NATURAL FEATURES

AND RESOURCES

Chapter of the
Marquette County Comprehensive Plan

Adopted _____
By the
Marquette County Planning Commission

Prepared by:

Resource Management & Development Department
Planning, Community Development, Forestry, & Recreation Division
Marquette County, Michigan

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Marquette County's diverse physical environment makes it unique among the 83 counties of Michigan. This uniqueness is first obvious from the county's size, shape, and location. Marquette County is the largest county in the state, containing some 1,873 square miles[1], well above the statewide average of 685 square miles. In addition, there are some 55 miles of Lake Superior shoreline along its northeast margin. First established in 1848, Marquette County's shape has gone through a lengthy metamorphosis of line-changing, once containing most of Alger, Dickinson, Delta, Schoolcraft, Iron, and Baraga counties. The result was a rather distinct shape, quite unlike the county's rectangular counterparts of southern Michigan.[2] Finally, the county is situated in the transition zone where the ancient Precambrian crystalline rocks emerge from beneath the more recently deposited Paleozoic sandstones and limestones of the Michigan Basin. This, coupled with as many as four occurrences of glaciation, created the mountainous landscape in the central and northern regions of the county and the rolling, forested glacial deposits to the south and east.

Development in Marquette County has historically been resource-dependent and has occurred in nodes or centers of mining, lumbering, or transportation activity. Common throughout our nation, Marquette County experienced a shift in developmental patterns out of the urban areas. Reasons for the development shift included: dramatic "improvement" of roads, in conjunction with dependence on the private automobile; the lure of lower tax structures in the townships; the development of employment opportunity at new locations (e.g., Eagle Mine); and the expansion of employment opportunity in existing centers of activity (e.g., Northern Michigan University (NMU),UP Health System).

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[1] *Many figures are cited in the literature concerning the actual size of Marquette County. "1,873" is listed in the County Fact Book prepared by County Clerk. Other figures are:

Federal Land Survey	1,855	sq. mi. (excludes some water)
Marquette County Road Commission	1,870	" "
Michigan Dept. of Commerce	1,828	" "
Prime Forest Lands Identification Project	1,827	" "
USDA Soil Conservation Service	1,841	" "
USGS	1,878	" "

[2] Indeed the county's shape, in conjunction with its natural dissection by rivers, creates a situation where in some instances one must leave the county and pass through another, Delta, to reach Ewing Township. Some plats from other counties are still on file in the Register of Deeds office, as well.

Further development of Marquette County's valuable natural-resource base will result in additional growth. Marquette County must recognize the problems and impacts that an increased population brings and take steps to conserve and use these important natural resources wisely.

Separate planning and development decisions, made without regard for all elements of an ecosystem, can lead to devastating results. Development of the County's human resources through its educational institutions is also an important part of the "natural system."

A. Purpose

It is the purpose of this Chapter to:

(1) Identify natural resources, features and systems, such as geology, soils, surface and groundwater, slope, vegetation and wildlife;

(2) Discuss "proper use" of natural resources in relation to their potential for development. Basically, "wise use" of natural resources can fulfill an ecological role by providing a healthful environment with clean water and air, vegetation and needed wildlife; an economic role by ensuring good soils are retained for agriculture and forestry, and minerals protected for extraction and sources of employment; a recreation role to meet the growing need for a variety of outdoor activities; and an amenity role to enhance the beauty and general livability of the area;

(3) Provide a basis for making sound zoning regulations and developmental decisions that will ensure a healthy balance between natural and altered aspects of the environment; and

(4) Provide some natural determinants, which, when coupled with the other socio-economic data of the plan, can provide a basis for public policy regarding the future developmental patterns of Marquette County.

2. BEDROCK GEOLOGY

Bedrock can be defined as the solid material which comprises the earth's crust. Bedrock geology refers to the spatial distribution, thickness, and sequence of these rocks. Although much of the bedrock in Marquette County is buried beneath glacial drift, sufficient data exists from outcrop observations and drilling and mining records to illustrate the extent of various types of bedrock underlying the surface. Basically there are two groups of rock which form this mantle; Precambrian and Paleozoic. Figure 2 displays the types of bedrock in Marquette County using data from Michigan Department of Environmental Quality (MDEQ) - Geologic Survey Division, 1987.

A. Description

(1) Precambrian

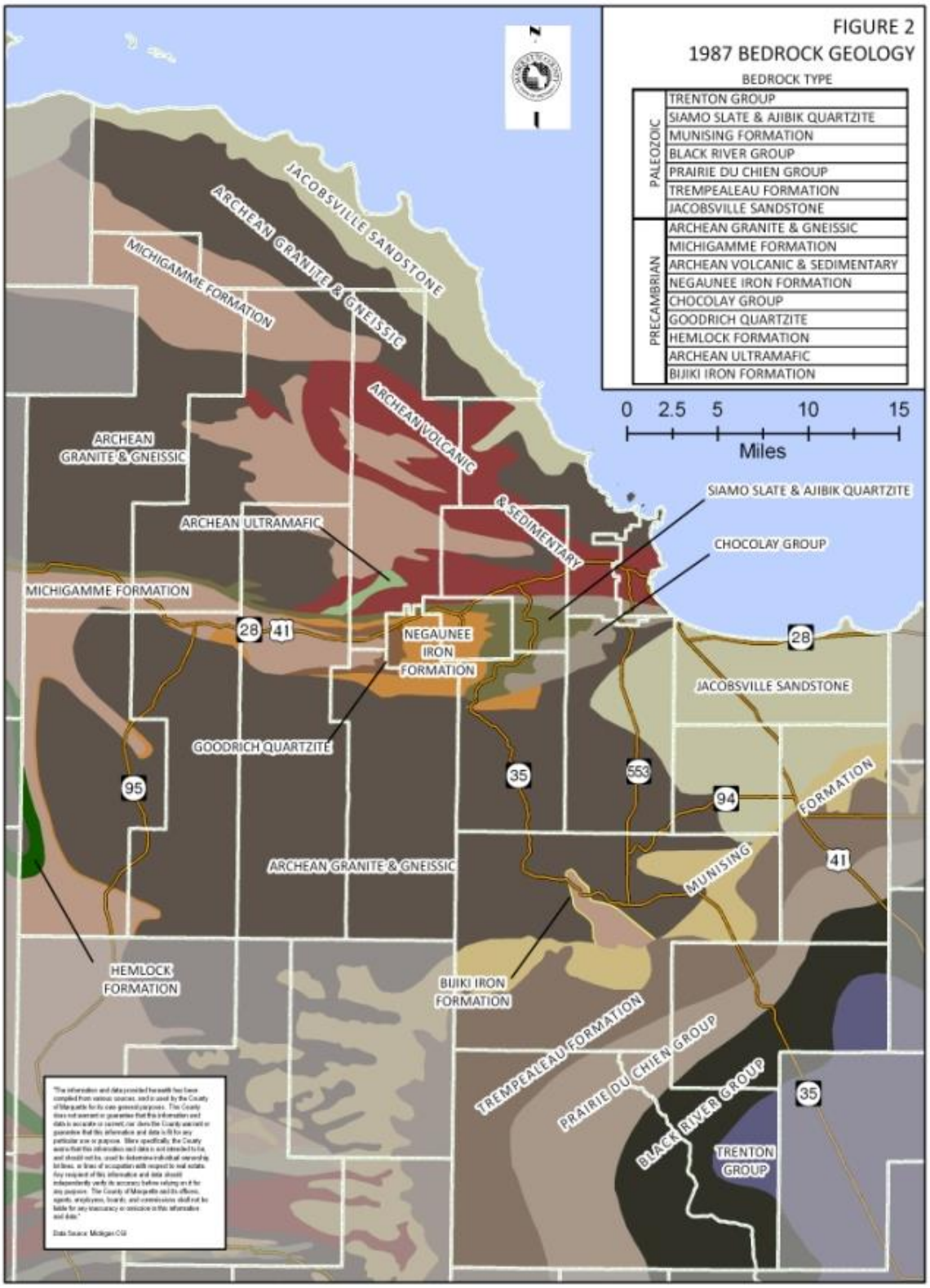
The rock of the Precambrian era is some of the oldest rocks on the face of the earth. These range in age from 600 million years to as much as four billion years, and are part of a large mass, the Laurentian Shield, which extends in to Canada. The oldest of these rocks are the lower Precambrian (Archean series) rocks, which consist of igneous lava flows and metamorphic, granites, granitic gneiss, and schists (green stone). The next younger rocks are the Middle Precambrian (Huronian series) rocks, which consist principally of a thick layer of sedimentary rocks that overlap the Archean series rocks, mainly graywackes and dolomites. Metamorphic rocks, mainly slates and quartzites, also occur in this series. The middle Precambrian rocks are the dominant series economically and geologically, as they contain what is known as the Marquette Range Super Group, the host of several iron formations. It is thought that iron was precipitated from solution in seawater as an oxide (magnetite, hematite), carbonate (siderite), silicate (glauconite), or sulfide (pyrite), in association with silica (chert), carbonates, and fine-grained clastic sediments.

The ***middle Precambrian*** rocks are the dominant series economically and geologically, as they contain what is known as the Marquette Range Super Group, the host of several iron formations.

(2) Paleozoic

The bedrock of the Paleozoic era is the youngest (425-600 million years) bedrock in the county. These are shallow sedimentary deposits which form the northwestern rim of the Michigan Basin, interfacing the older Precambrian rocks along an approximate line from Marquette City to the southeastern tip of Tilden Township. Rocks of this era include Cambrian and Ordovician sedimentary limestones and sandstones.

Figure 2 Bedrock Geology



B. Discussion

Bedrock is fundamentally important to Marquette County in two ways: It serves as the source of groundwater for domestic and other purposes and contains considerable mineral deposits which form the "foundation" of the county's present economic structure.

(1) Bedrock/Groundwater

The hard crystalline Precambrian rock is a poor aquifer. In upland areas, most wells fail to provide enough water for domestic purposes. Almost total reliance is placed on supply from permeable glacial drift. In valleys having more than 20 feet of this drift, wells drilled into the underlying bedrock may yield enough water for domestic purposes. A few may yield more than 50 gallons per minute (gpm). Occasionally fissure water may be encountered as water passes into fractures or fragmented areas of rock. Oftentimes this water is not filtered as it enters the underlying rock directly from surface water, creating a potential health risk. Drilling more than 300 feet into this bedrock is usually futile. During 1976, a drought year, many wells failed in the central and western areas of the county underlain by this type of bedrock.

The Paleozoic rocks are generally better producers of groundwater. Local formations are as follows:

(a) Black River and Trenton Groups
The Black River Formation is basically limestone. Wells drilled 40-300 feet may yield sufficient amounts of moderately hard water for farm or domestic purposes. Maximum thickness is about 400 feet. In some cases, enlarged fractures may yield as high as 30 gpm.

(b) Munising Formation
The Munising Formation will usually yield enough water for domestic purposes. Large-diameter wells drilled over 50 feet into bedrock may yield more than 100 gpm. Some wells in this group fail because of impermeable shale or crystalline igneous and metamorphic rocks encountered at shallow depths.

(c) Jacobsville Sandstone
Jacobsville sandstone occurs in a band along the Lake Superior shoreline and is one of the most important bedrock aquifers in the area. It is generally more porous and is a considerably thicker (estimate $\pm$ 600 feet) deposit. Interior areas composed of these strata will yield small quantities of water to wells. Sufficient amounts for domestic use are obtainable if no other source is available, but the water may contain high levels of chloride in some areas. Lake Superior shoreline formations

north of Marquette may yield as high as 30 gpm, due to weathering and increased storage capacity.

