7.17 Issues and Opportunities continued

- Humboldt Township currently levies a millage of 3 mils for road improvements.
- All of the roads in Humboldt Township that have been rated using the PAvement Surface Evaluation Rating (PASER) system are considered to be in fair or poor condition. The estimated cost to fix these roads is approximately $8.5 million.
- The widening and reconstruction of County Road 601 has improved traffic safety and allowed year-round access. Additional improvements to M-95 has safely accommodated the increase in commercial traffic between the Eagle Mine and Humboldt Mill.
- Humboldt Township will continue to review PASER ratings and consider a "Mix of Fixes" asset management approach to road improvements. The Board should consider developing a 5-year project priority list and update it annually.
- Humboldt Township has adopted Zoning Ordinance regulations for private roads and those requirements should be utilized to address all proposed private roads within the Township.
- Rail service upgrades included rail reinstatement initiating at the Humboldt Mill, crossing US-41, then east to the switch north of Koski's Korner (north of US-41). There may be a need for an additional rail siding along the former Mesabi industrially zoned property on County Road FN.
- Humboldt Township acquired the Humboldt Mill Grade to benefit economic development within the Township and western Marquette County.
- Humboldt Township has a partial ownership interest in the railroad spur to Eagle Mine's Humboldt Mill. In the event that the Mill closes in about five (5) years, it is not clear what will become of the Township's interest in the railroad spur.
- Humboldt and Republic Townships have entered into a preliminary agreement regarding the potential reactivation of the railroad line between Humboldt and Republic.
- In the event that significant additional and economically accessible ore body(ies) are discovered in the region near Humboldt Township (e.g. Sidnaw & Covington area), the Township might find it in their interests to take additional ownership interest in other railroad assets to facilitate ore shipment(s). This rail connection might be made in the same direction via Channing as the Republic connection mentioned above.
- Air service is available at Sawyer International Airport.

7.17 Issues and Opportunities continued

- Air service is available at Sawyer International Airport.
- There are several existing Multi-Use Trails currently traversing Humboldt Township.
- The Humboldt Township Board supported the development of County Road 595 in accordance with the resolutions adopted to protect established residential districts along any proposed routes. This project was also intended to enhance the public safety by rerouting truck traffic away from existing residential areas and the project was intended to promote a critical link to the future industrial development of the Township.
- The Humboldt Township "Road Improvement and Prioritization Plan" (5/22/17) is incorporated into this Master Plan by reference. Recommendations are included.
- Given the Township's plans and investments in local roads in recent years, it may be timely for the Township to think more broadly about what steps it wants to take next.

CHAPTER 8.0-NATURAL FEATURES

8.1 Introduction

A direct relationship exists between an area's natural features and the development that occurs in that area. Often, communities are established, or grow and shrink based on one or more natural features and resources. In the case of the Humboldt Township and neighboring communities, the presence of iron ore was critical to the development of the region. Mining and logging were mainstays of the early local economy in Humboldt Township and throughout Marquette County. These natural features are often interrelated and disturbance in one area has the potential to affect other areas. An understanding of these relationships is important for effective planning. More recently nickel and copper were discovered in the region.

8.2 Geology and Bedrock Geology

Bedrock is the solid material that forms the earth's crust. Bedrock geology consists of solid rock formations found below the soil formed during the early periods of the earth's development that form the earth's crust. These formations have undergone extensive folding, uplifting, eroding and weathering during the millions of years that have since passed and are now overlain by surface geology and soil.

