Chapter 4 SEVERE WEATHER

Residents of Marquette County take pride in their ability to deal with severe winter weather. Yet severe weather takes several forms, can occur at any time of the year and can create risks for life and property.

4.1 SEVERE WEATHER WARNINGS

The National Weather Service uses a tiered approach to forecasting severe weather, based upon the time until the weather related event and the certainty of the event.

An OUTLOOK is issued if there is a moderate or greater risk of severe weather. (Issued by 6:30 a.m. or 11:30 a.m. is forecast for afternoon or night).

A WATCH is issued hours in advance, when the risk has increased. It is issued for all types of events to allow time for preparation. Preparation actions will depend upon the specific weather event.

A WARNING is issued between 24 and 0 hours, when an event is highly probable, imminent or occurring. The event must be considered a real threat to life and property. Warnings are issued for tornadoes, severe thunderstorms, flash floods, floods, and winter storms.

An ADVISORY is issued between 24 hours and zero hours, when the event has high probability, is imminent, or is occurring. The event is considered primarily an inconvenience, but could threaten life and property. Advisories are generally issued for winter weather, wind, fog, and urban flooding.

The National Weather Service also distributes weather information over the NOAA (National Oceanic & Atmospheric Administration) weather wire (designed for news media and also valuable for emergency managers). Cost is between, $900 and $1,000 for initial start-up and $120 to $135 monthly.

Another means of disseminating information is NOAA Weather Radio. Individuals can purchase their own receivers from private manufacturers at a cost of $20 to $80. Tone alarm and battery backup features are recommended to increase their usefulness in emergencies. NOAA Weather Radio broadcasts include 5-day forecasts, short-term forecasts, marine forecasts, storm watches and warning, weather observations and climate information. A tower located at Morgan Meadows in Marquette Township, using radio frequency 162.550 (VHF), serves most of Marquette County. The northwest portion of the County may also receive signals from a tower in Houghton County using radio frequency 162,400. All but a small portion of the County has coverage (Figures 4-1 through 4-3, NOAA Weather Radio Coverage). Transmitters cost between $50,000 and $60,000. Further study should be done to determine if a tower located near the Wisconsin Border or in Schoolcraft County is feasible to improve service in the Central Upper Peninsula.

Recorded forecasts, including marine forecasts are available to individuals by phone (906-475-5212). NAWAS National Warning System is a party-line network of telephone circuits connecting Federal, State, and Local agencies. It uses local governmental units to warn the public. Communication points are usually in law enforcement centers.

EMWIN is the Emergency Managers' Weather Information Network. However, it can be used by anyone. It uses satellite or Internet (Http://iwin.nws.NOAA.gov/emwin/index.htm) reception. A satellite system can cost as low as $1000 for a 3' dish, demodulator, and software. There are no recurring costs. Text, graphics, as well as alarms are transmitted.