(d) Prairie du Chien Group and Trempealeau Formation
Yields of 50 gpm this can be expected from beds of sandstone in this unit. Conversely, strata of limestone and dolomites may only produce enough water for domestic use.

(2) Bedrock/Minerals

Iron-ore mining and beneficiation is the major industry in Marquette County. Substantial amounts of the high-grade, easily accessible, direct-shipping ore have been reduced by various methods of underground mining. Attractive reserves of these ores do exist in areas such as Richmond Township, where occurrences can be found at depths of 1000 feet. There is currently one active underground mining operation located within Marquette County. The Eagle Mine, located in Northern Marquette County, began operations to mine silver, copper, and other metals in 2014. Prior to this, the last operating underground mine was the Mather "B" which closed in 1979. Two open-pit mines are presently operating in the county (Empire and Tilden). The open-pit/beneficiation process necessarily utilizes vast amounts of water and land resources. Iron-ore mining is of course sensitive to the demand for steel and fluctuations in terms of production have historically affected the local economy. This subject and cost of production are discussed in more detail in Chapter 5, The Economy. Two distinct formations of iron-rich rock have been identified: Marquette Iron Range, stretching west from Negaunee to Michigamme and then south to Republic; and the Gwinn Iron District, located in central Forsyth Township. Occurrences of gold, silver, lead, nickel, copper, and zinc are found in the lower Precambrian greenstone which stretches from north of Ishpeming to Marquette and northwest to Baraga County in a "V" shape. Gold was produced from several mines in this deposit, including the Ropes, Michigan, Gold Lake, Superior, Peninsula, and Fire Center.

Proven reserves of copper mineralization occur in the Middle Precambrian kona dolomite interbeds in which begin in the Marquette Mountain area and runs west to Negaunee.

Concentrations of uranium which have higher readings than background can be found in the Middle Precambrian granites and Michigamme slate.

C. Summary/Planning Implications

(1) With respect to bedrock, developmental limitations are greatest in areas of thin glacial drift over Precambrian formations. Suitable quantities of groundwater for domestic use in these areas are questionable. In addition,

septic-tank absorption fields function improperly because of inadequate filtration and consequent “perching” of effluent on top of the bedrock.

(2) Groundwater conditions also have significant influence on the feasibility of developing and operating both underground and open-pit mines. Mining operations may affect groundwater levels in the immediate vicinity of mines. When an operation ceases groundwater levels often times rise, impacting adjacent development with water in basements.

(3) Concerning mining in general, iron production will undoubtedly continue for several decades. Extensive development of local copper, nickel, silver, gold and uranium deposits will depend upon economics.

Mining does have detrimental effects which should be taken into consideration. The presence of former mining areas may have an adverse effect on land values because of strippings or tailings deposits left on the land surface. As larger tonnages of lower-grade ore are mined, correspondingly greater areas will be needed for tailings-disposal areas.

Surface mining disturbs other natural resources. Timber is removed; wildlife habitat is destroyed; natural stream courses are redirected and subjected to excessive silt; dust and vibration result from blasting, inducing noise and air pollution. These areas will not return to a pre-mining condition without careful management. Mining of nonferrous metals is regulated under Part 632, Nonferrous Metallic Mining and Reclamation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). Part 632 was enacted in December 2004. Iron mining continues to be regulated under previously existing law, Part 631 of the NREPA. Local Zoning Ordinances should include a mineral-resource zoning district and mining-related regulations.

3. SURFICIAL GEOLOGY

Surficial geology deals with the composition, areal distribution, and thickness of the unconsolidated soil and rock materials lying above bedrock.

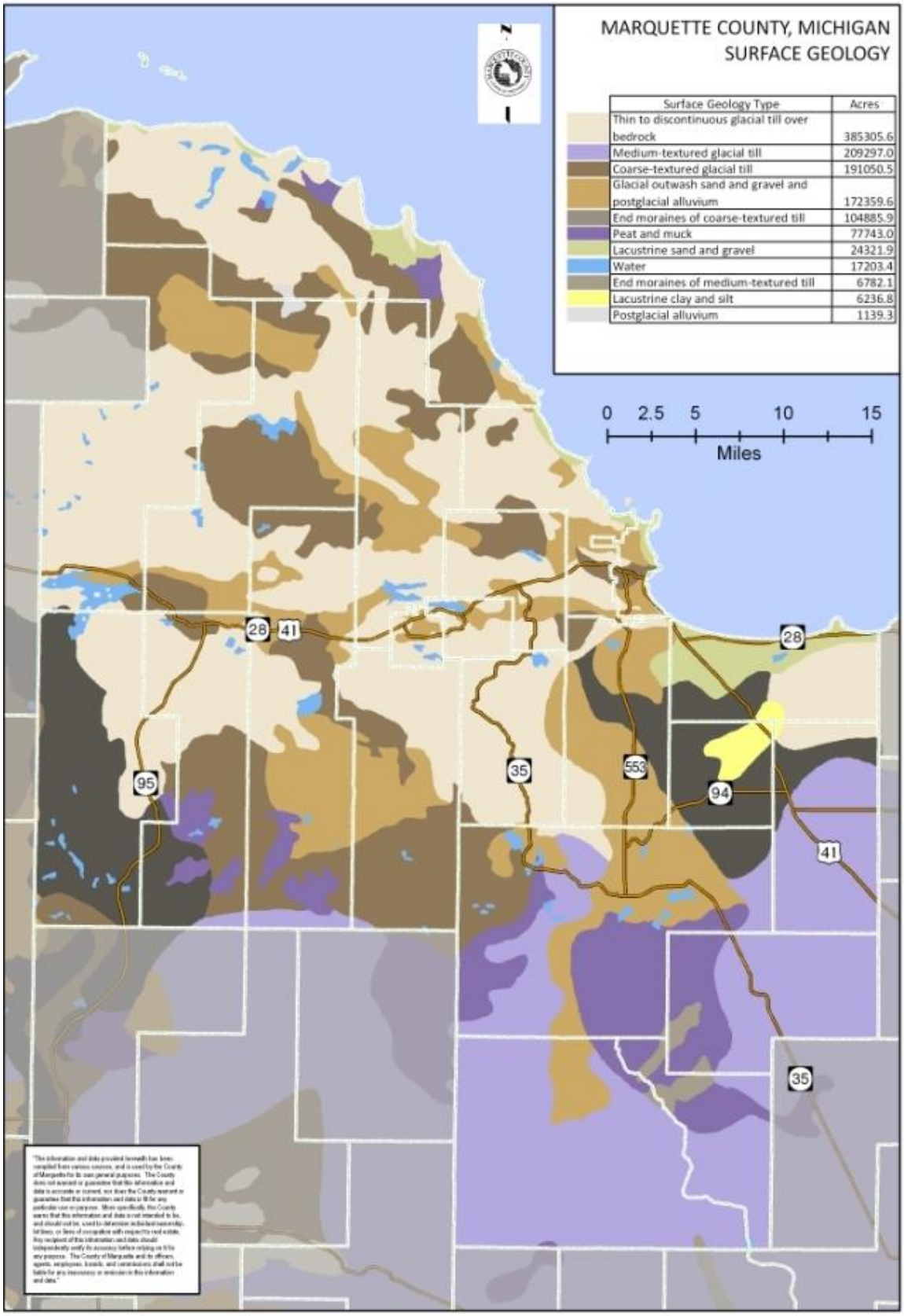
Little record remains as to what happened geologically in Marquette County between the Ordovician Period (some 500 million years ago), and the advance and retreat of glaciers during the Pleistocene Period. Huge masses of ice, estimated to attain a thickness of as much as 5,000 feet, passed through the region as many as four times scouring away the softer surface materials. The most recent glacial retreat occurred about 8,000 years ago during the Wisconsin Period. Melting glaciers subsequently left behind unconsolidated debris consisting of materials that range in size from clay to boulders. Glacial deposits range in depth from zero to 500 feet.

Glacial deposits- Four general categories

1. Till,
2. Lacustrine (lake) deposits,
3. Outwash and alluvium, and
4. Swamp or recent alluvium.

Figure 3 displays the types of surficial geology in Marquette County using data from the Michigan Natural Features Inventory and Michigan Department of Natural Resources, 1998.

Figure 3 Surface Geology



A. Description

(1) Thin to Discontinuous Glacial Till over Bedrock, Medium-textured Glacial Till, and Coarse-textured Glacial Till

Glacial till is unsorted or poorly sorted un-stratified drift, deposited directly underneath a glacier without subsequent reworking by wind or water. It is a very heterogeneous material, ranging from clay fines to large boulders; thickness may range from six-60 feet. Various deposits are distributed around the county.

There are areas where very thin glacial till (less than six feet thick) covers Precambrian bedrock. These areas generally have high relief, as much of the glacial deposition was literally washed off the rocky crests by melting ice. Large areas in this category occur in the central and northern parts of the county.

(2) Glacial Outwash Sand and Gravel and Postglacial Alluvium

These formations consist of stratified sand and gravel deposited by glacial melt-water streams and flows "washed out" in front of the glacier. They are commonly very permeable and range from ten feet to as much as 300 feet in depth. Outwash deposits are composed of sand and gravel, with few fines.

(3) End Moraines of Coarse-textured Till and End Moraines of Medium-textured Till

The majority of moraines in Marquette County are end moraines from the Wisconsin Period. As glaciers receded, a series of hills were left behind. These hills formed when the melting rate equaled the forward advance rate, creating a "conveyor belt" effect. There are several types of moraines. Lateral moraines occur along the ice front edges. Ground moraines can often be confused with till plains and are a result of deposition of materials carried within the ice after retreat. Often times true identity of many glacial features are masked, such as when a moraine from one glacial retreat is modified or buried by another advance. Permeability is quite variable, being high in outwash areas and considerably lower near clay and till deposits. Thickness can reach as much as 400 feet.

(4) Peat and Muck

Since the passing of the glaciers, organic deposition has occurred in many of the shallow, slow-moving surface water bodies. The result has been the formation of peat bogs and mucks along riverbanks. These materials are basically saturated organic materials mixed with small amounts of mineral soils and have the greatest limitations for development. A large area encompassing the Forsyth, Ewing, Turin, and Wells Township boundary lines consists of this type of surface geology.

(5) Lacustrine Sand and Gravel and Lacustrine Clay and Silt

Where the ground surface in front of a glacier sloped down toward the ice front, melt-water collected and formed a lake in front of the ice margin. These lakes essentially become settling ponds for fine sand, silt and clay particles. Such deposits are generally well sorted. Concentrations of more than 25% silt or clay can perch water and create swamps or marshes. The sand and gravel type is located in Chocolay Township, along the shoreline, and in the Big Bay area in Powell Township while an area of clay and silt is located in West Branch Township.

(6) Postglacial Alluvium

Flowing water associated with glaciers deposit alluvium which is a combination of sediments. A small area in the County spanning the Powell and Champion Township boundaries is considered postglacial alluvium.

(7) Drumlins

Drumlins are small, cigar-shaped features carved by the flow of glacial ice. They are generally aligned in the direction of ice movement. A few of these features are located in Wells Township, ranging in thickness from ten – 100 feet.

