Michigan Technological University
Multi-Hazard Mitigation Plan
May 2019

Updated Report Prepared by:
Michigan Technological University
Facilities Administration & Planning
1400 Townsend Drive
Houghton, MI  49931
E-mail: facilities@mtu.edu
https://www.mtu.edu/facilities/

Original Report Prepared by:
Western Upper Peninsula Planning &
Development Region
October 2008
TABLE OF CONTENTS

SECTION 1: INTRODUCTION .................................................................................................................. 1
  BACKGROUND & PURPOSE ................................................................................................................. 1
  HAZARD MITIGATION HISTORY ......................................................................................................... 2
  MICHIGAN TECHNOLOGICAL UNIVERSITY (MICHIGAN TECH) ......................................................... 3
  SCOPE AREAS CONSIDERED ............................................................................................................... 5
  PLANNING PROCESS ............................................................................................................................ 7
  PLAN OVERVIEW ................................................................................................................................... 9

SECTION 2: COMMUNITY PROFILE ...................................................................................................... 11
  COMMUNITY BACKGROUND .............................................................................................................. 11
  POPULATION & DEMOGRAPHICS ........................................................................................................ 13
  GEOGRAPHY & ENVIRONMENT .......................................................................................................... 13
  EMPLOYMENT & INDUSTRY ............................................................................................................... 15
  HOUSING & COMMUNITY DEVELOPMENT ....................................................................................... 16
  TRANSPORTATION NETWORK .......................................................................................................... 17
  POLICE, FIRE, & EMERGENCY FACILITIES ....................................................................................... 19

SECTION 3: UNIVERSITY PROFILE ...................................................................................................... 23
  UNIVERSITY IMPACT ............................................................................................................................ 23
  UNIVERSITY MISSION ............................................................................................................................ 23
  UNIVERSITY BACKGROUND .............................................................................................................. 24
  ORGANIZATIONAL STRUCTURE ......................................................................................................... 25
  SCOPE—AREAS CONSIDERED ............................................................................................................ 27
  ECONOMIC IMPACT ............................................................................................................................ 34

SECTION 4: HAZARD IDENTIFICATION & RISK ANALYSIS ................................................................. 36
  INITIAL HAZARD IDENTIFICATION .................................................................................................... 36
  STATE AND FEDERAL DISASTER DECLARATIONS ................................................................................ 38
  RISK & VULNERABILITY ....................................................................................................................... 38
  NATURAL HAZARDS ............................................................................................................................. 39
  TECHNOLOGICAL HAZARDS .............................................................................................................. 64
  SOCIETAL HAZARDS .............................................................................................................................. 74
  HAZARD PRIORITY RANKING ............................................................................................................ 80
  HAZARD SUMMARY ............................................................................................................................. 82

SECTION 5: MITIGATION STRATEGY ..................................................................................................... 84
  INTRODUCTION ..................................................................................................................................... 84
  MITIGATION GOALS .............................................................................................................................. 85
  IDENTIFICATION & ANALYSIS OF MITIGATION ACTIONS .................................................................... 86
  RECOMMENDATION & PRIORITIZATION OF MITIGATION ACTIONS ..................................................... 90
  POTENTIAL FUNDING SOURCES ......................................................................................................... 96

SECTION 6: PLAN MAINTENANCE PROCEDURES ................................................................................. 98
  ADOPTION & IMPLEMENTATION .......................................................................................................... 98
  MONITORING, REVIEWING, & AMENDING ......................................................................................... 99
  CONTINUED PUBLIC INVOLVEMENT ................................................................................................. 101

SECTION 7: RESOURCES ....................................................................................................................... 102
  ORIGINAL PLAN RESOURCES (2008) ................................................................................................. 102
  ADDITIONAL PLAN RESOURCES (2019) ............................................................................................ 106

APPENDICES ........................................................................................................................................ 108
  APPENDIX A: MICHIGAN TECH DRUAC MEETING AGENDAS ............................................................... 108
  APPENDIX B: PUBLIC INFORMATION DOCUMENTATION .................................................................... 115
  APPENDIX C: PRIORITY RANKING BENCHMARKS ............................................................................... 126
  APPENDIX D: BUILDING ASSESSMENT FORMS ................................................................................ 133
  APPENDIX E: OMITTED SECTIONS ...................................................................................................... 160
  APPENDIX F: VULNERABILITY ASSESSMENT (Section 6 of 2008 plan) ............................................. 168

Michigan Tech Multi-Hazard Mitigation Plan
Introduction

Section 1: Introduction
♦ Background & Purpose
♦ Hazard Mitigation History
♦ Michigan Technological University (Michigan Tech)
♦ Scope-Areas Considered
♦ Planning Process
♦ Plan Overview

Background & Purpose

Hazard mitigation is the process of taking action to reduce the consequence of future disasters. Hazard mitigation is about acting proactively, and when successful will lessen negative impacts to such a degree that future events could remain incidents instead of culminating into disasters.

The reason to mitigate hazards is to reduce the costs incurred when disaster strikes, in this case costs involved in the university setting. Costs include, but are not limited to, human life and injury, property damage, compromise of valuable research, loss of instruction, student & teacher departures, increases in insurance premiums, and reduced community involvement. When a university closes down and/or incurs costs due to disasters, the local community inevitably suffers as well. The university-community relationship is more important when the university is located in a small city in a rural isolated area. Hazard mitigation is accomplished through the coordination of resources, programs, and authorities.

Mitigation is essential in the emergency management process. The university and local community respond when disaster strikes, but often the response is focused on repairs and reconstruction to restore the damaged area to pre-disaster conditions as quickly as possible. These efforts expedite a return to “normalcy,” yet replication of pre-disaster conditions leaves the university vulnerable to the same hazards, resulting in a cycle of damage, reconstruction, and damage again. The goal of hazard mitigation is to break this cycle by analyzing the damages before reconstruction takes place so as to produce a repair process that allows for sounder and less vulnerable conditions.
Introduction

The Michigan Technological University Multi-Hazard Mitigation Plan was created in 2008 to protect the health and safety of the students, faculty, staff and visitors. It was created to reduce damages to property, research, instruction, and to minimize economic hardship for the university and the surrounding community by identifying the mitigation activities that can be undertaken both by the university and the local area. This document is intended to educate university officials about the hazards and vulnerabilities at Michigan Tech and to provide a comprehensive reference document for planning and mitigation activities.

This Michigan Tech Multi-Hazard Mitigation Plan is created in accordance with current federal rules and regulations governing local hazard mitigation plans. A FEMA approved mitigation plan is a condition for receiving certain types of non-emergency disaster assistance, including post-disaster funding under the Hazard Mitigation Grant Program. The first hazard mitigation plan was prepared by Michigan Technological University in 2008. This 2019 plan update is intended to reassess hazards on campus and review them based on current needs and available resources which could include new technologies. The updated plan also meets the ongoing requirements for obtaining funds through FEMA.

Hazard Mitigation History

FEMA’s Disaster Resistant University (DRU) program was initiated in 2000 through a pilot program involving 6 universities nationwide. The DRU initiative was created as an outreach of FEMA’s Project Impact Program to help universities develop actions to improve the safety of life and continuity of operations in the face of a natural disaster. Michigan Tech was awarded funds during the 2005 Fiscal Year. As a result, the Michigan Tech Disaster Resistant University Committee was created to align the mission, vision, and goals of the university to the purpose of the Hazard Mitigation Plan; the committee was charged with helping guide the process of the 2008 plan creation. The mission of the Michigan Tech Disaster Resistant University was created at the first Michigan Tech DRU Advisory Committee Meeting. The DRU mission statement was created to align the mission, vision, and goals of the university to the purpose of the Hazard Mitigation Plan. The Michigan Tech DRU Advisory Committee was created to help guide the process of the 2008 plan creation.
Introduction

Michigan Tech recognizes the importance of preparing to deal with emergency situations. More than a decade ago, Michigan Tech developed an Incident Command Team (ICT). The ICT is currently composed of 43 members of the University community. The ICT uses guidelines established by the Federal Emergency Management Association’s (FEMA) Incident Command System (ICS). The ICS is a standardized, on-scene, all hazards incident management concept that allows its users to adopt an integrated organizational structure in order to provide for the safety of university personnel, achieve tactical objectives, and use resources efficiently and effectively. The ICT also assists the University with large scale and/or complex events such as Graduation, K-Day, or Career Fair. The ICT meets monthly and participates in table top, functional, and full scale exercises. These exercises occur both in-house and in cooperation with a wide range of community members, including Houghton County, local police and fire departments, local emergency medical first responders, and local hospitals and health care agencies. All members of the ICT are trained in FEMA’s ICS at the 100, 200, 300, 700, and 800 levels.

University leadership recognized the need for an updated FEMA-approved Hazard Mitigation Plan to be used as the basis for prioritizing and addressing potential risks to human life and property, and as a prerequisite for mitigation grant opportunities. Because most members of the Michigan Tech DRU Advisory Committee were no longer available, the University assigned a new team to review and update the plan, seek and complete FEMA approval of the plan update, and provide recommendations for specific mitigation project(s) to reduce or eliminate the long-term risk to human life and property from natural hazards. In December 2018, Facilities Administration & Planning at Michigan Tech was charged with leading the development of an updated hazard mitigation plan in compliance with federal and state requirements for university use in seeking grant opportunities for mitigation planning and campus hazard mitigation projects.

Michigan Technological University (Michigan Tech)

Historically Michigan Tech and the surrounding area appear to be relatively safe from disasters, however, the threat always exists, as evidenced most recently by the June 2018 flooding emergency and resulting damage.
Introduction

The area is vulnerable to rapidly changing weather conditions, and is not immune to serious disaster. Michigan Tech strives to be a top research facility and deals with various hazardous materials to carry out research. In addition to the June 2018 flood event, the attempted bombing of the Forestry Building and U.S. Forest Service Building in 2001 is a prime example of the necessity of a multi-hazard mitigation plan at Michigan Tech. Founded in 1885, Michigan Technological University is a public research university with a population of over 7,000 students and 1,600 faculty and staff, the University has a major economic impact on the surrounding communities. Our seven Colleges and Schools develop, apply, and communicate science, engineering, technology, and mathematics in more than 120 undergraduate and graduate degree programs.

Michigan Tech is nationally ranked in a number of areas and programs. Recent rankings include:

- College Magazine: MTU ranked as the safest college campus in the nation (December 2017)
- Forbes.com ranked MTU No. 12 in the US for public universities whose graduates earn the highest mid-career salaries. (August 2017)
- BestColleges.com ranked MTU No. 18 in the US for ROI. Michigan Tech's 30-year net ROI—the average net earnings a graduate can expect over 30 years of work, minus the cost of their education—is $999,300. (May 2016)
- SmartAsset ranked MTU No. 1 in Michigan for best value. (2018)
- Payscale.com ranked MTU No. 1 among public universities in Michigan for mid-career salaries. (August 2015)
- Brookings Institution ranked MTU No. 1 in Michigan, No. 4 in US in “value-added” factors such as the kinds of majors offered—particularly in STEM (science, technology, engineering and math), graduation rates, student loan repayment rates, and the difference between predicted earnings and graduates’ actual earnings at mid-career and over a lifetime. (May 2015)
- Washington Monthly: MTU ranked No. 36. for contribution to the public good based on social mobility, research, and public service. (October 2018)
- Money Magazine: MTU ranked No. 112 overall and No. 63 among public universities for "Best Colleges for your Money". (July 2017)
- Money Magazine: MTU ranked No. 2 on the list of 11 Public Colleges Where Grads Make Six Figures. (December 2016)
- Money Magazine: MTU ranked No. 6 in nation in early career earnings. (July 2017)
- Princeton Review MTU recognized as one of 200 colleges across the nation that "pay you back". (March 2018)
- US News & World Report: Graduate rankings: Environmental Engineering (38), Mechanical Engineering (53), Biomedical Engineering (63), Electrical Engineering (92), and Computer Engineering (95). (March 2019)
Introduction

Total expenditures and other financial information for Michigan Tech for the year ending June 30, 2017 are list below.

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total expenditures</td>
<td>$256,022,538</td>
</tr>
<tr>
<td>State appropriation</td>
<td>$48,856,922</td>
</tr>
<tr>
<td>Tuition and fees</td>
<td>$95,869,984</td>
</tr>
<tr>
<td>Grants and contracts</td>
<td>$43,394,464</td>
</tr>
<tr>
<td>Auxiliary and other revenues</td>
<td>$34,430,942</td>
</tr>
<tr>
<td>Gifts raised</td>
<td>$52,390,000</td>
</tr>
</tbody>
</table>

Scope-Areas Considered

Hazards analyzed in the plan were given a risk degree rating as High, Moderate, Low or Negligible. An analysis of all potential hazards is presented in the plan, however, only those hazards that pose a greater risk will be focused upon.

Michigan Tech consists of multiple holdings located on the main campus and off. The main area of focus for this plan will be:

Main campus located at 1400 Townsend Drive, Houghton

Two other university facilities were considered for select hazards in the 2008 plan:

Ford Center located in Alberta in Baraga County; and
Keweenaw Research Center located at 23620 Airpark Blvd., Calumet.

In this updated plan an additional university facility was considered for select hazards:

Mont Ripley Ski Area located at 49051 Ski Hill Road in Hancock across the Portage Canal from the Main campus.

These locations can be viewed in Figure 1.1 which shows the locations of Houghton and Baraga Counties in relation to the State of Michigan.
Introduction
**Planning Process**

Hazard mitigation is any action taken before, during, or after a disaster to eliminate or reduce the risk to human life and property from natural, technological or societal hazards. This is accomplished through the coordination of resources, programs, and authorities. When successful, mitigation will lessen the impacts of hazards to such a degree that future events will remain incidents rather than culminate into disaster.

Mitigation is an essential part of the emergency management process. When a disaster strikes and a community responds, often the focus of repairs and reconstruction is to restore damaged property to pre-disaster conditions as quickly as possible. These efforts expedite a return to “normalcy,” yet replication of pre-disaster conditions leaves the community vulnerable to the same hazards, resulting in a cycle of damage, reconstruction, and damage again. Hazard mitigation allows this cycle to be broken, ensuring that post-disaster repairs and reconstruction take place after damages are analyzed and that sounder, less vulnerable conditions are produced. The disaster cycle is represented below.
Mitigation planning forces a community, in this case a university, to identify potential hazards, assess vulnerabilities, and develop mitigation strategies to deal with those hazards before an event occurs. Hazards and vulnerabilities are determined based on historical events, previous incidents at the university and in nearby communities, and scientific data and trends. Mitigation measures can be implemented systematically, as grant monies and other funding becomes available, or, in the worst case, through repair and reconstruction after hazard event occurs.

The process of creating a Multi-Hazard Mitigation Plan for Michigan Tech began in 2005 when the university applied for and received a grant through FEMA’s Pre-Disaster Mitigation Program. The university contracted with Western Upper Peninsula Planning & Development Region (WUPPDR) to coordinate the plan. An Advisory Committee was formed to guide in the plan’s development. The Michigan Tech Disaster Resistant University Advisory Committee (DRUAC) collaborated on all aspects of plan development while also contributing key information and direction individually. Participation of the public was encouraged from the onset of the process. Public comments on the draft plan were readily accepted throughout the planning process. Several university departments, staff, and faculty were consulted for input and comment. Advisory Committee meetings were open to the public, and comments from the community were solicited throughout the process.

Development of the 2019 Multi-Hazard Mitigation Plan began with a review of the 2008 plan by a new committee, which was formed specifically to update the plan. The group analyzed each section of the 2008 plan, provided updates as needed, and reviewed and adjusted the plan maintenance process in order to ensure that the University has a current and effective Hazard Mitigation Plan. The working committee for the 2019 Hazard Mitigation Plan included:

Lori Weir, Director of Administrative Services & Projects
Gregg Richards, Director of Engineering Services
Larry Hermanson, Director of Energy Management
Kerri Sleeman, Senior Engineer & Project Lead
Jennifer Johnson, AutoCad Technician

The committee consulted with experts from across campus, including: Public Safety & Police Services, the department of Information Technology, University Marketing &
Community Profile

Communication, the Office of Risk Management, the Office of Environmental Health & Safety, and Housing & Residential Life. The group also gathered information from the City of Houghton and Houghton County. The updated plan has been posted on our website for public comment.

Plan Overview

This report is divided into 7 sections and 6 appendices, which present the information and resources that assist in understanding the potential hazards that could affect the university, the university’s risk and vulnerability associated with identified hazards, and a mitigation strategy to reduce the university’s risk and vulnerability. The sections are as follows:

Section 1: Introduction

The Introduction presents the background and purpose of the Plan, briefly introduces the university, and details the scope of the plan and the planning process. The Planning Process specifies the methodology behind creation of the 2008 plan, as well as an explanation of the process for the updated 2019 plan.

Section 2: Community Profile

The Community Profile details the region in terms of demographics, geography, climate, industry, community development, transportation networks, and emergency facilities. It demonstrates some of the distinctive issues the university faces in terms of being located in an isolated rural environment.

