Chapter 6 – Hazard Identification

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Cheboygan County is vulnerable to a wide range of natural, technological and human-related hazards. Managing these many varied threats, and protecting life and property, are challenges faced by emergency management officials at all levels of government. In order to attain an effective emergency management capability to mitigate, prepare for, respond to, and recover from all types of hazards, an understanding of the multitude of hazards that confront the County must first be obtained. The first step is to identify potential hazards within a community. Next, the hazards are ranked according to the relative risk to the community. The final step in the process will be to assess the level of vulnerability for each identified hazard.

When coupled with relevant community profile information, the hazard identification and vulnerability assessment becomes a powerful planning tool that enables emergency management officials to set priorities and goals for resource allocation and mitigation and preparedness activities. This process should not be considered a reliable predictor of the occurrence of any hazard. Hazards have always had an uncanny way of occurring when least expected. This section can give communities a realistic base by which to plan for mitigation, preparedness, response and recovery activities.

High Priority Hazards in Cheboygan County

Severe Winter Weather Hazards

Winter weather hazards consisting of heavy snow from winter storms, freezing rain and blizzards are prevalent natural hazards that occur uniformly across Cheboygan County and can be expected to occur several times every year. Since January, 1993, 48 heavy snow or ice events have been recorded in Cheboygan County. Over the past 10 years the county has averaged 4.0 severe winter weather hazards each year. The number and intensity of winter weather hazards can fluctuate dramatically from year to year. In 1993 and 1997 heavy snowstorms, freezing rain and/or blizzards occurred 7 times while in 1996 only one heavy snowstorm was recorded by the National Climatic Data Center.

A. Ice and Sleet Storms: A storm that generates sufficient quantities of ice or sleet to result in hazardous conditions and/or property damage. Sleet storms differ from ice storms in that sleet is similar to hail (only smaller) and can be easily identified as frozen rain drops (ice pellets) that bounce when hitting the ground or other objects. Sleet does not stick to trees and wires, but sleet in sufficient depth does cause hazardous driving conditions. Ice storms are the result of cold rain that freezes on contact with the surface, coating the ground, trees, buildings, overhead wires, etc. with ice, sometimes causing extensive damage. When electric lines are downed, inconveniences are felt in households and economic loss and disruption of essential services is often experienced in affected communities. Michigan has had numerous damaging ice storms over the past few decades. During the past ten years Cheboygan County has experienced five freezing rain events as recorded by the National Climatic Data Center of the National Oceanic and Atmospheric Administration.

B. Snowstorms: A period of rapid accumulation of snow often accompanied by high winds, cold temperatures, and low visibility. Blizzards are the most dramatic and perilous of all snowstorms, characterized by low temperatures and strong winds bearing enormous amounts of snow. Most of the snow accompanying a blizzard is in the form of fine, powdery particles of snow, which are wind-blown in such great quantities that, at times, visibility is reduced to only a few feet. Blizzards have the potential to result in property damage and loss of life. Just the cost of clearing the snow can be enormous. As a result of being surrounded by the Great Lakes, Michigan experiences large differences in snowfall in relatively short distances. The annual mean accumulation ranges from 30 to 170 inches of snow. The highest accumulations are in the northern and western parts of the Upper Peninsula. Since winter storms tend to move from west to east, the western parts of the state usually have greater amounts of snow than the eastern parts. The highest seasonal snowfall recorded in Cheboygan County was 150 inches during the 1996-97 season. (Table 6-1)

Northern Michigan, with its extensive Great Lakes coastline is also susceptible to lake-effect snow. There are several main ingredients required to produce lake effect snow. The first is a relatively warm body of water supplied by the Great Lakes. The second ingredient is a source of cold air. In the Great Lakes Region, that source comes from the high latitudes of North America where arctic air masses often "spill southward" over those warm bodies of water. Heat and moisture from the warm lakes rises into the "modified" arctic air where it then cools and condenses into snow clouds. The third ingredient is prevailing wind direction, which determines where the snow will occur. Often these blinding local snowfalls can cause major disruption to automobile traffic.

Table 6-1, Cheboygan County – Snowfall Extremes 1917-2001

Month	High (in)	Year	1-DayMax (in)	Date
JAN	50	1997	18.0	01-25-1990
FEB	40	1995	18.0	02-04-1903
MAR	40.5	1926	15.7	03-02-1991
APR	19.1	1923	10.0	04-30-1909
MAY	7.3	1917	6.0	05-23-1917
JUN	0.0	-	-	-
JUL	0.0	-	-	-
AUG	0.0	-	-	-
SEP	0.5	1956	0.5	09-20-1956
OCT	12.6	1942	9.0	10-18-1930
NOV	26.5	1989	10.0	11-29-1958
DEC	26.5	1989	19.3	12-04-1970
Season (Jul-Jun)	159.0	1996-1997	19.3	12-04-1970
Recorded at Station: 201492, Cheboygan, MI Source: Midwest Regional Climate Center				

Hazardous Material Incident - Fixed Site:

A hazardous material incident occurs when there is an uncontrolled release of hazardous materials from a fixed site, capable of posing a risk to health, safety, property and the environment. Hazardous materials are present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other community facilities. Hazardous materials are materials or substances, which, because of their chemical, physical, or biological nature, pose a potential threat to life, health, property and the environment if they are released. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases. There are two 302 sites in Cheboygan County. Plans are on file with the Cheboygan Local Emergency Planning Committee.

Hazardous materials are highly regulated by the government to reduce risk to the general public, property and the environment. Despite precautions taken to ensure careful handling during the manufacture, transport, storage, use and disposal of these materials, accidental releases do occur. Areas at most risks are within a 1-5 mile radius of identified hazardous material sites. Many communities have detailed plans and procedures in place for responding to incidents at these sites, but releases can still cause severe harm to people, property and the environment if proper mitigative action is not taken in a timely manner.

Hazardous Material Incident – Transportation:

A transportation related hazardous material incident occurs when there is an uncontrolled release of hazardous materials during transport, capable of posing a risk to health, safety, property or the

environment. All modes of transportation - highway, railroad, seaway, airway, and pipeline - are carrying thousands of hazardous material shipments on a daily basis through local communities. A transportation accident involving any one of those hazardous material shipments could cause a local emergency affecting many people. The U.S. Department of Transportation regulates the transportation and shipping of over 18,000 different materials. Areas most at risk are within a 1-5 mile radius of a major transportation route along which hazardous material shipments move.

All areas in Michigan are potentially vulnerable to a hazardous material transportation incident, although the heavily urbanized and industrialized areas in southern Michigan are particularly vulnerable due to the highly concentrated population. In Cheboygan County the main transportation routes of I 75, US 23, M-68 and M-27 have the highest risk for a hazardous material incident.

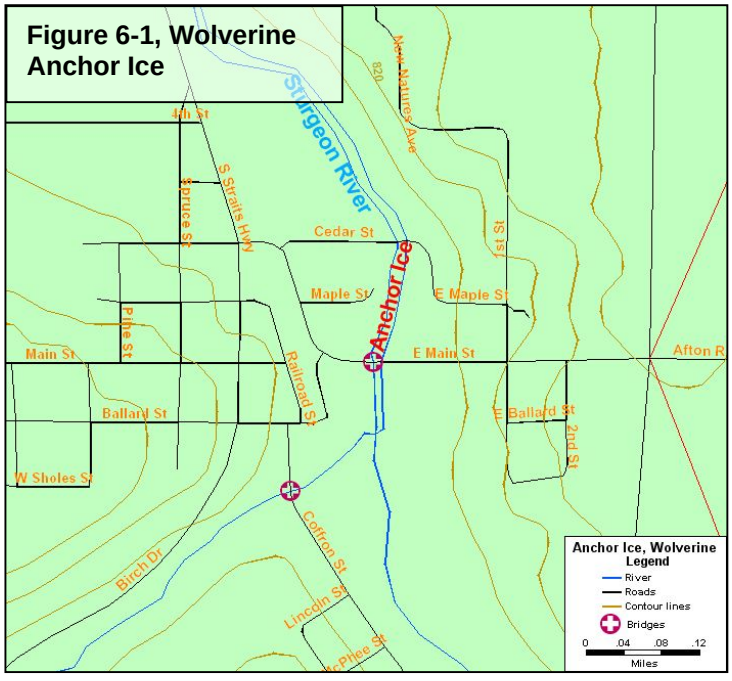
Riverine and Urban Flooding

Riverine flooding is defined as the periodic occurrence of overbank flows of rivers and streams resulting in partial or complete inundation of the adjacent floodplain. Riverine floods are generally caused by prolonged, intense rainfall, snowmelt, ice jams, dam failures, or any combination of these factors. Such overbank flows are natural events that may occur on a regular basis. Riverine floods occur on river systems whose tributaries may drain large geographic areas and encompass many independent river basins. Floods on large river systems may continue for several days

Flash flooding differs from riverine flooding in extent and duration. Flash floods are brief, heavy flows on small streams or in normally dry creeks. Flash floods are normally the result of locally intense thunderstorms resulting in significant rainfall. Flash floods are typically characterized by high velocity water, often carrying large amounts of debris. Urban flooding involves the overflow of storm sewer systems and is usually caused by inadequate drainage following heavy rainfall or rapid snowmelt.

. In Cheboygan County the Little Black system experienced major floods in 1923, 1925, 1929, 1935, 1938, 1943, 1948, and 1954 causing considerable damage to urban property in the City of Cheboygan. These floods occurred in early spring due to a combination of snowmelt and rainfall, and occasionally in the fall due to heavy rains. The installation of structural measures in the 1960's has had a significant effect in the reduction of floodwater damages.

The Village of Wolverine in southwestern Cheboygan County experiences a relatively exceptional form of flooding. Local residents indicate that a long, straight and fast flowing reach of the Sturgeon River, near the Village, experiences the phenomena of "Anchor Ice" about once every 5 years. On clear, very cold winter nights the rapid water becomes super-cooled and attaches to the streambed as it freezes. This action effectively forms a dam across the river with resultant flooding of several structures in the immediate floodplain. The general location of the Anchor Ice event is depicted in Figure 6-1.



Shoreline Flooding/Erosion

Flooding and erosion along Michigan's 3,200-mile long Great Lakes shoreline is typically caused by high Great Lakes water levels, storm surges, or high winds. Shoreline flooding and erosion are natural processes that occur at normal and even low Great Lakes water levels. During periods of high water, however, flooding and erosion are more frequent and serious, causing damage to homes, businesses,

roads, water distribution and wastewater treatment facilities, and other structures in coastal communities. Windstorms and differences in barometric pressure can temporarily tilt the surface of a lake up at one end as much as 8 feet. This phenomenon is called a storm surge and can drive lake water inland over large areas. Cheboygan County has over 32 miles of shoreline along the Straits of Mackinaw and Lake Huron

Cheboygan County has an extensive Lake Huron coastline, Little Black River and its tributaries and the extensive system of connecting inland lakes and rivers, provides the county with an exceptionally long coast and shoreline. The extent of critical sandy shoreline along these water bodies, and its inherent capacity for erosion, has generated remediation activities for many years to these shorelines. Implementation of land use policies and regulations is an important strategy used by local, state and federal units of government for protecting water quality. In addition to their benefits for aquatic resources, planning and zoning are tools used for ensuring the conservation of wildlife habitat, providing for sustainable development, protecting property values, and maintaining community character.

Extreme Temperatures

Prolonged periods of very high or very low temperatures, often accompanied by other extreme meteorological conditions such as high humidity, lack of rain (drought), high winds, etc. Extreme temperatures - whether it is extreme heat or extreme cold - share a commonality in that they both primarily affect the most vulnerable segments of society such as the elderly, children, impoverished individuals, and people in poor health. The major threats of extreme heat are heatstroke (a major medical emergency), and heat exhaustion. Extreme heat is a more serious problem in urban areas, where the combined effects of high temperature and high humidity are more intense. The major threats of extreme cold are hypothermia (also a major medical emergency) and frostbite. Cheboygan County is subject to both temperature extremes. The historic low temperature recorded on Feb. 6, 1895 of –38F, and high of 104 F, on Aug. 6, 1946. Monthly temperature threshold for Cheboygan are shown in **Table 6-2.**

Table 6-2 Temperature Threshold, Derived from 1970- 2000 averages

Month	# Days Max ≥ 90°F	# Days Max ≤ 32°F	# Days Min ≤ 32°F	# Days Min ≤ 0°F
JAN	0.0	22.6	30.7	7.8
FEB	0.0	17.7	27.7	8.3
MAR	0.0	9.3	28.7	2.8
APR	0.0	1.2	18.5	0.0
MAY	0.0	0.0	4.0	0.0
JUN	0.5	0.0	0.1	0.0
JUL	1.2	0.0	0.0	0.0
AUG	0.8	0.0	0.0	0.0
SEP	0.2	0.0	0.4	0.0
OCT	0.0	0.0	7.1	0.0
NOV	0.0	3.8	21.2	0.0
DEC	0.0	15.3	29.5	2.1

Public Health Emergencies:

A widespread and/or severe epidemic, incident of contamination, or other situation that presents a danger to or otherwise negatively impacts the general health and well-being of the public. Public health

emergencies can take many forms: 1) disease epidemics; 2) large-scale incidents of food or water contamination; 3) extended periods without adequate water and sewer services; 4) harmful exposure to chemical, radiological or biological agents; or 5) large-scale infestations of disease-carrying insects or rodents. Public health emergencies can occur as primary events by themselves, or they may be secondary events to another disaster or emergency, such as a flood, tornado, or hazardous material incident. The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, a large number of people. Public health emergencies can be statewide, regional, or localized in scope and magnitude.

A public health consideration in any community experiencing significant population/ruban expansion is related to increasing stresses on sewer and water system capacities. It is important to balance extension of services with the capacity of existing systems to absorb new loads. Commercial and industrial development along the newly extended system into Inverness Township could lead to capacity problems.

Perhaps the greatest emerging public health threat would be the intentional release of a radiological, chemical or biological agent with the potential to adversely impact a large number of people. Such a release would most likely be an act of sabotage aimed at the government or a specific organization or segment of the population. Fortunately, to date Michigan has not experienced such a release aimed at mass destruction. However, Michigan has experienced hoaxes and it is probably only a matter of time before an actual incident of that nature and magnitude does occur. If and when it does, the public health implications – under the right set of circumstances – could be staggering.

Another stress, specific to Northeast Lower Michigan, effecting public social and economic health is related to the impact of Bovine TB and resultant governmental regulations and enforcement impact. Various quarantines have had a direct effect on the agriculture and hunting industries across Northeast Lower Michigan. The stress from this situation has not only had economic ramifications, but also introduced social and psychological stress across the community.

Infrastructure Failures

An infrastructure failure is considered to occur when there is a break down of critical public or private utility infrastructure resulting in a temporary loss of essential functions and/or services. Such interruptions could last for periods of a few minutes to several days or more. Public and private utility infrastructure provides essential life supporting services such as electric power, heating and air conditioning, water, sewage disposal and treatment, storm drainage, communications, and transportation. When one or more of these independent, yet inter-related systems fails due to disaster or other cause - even for a short period of time - it can have devastating consequences. For example, when power is lost during periods of extreme heat or cold, people can literally die in their homes. When water or wastewater treatment systems in a community are inoperable, serious public health problems arise that must be addressed immediately to prevent outbreaks of disease. If storm drainage systems fail due to damage or an overload of capacity, serious flooding can occur. All of these situations can lead to disastrous public health and safety consequences if immediate mitigation steps are not taken. Typically, it is the most vulnerable segments of society - the elderly, children, ill or frail individuals, etc., that are most heavily impacted by an infrastructure failure. If the failure involves more than one system, or is large enough in scope and magnitude, whole communities and even regions can be negatively impacted.

Apart from potential hazards associated with the Mackinaw Bridge, Cheboygan County does not demonstrate any exceptional possibilities for infrastructure failure. An important issue of frozen waterlines in the City of Cheboygan presents a significant problem to the City. The need for back-up power generation for critical public functions and increased redundancies in emergency communication systems exists in Cheboygan County as it does in many Northern Michigan counties.

Air, Land and Water Transportation Accidents:

These incidents occur when there is a crash or accident involving an air, land or water-based commercial passenger carrier resulting in death or serious injury.

Areas vulnerable to accidents involving air, land and water transportation include: 1) communities with, or near, an airport offering commercial passenger service; 2) communities with railroad tracks on which

commercial rail passenger service is provided; 3) communities in which commercial intercity passenger bus or local transit bus service is provided; 4) communities with school bus service; and 5) communities in which commercial marine passenger ferry service is provided. A serious accident involving any of the above modes of passenger transportation could result in a mass casualty incident, requiring immediate life-saving community response. Cheboygan County's costal location provides a concentration of recreation and commercial marine activity and potential for high causality transportation accident. This would require water rescue operations to be conducted, possibly under dangerous conditions on the Great Lakes. During the shipping season, there are numerous freighters carrying potentially hazardous cargo and large passenger ferries traveling in and through the Straits of Mackinac.

In addition to the Cheboygan County airport, there are 3 private airports in the County. Pellston Airport in Emmet County is the closest airport offering commercial passenger service. Rail service no longer exists in the county and some rail right-of-ways have been converted to recreational trails. I-75, US23, M-33, M-68 and M27, are well traveled and can often experience extreme weather conditions, especially during the winter months. The county is also at the southern terminus of the Mackinaw Bridge, which presents special transportation hazards and mitigation situations.