B. Discussion

Surficial geology has definite links with soils, vegetation, and land use. Soil development is often dependent upon the decomposition of the underlying parent material. Consequently, there are sandy soils on outwash plains and clay soils in lacustrine deposits. Vegetation has adapted to these varied soils, with species like Jack Pine and Aspen predominating on the sandy, infertile dry-outwash areas, Northern Hardwoods on the more fertile moraines and till areas, and White Cedar and Black Spruce in recent deposits of alluvium.

Rough knobby areas, where rock outcrops from thin glacial drift, have been accessible for mineral exploration and have made extraction economical. Communities have developed in many of these areas.

Hilly moraines and some glacial till areas have given rise to more fertile soils upon which some agriculture has thrived.

Surficial geology also ties in closely with surface water flow, in that infiltration and consequently runoff are directly related to the permeability of the underlying materials, This factor governs the amount of water available for streams and the development and size of drainage patterns.

Groundwater is also governed by the amount (thickness and area) and permeability of the sub-strata. Developed areas, which lie on top of impermeable Precambrian bedrock, rely totally on glacial drift for the supply and recharge of water systems.

Outwash deposits, for example, are the best aquifers, as they have high permeability and can be quite extensive. Moraines and tills are generally poorer producers, containing impermeable clay.

Glacial deposits are also an important source of gravel. Major users of this resource include construction companies and the Marquette County Road Commission.

C. Summary/Planning Implications

(1) Areas of till/bedrock present many problems associated with development – shallow depth to bedrock, poor groundwater source, and inadequacy for septage disposal being the primary factors.

(2) Good potential exists for developing outwash plains as a possible groundwater source. (See Section 7, sub-surface water.)

(3) Thicker deposits of gravel can be found in moraines and some outwash areas which were near the ice front. These could be valuable sources of gravel for future road improvements or construction projects.

4. SLOPE AND TERRAIN

Marquette County has substantial topographic diversity which is directly attributable to the resistance of hard crystalline rock to glaciation, weathering and erosion; or types of glacial features such as moraine, drumlin, and outwash.

A. Description

One of the "mountain" masses in the Upper Peninsula, the Huron Mountains, arch across the northern edge of the county. Basically, these comprise lake/knob topography. The majority of slopes in the area range from 20-45%.

The remainder of the county varies from rolling in the west to almost level in the east, where there are many swampy depressions. Slopes are quite steep around kettle lakes in southern Republic, Humboldt, Tilden, and Forsyth Townships. There are also steep, dramatic cliffs, ravines and canyons along the Mulligan Plains, the Lake Superior shoreline, the Black Hills area north of Champion, and along segments of the Yellow Dog and Chocolay Rivers. Several waterfalls also exist where masses of bedrock meet such features as outwash plains.

Some of the highest topography (Greater than 1,800 feet in elevation) in Michigan is located in northwest Marquette County. Here relief ranges as high as 400 feet. Altitudes as compared with sea level range from about 600 feet along the Lake Superior shore to 1,900 feet in Section 31, T50N, R29W, in the northwest.

B. Summary/Planning Implication

(1) The varied landscape of Marquette County creates a wealth of opportunity for outdoor recreation, such as skiing, hiking, rappelling, and sightseeing, for example.

(2) Steep Slopes (see Figure 5), those greater than ten percent, can be aesthetically attractive for residential development as well as some commercial establishments. However, the steep grade increases the likelihood of soil movement and slides; the weight of the structure is an added force encouraging this movement. Besides such dangers, there is an added expense to this type of construction. Provisions should be made to protect steep slopes from these hazards. In general, extensive, high-density development should not occur on slopes with a gradient exceeding ten percent.

Figure 4 Topography

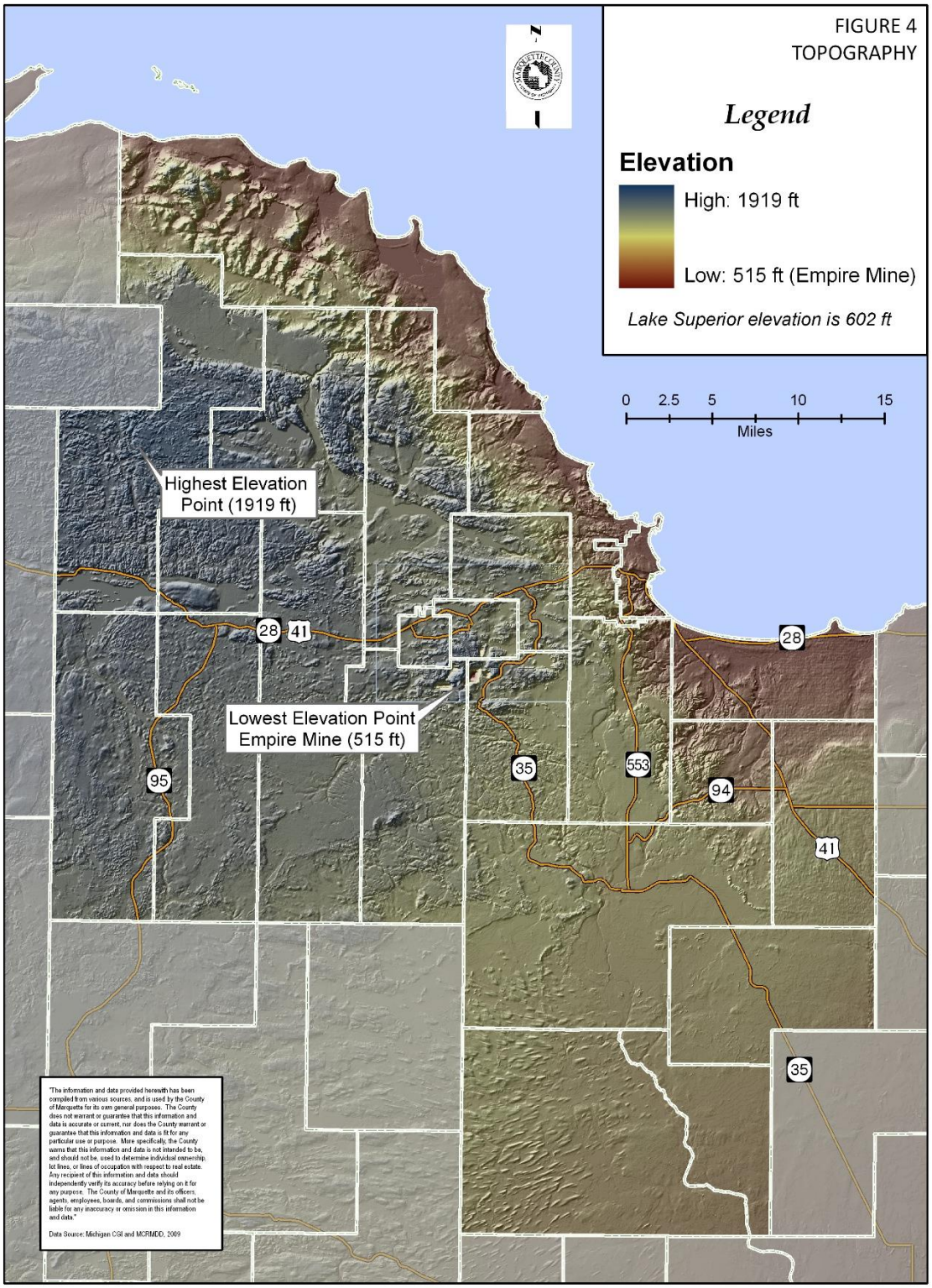
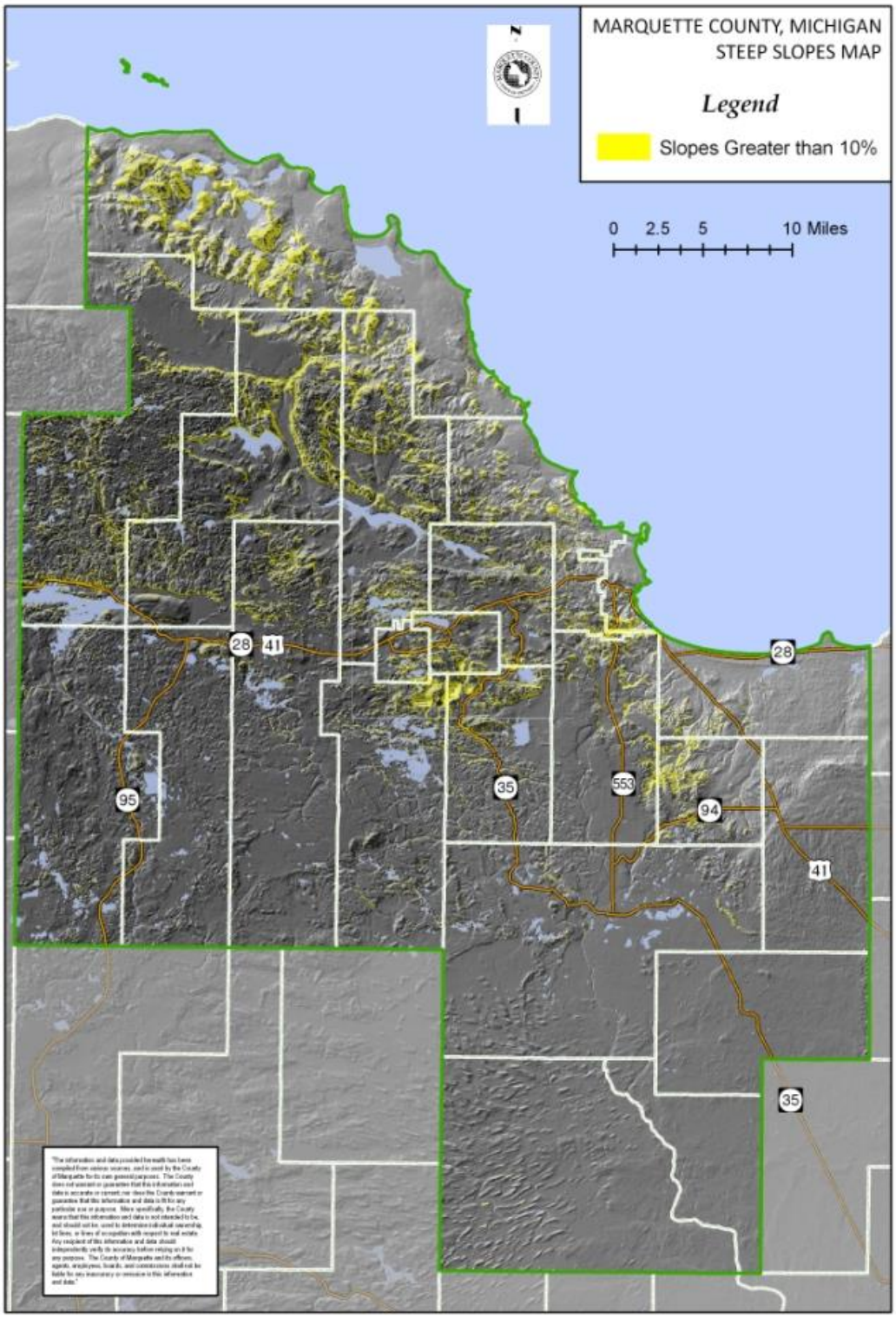


Figure 5 Steep Slopes Map



5. SOILS

The tons of pressure and slow movement of glaciers over the underlying bedrock material helped turn solid rock into an extremely fine-ground material, which was transported and randomly deposited. This process, together with local topography and drainage, vegetative and climatic controls, resulted in the scattered patterns of soil types seen on the soil map for Marquette County (Figure 6).