Section 3: University Profile

This section details Michigan Tech through its history, growth, mission, population, structure, and curriculum. Furthermore, it presents the impact the university has on the region socially, economically, and culturally.

Section 4: Hazard Identification & Risk Analysis

This section identifies all potential natural, manmade and technological hazards that could impact Michigan Tech. The hazards were analyzed and ranked based on a 2001 risk assessment that considered frequency of previous occurrences and impact. Vulnerability to future events was also analyzed, in terms of potential impact, susceptibility, and exposure. Vulnerability estimates also considered, when possible, processes and policies already implemented by the university to mitigate future hazard occurrences.
Community Profile

Section 5: Mitigation Strategy

The Mitigation Strategy presents Michigan Tech’s mitigation goals, potential mitigation techniques, and an action plan. The action plan consists of specific projects identified by plan stakeholders and evaluated by the 2019 working committee.

Section 6: Plan Maintenance Procedures

This section describes how Michigan Tech will ensure the plan’s implementation and maintenance. Also included are considerations for updating the plan, continuing public involvement, and identifying the party responsible for maintaining and implementing the plan in the future.

Section 7: Resources

Appendices

- Appendix A: Michigan Tech DRUAC Meeting Agendas
- Appendix B: Public Information Documentation
- Appendix C: Hazard Priority Rankings Benchmarks
- Appendix D: Critical Facility Building Assessments
- Appendix E: Omitted portions of plan
- Appendix F: Vulnerability Assessment (section 6 of 2008 plan)

REVISION

Overall, revisions to the previous (2008) plan reflect continuing concerns at the university. Flooding remains a high-priority issue due to the location of a number of our key buildings on campus as well as an aging storm sewer and drainage system. Mitigation goals remained generally the same but an increase focus on mitigating urban flooding in vulnerable areas of the main campus. This particular hazard was a priority in 2008 and remains at the forefront of the university’s mitigation strategy. A number of completed actions were eliminated, several were retained but modified.
Community Background

Michigan Tech rests on the Portage Canal in the City of Houghton, in Houghton County located in Michigan’s Upper Peninsula. The City of Houghton lies on the southern portion of the Keweenaw Peninsula, a 50-mile wide stretch of land that extends 75 miles out into Lake Superior (see Figure 2.1: Regional Location Map). Houghton’s sister city, Hancock, lies on the opposite side of the canal and is home to Finlandia University, a small private university with a proud Lutheran and Finnish Heritage founded in 1896. The Cities of Houghton and Hancock are known as the area cultural center due to the influence of both Michigan Tech and Finlandia, whose beginnings were both born of the area’s ‘Copper Boom’.

Figure 2.1: Regional Location Map
Community Profile

The area is rich in mining history with Houghton sitting at the center of the world’s largest deposit of native copper. Archaeological evidence suggests that the copper was mined by Native Americans in the Keweenaw continuously from about 3,000 B.C. through the 16th century. The ‘Copper Rush’ began in the 1840s after Michigan’s State geologist Dr. Douglass Houghton released information of the area’s deposits.

The region soon became industrialized and drew a labor force from all over Europe. The result of the mined copper decreased the country’s independence on British copper, and by the Civil War Keweenaw Copper was in huge demand. In 1885, the Michigan Mining School, today known as Michigan Technological University, was founded in Houghton to help meet the area and national demand for mining engineers.

The success of copper mining continued through the turn of the century, bringing along wealth and jobs. It was not until the 1910’s that the copper mines started to decline due to the fact that most of the copper was deep in the ground and difficult to access. Additionally, copper could be mined at lower costs elsewhere in the country. World War I brought the last surge for copper in the area, but by the 1960’s all efforts were abandoned.

As in the rest of the country, the remote Copper Country became steeped in cultural diversity from the draw of immigrants seeking wealth and prosperity during the ‘Copper Boom.’ The majority came from England, Ireland, Italy, Finland, France, Germany, and the Slavic nations. Today the area is a social patchwork reflecting the copper mining days represented in the old mine buildings, fire halls, churches, fishing communities, cemeteries, residential districts, and universities.
Community Profile

**Population & Demographics**

Houghton County consists of 14 townships, 2 incorporated cities, and 5 incorporated villages. Additionally, the County is home to numerous unincorporated small communities. Virtually all of these areas are remnants of much larger settlements founded during the copper mining era. According to the 2017 US Census estimate, Houghton County’s population was 36,305, with much of this population concentrated in the northern half of the County. Population distribution in the County is influenced largely by Michigan Tech, whose students comprise nearly 20% of the population and dramatically influences the demographics in the City of Houghton. Please refer to Table for a summary of area demographics.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>City of Houghton</th>
<th>Houghton County</th>
<th>Michigan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>7,888</td>
<td>36,305</td>
<td>9,962,311</td>
</tr>
<tr>
<td>Male</td>
<td>61.9%</td>
<td>54.1%</td>
<td>49.2%</td>
</tr>
<tr>
<td>Female</td>
<td>38.1%</td>
<td>45.9%</td>
<td>50.8%</td>
</tr>
<tr>
<td>Under Age 18</td>
<td>10.4%</td>
<td>20.2%</td>
<td>21.8%</td>
</tr>
<tr>
<td>Age 65 and over</td>
<td>9.4%</td>
<td>17%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Bachelor Degree or higher</td>
<td>54.3%</td>
<td>32.9%</td>
<td>28.1%</td>
</tr>
<tr>
<td>Poverty Level</td>
<td>38%</td>
<td>14.9%</td>
<td>14.2%</td>
</tr>
<tr>
<td>White</td>
<td>84.4%</td>
<td>93.6%</td>
<td>79.4%</td>
</tr>
<tr>
<td>Asian</td>
<td>9.4%</td>
<td>3.1%</td>
<td>3.2%</td>
</tr>
<tr>
<td>African American</td>
<td>2.1%</td>
<td>0.9%</td>
<td>14.1%</td>
</tr>
<tr>
<td>Blend of two or more races</td>
<td>3%</td>
<td>1.7%</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

*Source: U.S. Census Bureau*

**Geography & Environment**

Houghton County is composed mostly of highlands, upland plains, and lake-border plains. Forests, predominately upland hardwoods, cover over 80% of the land. The County’s 1,071 square miles abound with lakes, rivers and miles of Lake Superior Shoreline. The local area is known as an outdoor enthusiast’s wonderland, and is a consideration for many students who choose Michigan Tech for their education.
Community Profile

An additional consideration for prospective students and staff is the geographic isolation of the university. Houghton and Hancock are the two most northern cities in the State of Michigan. The nearest medium sized metropolitan center, Duluth, MN is 216 miles away to the west while the closest large cities are Minneapolis, MN and Chicago, IL, 370 miles and 420 miles away, respectively. Due to the location of Houghton and the Keweenaw Peninsula, the area is known as a destination rather than merely a place to pass through on the way to somewhere else. Not only are Michigan Tech and Houghton isolated, but the area is prone to long winters. Snow can be seen as early as September and as late as May. Even so, Michigan Tech draws students, staff and faculty from around the world.

CLIMATE

Houghton County lies within the Lake Superior Basin, which has a typical humid continental climate characterized by cold dry winters and warm humid summers. However, the lake exerts a strong microclimatic influence on the immediate shoreline, generally resulting in cooler summers and milder winters than those experienced a few miles inland. This is due to the effect Lake Superior has on the air temperatures and the prevailing westerly winds.

Sixty-year weather summaries are presented in the subsequent tables (Tables 2.2 to 2.4) with their measurements recorded at the Houghton County Airport, located 8 miles from Houghton and Michigan Tech’s main campus.

Table 2.2: Temperature Summary 1952-2012 NCDC Normals-Station: 203908 Houghton FAA Airport, MI

<table>
<thead>
<tr>
<th>Average Element</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>ANN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max °F</td>
<td>21.2</td>
<td>23.5</td>
<td>32.3</td>
<td>45.9</td>
<td>60.3</td>
<td>70.0</td>
<td>75.3</td>
<td>73.3</td>
<td>63.8</td>
<td>51.9</td>
<td>37.2</td>
<td>25.9</td>
<td>48.4</td>
</tr>
<tr>
<td>Min °F</td>
<td>9.0</td>
<td>8.8</td>
<td>16.9</td>
<td>29.6</td>
<td>40.0</td>
<td>49.1</td>
<td>55.2</td>
<td>54.5</td>
<td>46.8</td>
<td>37.3</td>
<td>26.2</td>
<td>14.8</td>
<td>32.3</td>
</tr>
</tbody>
</table>

Source: Midwestern Regional Climate Center

The moderating effect of the lake is experienced in spring and summer months when the cool water tends to level out temperature extremes and reduce the likelihood of frost.
Another effect of the lake is the formation of considerable cloud coverage when cold air passes over the lake in late fall and early winter. This causes early-season and heavy snow possibilities, referred to as the lake effect. Both of these effects lessen as one moves further away from Lake Superior.

Table 2.3: Precipitation Summary 1952-2012 NCDC Normals-Station: 203908 Houghton FAA Airport, MI

<table>
<thead>
<tr>
<th>Element</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>ANN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precip (in)</td>
<td>3.10</td>
<td>1.75</td>
<td>1.95</td>
<td>1.85</td>
<td>2.81</td>
<td>2.76</td>
<td>2.81</td>
<td>2.73</td>
<td>3.34</td>
<td>2.72</td>
<td>2.60</td>
<td>2.78</td>
<td>31.19</td>
</tr>
</tbody>
</table>

Source: Midwestern Regional Climate Center

Average precipitation annually is about 31 inches, while average snowfall exceeds 200 inches. The snowfall record, set in the winter of 1978-1979, is 376.1 inches. The large amounts of snowfall can generate heavy spring runoffs, and can lead to flooding in some areas. Weather conditions can vary greatly at any time throughout the region.

Table 2.4: Snowfall Summary 1952-2012 Averages-Station: 203908 Houghton FAA Airport, MI

<table>
<thead>
<tr>
<th>Element</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>ANN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snow (in)</td>
<td>63.0</td>
<td>32.8</td>
<td>22.5</td>
<td>7.3</td>
<td>1.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
<td>3.5</td>
<td>23.9</td>
<td>52.8</td>
<td>207.1</td>
</tr>
</tbody>
</table>

Source: Midwestern Regional Climate Center

### Employment & Industry

Ninety-two percent of Houghton County residents age 25 and older have the equivalent of at least a high school diploma, and about 32.9% are college graduates. Of those in the civilian labor force, 5.7% are unemployed. Nearly 45% of the population 16 years and over is not in the labor force, which again may reflect the large number of students in the county. In 2017, the median household income was $41,379 and the per capita income was $21,462. In 2017, in Houghton County, nearly 15% of the population lived in poverty, as defined by the US Census Bureau. This statistic was considerably higher than the State level of 12.3%.
Community Profile

Over 25% of the civilian workers in the County are employed by State and local government. The government sector dominates because Michigan Tech is a State-assisted institution and because several Federal and State service agencies maintain branch offices in Houghton County. Other major employment sectors include educational and health services (38.8%) and retail (10%), reflecting the area’s growing tourist economy. The construction industry accounts for 7% of all jobs, while just over 7% consists of manufacturing jobs centered primarily around lumber, newspaper publication, and high-tech industries.

Housing & Community Development

Single-family detached homes compose three quarters of the housing stock in Houghton County. Much of the housing is old, nearly half were constructed prior to 1940. However, growth in the area is represented by the fact that 5.9% of all homes have been built in the past 10 years. The median housing value in the County is $86,900, which is seventy-percent less than the National median.

In the City of Houghton, 37% of the homes were built before 1940, while 8.8% were built in the past 10 years. The median value of a house is much higher in the city, $129,000 as compared to the County. The lower housing costs area-wide lead to a higher homeownership rate, although this rate is offset by the large number of students who rent.

HISTORIC FEATURES

As previously mentioned, much of the mining remnants are leftover from the copper mining heyday. Preservation efforts are continual as the rich area history is a large draw for tourists. The area relies greatly upon the tourism industry for economic success. Among the many historic sites in the area, two that make their home at Michigan Tech include the Copper Country Archives and the A.E. Seaman Mineral Museum. The Copper County Archives are located in the bottom floor of the J.R. Van Pelt Library on Michigan Tech’s main campus. The archives include print, graphic, and manuscript resources, and house the area’s largest collection of local history items. They also hold collections from the Quincy Mining Company and the Calumet Hecla Mining Company. The archives contain unique one-of-a-kind items that tell the story of the Copper Country.
The A.E. Seaman Mineral Museum, located at 1404 E. Sharon Avenue, on the south side of Michigan Tech’s campus, houses the largest public exhibit of an outstanding collection of minerals from the Great Lakes region. The A. E. Seaman Mineral Museum was officially founded in 1902 and it was designated as the official Mineral Museum of Michigan in 1991. It is the unofficial Mineral Museum of the Great Lakes Region and draws thousands of visitors each year. Today, the museum complex consists of the:

- Main museum building
- Phyllis and John Seaman Garden
- Copper Pavilion - holding the world-record 17-ton native copper slab
- Mineral Preparation Annex

### Transportation Network

**ROADS**

Several major roadways cross Houghton County (see Figure 2.3). Thirty-four miles of US-41 (spanning 1,990 miles from the northern most part of the Keweenaw Peninsula to Miami, Florida) are located in Houghton County. US-41 edges Michigan Tech’s Ford Center in Alberta, intersects the main campus in Houghton and edges the Keweenaw Resource Center in Calumet. Other highways in the area include M-26, M-38, and M-203, additionally there are 858 miles of roads owned and maintained by the Houghton County Road Commission. Beyond that, each incorporated city owns and maintains the local street networks within its limits. Michigan Tech owns and maintains approximately 5 miles of roads.

**PORTAGE LAKE LIFT BRIDGE**

Historically, the Portage River and Lake provided a natural pathway across the Keweenaw Peninsula dividing it nearly in half. The Keweenaw Waterway was completed in the 1860s to serve as a ship canal by connecting Lake Superior in the west to Portage Lake in the
east. Completion of the shipping canal made the Keweenaw an island rather than a peninsula.

In 1875, the first bridge was constructed to connect Houghton and Hancock. The bridge was rebuilt and had undergone several renovations until the current bridge, the Portage Lake Lift Bridge, was built in 1959. The bridge is recognized as the heaviest aerial lift bridge in the world. Its unique double deck has two levels for traffic, the upper for cars and the lower was originally used by trains. Trains no longer travel the area, but in the winter months the lower level is used by recreational snowmobilers.

The bridge is a vital link for the area. The airport and two hospitals are all located north of the bridge in Hancock and Calumet. This leaves the residents of Houghton and surrounding areas vulnerable in the event the bridge becomes inoperable. The nearest hospital south of the bridge is located in L’Anse, MI, over 32 miles away.

**RAIL**
At one time rail was a critical factor in the development and economic growth of the area. Today, most tracks that connected towns, mines and ports have been removed. The corridors have since been turned into snowmobile, atv, hiking and biking trails. There are still freight trains operating in the western and southern portion of the U.P., but none left in the Copper Country.

**PORTS**
The Keweenaw Waterway is a shipping canal allowing for large vessel travel with maximum loads of 18,000 tons. Domestic ports facilities are available in Houghton. Additionally, the canal allows for ships or boats to seek refuge or an alternative route when Lake Superior seas do not allow for safe passage around the tip of the Keweenaw.
AIRPORTS
Houghton County Memorial Airport (CMX) is located 4 miles northeast of Hancock at an elevation of 1,095 feet. Houghton County owns the untowered airport that operates year-round with two paved runways. SkyWest (United Airlines) provides air service two times a day to Chicago O’Hare airport. Royale Air Service provides seasonal air charter service to Isle Royal National Park while approximately 3,000 corporate, charter and transient aircraft use the airport annually. Cargo operations are provided by FedEx and UPS with more than 600,000 pounds of freight hauled in and out of the airport annually. The Houghton County Memorial Airport is approximately 2,400 acres and hosts a 204 acre Industrial Park with the necessary infrastructure and utilities ready for hookup.

TRANSIT
The Indian Trails Bus Line serves both cities of Houghton and Hancock. Both cities also operate transit systems with scheduled and on-demand services. Taxi cabs services are available in Calumet, Hancock, and Houghton. During the fall and spring semesters, Michigan Tech Transportation Services provides shuttle service around campus and throughout downtown Houghton with four main shuttle routes:

- Husky Campus Shuttle
- Daniell Heights Shuttle
- City Commuter Shuttle
- Shopping Shuttle

Michigan Tech also partners with Zipcar to bring self-service, on-demand car sharing to campus.

Police, Fire, & Emergency Facilities

POLICE
The area is protected by the Michigan State Police District 8, Post #87, the Houghton County Sheriff’s Department (located in Houghton), Michigan Tech’s Public Safety & Police Services department, and local police stations. Houghton’s city police is composed of 7 full-time officers and some part-time officers.