Fire Hazards

Scrap Tire Fires:

Each year in the U.S., an estimated 250 million vehicle tires have to be disposed of. Michigan alone generates 7.5-9 million scrap tires annually. Many of these scrap tires end up in disposal sites (legal or illegal), some of which may have several hundred thousand tires. Michigan currently has more than 24 million scrap tires at disposal sites scattered across the state. Tire disposal sites can be fire hazards due to the large quantity of "fuel" onsite, coupled with the fact that the shape of a tire allows air to flow into the interior of a tire pile rendering standard fire fighting practices nearly useless. Flowing burning oil released by the burning tires spreads the fire to adjacent areas. Some scrap tire fires have burned for months, creating acrid smoke and an oily residue that can leach into the soil, creating long-term environmental problems. Scrap tire fires differ from conventional fires in several respects: 1) even relatively small scrap tire fires can require significant resources to control and extinguish; 2) the costs of fire management are often far beyond that which local government can absorb; 3) the environmental consequences of a major tire fire can be significant; and 4) the extreme heat from the fire converts a standard passenger vehicle tire into about two gallons of oily residue, which can then leach into the soil or migrate to streams. There are no known significant tire storage sites in Cheboygan County.

Structural Fires:

Any instance of uncontrolled burning which results in structural damage to residential, commercial, industrial, institutional, or other properties in developed areas. In terms of average annual loss of life and property, structural fires - often referred to as the "universal hazard" because they occur in virtually every community - are by far the biggest hazard facing most communities in Michigan and across the country. Each year in the U.S., fires result in approximately 5,000 deaths and 300,000 injuries requiring medical treatment. According to some sources, structural fires cause more loss of life and property damage than all types of natural disasters combined. Particularly devastating are large urban conflagrations, in which multiple structures are damaged or destroyed. Not surprisingly, Michigan's structural fire experience mirrors the national figures. The State Fire Marshal estimates that a structural fire occurs every 24 minutes in Michigan. In Cheboygan County there are several hundred structural fires a year, with 25% completely destroyed.

Like many of the more rural neighboring counties, Cheboygan County relies on a combination of paid and non-paid fire departments. (Table 6-3) This provides the county with an excellent array of fire fighting services available to the respective communities. However, the lack of full-time professional fire fighters in outlying rural townships means less time available to conduct fire inspections and take other preventive measures necessary to lessen structural fire threat. Out of necessity, efforts in these communities are directed at fire suppression. This typical scenario in rural areas of the state poses great challenges for maintaining a sustainable fire prevention and inspection program.

Table 6-3 Cheboygan County Fire Staffing					
Department	Sq. Miles	Population	Paid	Part-paid	Non-paid
Alverno FD	200	2,391	0	36	0
Cheboygan FD	12	6,500	2	18	0
Mackinaw City FD	100	1,880	0	24	0
Topinabee FD	21	1,200	0	17	0
Tuscarora Townshp VFD	180	8,000	0	0	26
Wolverine VFD	143	1,500	0	0	15
East Mullett FD	24	550	0	0	12
UAW Education Center FD	4	500	3	20	0
Inverness FD	144	3,849	0	22	0
Forest-Waverly FD	128	2,600	0	0	21
MDNR Indian River	State				
Totals		28,969	5	137	74

Wildfires:

Wild fire is defined as an uncontrolled fire in grass, brushlands, or forested areas. The most immediate dangers from wildfires are the destruction of homes and timber, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area. Long-term effects can be numerous and include scorched and barren land, soil erosion, landslides/mudflows, water sedimentation, and loss of recreational opportunities. Forests cover approximately one-half of Michigan's total land base. As a result, much of the state is vulnerable to wildfire. In addition, development in and around forests and grasslands is increasing rapidly, making public safety a primary consideration in wildfire mitigation and suppression efforts.

Contrary to popular belief, lightning strikes are not the primary cause of wildfires in Michigan. Today, only about 2% of all wildfires in Michigan are caused by lightning strikes; the rest are caused by human activity. Outdoor burning is the leading cause of wildfires in Michigan. Most Michigan wildfires occur close to where people live and recreate, which puts both people and property at risk. The immediate danger from wildfires is the destruction of property, timber, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area.

Although Michigan's landscape has been shaped by wildfire, the nature and scope of the wildfire threat has changed. Michigan's landscape has changed substantially over the last several decades as residential development continues to expand into the same historic wildfire prone areas. A 60% increase in the number of rural homes since the 1980's) has increased potential for loss of life and property from wildfires. There are simply not enough fire suppression forces available in rural areas to protect every structure from wildfire. The large number of permanent and seasonal homes in northeastern Michigan, coupled with an overall increase in tourists during the most dry (and therefore most vulnerable) times of the year, greatly increases the risk from wildfires.

The Oak-Pine forest type most susceptible to wild fire is generally distributed across Cheboygan County. The most significant concentration of this forest type is located in Tuscarora Township to the south of Burt Lake and across southern half of Koehler Township, additional concentrations are located in Waverly, Mentor and Ellis Townships. **(Figure 4-4 and Insert)**

Information from the Michigan Department of Natural Resources show that Cheboygan County ranked first among the eight NEMCOG counties with 874. There were 46 wildfires in Cheboygan County from 1981 to 1999. **(Table 6-4)** It should be noted that these figures do not include those wildfires suppressed

by local volunteer fire departments or the U.S. Forest Service. If records from these additional sources were readily available, and broken down by county, the statistics would be significantly affected. The relatively high number of wildfire occurrences in Cheboygan County during this time may be partially explained by the proximity of development centers close to the urban-wildland interface with the wildfire prone pine/oak forest of the County.

Table 6-4
Number of Wildfires by County in Northeast Michigan, 1981-99
(MDNR jurisdiction only)

County	Total Number of Wildfires (200+)	Number of Wildfire/ year (over 19 years)
Cheboygan	874	46
Crawford	677	36
Otsego	493	26
Alpena	465	24
Montmorency	300	16
Alcona	206	11
Presque Isle	169	9
Oscoda	144	8
Source: Michigan Department of Natural Resources, Forest Management Division (*rounded to nearest whole number)		

Other Natural Hazards

Severe Summer Weather

Although potential for violent storms is not predictable and can occur anywhere in the county, more densely populated urbanized sections of the county provide the greatest human/property risk and require the most concentrated mitigative consideration and action.

A. Tornadoes: A violently whirling column of air extending downward to the ground from a cumulonimbus cloud. The funnel cloud associated with a tornado may have winds up to 300 miles per hour and an interior air pressure that is 10-20 percent below that of the surrounding atmosphere. The typical length of a tornado path is approximately 16 miles, but tracks much longer than that - some even up to 200 miles - have been reported. Tornado path widths are generally less than one-quarter mile wide. Historically, tornadoes have resulted in the greatest loss of life of any natural hazard, with the mean national annual death toll being 111 persons. Property damage from tornadoes is in the hundreds of millions of dollars every year. Michigan averages approximately 16 tornadoes per year, most occurring in the southern Lower Peninsula. On average, one tornado is reported every 9.4 years in Cheboygan County.

Although relatively rare, tornadoes have occurred in Cheboygan County and have caused extensive damage. 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 15 years, 5 tornadoes have been recorded in Cheboygan County. Tornadoes are most common in the afternoon and all of the tornadoes in Cheboygan County occurred in the afternoon between the hours of 1:00 and 7:00 P.M. In Northern Michigan tornadoes are most likely in the summer months, although tornadoes have occurred in the spring and fall. In Cheboygan County, a tornado did occur on October 20, 1970, but the remainder was during the summer months. The Fujita Scale ranks tornadoes from F0 to F6 based on wind speed and intensity. F0 and F1 tornado's are described as weak tornado's with wind speeds from 40 to 112 mph, F2 and F3 are strong tornado's with wind speeds from 113-206 mph, F4 and F5 are violent tornado's with wind speeds from 207 to 318 mph and an F6 is an inconceivable tornado with wind speeds above 319 mph.

Of the 5 tornadoes that have been recorded in Cheboygan County since June 1955; two were F1, three were F0. Tornadoes occurred at a rate of about 1 each 10 years.

B. Severe Winds (Windstorm): According to the National Weather Service, winds in excess of 58 miles per hour are classified as a windstorm. Windstorms are a fairly common occurrence in many areas in Michigan. Along the Great Lakes shoreline, strong winds occur with regularity, and gusts of over 74 miles per hour (hurricane velocity) do occasionally occur in conjunction with a storm front. Severe windstorms can cause damage to homes and businesses, power lines, trees and agricultural crops, and may require temporary sheltering of individuals without power for extended periods of time. Some severe windstorms that have struck Lower Michigan are summarized in **Table 6-5**.

Table 6-5 – Severe Windstorms in Northern Michigan

Location	Summary of Impact
West Michigan	On April 6-7, 1997, an intense early spring low pressure system moving across the Great Lakes brought gale force winds to much of Lower Michigan. Wind gusts of 50-70 miles per hour created 10-15 foot waves on the Lake Michigan shoreline, causing widespread wind damage and lakeshore beach erosion. Private damage was estimated at $5 million, most of that occurring in a handful of West Michigan counties. The winds downed numerous trees and power lines across the region, causing roof damage to many structures and power outages for nearly 200,000 Consumers Energy electrical customers. No deaths or injuries were reported in this severe wind event.
Lower Michigan	On April 30, 1984 a windstorm struck the entire Lower Peninsula, resulting in widely scattered damage, 1 death, and several injuries. Wind gusts measured up to 91 miles per hour in some areas. Damage was widely scattered, but extensive, with 6,500 buildings, 300 mobile homes, and 5,000 vehicles being damaged. Over 500,000 electrical customers lost power. In addition, 10-16 foot waves on Lake Michigan caused severe shore erosion, collapsing some cottages and driving many boats aground.
Statewide	Nov. 10-11, 1998:One of the strongest storms ever recorded in the Great Lakes moved across Michigan on the 10th and 11th of November, 1998, producing strong, persistent winds that damaged buildings, downed trees and power lines, killed one person, and left over 500,000 electrical customers in the Lower Peninsula without power. Wind gusts of 50-80 miles per hour were common, and a peak gust of 95 miles per hour was reported on Mackinac Island. Damage was widespread but relatively minor for a storm of that intensity. However, there were several pockets of significant damage across the state. The U.S. Forest Service reported that at least $10 million worth of timber was lost in the Ottawa and Hiawatha National Forests.

Northern Lower Michigan	Sept. 26-27, 1998: During the weekend of September 26-27, 1998, severe thunderstorms ravaged northern Lower Michigan, producing strong winds that damaged or destroyed homes, businesses and public facilities, and downed trees and power lines. Otsego County, and specifically the city of Gaylord, was hardest hit, although damage was also reported in Crawford and Charlevoix counties as well. The storm front, which ran along and north of the M-32 corridor from East Jordan to Alpena, was approximately 12 miles wide and 15 miles long. When the front slammed into Gaylord, wind speeds had reached hurricane force of 80-100 miles per hour. The wind was accompanied by brief heavy rainfall and golf ball size hail. The storm lasted only a few minutes in Gaylord, but the damage was tremendous. Thousands of trees were snapped off at waist level, homes and businesses were torn apart, power lines were downed, and several public facilities were substantially damaged – including the Otsego County Courthouse, which lost half of its roof. Approximately 818 homes were damaged throughout Otsego County, including 47 that were destroyed and 92 that incurred major damage. In addition, the storm injured 11 persons – none seriously. Region-wide, about 12,000 electrical customers lost power. A Governor's Disaster Declaration was granted to the county to provide state assistance in the debris cleanup effort
West-Central and Central Michigan	On May 31, 1998, a line of severe thunderstorms passed through west-central and central Michigan, producing in some areas hurricane and tornado-force winds that damaged or destroyed 1,500 homes and 200 businesses, severely damaged numerous public facilities, and downed thousands of trees and power lines throughout the 15 county affected area. The downed power lines left nearly 900,000 electrical customers without power, some for up to one week. The storms directly and indirectly caused four fatalities and injured over 140 more. The severe winds were measured at speeds of up to 130 miles per hour in some areas – equivalent to an F2 tornado or strong hurricane. Damage to homes and businesses were estimated at $16 million, while public damage totaled another $36 million. A Presidential Major Disaster Declaration was granted for 13 of the 15 counties, making available both public and hazard mitigation assistance to affected local jurisdictions. In addition, Small Business Administration disaster loans were made available to 11 of the 15counties to help rebuild homes and businesses damaged in the storms.

C. Hailstorms: A condition where atmospheric water particles from thunderstorms form into rounded or irregular lumps of ice that fall to the earth. Hail is a product of strong thunderstorms that frequently move across the state. As these thunderstorms pass over, hail usually falls near the center of the storm, along with heaviest rain. Sometimes, however, strong winds occurring at high altitudes in the thunderstorm can blow hailstones away from the storm center, causing an unexpected hazard at places that otherwise might not appear threatened. Hailstones range in size from a pea to a golf ball, but hailstones larger than baseballs have occurred in the most severe thunderstorms. Hail is formed when strong updrafts within the storm carry water droplets above the freezing level, where they remain suspended and continue to grow larger, until their weight can no longer be supported by the winds. They finally fall to the ground, battering crops, denting autos, and injuring wildlife and people. Large hail is a characteristic of severe thunderstorms and it often precedes the occurrence of a tornado.

According to the Michigan Hazard Analysis Plan: A line of severe thunderstorms that ravaged northern Lower Michigan during the weekend of September 26-27, 1998 produced hail up to 2" in diameter in Manistee County, destroying an estimated 30,000-35,000 bushels of apples at area farms. The same storm system produced tennis ball size hail north of the town of Gladwin, which damaged several homes

and vehicles. In Arenac County, near Sterling, 3.5" diameter hail damaged crops and injured some livestock at area farms, and damaged several homes, satellite dishes, and vehicles.

The National Weather Service began recording hail activity in Michigan in 1967. Statistics since that time indicate that approximately 50% of the severe thunderstorms that produce hail have occurred during the months of June and July, and nearly 80% have occurred during the prime-growing season of May through August. As a result, the damage to crops from hail is often extensive. The incidence of hail follows the incidence of severe thunderstorms. Therefore, those areas of the state most prone to severe thunderstorms are also the areas most prone to large and damaging hail. Generally, severe thunderstorms that produce hail occur more frequently in the southern half of the Lower Peninsula than any other area of the state. However, damaging hail has occurred in every part of Michigan. The National Weather Service forecasts of severe thunderstorms usually give sufficient warning time to allow residents to take appropriate action to reduce the effects of hail damage to vehicles and some property. However, little can be done to prevent damage to crops.

The National Climate Data Center reports 10 hail events in Cheboygan County since June 1992, or an average of one storm each 1.2 years. The largest diameter hailstone recorded in the County was .75 inches.

D. Lightning: The discharge of electricity from within a thunderstorm. Although lightning is often perceived as a minor hazard, it damages many structures and kills and injures more people in the U.S. per year, on average, than tornadoes or hurricanes. Many lightning deaths and injuries could be avoided if people would have more respect for the threat that lightning presents. *Michigan ranks second in the nation in both lightning-related deaths and lightning-related injuries.*

The following information is compiled in the Michigan Hazard Analysis Plan: Statistics compiled by the National Oceanic and Atmospheric Administration (NOAA) and the National Lightning Safety Institute (NLSI) for the period 1959-1994 revealed the following about lightning fatalities, injuries and damage in the United States:

Location of Lightning Strikes

- 40% are at unspecified locations
- 27% occur in open fields and recreation areas (not golf courses)
- 14% occur to someone under a tree (not on golf course)
- 8% are water-related (boating, fishing, swimming, etc.)
- 5% are golf-related (on golf course or under tree on golf course)
- 3% are related to heavy equipment and machinery
- 2.4% are telephone-related
- 0.7% are radio, transmitter and antenna-related

Gender of Victims

- 84% are male; 16% are female

Months of Most Strikes

- July (30%); August (22%); June (21%)

Days of Most Strikes

- #1 – Sunday; #2 – Wednesday; #3 – Saturday

Time of Most Strikes

- • 2:00 PM – 6:00 PM

Number of Victims

- • One victim (91%); two or more victims (9%)

The NLSI estimates that 85% of lightning victims are children and young men (ages 10-35) engaged in recreation or work-related activities. Approximately 20% of lightning strike victims die, and 70% of survivors suffer serious long-term after-effects such as memory and attention deficits, sleep disturbance, fatigue, dizziness, and numbness.

Unfortunately, lightning has taken a tremendous toll on Michigan's citizens in terms of injury and loss of life.

Since 1959 when the National Weather Service began keeping such records, Michigan has incurred 99 lightning deaths, 693 lightning injuries, and 792 lightning casualties (deaths and injuries combined) – consistently ranking it near the top of the nation in all three categories. During the period 1959-1994 (the last period for which composite statistics are available), Michigan was ranked 2nd nationally (behind Florida) in lightning injuries, 12th nationally in lightning deaths, and 2nd nationally (again, behind Florida) in lightning casualties. Undoubtedly, the fact that Michigan is an outdoor recreation-oriented state contributes heavily to its high lightning death and injury tolls. As the table below indicates, Michigan's lightning deaths and injuries are fairly consistent with the national trends in terms of location of deadly or injury-causing strikes: **(Table 6-6).**

Table 6-6 -- Lightning-Related Deaths in Michigan: 1959-July 2001

Number of Deaths	Location	Percent of Total
28	Open fields, ball fields	28%
26	Under trees (not golf)	27%
11	Boats/water related	11%
10	Golf Course	10%
4	Near tractors/heavy equipment	4%
2	At telephone	2%
18	Other locations/unknown	18%
Source: Storm Data, National Climatic Data Center		

Drought

According to the Michigan Hazard Analysis: Drought is a normal part of the climate of Michigan and of virtually all other climates around the world – including areas with high and low average rainfall. Drought differs from normal arid conditions found in low rainfall areas in that aridity is a permanent characteristic of that type of climate. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. The severity of a drought depends not only on its location, duration, and geographical extent, but also on the water supply demands made by human activities and vegetation. This multi-faceted nature of the hazard makes it difficult to define a drought and assess when and where one is likely to occur.