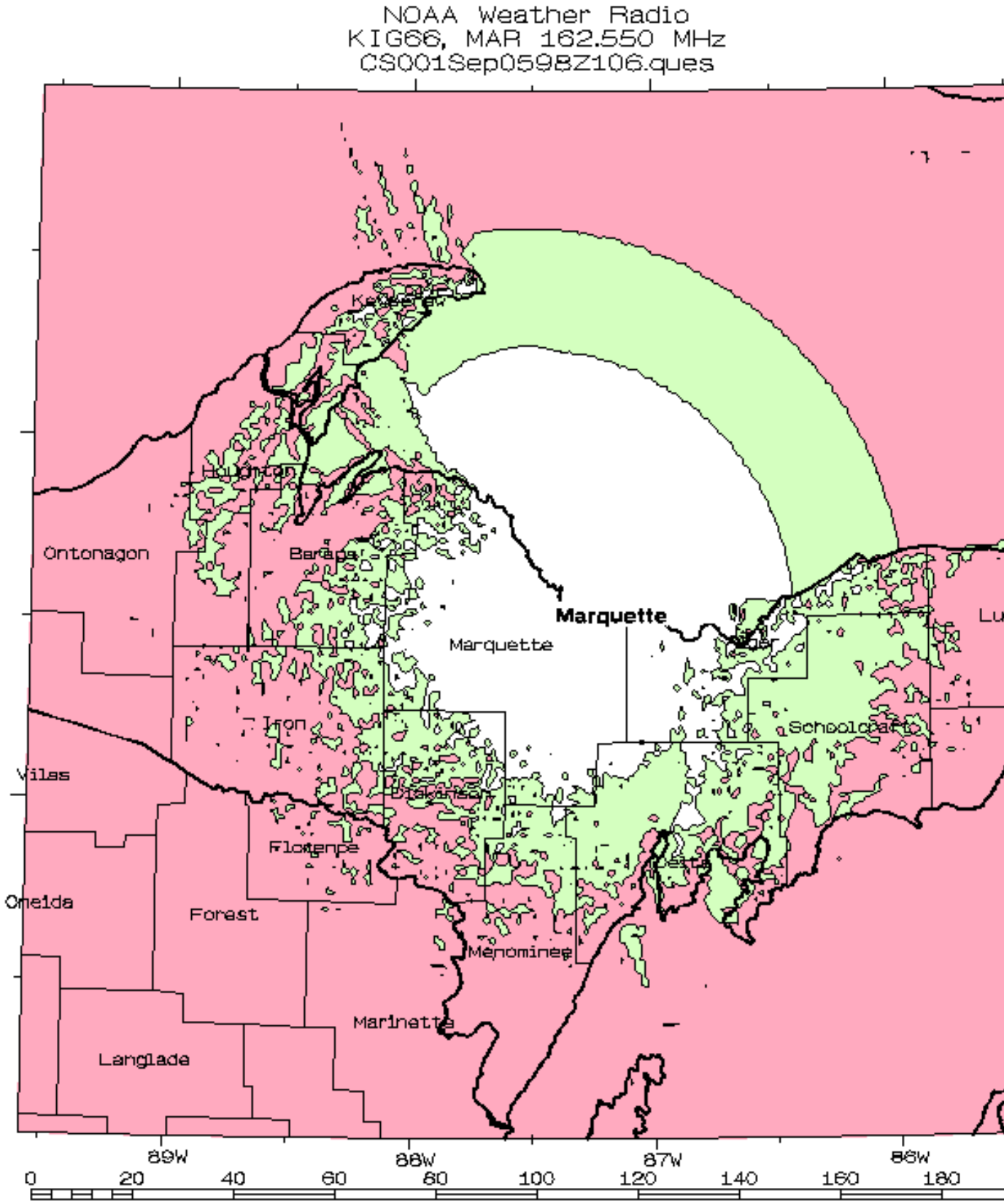
The Emergency Alert System is the tone heard over the radio and television to alert listeners to pertinent information that follows. This method of notification is used for tornado, severe thunderstorm, flash flood, and blizzard warnings.

4.2 SEVERE WINDS (STRAIGHT LINE, TORNADO AND DOWN GUSTS)

Tornadoes are defined as a violently rotating column of air extending from a thunderstorm to the ground. Wind speeds can reach 250 mph or more. Damage paths can be in excess of one mile in width and up to 50 miles long. Tornadoes occur in many parts of the world. They occur most frequently east of the Rocky Mountains in the United States during the spring and summer months. The most common form of tornado in the Upper Peninsula generates from thunderstorms. Before thunderstorms develop, there is a change in wind direction and an increase in wind speed with increasing height creates an invisible, horizontal spinning effect in the lower atmosphere. The rising air within the thunderstorm's updraft tilts the rotating air from horizontal to vertical. An area of rotation, two to six miles wide, extends through much of the storm. This rotating wall cloud is often nearly rain-free. Most strong winds and violent tornadoes form within this area of rotation. Large hail can also be generated. The tornadoes may appear nearly transparent until sufficient dust and debris has been picked up to give the familiar dark appearance.

Michigan experiences an average of 16 tornadoes per year. The risk to human life is high with deaths averaging just fewer than five per year. Statistics on injuries are unavailable, but are expected to be in the thousands. Risk to property is high. The estimate of damage statewide averages $8.75 million per year.