Michigan Tech’s Department of Public Safety & Police Services has the primary responsibility for maintaining a safe and secure environment at Michigan Tech. The
Community Profile

department is staffed by trained, certified State of Michigan police officers who have full law enforcement authority (including the power of arrest) throughout Houghton County. There are 12 full-time officers as well as 5 dispatchers. The department is staffed and operates 24 hours per day 7 days per week.

FIRE

There are 24 volunteer fire departments throughout Houghton County. The City of Houghton’s volunteer fire department includes a staff of 26 and has a service area of 4 square miles including Michigan Tech. The fire department is a crucial partner for the university and receives state funding to provide services to Michigan Tech.

MEDICAL

There are two hospitals in Houghton County, both north of the Portage Lake Lift Bridge. U.P. Health Systems Portage Health Complex is medical complex located in Hancock. The complex includes an Emergency Department, a 24 Hour Walk-In Care service, 36 in-patient beds, and 60 skilled nursing beds. Aspirus Keweenaw Hospital in Laurium, 12 miles north of Houghton, offers a variety of services including 24/7 access to emergency care and is supported by five clinic locations. Aspirus Keweenaw Hospital has 25 in-patient beds

Additional medical services include Mercy Ambulance, the Western U.P. District Health Department located in Hancock, and Baraga County Memorial Hospital located 32 miles away in L’Anse. Mercy Ambulance covers most of Houghton County and helps outside of the area when needed. Its advanced life support service employs 22 EMTs and paramedics, half full-time and half part-time.

Michigan Tech’s Emergency Medical Service provides first medical response to the campus community. Currently staffed with 39 fully certified volunteer medical technicians (EMTs), Tech EMS responds to emergencies on the main campus, with the ability to assist at any location within the city of Houghton.

Michigan Tech Multi-Hazard Mitigation Plan 20
Community Profile

COAST GUARD
The U.S. Coast Guard patrols the area’s waterways from its station located in Dollar Bay, located across the Portage Canal.

OFFICE OF EMERGENCY MANAGEMENT
The Houghton County Office of Emergency Management is located in Houghton in the County Courthouse. The office promotes emergency and disaster education and awareness and serves as an organization dispatch and ensures interagency coordination before, during and after disasters and or emergencies.
Section 3: University Profile

- University Impact
- University Mission
- University Background
- Organizational Structure
- Scope—Areas Considered
- Economic Impact

University Impact

Michigan Tech is the pulse of the local communities, and the impact of an institution of its size and stature is felt throughout the community culturally and economically. Michigan Tech hosts the local community for various events including university and local sporting matches, conferences, educational functions and cultural activities. The community is also drawn to the university to visit the Copper Country Archives and the A.E. Seaman Mineral Museum. By all popular definitions, Houghton is a college town. The relationship between Michigan Tech and the community is synergistic, and any disaster that affects one affects the other.

University Mission

Michigan Tech is committed to establishing world-class research and innovation grounded in science, engineering, and technology that promotes sustainable economic development in Michigan and the nation. Additionally, the university is diligent in attracting an outstanding and diverse population as well as providing a rigorous and distinctive learning experience.

Outlined in the Michigan Tech Strategic Plan:

Mission

“Create solutions for society’s challenges by delivering action-based undergraduate and graduate education, discovering new knowledge through research, and launching new technologies through innovation.”

Vision

“Michigan Tech is a globally recognized technological university that educates students, advances knowledge, and innovates to improve the quality of life and to promote mutual respect and equity for all people within the state, the nation, and the global community.”
University Profile

University Background

HISTORY
Michigan Tech was founded in 1885 as the Michigan Mining School with 4 faculty members and 23 students, but quickly became the Michigan College of Mines. It was established by the State of Michigan to meet the mining industry’s need for mining engineers, fueled by the local area’s ‘Copper Boom’. Over the years, as mining activities declined, the school evolved by expanding degree options and developing other areas of study. The school transformed from a college to a university, and in 1964 the school was renamed Michigan Technological University. During the 1960s and 1970s the school experienced tremendous growth in terms of students, curricula and property expansion. A good portion of the campus today was constructed during this time of growth. Moreover, Michigan Tech has become renowned for its College of Engineering. Presently, the university offers an array of degrees from certificates to doctorates in areas other than engineering such as: Arts and Human Sciences, Kinesiology and Integrative Physiology, Business, Computing, Environmental Studies, Sciences, and Technology.

The focus on graduate studies and research became prominent by the 1980s. Michigan Tech’s efforts in graduate and research programs continue to grow, and the university considers itself to be in the company of Michigan State, the University of Michigan, and Wayne State as top research centers in Michigan. Michigan Tech continues to strive for academic excellence and to be a top research university with research funds topping $50 million annually and growing.
POPULATION
Michigan Tech has a population of nearly 9,000, with the faculty of 450 and staff of 1,160 joined by over 7,300 students. Many of these students will add to the growing alumni list that is approaching 84,000 graduates. Michigan Tech’s success can in part be attributed to the talented faculty, of which 90% hold the highest degree in their field. Additionally, 1,400 of the 7,300 students are graduate students.

The student population count has remained relatively stable and the 2018 count is approximately 100 more than the 14 year average. Males have always had a greater presence at Michigan Tech than females, common in the engineering and technological fields; the 10 year ratio averaged about 3 males to every 1 female. However, Michigan Tech strives to attract a diverse student and faculty population. Nearly 9% of the student population is composed of international students and over 80 countries have been represented at Michigan Tech through its international community.

Organizational Structure
Michigan Tech, a public university, is governed by a President who reports to an eight-member Board of Trustees. Those reporting to the president include: The Athletic Director, the Dean of Students and Associate Provost for Student Affairs, the Vice President for Advancement, the Special Assistant to the President for Diversity and Inclusion, the Vice President for Research, the Chief Financial Officer and the Vice President for University Relations and Enrollment, and Student Affairs, and the Provost and Vice President for Academic Affairs. An organizational chart is presented in Figure 3.1 on page 27. Governance of the university is a collaborative effort and is coordinated through the: Board of Trustees, University Senate, Staff Council, Graduate Student Council, and Undergraduate Student Government.
Figure 3.1 – University Organization Chart
Michigan Tech’s main campus is located in the community of Houghton in Michigan’s Upper Peninsula. Michigan Tech is also home to Mont Ripley Ski Area, a ski hill located in Franklin Township across the Portage Canal from the university’s main campus, the Keweenaw Research Center (KRC), a research facility located several miles north of the main campus, and the Ford Center situated on over 1,700 acres of hardwood forests in Alberta, MI (40 miles from the main campus). Mont Ripley Ski Area is used for university physical education courses. The Ford Center is used for conferences, research and education for the School of Forest Resources and Environmental Science.

While the main focus of Michigan Tech’s Hazard Mitigation Plan is on the main campus; Mont Ripley, KRC, and the Ford Center will be considered for select hazard events. Campus and facility locations are presented in Figure 3.2.
Hazard Identification & Risk Analysis

Campus and Facility Location Map
Figure 3.2

0 2.5 5 10 Miles

Baraga County
Houghton County

Michigan Tech Multi-Hazard Mitigation Plan 28
THE KEWEENAW RESEARCH CENTER (KRC)
The KRC, located in Franklin Township adjacent to the Houghton County Memorial Airport 7 miles north of the main campus, is a Michigan Tech research facility (see Figure 3.3). Previously a test site of the U.S. Army Tank Automotive Command (TACOM), Michigan Tech assumed ownership in 1993 and TACOM continues to sponsor research and testing. KRC’s mission is: “To generate and conduct externally funded research in science and engineering in support of the University's overall educational mission.” KRC benefits its clients in the military, automotive, aerospace and marine industries by applying advanced engineering principles through all phases of engineering design, analysis and testing. Due to KRC’s proximity to the airport and the research nature of the facility, consideration of potential disaster should be taken seriously at this location.
THE FORD CENTER
Located 40 miles from the main campus in Alberta, Baraga County, the Ford Center lies on over 1,700 acres of hardwood forests with an additional 2,800 acres of forest in nearby parcels (see Figure 3.4). In 1935, the Ford Motor Company built from scratch the village of Alberta, complete with sawmill, homes, and schools to harvest the lumber from the surrounding hardwood forests for their automobile industry. By the 1950s, lumber was in decline as a component for automobile production so in 1954, Alberta and surrounding forest were donated to Michigan Tech to be used as a "Center for Research, Demonstration, and Education in Forestry". Today, the center is still used as an educational and research center, hosting not only Michigan Tech students, but also various public and private groups. The facility offers classrooms, a conference center, a dining hall, sleeping quarters and thousands of acres of wilderness.
MONT RIPLEY

Mont Ripley, located in Franklin Township between the cities of Houghton and Hancock, is a ski hill taken over by Michigan Tech in 1944. The ski area has 24 trails, 440-feet vertical drop, 112 acres of skiable terrain, six different Glade Runs, three lifts, 3-lane tubing park, a Chalet, and several other buildings (see Figure 3.5). Mont Ripley offers a learning area for college courses and community ski lessons. The Michigan Tech student activity fee includes access to the ski hill. The hill can safely support 1,000 users at a given time.

FIGURE 3.5
MAIN CAMPUS
The Houghton Campus (see Figure 3.6) rests on 925 acres in the City of Houghton near the Portage Canal. Complete with typical university structures, the university is also home to an 18-hole golf course, an alpine ski hill, and year round recreation trails used for both nordic skiing, snow shoeing, hiking, running, and biking. Figure 3.2 illustrated the locations of these facilities in regard to the main campus, Mont Ripley, the KRC and the Ford Center.

The Portage Lake Golf Club is located within a two minute drive from campus, on U.S. 41. The Club was established in 1903, one of the oldest in Michigan, and transferred over to Michigan Tech in 1945. Over the past 7 years the university has invested over $700,000 into the course. Open to the public, the golf course is a point of pride for the local community and Michigan Tech.

The cross country ski trails are located on the main campus south of the Student Development Complex. The world class 37 km trail network has hosted the Junior Olympics and the U.S. Cross Country Ski Championships in 2007 and 2008, and will host them again in 2019. During the non-winter months, the popular trails are used for hiking, biking and running.

While Michigan Tech has holdings throughout the local communities, the bulk of instruction and university function occur on the main campus in Houghton. Completion of Great Lakes Research Center, renovations to Chem-Sci Chemical Storage, and Phase 1 (planning and design) of a new HSTEM Engineering and Health Technologies Complex displays the dedication to university development and achievement. For Michigan Tech to better protect these investments and the university as a whole, consideration of potential hazards and mitigation activities are imperative. Furthermore, the remote nature of Michigan Tech’s location and the limited resources in the area reinforce the existing need for the university to develop a multi-hazard mitigation plan.
Michigan Tech is a major influence on the local economy, and is the area’s largest employer due in part to the aggressive improvement plans pursued by the City of Houghton and the university in the 1970s. Between 1920 and 1970 the area population decreased by 51%, caused largely by the decline of the region’s mining industry. The City of Houghton implemented a comprehensive improvement strategy that coincided with Michigan Tech’s plan to increase enrollment and expand facilities. Michigan Tech continued to grow through this period, attracting students and faculty, undergoing new construction, and further developing research and educational programs. This growth continues today with reinvestment by both the city and the university.

The educational aspect is not the only branch that impacts the economy; the research function generates a significant number of jobs and revenue using local goods and services to support the programs. According to the report, *Local Economic and Employment Impacts of Michigan Tech’s Externally Sponsored Programs: FY2001 through FY2004*, written by David Reed, Vice President for Research, externally sponsored programs (the majority of which is research) “generate approximately $30 million annually in local economic activity.” Indirect and direct impacts result in employment directly associated with university research, supplies purchased in the community in support of projects, and local spending by research employees, just to name a few. Reed’s estimates suggest that about 1,000 local jobs are directly or indirectly created by these externally sponsored programs.

Overall, the University’s output impact was nearly 10 times the state funding it received. Michigan Tech contributed nearly $450 Million to the Michigan economy in 2016 according to *The Economic Impact of Michigan Technological University* prepared by Anderson Economic Group, LLC and Traci Giroux, Consultant. Houghton County received nearly $130 Million. Michigan Tech salaries account for nearly $90 Million to faculty and staff and another $6 Million in student wages.
Hazard Identification & Risk Analysis

It is evident that the community provides an excellent environment for the university to thrive in, and it is also evident that Michigan Tech not only generates and promotes economic growth for the area but also brings a special vibrancy to the local community. Partnership is essential for either to operate, especially in the face of disaster. Potential hazards that could pose a threat to the university could also threaten the surrounding community and vice versa.
Section 4: Hazard Identification & Risk Analysis

- Initial Hazard Identification
- Federal Disaster Declarations
- Risk & Vulnerability
- Natural Hazards
- Technological Hazards
- Societal Hazards
- Hazard Summary
- Hazard Priority Rating
- Final Determinations

Initial Hazard Identification

Three categories of hazards were evaluated for the Michigan Tech Multi-Hazard Mitigation Plan: natural disasters, such as floods, wildfires, and severe weather, technological hazards, including infrastructure failures, hazardous material spills, transportation accidents, and major structural fires, and societal hazards, such as civil disturbances, public health emergencies, and terrorism or sabotage.

Hazard information was gathered using regional climate data, community and university historical data, personal interviews with campus and community experts, and various hazard mitigation planning materials. Potential hazards were identified using the following publications:

- FEMA-443 Building a Disaster Resistant University;
- EMD PUB-103 Michigan Hazard Analysis;
- Michigan Hazard Mitigation Plan;
- Houghton County Mitigation Plan;
- Baraga County Mitigation Plan; and

<table>
<thead>
<tr>
<th>2001 Vulnerability Analysis Team Composition</th>
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<tbody>
<tr>
<td>Public Safety</td>
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<td>Occupational Safety &amp; Health</td>
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<td>Information Technology</td>
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<td>Residential Services</td>
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<tr>
<td>Facilities Management</td>
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<tr>
<td>SDC/Auxiliary Services</td>
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<td>Central Heating/Facilities</td>
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</table>

In addition, findings from a university-wide vulnerability analysis developed by Michigan Tech staff in 2001 were used. The team explored potential disasters and established the level of risk to the university based on years of experience and knowledge of the university and area. The team included staff from the departments listed here.
Table 4.1 presents the results of that initial hazard compilation. Some hazards were removed because they did not pose risk to the university or surrounding area. The remaining hazards are profiled and assessed in this chapter. Landslide has been updated in the 2019 plan based on slope failure at Mont Ripley during the June 2018 flood.

Table 4.1: Hazards identified in other plans and for the Michigan Tech plan

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<thead>
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<tbody>
<tr>
<td><strong>Natural Hazards</strong></td>
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Since 1974 there have been three Presidential Declarations of Emergency in Houghton County and two in Baraga County. The first included both counties in a 1978 declaration that was in response to “The Great Statewide Blizzard of 1978.” The second declaration included Houghton County in 1994, and was in response to an extensive underground freeze. The governor declared the 1994 incident a major disaster, while the 1978 event was declared an emergency. The third, and most recent incident, was the “Father’s Day Flood of 2018” which occurred June-17, 2018 when Houghton County was struck by unrelenting rain, receiving over 7 inches in a 3-hour period. The disaster declaration included the counties of Gogebic, Houghton, and Menominee.

**Risk & Vulnerability**

For the purposes of this report risk and vulnerability are defined as:

**Risk:** Exposure to a chance of loss or damage from identified natural, technological and man-made hazards. Risk is a measure of how likely it is that some event will occur based on the frequency and magnitude of past occurrences to the university and the region.

**Vulnerability:** Level of potential impact, susceptibility and exposure to an identified hazard while taking into account, when possible, processes already implemented to mitigate future hazard occurrences.

Risk and vulnerability to each hazard have been identified as:

- Negligible
- Low
- Moderate
- High

It is noted here that although several hazards are classified as posing *Low Risk*, the potential for their occurrence with varying or unprecedented magnitudes remains possible in some cases. These risks will continue to be monitored and re-evaluated during future updates to this plan.
Natural Hazards

DROUGHT
A water shortage caused by a deficiency of rainfall, generally lasting for an extended period of time.

Risk Level: Low
Vulnerability Level: Low

Droughts occur in Michigan and are a common component of most climates. However, the drought is different from other natural hazards in that it is difficult to define, establish its start date, and determine its severity. While droughts can be devastating to agricultural functions, they can also adversely affect urban areas that depend on reservoirs. Nearly all areas of the country are impacted by drought through reduced agricultural outputs, reduced water supply, land subsidence (from excessive groundwater pumping), and increased risk of wildfires.

Droughts typically impact a large area that cannot be precisely defined geographically. The Palmer Drought Severity Index (PDSI), see Figure 4.2, is a tool that interprets temperature and rainfall information to determine dryness and illustrates the widespread nature of drought severity. Droughts more commonly affect natural resources than built physical structures and generally its effects are felt directly by the agricultural industry. However, the community at large may experience drought related effects if there is a water shortage.

