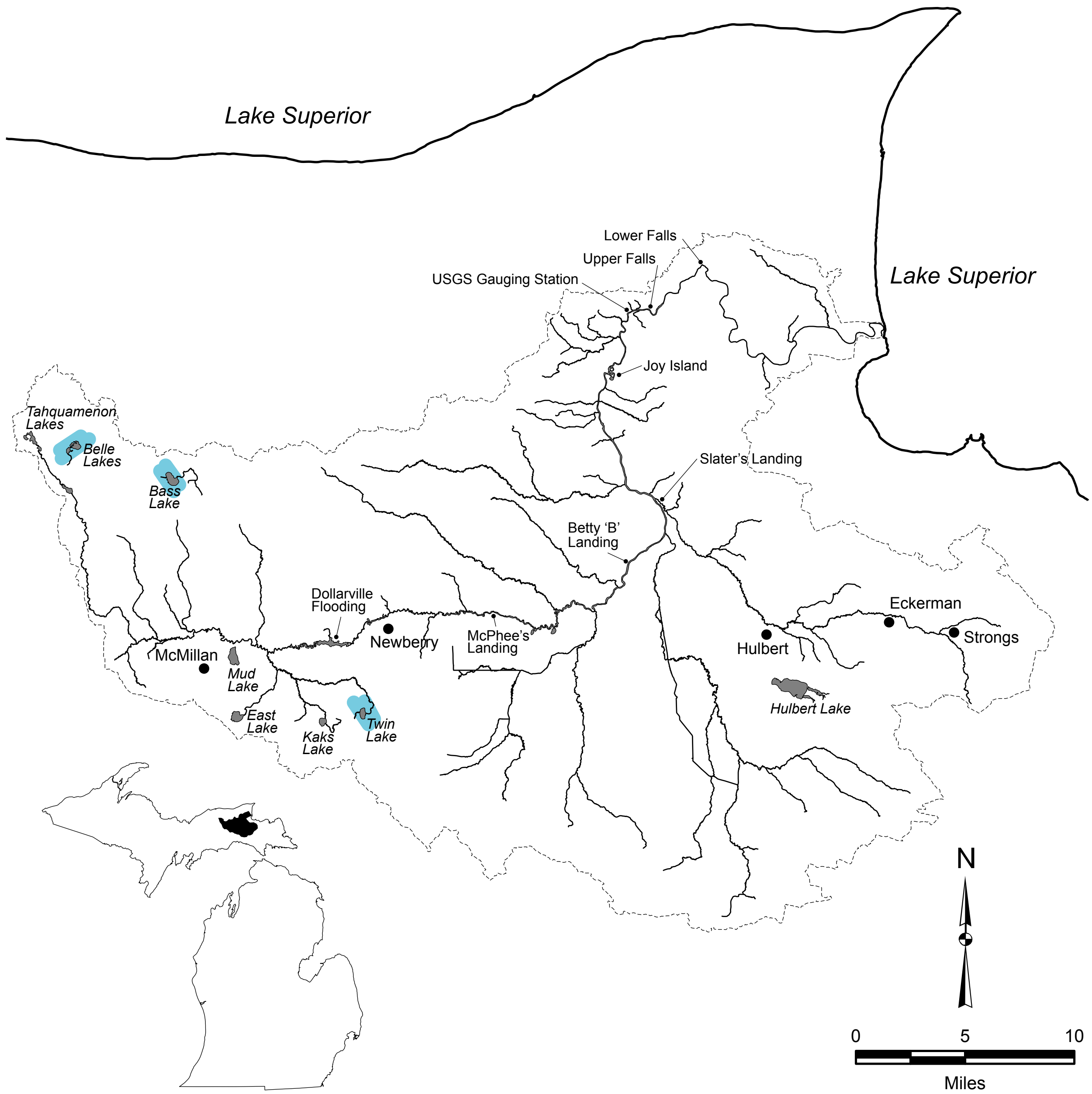


Splake *Salvelinus fontinalis x Salvelinus namaycush*

Habitat:

feeding - littoral habitat
- cool water lakes; also Lake Superior

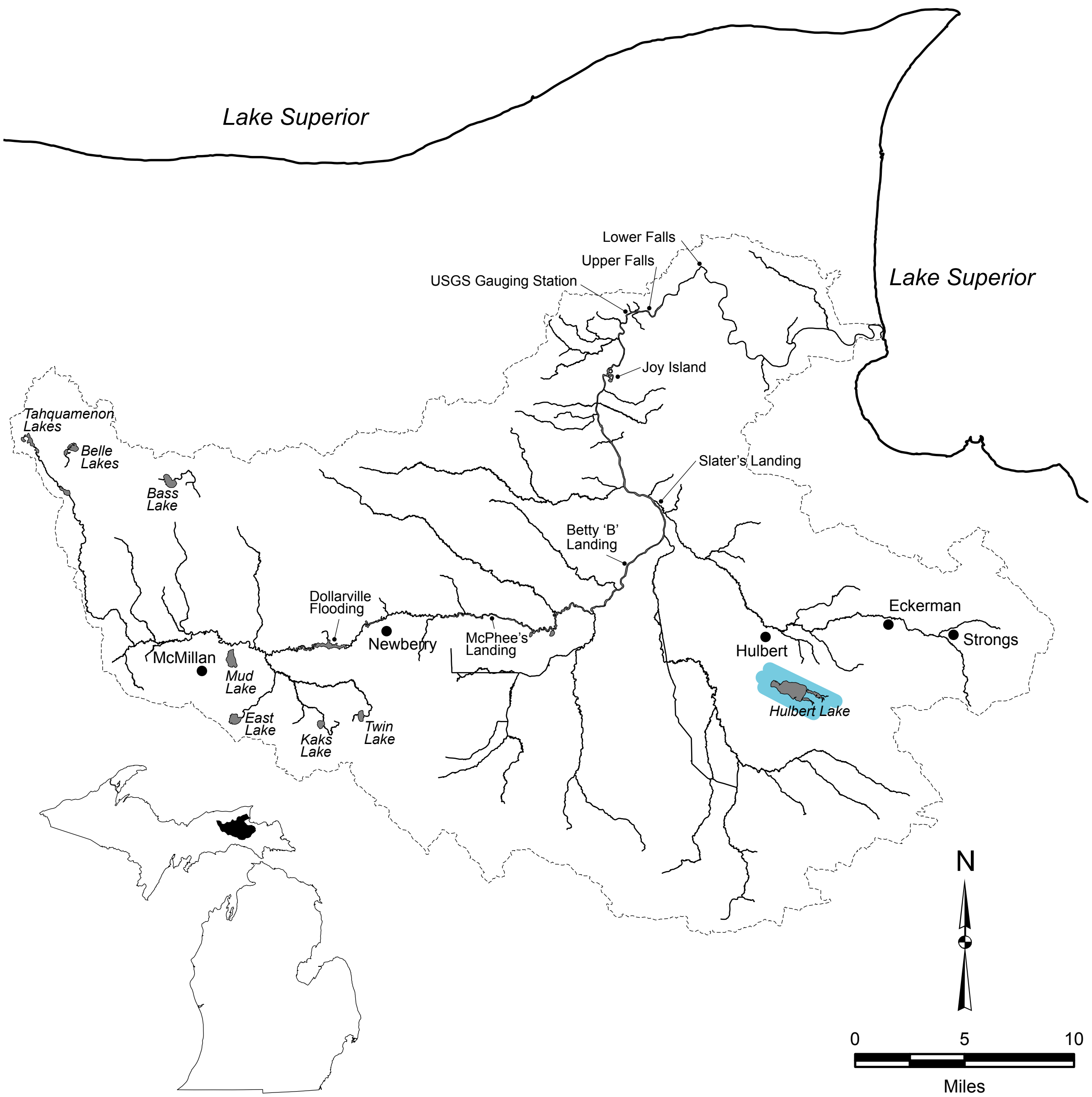
spawning - hatchery produced cross of brook and lake trout
- offspring usually fertile, but with lower fecundity than either parent species



Lake trout *Salvelinus namaycush*

Habitat:

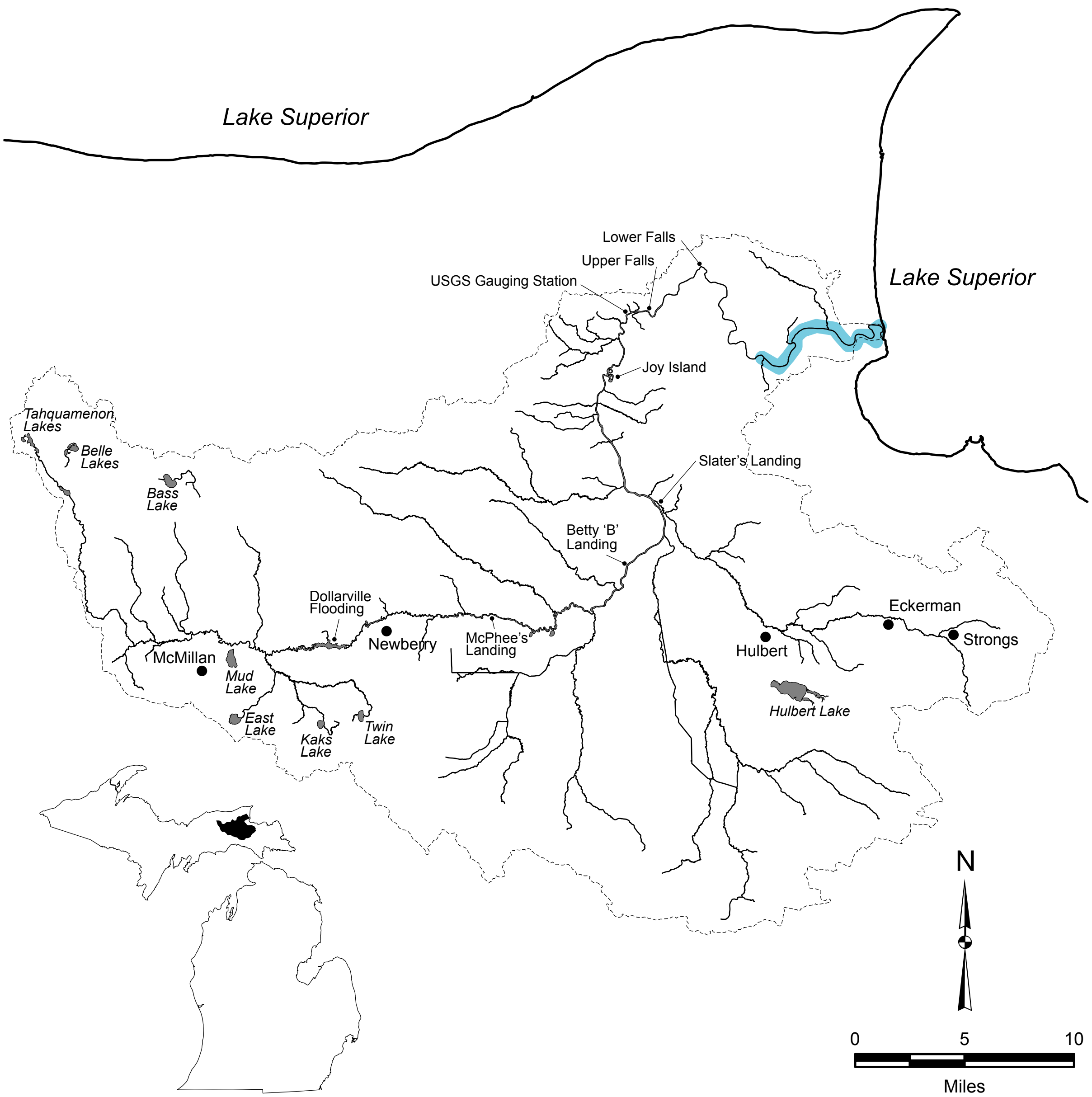
feeding - cold lakes and rivers
spawning - large boulder or rubble substrate
- shallow water of lakes and rivers



Trout-perch *Percopsis omiscomaycus*

Habitat**:**

feeding	-	clean sand or fine gravel substrate
	-	long deep pools in low gradient streams and Lake Superior
	-	highly intolerant of clayey silts
	-	avoids rooted aquatic vegetation
spawning	-	over rocks in shallows
	-	over sand and gravel substrates in Lake Superior