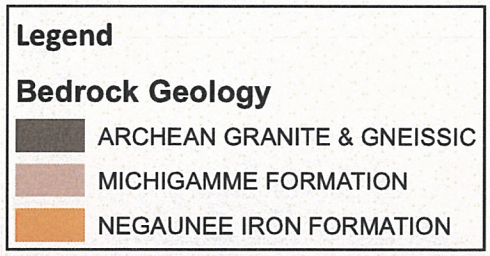
Data from the Michigan Department of Environmental Quality (MDEQ) - Geologic Survey Division, 1987 illustrates two groups of rock in Humboldt Township; Precambrian and Paleozoic. Much of the bedrock of Humboldt Township is buried beneath glacial drifts, but data from outcrop observations, drilling and mining records exists to illustrate subsurface bedrock. Precambrian rocks are the oldest rocks, generally more than 600 million years old and are part of the Laurentian Shield. The Laurentian Shield is a mass of bedrock covering much of Canada and dipping into the United States and cuts diagonally across Marquette County. Paleozoic bedrock is the youngest bedrock in the area, at 425-600 million years old.

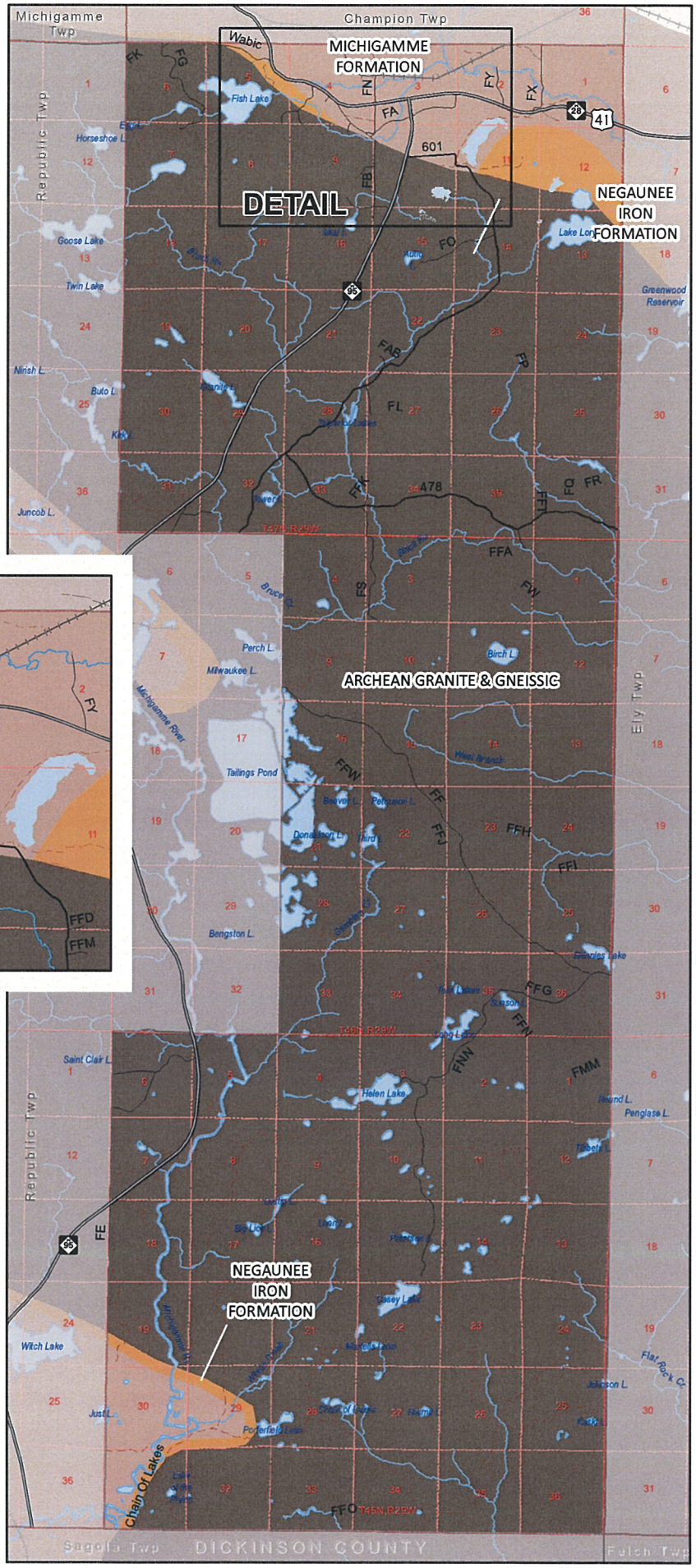
Among the primary factors that make geology important to a community's development is the ability to supply groundwater. The quality and quantity of groundwater are influenced by the types of bedrock in which it is found and also influenced by the layers through which the water passes before it is extracted. Certain types of bedrock increase the potential for groundwater contamination, particularly when the bedrock is close to the surface. When bedrock is close to the surface, the opportunity to filter out contaminants is diminished. This situation increases the potential for polluted runoff to enter the groundwater table. Bedrock at or near the surface also increases construction costs. Buildings must be constructed without basements and in some cases, blasting is required for utility and street construction or even for building site preparation. Bedrock in Marquette County has also provided substantial mineral deposits, as observed in Humboldt, Republic, Richmond, Tilden and Michigamme Townships.