Past Occurrences
Neither Houghton nor Baraga County has any historical records of severe drought events. Figure 4.2 illustrates that the region has experienced a very small amount of time in severe or extreme drought in the 100 year period. Michigan’s Upper Peninsula is in a zone of 5% to 9.99% less than or equal to -3 (-3 indicates severe drought). This can be interpreted to mean that severe drought is a relatively low risk to the region.

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1 All text in italics below hazard names (for Natural, Technological, and Societal Hazards) are definitions as provided in the Michigan Hazard Analysis EMD PUB-103.
Hazard Identification & Risk Analysis

Figure 4-2: Palmer Drought Severity Index

Palmer Drought Severity Index
1895–1995
Percent of time in severe and extreme drought

% of time PDSI ≤ -3
- Less than 5%
- 5% to 5.99%
- 10% to 14.9%
- 15% to 19.9%
- 20% or greater

Source: McKee et al. (1993); NOAA (1999); High Plains Regional Climate Center (1996)
Albers Equal Area Projection; Map prepared at the National Drought Mitigation Center

Source: National Drought Mitigation Center—University Nebraska—Lincoln

Risk & Vulnerability

Drought events affect widespread areas, yet it is difficult to determine exact geographical boundaries. If a drought event were to occur it would extend far past the university into the region; however, the risk and vulnerability of drought to the region is considered low. Therefore, the risk and vulnerability to life, property and environment at Michigan Tech is also considered low. The university does not have an agricultural program that could be affected by a drought event. Nevertheless, a drought could increase the risk of a secondary hazard, such as a wildfire, which could be of concern for Michigan Tech’s Alberta Campus (discussed later in this section).

Drought risk and vulnerability were both considered low in the 2008 plan. This section has not changed in the 2019 plan due to the continued low risk and vulnerability. Climate change could affect future precipitation patterns. Updated precipitation models and climate data will be considered in future hazard assessments.
Hazard Identification & Risk Analysis

EARTHQUAKE

A shaking or trembling of the crust of the earth caused by the breaking and shifting of rock beneath the surface.

Risk Level: Negligible
Vulnerability Level: Negligible

Most areas in the country, including Michigan, are subject to minor earthquakes which occur thousands of times per year. Usually, earthquakes are minor tremors that result in minimal or no loss of life, property, and essential services. Earthquakes pose danger because they can occur without warning and can cause severe loss and devastation. Death and injury are usually the result of secondary effects, such as collapsing structures.

Earthquakes are measured by their magnitude (amount of energy released at the epicenter) and intensity (measure of damage done at one location). The Richter Magnitude Scale is commonly used to determine earthquake magnitude and the Modified Mercalli Intensity Scale is used to define intensity. On the Richter Scale, a measure of 5.1 is considered a moderate event, while a measurement of 8.0 is a catastrophic event. The Mercalli Intensity Scale describes 12 increasing levels from imperceptible to catastrophic.

Past Occurrences

Michigan has a history of tremors and earthquake activity; however, none of this recorded activity has been the cause of death or serious damage. Most of the activity has occurred in the Lower Peninsula, which is also affected by activity from the New Madrid Seismic Zone located in the southern portion of the Mid-West. Figure 4.3 presents the United States Geographical Survey (USGS) National Seismic Hazard Map and shows that the Upper Peninsula, along with the rest of Michigan, is in the category with the lowest probability of ground movement.

A fault line, the Keweenaw Fault, does run along the spine of the Keweenaw Peninsula. However, this fault has not experienced any activity for over one billion years.
Hazard Identification & Risk Analysis

Interestingly, between 1905 and 1909 there was a series of recorded unusual underground disturbances. It was described as explosions and tremors which caused minor damage such as broken windows and sinkholes. These occurrences, now believed to be due to collapsing pillars in area mines, were at times felt up to 70 miles away. Aside from these incidents there is no history of recorded seismic activity in the region.

Figure 4-3: USGS National Seismic Hazard Map

![USGS National Seismic Hazard Map](image)

Source: United States Geological Survey

Risk & Vulnerability

Michigan is not an area of major earthquake activity, the fault lines in Michigan bedrock are considered to be relatively stable. Due to the stability of the Keweenaw Fault and lack of previous occurrences, there is negligible earthquake risk to Michigan Tech’s campuses and the surrounding areas. There is a <1% probability of an earthquake occurrence in Houghton or Baraga Counties. The USGS map in Figure 4.3 and verification of Keweenaw Fault inactivity in an interview with Dr. Wayne Pennington, Michigan Tech Department Chair of Geological & Mining Engineering & Sciences, further supports this claim. Additionally, both counties are a great distance from active fault zones, which minimizes the potential risk of an earthquake to affect Michigan Tech’s campuses.
Due to this negligible risk, Michigan Tech and area communities could be more vulnerable to an earthquake because of poor preparation. Structures and utilities are not necessarily built to withstand even small seismic events and instruction is not provided as to how to respond to an earthquake event. However, procedures and response actions are available in university emergency manuals. Nonetheless, because Michigan Tech is not located on or near any active faults vulnerability is also considered negligible in the 2008 and that has not changed for the 2019 plan.

**FIRE HAZARDS**

- Major Structural Fires
- Wildfires

**Major Structural Fires**

*A fire, of any origin, that ignites one or more structures, causing loss of life and/or property.*

<table>
<thead>
<tr>
<th>Risk Level: Moderate to High</th>
<th>Vulnerability Level: Moderate</th>
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The structural fire hazard has been called a universal hazard because it can affect any community at any time. Universities must be particularly diligent in fire prevention and education because of the nature of residence halls. Michigan Tech is home to three dormitories, Wadsworth Hall, McNair Hall, & Douglass Houghton Hall, which house over 2,000 students and the Daniell Heights apartments (campus owned) which house approximately 570 persons (including families). The Hillside Place Apartment building was built in 2010 and houses 194 students.

Michigan Tech is a research based university home to hundreds of laboratories located across campus. Research activities in these laboratories can pose fire and/or explosion risks. Fires as a result of a laboratory incident or explosion will be further examined in the Technological Hazards—Hazardous Materials Incident section later in this chapter.
Past Occurrences
There were 57 reported fire incidents on campus from 2010 - 2018. 55% of the reports were in residential buildings, 32% in academic, research or administrative buildings and 13% were exterior fires. (see Figure 4.4). Many reported fires were minor cooking fires or trash fires. There may also be small fires that occur on campus that go unreported. Therefore, it is difficult to estimate the true number of fire events.

The majority of the reported fire incidents were minor in nature. There were three fire incidents in the past ten years that caused significant damage to campus buildings and contents.

On the evening of June 30, 2010, a fire broke out in a maintenance/storage building at the Michigan Tech Portage Golf Course causing significant damage to the building and contents. The building did not have fire sprinklers.

A fire broke out in the Michigan Tech Archives located in the garden level of the Library building at approximately 11:30 AM on October 26, 2012. There was minor fire damage, but significant water damage to the garden level building and contents. The library building is fully sprinklered.

In the early morning of February 19, 2015, a piece of mobile equipment stored in the Facilities Management building caught fire. The fire caused major damage to the building and contents. Our grounds, engineering, transportation services, skilled trades, central receiving and facilities management offices were all displaced by the fire. Most of the snow removal equipment fleet was destroyed in the fire. Several other campus vehicles were damaged. There were no injuries or loss of life in the fire. The Facilities Building does not have fire sprinklers.
Students who live off campus often live in congregate housing facilities throughout Houghton, Hancock and other nearby communities. Many students live in large, older homes. A fire in the Phi Kappa Theta Fraternity house resulted in the tragic death of a Michigan Tech student in 2002, and underscored the importance of ensuring that off campus homes also meet current fire codes and have evacuation procedures. The City of Houghton now requires registration and annual safety inspections for all rentals within the city.

**Risk & Vulnerability**

While most fire incidents at Michigan Tech have been relatively minor, the potential for disaster remains, especially due to the large population that would require evacuation in the event of a large scale fire emergency. Affected areas could range from one room to multiple buildings on campus and affect any portion of the university population. Education and operational fire detectors can often mitigate the loss from this type of hazard, and education would benefit both those students who live on and off campus.

On the main campus, the residence halls are all equipped with sprinklers and smoke detection systems. The systems sound alarms directly to Michigan Tech Public Safety. In addition, the residence halls have 8 ‘surprise’ fire drill evacuations per year. Fire
extinguishers are inspected on a monthly basis. The sprinklers are checked every three months and the smoke detectors are also inspected on an annual basis.

Most of the other main campus buildings have sprinkler systems and smoke detectors installed. Fire extinguishers, sprinkler systems and smoke detectors are tested on a regular basis. Those buildings that could be further improved in these areas are listed as mitigation action items in Section 5: Mitigation Strategy. Finally, fire drills in the academic buildings should be conducted more frequently and effectively.

According to the Center for Campus Fire Safety, most fires occur in student housing (both off and on campus). Michigan Tech has been proactive in implementing fire mitigation activities in the residence halls, thus reducing risk and vulnerability. However, while mitigation has been addressed in the residence halls, academic and support buildings are still lacking somewhat in preventive methods to reduce fire risk and vulnerability.

At the Ford Forestry Center, based on 1 recorded fire incident, threat of a major structural fire is not particularly high, however, vulnerability is. Although most Ford Center buildings are equipped with smoke alarms and fire extinguishers, many of the buildings are not equipped with sprinkler systems. Limited water supply and the remoteness of the Ford Forestry Center increase the likelihood that incipient fires can grow to major structural loss.

**Wildfires**

*An uncontrolled fire in grasslands, brushlands or forested areas.*

<table>
<thead>
<tr>
<th>Risk Level: <strong>Low</strong></th>
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<tbody>
<tr>
<td>Vulnerability Level: <strong>Moderate</strong></td>
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The most immediate dangers from wildfires are the potential injury or death of persons who live or recreate in the affected area and the destruction of structures, timber, and wildlife. Long-term effects include scorched and barren land, soil erosion, landslides, water sedimentation, loss of recreational opportunities, and in the case of Michigan Tech, loss of instructional and research functions performed at the Ford Center in Alberta.
Past Occurrences
Both Houghton and Baraga Counties have roughly an 80% forest cover, and as previously mentioned, Michigan Tech’s Alberta Campus is located on 4,500 acres of heavily wooded area in Baraga County. Forest fires are most often caused by human activity while lightning causes only two percent. Although forest fires have only caused isolated damage in recent years, they remain a persistent threat. Between 1981 and 2000, 120 wildfires burned 807 acres in Houghton County, while 160 wildfires burned 570 acres in Baraga County, both under DNR jurisdiction.

Risk & Vulnerability
The risk for wildfire increases with the presence of people. Increasing urban infringement on rural areas elevates the likelihood and potential damages due to wildfires. The Michigan Tech Houghton campus and the KRC are located in developed areas and the risk of wildfire to these two locations is negligible.

The Ford Center is at a greater risk from wildfires due to its geographic location and forest surroundings. Frequency of forest fires in Baraga County is 8.1 per year based on 162 fires in a 20- year period. A wildfire could potentially affect the entire Ford Center campus and surrounding lands. Campus population could be affected, but the number varies with each season. There is a larger student population that lives at the Ford Center during the fall semester. The Ford Center also has year-round residents, including community members who rent housing, but have no ties to the university.

Conversely, the type of forest surroundings near Alberta—hardwood stands with little underbrush—has a lower risk of catching fire when compared to highly combustible vegetation such as softwood trees and shrubbery. Nonetheless, the risk of wildfire does rise due to the increased human activity the Ford Center has, involving its regular university activities, public educational functions, and conference gatherings. Risk is also increased because wildfires often occur in remote areas, making emergency response more difficult. The nearest fire response is a volunteer fire department located 9 miles away in the Village of L’Anse. At one time, Alberta had equipment to pump water out of the nearby lake to combat fire, but the equipment no longer exists. In recent years, fires in Baraga County have been minimal; however the possibility of a catastrophic wildfire is always present and
increases in times of drought. While risk of a serious wildfire event at Alberta is low, its vulnerability is moderate due to lack of on-site fire response.

**FLOODING HAZARDS**

- Dam Failures
- Riverine & Urban Flooding

**Dam Failures**

_The collapse or failure of an impoundment that results in downstream flooding._

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<tr>
<th>Risk Level: Low</th>
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<tbody>
<tr>
<td>Vulnerability Level: Low</td>
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Dam failure can result in extensive damage to property and natural resources, miles downstream from the failure. Failure can occur due to poor operation, lack of maintenance, vandalism, and during flood events which cause overflow of the dam. Most failures are catastrophic because they are unexpected, with little or no evacuation time.

**Past Occurrences**

There is no immediate threat of dam failure to the Houghton campus or the KRC, as there are no dams in their proximity. The dam with the greatest risk of failure in Houghton County is located some 15 miles away from both areas, posing no threat.

The Ford Dam, in Alberta, is located across from the Ford Center serving as the road surface for US Hwy 41. According to an inspection conducted by a private engineering firm in 2006, the Ford Dam is an approximately 500 foot earthen embankment that stretches across the valley along Plumbago Creek and is approximately 20 feet high (see Figure 4.5). The Ford Motor Company constructed the dam in 1936 to supply water to the sawmill in Alberta. In 1946, MDOT rerouted U.S. Hwy-41 across the Ford Dam Crest and in 1954, the dam, buildings and properties were donated to Michigan Tech. Presently the dam serves as the U.S. Hwy-41 road surface, a water supply impoundment for fire protection, and the public
uses the reservoir for recreation. There are no records indicating that the dam has overtopped and caused flooding since its construction in 1936.

**Figure 4-5: Ford Dam**

![Ford Dam](image)

*Source: Michigan Tech*

**Risk & Vulnerability**

Failure of the Ford Dam would cause the old Hwy 41 Bridge (replaced by a newly constructed timber bridge), located northwest of the current bridge, to be submerged, and flood waters could reach the first floor elevations of several of the buildings at the Ford Center. Erosion of the Hwy 41 embankment is possible with a breach of the dam and could cause the loss of telephone and other utility lines along the toe of the downstream slope of the dam embankment. Emergency plans are in place for areas potentially affected by a dam failure at the Ford Dam and flow data is available on a continuous basis on the NOAA website.

The Ford Dam is inspected on a regular basis by both the university and the Michigan Department of Transportation (MDOT). Dam Safety Inspections are completed by a professional engineering firm every 3 years. The latest inspection was completed in 2018. Additionally, recent repairs and maintenance have improved dam function and increased protection from dam failure and include:

- 2005—replacement of the main spillway structure and culvert that crosses U.S. Hwy-41 which has improved the discharge capacity of the dam;
- 2005—sealing and grouting of a 48 inch diameter CMP (corrugated metal pipe)
located between the dam and the downstream slope of the impoundment;

- 2006—replacement of a deteriorated concrete bridge with a wood structure downstream of the dam.

Both risk and vulnerability to dam failure are low at the Ford Center, having no previously recorded incident over the past seventy years. Additionally, the 2006 inspection performed by a private engineering firm revealed no observed dam deficiencies.

Dam Failure risk and vulnerability were both considered low in the 2008 plan. The Ford Dam continues to be inspected and maintained on a regular schedule. This section remains low risk and vulnerability in the 2019 plan.

**Riverine and Urban Flooding**

The overflowing of rivers, streams, drains and lakes due to excessive rainfall, rapid snowmelt or ice.

Riverine flooding is also defined as the periodic occurrence of overbank flows of streams and rivers, resulting in the inundation of the adjacent floodplain. Prolonged intense rainfall, snowmelt, ice jams, dam failures, or any combination of these factors, can cause riverine floods. These overbank flows are natural and may occur on a regular basis on river systems that drain large geographic areas. Floods on large river systems may last for several days. Many areas of Michigan are subject to riverine flooding.

Flash floods are typically brief, heavy flows on small streams or normally dry creeks, and they differ from riverine floods in extent and duration. Normally, locally intense thunderstorms paired with significant rainfall are the cause of flash floods. This results in high velocity water, which often carries large amounts of debris. These conditions can be exacerbated by secondary or cascading events, such as beaver dam failure. Spring is the highest risk time of the year, when saturated or frozen ground with little infiltration capacity, along with quick rises in temperature, rapid snowmelt and intense precipitation can quickly overwhelm an area.
Urban flooding includes the overflow of storm sewer systems and is usually caused by inadequate drainage following heavy rainfall or rapid snowmelt.

**Past Occurrences**

Michigan Tech’s campuses did not suffer direct damages from these flood incidents; however, urban flooding has occurred at the Houghton campus. While most flooding was a result of heavy rains, structural issues and cold weather can also be a factor. A brief history is as follows:

- **September, 1978 Houghton Campus:** A plugged storm sewer drain and heavy rains caused flooding to the Administration Building parking lot, with about 2 inches of water spilling into the ground floor of the building.