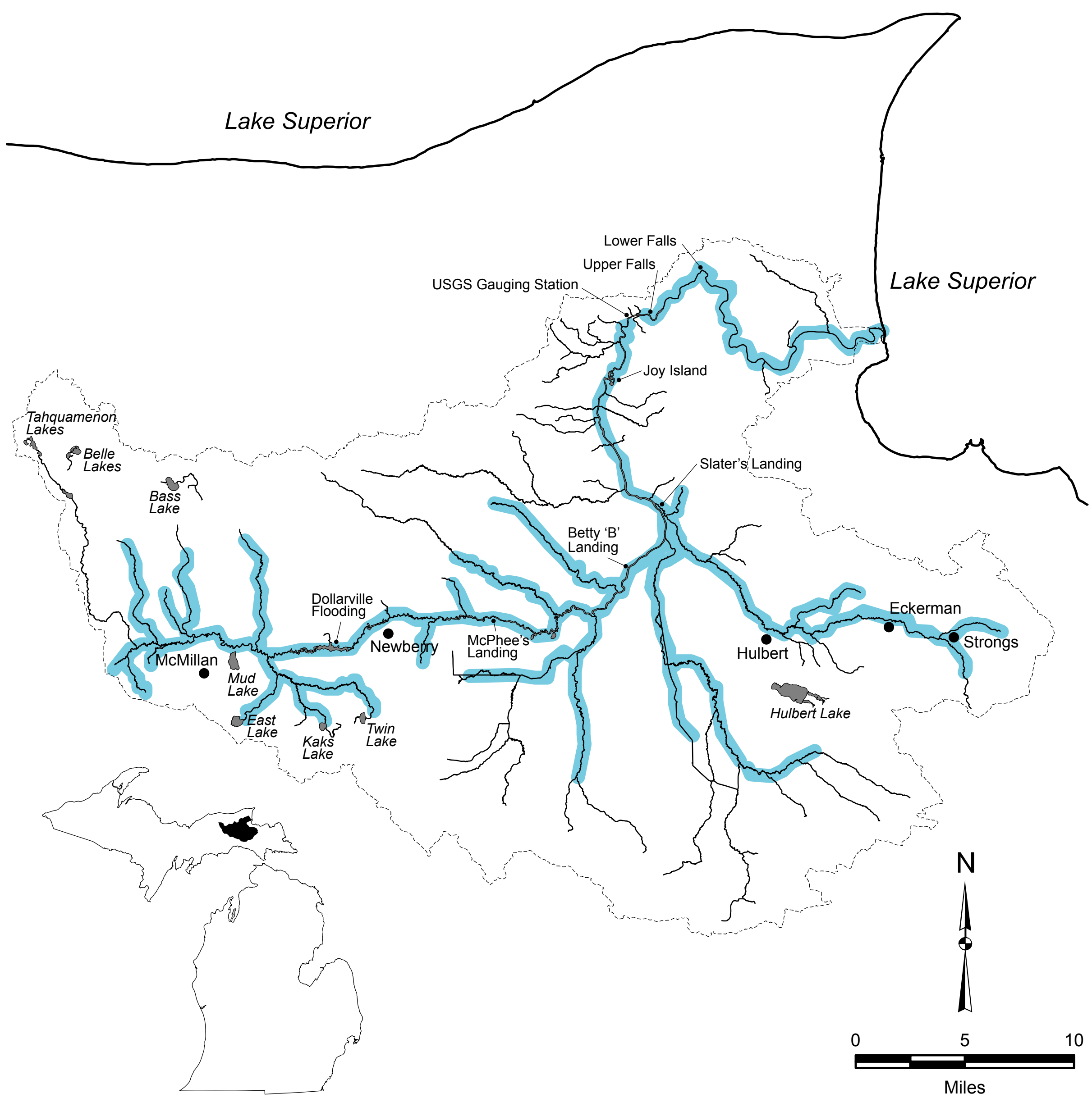


Burbot *Lota lota*

Habitat:

feeding - deep cold lakes and large cool rivers
- mud, sand, rubble, boulder, silt, and gravel substrates

spawning - in 1 to 4 feet of water in shallow bays or on shoals 5-10 feet deep usually in lakes, sometimes rivers
- over sand or gravel substrate
- under ice

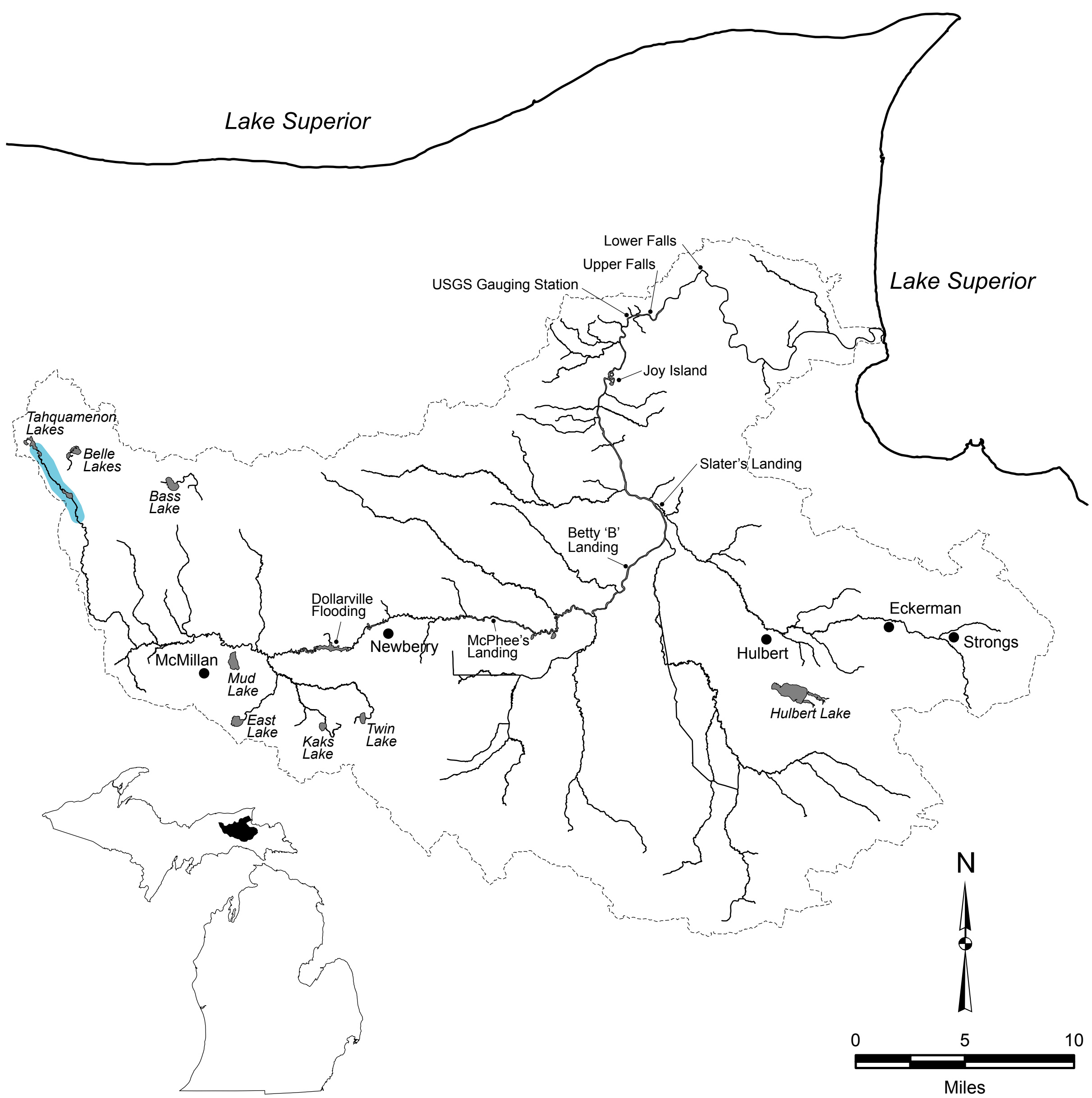


Western banded killifish *Fundulus diaphanus menona*

Habitat:

feeding - quiet backwaters at the mouths of streams and lakes
- substrate of sand, gravel, and a few boulders
- also found over detritus substrate where patches of submerged aquatic vegetation are present

spawning - quiet areas of weedy pools

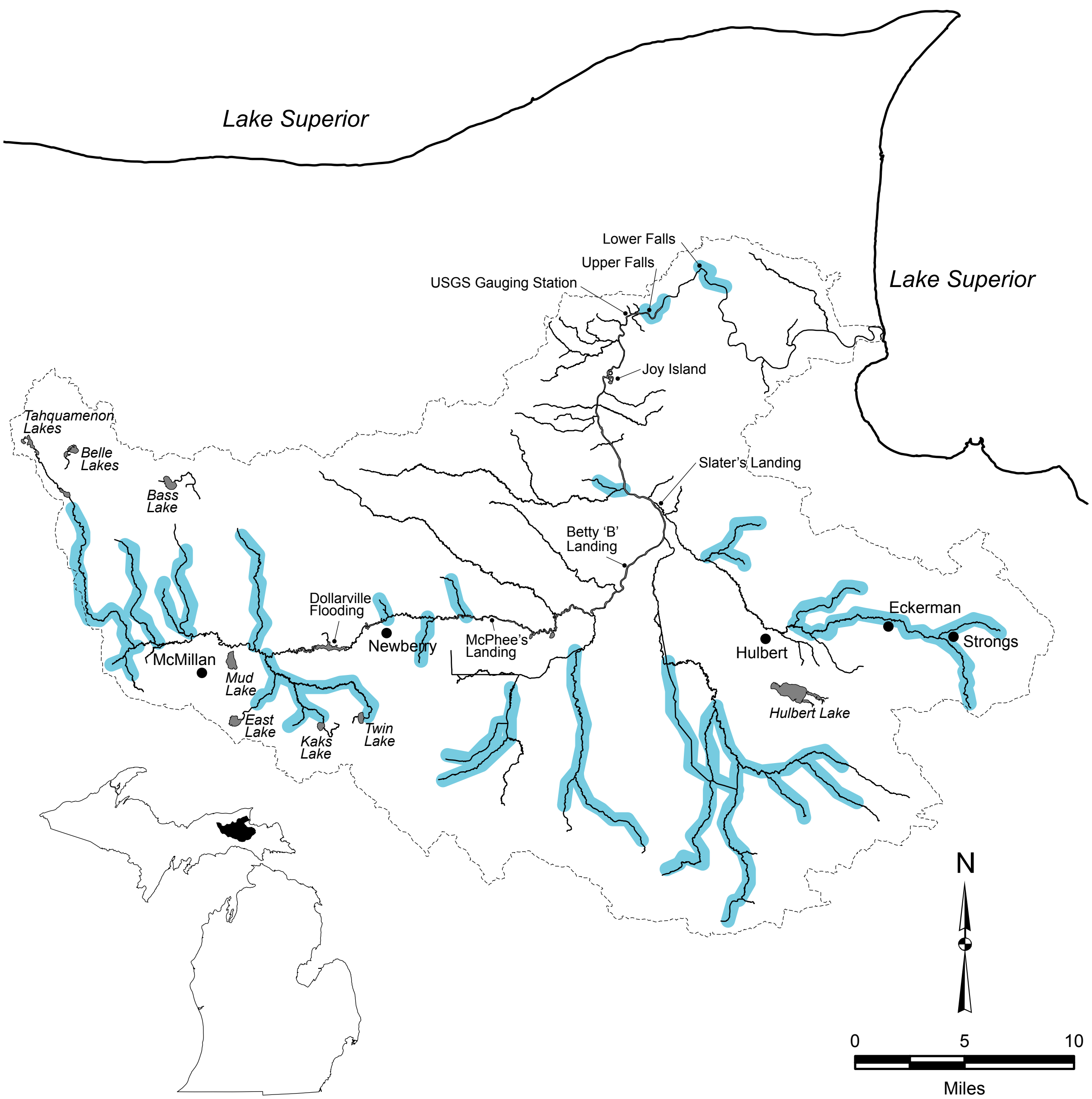


Brook stickleback *Culaea inconstans*

Habitat**:**

feeding - clear, cold, densely vegetated streams, and swampy margins of lakes
- low gradient
- muck, peat, or marl substrate
- not tolerant of turbidity