Droughts can cause many severe impacts to a wide range of communities and economic activity across the County including: 1) water shortages for human consumption, industrial, business and agricultural uses, power generation, recreation and navigation; 2) a drop in the quantity and quality of agricultural crops; 3) decline of water quality in lakes, streams and other natural bodies of water; 4) malnourishment of wildlife and livestock; 5) increase in wildfires and wildfire-related losses to timber, homes and other property; 6) declines in tourism in areas dependent on water-related activities; 7) declines in land values due to physical damage from the drought conditions and/or decreased economic or functional use of the property; 8) reduced tax revenue due to income losses in agriculture, retail, tourism and other economic sectors; 9) increases in insect infestations, plant disease, and wind erosion; and 10) possible loss of human life due to food shortages, extreme heat, fire, and other health-related problems such as

diminished sewage flows and increased pollutant concentrations in surface water. Some other drought related economic impacts are reflected in **(Table 6-7)**.

The 1976-77 drought in the Great Plains, Upper Midwest, and West also severely impacted Michigan. Extreme drought conditions contributed to wildfire, crop damage and low Great Lakes levels. The 1988 drought / heat wave in the Central and Eastern U.S. (an event that greatly impacted Michigan) caused an estimated $40 billion in damages from agricultural losses, disruption of river transportation, water supply shortages, wildfires, and related economic impacts.

In response to the 1988 drought, Michigan communities instituted temporary water use restrictions. To stem the potential for wildfire in Michigan, the Governor issued (in June, 1988) a statewide outdoor burning ban. The summer of 1998 drought / heat wave from Texas to the Carolinas caused an estimated $6-9 billion in damage. The summer of 1999 drought / heat wave caused over $1 billion in damage – mainly to agricultural crops in the Eastern U.S. The summer of 2000 drought / heat wave in the South-Central and Southeastern U.S. resulted in over $4 billion in damages and costs. The drought / heat wave that struck Michigan during the summer of 2001 damaged or destroyed approximately one-third of the state's fruit, vegetable and field crops, resulting in a U.S. Department of Agriculture Disaster Declaration for 82 of the state's counties.

In addition, the drought / heat wave caused water shortages in many areas in Southeast Michigan, forcing local officials to issue periodic water usage restrictions. In Cheboygan County, impacts from extended drought are reduction in crop and livestock production, increased potential for wildfires, reduction in farm products, reduction in timber production, and loss of tourism and decreased watercraft access to Lake Huron and large inland lakes.

Table 6-7 -- Economic Impact of Drought	
Costs and losses to agricultural producers	• Annual and perennial crop losses • Damage to crop quality • Income loss for farmers due to reduced crop yields • Reduced productivity of cropland (wind erosion, long-term loss of organic matter, etc.) • Insect infestation • Plant disease • Wildlife damage to crops • Increased irrigation costs • Cost of new or supplemental water resource development (wells, dams, pipelines)
Costs and losses to livestock producers	• Reduced productivity of rangeland • Reduced milk production • Forced reduction of foundation stock • Closure/limitation of public lands to grazing • High cost/unavailability of water for livestock • Cost of new or supplemental water resource development (wells, dams, pipelines) • High cost/unavailability of feed for livestock • Increased feed transportation costs • High livestock mortality rates • Disruption of reproduction cycles (delayed breeding, more miscarriages) • Decreased stock weights • Increased predation • Range fires

Loss from timber production	• Wildland fires • Tree disease • Insect infestation • Impaired productivity of forest land Direct loss of trees, especially young ones
Loss from fishery production	• Damage to fish habitat • Loss of fish and other aquatic organisms due to decreased flows
General economic effects	• Decreased land prices • Loss to industries directly dependent on agricultural production (e.g., machinery and • fertilizer manufacturers, food processors, dairies, etc.) • Unemployment from drought-related declines in production • Strain on financial institutions (foreclosures, more credit risk, capital shortfalls) • Revenue losses to federal, state, and local governments (from reduced tax base) • Reduction of economic development • Fewer agricultural producers (due to bankruptcies, new occupations) • Rural population loss
Loss to recreation and tourism	• Loss to manufacturers and sellers of recreational equipment • Losses related to curtailed activities: hunting and fishing, bird watching, boating, etc.
Energy-related effects	• Increased energy demand and reduced supply because of drought-related power curtailments • Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power
Transportation	Loss from impaired navigability of streams, rivers, and canals
Food Production decline	• Increase in food prices • Increased importation of food (higher costs)
	• Source: National Drought Mitigation Center, University of Nebraska, Lincoln

Earthquakes:

A sudden motion or trembling in the earth caused by an abrupt release of slowly accumulating strain, which results in ground shaking, surface faulting, or ground failures. Most areas of the United States are subject to earthquakes including parts of Michigan, and they occur literally thousands of times per year. Northeastern Michigan to date has been out of known earthquakes impact areas and Cheboygan County is located in an area with less than a 2%g (peak acceleration) and has a relatively low seismic risk.

Subsidence:

Depressions, cracks, and sinkholes in the ground surface, which can threaten people and property. Subsidence depressions, which normally occur over many days to a few years, may damage structures with low strain tolerances, such as dams, nuclear reactors, and utility infrastructure. The sudden collapse of the ground surface to form sinkholes poses an immediate threat to life and property. Such ground movements may continue for several days, weeks, months or even years, until the walls stabilize. The population most at risk would be in areas where industrial or residential development has occurred above active or abandoned mines where underground cavities are present near the surface, as well as areas where an extensive amount of groundwater has been withdrawn.

The population most at risk would be in areas where industrial or residential development has occurred above active or abandoned mines where underground cavities are present near the surface, as well as

areas where an extensive amount of groundwater has been withdrawn. The most prevalent subsidence features in Northern Michigan are Karst sinkholes. Collapse of a sink is usually a localized natural hazard. Karst subsidence also offers the threat of exposing groundwater to rapid contamination in certain circumstances.

Other Technological Hazards

Dam Failures:

Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act (451 P.A. 1994), as amended, provides for the inspection of dams. This statute requires the MDEQ to rate each dam as either "high", "significant", or "low" hazard potential, according to the potential downstream impact if the dam were to fail (not according to the physical condition of the dam). The MDEQ has identified and rated over 2,400 dams. This statute regulates dams over 6 feet in height that create an impoundment with a surface area of more than 5 acres. Dam owners are required to maintain an EAP for "high" and "significant" hazard potential dams. Owners are also required to coordinate with local emergency management officials to assure consistency with local emergency operations plans. Dams regulated by FERC, such as hydroelectric power dams, are generally exempt from this statute. The FERC licenses water power projects (including dams) that are developed by non-federal entities, including individuals, private firms, states and municipalities. Under provisions of the Federal Power Act and federal regulations, the licensee of the project must prepare an EAP. This plan must include a description of actions to be taken by the licensee in case of an emergency. Licensees must conduct a functional exercise at certain projects, in cooperation with local emergency management officials.

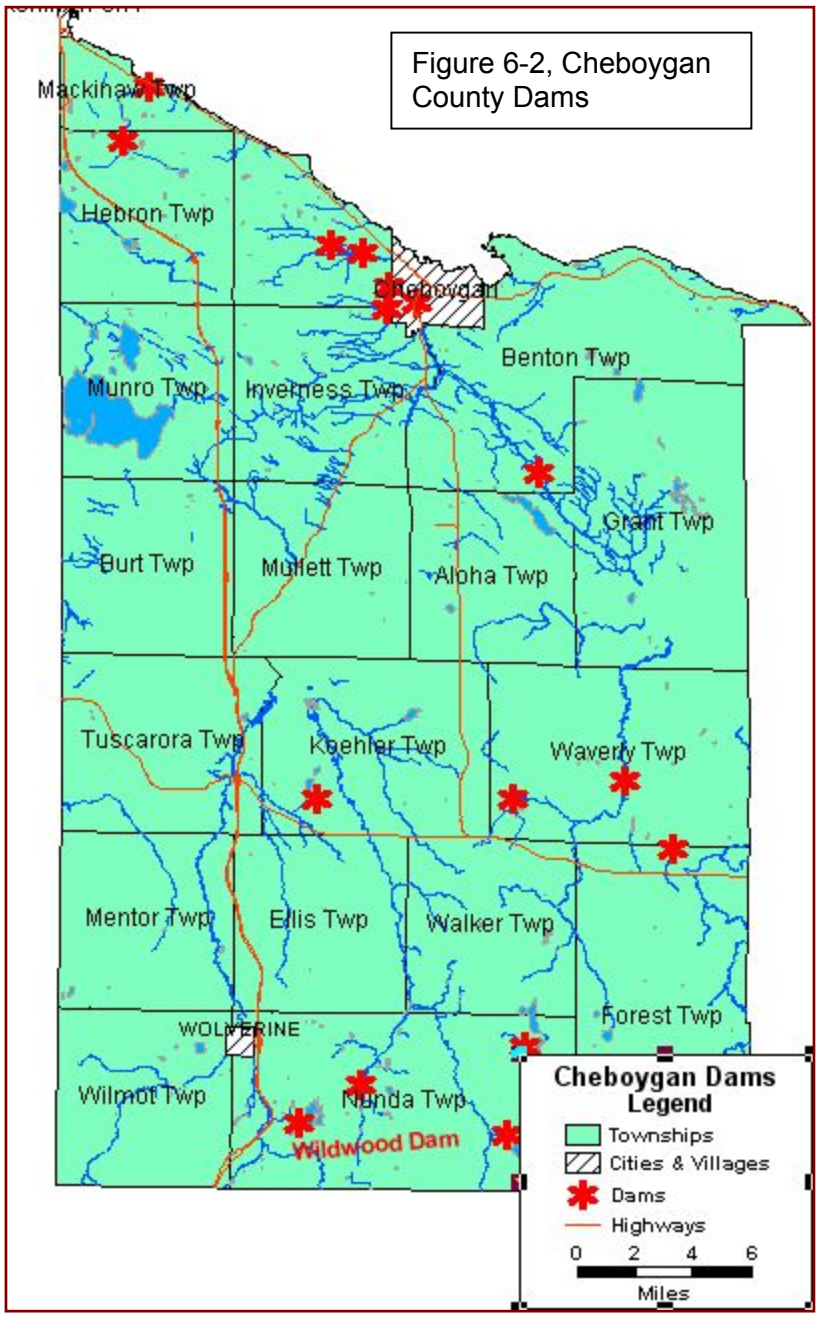


Figure 6-2, Cheboygan County Dams

Dam failure is defined as the collapse or failure of an impoundment resulting in downstream flooding. Dam failures can result in loss of life and extensive property or natural resource damage for miles downstream from the dam. Failure of a dam does not only occur during flood events, which may cause overtopping of a dam. Failure can also result from mis-operation, lack of maintenance and repair, and vandalism. Such failures can be catastrophic because they occur unexpectedly, with no time for evacuation. Michigan has experienced over 260 dam failures in its history. Cheboygan County has 15 dams, 7 of which are rated as high hazards on the National

Inventory of Dams. (Figure 6-1) The Wildwood Dam in Nunda Township currently is the most critical of the high hazard dams in the county

A field inspection of the Wildwood Lake Dam was conducted on July 10, 2002.

This report indicated that there was no indication of wet or marshy areas on the dam crest. Seepage was reported on the downstream slope, but has not changed since a previous inspection in 1999.

Another inspection was reported on August 20, 2003 that included recommendations for rehabilitating the structure.

Oil and Gas Pipeline Accidents:

An oil and gas pipeline accidents occur when an uncontrolled release of oil or gas or the poisonous by-product hydrogen sulfide, from a pipeline. As a major oil and gas consumer in the United States, vast quantities of oil and natural gas are transported through and stored in Michigan. Though often overlooked as a threat because much of the oil and gas infrastructure in the state is located underground, oil and gas pipelines can leak, erupt or explode causing property damage, environmental contamination, injuries and loss of life. In addition to these hazards, there is also a danger of hydrogen sulfide release. Hydrogen sulfide is an extremely poisonous gas that is also explosive when mixed with air temperatures of 500 degrees or above. In addition to pipelines, these dangers can be found around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities where the gas or oil has a high sulfur content.

Oil and Gas Well Accidents:

Accidents at oil and gas wells are defined as coming from an uncontrolled release of oil or gas, or the poisonous by-product hydrogen sulfide, from wells. See Oil and Gas Pipeline Accidents for hazard description. Oil and gas are produced from fields in over 60 counties in the Lower Peninsula.

In addition to these hazards, many of Michigan's oil and gas wells contain extremely poisonous hydrogen sulfide (H2S) gas. Hydrogen sulfide is a naturally occurring gas mixed with natural gas or dissolved in the oil or brine and released upon exposure to atmospheric conditions. Over 1,300 wells in Michigan have been identified as having H2S levels exceeding 300 parts per million (ppm). As the table below indicates, at concentrations of 700 ppm, as little as one breath of hydrogen sulfide can kill. Although hydrogen sulfide can be detected by a "rotten egg" odor in concentrations from .03 ppm to 150 ppm, larger concentrations paralyze a person's olfactory nerves so that odor is no longer an indicator of the hazard. Within humans, small concentrations can cause coughing, nausea, severe headaches, irritation of mucous membranes, vertigo, and loss of consciousness. Hydrogen sulfide forms explosive mixtures with air at temperatures of 500 degrees Fahrenheit or above, and is dangerously reactive with powerful oxidizing materials. Hydrogen sulfide can also cause the failure of high-strength steels and other metals. This requires that all company and government responders be familiar not only with emergency procedures for the well site, but also with the kinds of materials that are safe for use in sour gas well response.

Over 40,000 wells have been drilled in these counties. More than 9,600 wells have been drilled in the eight counties of Northeast Lower Michigan. Of the State total, approximately one-half (20,000) have produced oil or gas. Over 1.1 billion barrels of crude oil and 3.6 trillion cubic feet of gas have been withdrawn from these wells. In Cheboygan County approximately 90 wells have been drilled and 7 are currently producing oil. The majority of the wells are in the southeast portion of the County in Forest Township.

Other Infrastructure Failures

Nuclear Power Plant Accidents:

An actual or potential release of radioactive material at a commercial nuclear power plant or other nuclear facility, in sufficient quantity to constitute a threat to the health and safety of the off-site population. Such an occurrence, though not probable, could affect the short and long-term health and safety of the public living near the nuclear power plant, and cause long-term environmental contamination around the plant. As a result, the construction and operation of nuclear power plants are closely monitored and regulated by the Federal government. Communities with a nuclear power plant must develop detailed plans for responding to and recovering from such an incident, focusing on the 10 mile Emergency Planning Zone (EPZ) around the plant and a 50 mile Secondary EPZ that exists to prevent the introduction of radioactive contamination into the food chain. Michigan has 3 active and 1 inactive commercial nuclear power plants, in addition to 4 small nuclear testing/research facilities located at 3 state universities and within the City of Midland. Cheboygan County does not have a Nuclear power plant.

Other Societal Hazards

Civil Disturbances

A public demonstration or gathering (such as a sports event), or a prison uprising, that results in a disruption of essential functions, rioting, looting, arson or other unlawful behavior. Large-scale civil disturbances rarely occur, but when they do they are usually an offshoot or result of one or more of the following events: 1) labor disputes where there is a high degree of animosity between the two dissenting parties; 2) high profile/controversial judicial proceedings; 3) the implementation of controversial laws or other governmental actions; 4) resource shortages caused by a catastrophic event; 5) disagreements between special interest groups over a particular issue or cause; or 6) a perceived unjust death or injury to a person held in high esteem or regard by a particular segment of society.

Areas subject to civil disturbances may encompass large portions of a community. Types of facilities that may be subject to or adversely impacted by civil disturbances may include government buildings, military bases, Community College, businesses, and critical service facilities such as our hospital, police and fire facilities. Civil disturbances (including jail uprisings) often require the involvement of multiple community agencies in responding to and recovering from the incident. There have been no recorded incidences of civil disturbances in recent history.

Nuclear Attack:

Any hostile attack against the United States, using nuclear weapons, which results in destruction of military and/or civilian targets. All areas of the United States are conceivably subject to the threat of nuclear attack. However, the strategic importance of military bases, population centers and certain types of industries place these areas at greater risk than others. The nature of the nuclear attack threat against the U.S. has changed dramatically with the end of the “Cold War” and the conversion of previous adversaries to more democratic forms of government. Even so, the threat still exists for a nuclear attack against this country. Despite the dismantling of thousands of nuclear warheads aimed at U.S. targets, there still exists in the world a large number of nuclear weapons capable of destroying multiple locations simultaneously. In addition, controls on nuclear weapons and weapons components are sporadic at best in the former Soviet Union, and the number of countries capable of developing nuclear weapons continues to grow despite the ratification of an international nuclear non-proliferation treaty. It seems highly plausible that the threat of nuclear attack will continue to be a hazard in this country for some time in the future.

At this point, attack-planning guidance prepared by the Federal government in the late 1980s still provides the best basis for a population protection strategy for Michigan. That guidance has identified 25 potential target areas in Michigan, and 4 in Ohio and Indiana that would impact Michigan communities, classified as follows: 1) commercial power plants; 2) chemical facilities; 3) counterforce military installations; 4) other military bases; 5) military support industries; 6) refineries; and 7) political targets.

For each of these target areas, detailed plans have been developed for evacuating and sheltering the impacted population, protecting critical resources, and resuming vital governmental functions in the post-attack environment.

Sabotage/Terrorism:

An intentional, unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political, social, or religious objectives. Sabotage/terrorism can take many forms or have many vehicles for delivery, including: 1) bombings; 2) assassinations; 3) organized extortion; 4) use of nuclear, chemical and biological weapons; 5) information warfare; 6) ethnic/religious/gender intimidation (hate crimes); 7) state and local militia groups that advocate overthrow of the U.S. Government; 8) eco-fanatacism, designed to destroy or disrupt specific research or resource-related activities; and 9) widespread and organized narcotics smuggling and distribution organizations. Because sabotage/terrorism objectives are so widely varied, so too are the potential targets of such actions. Virtually any public facility or infrastructure, or place of public assembly, can be considered a potential target. In addition, certain types of businesses engaged in controversial activities are also potential targets, as are large computer systems operated by government agencies, banks, financial institutions, large businesses, health care facilities, and colleges/universities.