- **October, 2007 Houghton Campus:** Intense heavy rains caused flooding and ponding at areas on the main campus, due to overburdened storm sewers including the parking lot outside of the Administration Building and onto Hwy-U.S. 41, along Houghton Avenue on the south side of the Library Building and in Parking Lot 14 outside of the Walker Arts and Humanities Building. Fortunately there was no major flooding in the buildings—just small issues with minor leaks.

- **June, 2018 Houghton Campus:** Multiple rounds of very heavy rain fell across much...
of the western portions of Upper Michigan during the 2018 Father’s Day weekend (June 15th - 17th). The hardest-hit area was in Houghton County, MI. Up to 7 inches of rain fell in the area between 11pm and 8am, with the majority of the rainfall coming in the 2am to 5am time frame, causing massive amounts of damage to the City of Houghton and surrounding areas. Many roads were washed out affecting staff and students’ ability to reach campus. The Michigan Tech campus was closed on Monday, June 18th. The Administration and Facilities Management buildings received the greatest amount of damage due to flood waters and backed up sewage entering the buildings. The garden level of the Administration building was flooded with 6 to 36 inches of water causing significant damage to electrical and mechanical equipment and building finishes. The Administration building was closed for 2 weeks. Portable diesel generators served the building for 6 months until the main electrical equipment in the building could be repaired. The Garden level of the building remains closed due to flood damage. Flood repairs in the Garden level are expected to be completed by January 1, 2020, over 18 months after the flood. The Facilities Management Building received a moderate amount of damage when the nearby city sanitary sewer main line was overloaded from the storm water infiltration. Two manhole structures were damaged causing an estimated 250,000 gallons of sewage to be discharge across the surface of the parking lot around the building. Sewage also backed up through the building piping causing flooding in the grounds Department, Central Receiving, and Engineering services offices. The grounds department area was relocated for several weeks while the area was cleaned and repaired. Several packages were damaged in Central receiving. The intense rainfall affected other Michigan Tech properties. The main entrance road, retaining wall, and cart paths were heavily damaged at the Portage Lake Golf Course. Several bridges were washed away and trails damaged at the MTU Recreation Trails. The Keweenaw Research Center test tracks and access roads were heavily damaged by washouts and erosion. Several culverts were washed out creating impassable roads. Other areas affected include Peepsock Creek near the Student Development Complex, Woodmar Drive pavement damage, and landside along Cemetery Road.

- June, 2018 – Mont Ripley: The Mont Ripley Ski Hill located across the Portage Canal received severe damage to the hill. Large portions of the hillside were washed away by the runoff from the heavy rains. The legacy storm structures
located upstream from the hill failed contributing to the degree of damage. Debris and runoff caused catastrophic damage to the several properties located in the town of Ripley directly adjacent to the hill. Emergency stabilization and debris removal were completed by the end of the summer. Several ski runs were closed for the ski season. Final repairs and stabilization are planned to be completed by the start of the 2019-2020 ski season.

A number of areas in Houghton County are susceptible to both riverine and urban flooding, but urban flooding is a greater threat to the Houghton campus. Areas with inadequate culverts become overburdened and can fail when faced with excessive snow melt and/or heavy rains. An additional consideration for Michigan Tech’s Houghton campus concerns the geography of the city. Houghton was built on a hill with steep grades that increase velocity of water runoffs. The majority of the main campus is located at the bottom of the hill. Storm water is funneled into three culverts, two that fork off at the bottom of MacInnes Drive and the third collects water at the bottom of Clark Street. They then empty into the Portage Canal.

Risk & Vulnerability
The risk of urban flooding at the Houghton campus is moderate to high due to the geography of the campus, with a potential for storm sewers to become overburdened. Reasons that flooding occurs could include inadequate inlet structures on campus, combined with debris that hinders water flow through these inlets. The threat to urban flooding is further increased due to aging storm sewer systems on and off campus. Overwhelmed storm sewers on neighboring city streets or US Highway 41 can lead to increased runoff onto campus further overloading campus storm sewer system. The geographic location, at the bottom of a steep hill, of much of the main campus (including many academic and administrative buildings) indicates a higher level of vulnerability, which is estimated to be high.

There is a history of heavy rains and snowmelts in the area. Past occurrences of flooding on Main Campus, coupled with the regional weather history, exposes Michigan Tech to a higher risk of urban flooding; risk is estimated at moderate to high. Past occurrences of
flooding on campus have resulted from short durations of heavy rainfall resulting in rapidly developing flood events.

Michigan Tech has not performed a campus drainage analysis. A storm drainage study would identify high risk buildings on campus and infrastructure needs to mitigate the risk of flooding and better manage stormwater flow. It would also allow the university to consider incorporating innovative and appropriate stormwater practices into new campus construction and landscape design.

**LAND SUBSIDENCE**

*The lowering or collapse of the land surface caused by natural or human-induced activities that erode or remove subsurface support.*

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<thead>
<tr>
<th>Risk Level: Low</th>
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<tr>
<td>Vulnerability Level: Low</td>
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Depressions, cracks and sinkholes in the ground surface can threaten people and property. Although the sudden collapse of ground surface does pose an immediate threat to life and property, subsidence depressions normally happen over a period time varying from several days to several years.

From the mid to late 1800s, the Keweenaw Peninsula was the largest producer of native copper ore in North America. The populations most at risk from ground subsidence live or work in an area where development has occurred above active or abandoned mines, where underground cavities are present near the surface. Many of the 800 mines (with more than 2,300 shafts or openings) in Michigan opened in the 1840s, and while many mine sites have been investigated by County mine inspectors, some are still unknown and/or unmarked. There are limited records of the locations of shafts, and the extent of the mine voids and proximity to the surface may be unknown. A Michigan Abandoned Underground Mine Inventory was completed in late 1998. The inventory includes information on about known mine locations and surface openings. The Houghton County Mining Inspector reports that numerous ground failures occur each year in Houghton County, often due to inadequate mine capping techniques.
Subsidence may also occur over old foundations or lauders—rock pipes installed by mine companies to be used as storm drains. A small sinkhole about 3 feet deep developed in Calumet in April of 2001. It formed presumably when the foundation of a church that once occupied the site collapsed.

**Past Occurrences**
The A.E. Seaman Mineral Museum was built on campus in 2011. Two open and uncapped mine shafts were discovered during construction of the building. The shafts are part of the Mabbs mine which operated in the 1860’s. One of the shafts is located under the West wall of the building and has been capped with concrete. The other shaft has been secured with fencing. The location of the shaft and the underground workings of the mine have been located and mapped.

**Risk and Vulnerability**
Areas adjacent to the historic copper mines are susceptible to future subsidence and awareness is important to mitigate hazard impact. The Michigan Abandoned Underground Mine Inventory identified over 130 shafts that were in need of immediate mitigation throughout the Western Upper Peninsula. Mines on State of Michigan land were addressed through a FEMA grant, however, most shafts are on private lands and continue to pose a risk.

Vulnerability of subsidence is estimated at low, however, this was difficult to determine due to the slight history and unavailability of data on specific dangerous locations.

**SEVERE WEATHER**
- Extreme Temperatures
- Hail
- Ice & Sleet Storms
- Lightning
- Severe Winds
- Snow Storms
- Tornadoes
**Extreme Temperatures**

Prolonged periods of very high or very low temperatures, often accompanied by other extreme meteorological conditions.

| Risk Level: Low | Vulnerability Level: Low |

Other meteorological conditions that can accompany extreme temperatures could include high humidity and lack of rain, or heavy snowfall and high winds. Extreme temperatures primarily affect the most vulnerable segments of the population, including the elderly, children, impoverished and those in poor health. Threats from extreme heat include heat stroke (a medical emergency) and heat exhaustion. Extreme heat is more of a problem in urban areas where the high temperature and humidity can be more intense. Threats from extreme cold include hypothermia (a medical emergency) and frostbite. An additional risk during winter months includes the freezing of water pipes, due to limited snow cover or other insulation. With frozen pipes comes the added risk of bursting pipes, which can cause flooding incidents and damages from these incidents are not always minor.

**Past Occurrences**

Incidents related to extreme cold are listed below:

- **January 5, 1981 Electrical Energy Resources Center-Houghton Campus:** Sub-zero temperatures and an open window caused pipes to freeze and then burst. Water seeped to the first floor, down into the basement and sub-basement of the building, causing minor damage to ceiling tiles and flooring. Estimates of damages were not available, however, damage was minor.

- **January 13, 1994 Areas throughout Michigan:** Record cold temperatures resulted in frozen pipes throughout Michigan; estimated loss in the Upper Peninsula was $2 million.

- **January 1994 Areas throughout Michigan:** Record cold temperatures resulted in frozen pipes throughout Michigan; estimated loss in the Upper Peninsula was $2 million.

- **January 23, 1998 Harold Meese Center-Houghton Campus:** Cold weather was
suspected of causing minor flooding and water damage when the sprinkler system was activated and a pipe broke in the building, allowing water to leak for 20 hours over a weekend. Minor damages included ruined ceiling tiles, plywood, and carpets.

- **March 1, 2006 JR Van Pelt Opie Library-Houghton Campus:** A water pipe that led to a fire sprinkler on the library’s third floor froze (due to proximity to the roof) and then burst, causing water to flow into the library at 50 gallons per minute. Damage was minor, affecting only carpeting, furniture, walls, etc., due to the quick response of university staff and personnel. The water did not affect any library collections.

- **January, 2019:** The Michigan Governor declared a state emergency due to extreme cold weather. Michigan Tech campus was closed for 2 days.

### Risk & Vulnerability

All areas of the State, and subsequently the Michigan Tech campuses, are subject to extreme temperatures. The probability of an extreme cold event occurring in any given year is about 46% while the risk of an extreme heat event is very small, both based on the frequency of past events. Cold weather is a way of life in this part of the country that most people expect and are prepared to deal with. Students and faculty coming from warmer parts of the nation and world are provided guidance on how to prepare for the cold weather.

Extreme cold may cause pipes to freeze and subsequently burst, as seen in recorded events. However, new constructions do include the consideration of pipe placement to minimize freezing pipes. Probably the greatest issue related to cold weather is the possibility of university closure, however, for this to occur the cold weather is usually also teamed with high winds and/or heavy snowfall. The loss in operating costs of university closure is approximately $700,000 per day (composed primarily of salaries, wages, benefits, supplies and services, and utilities). University closure is rare because the region and the university are both well prepared to handle such weather events. Michigan Tech’s risk and vulnerability to extreme temperatures are both considered low.

### Hail

*Conditions where atmospheric water particles from thunderstorms form into rounded or irregular lumps of ice that fall to the earth.*
Risk Level: Low
Vulnerability Level: Low

Hail, a product of strong thunderstorms, usually falls from the center of the storm along with the heaviest rain. At times, strong winds at high altitudes in the thunderstorm blow the hail away from the storm center, causing hazards in unexpected places. Hailstones can range in size from that of a pea to a golf ball, but are sometimes larger than baseballs. Hailstones can damage crops, dent automobiles, and injure people and wildlife.

Past Occurrences
No significant hail events have been reported for the university in recent years.

Risk & Vulnerability
Hail is usually an accompaniment of thunderstorms and storms can vary in size, location, intensity and duration. All areas of each campus, in addition to the community, could be affected by a hail storm event. Average frequency for the combined counties is .91 events per year or about 1 hail event per year. Thus, risk that a hail event will occur and impact any of Michigan Tech campuses is relatively low. Damage from hail in the counties has generally been minor and incurred by individual property owners. The university has no reported damages from hail. Vulnerability is considered low.

Ice & Sleet Storms
A storm that generates sufficient quantities of ice or sleet to result in hazardous conditions and/or property damage.

Risk Level: Moderate
Vulnerability Level: Low

Severe winter weather hazards can include sleet storms and ice storms. Sleet storms occur when frozen raindrops or ice pellets fall from the sky. Though sleet does not stick to automobile tires, sleet in sufficient depth does cause hazardous driving conditions. Ice storms are the result of cold rains that freeze upon contact with a cold surface, coating the ground, trees, buildings, and overhead wires with ice, at times causing extensive damage.
Past Occurrences
There was 1 ice storm recorded from 1994-2004 in Houghton County while there were 2 ice storms recorded in Baraga County during this time period. On both occasions, about ¼ inch of ice accumulated causing only minor accidents and damages.

Risk & Vulnerability
The probability of future ice storms occurring in the regions where Michigan Tech’s campuses are located does exist. Taking the average probability for both Houghton and Baraga County based on past events, future occurrence would be approximately 1 event every 3 ½ years. Due to the nature of this type of storm event, affected areas will vary as will the duration and intensity of the storm. All areas of Michigan Tech’s campuses could be affected along with the local area. Several critical services can be disrupted by ice storms, but most of Michigan Tech’s utilities run underground. Vulnerability to Michigan Tech, while difficult to determine, is considered low. The possibility of automobile accidents does increase during such slippery driving conditions, but the impact on the university’s population and holdings would most likely be minor. An additional consideration includes the possibility that emergency response time could be reduced due to icy conditions, but this is complicated to quantify.

Lightning
The discharge of electricity from within a thunderstorm.

Risk Level: Low
Vulnerability Level: Low

Lightning is often perceived as a minor hazard, but it damages many structures and kills and injures as many, if not more, people in the United States each year (on average) than tornadoes or hurricanes. Michigan ranks second in the nation in both lightning-related deaths and injuries. Many deaths and injuries could be avoided if people were educated about the threat of lightning.

Past Occurrences
There have been no reports of serious incidents caused by lightning at Michigan Tech.
Specific data regarding lightning incidents were not available for Baraga and Houghton Counties, but data on thunderstorms were. For the 15 year period of 1992-2006 there were 24 thunderstorm events reported in Baraga County and 19 in Houghton County.

**Risk & Vulnerability**

Any of the university holdings could be struck by lightning, but affected areas would most likely not be widespread. The frequency of thunderstorms, based on the 2 county average of recorded storms, is approximately 2 thunderstorms per year. Several of the reported thunderstorms resulted in recordable damage; however, these damages were a result of high winds rather than lightning. According to the 2001 Michigan Tech vulnerability analysis, probability of a lightning storm occurrence is 2 to 3 times per year. Risk from lightning is low. Vulnerability to lightning is also low due to the lack of damage caused in the past by lightning and also as a result of the mitigative efforts already in place by the university. Proper grounding procedures are followed for permanent and temporary equipment, protection procedures are in place for outdoor events, and weather monitoring and appropriate warnings are provided for the population.

**Severe Winds**

*Non-tornadic winds of 58 miles per hour or greater.*

| Risk Level: Moderate | Vulnerability Level: Low |

Severe winds are fairly common in various parts of Michigan. Along the Great Lakes shoreline, high winds occur regularly and gusts of over 74 miles per hour (hurricane velocity) occasionally occur with a storm system. Severe winds can cause damage to structures, power lines, and trees. Power outages can result in the need for sheltering those left without power for extended periods.

**Past Occurrences**

Historically, in Houghton County windstorms are rarely a singular event, but usually accompany other severe weather such as thunderstorms and blizzards. The largest wind gust recorded in the county since 1950 occurred near Houghton on August 1, 2002, when
92 mile per hour winds peeled off the roof of a warehouse, overturned a truck, and downed numerous trees and power lines. Severe winds usually occur near the shoreline in Michigan. Michigan Tech is located 8 miles from Lake Superior and has experienced severe winds in the past, which have at times blown out campus building windows. Damages have been minor, and no injuries have been reported as a result of these occurrences.

**Risk & Vulnerability**

As can be seen in Figure 4.6, Michigan Tech (along with most of the Upper Peninsula) is located in a Zone II (160 mph) wind zone. At Michigan Tech, severe winds affect the campus about once every 2 years, while Houghton County averages 3 occurrences and Baraga County averages 2 per year. The average probability of a severe wind occurring in either county in any given year is approximately 46%. Impacts of severe winds on the Houghton campus are most prominent in the buildings whose windows have been recorded to be blown out by these high winds. Vulnerability to high winds is low. University mitigation efforts include protection procedures for outdoor activities, a warning system and communication of advisories and instructions.

**Figure 4-6: Wind Zones in the United States**
Hazard Identification & Risk Analysis

Snow Storms
*A period of snow often accompanied by high winds, cold temperatures, and low visibility.*

| Risk Level: Moderate | Vulnerability Level: Low |

Blizzards are the most dramatic and perilous of all snowstorms, as the snow is accompanied by low temperatures and strong winds. Blizzard snow usually takes the form of fine, powdery particles windblown in such great quantities that, at times, visibility is reduced to only a few feet.

Past Occurrences
The frequency of snow events in the area is a certainty each year. Average snowfall per year is over 200 inches, but potential snowfall is substantially greater, as reflected in the record winter of 1978-1979 where annual snow accumulations measured to nearly 400 inches. The 2018-2019 winter recorded 357-inches of snow in Houghton County.

