Chapter 2: Physical Environment

Overview

The greatest attraction for the residents and visitors to northeast Lower Michigan is the area's environment and generally rural nature. Recreational activities such as hunting, fishing, golfing, snowmobiling, boating and a multitude of other outdoor activities attract people from Michigan's urban areas to the south, as well as from many other states. Often, long time visitors decide to move to the area upon retirement. Because of the abundant outdoor recreation opportunities, the natural environment is a major economic base and income generator.

At the same time, the environment places constraints upon human activities. Certain critical and sensitive parts of the natural landscape cannot be altered without creating problems that are not easily corrected. Increased flooding and soil erosion due to the indiscriminate filling of wetlands and clearing of land are but two examples. Therefore, it is essential that any future development respect the different characteristics of the natural environment. This is important in preserving the attractiveness of this part of the State, preventing potential hazards related to undue alteration of the land, and maximizing the economic benefits of the tourist and recreation industry.

Climate

Cheboygan County's climate is directly affected by the Great Lakes and inland lakes of Michigan. The effect of Lake Huron on Cheboygan's climate is particularly strong during periods of easterly to northeasterly winds. Under these conditions, the long trajectory of the air over Lake Huron gives Cheboygan cooler summer temperatures while increased snow shower activity may accompany the milder fall and early winter temperatures. As a result of the prevailing westerly winds, Cheboygan does experience some additional lake effect; however, this is minimal and essentially limited to increased cloudiness during the late fall and early winter. With light southwesterly winds, a localized lake breeze may be nearly as effective in giving Cheboygan cooler summer temperatures. Differences in temperature and precipitation exist between the northern and southern portions of the county. This is generally attributed to the moderating influence of the lakes in the northern portion of the county. The local weather conditions in the southern portion are similar to those in the Vanderbilt and Gaylord areas.

The average temperature in the summer months as recorded by the Cheboygan weather station is 65 degrees Fahrenheit, while the winter average is 19 degrees (**Table 2-1**). From 1971 to 2000, the maximum annual average temperature for Cheboygan County was 52 degrees and the minimum was 33 degrees. Historical temperature data illustrates the following county temperature extremes:

- Highest recorded temperature: 104 degrees (8/6/47)
- Lowest recorded temperature: 38 degrees below zero (2/6/95)

In the late winter as ice builds up on the lakes, Cheboygan is subjected to temperature variations which are more closely associated with interior locations. Diminished wind speeds or winds that do not traverse large unfrozen lakes often produce clearing skies and the colder temperatures expected at continental locations. Because movement of pressure systems controls day-to-day weather across the nation, this area seldom experiences prolonged periods of hot, humid weather in the summer or extreme cold during the winter.

Precipitation was well distributed throughout the year with the crop season, April-September, receiving an average of 17.35 inches or 62% of the average annual total for the 1951-80 period. During this same period the average wettest month was September with 3.80 inches, while the average driest month was February with 1.20 inches. Precipitation extremes, based on the time period of this station's published record, are as follows:

- Greatest published 24-hour total: 6.34 inches (recorded July 7-8, 1890)

- Greatest monthly total: 9.41 inches (recorded September 1970)
- Least monthly total 0.10inches (recorded March 1968 and 1 earlier date)

Soil moisture replenishment during the fall and winter months plays an important role in the success of agriculture for this area. While drought occurs periodically, the Palmer Drought Index indicated drought conditions reached extreme severity only 3% of the time.

Table 2-1
Temperature and Precipitation Summary 1971-2000

	Temperature Averages			Precipitation Averages	
Period	Max	Min	Mean	Precip	Snow
January	26.3	8.2	17.3	1.75	26.2
February	28.3	7.6	18.0	1.2	15.9
March	36.6	16.7	26.7	1.86	12.4
April	48.7	29.5	39.1	2.48	3.5
May	62.1	40.4	51.3	2.6	0.1
June	71.5	50.7	61.1	2.58	0.0
July	77.4	57.1	67.3	3.14	0.0
August	75.5	55.6	65.6	3.03	0.0
September	67.6	48.0	57.8	3.61	0.0
October	55.8	37.1	46.5	2.87	0.1
November	42.5	27.9	35.2	2.39	7.6
December	31.5	17	24.3	2.05	24.2
Annually	52.0	33.0	42.5	29.56	90.0

Source: Midwestern Regional Climate Center, Champaign IL Station 201492 Cheboygan MI