spawning - shallow cool (<66°F) water
- aquatic reeds or grasses necessary

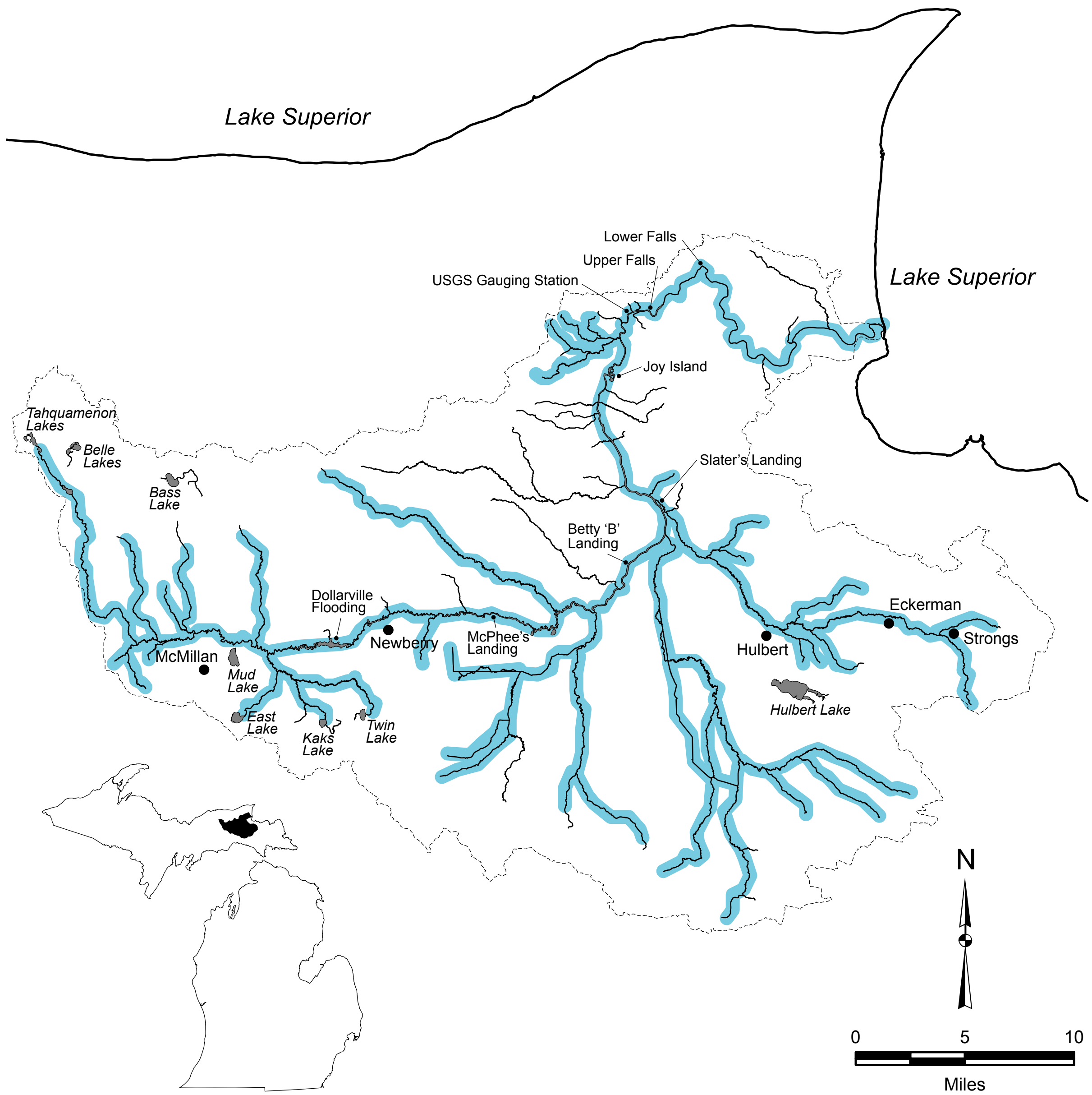


Mottled sculpin *Cottus bairdii*

Habitat:

feeding - cool to cold streams
- riffle and rock substrates preferred
- clear to slightly turbid shallow water

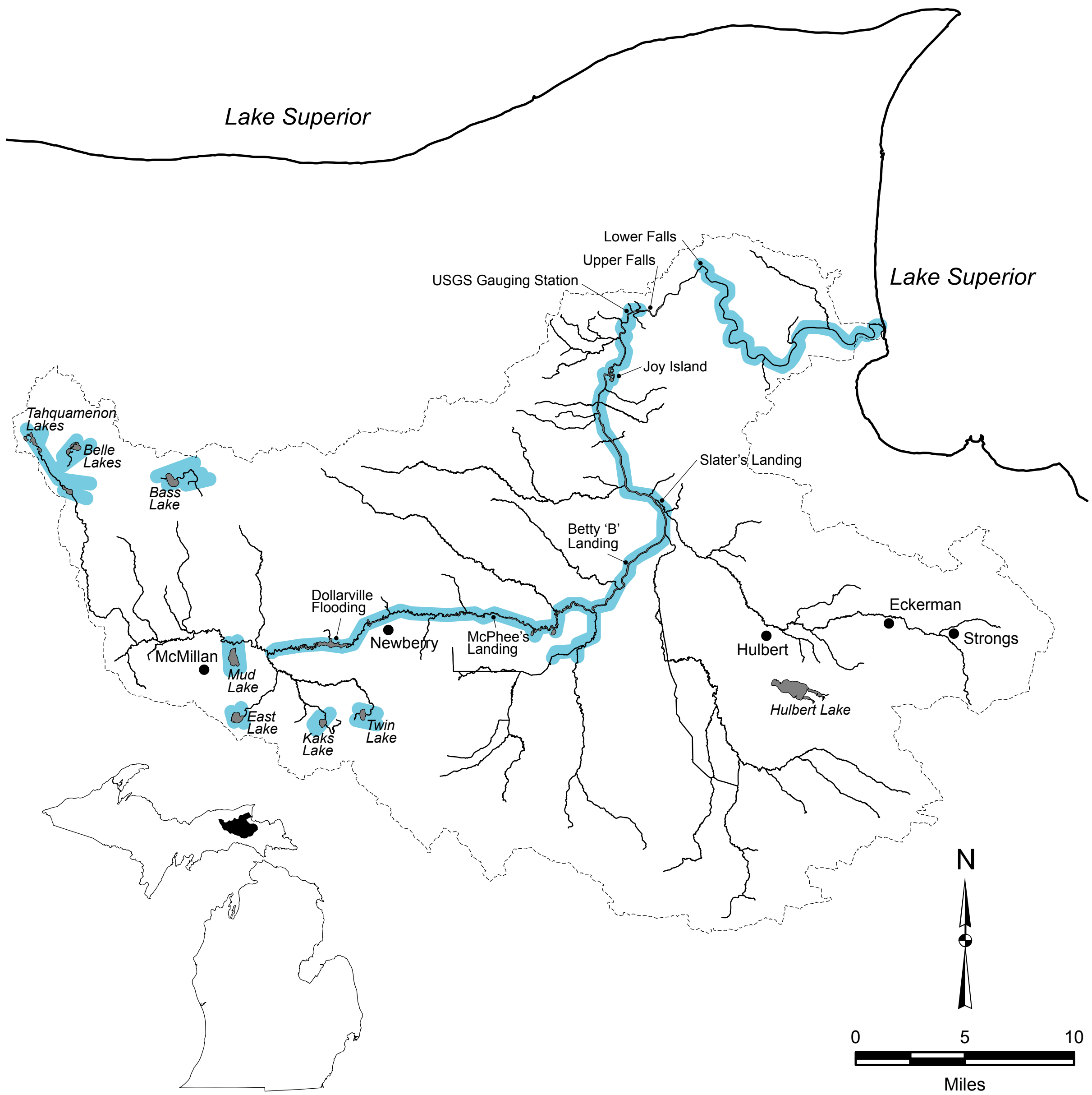
spawning - nests under logs or rock



Rock bass *Ambloplites rupestris*

Habitat**:**

feeding	-	clear, cool streams, rivers, and lakes
	-	rocky to sand substrate
	-	woody or vegetative cover
spawning	-	sand or gravel nests
	-	shallow water
winter refuge	-	deep water

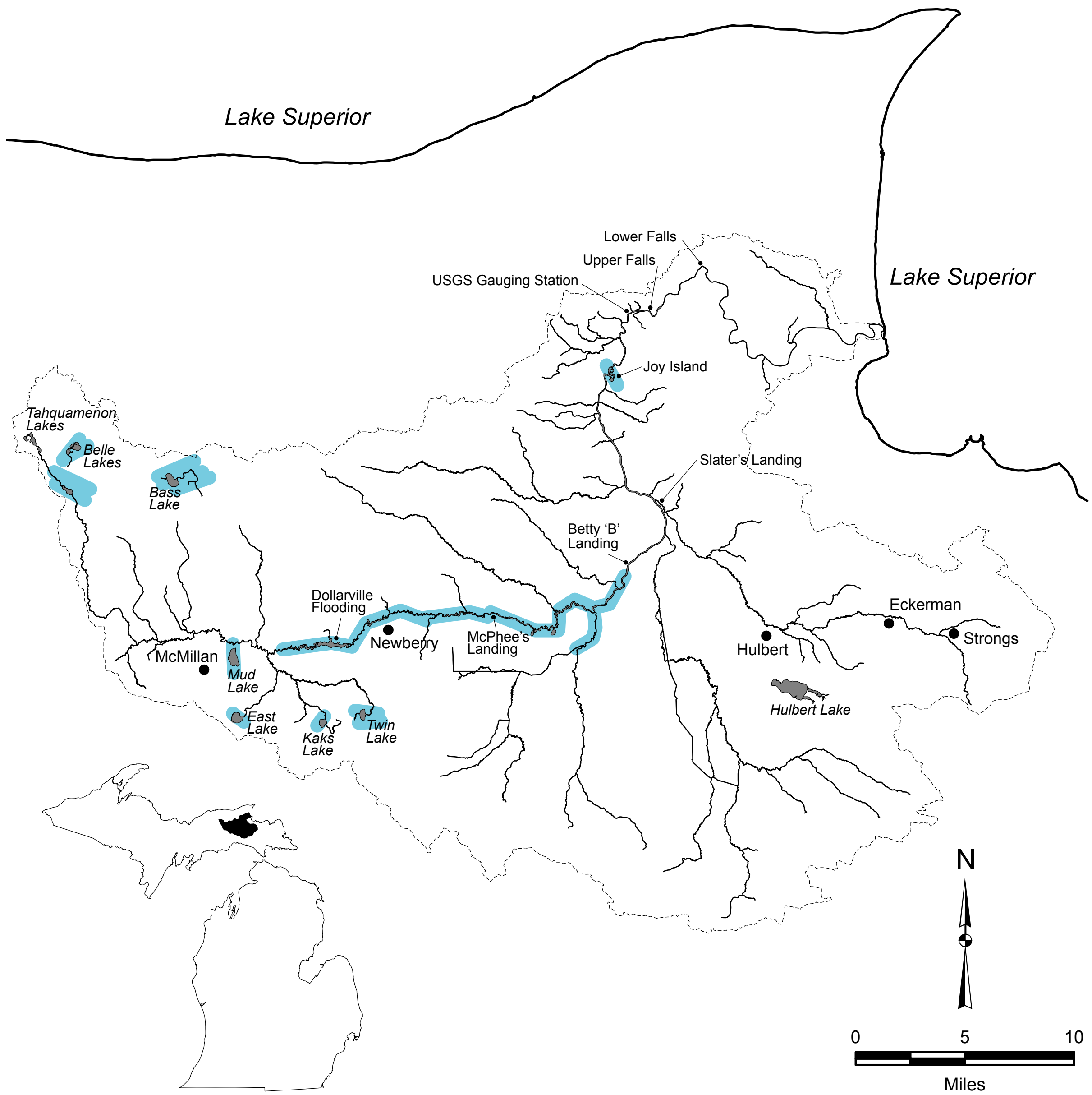


Pumpkinseed *Lepomis gibbosus*

Habitat**:**

feeding - non-flowing clear water in streams and rivers; also lakes and impoundments
- muck or sand partly covered with organic debris substrate
- dense beds of submerged aquatic vegetation

spawning - nest in sand, gravel, or rock substrate
- in shallow water near submerged vegetation