- **March 2, 2007:** Michigan Tech campus was closed for one day due to a severe winter storm.
- **January 30, 2008:** Michigan Tech was closed for one day due to snow and wind
- **February 19-20, 2013:** Michigan Closed for a 1/2 day on the 19th and all day on the 20th. Career Fair was still held.
- **January 30 – 31, 2019:** Michigan Tech was closed for two consecutive days. Governor Whitmer declared a state of emergency for the State of Michigan due to extremely cold temperatures.
- **February 25, 2019:** Michigan Tech campus was closed due to a severe winter storm with extreme wind chill, poor visibility and drifting snow.

Risk & Vulnerability
Heavy snowfall affects the local area and often times the greater region. Heavy snowfall can accumulate on roofs and, if not removed, can cause cave-in type damages. However, there is no history of such events occurring to university holdings. The cost of a typical snowstorm is difficult to estimate, as a series of small events can have the financial impact of one large event. In general the local area, along with the university, is aware of and
Hazard Identification & Risk Analysis

preparing to deal with excessive snow. Perhaps the greatest threat of snowstorms is closure of the school, which does happen on rare instances (with the most recent closures in January and February 2019 for 3 days). As mentioned previously, if the weather becomes inclement enough for the university to close down, the university would incur approximately $700,000 in losses per day. University risk from a snowstorm is moderate, yet vulnerability is low considering the precautions taken by the university and local community.

**Tornadoes**

*An intense rotating column of wind that extends from the base of a severe thunderstorm to the ground.*

| Risk Level: Negligible | Vulnerability Level: Low |

The funnel associated with tornadoes can have winds of up to 300 miles per hour and interior air pressure that is 10-20% below that of the surrounding atmosphere. The typical length of a tornado path is 16 miles, but tracks of up to 200 miles have been reported. The path’s width is usually less than one-quarter mile, but can be over a mile. Historically, tornadoes have been one of the leading causes of death by natural disaster in the nation (lightning is another). Property damage resulting from tornadoes is in the hundreds of millions of dollars every year. While the State of Michigan does see tornado activity yearly, it is rare for tornadoes to strike the Upper Peninsula, let alone the Keweenaw Peninsula.

**Past Occurrences**

There has only been 1 recorded tornado in Houghton County in the past 50 years. The tornado occurred in July, 1987, was rated an F0, resulted in no deaths or injuries and caused only $2,500 in damages. In Baraga County there have been 2 reported tornadoes in the previous 50 years—1 in 1968 and 1 in 1980.

**Risk & Vulnerability**

There is minimal threat of a tornado affecting any of Michigan Tech’s facilities, according to the County Hazard Mitigation Plans. In Houghton County, there is a 2% risk of an F0 tornado occurring in the future, and a 4% risk of up to an F2 tornado in Baraga County.
Vulnerability at Michigan Tech is considered low due to the fact that the university has not seen loss of life or had property damaged due to a tornado. Additionally, the university conducts 2 tornado drills for the residence halls per school year—1 in the fall and 1 again in the spring.

**Technological Hazards**

**HAZARDOUS MATERIALS INCIDENT: FIXED SITE**

*An uncontrolled release of hazardous materials from a fixed site capable of posing a risk to life, health, safety, property or the environment.*

<table>
<thead>
<tr>
<th>Risk Level: Moderate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vulnerability Level: High</td>
</tr>
</tbody>
</table>

A hazardous material is any solid, liquid, or gas that can cause harm to humans and other living organisms due to it being radioactive, flammable, explosive, toxic, corrosive, a biohazard, an oxidizer, an asphyxiant, or capable of causing severe allergic reactions. Hazardous materials are present in quantities of concern in business and industry, universities, hospitals, agriculture, utilities, and other community facilities. Michigan Tech is a research university, home to approximately 370 laboratories where various chemicals are used for research and experimentation. Additionally, the main campus has 6 diesel fuel tanks with an inventory of number 2 fuel oil on hand. Furthermore several bottled gases such as Freon, MG, Propane, Nitrogen, Halon, are present on the main campus, some of which are piped directly into some of the academic buildings.

**Past Occurrences**

Michigan Tech does have a history of chemical spills, releases and leaks, some of which have resulted in fires and explosion. From 1996 to October 2007 there have been 41 reported incidents, many of which required evacuation. Most spills and releases were minor; however, the risk of more serious incidents is ever present.
A summary of the more serious occurrences are as follows:

- **November 10, 1981: Chemistry/Metallurgy Building-Main Campus**: A chemical explosion in a sixth floor advanced organics lab sent one man to the hospital seriously injured as a result of burns and cuts received from being sprayed with burning solvent and glass. Quick reaction by colleagues who immediately administered first aid helped to save the man’s life. Damages to the lab were estimated to be around $500.

- **May 10, 1995: 605 MEEM Building-Main Campus**: A spark landed on a pile of ground magnesium in a sixth floor lab and caught fire, filling the sixth floor with smoke. The students in the lab immediately put out the fire using a fire extinguisher, as they had been trained on how to handle this type of fire. There were no injuries or damages reported.

- **October 6, 1999: 708 Chemistry/Metallurgy Building-Main Campus**: A fire started and filled the lab with smoke as a result of an item in an oven catching fire. The Houghton Fire Department was called in to check out the scene. The fire was extinguished. No injuries were reported and damages to property were recorded at a value of $100.

- **April 24, 1999: 614 Chemistry Building-Main Campus**: A small explosion injured one man, requiring local ambulance personnel to respond to the scene. The man was working on a procedure to make sulfoacetic acid in a vented hood. The temperature of the solution became too high and during the process of icing down the one liter container, it exploded. The man was transported to the hospital; there were no damages to the laboratory.

- **June 5, 2001: 181 Forestry Building-Main Campus**: A fire started of unknown cause, between 11:00 PM and 6:00 AM, and burned for a total of an hour to an hour and a half in an unoccupied laboratory. There were no injuries or damages recorded.

- **March 29, 2005: Micro Biology Lab Forestry Building-Main Campus**: A researcher had left a beaker unattended which overheated and let off odors and fumes. Since the researcher was absent the contents of the container were unknown. An evacuation of the building ensued as a precaution, in case the fumes were toxic. The Houghton Fire Department was called in to handle the situation. The researcher returned and advised as to what the contents were. After approximately
30 to 45 minutes it was determined that staff could re-enter the building.

- **April 14, 2006: Rm 317 Minerals & Materials Building-Main Campus:** A powder ignition in an enclosed research vessel occurred, resulting in an explosion. A small amount of the chemical powder detonated in a glovebox antechamber, causing a pan of the powder to flip over and generate a pressure surge inside the glovebox—fracturing a portion of the glovebox window on the back side of the box. The remaining powder was deemed unstable and the laboratory was sealed off until the method for proceeding was determined. Fortunately there were no injuries, but the potential for a serious explosion was present which could have caused a fatality and injuries to others had the explosion destroyed the laboratory’s walls, floor and ceiling. A special hazardous materials team had to be brought in to stabilize and clean up the laboratory. The laboratory was closed for three months as the process (from determining the best way to proceed to actual clean up) took this long.

- **February 23, 2007: Electrical Energy Resources Center (EERC)-Main Campus:** A hazardous condition was a result of spilled gasoline in a laboratory in the basement of the EERC. It is believed that gasoline in an improperly vented gas can, filled that morning, had expanded due to cold temperatures. About 2 inches of gasoline spilled from the can. No injuries or damages were reported, but cancellation of one class did occur.

**Risk & Vulnerability**

Michigan Tech is a renowned research facility and the presence of hazardous materials for use in research and experimentation is to be expected. However, the proper management of these materials (referring to the diligent labeling, appropriate storage, and the implementation of safety training) and best handling procedures of chemicals (for those staff, faculty and students that have contact with them) is vital in reducing disastrous events involving hazardous materials.

A program was implemented in 2002, with the goal of broadening awareness and responsibility for safety among the university community. Activities to achieve a higher safety level included, allocating more time and resources to undertake corrective measures (for example conduct training). The program involved the Occupational Safety & Health
Services (OSHS) office in performing annual laboratory audits/inspections focusing on: Training & Education on Safety, Life Safety Issues, Environmental Issues and Improvements from Previous Audits. Please note that not all laboratories are audited annually, due to the large number of laboratories on campus and limited staff.

According to OSHS, laboratory audits from the start of the program to date revealed areas where further improvements should be made in approximately 10% of university laboratories. Areas of improvement include: safety training, laboratory management, chemical labeling procedures, appropriate storage of chemicals, and controlling chemical inventory levels. While the majority of the university is successful in its laboratory management, the few problem areas put the entire university at risk. Risks from a hazardous materials event include death, injury and property damage which could lead to several secondary problems for the university, including loss of operations, law-suits, and damage to reputation (which could hinder attracting and maintaining students and faculty).

Due to the above listed reasons, risk from hazardous materials incidents is estimated at a moderate level, while vulnerability is high. Fortunately, to date, Michigan Tech has not lost any lives to these incidents, but severe injuries and damages have been reported.

Vulnerability is further increased as a result of a lack of a local hazardous materials response team; the closest team is located over 2 hours away. Many hazardous materials incidents can be mitigated through comprehensive training programs and proper handling, storing and disposal procedures. While the university and the local fire departments have handled situations in the past, the university could further secure its safety by mitigating risk and vulnerability through activities such as: closely monitoring chemical storage areas, designating specific receiving areas of chemicals that are shipped on campus, performing training audits, and enforcing consequences for those laboratories that consistently do not comply with audit findings. Additionally, the formation of a Hazardous Materials Response Team, in conjunction with local agencies, to serve the university and local area, could dramatically reduce response time and improve safety.

HAZARDOUS MATERIALS: TRANSPORTATION INCIDENT

An uncontrolled release of hazardous materials during transport capable of posing a risk
Highway, railroad, seaway, airway, and pipeline systems are carrying thousands of hazardous material shipments on a daily basis through local communities. A transportation incident with hazardous materials could cause a local emergency. Areas at risk are those within 1-5 miles of major transportation routes for hazardous materials. The U.S. Department of Transportation regulates the transport and shipping of over 18,000 different materials. All areas of Michigan are vulnerable to a hazardous materials transportation incident, with more urban industrial areas being at greater risk.

Past Occurrences
The local region is divided by highways and a shipping canal and is surrounded by Lake Superior which is host to shipping traffic. Michigan Tech’s main campus is located between the Portage shipping canal and U.S. Hwy-41 and while the university has not been directly affected by previous transportation incidents involving hazardous materials, the local area has been.

- **August 6, 2002 7:30 AM: U.S. Hwy-41, Santori’s Corner, Hancock, MI**: A tanker truck full of 6,300 gallons of hot asphalt, traveling north on U.S. HWY-41 in the City of Hancock, turned on its side. Product leaked from the vent onto the highway at about 3-4 gallons per minute. Due to the quick action of local fire departments and the Houghton County Road Commission, the flow was diverted from storm drains and sewers. Local agencies continued to work to contain...
the spill, to right the truck and trailer, and to reclaim the spilled materials. The total amount of product spilled was 1,600 gallons, but none of it made it into the natural environment in or around the spill site. The affected section of the highway was closed overnight and on the morning of August 7, the affected road surface was ground and repaved with asphalt. The road was reopened to the public by about 3:30 PM that day.

- **October, 2003 Lake Superior West of Eagle Harbor:** Houghton County has many miles of shoreline susceptible to shipping accidents on Lake Superior and along the Portage Canal (where Michigan Tech’s main campus is located). In October, 2003, a Great Lakes freighter spilled fuel oil during an internal fuel transfer about 25 miles west of Eagle Harbor (Eagle Harbor is located on the northwestern side of the Keweenaw Peninsula). About 1,300 gallons were lost, with about 800 gallons of dime sized tar balls washing up on shore about four miles south of the Portage Lake Canal, north entry.

- **February 3, 2018 US-41 Chassell Township:** A tanker truck was involved in a multi-vehicle accident causing the tanker truck to overturn. One of the vehicles in the car accident suffered a fatality. The tanker overturned on US HWY 41 at the Sturgeon River bridge approximately 1.25-miles southeast of Chassell in Houghton County, Michigan. The highway was completely closed through Saturday night. The tanker was carrying clear diesel fuel and gasoline that leaked onto the road surface and migrated onto the frozen surface of the Sturgeon River. The release volume was estimated at 4,000 gallons of gasoline and 400 gallons of diesel. The Chassell Fire Department and other area first responders provided initial containment and recovery work. U.S. EPA mobilized to lead and oversee spill recovery and public health response. Subsequently the truck owner, Klemm Tank Lines, retained local contractors and mobilized additional response contractors to mitigate the release.
Risk & Vulnerability

Hazardous material-transportation incidents have occurred in the region in the past. Although none of these incidents occurred on a Michigan Tech campus, risk from such an event remains due to the main campus location resting between the Portage Shipping Canal and U.S. Hwy-41. Trucks carrying hazardous materials, such as fuel trucks, traverse the area in addition to trucks carrying anhydrous ammonia, a toxic and flammable chemical. The trucks that transport anhydrous ammonia pass by the main campus an average of 8 times per year on their way to a local company that uses the chemical in its manufacturing process. Uncontrolled releases of any type of hazardous material usually occur with no prediction or warning, which makes these hazards more dangerous.

Risk to Michigan Tech is low, based on the fact that this type of event has not occurred on any of the campuses in the past. Vulnerability is more difficult to determine, since there have been no previous damages to the university. It is impossible to determine when a vehicle carrying a hazardous material is going to have an accident, resulting in an uncontrolled release. The local area, along with the campus environment, buildings and population could be affected by such an event; vulnerability is estimated to be moderate.

INFRASTRUCTURE FAILURE & SECONDARY TECHNOLOGICAL HAZARDS

The failure of critical public or private utility infrastructure, resulting in a temporary loss of essential functions and/or services.

| Risk Level: Moderate |
| Vulnerability Level: Difficult to Determine |

Public and private utilities provide essential services such as electric power, heating and air conditioning, water, sewage disposal and treatment, storm drainage, communications, and transportation. When one or more of the utility systems fail, due to a disaster or other cause (even for a short time), it can have devastating consequences. During power outages, people can die in their homes from extreme heat or cold. When water or wastewater treatment facilities are inoperable, serious health problems can arise and action must be
taken immediately to prevent outbreaks of disease. If the infrastructure failure results from a natural hazard event, it is termed a secondary technological hazard.

**Past Occurrences**

Though many of the hazards considered in this plan could cause infrastructure failures, these failures are dangerous in and of themselves due to the harsh climate and remoteness of the region. Michigan Tech is served by a number of systems including power, water treatment, phone, etc. and loss of any or all of the systems can have a detrimental impact on the functioning of the university. A failure of infrastructure or utilities can include anything from power outages to a malfunctioning of the Portage Lift Bridge, which could cut Michigan Tech off from the two nearest hospitals.

Michigan Tech has been affected by the loss of power on a number of occasions. While power outages are usually of a short duration, up to a few hours, the impacts of an extended outage could affect the health and safety of the campus community, along with detriment to temperature sensitive research related activities. A water leak at the Ford Center was repaired in the summer of 2018. The leak did not cause the immediate closure of the facility. The leak did cause the system to draw down the well system to a dangerously unsafe condition. The leaks have since been repaired but the age of the system causes concern for more leaks in the future. Table 4.2 identifies university infrastructure and frequency of failure in the past as per the university vulnerability analysis performed in 2001 and has been updated based on the addition of generators.

**Table 4.2: Infrastructure Failure Likelihood**

<table>
<thead>
<tr>
<th>Infrastructure Failure</th>
<th>Probability of Occurrence</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Heating Plant Failure</td>
<td>Very Low</td>
<td>Once every 30 years</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Low</td>
<td>Once every 5 years</td>
</tr>
<tr>
<td>Water Failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Broken Main Water Line to Building</td>
<td>Moderate</td>
<td>Once every 2 years</td>
</tr>
<tr>
<td>- Broken Pipe in Building</td>
<td>Moderate</td>
<td>Once every 2 years</td>
</tr>
<tr>
<td>- Water Contamination</td>
<td>Very Low</td>
<td>Once every 30 years</td>
</tr>
<tr>
<td>- Water Shortage</td>
<td>Very Low</td>
<td>Once every 30 years</td>
</tr>
<tr>
<td>Phone System Failure</td>
<td>Low</td>
<td>Once every 10+ years</td>
</tr>
<tr>
<td>Critical Records Loss/Data Security File</td>
<td>Low</td>
<td>Once every 5 years</td>
</tr>
<tr>
<td>Fume Hood/Exhaust/Ventilation - Critical System Failure</td>
<td>Moderate</td>
<td>Once every 2 years</td>
</tr>
</tbody>
</table>

*Source: 2001 Michigan Tech Vulnerability Analysis*

*Updated Power outage info based on addition of generators*
Risk & Vulnerability
Overall, Michigan Tech’s risk to an infrastructure failure is considered moderate. The main campus is heated from steam generated by four boilers located in the university central heating plant, all of which are powered by gas or fuel oil. Natural gas is brought in over the local distribution system; if this system fails, the university keeps an inventory of No. 2 fuel oil on campus. If necessary, the university is capable of supporting both electric and heat functions with the fuel oil for approximately 15 days, or supporting one of the two functions for approximately 25 days.