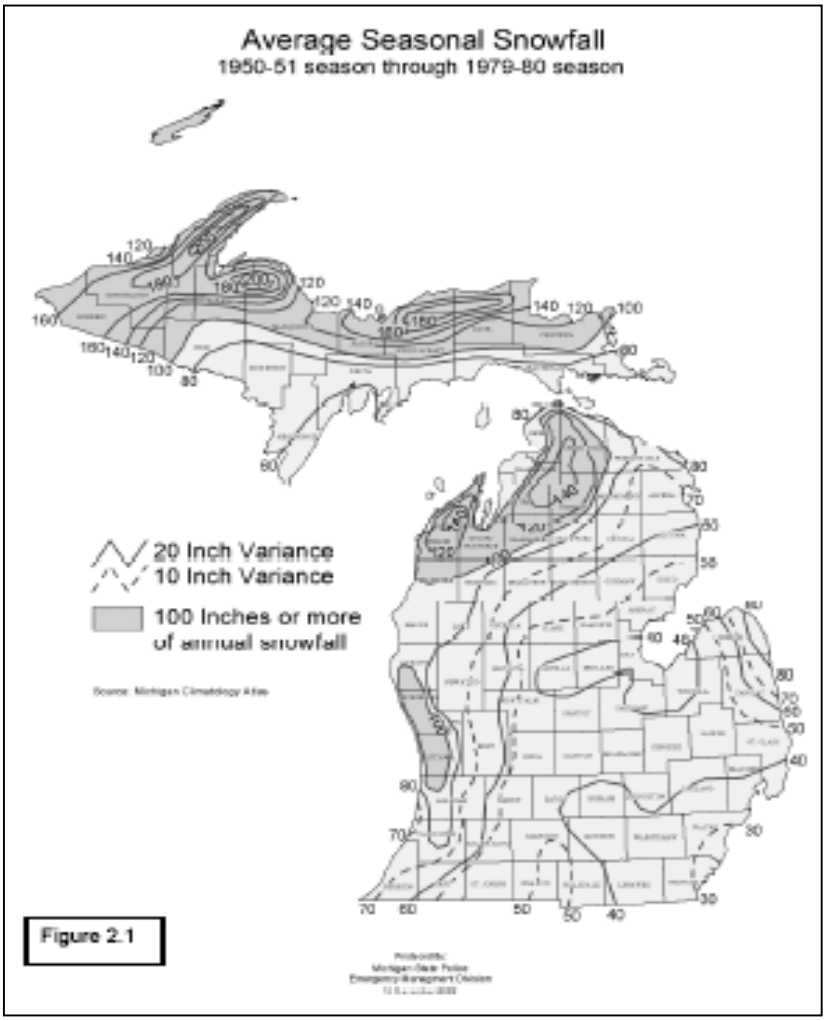
Severe Weather

Data from the National Oceanic and Atmospheric Administration shows that from 1955 through 2002 there were 104 severe weather events in Cheboygan County causing over 10.1 million dollars in damages.

Although relatively rare, tornados have occurred in Cheboygan County. Michigan is located on the northeast fringe of the Midwest tornado belt. The lower frequency of tornadoes occurring in Michigan may be, in part, the result of the colder water of Lake Michigan during the spring and early summer months, a prime period of tornado activity. Michigan averages approximately 15 tornadoes per year. Over the past 47 years, 5 tornados touched down in the Cheboygan County, causing over $25,000 in property damage. All of the tornados occurred in the afternoon between 12:00 and 6:00 P.M. The majority of tornados have occurred in the month August, although tornados can occur in the spring and fall. In 1970, a tornado struck Cheboygan County on October 2nd. The magnitude of a tornado is described by using the Fujita Scale. The Scale ranks tornados from F0 to F6 based on wind speed and intensity. F0 and F1 tornados are described as weak tornados with wind speeds from 40 to 112 mph, F2 and F3 are strong tornados with wind speeds from 113-206 mph, F4 and F5 are violent tornados with wind speeds from 207 to 318 mph and an F6 is an inconceivable tornado with wind speeds above 319 mph. Of the 9 tornados that have struck Cheboygan County, two were F1 and three were F0.

Strong winds and thunderstorm winds are the most prevalent severe weather that affects Cheboygan County. Annually, thunderstorms will occur on an average of 24 days per year and on average one or two thunderstorms per year will have severe winds. Since 1967 there have been 39 severe wind events recorded in the County causing over $50,000 in damage. Strong winds are most likely in the summer months of June, July, and August, but can occur any time of year. One of the most powerful windstorms ever recorded in the Great Lakes region occurred on November 10, 1998. Wind speeds from this powerful storm reached 82 knots.

Winter storms consisting of heavy snow, freezing rain and blizzards are common seasonal hazards that can be expected to occur several times every year. Since 1993, 19 heavy snowstorms and 4 blizzards have been recorded in Cheboygan County. (**Figure 2-1**)Over the past 10 years the county averaged 3 heavy snowstorms and/or blizzards each year, although the number and intensity of snowstorms can fluctuate dramatically from year to year. In 1994, heavy snowstorms and or blizzards occurred 6 times while in 1996 no heavy snowstorms or blizzards were recorded. Improved weather forecasting methods and better understanding of global phenomenon such as el-ninó and la-nina have increased the reliability of forecasting future long-term trends. While general trends, such as mild or severe winters can be, and are, predicted, they are not always completely accurate.



Snowfall extremes, based on the time period of this station's published record, are as follows:

- Greatest observation-day total: 19.3 inches (recorded December 4, 1970)
- Greatest monthly total: 52.0 inches (recorded December 1985)

- Greatest seasonal total: 139.0 inches (recorded during 1984-85)
- Least seasonal total: 19.5inches (recorded during 1901-02)
- Greatest snow depth: 53 inches (recorded March 1, 1918)

The 1950-51 through 1979-80 average seasonal snowfall was 77.9 inches. During this period, 117 days per season averaged 1 inch or more of snow on the ground, but varied greatly from season to season.

Freezing rain events can cause wide spread damage and can be an extremely costly natural hazard. Ice laden limbs break off trees and cause damage to homes and power lines and travel on ice covered roads is extremely hazardous, if not impossible. On January 27, 1994 a freezing rain storm that swept across northern Michigan paralyzed the area and caused over 5.0 million dollars in damages. Freezing rain events can happen throughout the winter but are most likely to occur in January, February and March.