Local Jurisdictions

Mitigation Planning Sectors

The hazard mitigation planning approach being used is to divide Cheboygan County into geographic sub-parts (sectors) for the purpose of developing a more detailed, targeted hazard analysis and set of mitigation, preparedness, and response and recovery strategies. Sectoring is being accomplished by using existing municipal boundaries. Each planning sector has a map of the area showing community facilities and infrastructure and some general information on population, housing and land use. Information received from the communities was used to help define the potential hazards the community may encounter.

Aloha Township

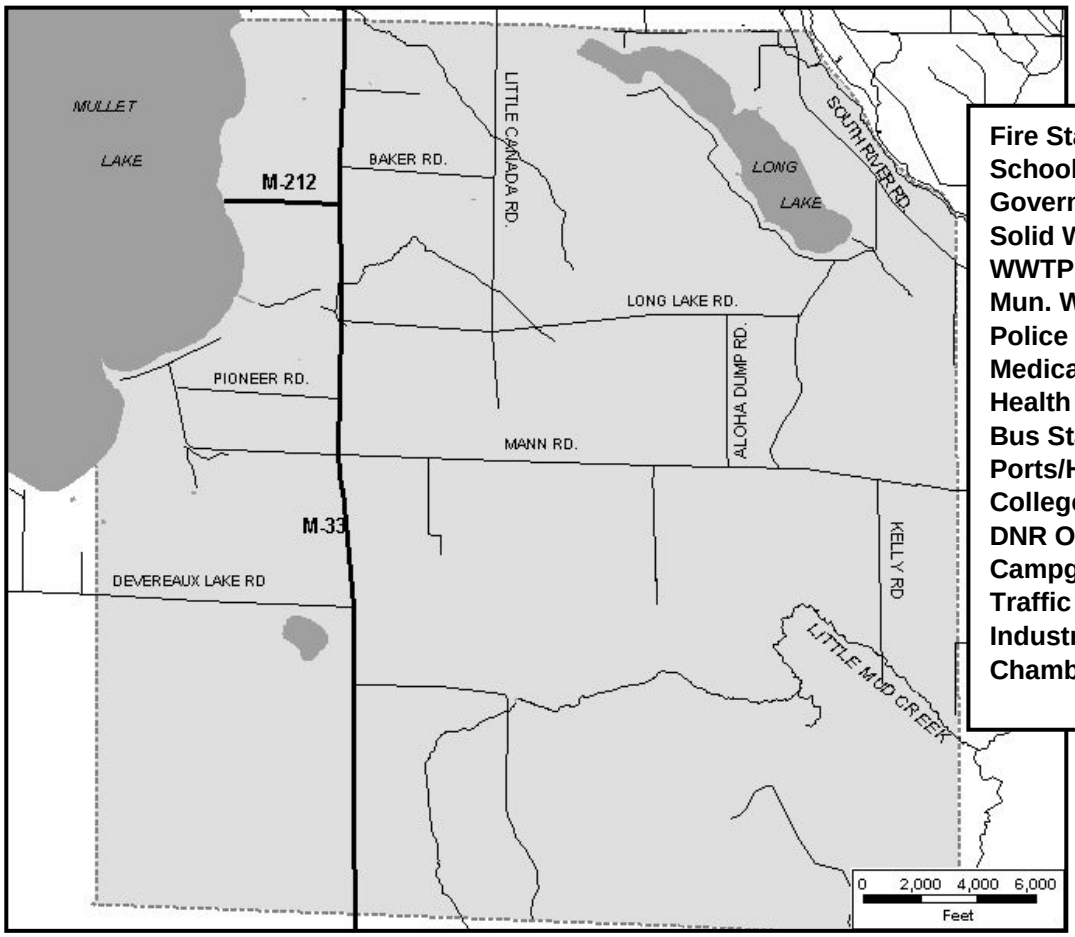
- 2000 population 1,041; 670 housing units, 423 occupied, 206 seasonal.
- 22.5% of housing units are 40+ years old, 12.1% are mobile homes.
- Predominant land cover is upland forest and agricultural. Large seasonal population at Aloha state park and village.
- M-33 AADT, 2,200 vehicles.

Potential Hazards

Natural: Shoreline flooding/erosion

Technological: Transportation accident (water, land, air), structural fire, hazardous material spill

Societal: West Nile, Bovine TB, civil disturbance



Fire Stations	**1**
Schools	**2**
Government Buildings	**3**
Solid Waste Facilities	**4**
WWTP	**5**
Mun. Water Supplies	**6**
Police Stations	**7**
Medical Facilities	**8**
Health Dept Buildings	**9**
Bus Stations	**10**
Ports/Harbors	**11**
Colleges/Universities	**12**
DNR Offices	**13**
Campgrounds	**14**
Traffic Counts	**15**
Industrial Parks	**16**
Chambers of Comm.	**17**

Beaugrand Township

- 2000 population 1,157; 643 housing units, 484 occupied, 120 seasonal.
- 27% of housing units are 40+ years old, 12.7% are mobile homes.
- Predominant land cover is lowland forest and agricultural.
- Cheboygan airport, industrial uses. Dam on Little Black River. US 23 AADT, 4,300 vehicles.

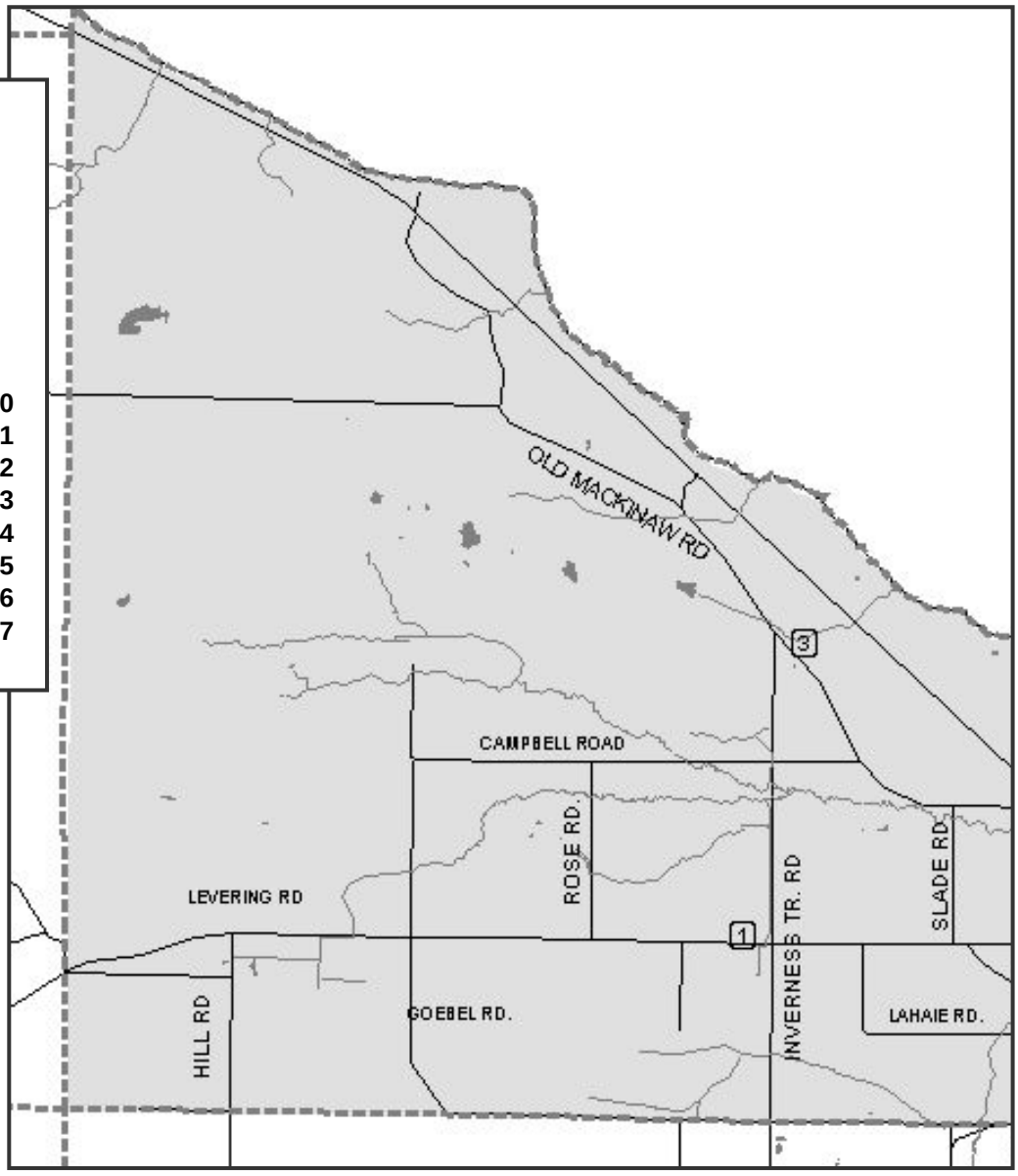
Potential Hazards

Natural: Shoreline flooding/erosion

Technological: Transportation accident (water, land, air), structural fire, hazardous material spill, industrial accident, dam failure

Societal: West Nile, Bovine TB

Fire Stations	**1**
Schools	**2**
Govt. Buildings	**3**
Solid Waste Facilities	**4**
WWTP	**5**
Mun. Water Supplies	**6**
Police Stations	**7**
Medical Facilities	**8**
Health Dept Bldgs	**9**
Bus Stations	**10**
Ports/Harbors	**11**
Colleges/Universities	**12**
DNR Offices	**13**
Campgrounds	**14**
Traffic Counts	**15**
Industrial Parks	**16**
Chambers of Comm.	**17**



Benton Township

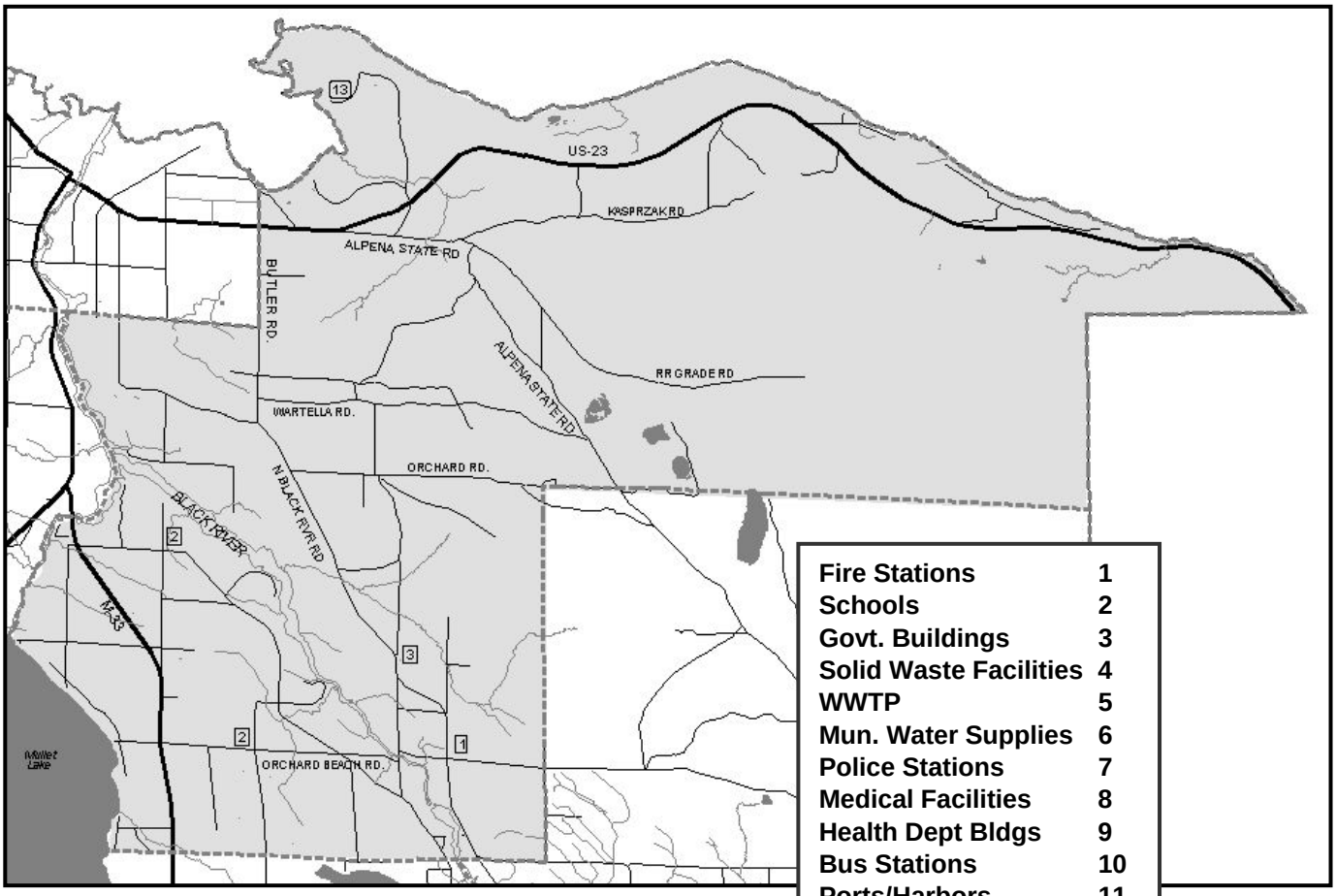
- 2000 population 3,080; 1,627 housing units, 1,248 occupied, 312 seasonal.
- 17.7% of housing units are 40+ years old 12.9% are mobile homes.
- Predominant land cover is upland forest and agricultural. Bisected by Black River.
- US 23 AADT 2,200 vehicles; M 33 AADT, 2,200 vehicles.
- Large retirement population.

Potential Hazards

Natural: Riverine flooding, Shoreline flooding/erosion

Technological: Transportation accident (water, land), structural fire, hazardous material spill, infrastructure failure, dam failure

Societal: West Nile, Bovine TB



Burt Township

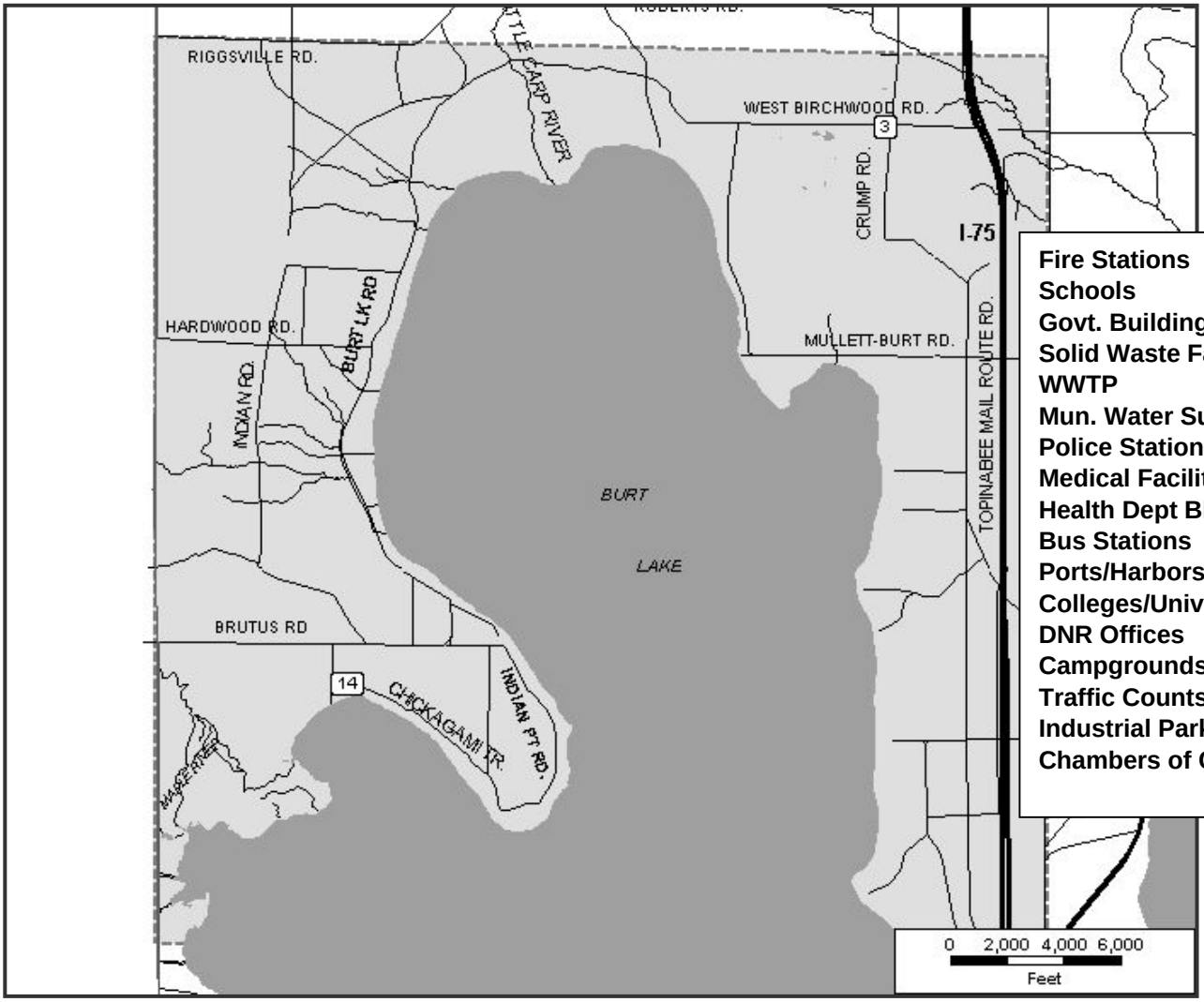
- 2000 population 654; 794 housing units, 482 occupied, 444 seasonal.
- 21.8% of housing units are 40+ years old, 5.4% are mobile homes.
- Predominant land cover is upland forest.
- I-75 AADT, 8,100 vehicles.