8.2 Geology and Bedrock Geology continued

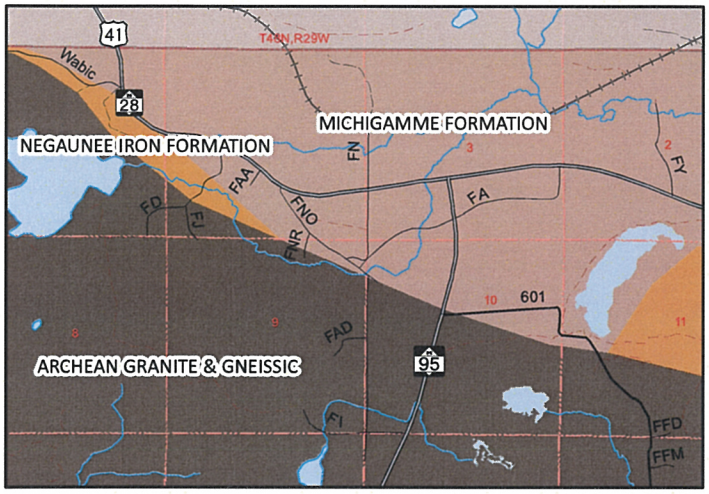
The Negaunee Iron Formation, Archean Granite and Gneissic and the Michigamme Formation are all types of Precambrian bedrock. As shown on Map 8-1, Bedrock Geology Map, the vast majority of Humboldt Township's Bedrock Geology consists of the Archean Granite and Gneissic group. The hard crystalline Precambrian rock is a poor aquifer. Paleozoic rocks are generally better producers of ground water; there are no Paleozoic rock formations underlying Humboldt Township. These ancient igneous and metamorphic rocks contain granite, gneiss and iron ore. In upland areas, many wells will fail to obtain enough potable water for domestic purposes.

Map 8-1 Bedrock Geology





DETAIL

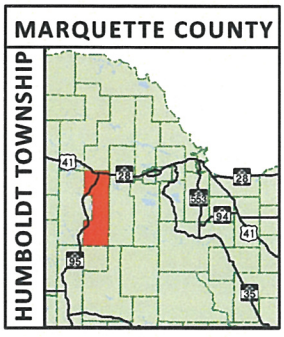


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MP Bedrock Geology Map 5.18.12

CHAPTER 8.0-NATURAL FEATURES

8.3 Surface Geology

Surface geology is an important factor in terms of the ability to filter contaminants, the ability of the soil to support structures, roads, etc. and the suitability of a site for various uses. Immense masses of ice passed through the region, removing soft surface materials. Melting glaciers left materials behind. The glacial deposits occurred in one of three ways: materials (till) deposited directly by glaciers, with little or no further movement as a result of surface water; materials deposited by moving streams, or outwash; and materials deposited by glacial lakes, known as lake deposits. End or recessional moraines are a type of till, deposited at the edge of a glacier, or left as the glacier melts and recedes.