Geology

The surface and subsurface features of Cheboygan County and the surrounding vicinity are directly attributed to geologic activity. Throughout history, advancing and retreating glaciers created varying landscapes. The last glacial advance, which is principally responsible for the development of present-day features, occurred approximately 11,800 years ago. As the glaciers moved, they carried along and deposited debris. The advancing and retreating motions deposited unsorted sand, gravel, rock and clay at the margin of the glacier to form the moraines. A moraine represents the former position of a glacier's edge. Moraines primarily occur in the southern portion of the county.

Some areas in the southern portion of the county were subjected to the onslaught of rapidly melting waters. Melting waters carried debris as they spread out in sheet-like formation away from the glaciers. This formation is clearly evident in the county's present day landscape as outwash and glacial channels. When the glaciers stopped advancing and began to rapidly melt, channels were formed through, on and under the ice mass. The rushing water carried with it debris which eventually filled the channel. As the glaciers continued to melt, the rubble was deposited in long, narrow channels, which spread and settled once the retaining walls of the channel had melted. Such a formation is called an "esker". One such esker exists in Koehler and Waverly townships, and is seven miles long.

Large blocks of ice were left behind when the glaciers melted. Many of these ice chunks formed the lakes, such as Burt and Mullett Lakes, within Cheboygan County. As the ice receded further north, the meltwaters flooded areas of the county. The higher elevations, above water formed islands. Areas above the meltwaters, predominantly in the southern portion of present day Cheboygan County, were not submerged. During this period the clays and sands of the northern part of the county were deposited on the lakebed of Lake Algonquin.

As the glaciers melted further to the north, a low outlet valley caused a drastic dip in the elevation of the lakes. Finally, the lake rose again and a new lake level was established, Lake Nipissing. It covered the present shoreline of Cheboygan County and raised the level of the inland lakes. Nipissing cut into the old Algonquin Lake bed and formed the terraces on which US-23 was built. The City of Cheboygan and Village of Mackinaw City are built on the former floor of Lake Nipissing. During this time period, the Cheboygan River did not exist. This was formed in post-Nipissing years by the action of a tributary of the Black River.

Topography

Awareness of topography is important for planning purposes, since it can affect development. **(Figure 2-2)** Steep hills tend to be poor development areas. Septic system failures, soil erosion, and winter driving problems occur in areas with steep inclines. Extreme flatlands or valleys, too, may have the disadvantage of poor drainage, which could leave standing water in low-lying areas. This is also dependent on the types of underlying soils which are present.