Figure 4-1


NOAA Weather Radio
KIG66, MAR 162.550 MHz
CS001Sep0598Z106.ques
Ontonagon
Marquette
Marquette
Iron
Florence
Oneida
Forest
Menominee
Marinette
Langlade
Schoolcraft
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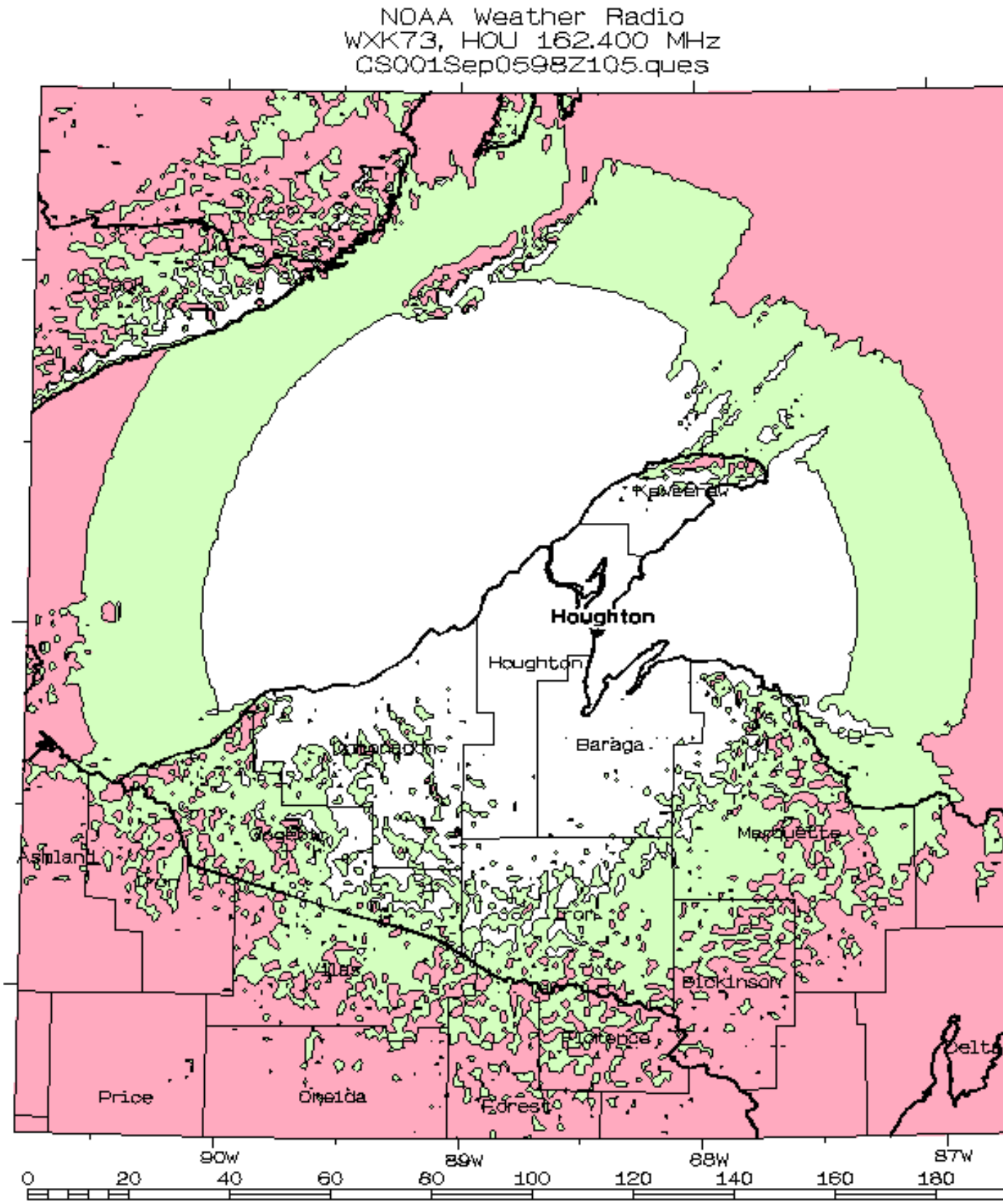
88W
87W
86W
0
20
40
60
80
100
120
140
160
180