Areas of till/bedrock may lead to issues associated with development including shallow depth to bedrock, poor groundwater source and inadequacy for septic systems. Areas where rock outcrops are present from thin glacial drift have been accessible for mineral exploration and have made extraction economical. Communities, such as Humboldt, have developed in many such areas. Surface 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 (Source: Marquette County Comprehensive Plan).

Map 8-2, Surface Geology Map, displays the types of Surface Geology within Humboldt Township using data from the Michigan Natural Features Inventory and Michigan Department of Natural Resources, 1998. By categorizing the deposits into general classes, certain assumptions about the material can be made. Humboldt Township's surface geology is identified as coarse textured glacial till, medium textured glacial till, glacial outwash sand and gravel and postglacial alluvium as well as thin to discontinuous glacial till over bedrock.

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-sixty 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.

CHAPTER 8.0-NATURAL FEATURES

8.3 Surface Geology continued

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. Rough knobby areas, where rock outcrops form thin glacial drift, have been accessible for mineral exploration and have made extraction economical.

End Moraines of Coarse-textured Till and End Moraines of Medium-textured Till

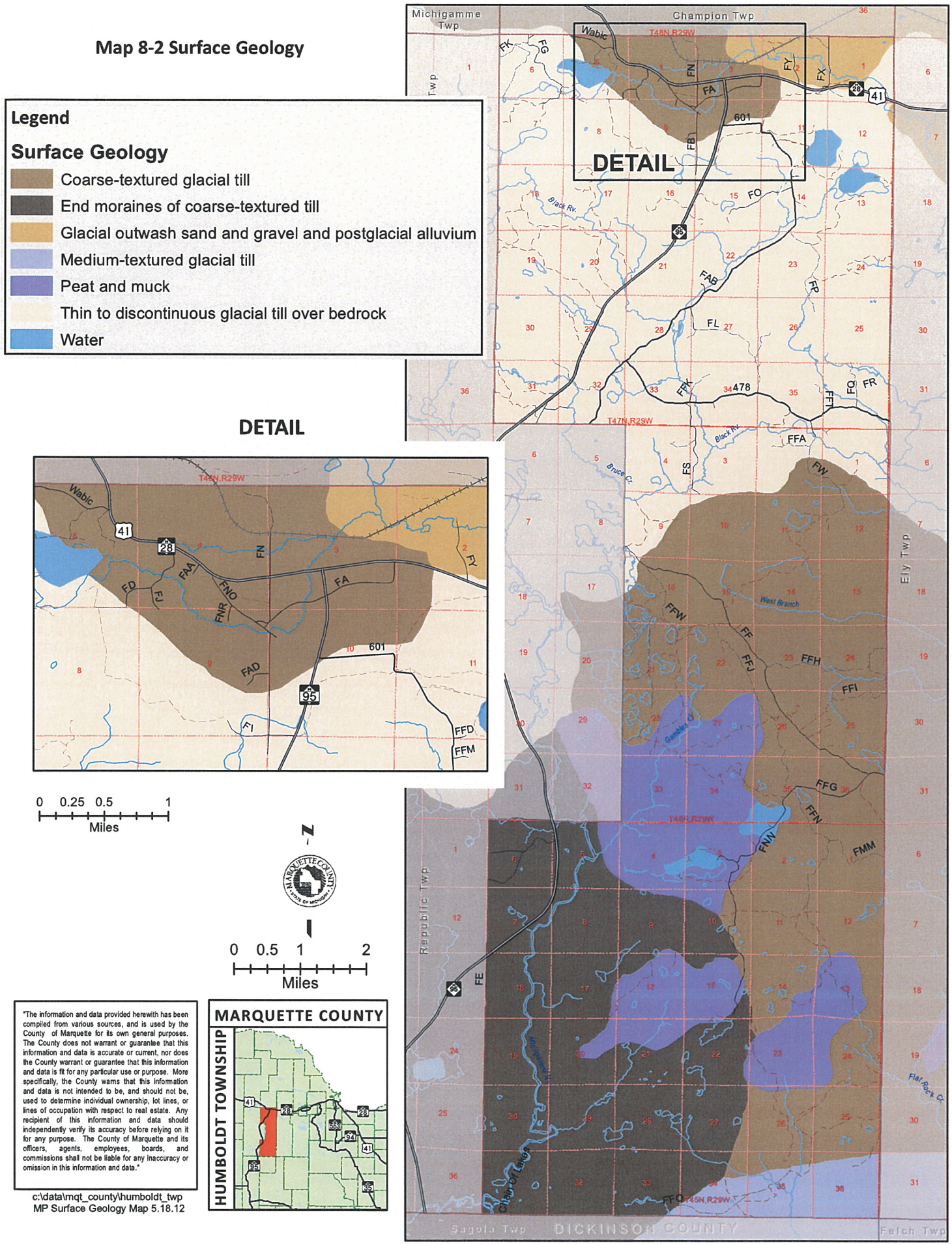
The majority of moraines in Humboldt Township are end moraines from the Wisconsin Period. As glaciers receded, a series of hills were left behind. These hills formed when the melting rate equaled the forward advance rate, creating a "conveyor belt" effect. There are several types of moraines. Lateral 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.