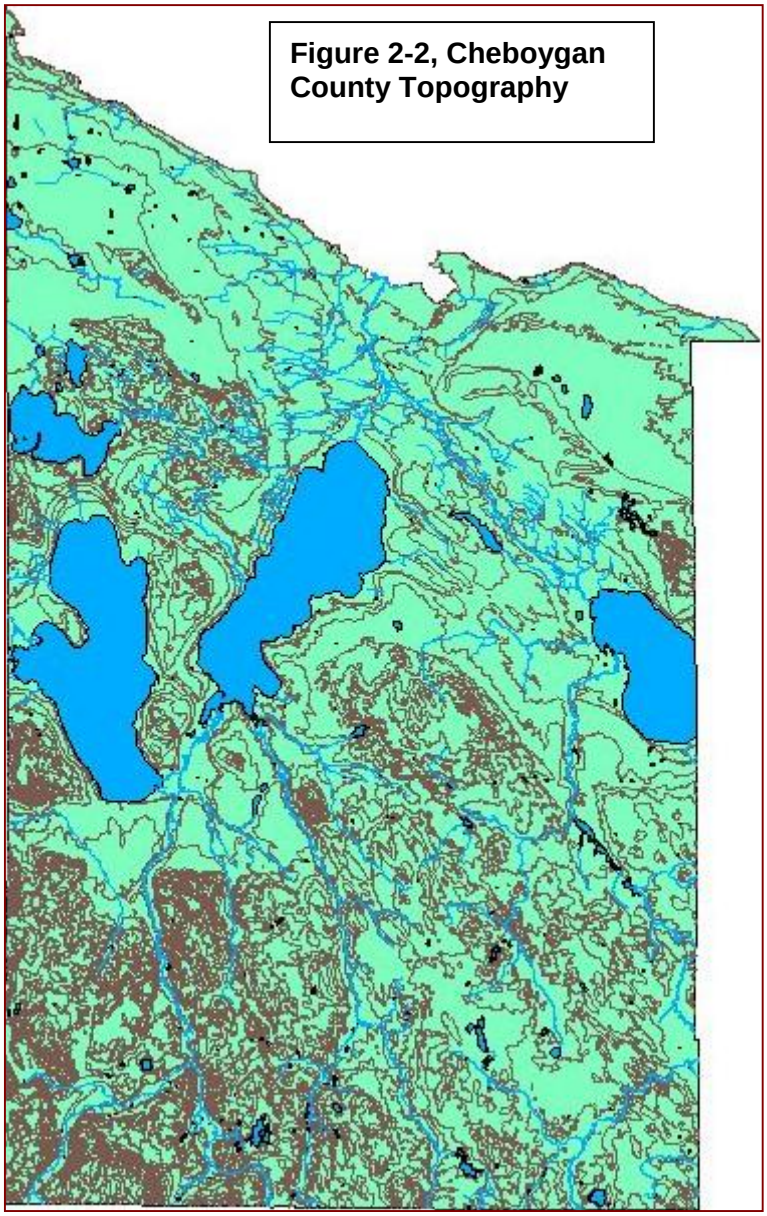


Figure 2-2, Cheboygan County Topography

The southern portion of the county is predominantly rolling or hilly. This high plateau-like area formed from moraines and outwash, ranges in elevation from 800 to over 1000 feet above sea level. This contrasts to the northern portion of the county, which was once covered by Lake Algonquin and has elevations ranging from 600 to 750 feet above sea level. The contour lines of 750 feet and above designate the outline of this lake which established its level at approximately 740 feet. These lines designate the island areas, as is the shoreline of Algonquin in the southern portion of the county.

Soils

Soil characteristics help define the lands capacity to support certain types of land uses. **(Figure 2-3)** Soils most suitable for development purposes are well drained and not subject to a high water table. Adequate drainage is important to minimizing storm water impacts and the efficient operations of septic drain fields. Adequate depths to the water table are necessary to prevent ground water contamination from septic systems. A high water table also limits the construction of basements. Though civil engineering techniques can be employed to improve drainage and maintain adequate separation from the water table, such techniques are expensive to construct and maintain. At the other extreme, excessive slope presents problems to development from erosion potential. The costs of providing adequate erosion control practices in building maintenance and construction in high or moderate slope areas is significant.

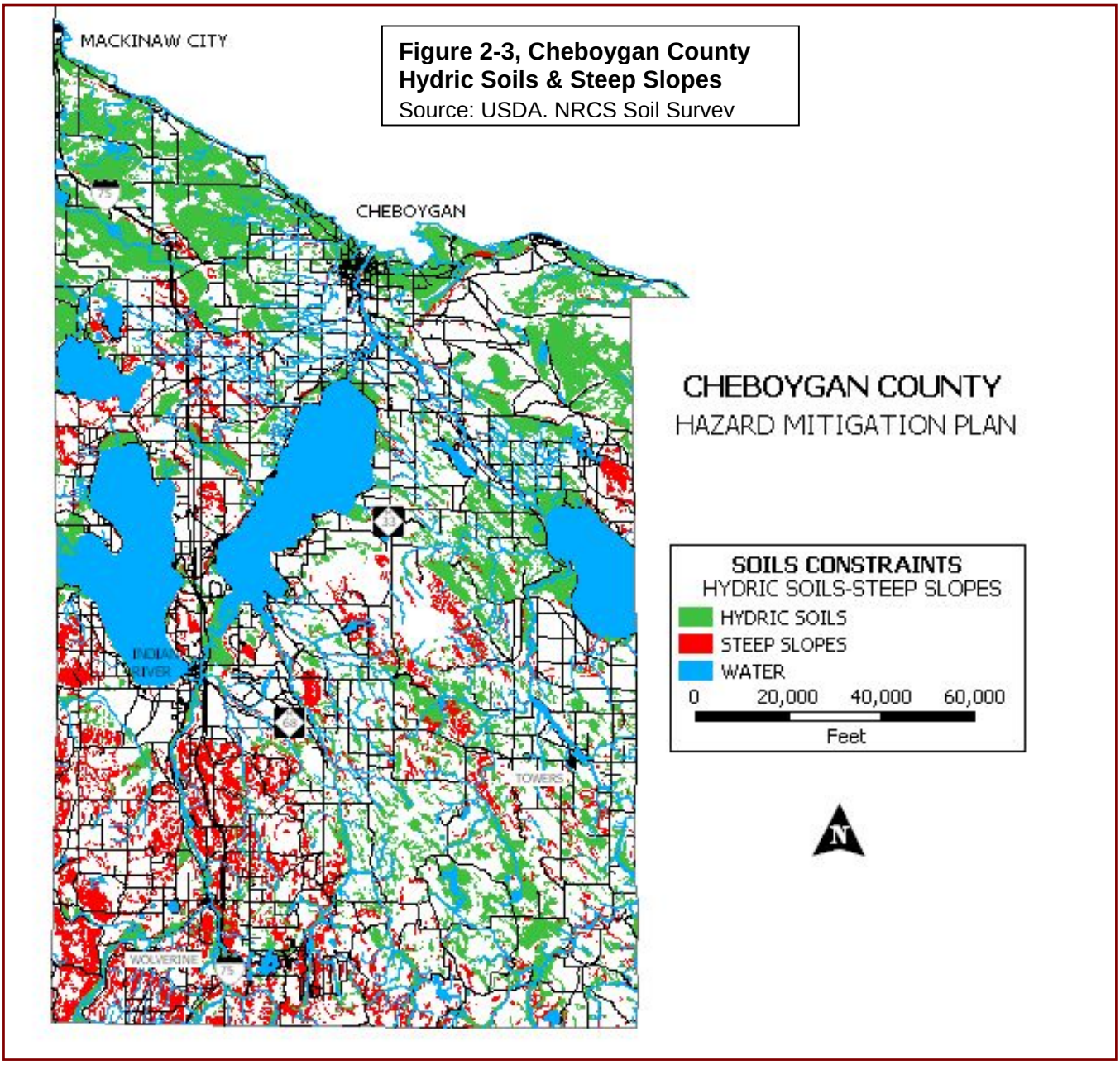


Figure 2-3, Cheboygan County Hydric Soils & Steep Slopes
Source: USDA, NRCS Soil Survey