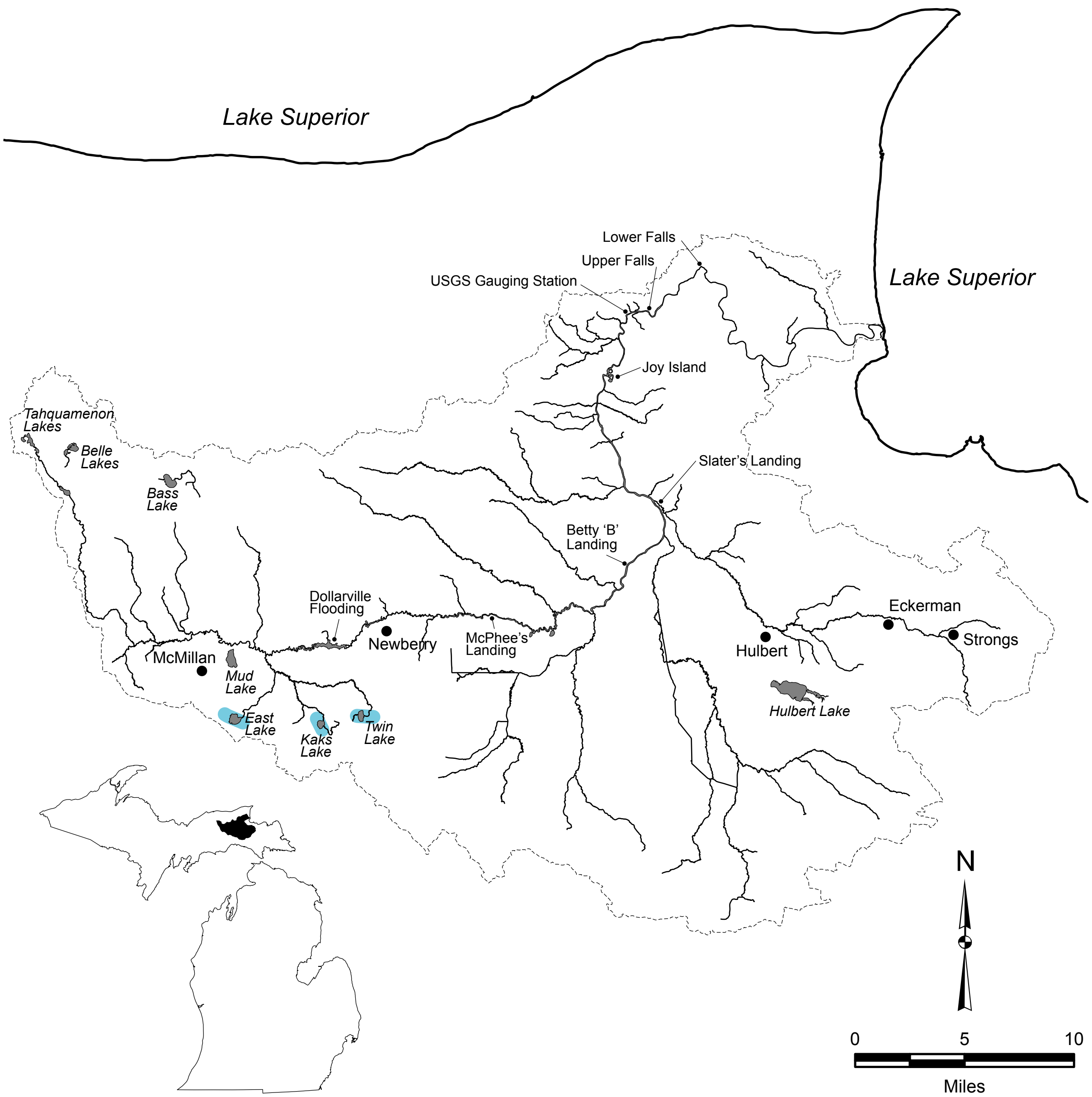
Bluegill *Lepomis macrochirus*

Habitat**:**

feeding - non-flowing clear streams and rivers; also lakes and impoundments
- sand, gravel, or muck containing organic debris substrate
- scattered beds of aquatic vegetation
- cannot tolerate low oxygen or continuous high turbidity and siltation

spawning - nests in firm substrate of gravel, sand, or mud

winter refuge - deep water



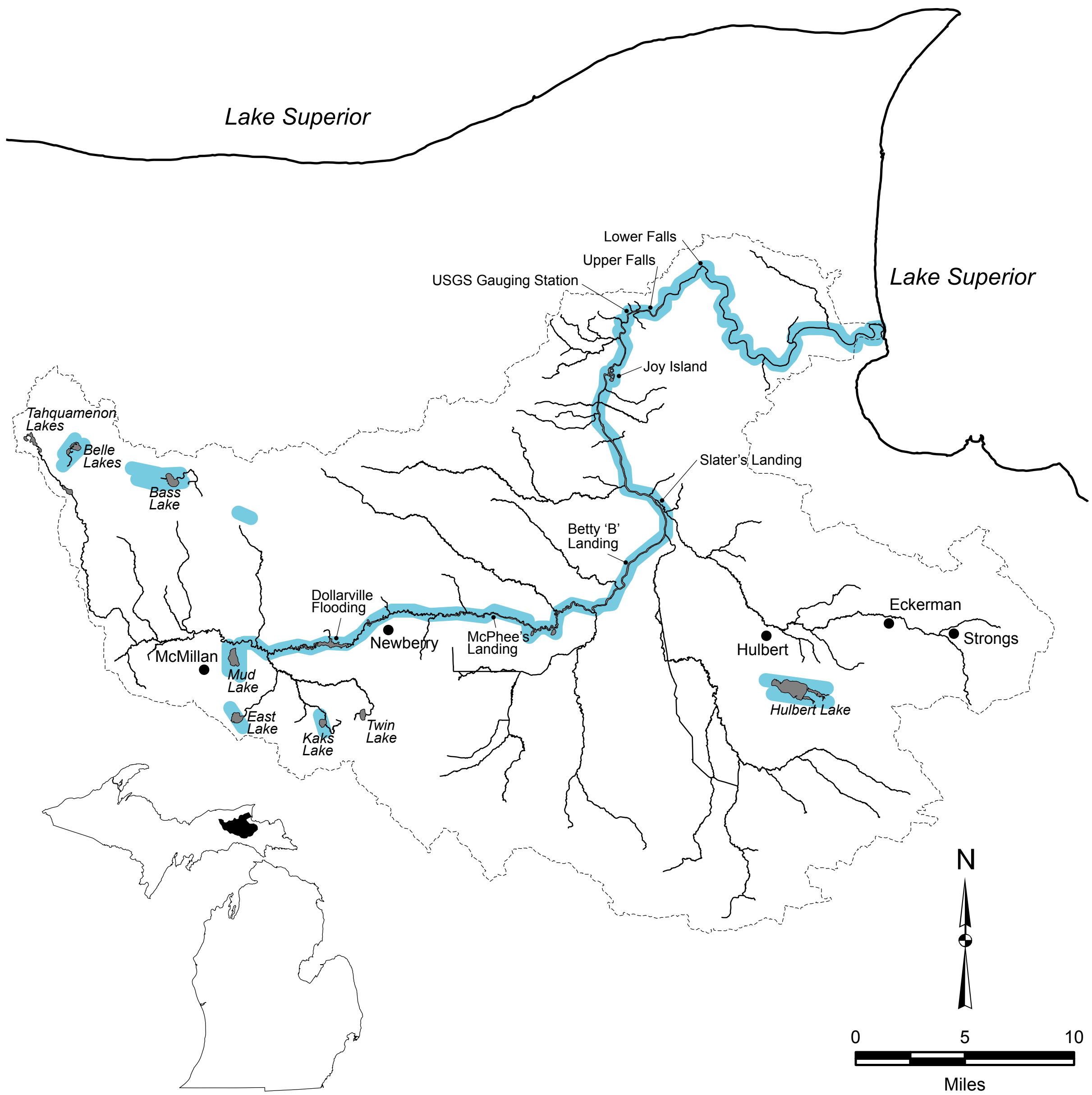
Smallmouth bass *Micropterus dolomieu*

Habitat**:**

feeding - clear, cool, deep lakes and rivers
- streams where 40% consists of riffles over clean gravel, boulder, or bedrock substrate
- in pools with a current and >4 feet of depth
- gradients between 4 and 25 feet per mile

spawning - nest in sandy, gravel, or rocky substrate
- gradients 7 to 25 feet per mile
- streams 20 to 100 feet wide

winter refuge - larger deeper waters with gradients between 3 to 7 feet per mile

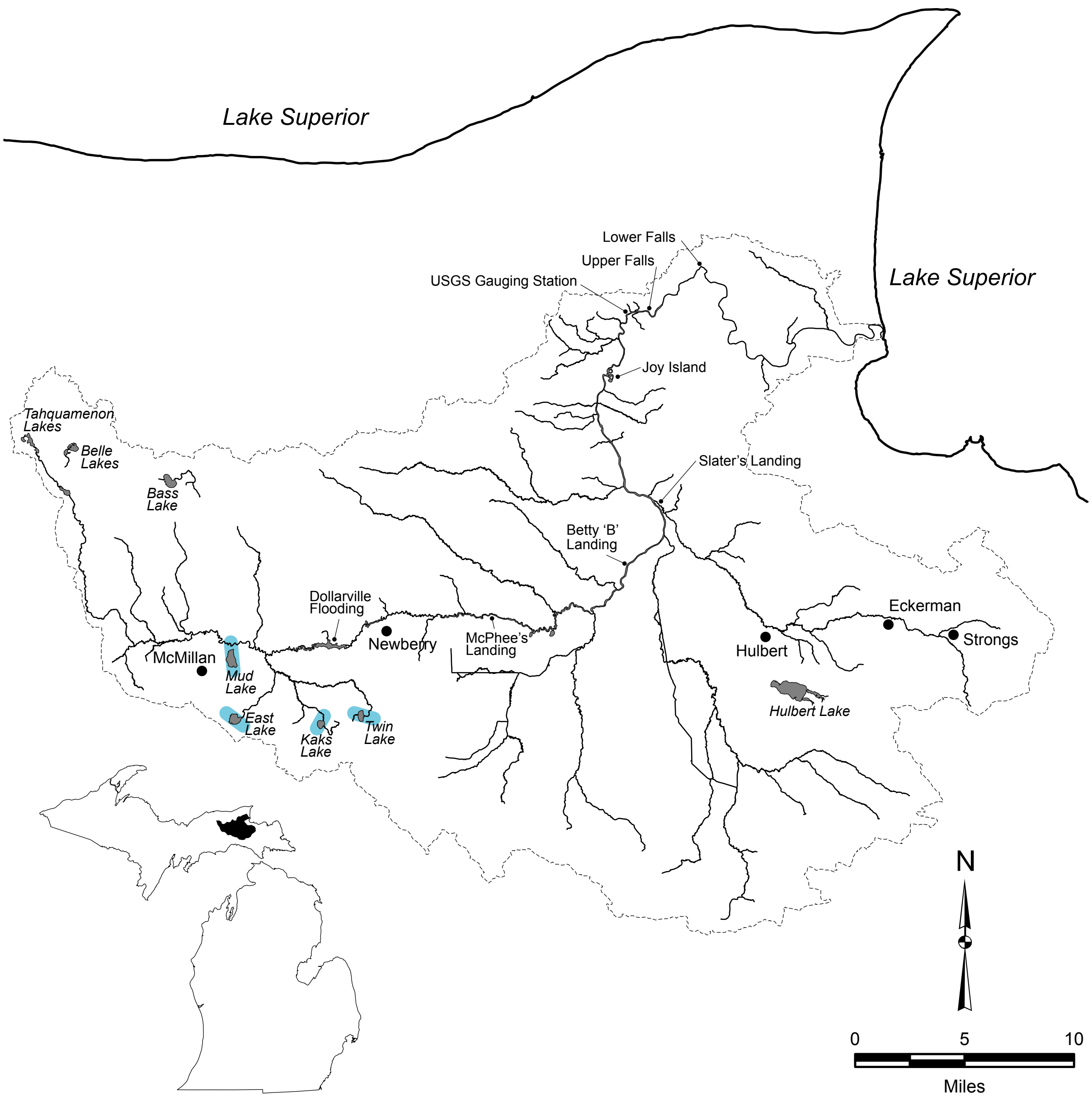


Largemouth bass *Micropterus salmoides*

Habitat:

feeding - non-flowing clear waters - lakes, impoundments, and pools of streams
- abundant aquatic vegetation
- soft muck, organic debris, gravel, sand, and hard non-flocculent clay substrates

spawning - nest in gravelly sand to marl and soft mud substrates
- emergent vegetation
- quiet shallow bays; no current