Figure 4-2


NOAA Weather Radio
WXK73, HOU 162.400 MHz
CS001Sep0598Z105.ques
Houghton
Houghton
Baraga
Marquette
Iron
Vilas
Dickinson
Florence
Price
Oneida
Forest
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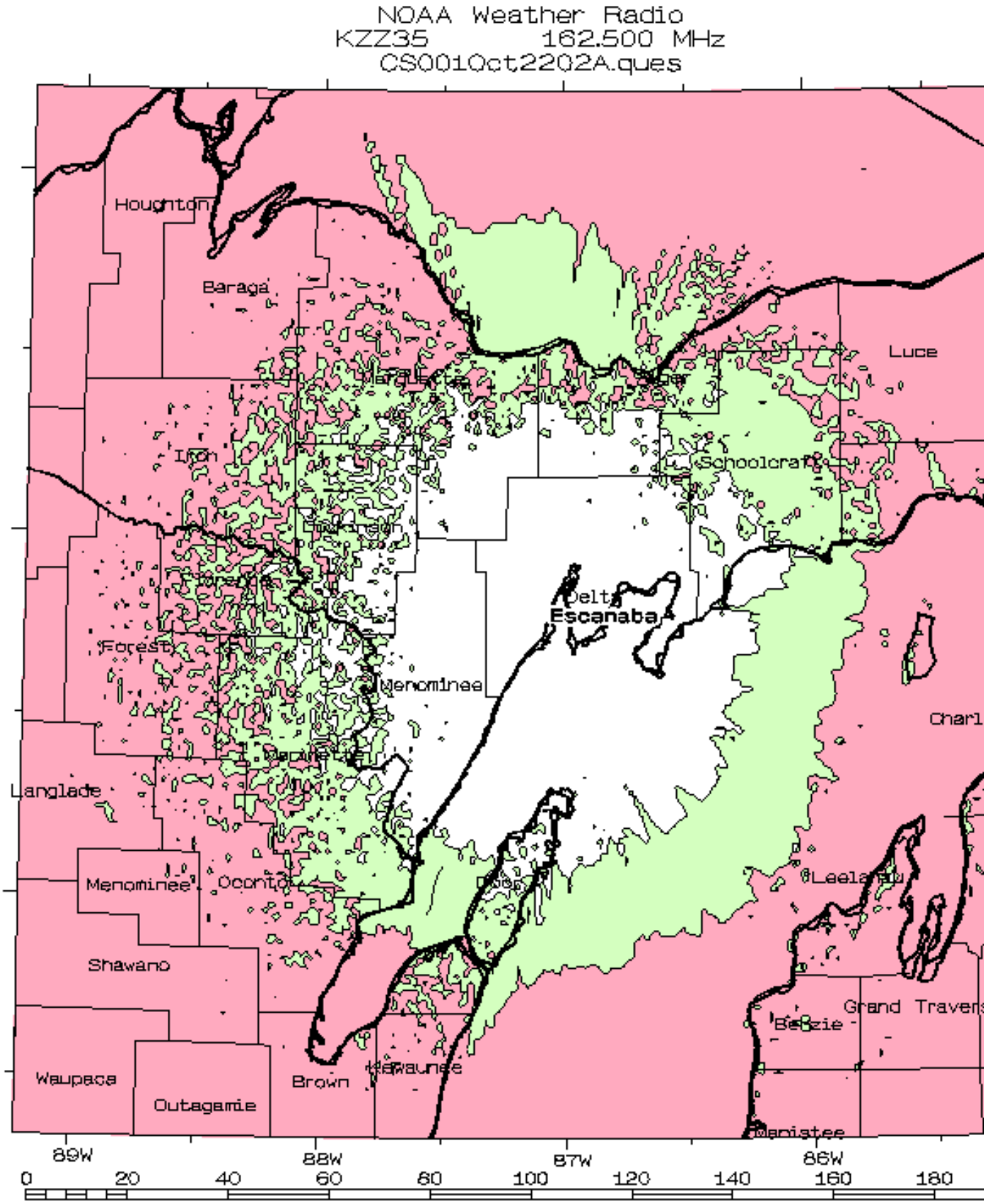
89W
88W
87W
0
20
40
60
80
100
120
140
160
180