The USDA soil survey of Cheboygan County also rates the suitability of soils for various uses such as building site development and identifies the limiting factors such as steep slopes, soil types, or high water table. Areas with well-drained soils and slopes less than 10 percent tend to have slight limitations for building development. Areas with slopes greater than 18 percent, high water tables and organic soils or rocky soils have severe limitations. A critical development issue occurs when the water table is close to the surface or when high-density development occurs. Limiting types and density of development or making public water and sewer available for high-density development are likely the best options for protecting the groundwater resources. Based on criteria established by the Natural Resource Conservation Service (NRCS), building constraints maps were developed **(Figure 2-4)**.

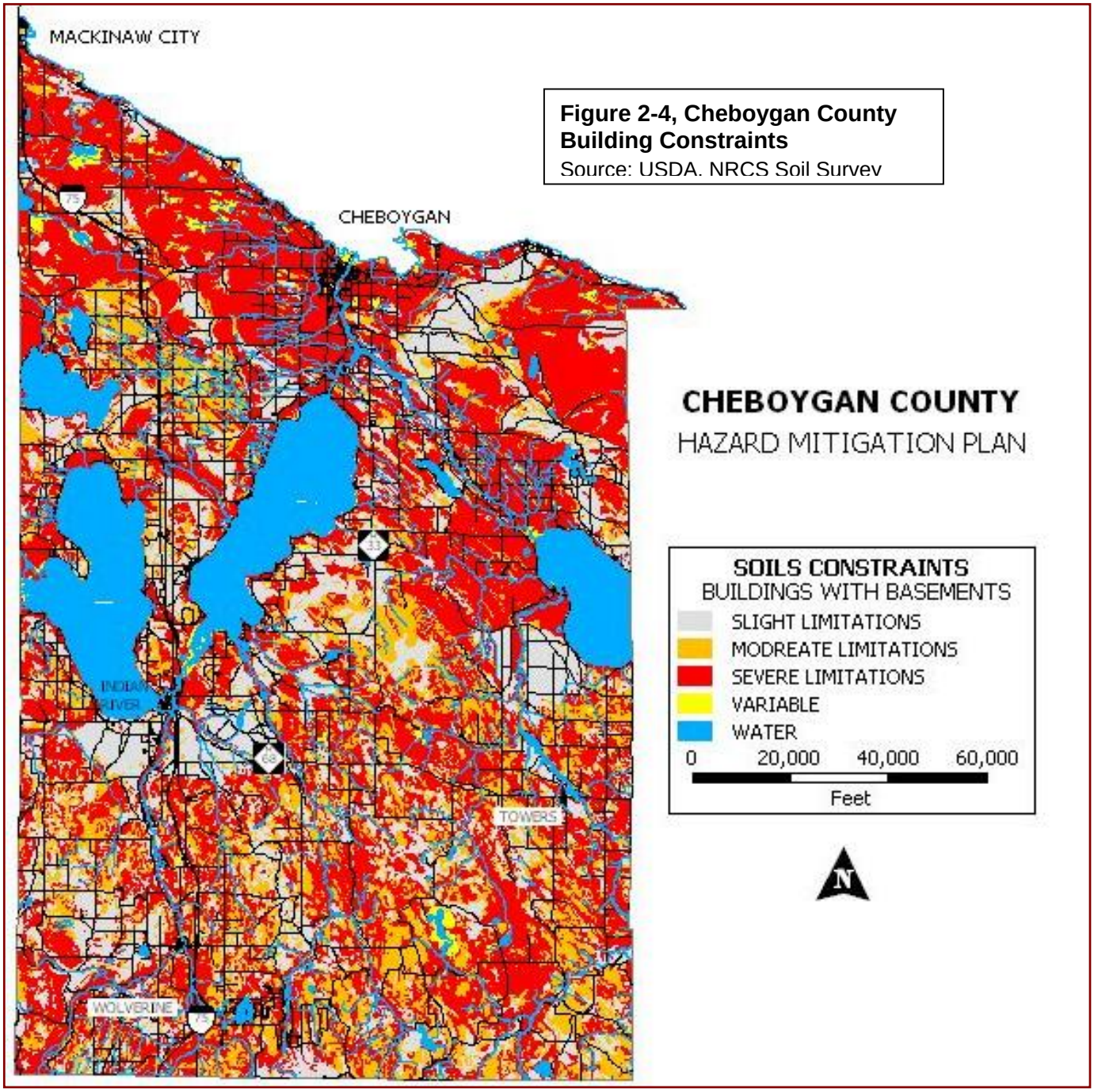


Figure 2-4, Cheboygan County Building Constraints
Source: USDA, NRCS Soil Survey

Water Resources

Surface Water

Cheboygan County contains numerous rivers and inland lakes (**Figure 2-5**). Thirty-eight miles of Lake Huron shoreline establish the northern boundary of the county. Inland lakes cover 10% (51,358 acres) of the county's total surface area, the largest percentage of any county in the state. There are several large bodies of water in the county. The largest inland lake in the county and the fourth largest in the State is Burt Lake (17,335 acres). The second largest is Mullett Lake (16,744 acres), followed by Douglas Lake (3,745 acres) and Black Lake, of which 7,887 acres are in the county. Of the 182 miles of inland lakeshore, 46 miles are publicly owned.