The university’s main campus electric service is supplied by the privately owned Upper Peninsula Power Company (UPPCO) and four diesel generators (implemented in 2006, after the 2001 vulnerability analysis). The generators provide campus electricity during peak hours and offer the university uninterrupted electric service in the event UPPCO electricity fails. Prior to the generators, the university experienced several power outages a year, but now failure has virtually been eliminated.

Water systems, wastewater systems and phone service can also be affected by failure or secondary failure. In the past, water loss or contamination has not been an issue, although broken water pipes, usually caused from extreme cold as mentioned previously, have occurred. Also in the past, the loss of phone service has been minimal. One failure which could be an issue is a breakdown in the computer network. While the university takes steps to perform backups in several locations, there is not a backup performed at an off-site location. Off-site here refers to a location several miles away so as to circumvent data loss in the event of widespread (university or region-wide) event. The failure of an exhaust system remains a reality with a moderate level of occurrence. Procedures and backup plans are in place if such an event occurs.

An additional area of concern lies with the Portage Lake Lift Bridge. Although the bridge is not part of the university, its failure would separate the university population from medical services. Alternate emergency plans, in conjunction with area municipalities, could help lessen the burden of medical situations in the event of a prolonged bridge failure. The closest hospital on the south side of the bridge is located 32 miles away in the L’Anse Township.
Numerous factors contribute to the impact of an infrastructure failure, including services affected, weather conditions, response capabilities, time of day, etc. Therefore vulnerability is difficult to calculate. However, based on the university infrastructure system, it is unlikely that one type of failure will affect the entire campus at a given time.

**PETROLEUM & NATURAL GAS LEAKS**

*An uncontrolled release of petroleum or natural gas, or the poisonous by-product hydrogen sulfide.*

| Risk Level: Low | Vulnerability Level: Moderate |

These types of accidents are often overlooked as a threat because much of the petroleum and gas infrastructure in the area and State, is located underground. Petroleum and gas pipelines can leak, erupt, or explode, causing property damage, environmental contamination, injuries or loss of life. In addition, if hydrogen sulfide is released, it is an extremely poisonous gas that is explosive when mixed with air at temperatures of 500°F or above. Inhalation of even minute amounts of this gas can be fatal. These dangers can be found around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities as well as in pipelines.

The threat of potential explosion, fire or atmospheric condition as a result of one of the other gases present on campus (Freon, MG, Propane, N2, Halon) exists, but this type of gas leak was considered in the Hazardous Materials: Fixed Site Incidents section.

**Past Occurrences**

Michigan Tech receives natural gas over the local distribution channels, but also stores fuel oil in six 35,000 gallon horizontal single wall tanks. The tanks are located within a secondary concrete containment structure. Fuel leak detections systems also add a level of safety. The tanks were installed in the fall of 2015 to replace a 1,000,000 gallon tank. There was a report of a natural gas leak on August 15, 1996 in the Chemistry Building that
caused the evacuation of 20 people. No injuries or damages were reported.

**Risk & Vulnerability**

There is a risk of a future petroleum or natural gas incident at the main campus caused by either sabotage or aging transmission lines. Michigan Tech’s oil tanks are inspected by the Michigan Department of Environmental Quality on a regular basis. A locked fence provides a minimal level of security to protect the tanks from sabotage.

Risk from a natural gas leak is low, according to the 2001 Michigan Tech Vulnerability Analysis, indicating the probability of a natural gas line failure is less than once every 10 years. Therefore overall risk to a natural gas leak is considered to be low. Vulnerability to a natural gas or petroleum leak includes the campus population, holdings, and environment, and is estimated at moderate.

### Societal Hazards

**CIVIL DISTURBANCES**

A public demonstration or gathering that results in a disruption of essential functions, rioting, looting, arson or other unlawful behavior.

| Risk Level: Low | Vulnerability Level: Low |

Large-scale civil disturbances, while rare, are typically instigated by an event, which could include labor disputes, controversial activities, resource shortages, celebrations, or disagreement concerning a particular issue between two or more groups. Some places that may be impacted by such disturbances are government buildings, prisons, military bases, businesses, critical service facilities, and universities.

**Past Occurrences**

Michigan Tech does not have a history of civil disturbance. Over the years students have gathered for peaceful protests, sporting events, commencements, and celebrations, but
none have resulted in civil disturbances, unrest or riots.

**Risk & Vulnerability**

Although the university has no history of civil disturbances, the risk of one in the future does exist due to the nature of educational institutions. Historically, universities have been areas for demonstrations, especially during the widespread political protests during late 1960s and early 1970s. Today most university-related riots continue to have been fueled by sporting event outcomes. Alcohol consumption is often a factor in sport-related unrest, as was the case a number of riots occurring in the Midwest region, listed below:

- **Michigan State University—March 27, 1999**: Riots broke out after the MSU men’s basketball team lost to Duke in the NCAA final four.
- **Ohio State University - November 23, 2002**: Riots broke out as part of the celebration after Ohio football team defeated arch-rival Michigan.
- **Minnesota State University, Mankato—October 4, 2003**: Riots broke out during homecoming weekend after the loss of the university football team.

While civil disturbance is a threat to any public institution, the risk and vulnerability levels at Michigan Tech are considered low based upon university history and the presence of on-campus police through the Public Safety Department. However, vulnerability to such an event is campus-wide, with potential for affecting campus population and property.

**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.*

| Risk Level: Moderate | Vulnerability Level: Difficult to Determine |

Public health emergencies can take on many forms: disease epidemics, large-scale food or water contamination, extended periods without adequate water or sewer services, harmful exposure to chemical, radiological or biological agents or large-scale infestations of disease carrying insects or rodents. Public health emergencies can occur by themselves or may be
Hazard Identification & Risk Analysis

A secondary event caused by other emergencies or disasters such as a flood or hazardous material incident. The common characteristic of public health emergencies is that they adversely impact or have the potential to impact a large number of people. Additionally, the strain on public health facilities can be further exacerbated by the “worried well” who could overwhelm the system by seeking treatment when unnecessary.

University campuses across the nation are concerned with communicable diseases. Due to the “close quarters” nature of residence hall living, contagions can spread more quickly among the student population. Additionally, with students and staff coming from across the country and internationally, the risk of disease exposure increases. Diseases of concern to university populations include, but is not limited to: influenzas, mumps, measles, tuberculosis, chicken pox, severe acute respiratory syndrome (SARS), methicillin-resistant staphylococcus aureus (MRSA) m, ononucleosis, and the most serious—meningococcal disease.

Past Occurrences
There is no recent history of widespread public health emergencies on Michigan Tech’s campuses or in the local communities. Small incidences of flu outbreaks do occur, but the extent of the emergency has been limited.

In 2009, public concern of the spread of the H1N1 virus was a national concern and to mitigate risk, Michigan Tech set-up a steering committee to work with the Western Upper Peninsula Health Department and local medical facilities to monitor flu conditions. They also encouraged and offered flu vaccinations as well as stared information about symptoms and how faculty, staff and students to help limit the spread of any flu.

In 2018-2019, a similar world-wide concern over the measles virus is affecting communities and campuses. While Michigan Tech has no recorded outbreaks on campus, the state of Michigan is experiencing outbreaks, and college campuses in California are dealing with incidences. Michigan Tech is mitigating risk by providing communications, resources, and educating the campus community, especially in regards to how to protect yourself when traveling to areas that have recorded cases of measles.
There have been 10 reported cases of MRSA on campus since 2014. There was also the case of one Michigan Tech Freshman dying as the result of meningitis, and while this incident was isolated, the possibility of a disease outbreak and contamination does exist either as an isolated event or as a secondary event from flooding or other disasters. The flooding that occurred in Houghton County on June 17, 2018 is such an example. While Michigan Tech took rapid action to minimize potential public health emergencies associated with the flooding, there does always exist the possibility of food and water safety issues and mold or sewage contamination.

**Risk & Vulnerability**

Michigan Tech is aware of and prepared to deal with the risks associated with public health emergencies. Residential Life, Facilities Management and Dining Services personnel are trained annually on emergency response procedures including health emergencies. While awareness and planning are key, a large magnitude epidemic could overload limited emergency facilities that are not equipped to deal with this type of emergency. Houghton County has been designated a Health Professionals Shortage Area (HPSA) by Michigan’s Department of Community Health, based on the county’s population to physician ratio and certain other health and income statistics. The remoteness of the university could also be a factor during a large-scale emergency. Based on numerous factors, risk from a public health emergency is estimated to be moderate.

Influenza-type illness is by far the most common communicable disease, however, as in the past, the average mortality rate of 8.3 per 100,000 residents from 2007 to 2009 in Houghton County was significantly lower than Michigan’s rate of 15.2. The vulnerability of the university in a public health emergency is difficult to determine as this hazard has the potential to impact the entire university population and the local community at large, or vice versa. The Office of Emergency Measures Coordinator and the Director of the Western Upper Peninsula Health Department have collectively determined that the greatest public health threat faced by Houghton County is the contamination of the food supply, either accidental or intentional, or an outbreak of pandemic or widespread flu. The university has a pandemic response plan which outlines response procedures Michigan
Hazard Identification & Risk Analysis

Tech will carry out to handle a widespread pandemic influenza outbreak. Additionally, educational programs and materials are utilized annually to educate the campus community about measures that should be taken to reduce the spread of influenza.

SABOTAGE/TERRORISM

An intentional, unlawful use of force, violence or subversion 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.

<table>
<thead>
<tr>
<th>Risk Level: Moderate</th>
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</thead>
<tbody>
<tr>
<td>Vulnerability Level: Difficult to Determine</td>
</tr>
</tbody>
</table>

Sabotage/Terrorism can take many forms, including: bombings; assassinations; organized extortion; use of nuclear, chemical and biological weapons; information warfare; ethnic/religious/gender intimidation (hate crimes); pre-mediated plans of attack on institutions of public assembly; and disruption of legitimate scientific research or resource-related activities (eco-extremism). Due to recent events in the nation, virtually any public space is vulnerable to the threat of sabotage and terrorism. Universities, like other large institutions, must take additional precautions to protect their information technology services and computer services from hackers. Saboteurs and terrorists often go to great lengths to avoid detection by authorities while still seeking publicity for their organization and/or ideals, often the motive for these events.

Past Occurrences

As remote an area as Michigan Tech and the Keweenaw Peninsula are, they are not immune to acts of terrorism and sabotage. A bank robbery by a former Michigan Tech student on a Houghton bank resulted in fatalities. Eco-terrorism continues to be an issue for the local area, with loggers, on occasion, reporting vandalized equipment and spiked trees, which endanger the lives of anyone unlucky enough to be sawing through them. Michigan Tech is a premier science and engineering research university and susceptible to attacks on its offices, labs, and computer systems. A bomb scare in 2001 on the Houghton campus has been linked to eco-terrorism.

Michigan Tech student with a history of paranoia and schizophrenia robbed the MFC First National Bank in downtown Houghton. One employee was shot and lost her arm due to that injury. Another was held hostage for 17 hours; ending in the shooting death of the robber.

- **November 5, 2001 Forestry Buildings—Main Campus:** Overnight Michigan Tech public safety officers discovered two incendiary bombs on the Houghton campus while on a routine patrol. One bomb was found outside of the U.J. Noblet Forestry Building and one was outside of the adjacent U.S. Forestry Service laboratory. The Michigan State Police Bomb Squad in Negaunee and agents from the FBI and Bureau of Alcohol, Firearms, & Tobacco in Marquette, were called in and by 1:00 p.m. the bombs were secured. The buildings reopened by 4:00 p.m. the same day. No one has claimed responsibility for the incident and the perpetrators were never found.

Although incidents, such as those mentioned, are rare in the remote Keweenaw Peninsula, these two examples are proof that Michigan Tech and the area are vulnerable to acts of terrorism and sabotage.

**Risk & Vulnerability**

Michigan Tech does have a short list of historic sabotage/terrorist activities and could be susceptible in the future as a center for research and education. In the aftermath of the attempted Forestry Building bombings, security cameras were installed to mitigate future attempts to harm the university, however, it is not feasible to post surveillance cameras everywhere on campus. Vulnerability to such events varies and is difficult to quantify (there were no damages with the past occurrences), but could be devastating and include the campus population, laboratories, buildings, property and community members. Based on previous occurrences, the university 2001 Vulnerability Assessment, and in light of recent nation-wide shooting events at universities and schools, probability for future occurrences and therefore risk is considered moderate.

As a result of these concerns Michigan Tech Public Safety and Police Services now offers “Active Shooter Training for Workplaces”. The program is delivered by Lt. Marc
Hazard Identification & Risk Analysis

Geborkoff at Public Safety Police Services along with other local law enforcement active shooter instructors depending on class size. The training is roughly 3 hours depending on group sizes and consists of a 45 minute presentation followed by live scenarios, if the work area allows for it. These trainings for our campus community started in early January of 2017 and are currently offered to present date. So far, close to approximately 800 faculty and staff have been through this training.

**Hazard Priority Ranking**

Mitigation activities for Michigan Tech and surrounding areas are prioritized by hazard ranking based on the following criteria: historical occurrence, affected area, speed of onset, impact, economic effects, duration, seasonal pattern, predictability, collateral damage, availability of warnings, and mitigation potential. A score from 1 (least risk) to 10 (greatest risk) was assigned for each of the risk factors for all hazards surrounding Michigan Tech in order to develop an overall score and ranking. The scoring for each hazard was based on the following:

- **Historical Occurrence:** Low Occurrence (1 pt)—Excessive Occurrence (10 pts)
- **Affected Areas:** Single Site (1 pt)—Large area (10 pts)
- **Speed of Onset:** Greater than 24 hours (1 pt)—Minimal/No Warning (10 pts)
- **Population Impact:** No Impact (1 pt)—High Impact (10 pts)
- **Economic Effects:** Minimal Effects (1 pt)—Significant Effects (10 pts)
- **Duration:** Minimal Duration (1 pt)—Long Duration (10 pts)
- **Seasonal Pattern:** One Season (1 pt)—Year Round (10 pts)
- **Predictability:** Highly Predictable (1 pt)—Unpredictable (10 pts)
- **Collateral Damage:** No Possibility (1 pt)—High Possibility (10 pts)
- **Availability of Warnings:** Warnings Available (1 pt)—Not Available (10 pts)
- **Mitigative Potential:** Easy to Mitigate (1 pt)—Impossible to Mitigate (10 pts)

Table 4.3 displays each hazard and their respective criteria scores along with their hazard ranking. Those final scores highlighted in red represent the top ranking hazards that could pose the most threat to the university. Please see Appendix C and F for a more in-depth view of the ranking benchmarks as well as the Vulnerability Assessment used in the 2008 plan.
### Table 4.3: Michigan Tech Hazard Profile & Evaluation

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Historical Occurrence</th>
<th>Affected Area</th>
<th>Speed of Onset</th>
<th>Popul. Impact (casualties)</th>
<th>Economic Effects</th>
<th>Duration</th>
<th>Seasonal Pattern</th>
<th>Predictability</th>
<th>Collateral Damage</th>
<th>Availability of Warnings</th>
<th>Mitigative Potential</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>10</td>
<td>4</td>
<td>4</td>
<td>1</td>
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<tr>
<td>Fire: Structural</td>
<td>4</td>
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<td>10</td>
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<td>7</td>
<td>10</td>
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<td>74</td>
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<td>Fire: Wildfires</td>
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<td>1</td>
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<td>4</td>
<td>7</td>
<td>4</td>
<td>4</td>
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<td>53</td>
</tr>
<tr>
<td>Flooding: Dam Failure</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<td>4</td>
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<tr>
<td>Flooding: Urban</td>
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<td>10</td>
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<td>10</td>
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<td></td>
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</tr>
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<td>Subsidence</td>
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<td>1</td>
<td>1</td>
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<td>1</td>
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<td>Severe Weather: Ice and Sleet Storms</td>
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<td>Severe Weather: Lightning</td>
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<tr>
<td>Haz-material: Fixed Site Incident</td>
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<td>10</td>
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<td>Haz-material: Transport. Incident</td>
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<tr>
<td>Infrastructure Failure/Secondary Tech. Hazards</td>
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<td>7</td>
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<td>Civil Disturbances</td>
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<td>7</td>
<td>4</td>
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<td>7</td>
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<td>Public Health Emergencies</td>
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<td>Sabotage/Terrorism</td>
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<td>7</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>68</td>
</tr>
</tbody>
</table>

*Urban Flooding Speed of Onset score increased from 7 to 10 due to the rapid onset of past flooding events on campus.

** Added Landslide based on slope failure at Mont Ripley due to flooding events.
Hazard Identification & Risk Analysis

**Hazard Summary**

The following total scores represent results of the hazard priority ranking completed by the Michigan Tech Disaster Resistant University Advisory Committee in 2008 and have been reviewed and updated by the working committee in 2019. *Earthquakes* were not included in the hazard ranking because they are not likely to occur in the region.