A. Description

There is a direct relationship between soil types and underlying glacial deposits. Soils overlying outwash are predominantly sand or sandy loam at the surface grading downward to sand and gravel. Soils that have formed over clay-rich glacial till and lacustrine deposits consist of silty loam to loamy clay. Thick, mucky peat soils overly organic deposits. Little or no soil has developed in areas where bedrock is exposed, primarily due to the resistance to weathering and break-up of the rocks and the natural ability of materials to move downhill.

The types of soil present have an obvious effect on vegetation and consequent land use. Sugar Maple, Yellow Birch, and associated Hemlock are found on well-drained loam. They give way to Spruce, Balsam, and Pine on well-drained, fertile outwash soils. Swamp conifers occur on poorly drained soils. Mixed forests, including Spruce, Balsam, Birch, and Jack Pine, are found on infertile outwash soils, giving way to stands of Aspen, Willow, or Tag Alder in poorly drained areas. Bogs and depressions, characterized by high acid, mucky peat soils, thin and rocky or sandy soils, have little value on cropland or pasture because of their natural unsuitability.

B. Discussion

Awareness of soil characteristics should be a prerequisite to development. Pertinent soil characteristics include moisture content for agriculture, bearing capacity for structures, permeability levels affecting drainage, erosion factors, and many other important considerations. Soils are major components of the ecosystem. Limitations can sometimes be overcome by careful applications of technology. Too often however, natural systems are overpowered by technological solutions that are ill advised.

Figure 6 General Soil Associations

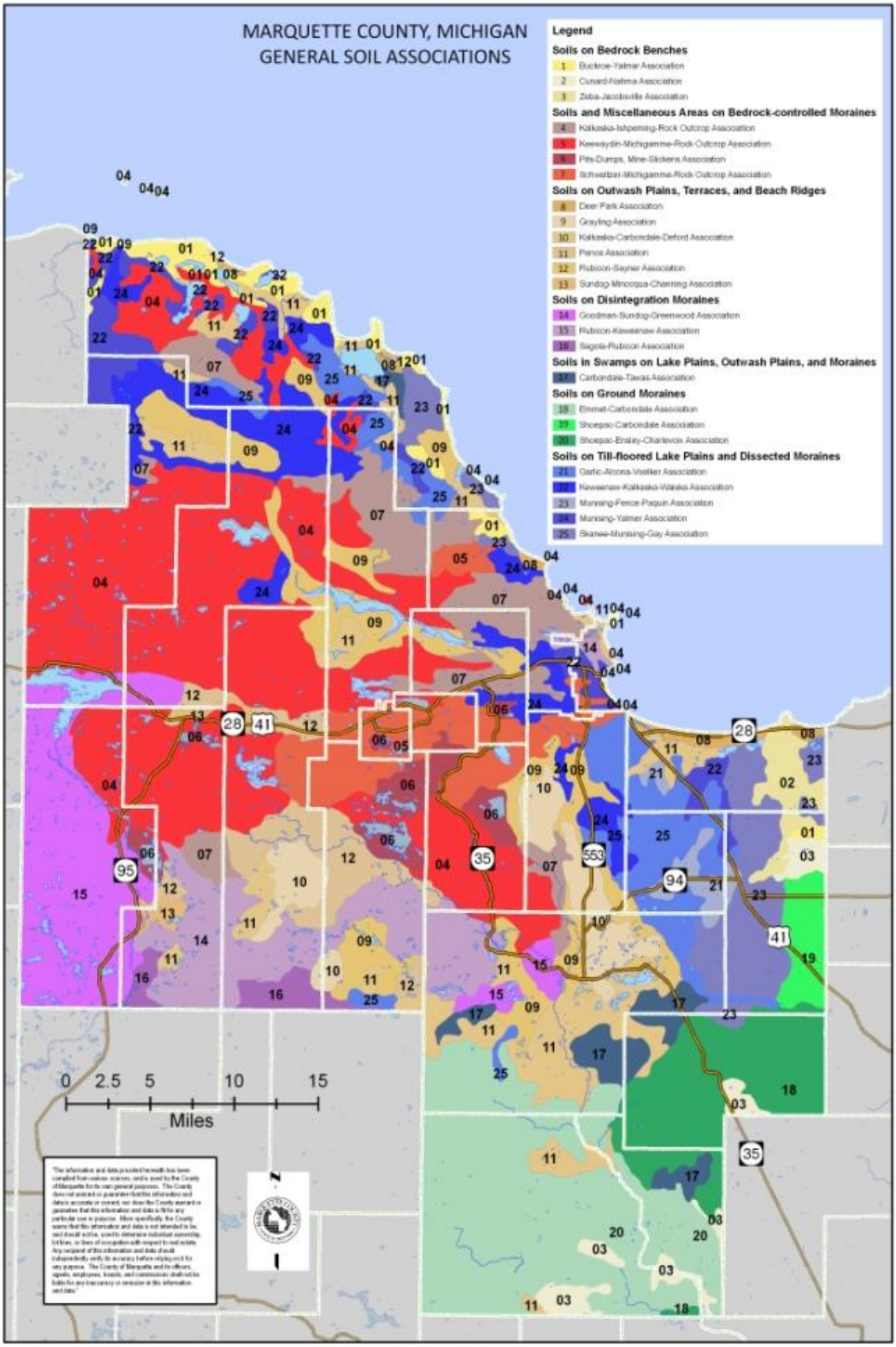


Table 1 lists the 25 general soil associations as defined by the United States Department of Agriculture (USDA) and the Natural Resources Conservation Service (NCRS) in the *Soil Survey of Marquette County,* issued in 2007. The numbers on the General Soils Map, Figure 6 corresponds with the numbers listed in the table.

Table 1 General Soil Associations

Association	Description	Management Concerns	Management Considerations
1. Buckroe-Yalmer Association	Shallow and very deep, nearly level to very steep, excessively drained and moderately well drained, sandy soils; on sandstone benches	Erosion hazard, equipment limitations, seedling mortality, Windthrow hazard, plant competition	• Building roads on the contour, installing water bars and culverts, and seeding logging roads help to prevent excessive soil loss. • Special logging methods, such as yarding with a cable, may be needed in very hilly areas. • Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate. • Such harvest methods as selective cutting can reduce the windthrow hazard. • Site preparation helps to control plant competition.
2. Zeba-Jacobsville Association	Moderately deep, nearly level, somewhat poorly drained and poorly drained, loamy soils; on sandstone benches	Equipment limitations, seedling mortality, windthrow hazard, and plant competition	•Access is easiest during the winter. Year-round logging roads require a gravel base. • Because of wetness, seedling mortality, and plant competition, trees are generally not planted on these soils. • Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard.
3. Cunard-Nahma Association	Moderately deep, nearly level and gently undulating, well drained and poorly drained, loamy soils; on dolomitic benches	Equipment limitations, seedling mortality, windthrow hazard, and plant competition	• The seasonal high water table in areas of the Nahma soils restricts the use of equipment to midsummer or winter. • Because of wetness, seedling mortality, and plant competition, trees are generally not planted on the Nahma soils. • Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard.
4. Keewaydin-Michigamme-Rock Outcrop Association	Rock outcrop and very deep and moderately deep, nearly level to very hilly, well drained soils; on bedrock-controlled moraines	Erosion hazard, equipment limitations, and plant competition	• Building roads on the contour, installing water bars, and seeding logging roads help to prevent excessive soil loss. • Special logging methods, such as yarding with a cable, may be necessary in the very hilly areas. • Selective cutting can reduce the windthrow hazard. • Site preparation helps to control plant competition.
5. Schweitzer-Michigamme-Rock Outcrop Association	Rock outcrop and very deep and moderately deep, gently rolling to very hilly, well drained, loamy soils; on bedrock-controlled moraines	Erosion hazard, equipment limitations, windthrow hazard, and plant competition	• Building roads on the contour, installing water bars, and seeding logging roads help to prevent excessive soil loss. • Special logging methods, such as yarding with a cable, may be necessary in the very hilly areas. • Such harvest methods as selective cutting can reduce the windthrow hazard. • Site preparation helps to control plant competition.

6. Pits-Dumps, Mine-Slickens Association		Onsite investigation is needed to determine the suitability for specific uses.	
7. Kalkaska-Ishpeming-Rock Outcrop Association	Rock outcrop and very deep and moderately deep, gently rolling to very hilly, somewhat excessively drained, sandy soils; on bedrock-controlled moraines	Erosion hazard, equipment limitations, and seedling mortality	• Building roads on the contour, installing water bars, and seeding logging roads help to prevent excessive soil loss. • Special logging methods, such as yarding with a cable, may be necessary in the very hilly areas. • Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate.
8. Deer Park Association	Very deep, nearly level to rolling, excessively drained, sandy soils; on beach ridges and dunes	Equipment limitations and seedling mortality	• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized. • Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate.
9. Rubicon-Sayner Association	Very deep, nearly level to very hilly, excessively drained, sandy soils; on outwash plains and outwash terraces	Erosion hazard, equipment limitations, and seedling mortality	• Building roads on the contour, installing water bars, and seeding logging roads help to prevent excessive soil loss. • Special logging methods, such as yarding with a cable, may be necessary in the very hilly areas. • Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized. • Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate.
10. Grayling Association	Very deep, nearly level to very hilly, excessively drained, sandy soils; on outwash plains	Erosion hazard, equipment limitations, and seedling mortality	• Building roads on the contour, installing water bars, and seeding logging roads help to prevent excessive soil loss. • Special logging methods, such as yarding with a cable, may be necessary in the very hilly areas. • Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized. • Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate.
11. Kalkaska-Carbondale-Deford Association	Very deep, nearly level to very hilly, somewhat excessively drained, very poorly drained, and poorly drained, sandy and mucky soils; on outwash plains and outwash terraces	Erosion hazard, equipment limitations, seedling mortality, windthrow hazard, and plant competition	• Building roads on the contour, installing water bars, and seeding logging roads help to prevent excessive soil loss. • Access is easiest during the winter. Year-round logging roads require a gravel base. Culverts are needed to maintain the natural drainage system. • Because of wetness, seedling mortality, and plant competition, trees are generally not planted on the Carbondale and Deford soils. • Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate in areas of the Kalkaska soils.
12. Pence Association	Very deep, nearly level to very hilly,	Erosion hazard and equipment limitations	• Building roads on the contour, installing water bars, and seeding logging roads help to prevent

	somewhat excessively drained, sandy soils; on outwash plains and outwash terraces		excessive soil loss. • Special care is needed in laying out logging roads and operating logging equipment in the very hilly areas. The grade should be kept as low as possible.
13. Sundog-Minocqua-Channing Association	Very deep, nearly level to very hilly, well drained, poorly drained, and somewhat poorly drained, loamy soils; on outwash plains and outwash terraces	Erosion hazard, equipment limitations, seedling mortality, windthrow hazard, and plant competition	• Building roads on the contour, installing water bars, and seeding logging roads help to prevent excessive soil loss. • The seasonal high water table in areas of the Minocqua and Channing soils restricts the use of equipment to midsummer, when the soils are dry, or midwinter, when there is adequate snow cover. Year-round logging roads require a gravel base. Culverts are needed to maintain the natural drainage system. • Special care is needed in laying out logging roads and operating logging equipment in the very hilly areas of the Sundog soils. The grade should be kept as low as possible. • Because of wetness, seedling mortality, and plant competition, trees are generally not planted on the Minocqua and Channing soils. • Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard in areas of the Minocqua and Channing soils.
14. Rubicon-Keweenaw Association	Very deep, gently undulating to very hilly, excessively drained and well drained, sandy soils; on disintegration moraines	Erosion hazard, equipment limitations, and plant competition	• Building logging roads on the contour, installing water bars and culverts, and seeding logging roads help to prevent excessive soil loss in the very hilly areas. • Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized. • Special care is needed in laying out logging roads and operating logging equipment in the very hilly areas. The grade should be kept as low as possible. • Site preparation helps to control plant competition.
15. Goodman-Sundog-Greenwood Association	Very deep, nearly level to very hilly, well drained, loamy soils and very poorly drained, peaty soils; on disintegration moraines	Erosion hazard, equipment limitations, and plant competition	• Building logging roads on the contour, installing water bars and culverts, and seeding logging roads help to prevent excessive soil loss in the very hilly areas. • Special care is needed in laying out logging roads and operating logging equipment in the very hilly areas. The grade should be kept as low as possible. • Such harvest methods as selective cutting can reduce the seedling mortality rate. • Because of extreme acidity and wetness, the Greenwood soils are generally unsuited to woodland.