Potential Hazards

Natural: Shoreline flooding/erosion

Technological: Transportation accident (water, land, air), structural fire, hazardous material spill

Societal: West Nile



City of Cheboygan

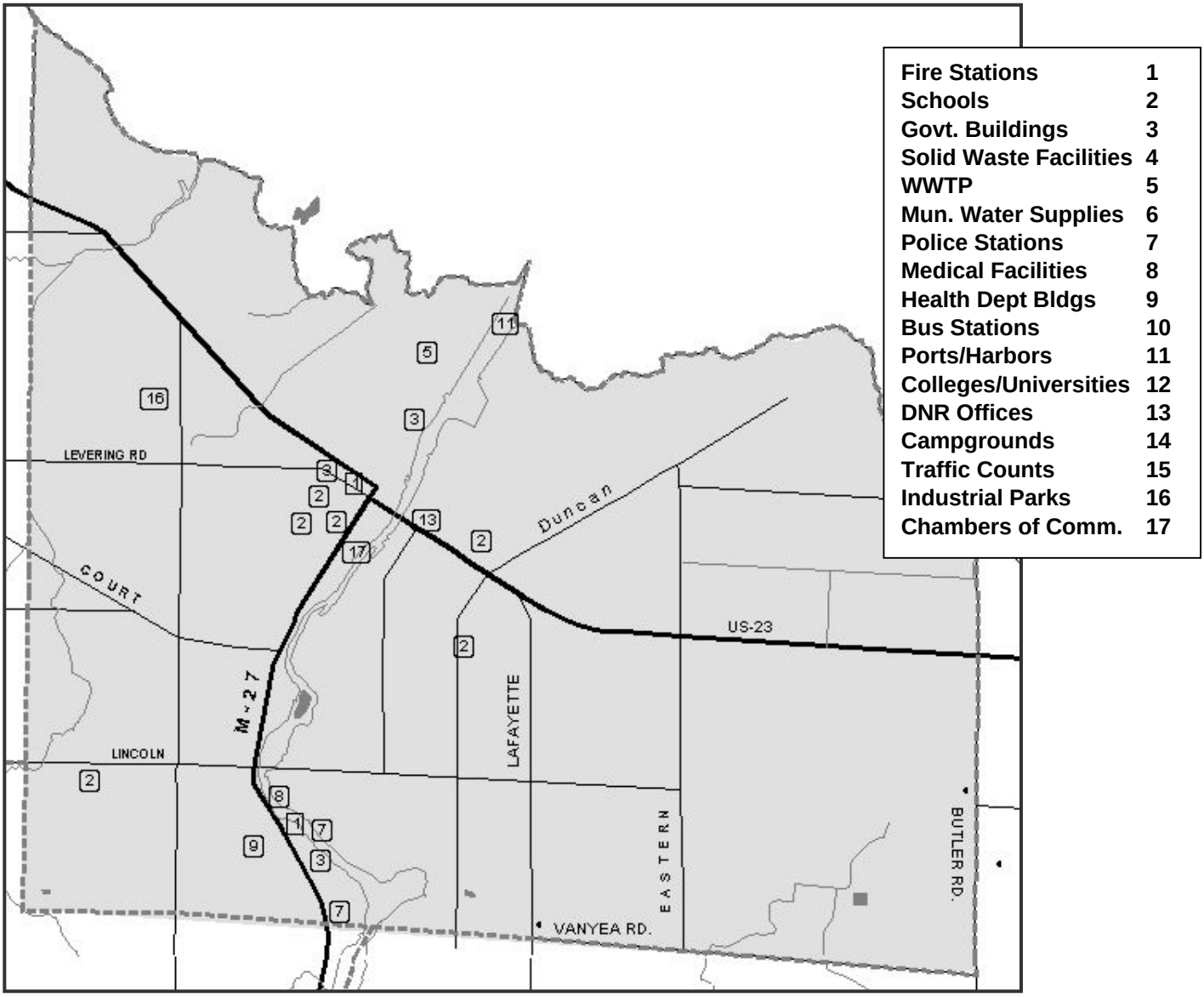
- 2000 population 5,295; 2,366 housing units, 2,146 occupied, 59 seasonal.
- 61.7% of housing units are 40+ years old, 6.0% are mobile homes.
- Predominant land cover is residential. Concentration of people and infrastructure. Bisected by Cheboygan River.
- Locks and critical bridges. US 23 AADT, 12,600 vehicles; M 27 AADT, 15,100 vehicles.

Potential Hazards

Natural: Riverine flooding, Shoreline flooding/erosion

Technological: Transportation accident (water, land, air), structural fire, hazardous material spill, industrial accident, infrastructure failure,

Societal: Civil disturbance, public health



Ellis Township

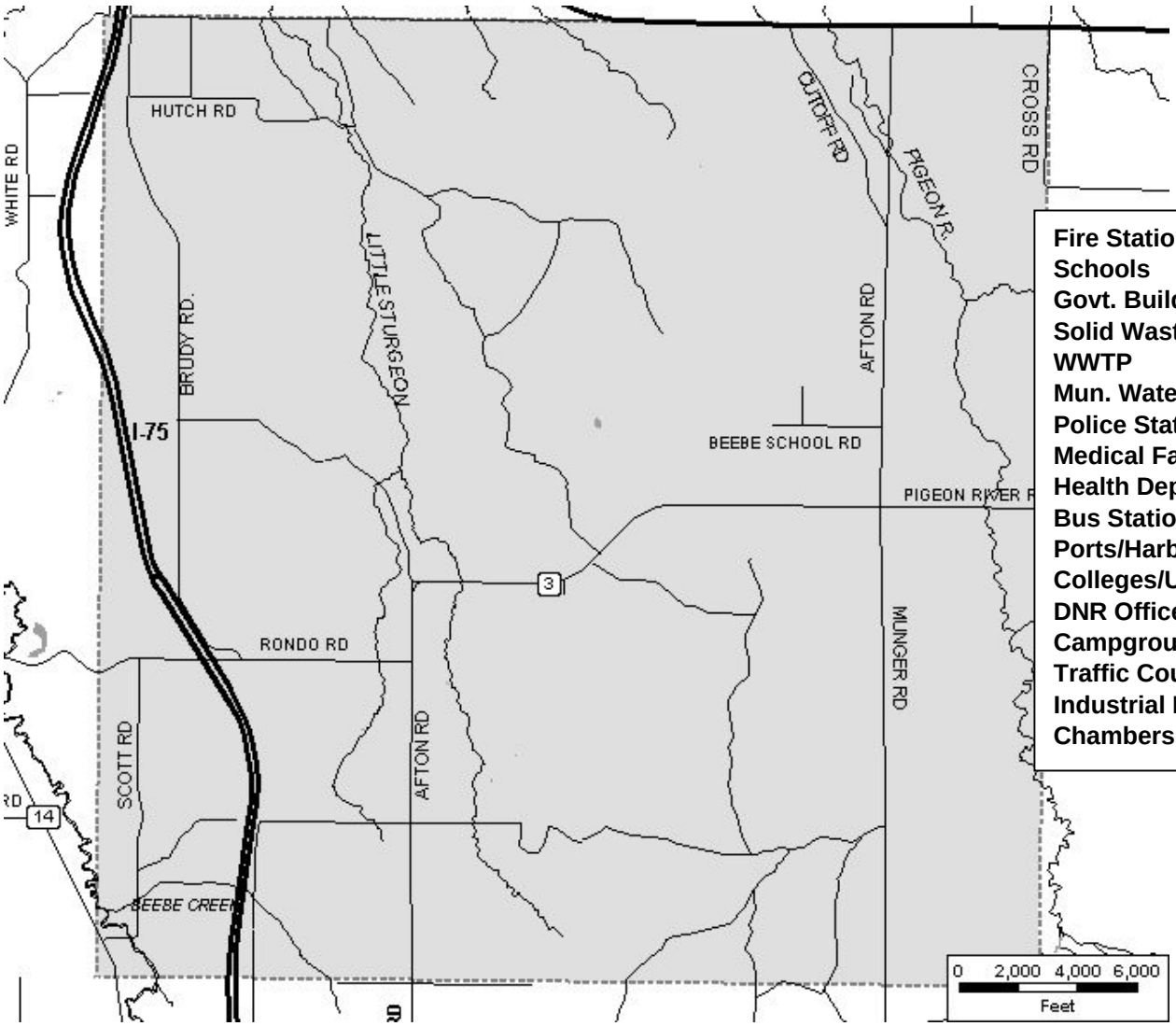
- 2000 population 519; 329 housing units, 190 occupied, 115 seasonal.
- 23.4% of housing units are 40+ years old15.1% are mobile homes.
- Predominant land cover is upland forest. Bisected by the Pigeon and
- Little Sturgeon Rivers.
- I-75 AADT, 8,700 vehicles; M-68 AADT 5,400 vehicles.

Potential Hazards

Natural: Riverine flooding, wildfire

Technological: Transportation accident (land), structural fire, hazardous material spill

Societal: West Nile, Bovine TB



Forest Township

- 2000 population, 1,080; 620 housing units, 431 occupied, 153 seasonal. 26.3% of housing units are 40+ years old, 21.1% are mobile homes.
- Predominant land cover is upland forest and lowland forest.
- M 68 AADT, 3,600 vehicles per day. Large amount of public recreation land. Tower Dam.

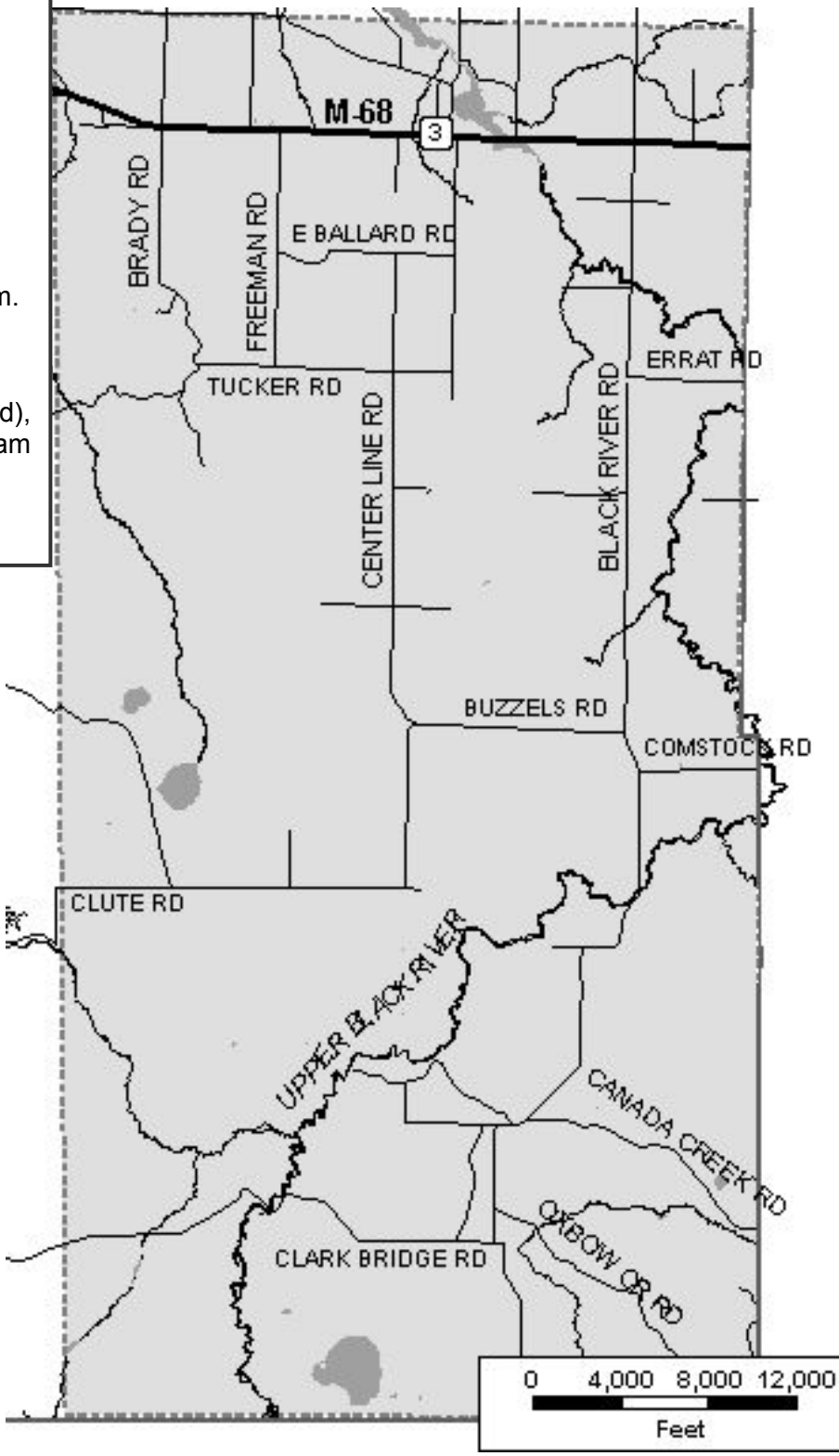
Potential Hazards

Natural: Rivirene flooding, wildfire

Technological: Transportation accident (land), structural fire, hazardous material spill, dam failure

Societal: Bovine TB, West Nile

Fire Stations	**1**
Schools	**2**
Govt. Buildings	**3**
Solid Waste Facilities	**4**
WWTP	**5**
Mun. Water Supplies	**6**
Police Stations	**7**
Medical Facilities	**8**
Health Dept Bldgs.	**9**
Bus Stations	**10**
Ports/Harbors	**11**
Colleges/Universities	**12**
DNR Offices	**13**
Campgrounds	**14**
Traffic Counts	**15**
Industrial Parks	**16**
Chambers of Comm.	**17**



Grant Township

- 2000 population, 947; 817 housing units, 428 occupied, 347 seasonal. 31.6% of housing units are 40+ years old, 11.5% are mobile homes.
- Concentration of residences Black Lake. Predominant land cover is upland forest and agricultural. Large amount of public recreation land.

Potential Hazards

Natural: Rivirene flooding, shoreline flooding/erosion wildfire.

Technological: Transportation accident (land, water), structural fire, hazardous material spill

Societal: Bovine TB, West Nile

Fire Stations	**1**
Schools	**2**
Govt. Buildings	**3**
Solid Waste Facilities	**4**
WWTP	**5**
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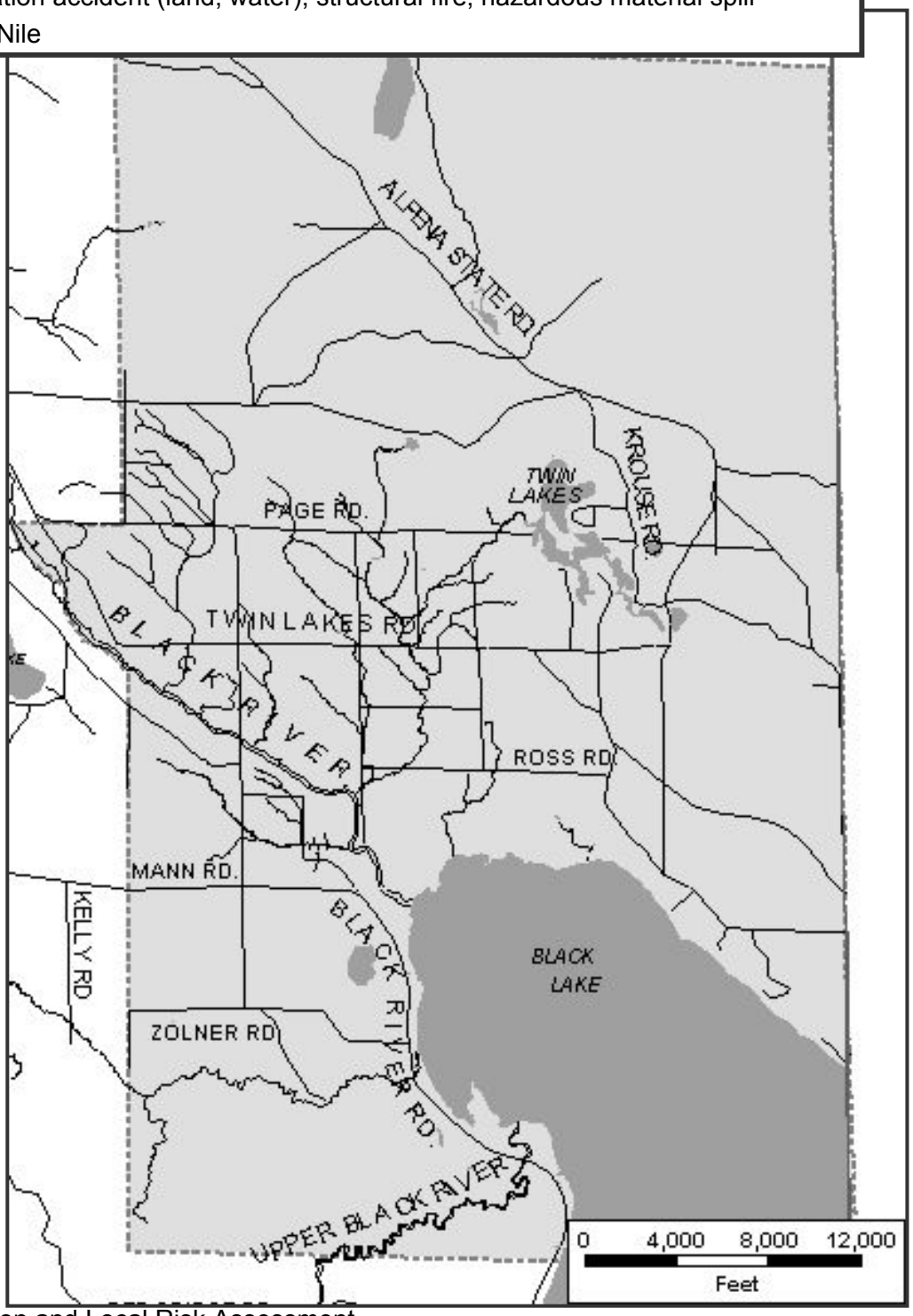
Chambers of Comm.	**17**