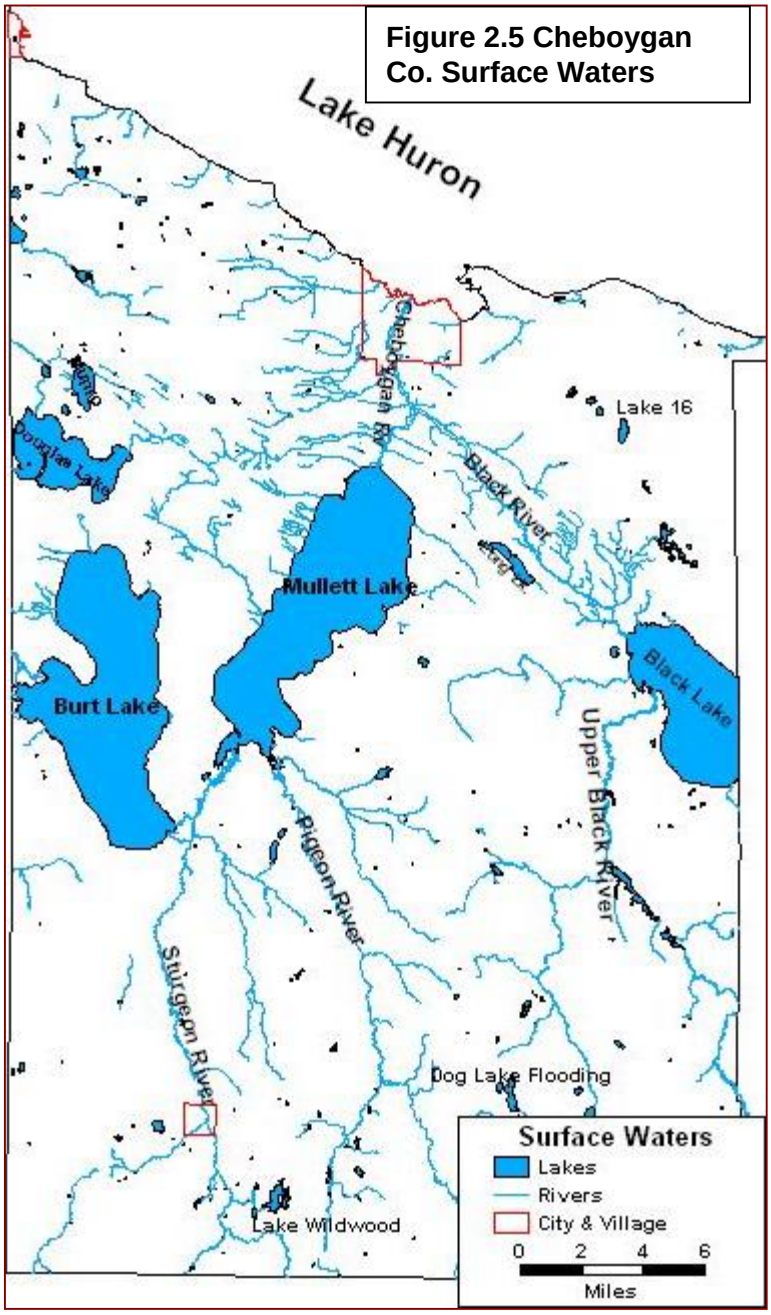


Figure 2.5 Cheboygan Co. Surface Waters

Cheboygan County, along with portions of the Counties of Presque Isle, Emmet, Otsego, Montmorency and Charlevoix, is within the Cheboygan River Watershed. Within the Cheboygan River Watershed and the boundary of Cheboygan County are the watersheds of the Sturgeon, Pigeon and Black Rivers. Drainage from the Cheboygan River Watershed flows into the Cheboygan River through the City of Cheboygan and into Lake Huron. Portions of the county northwest and east of the City of Cheboygan are part of the coastal watershed, which drains directly into Lake Huron.

Within each of these watersheds are numerous lakes and rivers. The Sturgeon River Watershed, in the western portion of the county, includes the Sturgeon River. Directly adjacent is the renowned Pigeon River Watershed. The Pigeon River flows into Mullett Lake that empties into the Cheboygan River and directly into Lake Huron. The western portion of the county includes the Black River Watershed. The Upper Black River and its tributaries within the county drain directly into Black Lake. The Black River carries lake water directly into the Cheboygan River.

Groundwater

Groundwater is the source of drinking water for over 90 % of Northeast Michigan's population. In the more rural areas, virtually everyone uses a well to provide clean drinking water. Large supplies of groundwater can be found under the surface throughout much of northern Michigan.

Cheboygan County has been blessed with abundant groundwater supplies of very high quality. The generally thick glacial deposits in Cheboygan County result in ample groundwater aquifers and a large number of springs and streams with cold, steady, high quality flows of groundwater. The bedrock

geology and the large amount of limestone in the glacial deposits influence the chemical quality of groundwater and most surface waters, resulting in moderately high hardness and alkalinity.