16. Sagola-Rubicon Association	Very deep, gently undulating to very hilly, well drained and excessively drained, loamy and sandy soils; on disintegration moraines	Equipment limitations, seedling mortality, and plant competition	• Year-round logging roads should be stabilized. • Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate in areas of the Rubicon soils. • Site preparation helps to control plant competition.
17. Carbondale-Tawas Association	Very deep, nearly level, very poorly drained, mucky soils; in swamps on lake plains, outwash plains, and moraines	Equipment limitations, seedling mortality, windthrow hazard, and plant competition	• Access is easiest in winter, when the soils are frozen or have adequate snow cover. • Because of wetness, seedling mortality, and plant competition, trees are generally not planted on these soils. • Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.
18. Shoepac-Ensley-Charlevoix Association	Very deep, nearly level and gently undulating, moderately well drained, poorly drained, and somewhat poorly drained, loamy soils; on fluted ground moraines	Equipment limitations, seedling mortality, windthrow hazard, and plant competition	• The seasonal high water table restricts the use of equipment to summer, when the soils are dry, or midwinter, when the soils are frozen or have adequate snow cover. • Year-round logging roads require a gravel base. Culverts are needed to maintain the natural drainage system. • Because of wetness and plant competition, trees are generally not planted on the Ensley and Charlevoix soils. • Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.
19. Shoepac-Carbondale Association	Very deep, nearly level and gently undulating, moderately well drained and very poorly drained, loamy and mucky soils; on fluted ground moraines	Equipment limitations, seedling mortality, windthrow hazard, and plant competition	• In areas of the Carbondale soils, access is easiest during the winter, when the soils are frozen or have adequate snow cover. • Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base. Culverts are needed to maintain the natural drainage system. • Because of wetness and plant competition, trees are generally not planted on the Carbondale soils. • Harvest methods that do not leave the remaining trees widely spaced can reduce the windthrow hazard.
20. Emmet-Carbondale Association	Very deep, nearly level to steep, well drained and very poorly drained, loamy and mucky soils; on drumlinized ground moraines	Erosion hazard, equipment limitations, seedling mortality, windthrow hazard, and plant competition	• Building roads on the contour, installing water bars and culverts, and seeding logging roads help to prevent soil loss in steep areas of the Emmet soils. • Special care is needed in laying out logging roads and operating logging equipment in the very hilly areas. The grade should be kept as low as possible. • Year-round logging roads require a gravel base. Culverts are needed to maintain the natural drainage system. • In areas of the Carbondale soils, access is easiest during the winter, when the soils are frozen or have adequate snow cover. • Because of wetness and plant competition, trees are generally not planted on the Carbondale soils.
21. Munising-	Very deep, nearly	Erosion hazard,	• The hazard of erosion can be reduced by seeding

Fence-Paquin Association	level to moderately sloping, moderately well drained, loamy, silty, and sandy soils; on dissected moraines and till-floored lake plains	equipment limitations, windthrow hazard, and plant competition	logging roads, landings, and areas that have been cut and filled and by installing culverts and water bars. Skidders should not be used during periods when ruts form easily. Year-round logging roads require a gravel base. • Selective cutting can reduce the windthrow hazard. • Site preparation helps to control plant competition.
22. Munising-Yalmer Association	Very deep, nearly level to gently sloping, moderately well drained, loamy and sandy soils; on till-floored lake plains	Erosion hazard, equipment limitations, windthrow hazard, and plant competition	• The hazard of erosion can be reduced by seeding logging roads, landings, and areas that have been cut and filled and by installing culverts and water bars. Skidders should not be used during periods when ruts form easily. Year-round logging roads require a gravel base. • Selective cutting can reduce the windthrow hazard. • Site preparation helps to control plant competition.
23. Skanee-Munising-Gay Association	Very deep, nearly level to rolling, somewhat poorly drained, moderately well drained, and poorly drained, loamy soils; on till-floored lake plains and ground moraines	Erosion hazard, equipment limitations, seedling mortality, windthrow hazard, and plant competition	• In areas of the Munising soils, the hazard of erosion can be reduced by seeding logging roads, landings, and areas that have been cut and filled and by installing water bars and culverts. • Access is easiest during the winter, when the soils are frozen or have adequate snow cover. Year-round roads require a gravel base. Culverts are needed to maintain the natural drainage system. • Trees are generally not planted on the Skanee and Gay soils because of wetness and plant competition. • Selective cutting can reduce the windthrow hazard.
24. Keweenaw-Kalkaska-Waiska Association	Very deep, moderately sloping to very steep, well drained, somewhat excessively drained, and excessively drained, sandy soils; on dissected moraines and till-floored lake plains	Erosion hazard, equipment limitations, seedling mortality, and plant competition	• Skid trails and roads should be located in the less sloping areas between ravines. • Seeding logging roads helps to prevent excessive soil loss. • Special logging methods, such as yarding with a cable, may be needed in the very steep areas. • Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate. • Site preparation helps to control plant competition.
25. Garlic-Alcona-Voelker Association	Very deep, moderately sloping to very steep, well drained, sandy and loamy soils; on dissected moraines and till-floored lake plains	Erosion hazard, equipment limitations, seedling mortality, and plant competition	• Skid trails should be located in the less sloping areas between ravines. • Seeding logging roads helps to prevent excessive soil loss. • Special logging methods, such as yarding with a cable, may be needed in the very steep areas. • Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate. • Site preparation helps to control plant competition.

Although local soil erosion is not as serious as it is in many regions of the country, it is becoming an increasingly important developmental problem in Marquette County. Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act (PA 451 of 1994) is directed at preventing excessive erosion of the state's soils. The Act is enforced locally by the Marquette County Building Codes Department.

C. Summary/Planning Implications

(1) Soil data should be used when evaluating land use proposals.

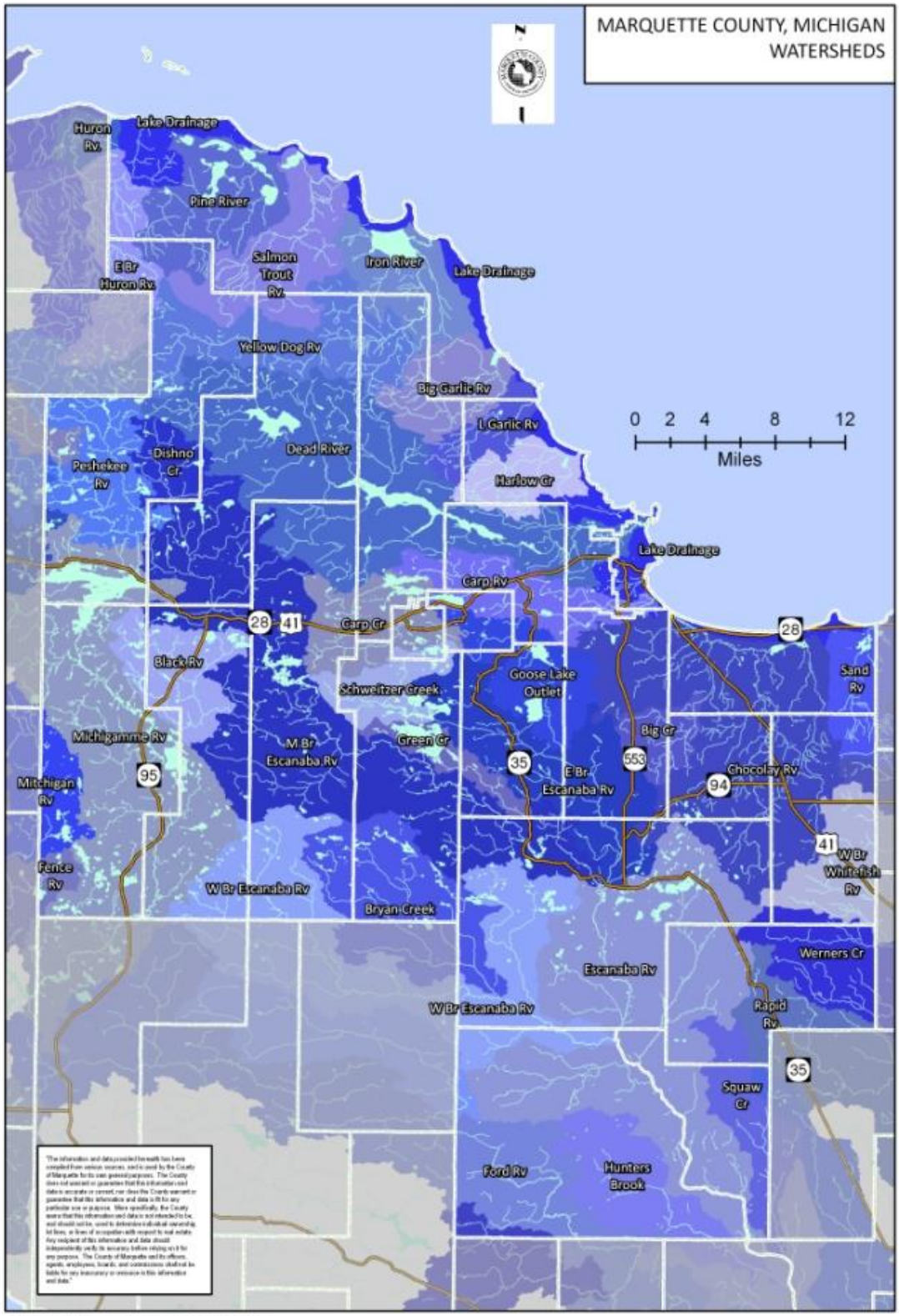
(2) Although agriculture has not played a dominant economic role in the county, it does play the essential role of producing healthy food locally. Potential exists for more farm development, in terms of soil types. Negative factors affecting farming can include land value and competition with residential use. The Farmland and Open Space Preservation Program (PA 116) consists of five methods for approving farmland and open space. Economics and harsh climate continue to be factors affecting further agricultural development.