Hebron Township

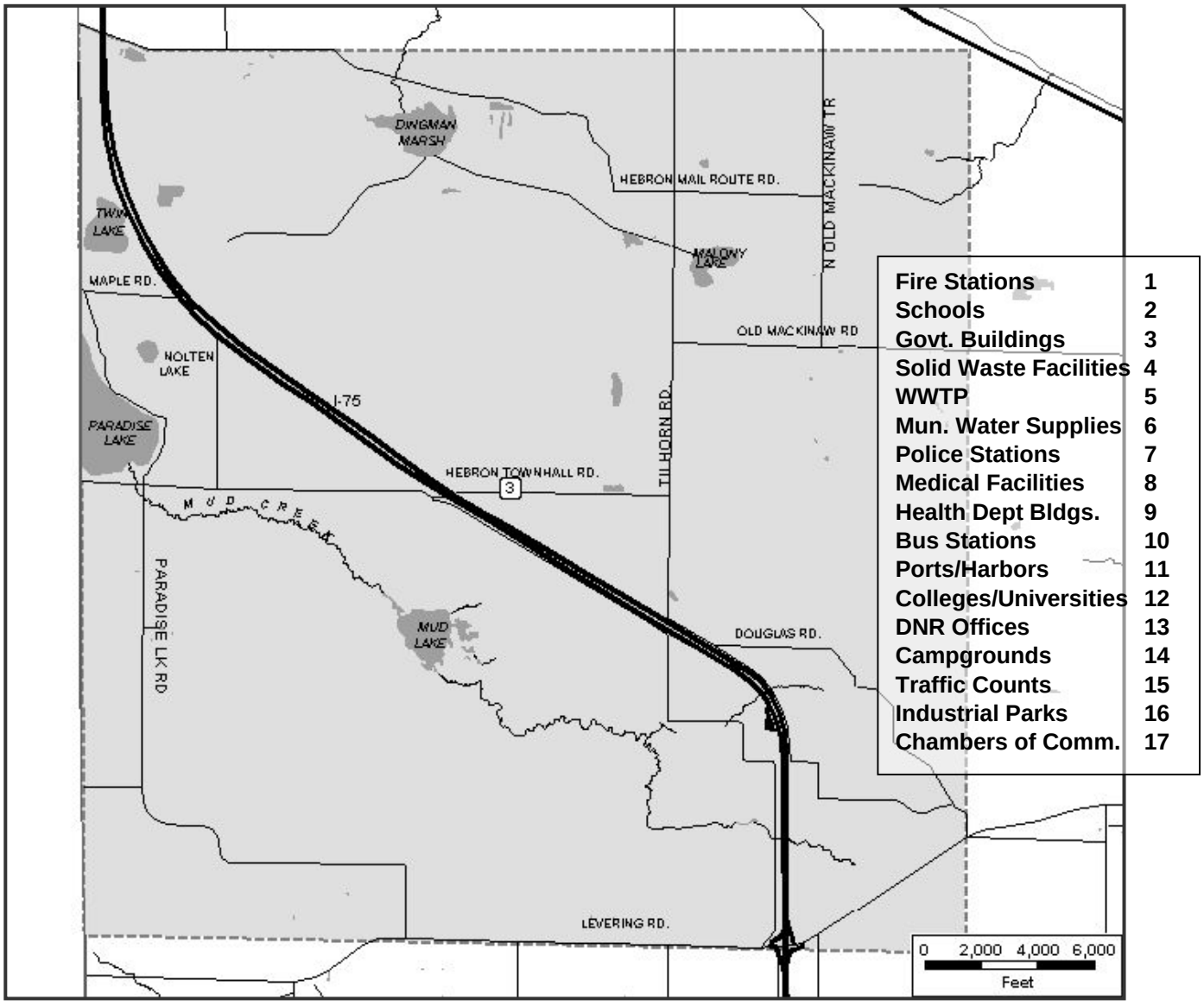
- 2000 population 303; 195 housing units, 118 occupied, 67 seasonal.
- 27.2% of housing units are 40+ years old, 20.3% are mobile homes.
- Predominant land cover is lowland forest and wetlands.
- I-75 AADT, 8,500 vehicles.

Potential Hazards

Natural: Riverine flooding, wildfire

Technological: Transportation accident (land), structural fire, hazardous material spill.

Societal: West Nile, Bovine TB



Fire Stations	**1**
Schools	**2**
Govt. Buildings	**3**
Solid Waste Facilities	**4**
WWTP	**5**
Mun. Water Supplies	**6**
Police Stations	**7**
Medical Facilities	**8**
Health Dept Bldgs.	**9**
Bus Stations	**10**
Ports/Harbors	**11**
Colleges/Universities	**12**
DNR Offices	**13**
Campgrounds	**14**
Traffic Counts	**15**
Industrial Parks	**16**
Chambers of Comm.	**17**

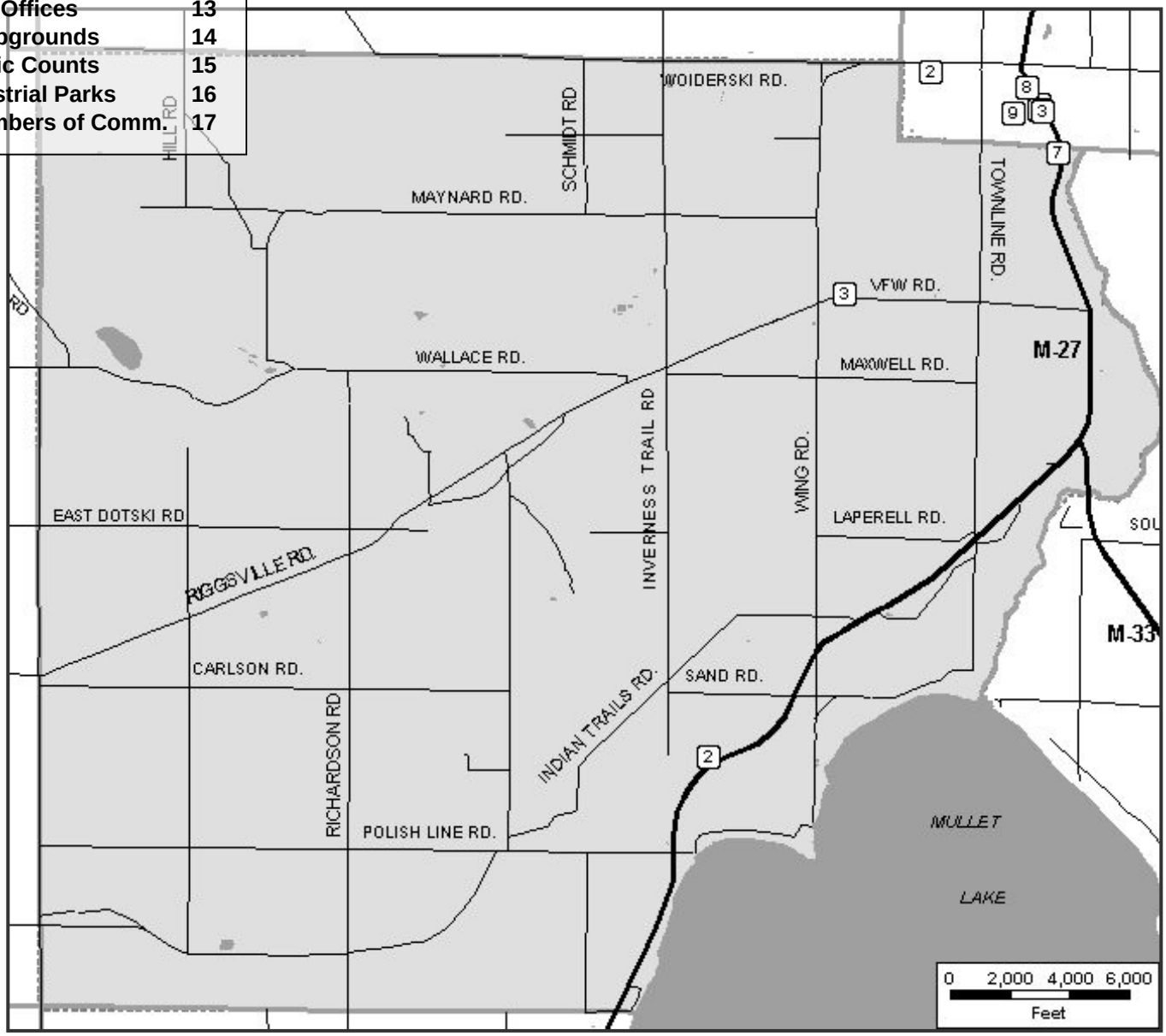
Inverness Township

- 2000 population 2,278; 1,226 housing units, 914 occupied, 221 seasonal.
- 31% of housing units are 40+ years old, 14.5% are mobile homes.
- Predominant land cover is agricultural.
- M-27 AADT, 4,600 vehicles.

Potential Hazards

Natural: Riverine flooding, shoreline flooding/erosion

Technological: Transportation accident (water, land,) structural fire, hazardous material spill,



Koehler Township

- 2000 population 1,168; 795 housing units, 444 occupied, 318 seasonal.
- 21.3% of housing units are 40+ years old, 15.6% are mobile homes.
- Predominant land cover is upland forest. Bisected by Pigeon River,
- M-68 AADT, 5,400 vehicles; M-33 AADT, 2,200 vehicles.

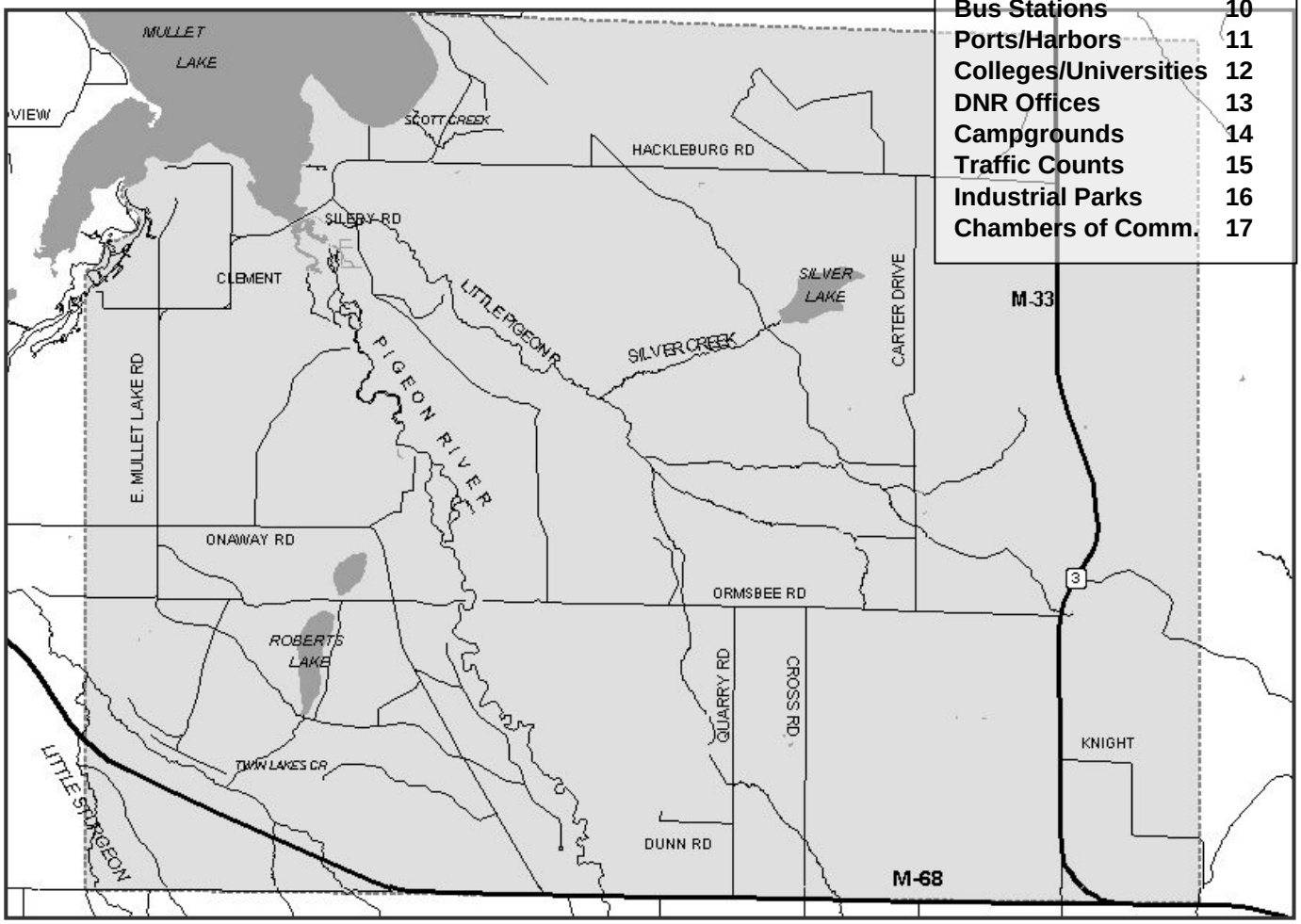
Potential Hazards

Natural: Riverine flooding, shoreline flooding/erosion, wildfire

Technological: Transportation accident (water, land), structural fire, hazardous material spill

Societal: West Nile

Fire Stations	**1**
Schools	**2**
Govt. Buildings	**3**
Solid Waste Facilities	**4**
WWTP	**5**
Mun. Water Supplies	**6**
Police Stations	**7**
Medical Facilities	**8**
Health Dept Bldgs.	**9**
Bus Stations	**10**
Ports/Harbors	**11**
Colleges/Universities	**12**
DNR Offices	**13**
Campgrounds	**14**
Traffic Counts	**15**
Industrial Parks	**16**
Chambers of Comm.	**17**



Mackinaw Township

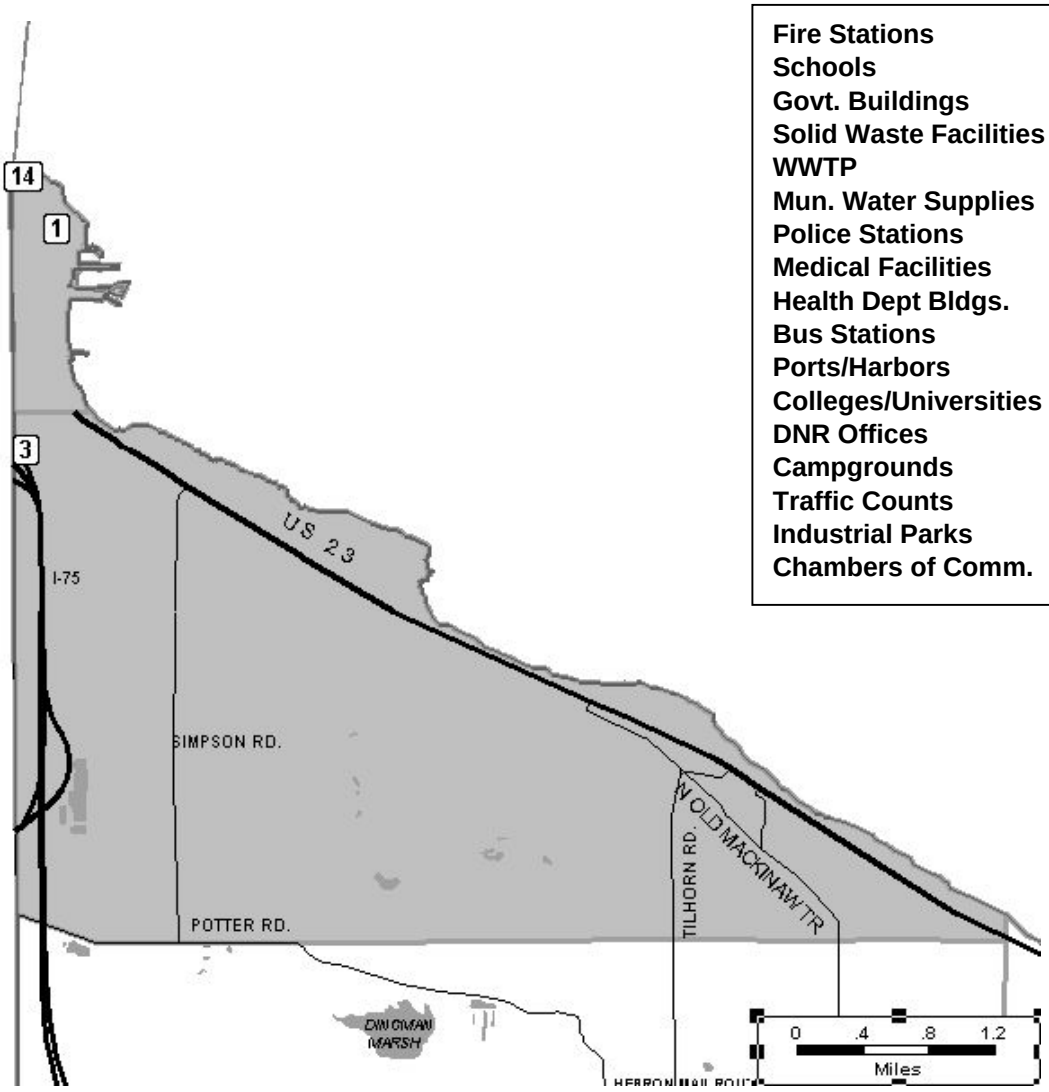
- 2000 population 576; 415 housing units, 260 occupied, 118 seasonal.
- 39.6% of housing units are 40+ years old, 2.9% are mobile homes.
- Predominant land cover is upland and lowland forest. Bisected by Mill
- Creek.
- US-23 AADT, 4,600 vehicles; I-75 AADT, 10,300 vehicles.