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.

Surface 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. (Source: Marquette County Comprehensive Plan).

Map 8-2 Surface Geology



CHAPTER 8.0-NATURAL FEATURES

8.4 Soils

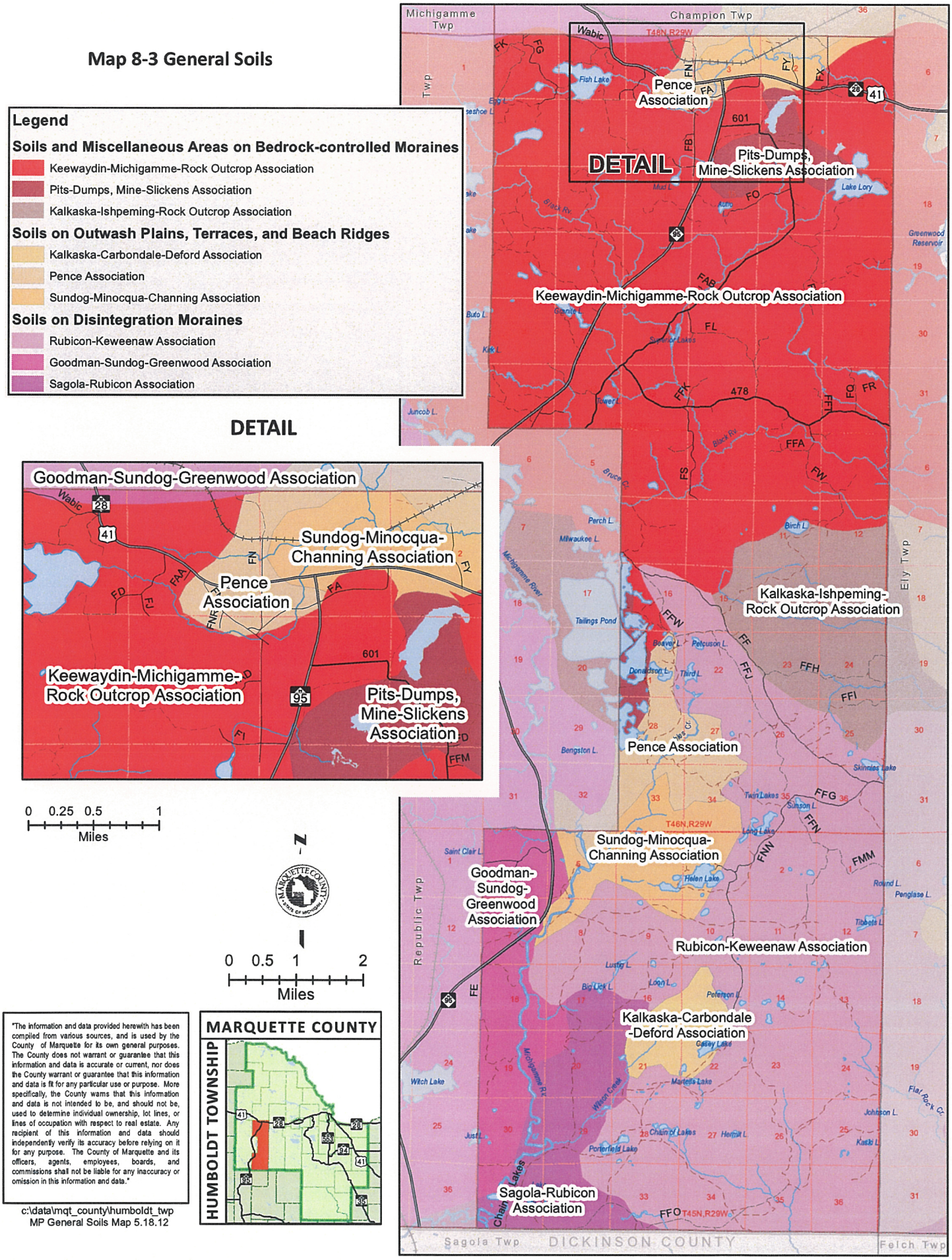
A firm understanding and knowledge of the soil types, soil suitability and soil permeability within Humboldt Township is useful when considering future land use development. For example, some soil types limit infiltration of fluids, presenting limitations to the use of on-site wastewater treatment systems. These limitations can be very important to developers given that Humboldt Township relies upon on-site wastewater treatment systems. Soil is the surface layer of the land that was formed through the interaction of many factors. Physical, chemical and mineral composition of the parent material combined with climate, plant and animal life on and in the soil are major factors. Other factors include time and relief, or lay of the land.