(3) Concerning erosion, strict enforcement of the Soil Erosion and Sedimentation Control Act will help ensure soil conservation in the county. Stream bank erosion will continue to be a problem on the Chocolay River, as well as others, where there has been substantial residential development. Regulation of development along shorelines and riparian area overlay zones are other ways municipalities can manage waterfront development.

6. SURFACE WATER

One of the most valuable natural resources in Marquette County is the relative abundance of fresh water. Surface water is but one element of the hydrologic cycle. Major drainage basins and surface water features are shown in Figure 7.

Figure 7 Watersheds



c:\data\mqt_county\comp_plan_maps watershed

A. Description

The surface waters of Marquette County face development pressure. This pressure is more apparent along water bodies near urban areas and transportation networks. However, several considerably isolated water bodies also face development pressure. Other than residential lots, some of the main uses of streams, lakes and reservoirs are for recreation, agriculture, fishing, dilution of wastewater, hydro-electric power generation and iron ore processing. Lake Superior naturally represents the major surface water feature in the County. Some of the larger reservoirs include Lake Michigamme (4,212 acres), the Dead River Storage Basin (2,704 acres), and the Silver Lake Basin (1,214 acres at its restored state). The Greenwood Reservoir/Escanaba River (1,400 acres) and Switzer's Reservoir (650 acres) are used by the mining industry as a source of water for iron-ore beneficiation.

In areas of the county underlain by Precambrian bedrock, stream networks are highly developed and there is efficient drainage. These areas exhibit a "flashy" stream behavior, where streams rise quickly after precipitation (and especially snow melt), have high peak flows and subside quickly. The remainder of the county has a poorly developed drainage system containing numerous ponds, lakes and swamps. Stream flows in these areas have a relatively uniform flow behavior, being supplied by groundwater during dry periods and storing water in ground strata and swamps during high flow.

B. Discussion

Of particular concern is the amount of sediment allowed to enter surface water from land adjacent to water features. Transported sediments degrade water quality, destroy natural plant growth, increase nutrient levels, and decrease the carrying capacities of watercourses. The highest sediment yields in the county can be expected from exposed soil materials. Increased recreational use of lakes and streams, more development in general, and poor farming practices can greatly increase sediment yields. Beach erosion, both natural and man-caused, has been an issue along the Lake Superior shore. In Chocolay and Powell Townships and in the City of Marquette, high risk erosion areas have occurred. Naturally occurring long-shore currents along the Lake Superior shoreline continually transport material (sand). The process causes erosion along some areas of the coastline and can infill other areas. This process has implications in that it causes valuable recreational beach loss and necessitates dredging of harbors such as the Big Bay Harbor of Refuge and Marquette City harbors.

Industrial, municipal, and domestic pollution of lakes is not a major problem at this time. However, because of natural limitations, density of dwelling units, and improper septage disposal, some communities have experienced problems with water systems.

Rivers, streams, and creeks have areas adjacent to them that are inundated at times by water overflowing the natural channel. These areas serve as an expansion chamber for excess volume, as well as providing surface area which can absorb surplus stream flow. Flooding may occur every spring or as seldom as at 20-50 year intervals, depending on drainage basin size, capacity of the stream, normal flow, average rain, snowfall, and similar factors. Such flooding presents a hazard to persons or property located in these areas and development in such areas should be carefully regulated. Flood zones have been designated under the guidelines of the National Flood Insurance Program, designed to federally-subsidize flood insurance for homes and businesses in exchange for assurances that local protection measures such as zoning, setbacks, and building codes are in effect. Seven local units of government participate in this program. More information can be found in Chapter Three of the Marquette County Hazard Mitigation Plan.

Wetlands have many definitions but generally are areas of low, level or nearly level, poorly drained soils. For much of the year water is at or near the surface. Water tends to dissipate through evapo-transpiration, rather than by runoff or by entering the ground strata. These areas are often described as marsh, swamp, bog or muck areas. Production of food and cover for wildlife, natural filtration of surface water and surface water storage are some of the functions of these areas.

Michigan's wetland statute, Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended is intended to provide for the preservation, management, protection and use of wetlands. The Act requires permits for altering these areas. In addition, provision is made for identifying the location of wetlands.

Considerable urbanization along U.S. 41 Whetstone and Badger Creek watersheds in the City of Marquette and Marquette Township has resulted in excessive surface runoff which consequently affects low lying areas downstream. The area constitutes the county’s first drainage district established under Act 40 of 1956, the Drain Code.

Several local problems relate to surface water runoff. Beaver populations can block culverts, cause roadway washouts, and alter flowage into tailing basins. Ice damming of peak flows during spring breakup can jeopardize development near the mouths of rivers entering Lake Superior. This has been a problem on the Chocolay River in Chocolay Township.

C. Summary/Planning Implications

Surface water and its role in the future development of Marquette County appear to be important in terms of the following:

(1) Increased development will occur on many inland lakes and streams, as well as on Lake Superior. Measures should be taken to assure mitigation of adverse environmental impacts.

(2) Lake and stream water quality should be monitored to maintain or improve its existing status.

(3) Increased mining activity could place additional demands on existing surface water systems for supply of process water and disposal of tailings. Other instances can enhance surface water supply via., Greenwood Reservoir.

(4) As developmental pressures increase, the issue of Riparian Rights will become more important.

7. SUB SURFACE WATER

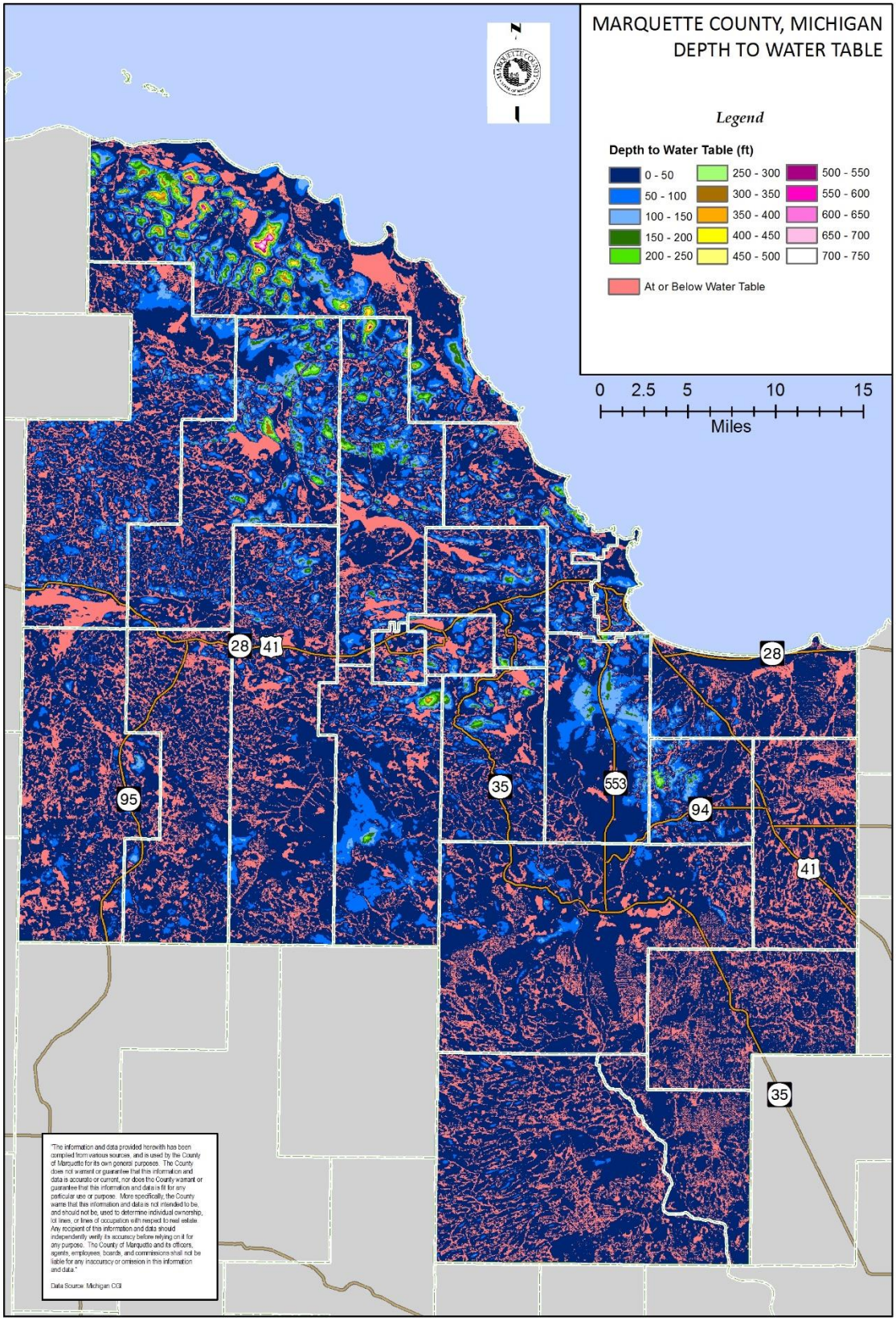
Much of the development in Marquette County, which utilizes groundwater as a source for municipal or industrial use, is located on the Precambrian bedrock formations. Here glacial drift is the main source of sub surface water. Glacial outwash deposits in these areas appear to be the best source of potential groundwater. These deposits are up to 250 feet thick.

A. Description

According to a 1982 publication titled Ground water and geology of Marquette County, Michigan by Doonan and VanAlstine, ground water resources are evenly divided between bedrock aquifers and aquifers in glacial deposits. Most wells in the northern and extreme southern part of the county are completed in bedrock at depths less than 100 feet with yields between 3 and 40 gallons per minute. Deeper wells are found in the central part of the county completed in glacial deposits and yield up to 200 gallons per minute.

The static water table is near ground surface (0-50 feet) in most of the county. However, some areas, such as area outwash or hilly terrain underlain by bedrock, this figure may approach 100 or more feet. See figure 8.

Figure 8 Depth to Water Table



B. Summary/Planning Implications

(1) Groundwater quality is generally good in Marquette County. Obtaining adequate amounts in areas of Precambrian bedrock appears to be a problem should further development occur in these areas.

(2) Possible contamination of groundwater aquifers is potentially a problem in permeable soils or where a high water table is combined with bedrock.

(3) Aquifer water levels and lake levels have declined significantly in Sands Plain and other Marquette County watersheds during the most recent 10 –15 year period.

8. CLIMATE

Climate has a strong influence on all natural and cultural processes. It controls social patterns—recreation, for example—and impacts agriculture as well as other types of land use activities. Energy consumption is tied to climatic conditions. Stream flow and availability of groundwater are also affected.

A. Description

One of the major factors affecting Marquette County's macro-climate is its position in the prevailing westerly wind belt circling the earth above 30° latitude. It is characterized by a procession of high and low atmospheric pressure weather systems. Because of the lack of natural barriers in the central part of the United States, warm, moist Gulf (tropical) air masses from the south mix with cool, dry air masses from the west and bitter cold, artic air masses from the north, giving the region extremely variable weather.