Potential Hazards

Natural: Riverine flooding, shoreline flooding/erosion, wildfire, subsidence

Technological: Transportation accident (water, land), structural fire, hazardous material spill,

Societal: West Nile



Fire Stations	**1**
Schools	**2**
Govt. Buildings	**3**
Solid Waste Facilities	**4**
WWTP	**5**
Mun. Water Supplies	**6**
Police Stations	**7**
Medical Facilities	**8**
Health Dept Bldgs.	**9**
Bus Stations	**10**
Ports/Harbors	**11**
Colleges/Universities	**12**
DNR Offices	**13**
Campgrounds	**14**
Traffic Counts	**15**
Industrial Parks	**16**
Chambers of Comm.	**17**

Mentor Township

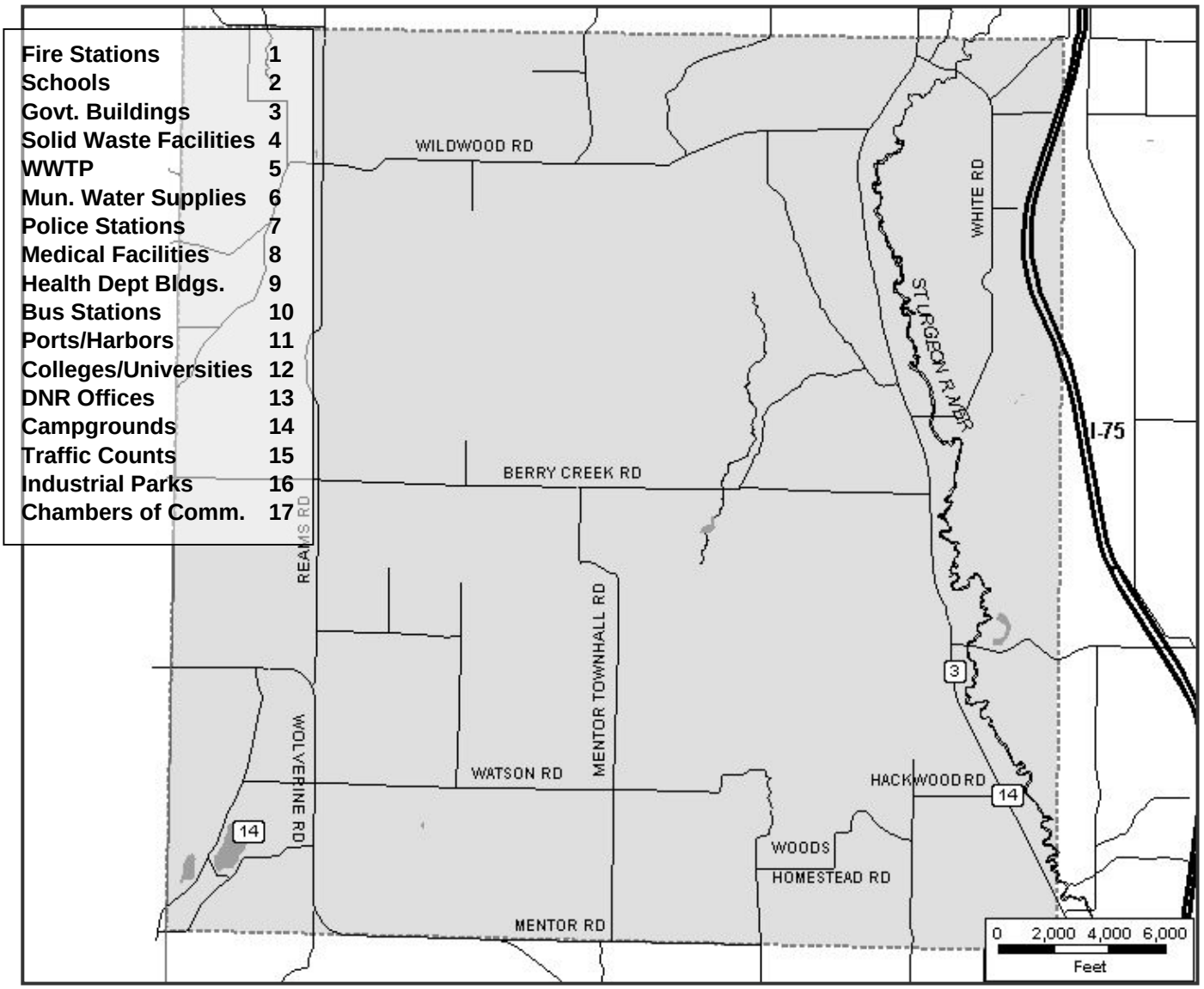
- 2000 population 781;455 housing units, 317 occupied, 114 seasonal.
- 24.3% of housing units are 40+ years old, 13.2% are mobile homes.
- Predominant land cover is upland forest. Bisected by Sturgeon River.
- I-75 AADT, 9,700 vehicles.

Potential Hazards

Natural: Riverine flooding

Technological: Transportation accident (land), structural fire, hazardous material spill

Societal: Bovine TB, West Nile.



Mullet Township

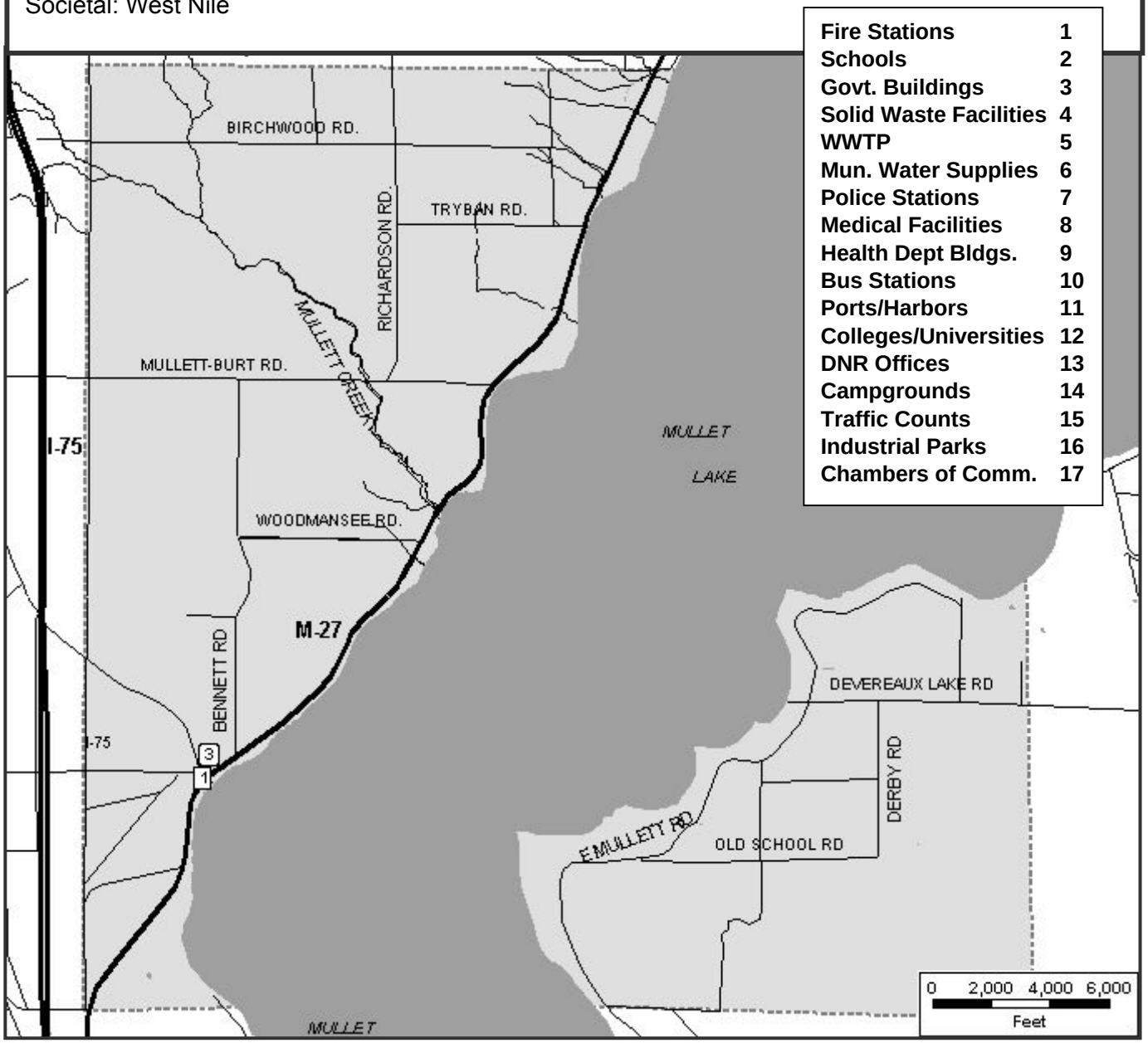
- 2000 population 1,284; 1,076 housing units, 545 occupied, 448 seasonal.
- 37.3% of housing units are 40+ years old, 11.7% are mobile homes.
- Predominant land cover is upland forest.
- M-27AADT, 3,400 vehicles. Airstrip.

Potential Hazards

Natural: Shoreline flooding/erosion, riverine flooding, wildfire.

Technological: Transportation accident (air, water, land), structural fire, hazardous material spill

Societal: West Nile



Munro Township

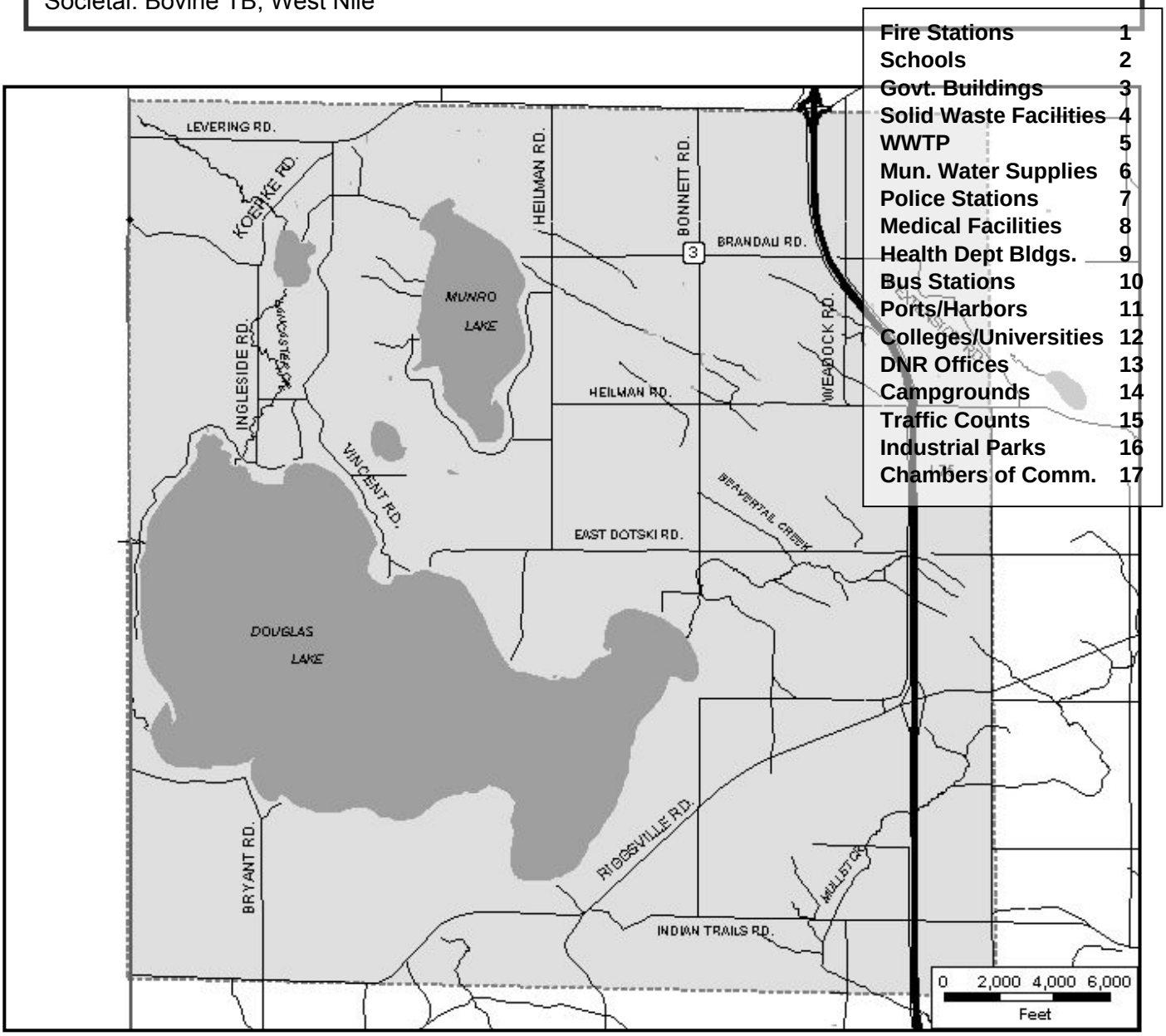
- 2000 population 679; 650 housing units, 270 occupied, 347 seasonal.
- 28.1% of housing units are 40+ years old 7.6% are mobile homes.
- Predominant land cover is agricultural and upland forest.
- I-75 AADT, 8,500 vehicles.

Potential Hazards

Natural: Shoreline flooding/erosion, riverine flooding, wildfire

Technological: Transportation accident (water, land), structural fire, hazardous material spill

Societal: Bovine TB, West Nile



Nunda Township

- 2000 population 925; 706 housing units, 370 occupied, 301 seasonal.
- 21.2% of housing units are 40+ years old, 19.3% are mobile homes.
- Predominant land cover is upland forest. Bisected by Pigeon and Little Pigeon Rivers.
- I-75 AADT, 9,700 vehicles. Large amount of public recreation land.

Potential Hazards

Natural: Riverine flooding, wildfire

Technological: Transportation accident (land), structural fire, hazardous material spill

Societal: West Nile, Bovine TB

Fire Stations	**1**
Schools	**2**
Govt. Buildings	**3**
Solid Waste Facilities	**4**
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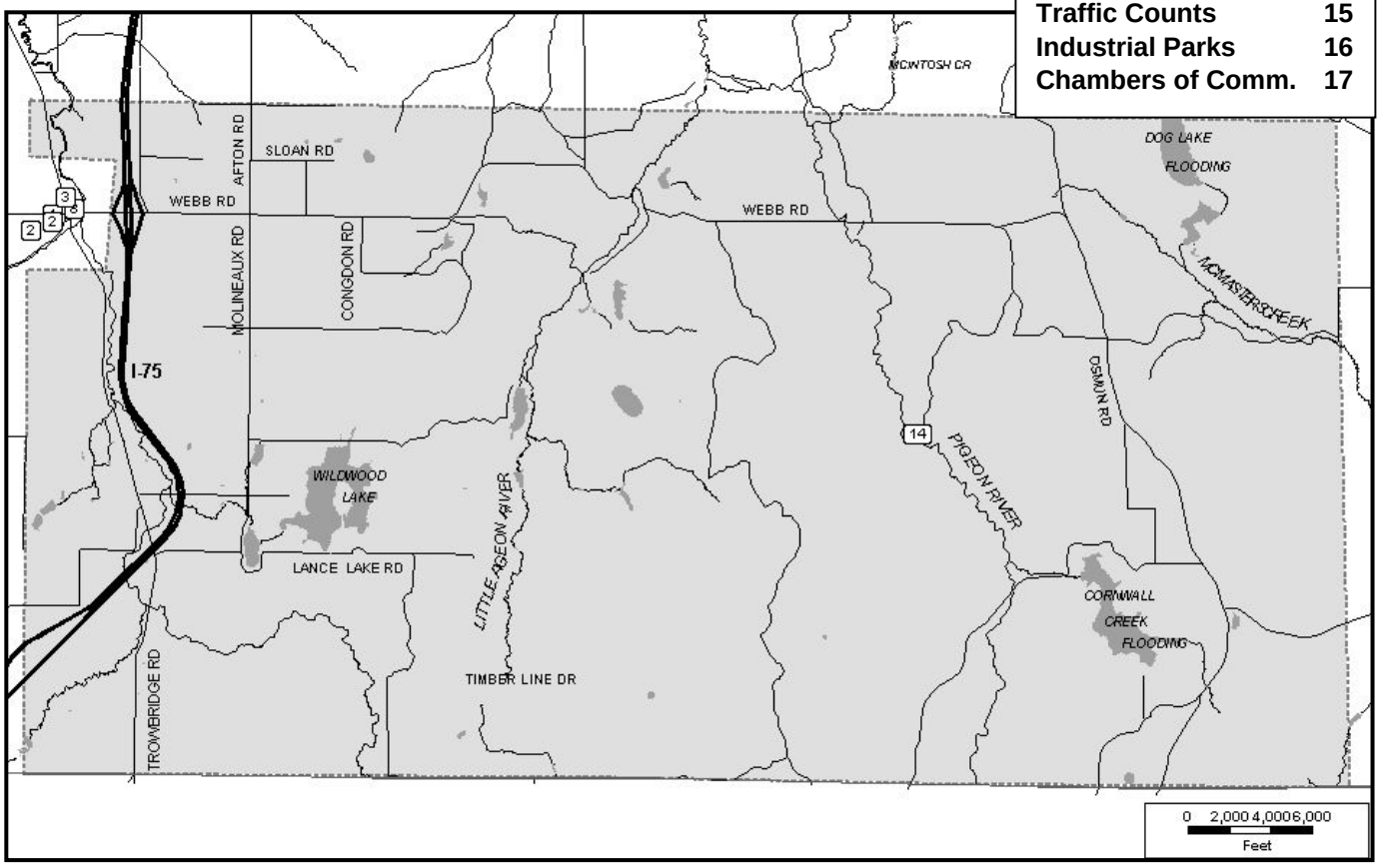
Industrial Parks	**16**
Chambers of Comm.	**17**