Parent materials in Humboldt Township are the result of glacial deposition or outwash from meltwater. Glaciers moving over bedrock material, whose massive pressure and slow movement turn the solid rock into extremely fine-ground material. The different types of soil created from the contractions of these glacial sheets were deposited throughout the area and scattered patterns of soil types are displayed throughout Humboldt Township.

Soils are grouped into associations based on common characteristics such as drainage, slope, and texture. The soils in these associations respond similarly to the various uses to which they may be subjected. Development should be planned in such a way as to take into account the suitability of the soils in the project area. Residential subdivisions should avoid areas of shallow and/or poorly drained soils or areas where the water table is close to the surface, since such soils are unsuitable for septic drain fields and are problematic for roads. Limitations can sometimes be overcome by careful applications of technology. Technological tampering with natural features should be done carefully and immediate and long-range consequences need to be considered and steps taken to minimize negative results. A study and analysis of soils in Humboldt Township is one of the first steps in locating suitable areas for development.

Soil Types found within Humboldt Township are identified in Map 8-3, General Soils Map, and defined in Table 8-1, General Soil Associations, Humboldt Township, by the United States Department of Agriculture (USDA) and the Natural Resources Conservation Service (NCRS) in the *Soil Survey of Marquette County (2007)*. A Soil Association is made up of one or more soil types, having similar characteristics. By relating the characteristics of each type with its proportion of the association, an interpretation is made of the soil suitability for various uses. Development limitations, including slopes greater than 10 percent and hydric soils in Humboldt Township are identified in Map 8-4, Critical Soils and Slopes Map. Slopes greater than 10 percent are mainly located in the northern third of Humboldt Township, near the Humboldt Mill site and hydric soils are scattered throughout Humboldt Township. Hydric soils are soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to have anaerobic conditions in the upper part and may restrict development.

Map 8-3 General Soils



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MP General Soils Map 5.18.12