The groundwater of Cheboygan County is an extremely valuable resource. Groundwater discharge is important to the recreational values of the county. Groundwater is the principal source of water in streams and rivers during dryer, rainless periods, providing Cheboygan County with rivers and streams that flow year-round. Groundwater has a large influence on water temperatures. Because groundwater leaves the ground at a constant temperature year round, it has the effect of moderating water temperature. Streams that receive large amounts of groundwater are generally cooler in summer and warmer in winter than those where groundwater inputs are small. These temperature moderations and year-round flows provide ideal conditions for many fish, including trout, as well as other wildlife.

A number of factors, such as soil permeability, the amount, timing and intensity of precipitation, vegetative cover and land use govern the amount of groundwater recharge on any area of land. Precipitation and permeability usually exert the greatest influence on groundwater recharge. In Cheboygan County, rainfall intensity is seldom greater than soil permeability, resulting in large quantities of infiltration and groundwater recharge.

Wetlands

Cheboygan County's wetlands **(Figure 2-6)** are unique ecosystems that serve as the transitional zone between upland and aquatic habitats. The purity and clarity of lakes and streams is maintained and enhanced, in large part, by wetlands. Wetlands filter out nutrients and sediments, some of the most harmful pollutants associated with lakes and streams. Without wetlands these pollutants can cloud once clear waters and accelerate the growth of choking aquatic weeds. Since many of the existing undeveloped waterfront properties contain environmental limitations such as wetlands, floodplains, or soils poor for septic development, there will be more and more pressure to alter these landscapes. To preserve the water quality of area lakes and streams and their associated property values, attempts must be made to preserve wetlands and other environmentally sensitive landscapes. This will insure that the quality of life and natural resources of the county remain its chief economic assets. The ecological functions that wetlands provide benefit numerous property owners. Conversely, land use alterations that disturb or alter wetland functions can create nuisances or cause damage to surrounding land owners (e.g., downstream flooding as a result of upstream wetland filling) as well as effecting broader public health issues (e.g., wetland loss can lead to water quality impairment of lakes and streams)**.**

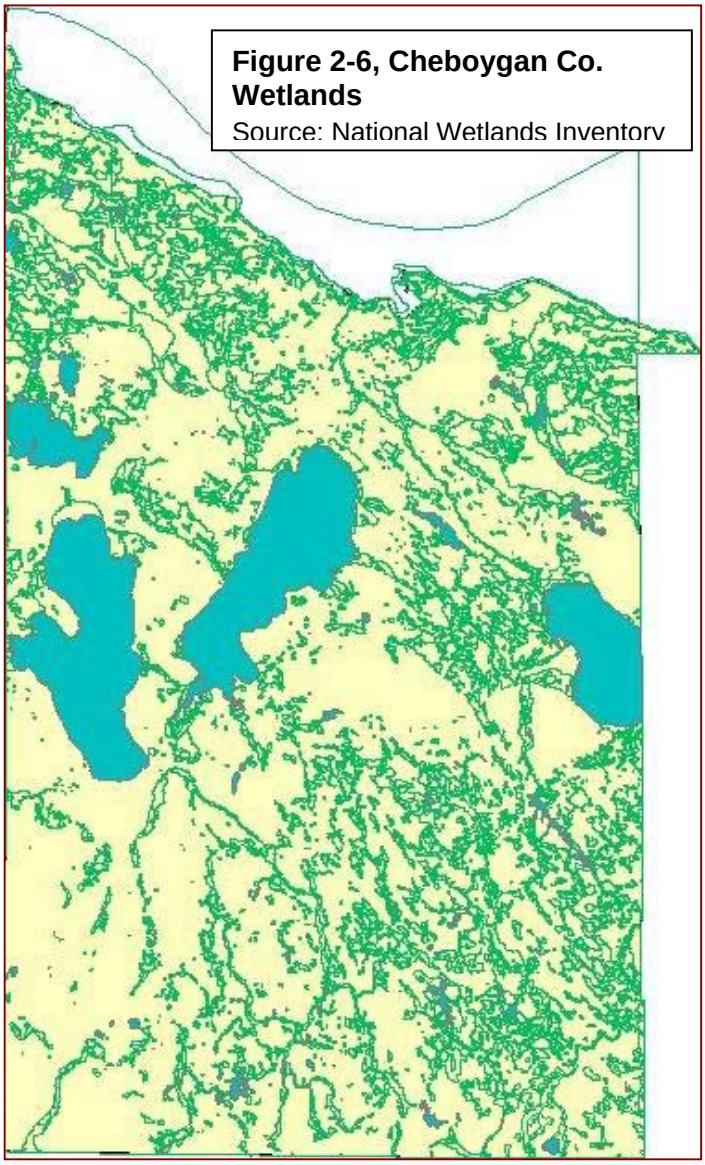


Figure 2-6, Cheboygan Co. Wetlands
Source: National Wetlands Inventory

Woodlands

According to 2001 statistics from the U.S. Forest Service, forestland accounts for approximately 81% of the county's total land area. **Table 2-2** shows that the major forest species found in the county are Maple/Beech/Birch (30%) and Aspen (27%). Northern White Cedar and Elm/Ash/Cottonwood total approximately 10% and 8% respectively. Smaller amounts of forestland are comprised of Red Pine (5%), Balsam Fir (5%), and Oak/Hickory (4%). Smaller acreages of Jack Pine, Exotic Softwoods, Eastern White Pine, Black Spruce, Tamarack, Black Ash/American Elm/Red Maple, Sugar Maple/Beech/Yellow Birch, Paper Birch, and Balsam Poplar are also present.