Figure 4-3


NOAA Weather Radio
KZZ35 162.500 MHz
CS001Oct2202A.ques
Houghton
Baraga
Luce
Iron
Schoolcraft
Delta
Escanaba
Forest
Menominee
Charl
Langlade
Menominee
Oconto
Leela
Shawano
Grand Traver
Benzie
Waupaca
Outagamie
Brown
Manistee
89W
88W
87W
86W
0
20
40
60
80
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Since 1950, there have been 7 tornado events in Marquette County:

Marquette	Aug. 19, 1973
Marquette	June 20, 1979
Marquette	Sept. 8, 1980
Marquette	Aug. 18, 1987
Northland	Aug. 16, 1997
Marquette	July 14, 1998
Gwinn	June 10, 2000

The total reported property damage was $3,000 for the 1973 event. The total reported crop damage was $5,000 for the 2000 event. None of the other events reports contained damage figures. It is probable that some damage occurred but was not reported.

On the average, severe, straight-line winds can be expected 2-3 times per year in the Upper Peninsula, and 3-7 times per year in the Lower Peninsula. The risk to human life is considered moderate. Statewide, an average of 3.7 deaths and 12 injuries occur each year from major severe winds. The number of injuries is expected to be higher if all wind events were accounted for. The risk to property is considered moderate to high. Over a 20-year period, damage estimates average a conservative $13 million per year.

Of weather events, severe winds are second to ice/snow for damage potential. Most strong winds are localized, but damage paths can be in the 10's of miles wide, and extend the length of the county. Marquette County has suffered 55 thunderstorm/wind events since 1950, with four high wind events since 1993. In that period, one death was recorded. Total reported damages exceeded $51,000, primarily for tree loss. Actual damages are believed to be much higher.

On July 3, 1983, the City of Negaunee suffered from severe winds. Approximately $900 damage was done to public utilities. Other clean-up costs totaled $500. Damages to private property were not estimated.

On July 14, 1984, approximately 100 trees were uprooted or broken off near Casey Lake. Fortunately, there was insignificant structural damage and no injuries. However, the area was left without power for an extended period. On the same date, the Big Shag Lake and Bass Lake Areas and portions of CR 557 in Forsyth Township also received strong winds because of a downburst or storm edge. Sixty large trees were downed and power lines were out of service.

On average, Marquette County is struck by tornadoes once or twice a decade, and straight-line winds about twice a decade.

4.3 THUNDERSTORMS, LIGHTNING, AND HAIL

The typical thunderstorm is about 15 miles in diameter and lasts an average of 30 minutes. Each year there is an estimated 16 million thunderstorms in the world. There

are an estimated 100,000 storms each year in the United States. Despite their frequency, thunderstorms are dangerous. Roughly, 10% (10,000 each year) are classified as severe. The main threat is lightning, which kills more people than tornadoes. A thunderstorm is considered severe if it produces hail at least ¾ inch in diameter, wind at 58 mph or greater or tornadoes. Thunderstorms can occur year-round and at any hour. They are most likely however in the spring and summer and during the afternoon and evening.

Thunderstorms are produced when warm, unstable air, moisture, and lifting occur. The moisture forms clouds and rain. The unstable air can rise rapidly. Lifting can be accomplished by fronts, sea breezes, or topography. In the first stage of a thunderstorm, which lasts about ten minutes, towering cumulus clouds indicate rising air. There is little rain and only occasional lightning. In the mature state, there is heavy rain, strong winds, frequent lightning, possible hail, and tornadoes. This stage averages 10 to 20 minutes, but may last much longer. In the dissipating stage, rainfall decreases. Lightning remains a danger and the storm may still produce bursts of strong winds. High winds pose threats to people in vehicles, campers, tents, and mobile homes. People in vehicles are also threatened by possible flash flooding.