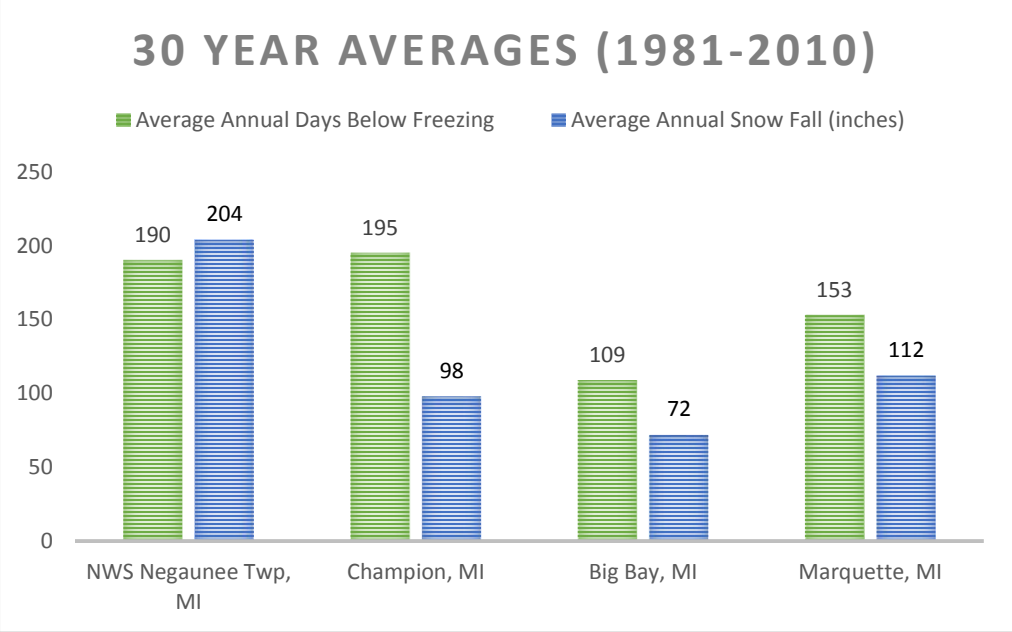
Marquette County has a temperate continental climate of the cool summer type, influenced by its proximity to the Great Lakes, which has a stabilizing effect on temperatures along the coastal areas where winter temperatures range from six to eight degrees Fahrenheit (F) warmer than the interior regions of the county. Conversely, summer temperatures are five-six degrees cooler. The hottest months are July and August, with mean maximum temperatures at 77.0° and 74.9° and mean minimum temperatures of 53.4° and 52.6° F, respectively. A record high temperature of 108°F was recorded in 1901, in Marquette. The coldest temperatures occur in January and February, with mean maximum temperatures of 22.7°F and 27.3°F and minimum means of 5.6°F and 7.7°F, respectively. The record low

Winter 2013-14 Records at NWS Marquette

- Mean temperature December 2013-March 2014 was 9.6°F breaking the previous record of 12.2°F set in 1962-63.
- 75 consecutive days with high temperature at or below 32°F breaking previous record of 72 set in 1978-79
- 65 subzero days breaking previous record of 56 in 1962-63

temperature was recorded in Humboldt, at -49°F in February, 1899. The mean diurnal (daily) temperature (fluctuation) range can vary from as little as 16° near the Lake Superior coast to greater than 24° in the western interior portions of the county.

Figure 9 30 Year Averages



Heating-degree days (HDD) is a unit based upon temperature and time and is used to estimate heating costs. To calculate the heating degree days for a particular day, find the day's average temperature by adding the day's high and low temperatures and dividing by two. If the number is above 65, there are no heating degree days that day. If the number is less than 65, subtract it from 65 to find the number of heating degree days.
For example, if the day's high temperature is 60 and the low is 40, the average temperature is 50 degrees. 65 minus 50 is 15 heating degree days. From 1981-2010, the annual average number of HDD was 9181.

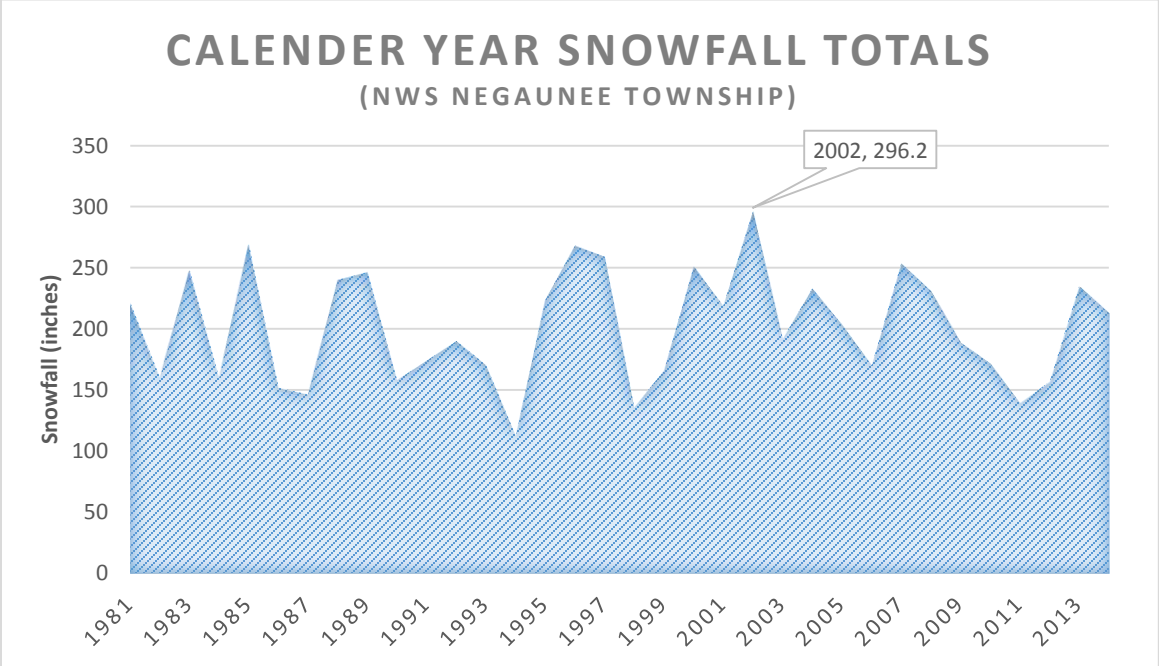
The average first freezing temperatures in autumn occur between August and September, in the interior, and during October near low altitude shoreline areas. The last average date of frost in the spring occurs during June in the interior to mid-May near Lake Superior. The growing season ranges from 60 days inland to as much as 140 days in the shore land areas.

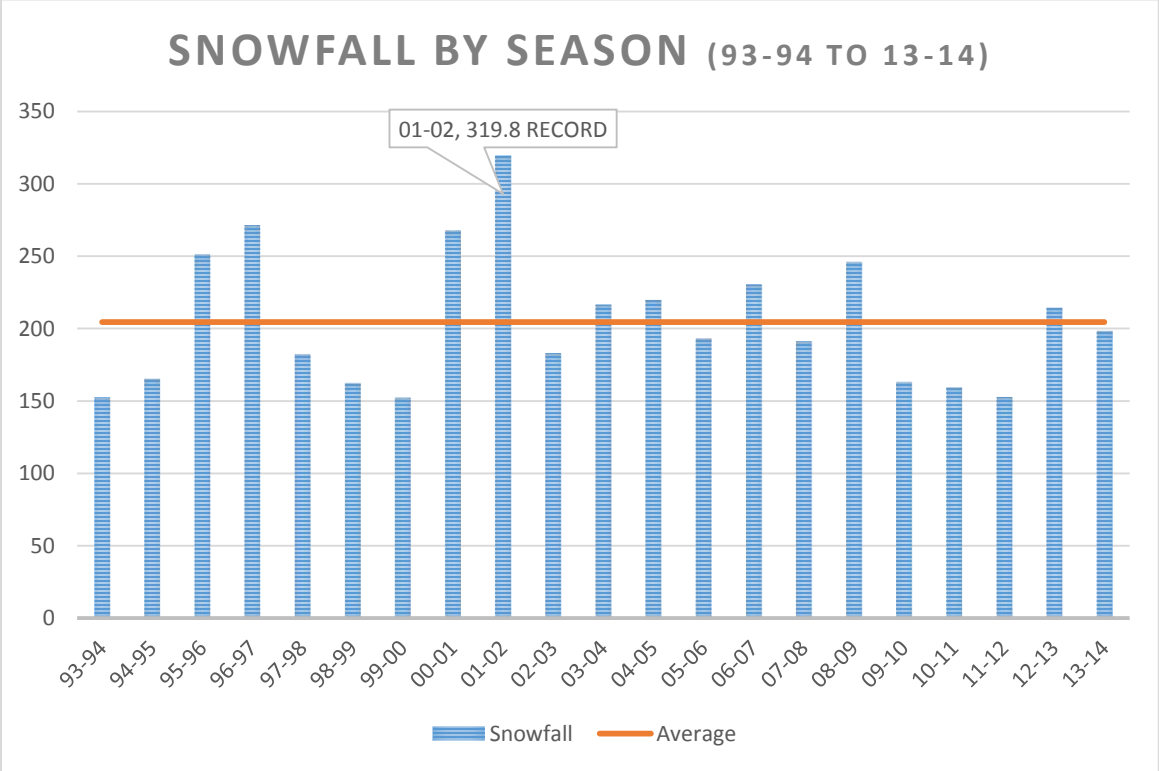
Precipitation is from less than 30 inches to more than 32 inches and is relatively evenly distributed during the year. Summer rainfall is harder (thunderstorms) and of shorter duration than other seasons, making periods without rain during summer seem longer.

Snowfall occurs from September to May. A trace has been recorded in June (two inches on June 2, 1945). Winter winds crossing Lake Superior/Michigan pick up moisture,

causing cloudy weather through much of the winter and upslope winds, heavy with moisture, cool and deposit snow. Highest snowfall amounts are near the highest elevations (northern Michigamme Township). The least snowfall occurs in the southern townships (Wells and Ewing). Occasionally during winter months, polar highs will dip into the area creating extremely cold clear periods of weather.

Figure 10 Snowfall Totals





B. Summary/Planning Implications

(1) Past records show years of precipitation greater than 40 inches can cause extensive flooding, while less than (say) 25 inches of precipitation have created widespread drought.

(2) Weather and climate have several impacts on highway transportation, resulting in seasonal weight restrictions and general access problems. Winter snow-plowing funds for county plows are allocated partially on the basis of snowfall records.

(3) Frost penetration has implications for construction of roads, as well as buildings and public utilities, and should be reflected in local codes and ordinances.

(4) Heating-degree days, as well as other climatic data, are important in general energy planning, as well as in the siting of new construction. These factors should be taken into account when considering new projects.

9. AIR QUALITY

Six Criteria Air Pollutants
Carbon Monoxide
Lead
Nitrogen Dioxide
Ozone
Particle Pollution
Sulfur Dioxide

The Clean Air Act (CAA) is the comprehensive federal law that regulates air emissions from stationary and mobile sources. Among other things, this law authorizes EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate emissions of hazardous air pollutants. Marquette County is part of the US EPA Region 5. The Air and Radiation Division is responsible for helping to achieve and maintain clean and breathable air. The state is responsible for developing plans and implementing programs to meet and maintain the National Ambient Air Quality Standards (NAAQS).

A. Description

There is very limited data on air quality in the Upper Peninsula. The nearest government operated air monitoring station is located in the Seney National Wildlife Refuge. This station monitors ozone, deposition, visibility, organics, and particulates. The Superior Watershed Partnership coordinates and implements independent air monitoring related to operations at the Eagle Mine in Northern Marquette County. If NAAQS Standards are met, an area is considered in attainment. The entire state of Michigan is currently designated "attainment" with the exception of an area in Wayne County for sulfur dioxide and a small area in Ionia County for lead.