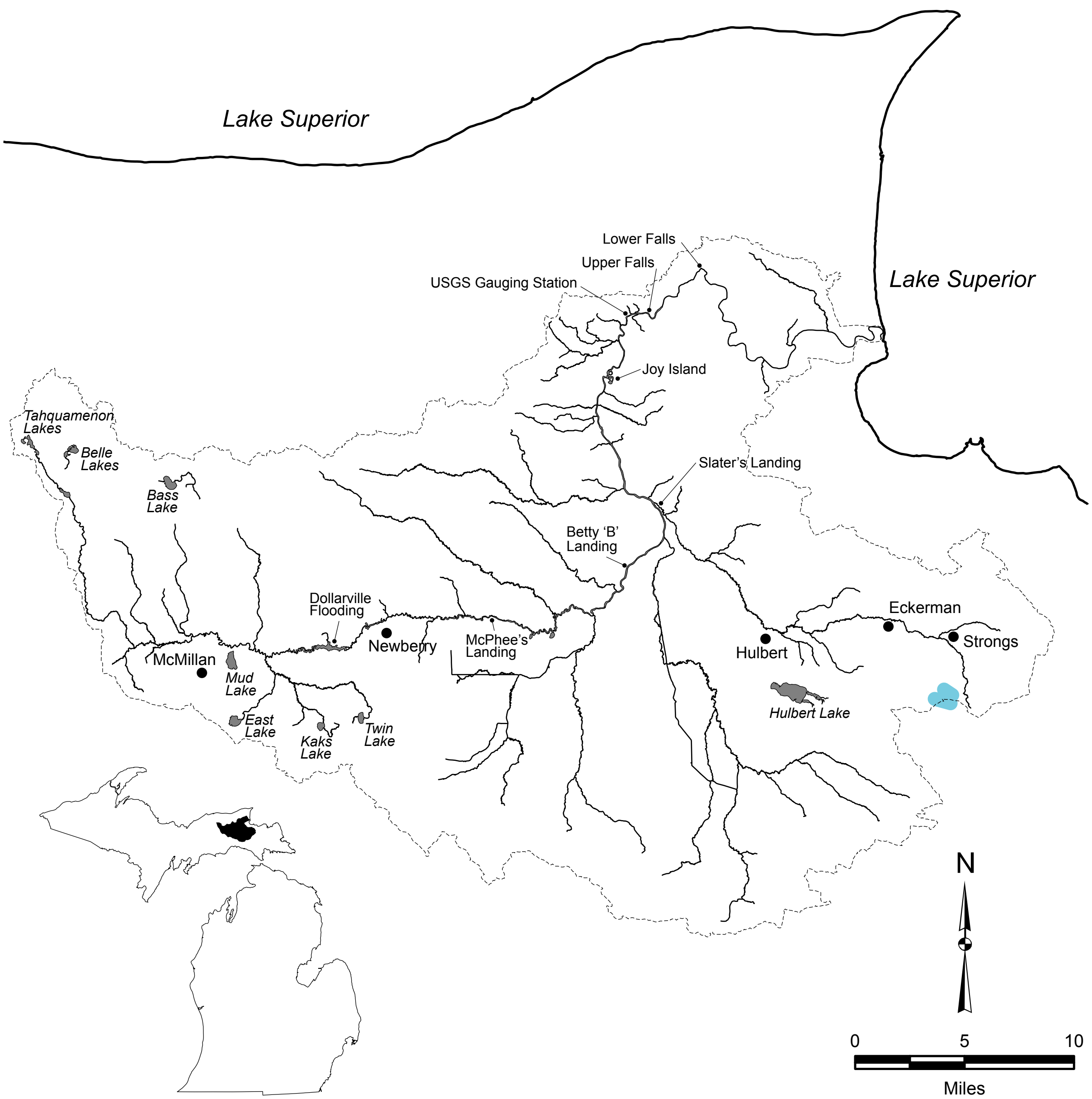


Black crappie *Pomoxis nigromaculatus*

Habitat**:**

feeding
- larger clear non-silty low-gradient rivers; also in lakes and impoundments
- clean hard sand or muck substrate
- associated with submerged aquatic vegetation
- does not tolerate silt or turbidity well

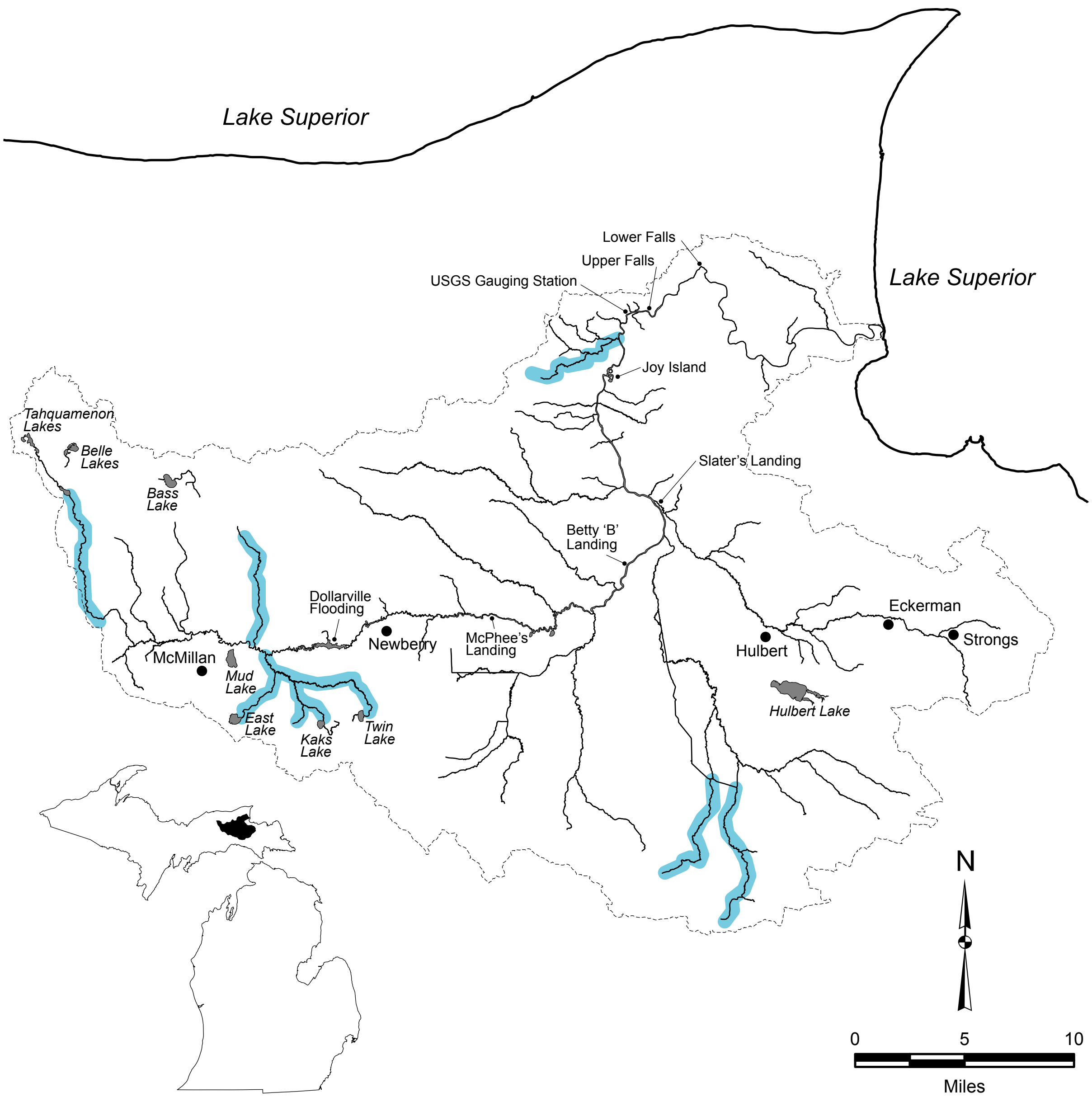
spawning
- nests in gravel, sand, or mud substrate
- some vegetation must be present
- sometimes nests under banks



Iowa darter *Etheostoma exile*

Habitat**:**

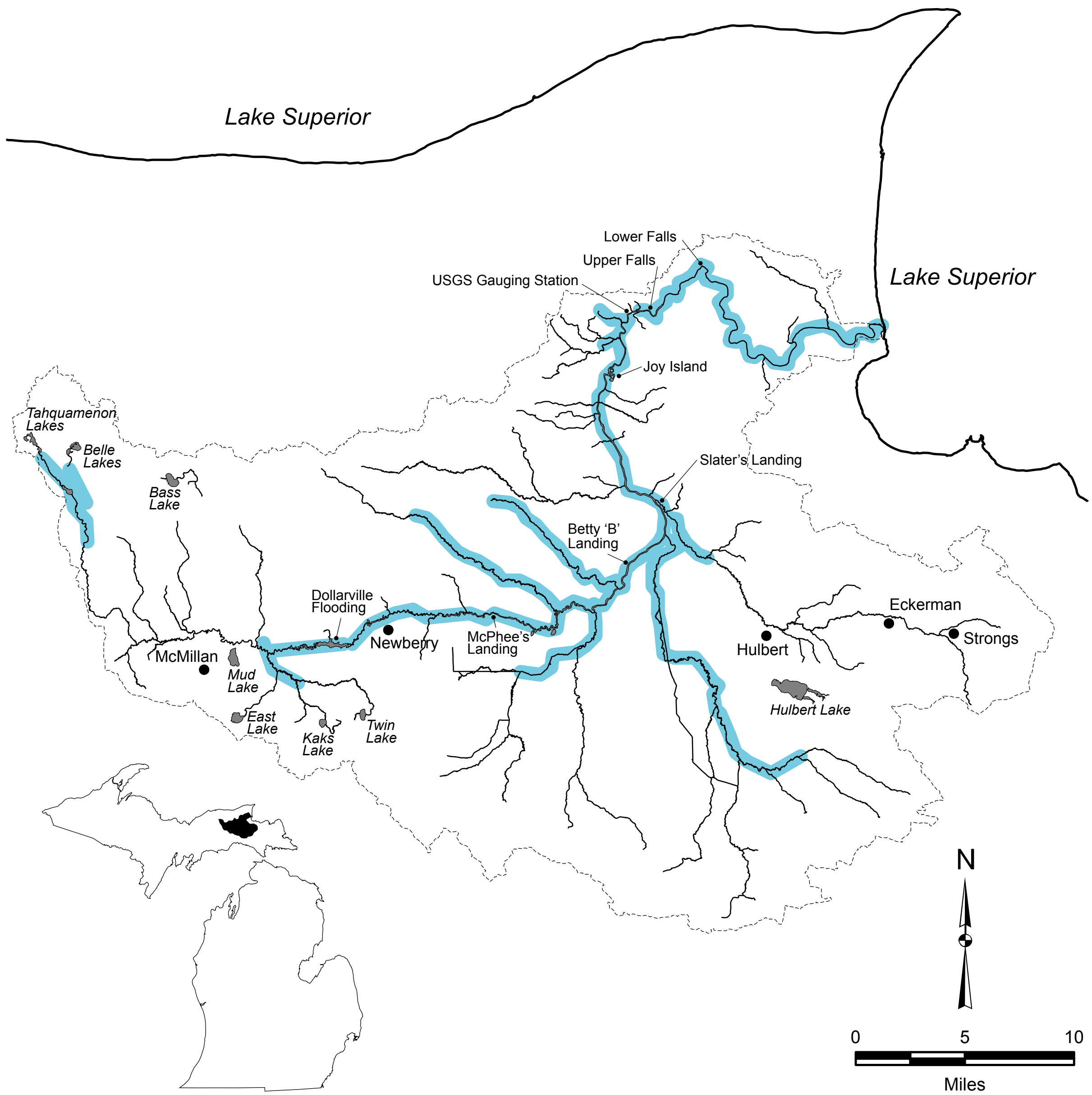
feeding	-	clear, slow moving streams and lakes
	-	sandy to muddy substrates
	-	intolerant of turbid water
	-	lives in rooted aquatic vegetation
spawning	-	in pond-like extensions of streams on organic matter or roots
	-	in shallows