Nationally lightning causes an average of 73 deaths and over 300 injuries per year. In Michigan, there are 20 to 60 thunderstorms per year, yielding approximately 2.4 deaths per year and 16.5 injuries per year. The area of impact is local to regional. There is a moderate to high risk to human life and a high risk of property damage. Only two lightning storms with reported damage/injury have occurred in Marquette County since 1993. One resulted in a single injury and another caused a residential fire and probably a church fire, with damage estimated at $5 million. There was much damage, particularly to inadequately grounded electronic equipment, may go unreported. Those in the greatest risk from lightning include people who are outdoors, especially under or near tall trees, in or on water, or near hilltops.

There is a major hail event approximately every 2-3 years in Michigan. The typical impact area is local to regional. Since hail usually accompanies thunderstorms, deaths and injuries tend to be attributed to the storm. The risk from hail tends to be lower than the other risks associated with thunderstorms. Damage to property is a moderate to high risk. Marquette County has had 37 events with hail ¾ inch or larger since 1950. No deaths or injuries were reported. No official damage records were kept.

On July 13, 1995, a severe storm approached Marquette County resulting in a special marine warning. Resulting winds were in excess of 60 mph, with thunder, lightning, and hail. Funnels were reported over Lake Superior, but not confirmed. Central Dispatch received a report of a possible boat capsized off the shoreline of Chocolay Township. Although in trouble, the boat was able to reach shore. In the Skandia area, trees and wires were downed by the winds and caused several fires.

Marquette County was hit by a “supercell” thunderstorm on June 20, 2007. Hail up to three inches in diameter fell on Marquette Township, the City of Marquette, and Chocolay Township. The City of Marquette was hardest hit. Hail severely damaged

cars, roofs, and vinyl siding. Insurance companies and auto body shops were kept busy for months afterwards.

Thunderstorms that result in personal injury or death occur about twice a decade in Marquette County.

4.4 ICE, SLEET, AND SNOW (VISIBILITY & ACCUMULATION)

Ice or Sleet storms occur on an average of just over one per year in Michigan. The direct risk to human life is low, although secondary risks are moderate. The secondary risks include automobile accidents, heart attacks and downed power lines. The risk to property is moderate to high.

Since 1993 Marquette County has experienced 55 snow & Ice events, most of which extended beyond the County's boundaries. Four events caused a total of $10.8 million in damage, although much of the damage was outside the County's borders. The state acknowledges that the numerous snowstorms that occur in the Upper Peninsula and Northern Lower Peninsula on a regular basis would probably be considered major snowstorms in the Southern Lower Peninsula, where the average annual snowfall totals are much lower. Yet, using the official definition of blizzard, (sustained wind speeds or repeated gusts of 35 mph or greater and visibility of ¼ mile or less for a period of three hours or more), the County has had only two blizzards in the past 20 years. A major snowstorm occurs on the average of every five years. The area of impact can vary from local to statewide. The risk to human life is difficult to quantify since deaths or medical treatment is attributed to traffic accidents, heart attacks, or other pre-existing conditions. The risk however is believed to be moderate. Changed data collection procedures will begin recording indirect deaths, injuries, and damage to confirm or modify that assumption. Generally, the risk to property is moderate. Heavy accumulations of snow however do generate the risk of roof collapse, falling trees, and other forms of minor damage.