B. Summary/Planning Implications

(1) Future development, particularly commercial or industrial activities, could result in new point-source air pollution. State agencies should give careful consideration in permitting these activities, as they can have broad impacts on communities. Wood burning for home heating may create a pollution problem and is noticeable in some areas of the county. Local units of government should be encouraged to adopt wood burning regulations.

10. VEGETATION

The vegetation patterns that originally occupied Marquette County before 1840 have been altered considerably. Large stands of hardwood were harvested during the late 1800's for use in blast furnaces for making pig iron. Pure strands of pine and other species were cut to provide building materials and supports for underground mining. Both man-caused and wildfire followed extensive timber cutting and this drastically altered soil conditions which resulted in a change in the capability of many sites to produce the same species.

A. Description

The major plant group which occupies Marquette County is of course trees, which cover over 90% of the county. Other vegetative cover consists of shrubs, mainly on river bottoms, floodplains and unfertile sand plains; and grass and sedges on open meadows and bogs. Specific information regarding trees species is given in Appendix Table B-10. There are several major associations or groupings of trees which naturally occur locally. These include: the Northern Hardwoods (Sugar Maple, Hemlock, Yellow Birch), Lowland Hardwoods (Red Maple), Upland (Aspen Birch, Spruce-Fir), and Mixed Swamp Conifers (Black Spruce, Tamarack, Cedar) associations. Pure stands of Jack Pine occur on sandy outwash plains and Cedar in swampy areas.

The Michigan Natural Features Inventory (MNFI) lists several plant as either endangered, threatened, or of special concern. Table 2 lists plant species historically or presently located in Marquette County. Endangered species (E) are believed to be near extinction, while threatened species (T) have a likelihood of becoming endangered. The table also lists species of special concern (SC).

Table 2 Plants Species: Endangered, Threatened, Special Concern

Scientific Name	Common Name	State Status	Taxonomic Group	Source
Adlumia fungosa	Climbing fumitory	SC	Flowering Plants	MNFI
Allium schoenoprasum	Chives	T	Flowering Plants	MNFI
Amerorchis rotundifolia	Small round-leaved orchis	E	Flowering Plants	MNFI
Armoracia lacustris	Lake cress	T	Flowering Plants	MNFI
Asplenium trichomanes-	Green spleenwort	SC	Ferns and Fern Allies	MNFI

ramosum				
Botrychium pallidum	pale moonwort	SC	Ferns and Fern Allies	MNFI
Calamagrostis lacustris	Northern reedgrass	T	Flowering Plants	MNFI
Calypso bulbosa	Calypso or fairy-slipper	T	Flowering Plants	MNFI
Carex atratiformis	Sedge	T	Flowering Plants	MNFI
Clematis occidentalis	Purple clematis	SC	Flowering Plants	MNFI
Collinsia parviflora	Small blue-eyed Mary	T	Flowering Plants	MNFI
Crataegus douglasii	Douglas's hawthorn	SC	Flowering Plants	MNFI
Cypripedium arietinum	Ram's head lady's-slipper	SC	Flowering Plants	MNFI
Cystopteris laurentiana	Laurentian fragile fern	SC	Ferns and Fern Allies	MNFI
Danthonia intermedia	Wild oat grass	SC	Flowering Plants	MNFI
Draba arabisans	Rock whitlow grass	SC	Flowering Plants	MNFI
Drosera anglica	English sundew	SC	Flowering Plants	MNFI
Dryopteris filix-mas	Male fern	SC	Fern and Fern Allies	MNFI
Dryopteris fragrans	Fragrant cliff woodfern	SC	Fern and Fern Allies	MNFI
Elymus glaucus	Blue wild-rye	SC	Flowering Plants	MNFI
Gentiana linearis	Narrow-leaved gentian	T	Flowering Plants	MNFI
Gymnocarpium jessoense	Northern oak fern	E	Fern and Fern Allies	MNFI
Gymnocarpium robertianum	Limestone oak fern	T	Fern and Fern Allies	MNFI
Huperzia selago	Fir clubmoss	SC	Fern and Fern Allies	MNFI
Juncus stygius	Moor rush	T	Flowering Plants	MNFI
Leymus mollis	American dune wild-rye	SC	Flowering Plants	MNFI
Moehringia macrophylla	Big-leaf sandwort	T	Flowering Plants	MNFI
Myriophyllum alterniflorum	Alternate-leaved water-milfoil	SC	Flowering Plants	MNFI
Myriophyllum farwellii	Farwell's water milfoil	T	Flowering Plants	MNFI
Nuphar pumila	Small yellow pond lily	E	Flowering Plants	MNFI
Opuntia fragilis	Fragile prickly pear	E	Flowering Plants	MNFI
Oryzopsis canadensis	Canada rice grass	T	Flowering Plants	MNFI
Pinguicula vulgaris	Butterwort	SC	Flowering Plants	MNFI
Pterospora andromedea	Pine-drops	T	Flowering Plants	MNFI
Ribes oxyacanthoides	Northern gooseberry	SC	Flowering Plants	MNFI
Rubus acaulis	Dwarf raspberry	E	Flowering Plants	MNFI
Rumex occidentalis	Western dock	E	Flowering Plants	MNFI
Sagina nodosa	Pearlwort	T	Flowering Plants	MNFI
Salix pellita	Satiny willow	SC	Flowering Plants	MNFI
Scirpus clintonii	Clinton's bulrush	SC	Flowering Plants	MNFI
Tanacetum huronense	Lake Huron tansy	T	Flowering Plants	MNFI
Trisetum spicatum	Downy oat-grass	SC	Flowering Plants	MNFI
Vaccinium cespitosum	Dwarf bilberry	T	Flowering Plants	MNFI
Viola novae-angliae	New England violet	T	Flowering Plants	MNFI
Woodsia alpina	Northern woodsia	E	Fern and Fern Allies	MNFI
Woodsia obtusa	Blunt-lobed woodsia	T	Fern and Fern Allies	MNFI

B. Discussion

Marquette County owns large blocks of land in Sands and Forsyth Townships which are well-suited for Jack Pine production. These lands comprise the County Forest and is managed for timber production. Refer to the Marquette County Forestry Management Plan for more information regarding the County forest lands.

State forested lands as well as private property enrolled in the Commercial Forest Act program, are also managed for timber production in Marquette County.

11. WILDLIFE

A. Discussion

Original forest conditions were dramatically altered with the advent of logging at the turn of the century. Wildfires were probably never uncommon, but because of the mosaic-like distribution of vegetative cover and soil conditions, they were never very extensive. Large-scale clear cutting destroyed this natural pattern of firebreaks and allowed numerous larger fires to sweep across the peninsula between 1920 and 1927. Some animal species of the deep, unbroken forests, like Fisher, Pine Marten and Cougar disappeared nearly completely. Other species, such as the Coyote, flourished with the extension of habitation and settlement. Other animals, such as the Wolf and Lynx, were able to retreat to inaccessible habitats, where a few remnant populations exist today. Some animals, such as the Beaver, Otter, Mink, Muskrat, and Black Bear were depleted by trapping. Elk is an extirpated species and are not generally compatible with human activity. New species adapted in the new habitat and flourished. These included the White-tailed Deer, Ruffed Grouse, Sharp-Tailed Grouse, and Snowshoe Hare, which favored unbroken openings.

During the 1930's, efforts were made to re-forest large areas of the Upper Peninsula. The resulting maturing forests are changing wildlife habitat and will alter species composition again.

Table 3 lists animal species historically or presently located in Marquette County. Data was collected from the Michigan Natural Features Inventory, the United State Fish and Wildlife Service, and the US EPA Endangered Species Program. Endangered species (E) are believed to be near extinction, while threatened species (T) have a likelihood of becoming endangered. The table also lists species of special concern (SC). The Kirtland's warbler and the American burying beetle are listed endangered (LE) under federal status. The State lists the American burying beetle's status with an (X) which means presumed extirpated (legally 'threatened' if rediscovered).

Table 3 Animal Species: Endangered, Threatened, Special Concern

Scientific Name	Common Name	Status	Taxonomic Group	Source
Accipiter gentilis	Northern goshawk	SC	Birds	MNFI
Boloria frigga	Frigga fritillary	SC	Insects	MNFI
Botaurus lentiginosus	American bittern	SC	Birds	MNFI
Buteo lineatus	Red-shouldered hawk	T	Birds	MNFI
Cincinnatia cincinnatiensis	Campeloma spire snail	SC	Snails	MNFI
Coregonus artedi	Lake herring or Cisco	T	Fish	MNFI
Coregonus hubbsi	Ives lake cisco	T	Fish	MNFI
Coregonus kiyi	Kiyi	SC	Fish	MNFI
Coregonus zenithicus	Shortjaw cisco	T	Fish	MNFI
Cottus ricei	Spoonhead sculpin	SC	Fish	MNFI
Dendroica kirtlandii	Kirtland's warbler	E	Birds	MNFI, USFWS
Emydoidea blandingii	Blanding's turtle	SC	Reptiles	MNFI
Erebia discoidalis	Red-disked alpine	SC	Insects	MNFI
Falcipennis canadensis	Spruce grouse	SC	Birds	MNFI
Falco peregrinus	Peregrine falcon	E	Birds	MNFI
Gavia immer	Common loon	T	Birds	MNFI
Glyptemys insculpta	Wood turtle	SC	Reptiles	MNFI
Haliaeetus leucocephalus	Bald eagle	SC3	Birds	MNFI
Lycaeides idas nabokovi	Northern blue	T	Insects	MNFI
Nicrophorus americanus	American burying beetle	X	Insects	MNFI
Pandion haliaetus	Osprey	SC	Birds	MNFI
Planorbella multivolvis	Acorn ramshorn	E	Snails	MNFI
Rallus elegans	King rail	E	Birds	MNFI
Sphaerium fabale	River fingernail clam	SC	Fingernail and Pea Clams	MNFI
Canis lupus	Gray Wolf	E4	Mammal	UP EPA, USFWS
Lynx canadensis	Canada Lynx	T	Mammal	USFWS
Calidris canutus rufa	Rufa Red knot	T	Bird	USFWS
Myotic septentrionalis	Northern long-eared bat	T	Mammal	USFWS

B. Summary/Planning Implications

(1) Measures should be taken to protect valuable fish and wildlife habitats, such as spawning areas, deeryards, or those of endangered species.

[3] Bald eagles are no longer protected under the federal Endangered Species Act and Section 7 consultation with the U.S. Fish and Wildlife Service is no longer necessary. However, the bald eagle remains protected under the Bald and Golden Eagle Protection Act.

[4] Due to a Federal court decision, gray wolves in the western Great Lakes area (including Michigan, Minnesota, and Wisconsin) were relisted under the Endangered Species Act, effective December 19, 2014.

(2) Fish populations will be affected by water quality, especially early eutrophication (environmental aging) of lakes and streams near development.

(3) Future land use policies should be coordinated with appropriate wildlife experts and interests.

12. SUMMARY

The components of this Chapter can be used to determine lands suited for development. The growth strategy for Marquette County must take into consideration natural resource characteristics to ensure a good environmental quality and to minimize public and private development costs. Furthermore, each of the elements of this Chapter suggests developmental determinants which can be used to prepare goals and policies to attain these ends. Through zoning regulations, local units of government can influence where development occurs in their jurisdiction.