Johnny darter *Etheostoma nigrum*

Habitat**:**

feeding	-	sand and silt substrate
	-	little to moderate current
	-	shallow areas of streams, rivers, lakes, and impoundments
	-	tolerant of many organic and inorganic pollutants and turbidity
spawning	-	underneath rocks
	-	in stream pools or protected shallows of lakes

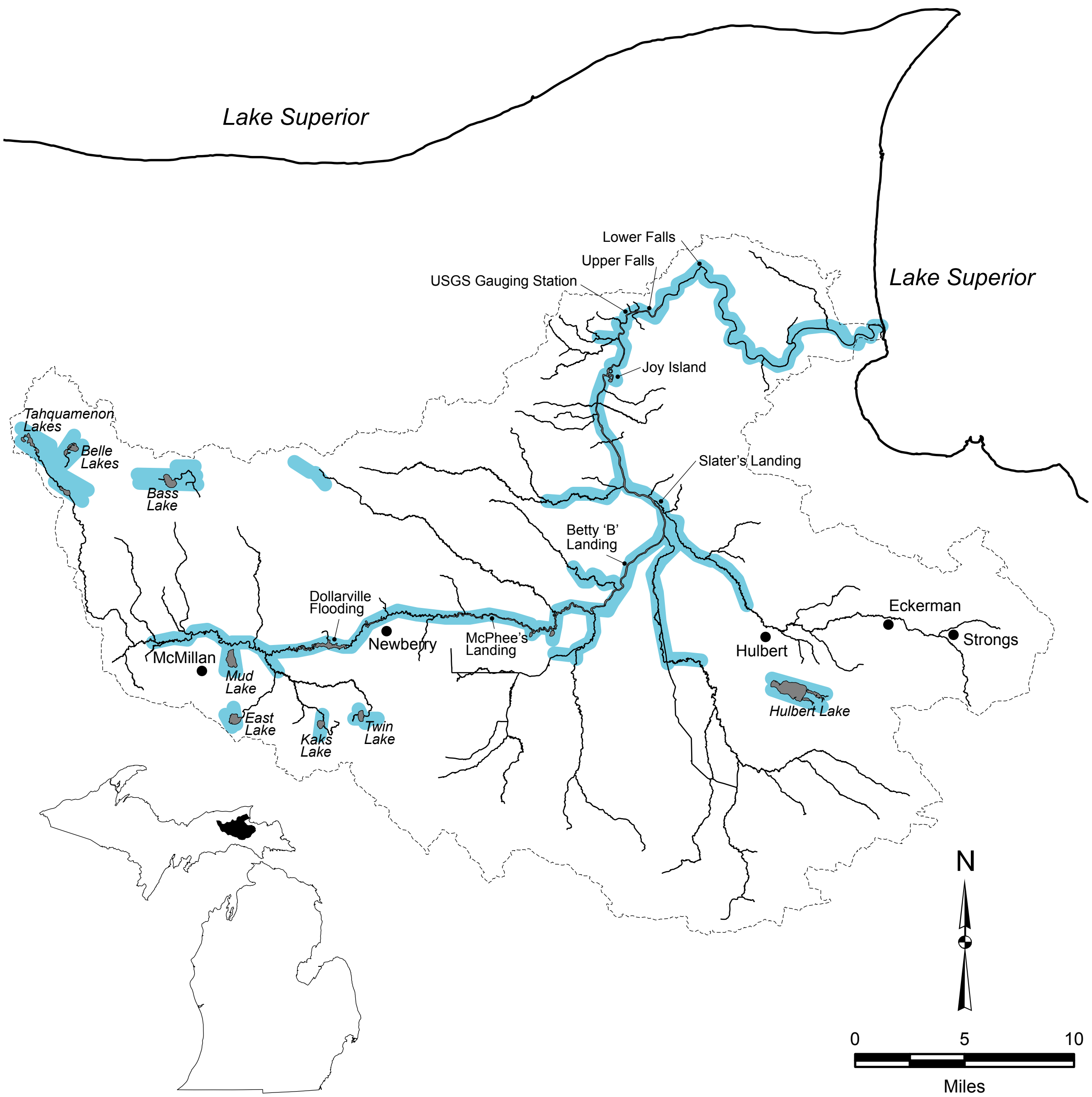


Yellow perch *Perca flavescens*

Habitat**:**

feeding - clear lakes and impoundments; also Lake Superior
- low gradient rivers
- abundance of rooted aquatics
- muck, organic debris, sand, or gravel substrate
- does not tolerate turbidity and siltation

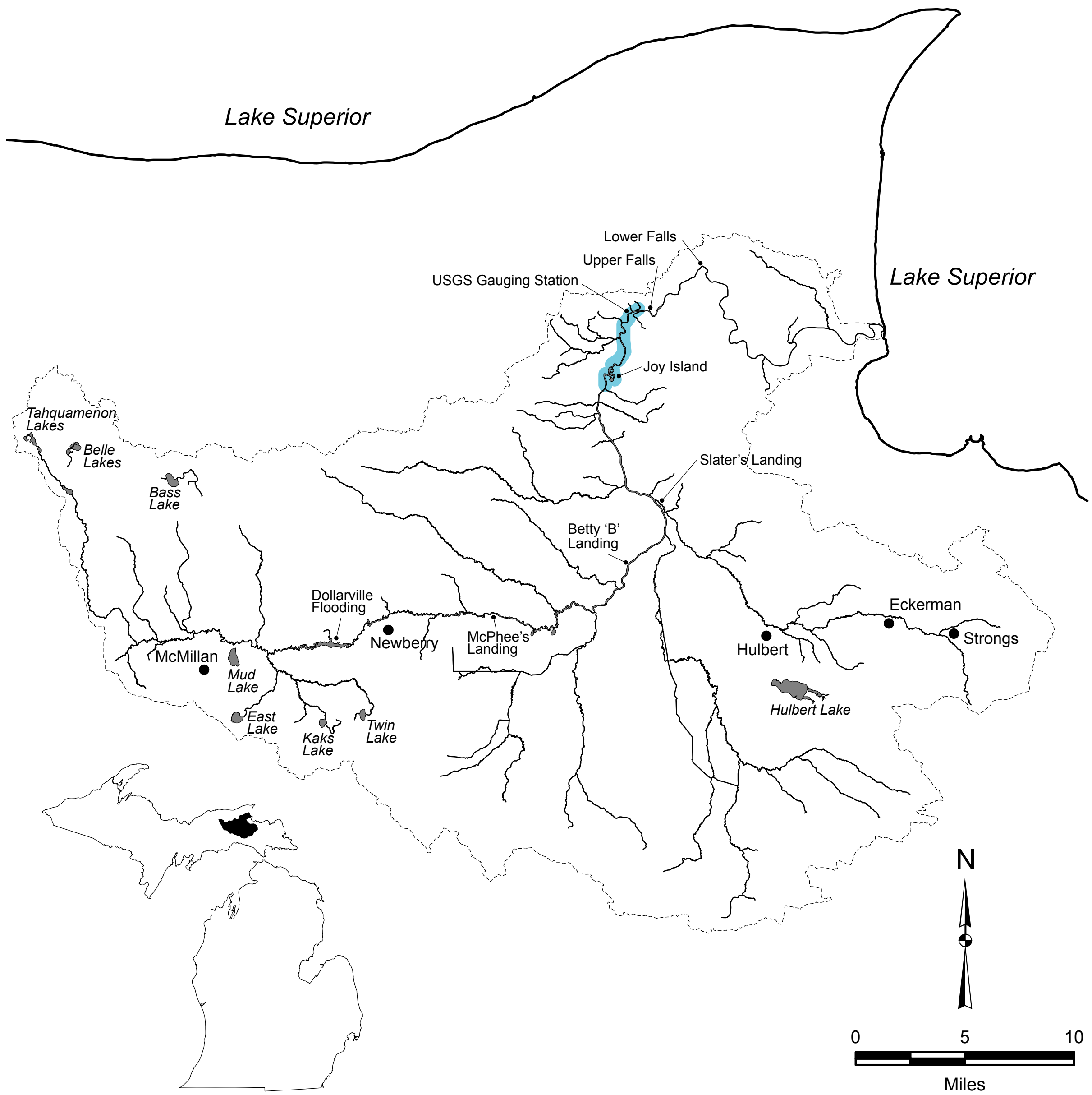
spawning - shallows of lakes, tributaries of streams
- occurs over rooted vegetation, submerged brush, fallen trees
- may occur over sand or gravel



Northern logperch *Percina caprodes semifasciata*

Habitat**:**

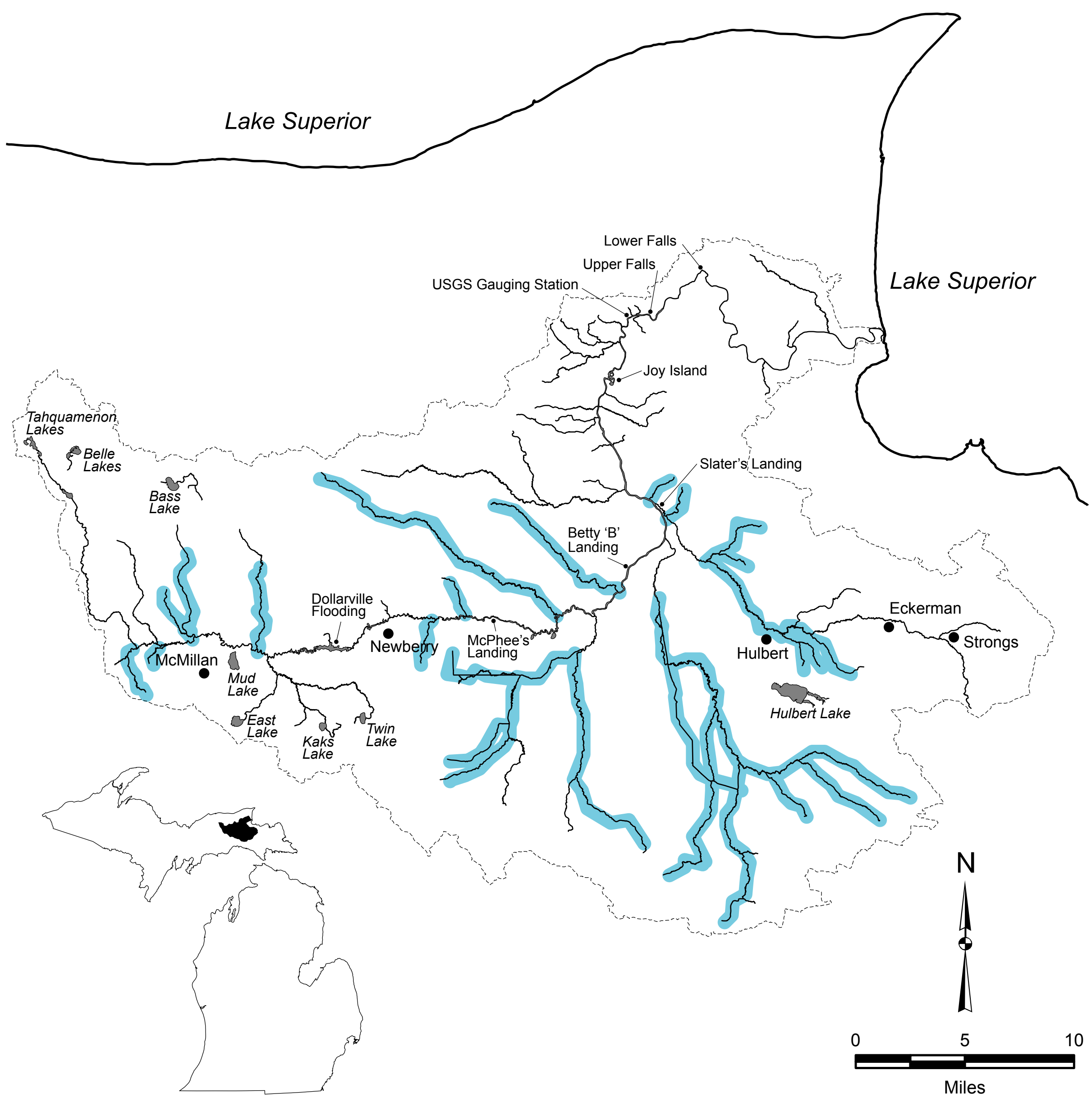
feeding	-	gravel riffles, deeper slower sections of rivers
	-	medium size streams; also lakes, impoundments, and Lake Superior
	-	sand, gravel, or rock substrate
	-	avoids turbidity and silt
spawning	-	riffles or sandy in-shore shallows