Preparing for and removing snow can be expensive in terms of labor and equipment. To be a snow event, eight inches must fall in a 12-hour period or 10 inches in a 24-hour period. Most recently, heavy snows during the winter of 2000-2001 placed serious burdens on public works crews and community finances. The three cities, where 55% of the County's population resides, experienced increases of 62% ($1 million combined) in their expenditures. Many local units had to sacrifice their summer maintenance budgets for snow removal. Sawyer International Airport crews put in 645 hours of overtime keeping the runways plowed and safe. Roofs on five commercial buildings collapsed, resulting in an estimated repair cost of $608,000. Local insurance companies reported receiving 3 times the normal number of damage claims by their policyholders. Most of the claims were for water damage and ice buildup. Snow events kept citizens from keeping health care appointments, attending school and shopping. Business closings meant loss of pay for many employees. Narrow streets interfered with fuel deliveries and hampered emergency response services. Local units attempting to keep fire hydrants

accessible and improving visibility at intersections incurred additional expense. In spite of these efforts, traffic accident counts were higher than usual, putting a strain on police personnel. Some programmed maintenance of sewers was deferred, which contributed to other damage later in the spring. Garbage pick-up had to be curtailed during some storms, as bags were lost in snow banks. This increased spring clean-up costs and created health risks.

A"blizzard" event occurring January 26-28, 1978 resulted in several local units being eligible for reimbursement of snow removal costs. Local records show that the County of Marquette received $38,098, the City of Ishpeming received $20,000, and the City of Negaunee received $4,926. It is not known whether other units sought reimbursement. Stranded travelers filled all local hotels. A 20-person emergency shelter was set up to accommodate the overflow. The Sheriff's department provided food.

A January 2-3, 1999 snowstorm resulted in an emergency declaration by Gov. Engler for Wayne County. Marquette County was added by merit of snow record data. Eligible snow removal costs for the 48-hour period totaled $3,093.34. Record snows arriving primarily in February and March 2002 again strained local budgets.

Marquette County is no stranger to snow. Snow events occur ten to twenty times a year, though perhaps five per year are disruptive. Disruptive ice or sleet events and blizzards both occur about twice a decade.

4.5 DROUGHT

Michigan experiences a major drought event approximately every 20 to 25 years. The impact area is typically regional to statewide. The risk to human life or to property damage is relatively low, although it can have a significant effect on agriculture and those who engage in it.

Drought is a prolonged period without precipitation. It can have a number of adverse effects. Agriculture can suffer, particularly during the planting and growing seasons. Forests can be stressed, leading to higher fire risks. Lake levels can drop significantly, stressing aquatic life and waterfowl and affecting navigation and recreational usage. If the drought is prolonged, groundwater levels and well production can be affected. In extreme cases, subsidence of soil can be triggered. In addition, watering of yards and gardens can strain public and private water systems. In much of the county, drought is a concern because it greatly increases the risk of wildfires.

On February 22, 1977, water delivery service was implemented to 140 families in Western Marquette County due to drought conditions. The deliveries continued into June of that year. Most of the affected households had shallow wells, from 10 to 40 feet deep, and were occupied by elderly and infirm individuals. The Michigamme Township Hall served as a pick-up point for water for additional households. The City of Ishpeming reservoir (Lake Sally) was also critically low. In all, there were an estimated 380 low-producing or dry wells.

Drought has affected the entire Upper Peninsula in recent years, reaching the severe level during the summer of 2007. Long-term drier weather coincided with near-record low levels in the Great Lakes. Precipitation eased the drought situation somewhat in the fall of 2007. Marquette County experiences drought about every 20 to 25 years, similar to the state as a whole.

Available counts of affected households include:

Champion	70
Humboldt	101
Michigamme	56
Tilden	60-70
Republic	9
Negaunee	20
Sands	20
Chocolay	15
Ely	12
Richmond	6
Turin	2
TOTAL	371-381

Since 1993, there have not been any recorded drought events. In spite of lack of official designation, that has not precluded areas from suffering from lack of precipitation. The Federal Gazette indicated that ten Upper Peninsula Counties were included in a disaster assistance request in November 2001. Roughly, 1/3 of the crops in 73 Counties in the state had been lost. Less than 1 inch of rain had fallen in the U. P. from mid-June to mid-August. Eligible producers would receive emergency loans for up to 80% of weather related losses. The USDA Farm Services agency reports that in the Central Upper Peninsula farmers suffered the following crop losses due to inadequate precipitation and soil moisture:

2000	35-40%
1998	>50%
1995	35-50%
1994	35%
1993	35%
1986-88	>50%

4.6 EXTREME TEMPERATURES

Michigan is subject to both extreme heat and extreme cold. Periods of extreme temperature occur every year. The most vulnerable populations are the elderly and the young, and those with medical problems. The poor are the least equipped to deal with these threats. The threats are often accompanied by other weather conditions, such as drought or high humidity, blizzards or high winds. These conditions make the problem more intense. During the winter of 1993-4, light snow cover combined with intense and

prolonged cold, resulted in major damage to water and wastewater infrastructure and a total expense of 4.3 million. **Marquette County experiences disruptive extreme temperatures (primarily extreme cold) about once a decade.**

4.6.1 HEAT

In a normal year, about 175 Americans officially succumb to heat. However that number could be as high as 384 per year as extreme heat taxes body functions which may be stressed due to age or disease, disguising the immediate cause of death. Because heat can cause materials to expand, occasional infrastructure problems can be encountered.

Major threats caused by extreme heat are heat stroke and heat exhaustion. Heat stroke is a life-threatening medical emergency. Nursing homes should be watchful for signs of stress. State law now provides that air conditioning be provided in nursing homes. During prolonged periods of excessive heat, consideration should be given to opening air-conditioned facilities for shelters for at least the hottest portion of the day. When air conditioned sites are not available as an alternative, fans should be used. Fans do not cool the air, but do aid in sweat evaporation that cools the body. The lowest level of a building is usually the coolest.

For the general public recommendations, include:

Adjusting activities to reflect the heat index,
Wear light weight, loose, light colored clothing
Drinking lots of water (avoid alcohol and caffeine, which dehydrate the body)
Eating smaller meals more frequently, avoiding high protein
Do not use salt tablets unless directed by a physician and
Spending time in an air-conditioned building.

Extreme heat is generally more serious in urbanized areas because development patterns create a heat island, which is unable to cool during the nighttime. Portions of Marquette County, however, benefit from the cooling effect of Lake Superior. Limited paved surfaces reduce heat absorption. The abundance of trees also has a cooling effect. Marquette County has not had a formally declared period of prolonged heat since prior to 1993.That is not to say however that members of vulnerable populations (elderly, very young and those with health problems) have not suffered.

4.6.1 COLD

Michigan has between 90 and 180 days per year below freezing. The area of impact ranges from regional to statewide. Marquette County has a yearly average of 40 days below 0 degrees Fahrenheit. Nationally there is an average of 700 deaths per year from extreme cold. In 1936, Michigan recorded 570 deaths. Generally, however, the risk to human life is considered moderate to high. In 2001, changes were made in how wind chill factors were calculated, to improve quantification of exposure risks. Risk to property is generally low, although cold weather can take its toll on equipment that can

become brittle and break. The risk to infrastructure increases with prolonged extreme cold.

Extreme cold is a more serious problem than extreme heat in Marquette County. Hypothermia and frostbite are the most common threats of extreme cold. Hypothermia is a life-threatening medical emergency. Unreliable transportation creates a great risk for exposure to this hazard. Longer distances between shelters also increase the risk. In addition, 43%% of the housing in Marquette County is greater than 40 years old. Many units have substandard insulation and older, inefficient, costly heating systems. Elderly and low-income households may be forced to endure less than optimum temperatures, exacerbating health risks.

Extreme cold can also affect the functioning of infrastructure. Cold makes metal brittle and susceptible to breakage. In addition, it can cause freezing of water and breakage of service lines and mains. Marquette County suffered through a severe winter in Jan-Feb. 1996 and endured weeks of interrupted water service. In addition to inconvenience and health risks, there were concerns over ability to fight fires. Loss of pressure from a water main break serving one of the City of Marquette's water tanks created a vacuum. In many homes, older water heaters (without backflow prevention valves) were imploded due to the suddenly created loss of pressure.

4.7 STORMREADY PROGRAM

The National Oceanic & Atmospheric Administration has created a Storm Ready program to promote community preparedness. The program has four levels, based upon population and community resources. It addresses communication and coordination, reception of warnings, monitoring and warning dissemination, community education, development of local response plans and annual exercises relating to natural disasters.