Forestland in Cheboygan County is fairly evenly split between State and private ownership. 53% is privately owned and 47% is State-owned in the form of Pigeon River State Forest, Black Lake State Forest, and Hardwood State Forest. In addition to using the forest resources for timber and fiber, woodlands are also used for all types of outdoor recreation.

Table 2-2
Cheboygan County Acres of Timberland by Forest & Ownership Type

	State	Private	TOTAL	%
Maple / Beech / Birch Group	52523.1	60279.1	112802.2	30.4%
Aspen	47485.4	53035.1	100520.5	27.1%
Northern White Cedar	9908	25466	35374	9.5%
Elm/Ash/Cottonwood Group	13911.4	14261.5	28172.9	7.6%
Red pine	16077.4	1227.7	17305.1	4.7%
Balsam Fir	13265.7	3889.5	17155.2	4.6%
Oak / Hickory Group	5186	10372	15558	4.2%
Exotic Softwoods Group		9754.5	9754.5	2.6%
Jack pine	9388.6		9388.6	2.5%
Balsam Poplar		5186	5186	1.4%
Black Spruce		5186	5186	1.4%
Tamarack		4722	4722	1.3%
Eastern White Pine	4722		4722	1.3%
Paper Birch		2593	2593	0.7%
Black Ash/American Elm/Red Maple	998.3		998.3	0.3%
Sugar Maple/Beech/Yellow Birch		956.2	956.2	0.3%
Nonstocked	519.4		519.4	0.1%
TOTAL	173,985.3	196,928.6	370,913.9	100%

Source: U.S. Forest Service 2001

Sites of Environmental Contamination

The Michigan Environmental Response Act 307 of 1982, as amended, provides for the identification, evaluation, and risk assessment of sites of environmental contamination in the State. The Environmental Response Division (ERD) is charged with administering this law. A site of environmental contamination, as identified by ERD, is "a location at which contamination of soil, ground water, surface water, air or other environmental resource is confirmed, or where there is potential for contamination of resources due

to site conditions, site use or management practices". **Table 2-3** is a list of environmentally contaminated sites in Cheboygan County showing the sites by name, pollutant(s) and site status.

Table 2-3
Cheboygan County Contamination Sites

Site ID & Status	Location	Source	Pollutant	SAM Score
16000001 Active	915 East Western Avenue	Engine component	Cyanide	0
16000002 No Action Taken	Straights Hwy at Bunker Rd	Salt storage	Chloride	26
16000003 Active	Eastern Avenue	Landfill	Benzene	26
16000004 Active	END OF INVERNESS RD	Dump	Lead , Chromium , Manganese	36
16000005 Monitoring Only	Mason Road	Refuse Systems	Arsenic	35
16000007 Active	U.S. 23 North	Petro Bulk Storage	BTEX	31
16000012 No Action Taken	5993 Sholes Rd	Unknown	TCE , Chloroform	21
16000036 Potentially Liable Party Action	West State Street	Petroleum Bulk Stations & Term	BTEX Naphthalene , Chrysene Acenapthene , Florene Benzo(b)flo	36
16000037 Active	1985 Levering Road	Motor Vehicle & Car Bodies	Gasoline , Diesel Fuel	35
16000040 Active	null	null	N/A	0
16000043 No Action Taken	12600 Inverness Trail Road	General Automotive Repair Shop	Petroleum Products	20
16000050 Active	North Huron Street	Truck Terminal Facilities	BTEX , Chrysene	30
16000056 Monitoring Only	Osmun Road	null	N/A	37
16000071 No Action Taken	727 Court Street	Motor Vehicle & Car Bodies	Gasoline , Diesel Fuel	27
16000073 Active	992 South Main Cheboygan	Laundry Dry Cleaner	Tetrachloroethylene	28
16000092 No Action Taken	Club Rd	null	Benzene , Napthalene	37
16000095 Monitoring Only	Cleveland Ave	Lumber & Wood Products	Barium , lead , zinc	35

Source: Department of Environmental Quality

A Site Assessment Model (SAM) score is computed to assess the relative risk a site may pose and to help determine the aggressiveness of clean up efforts. SAM scores range from 0 to 48 with 0 being the least contaminated and 48 the most contaminated. In some instances, where the score is high and further contamination is possible, immediate response may be required. Conversely, a location where the score is low and the conditions of the site are not likely to change, no action may be the preferred course.

In Cheboygan County there are currently 17 listed contamination sites. The status of 8 of the sites is listed as active, which means that some level of clean up activity is ongoing. Four of the sites are being monitored only, potentially liable party action has been taken on one site, and no action has been taken at the remainder of the sites.

Potential Contamination

Future supplies of groundwater should be protected from contamination. The ways in which land is utilized is directly related to the potential for groundwater resource degradation. Potential ground water contamination sites are those on which land use activities could cause ground water contamination. These activities include commercial, industrial and municipal discharges, closed dumps, oil and gas drilling, production and disposal sites, bulk fuel storage facilities, septic disposal sites, businesses which utilize small quantities of hazardous materials, agriculture, and densely developed areas which do not have sewers.

Analyzing the soil suitability of a region should be included in determining the most suitable location for these land use activities. Steps to locate new development to the most suitable location and to prevent existing development from having an adverse affects on the groundwater supply should be taken by enacting proper zoning laws and regulations.