Blackside darter *Percina maculata*

Habitat:

feeding	- small to medium streams
	- low to medium gradient
	- gravel and sand substrate
	- tolerate some turbidity
spawning	- gravel and sand substrate



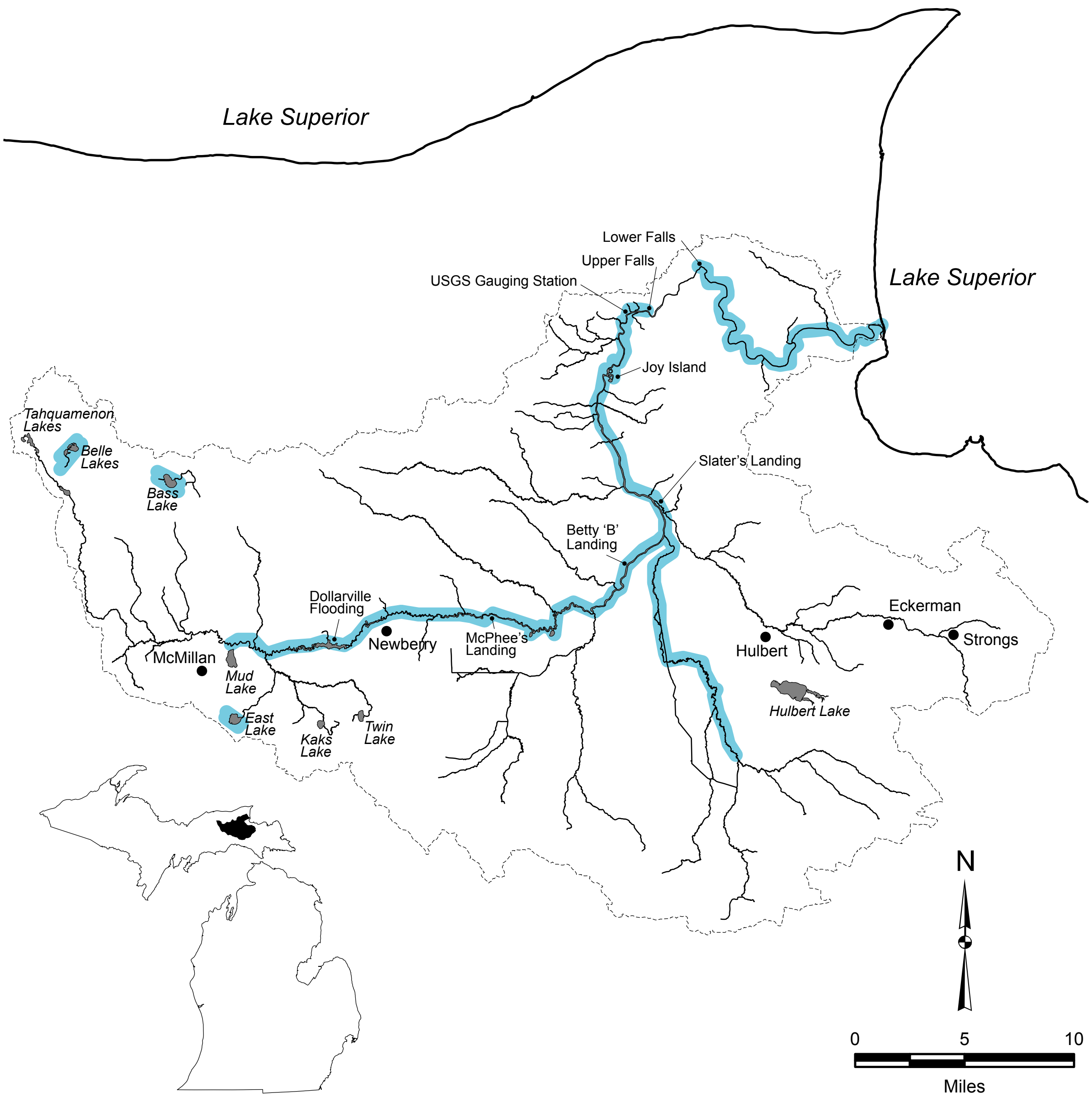
Walleye *Sander vitreus*

Habitat**:**

feeding - larger, deeper streams and in large, shallow, turbid lakes and impoundments; also Lake Superior
- gravel, bedrock, and firm substrates preferred
- does not tolerate a lot of turbidity or low oxygen

spawning - rocky substrates in high gradient water in rivers
- boulder to coarse gravel shoals in lakes

winter refuge - avoids strong currents



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Appendix B

Historical Creel Census Records

Total fishing effort and harvest observed by conservation officers during 1929 to 1964 in the Tahquamenon River watershed.

B.1. – Tahquamenon River mainstem and the East Branch Tahquamenon River

B.2. – Select streams within the Tahquamenon River watershed.

B.3. – Select lakes within the Tahquamenon River watershed.

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B.1.–Historic Creel data for the Tahquamenon River mainstem and the East Branch Tahquamenon River.

County	Stream	Year	No. anglers (lines)	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth Bass	Largemouth Bass	Bluegill	Pumpkinseed	Rock bass	Perch	Grass Pike	Walleye	Northern pike	Bullheads	Suckers
Luce	Tahquamenon River	1930		48	89													
		1931	16	65	146													
		1932	38	38.5	11													
		1933	11	15	8													
		1934	4	17	17													
		1935	4	26	42													
		1936	5	49	48													
		1937	19	96	86													
		1938	11	45	52								10		2		9	
		1939	63	277	130						16	40	21		18	4		3
		1940	44	230	258							1	53		3	1		
		1941	73	384	387							68	64		1	12		67
		1942	69	405	246							209	80		1	18	18	35
		1943	20	74	38													
		1944	21	63.5	70													
		1945	41	221	151							3	26			9		
		1946	19	87.5	70										9	7		
		1948	18	71	80							2	7		2	6		
		1949	33	155	142							11	26			4		38
		1950	27	74	37							3	65		9	5	2	5
		1951	3	4									1					
		1952	279	1,188	621			4				387	498		4	24		5
		1953	23	101	91								35					5

B.1.–Continued.

County	Stream	Year	No. anglers (lines)	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth Bass	Largemouth Bass	Bluegill	Pumpkinseed	Rock bass	Perch	Grass Pike	Walleye	Northern pike	Bullheads	Suckers
Luce	Tahquamenon River– continued.	1954	101	456	374		2	1				2	93		4	21		25
		1955	189	745	612			1				110	378		8	10	45	9
		1956	159	578	365	30	25	3				4	163		16	5		11
		1957	268	1,111	650		3	8			3	132	547		5	9		11
		1958	199	647	556	1						92	373			5		7
		1959	166	547	497	9	22					3	37		1	1		1
		1960	36	94.5	65			1		2			13			7		
		1961	82	198	206							25	30		1	1	3	8
		1962	43	109	97	4						26	30		17	6	3	1
		1963	53	165	80			1					100		12	5		
		1964	97	239	32	1						8	183		4	11		
Chippewa	Tahquamenon River	1929		15	36													
		1930		3										1				
		1938	6	13				1					3			5		
		1940	63	204					1	17			540		19	90		
		1941	36	169									107		9	53		
		1942	1	4											1			
		1944	15	42								3	3		18			7
		1946	127	305					2			19	17		60	15		
		1947	37	68.5	72	1							1		3			
		1948	25	91									6		6	3	17	
		1949	59	133	24	10	19					7	43		1	34		
		1950	29	63				1				10	4		3	5		

B.1.–Continued.

County	Stream	Year	No. anglers (lines)	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth Bass	Largemouth Bass	Bluegill	Pumpkinseed	Rock bass	Perch	Grass Pike	Walleye	Northern pike	Bullheads	Suckers
Chippewa	Tahquamenon River– continued.	1951	56	139								7	10			11		
		1952	26	53	5	4		1				1			2	3		
		1953	2	4									1		3			
		1954	56	150	2		3		2				136		13	8		
		1955	67	183									1,059			3		
		1956	175	374	2		2					7	963		12	8		2
		1957	75	219			1		1			2	256		4	5	1	
		1958	12	31	4	6	10						12					
		1959	15	57	1		1								12	5		
		1960	3	10	1	14	2											
		1962	11	32		2									1	5		
		1963	49	135	1	1	3	11			2		8		8	2		1
	Tahquamenon River, E Br	1929		57	56									1				
		1930		149	252		4											
		1932		87	146													
		1933	1	4	5													
		1937	50	137	66													
		1938	18	57.5	160													1
		1939	10	41	49		8											
		1940	1	8	10													
		1941	6	16.5	17										2			
		1944		14	10													
		1945	7	6	2													

B.1.–Continued.

County	Stream	Year	No. anglers (lines)	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth Bass	Largemouth Bass	Bluegill	Pumpkinseed	Rock bass	Perch	Grass Pike	Walleye	Northern pike	Bullheads	Suckers
Chippewa	Tahquamenon River, E Br–continued.	1947	4	7	4													
		1949	32	95.5	99													
		1950	25	75	82		1											
		1951	593	2,174	2,774	6	17	1										
		1952	444	1,190	1,306	1	5						2					
		1953	354	1,006	1,012	1	2								1			
		1954	296	587	696	1												
		1955	72	294	267													20
		1956	18	67	40								27		4			3
		1957	34	89	126	3									3	1		
		1958	6	12	9	2												
		1959	12	30	14													
		1960	17	24.5	22													
		1961	4	18	20													
		1962	5	8	3													
		1963	4	9	9													

B.2.–Historic creel census data for select Tahquamenon River watershed streams.

County	Stream	Year	No. anglers (lines)	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth Bass	Largemouth Bass	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Bullheads	Suckers
Luce	Auger Creek	1934	6	4															
	East Creek	1937	2	6	11														
		1940	5	19	22														
		1941	5	18	27														
		1942	3	9	25														
		1943	7	16	19														
		1945	6	9	4														
		1950	2	2															
		1952	16	32	30														
		1954	2	3	4														
		1955	11	21	24														
		1956	15	32	31														
		1957	18	35	40														
		1958	9	16.5	14														
		1959	19	42	78														
	Sage River	1938	5	10								8		57		4			
		1939	2	4		2													
		1946	3	9								8	2	12					
		1947	2	4															
	Sage River, E Branch	1939	1	2		3													
		1946	4	8		8													
		1949	21	28		35													
		1952	17	42.5		41													
		1957	2	3		1													

B.2.–Continued.

County	Stream	Year	No. anglers (lines)	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth Bass	Largemouth Bass	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Bullheads	Suckers
Luce	Sage River, E Branch–continued.	1958	8	8															
		1959	7	14															
		1961	3	7															
	Sage River, W Branch	1946	3	7															
		1952	3	3		5													
	Syphon Creek	1934	3	3	3														
		1937	4	12	12														
		1940	4	22	30														
		1941	5	21	39														
		1942	2	8	8														
		1943	5	19	22														
		1944	4	17	68														
		1945	4	7	6														
		1952	2	3	1														
		1952	2	2	1														
		1952	2	4	3														
		1952	4	5	1														
		1952	1	1	1														
		1952	2	8	9														
		1952	2	6	7														
		1952	1	2	1														
		1952	3	9	3														
		1952	2	7	9														

B.2.–Continued.

County	Stream	Year	No. anglers (lines)	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth Bass	Largemouth Bass	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Bullheads	Suckers
Luce	Syphon Creek–continued.	1952	2	7	5														
		1952	23	54	41														
		1955	11	23	36														
		1956	6	13	15														
		1957	24	46	46														
		1958	11	43	64														
		1959	7	18	25														
		1960	4	5	15														
		1961	2	7	11														
		1962	1	2	4														
	Tahquamenon R, Branch	1955	7	18								9		18			5		
	Third Creek	1954	4	8	16														
		1958	3	6	1														
		1964	1	1															
	Thirty-Nine Creek	1960	8	13	33														
		1964	3	9	7														
Mackinac	Hendrie River	1956	2	2															
		1960	2	2															
Chippewa	Cheney Creek	1944	1	5	15														
		1946	1	2	6														
	No. 14 Creek	1956	2	4	1														
	Grant Creek	1942	4	8	15														
		1943	3	8	1														

B.2.–Continued.