Tuscarora Township

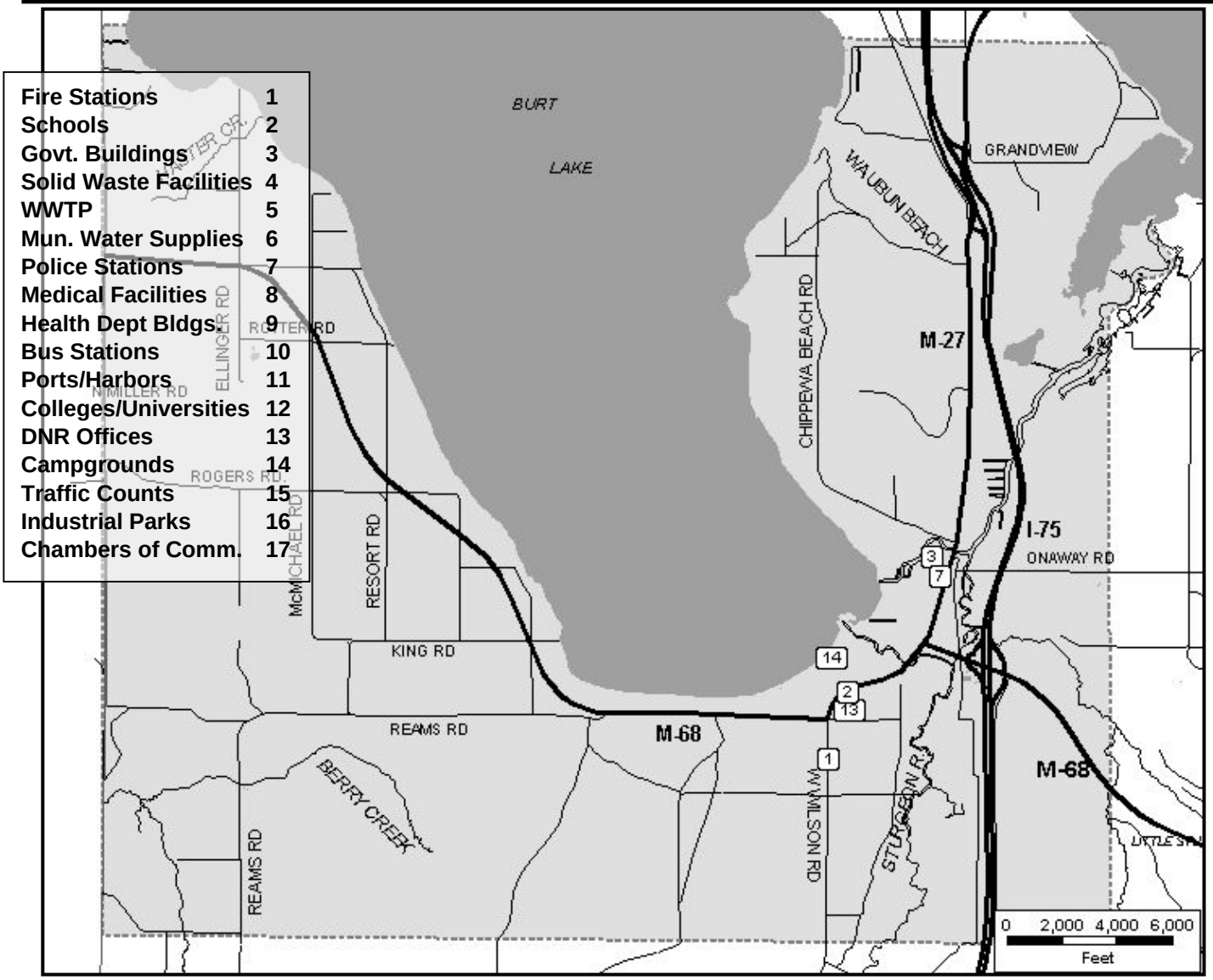
- 2000 population 3,091; 2,162 housing units, 1,357 occupied, 692 seasonal.
- 25.7% of housing units are 40+ years old, 7.2% are mobile homes.
- Predominant land cover is upland forest with concentration of residential and commercial in Indian River. Bisected by Sturgeon River.
- I-75 AADT, 8,100 vehicles; M-68 AADT, 11,800 vehicles; M-27 AADT, 4,500 vehicles. Airstrip.

Potential Hazards

Natural: Riverine flooding, shoreline flooding/erosion, wildfire

Technological: Transportation accident (water, land, air), structural fire, hazardous material spill, infrastructure failure,

Societal: West Nile, Bovine TB



Walker Township

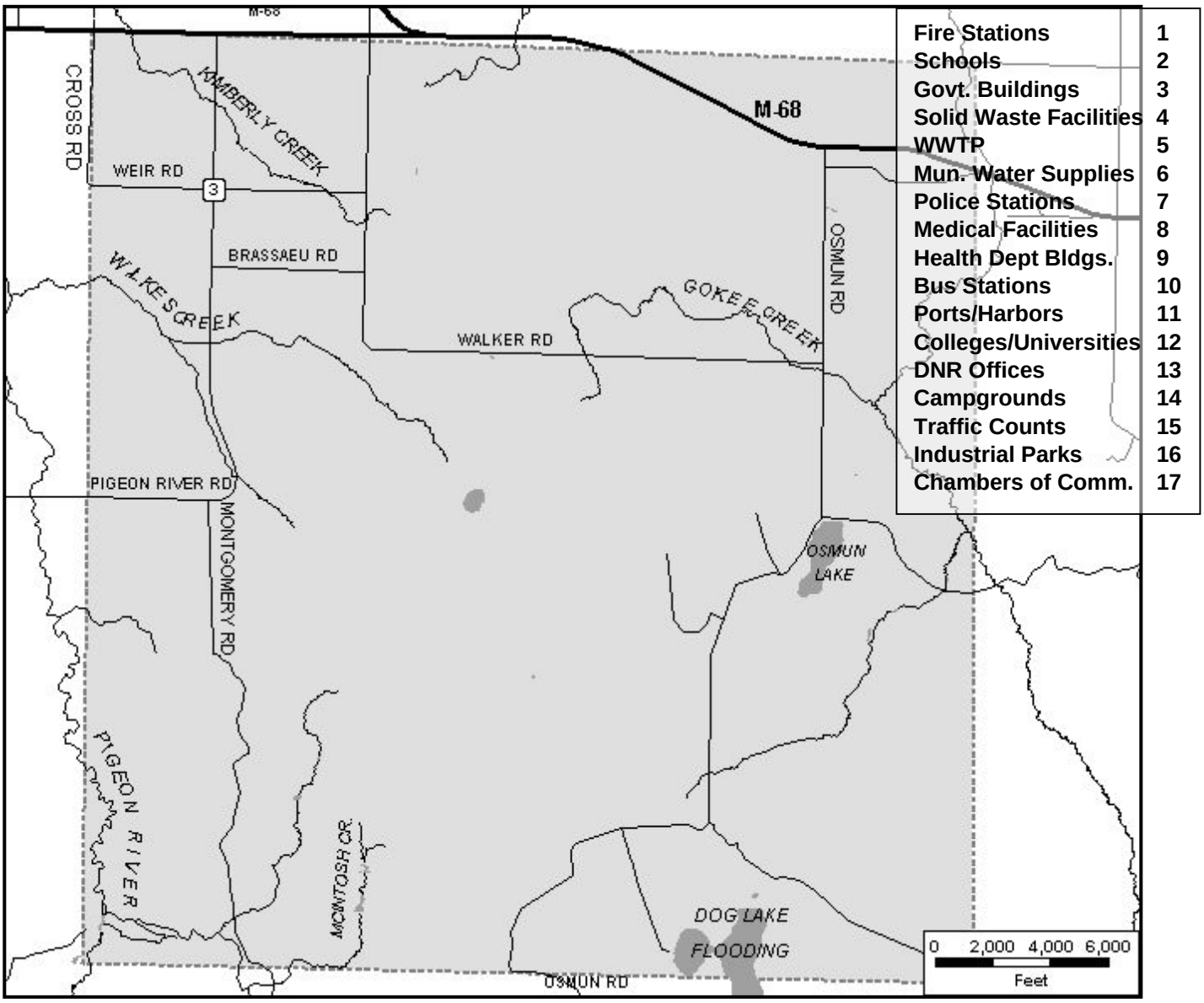
- 2000 population 292; 170 housing units, 101 occupied, 51 seasonal.
- 15.9% of housing units are 40+ years old, 33.7% are mobile homes.
- Predominant land cover is upland forest, agricultural.
- M-68 AADT, 3,600 vehicles. Large amount of public recreation land.

Potential Hazards

Natural: Wildfire, riverine flooding

Technological: Transportation accident (land), structural fire, hazardous material spill

Societal: West Nile, Bovine TB



Waverly Township

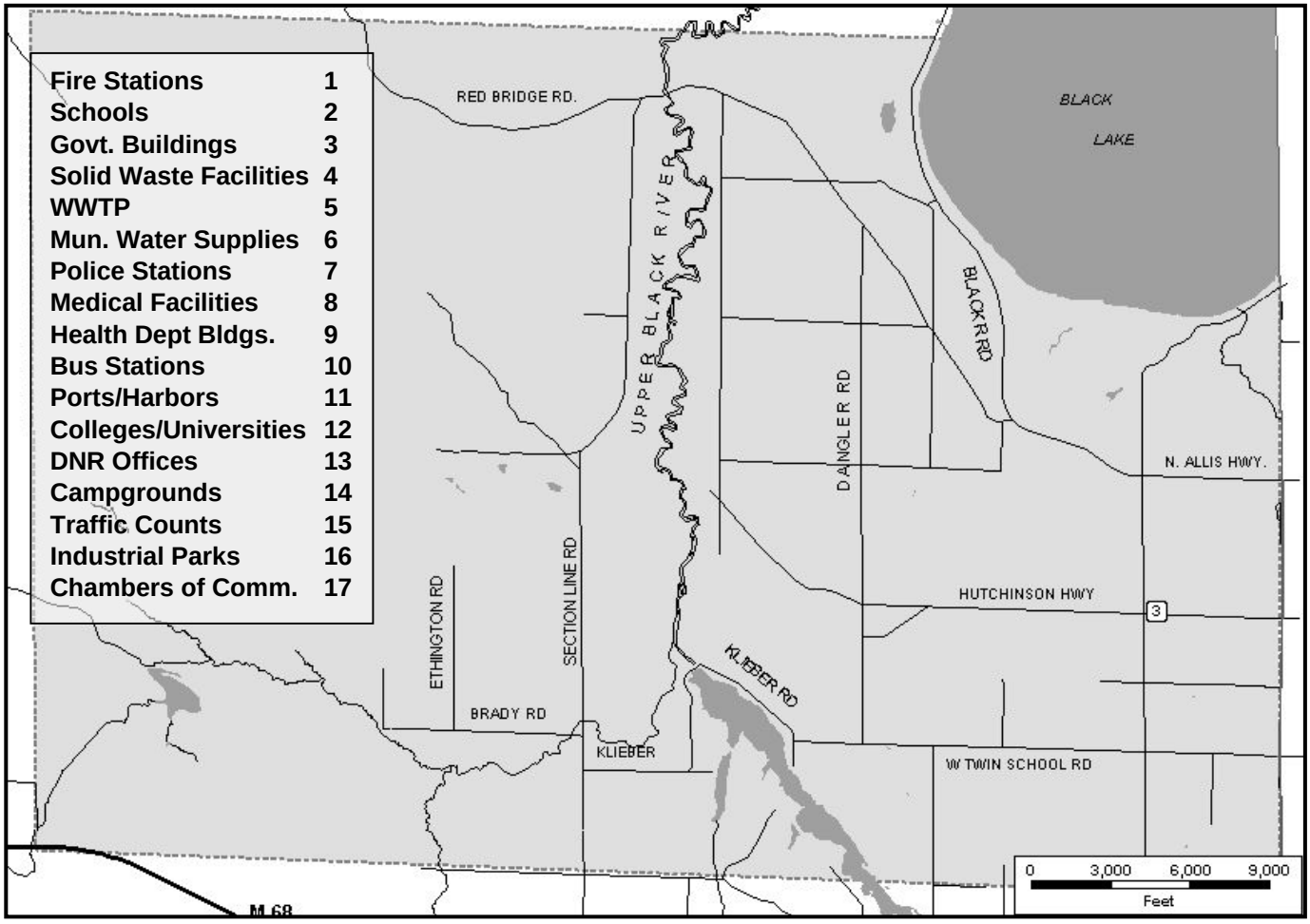
- 2000 population 472; 404 housing units, 182 occupied, 199 seasonal.
- 48.7% of housing units are 40+ years old, 11.2% are mobile homes.
- Predominant land cover is upland forest, agricultural. Bisected by Upper Black River. Stoney Creek dam and Upper Lake Dam.
- Large amount of public recreation land.

Potential Hazards

Natural: Riverine flooding, shoreline flooding/erosion, wildfire

Technological: Transportation accident (water, land), structural fire, hazardous material spill, dam failure

Societal: West Nile, Bovine TB



Wilmot Township

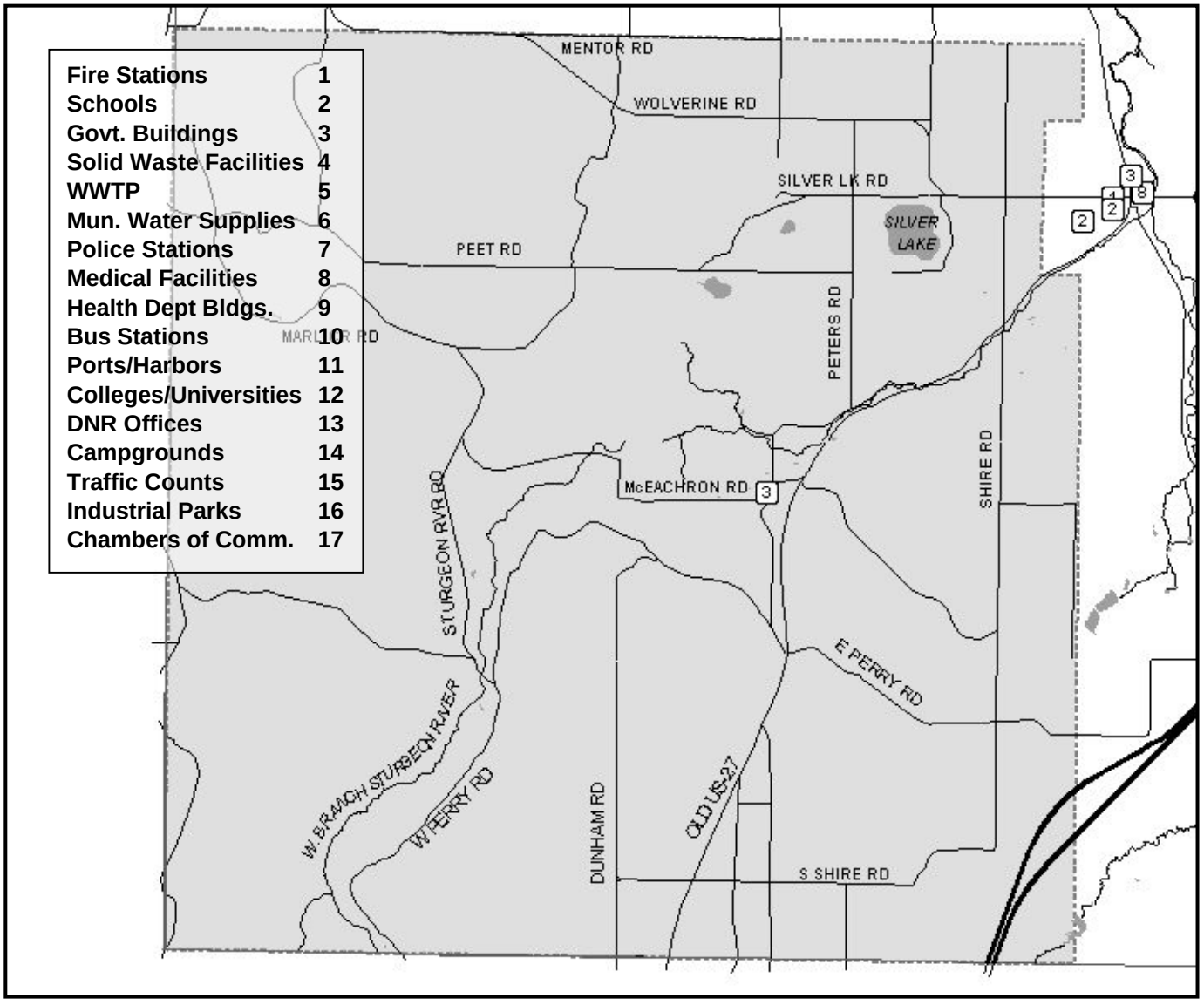
- 2000 population 826; 464 housing units, 295 occupied, 145 seasonal.
- 14.3% of housing units are 40+ years old, 25.6% are mobile homes.
- Predominant land cover is upland forest. Bisected by Sturgeon River.

Potential Hazards

Natural: Riverine flooding, wildfire

Technological: Transportation accident (land), structural fire, hazardous material spill

Societal: West Nile, Bovine TB



Village of Wolverine

- 2000 population 359; 158 housing units, 131 occupied, 17 seasonal.
- 58.3% of housing units are 40+ years old, 8% are mobile homes.
- Predominant land cover is residential. Bisected by Sturgeon River.

Potential Hazards

Natural: Riverine flooding,

Technological: Transportation accident (land), structural fire, hazardous material spill

Societal: West Nile