County	Stream	Year	No. anglers (lines)	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth Bass	Largemouth Bass	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Bullheads	Suckers
Chippewa	Grant Creek–continued.	1947	4	21	3														
		1951	5	15	26														
		1952	10	23	28														
		1954	5	13	12														
		1960	2	4			6												
		1962	2	8	20														
		1963	4	1															
	Hendrie River	1930		3															
		1950	3	24															
		1952	12	12											3				
		1962	6	9															1
	Riley Creek	1941	1	2	2														

B.3.–Historic creel census data for select Tahquamenon River watershed lakes.

Lake	Township	Range	Section	Year	No. anglers (lines)	Total hours	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Muskellunge	Bullheads	Suckers	Smelt
Hulbert	45N	7W	1	1929		10		5												
	45N	7W	1	1946	6	20	1						11		1					
	45N	7W	1	1950	14	27	4	5	1				5							
	45N	7W	1	1952	34	50	1	16	5		4		2	2	3					
	45N	7W	1	1956	2	4							26							1
	45N	7W	1	1959	35	73.5				1	10		688							23
	45N	7W	1	1960	13	34							191							2
	45N	7W	1	1963	22	68					13		443							8
	45N	7W	1	1965	4	5							2							
Walker	45N	5W	6	1950	2	2							35							
	45N	5W	6	1958	5	9							20							
	45N	5W	6	1959	8	16												7		
Williams	45N	6W	10	1953	10	36							131							
	45N	6W	10	1954	3	7							62							
Barret	47N	10W	18	1937	1	1														
	47N	10W	18	1938	8	28		2	41											
	47N	10W	18	1939	10	36.5	7		79				4							
	47N	10W	18	1940	1	2			4											
Belle	47N	12W	9	1933	3	5		12												
	47N	12W	9	1934	2	6	7													
	47N	12W	9	1935	19	88	90													
	47N	12W	9	1937	19	110	50													
	47N	12W	9	1938	9	50	22						14							

B.3.–Continued.

Lake	Township	Range	Section	Year	No. anglers (lines)	Total hours	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Muskellunge	Bullheads	Suckers	Smelt
Belle–continued	47N	12W	9	1939	12	66	23						41							
	47N	12W	9	1940	15	51	35						98							
	47N	12W	9	1941	6	11							28							
	47N	12W	9	1942	27	64	25						122							
	47N	12W	9	1950	3	5	1						13							
	47N	12W	9	1952	4	12	5						62							
	47N	12W	9	1953	3	8	5						1							
	47N	12W	9	1954	8	23	5			15	8		24							
	47N	12W	9	1955	4	13				16	5		39							
	47N	12W	9	1956	7	15	3						42							
	47N	12W	9	1957	3	15	3						31							
	47N	12W	9	1958	3	12							22							
	47N	12W	9	1959	2	3			7		12									
	47N	12W	9	1960	4	7	1				1		12							
	47N	12W	9	1962	4	11				6			110							
	47N	12W	9	1963	2	14														
Bennet Springs	47N	12W	17	1960	4	2														
Benny	47N	12W	24	1961	64	128														
	47N	12W	24	1962	41	65														
	47N	12W	24	1963	54	106														
Camp 7	47N	12W	16	1940	1	3							3			1				
	47N	12W	16	1941	3	12			1				8							
	47N	12W	16	1942	4	8										3				

B.3.–Continued.

Lake	Township	Range	Section	Year	No. anglers (lines)	Total hours	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Muskellunge	Bullheads	Suckers	Smelt
Camp 7–continued	47N	12W	16	1943	7	12										5				
	47N	12W	16	1952	14	33										19				
	47N	12W	16	1955	2	3										1				
	47N	12W	16	1956	11	37	3		15				25			8				
	47N	12W	16	1957	3	12										7				
	47N	12W	16	1958	10	32			13							9				
	47N	12W	16	1959	1	1														
	47N	12W	16	1961	6	14							1							
	47N	12W	16	1964	2	2														
Cleveland Cliffs	47N	10W	17	1948	2	5										7				
Dishpan	47N	12W	22	1939	4	15			8				33							
East	45N	11W	10	1930	3	6									12					
	45N	11W	10	1941	10	25	1		51				8		4					
	45N	11W	10	1949	4	8			32											
	45N	11W	10	1951	4	7			30				42							
	45N	11W	10	1952	4	10			5				21							
	45N	11W	10	1955	2	10			17				7							
Frank	47N	12W	5	1958	8	27							157							
	47N	12W	5	1959	17	41							150							
	47N	12W	5	1964	4	9														
Fur Farm	47N	12W	22	1934	6	10							44							
	47N	12W	22	1938	2	20	1				8		22							
	47N	12W	22	1940	4	16							46							

B.3.–Continued.

Lake	Township	Range	Section	Year	No. anglers (lines)	Total hours	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Muskellunge	Bullheads	Suckers	Smelt
Grass	47N	12W	17	1959	4	5														
	47N	12W	17	1960	9	21							10							
	47N	12W	17	1961	2	6														
	47N	12W	17	1962	2	2														
	47N	12W	17	1963	4	4														
Halfway	47N	10W	17	1950	2	3														
	47N	10W	17	1951	4	8							81							
	47N	10W	17	1952	30	58							263							
	47N	10W	17	1953	3	7							75							
Hamilton	46N	10W	35	1962	4	4							29							
Kaks	45N	10W	9	1949	7	15							55			1				
	45N	10W	9	1950	4	8				1			25							
	45N	10W	9	1951	13	26					3		128							
	45N	10W	9	1952	5	15	2						37			1				
	45N	10W	9	1953	5	5							69							
	45N	10W	9	1954	19	37					6		237							
	45N	10W	9	1955	5	13							48			2				
	45N	10W	9	1956	11	21				5	4		28							
	45N	10W	9	1957	2	6							40							
	45N	10W	9	1960	2	3							7							
Kelly	47N	11W	26	1956	16	54			6	4	1		153					43		
	47N	11W	26	1957	3	5			7				3							

B.3.–Continued.

Lake	Township	Range	Section	Year	No. anglers (lines)	Total hours	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Muskellunge	Bullheads	Suckers	Smelt
Long	47N	12W	21	1950	1	2														
	47N	12W	21	1952	2	4							1							
	47N	12W	21	1955	3	5														
	47N	12W	21	1957	3	4										1				
	47N	12W	21	1959	5	8														
	47N	12W	21	1960	6	7														
	47N	12W	21	1961	2	5														
	47N	12W	21	1962	2	3														
	47N	12W	21	1964	12	29														
Lost (Little Fur Farm)	47N	12W	22	1940	2	8							34							
	47N	12W	22	1942	2	2							14							
	47N	12W	22	1949	2	6														
	47N	12W	22	1950	32	74														
	47N	12W	22	1951	31	74														
	47N	12W	22	1952	23	47														
	47N	12W	22	1953	24	33														
	47N	12W	22	1954	12	15														
	47N	12W	22	1955	12	15														
	47N	12W	22	1956	10	18														
	47N	12W	22	1957	13	18														
	47N	12W	22	1958	15	49														
	47N	12W	22	1959	33	62														
	47N	12W	22	1960	9	17														
	47N	12W	22	1961	4	15														
	47N	12W	22	1962	21	60														

B.3.–Continued.

Lake	Township	Range	Section	Year	No. anglers (lines)	Total hours	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Muskellunge	Bullheads	Suckers	Smelt
Lost (Little Fur Farm)–continued	47N	12W	22	1963	9	15														
	47N	12W	22	1964	10	18														
Marsh	47N	12W	5	1958	42	122							728					1		
	47N	12W	5	1959	12	20							59							
	47N	12W	5	1960	2	9							20							
Mud	46N	11W	27	1936	1	4								1						
	46N	11W	27	1939	11	64								20						
	46N	11W	27	1940	11	66								23		9				
	46N	11W	27	1941	5	32										18				
	46N	11W	27	1942	31	73										13	1			
	46N	11W	27	1943	9	47										22				
	46N	11W	27	1944	7	34										23	2		1	
	46N	11W	27	1945	6	27										11				
	46N	11W	27	1949	10	59							41			17	1			
	46N	11W	27	1952	26	85							5			41			1	
	46N	11W	27	1954	36	151							45			53				
	46N	11W	27	1955	49	176							21			58				
	46N	11W	27	1956	51	210	1	1					75			92				
	46N	11W	27	1957	10	41							46			10				
	46N	11W	27	1958	16	69							3			43				
	46N	11W	27	1959	14	67										26				
	46N	11W	27	1960	4	18							14			8				
	46N	11W	27	1961	4	8														
	46N	11W	27	1964	10	26							1			8				

B.3.–Continued.

Lake	Township	Range	Section	Year	No. anglers (lines)	Total hours	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Muskellunge	Bullheads	Suckers	Smelt
Musgrave	47N	12W	22	1949	2	8														
	47N	12W	22	1950	7	11							4							
	47N	12W	22	1952	3	17							14							
	47N	12W	22	1953	5	12							23							
	47N	12W	22	1957	3	6							25							
Peanut	47N	11W	30	1934		7	4													
	47N	11W	30	1935	2	8	9													
	47N	11W	30	1942	3	7	3													
	47N	11W	30	1949	3	3														
	47N	11W	30	1950	35	60														
	47N	11W	30	1951	113	245														
	47N	11W	30	1952	14	32														
	47N	11W	30	1953	69	169														
	47N	11W	30	1954	12	16			25											
	47N	11W	30	1955	33	88			14											
	47N	11W	30	1956	4	2			20				1							
	47N	11W	30	1957	67	189			55		13		4							
	47N	11W	30	1958	2	3														
	47N	11W	30	1959	120	291														
	47N	11W	30	1960	17	34														
	47N	11W	30	1969	70	169														
	47N	11W	30	1962	46	100														
	47N	11W	30	1963	51	148														
	47N	11W	30	1964	49	165														

B.3.–Continued.

Lake	Township	Range	Section	Year	No. anglers (lines)	Total hours	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Muskellunge	Bullheads	Suckers	Smelt
Quinlan	47N	12W	35	1934																
	47N	12W	35	1952	2	9			19				2							
	47N	12W	35	1955	2	9			22				1							
	47N	12W	35	1958	4	8			37											
Smith	47N	12W	23	1961	2	4														
Syphon	47N	12W	24	1960	10	13														
	47N	12W	24	1961	28	73														
	47N	12W	24	1962	7	23														
	47N	12W	24	1963	3	6														
Tahquamenon	47N	12W	7	1955	3	14				2			67							
	47N	12W	7	1959	16	55							246							
Young	47N	11W	29	1937	1	5														
	47N	11W	29	1938	20	120														
	47N	11W	29	1939	13	60														
	47N	11W	29	1940	2	10														
	47N	11W	29	1942	1	4														
	47N	11W	29	1943	11	32														
	47N	11W	29	1944	4	8							4							
	47N	11W	29	1945	4	12							4							
	47N	11W	29	1946	2	5														
	47N	11W	29	1949	17	46														
	47N	11W	29	1950	9	9														
	47N	11W	29	1951	12	32														

B.3.–Continued.

Lake	Township	Range	Section	Year	No. anglers (lines)	Total hours	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Black Crappie	Perch	Grass Pike	Walleye	Northern pike	Muskellunge	Bullheads	Suckers	Smelt
Young–continued	47N	11W	29	1952	11	22														
	47N	11W	29	1953	26	52														
	47N	11W	29	1954	22	44														
	47N	11W	29	1955	22	47							1							
	47N	11W	29	1956	50	65														
	47N	11W	29	1957	70	178														
	47N	11W	29	1958	28	98														
	47N	11W	29	1959	88	181														
	47N	11W	29	1960	23	36														
	47N	11W	29	1961	35	64														
	47N	11W	29	1962	39	94														
	47N	11W	29	1963	25	41														
	47N	11W	29	1964	15	45														
	47N	11W	29	1964	2	1														
	47N	11W	29	1964	17	46														