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Score out of 100</th>
<th>Mitigation Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Hazards</td>
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<td></td>
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<tr>
<td>Urban Flooding</td>
<td>74</td>
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<tr>
<td>Major Structural Fires</td>
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<td>1</td>
</tr>
<tr>
<td>Severe Weather: Snowstorms</td>
<td>53</td>
<td>6</td>
</tr>
<tr>
<td>Wildfires</td>
<td>53</td>
<td>6</td>
</tr>
<tr>
<td>Landslides</td>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td>Subsidence</td>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td>Severe Weather: Extreme Temperatures</td>
<td>47</td>
<td>8</td>
</tr>
<tr>
<td>Severe Weather: Severe Winds</td>
<td>44</td>
<td>9</td>
</tr>
<tr>
<td>Severe Weather: Ice &amp; Sleet Storms</td>
<td>41</td>
<td>10</td>
</tr>
<tr>
<td>Flooding: Dam Failure</td>
<td>41</td>
<td>10</td>
</tr>
<tr>
<td>Drought</td>
<td>41</td>
<td>10</td>
</tr>
<tr>
<td>Severe Weather: Lightning</td>
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<td>11</td>
</tr>
<tr>
<td>Severe Weather: Hail</td>
<td>35</td>
<td>12</td>
</tr>
<tr>
<td>Severe Weather: Tornadoes</td>
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<td>12</td>
</tr>
<tr>
<td>Technological Hazards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazardous Material: Fixed Site Incident</td>
<td>71</td>
<td>2</td>
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<tr>
<td>Infrastructure Failure/ Secondary</td>
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<td>4</td>
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<tr>
<td>Technological Hazards</td>
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<td></td>
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<tr>
<td>Haz-Material: Transport. Incident</td>
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<tr>
<td>Petroleum/Natural Gas Accidents</td>
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<td>Societal Hazards</td>
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<td>Sabotage/Terrorism</td>
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<td>Public Health Emergencies</td>
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<td>4</td>
</tr>
<tr>
<td>Civil Disturbances</td>
<td>47</td>
<td>8</td>
</tr>
</tbody>
</table>

Although many of the hazards identified can and do occur in and around Michigan Tech University, the six highest priority hazards include:

- Urban Flooding
- Major Structural Fires
- Hazardous Materials Incidents: Fixed Site
- Sabotage/Terrorism
- Public Health Epidemics
- Sabotage/Terrorism
Hazard mitigation activities will focus on mitigating losses due to these priority hazards while also considering activities that may mitigate losses due to lower-ranking hazards. Before identifying specific mitigation activities, further investigation of university vulnerability is discussed in the next section, followed by estimated losses from potential hazard events.
Section 5: Mitigation Strategy

- Introduction
- Michigan Tech DRU Mission and Mitigation Goals
- Identification & Analysis of Mitigation Actions
- Recommendation & Prioritization of Mitigation Actions
- Potential Funding Sources

Introduction

The purpose of this section of the Plan is to provide an outline for Michigan Tech to follow to become less vulnerable to identified hazards. Michigan Tech’s mitigation strategy is based on the findings from Section 4: Hazard Identification & Risk Analysis, the 2001 Vulnerability Assessment (Appendix F), the original work done by the DRU Advisory Committee in 2008, and consensus of the 2019 working group along with input from experts from across campus.

The mitigation strategy will serve Michigan Tech as guiding principles for future mitigation policy, implementation and project administration. Additionally, the strategy will provide an analysis of techniques, where available, to best meet mitigation goals and reduce the impact of potential hazard events. Developing the strategy is a four step process:

1. The first step in developing the mitigation strategy is to revisit the Mission Statement to ensure it guides mitigation goal creation.
2. The second step is the review of Michigan Tech’s mitigation goals (developed in 2008).
3. The third step involves identifying specific action-based mitigation activities (projects and policies) and analyzing these activities to determine if they are feasible economically, socially, environmentally, etc.
4. The last step in designing the mitigation strategy is the selection and prioritization of university mitigation actions (provided in the next section). The outcome is the mitigation action plan that lists prioritized projects and policies for Michigan Tech to carry out. Additional information listed in the action plan includes: departments or lead personnel assigned responsibility for project implementation, potential funding sources, and estimated project duration. The comprehensive summary of the action plan will serve as a quick reference of mitigation projects for university decision makers.
Mitigation Strategy

Through the updating of the mitigation action plan, the committee considered Michigan Tech’s overall risk, vulnerability, and capacity to mitigate the effects of identified hazards. There was careful consideration of undertaking feasible mitigation projects. This process was guided by evaluating proposed mitigation activities with the FEMA-recommended STAPLEE criteria discussed further in this section.

Mitigation Goals

Goals for the Michigan Tech Multi-Hazard Mitigation Plan were created to address the highest priority hazards identified in Section 4 of this plan that could afflict the university:

- Urban Flooding
- Major Structural Fires
- Hazardous Materials Incidents: Fixed Site
- Sabotage/Terrorism
- Public Health Emergencies
- Infrastructure Failure/Secondary Technological Hazard

Consideration was also given to efforts that could assist with lower ranking or unknown hazards that may affect the university campuses. In 2008, six general goals were established to guide mitigation efforts. In the 2019 plan, the goals are still considered comprehensive and give guidance to identifying mitigation activities at Michigan Tech.

Goal 1: Protect the lives, safety and welfare of all Michigan Tech students, faculty, staff and visitors from known hazards while focusing on priority hazards.

Goal 2: Improve capabilities to minimize losses of Michigan Tech property, cultural resources, and research investments by identifying and undertaking feasible projects that will help mitigate future events.

Goal 3: Maintain and improve communications regarding disasters and emergency measures within Michigan Tech and with neighboring jurisdictions.
Goal 4: Enhance emergency preparedness, increase awareness, and promote risk reduction activities through education of and outreach to Michigan Tech’s population.

Goal 5: Be proactive in protecting Michigan Tech campuses and critical facilities by enhancing and maintaining hazard mitigation as a part of the University’s standard operating procedure.

Goal 6: Ensure that Michigan Tech’s business continuation will not be significantly disrupted by disasters, through implementation of up-to-date response plans and through upgrades as needed.

Identification & Analysis of Mitigation Actions

A wide range of mitigation activities can be considered in order to help achieve established mitigation goals to create a feasible mitigation strategy and action plan. Mitigation activities can fall into a number of categories, including preventative measures, property protection, public education & awareness, natural resource protection, emergency services, and structural projects. The following is an overview of potential activities by category:

1. Preventative Measures

The purpose of preventative measures is to protect new development from hazards and ensure that potential loss is not increased. Preventative measures are typically guided through regulatory programs or enforcement actions that influence the way land is developed, buildings are constructed, or how people respond. Prevention activities can be particularly effective where development has not yet occurred or where capital improvements have not been significant. Preventative mitigation activities include:

- Planning & Design
- Open Space Preservation
- Stormwater Management
- Law Enforcement (crime deterrence)
- Facilities Construction
- Capital Improvement Programming
2. Property Protection

The purpose of property protection measures is to prevent a hazard from damaging a building. Property protection measures are typically implemented by the university, but government can often provide technical and sometimes financial assistance. There are five general activities that can be classified as property protection:

- Building Relocation/Building Elevation
- Retrofitting (security enhancements, windproofing, fireproofing, etc.)
- Insurance Coverage
- Demolition
- Barriers (safe rooms, shutters, impact resistant glass)

3. Public Education and Awareness

Public education and awareness is a mitigation strategy that has a broad reaching impact across both the university and community. Activities that provide university officials, faculty, staff and students, along with local governments, businesses and residents, with information on how to protect themselves and others from potential hazards that may have the greatest impact of all mitigation strategies. Information empowers people to protect their own property and lives.

Examples of public education include:

- Outreach Projects
- Speaker Series
- Mock Events, Training & Preparation
- Hazard Map Information

4. Natural Resource Protection

Resource protection mitigation activities are a way to enable land to function in a natural way. Because many natural areas have been affected by development and will be affected by development in the future, there are a number of ways to protect and restore the environment.

Resource protection activities can include:

- Wetlands Protection
- Erosion & Sedimentation Control
- Watershed Management
- Best Forest & Vegetation Management Practices
- Habitat Preservation

There are many benefits to naturally functioning watersheds, floodplains, and wetlands and they can include:

- Reduction in runoff from rainwater and snowmelt
Mitigation Strategy

- Infiltration and velocity control during overland flow
- Filtering of excess nutrients, pollutants and sediments
- Floodwater storage
- Water quality improvement
- Groundwater recharge
- Habitat availability
- Recreation and aesthetic qualities

5. Emergency Services
Emergency services provide protection for people both during and after a disaster. A thorough emergency services program addresses all hazards and involves all response departments and facilities, including those beyond the university in the community. While not typically considered a “mitigation” technique, emergency service measures do minimize the impact of a hazard event on people and property. There are a number of components to emergency services and they include:

- Threat Recognition
- Warning
- Response
- Critical Facilities Protection
- Post-Disaster Recovery & Mitigation

6. Structural Projects
Structural projects are intended to protect people and infrastructure from damage due to natural hazards. Structural projects are typically used to manage and control flood waters. The complexity and cost of structural projects can vary greatly and are dependent on individual circumstances. Structural projects are undertaken where non-structural measures would not be effective. Structural projects may include:

- Reservoirs and Detention Areas
- Roadway & Crossing Improvements
- Dams/Levees/Floodwalls/Seawalls
- Drainage and Stormwater Improvements/Maintenance
- Channel Improvements

Mitigation activities are detailed action-based projects and policies that the university and its partners could engage in to reduce risk from potential hazards. The selected mitigation activities that were included in this plan were evaluated using various criteria as recommended by FEMA. This includes using the “STAPLEE” evaluation criteria: Social, Technical, Administrative, Political, Legal, Economic, and Environmental considerations, presented in
Table 5.1. Those proposed activities that were deemed to not adequately meet the STAPLEE evaluation criteria were omitted from further consideration in the development of the mitigation strategy.

Table 5.1: STAPLEE Evaluation Criteria

<table>
<thead>
<tr>
<th>Socially Acceptable</th>
<th>Is the proposed activity socially acceptable to the university community? Is the activity compatible with present and future university values? Are there disparity issues that would leave one part of the university community adversely affected?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technically Feasible</td>
<td>Will the proposed activity be effective in the long run? Will it create negative secondary impacts? Will it create more problems than it solves? Will it solve the problem or only the symptom?</td>
</tr>
<tr>
<td>Administratively Possible</td>
<td>Does the university have the capability to implement the proposed activity? Is there someone who will coordinate, implement, and maintain the activity?</td>
</tr>
<tr>
<td>Politically Acceptable</td>
<td>Is there political support to implement the proposed activity? Is there enough university and/or community support to ensure the success of the activity?</td>
</tr>
<tr>
<td>Legal</td>
<td>Does the university have the authority to implement the proposed activity? Is there a clear legal precedent, and are there any potential legal consequences of the activity?</td>
</tr>
<tr>
<td>Economically Sound</td>
<td>Are there current sources of funding to implement the proposed activity? Do the benefits outweigh the costs of the activity? Is the activity compatible with other economic goals of the university?</td>
</tr>
<tr>
<td>Environmentally Sound</td>
<td>How will the proposed activity affect the environment? Will this activity comply with local, state, and federal environmental laws and regulations? Is the activity consistent with university environmental goals?</td>
</tr>
</tbody>
</table>

Source: FEMA Publication 386-3: Developing the Mitigation Plan
Mitigation Strategy

**Recommendation & Prioritization of Mitigation Actions**

A wide range of mitigation activities were considered in order to help achieve the established mitigation goals. These activities were suggested and discussed by advisory board members and various university staff. All identified projects in Table 5.2 are consistent with Michigan Tech’s mitigation goals.

Once activities were selected for inclusion in the mitigation strategy, each activity was assigned a priority level (or ranking) for implementation. Priority was determined by evaluating each mitigation action on seven different criteria. A score from 1 to 5 was assigned for each of the mitigation criteria for all identified mitigation actions in order to develop an overall score and ranking. The higher the score, the higher priority ranking the mitigation action received. The scoring for each mitigation action was based on:

- **Number of Goals Addressed**: One goal (1 pt)—Five or more goals (5 pts)
- **Number of Hazards Addressed**: One hazard (1 pt)—All Hazards (5 pts)
- **Life Safety Affected**: Low (1 pt)—High (5 pts)
- **Protection of Property**: Low (1 pt)—High (5 pts)
- **Affected Area**: Partial Building (1 pt)—Campus-wide (5 pts)
- **Cost**: $500,000< (1 pt)—< $25,000 (5 pts)
- **Urgency to Implement**: 5+ years (1 pt)—Immediate (5 pts)

The evaluation and benchmarking tools used to assign priority, along with the results for each mitigation activity, can be found in Appendix C. A summary of projects and details are listed in Table 5.2: Proposed Mitigation Projects—Facilities Based and Table 5.3 Proposed Mitigation Projects—Staff Based. Projects vary from structural measures to education and are prioritized based on impacts from persistent, known hazards and potential resources available to complete the project. Although projects are prioritized on a university-wide basis, this does not limit the university or coordinating department’s ability to pursue identified projects as funding becomes available. A number of these projects are ongoing action activities that will be accomplished as time and resources permit.
Table 5.2: Proposed Mitigation Projects—Facilities Based

<table>
<thead>
<tr>
<th>#</th>
<th>Proposed Activity</th>
<th>Site/ Location</th>
<th>Hazard(s) Addressed</th>
<th>Goals Addressed</th>
<th>Estimate Cost</th>
<th>Coordinating Department</th>
<th>Implementation Schedule</th>
<th>Priority Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Install passive flood barrier at the driveway entrance to Admin Building/Lot</td>
<td>Admin Bldg/Lot</td>
<td>Urban Flooding</td>
<td>1,2,5,6</td>
<td>$300,00</td>
<td>Facilities</td>
<td>Contingent upon funding: 12-24 months</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Complete a Campus Drainage Assessment to better address storm water back-up and flooding on campus</td>
<td>Main Campus</td>
<td>Urban Flooding</td>
<td>2,5,6</td>
<td>$125,000</td>
<td>Facilities</td>
<td>Contingent upon funding: 12 months</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Implement remote lockdown of all exterior doors on campus</td>
<td>Main Campus-wide</td>
<td>Sabotage/ Terrorism</td>
<td>1,5,6</td>
<td>$600,000</td>
<td>Public Safety &amp; Police Services</td>
<td>Contingent upon funding: unknown</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Hardwire smoke detectors in Daniell Heights to alert at Public Safety</td>
<td>Daniell Heights Apartments</td>
<td>Major Structural Fire, Hazardous Materials Incident</td>
<td>1,2</td>
<td>$268,000</td>
<td>Environmental Health &amp; Safety</td>
<td>Contingent upon funding: Unknown</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Plan and implement network, telephone, cellular and catv along with backup power generation at 3 emergency operations sites</td>
<td>Main Campus-wide</td>
<td>All</td>
<td>1,3,6</td>
<td>$75,000</td>
<td>Information Technology</td>
<td>Contingent upon funding: 12 months</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Plan and implement supplemental power generation for communications infrastructure in campus buildings</td>
<td>Main Campus-wide</td>
<td>All</td>
<td>2,6</td>
<td>$50,000</td>
<td>Information Technology</td>
<td>Contingent upon funding: 9 months</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Install fire suppression/sprinkler system</td>
<td>Daniell Heights Apartments</td>
<td>Major Structural Fire, Hazardous Materials Incident</td>
<td>1,2</td>
<td>$1,275,000</td>
<td>Facilities</td>
<td>Contingent upon funding: 6 months</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Install dry fire pump system for fire combat</td>
<td>Ford Center</td>
<td>Major Structural Fire, Wildfire</td>
<td>1,2</td>
<td>$35,000</td>
<td>Ford Center</td>
<td>Contingent upon funding: unknown</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Implement redundant hardware and software to maintain hot standby production databases</td>
<td>Main Campus</td>
<td>All</td>
<td>2,6</td>
<td>$200,000</td>
<td>Information Technology</td>
<td>Contingent upon funding: 9 months</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>Install storm sewer outtakes in problem parking lots</td>
<td>Main Campus</td>
<td>Urban Flooding</td>
<td>2,6</td>
<td>$65,000/$70,000 ResPECTively</td>
<td>Facilities</td>
<td>Contingent upon funding: 24 months</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Develop and implement a water (flood) mitigation plan for the Network Operations Center</td>
<td>EERC Building</td>
<td>Urban Flooding</td>
<td>2,5,6</td>
<td>$35,000</td>
<td>Information Technology</td>
<td>Contingent upon funding: 9 months</td>
<td>11</td>
</tr>
<tr>
<td>#</td>
<td>Proposed Activity</td>
<td>Site/ Location</td>
<td>Hazard(s) Addressed</td>
<td>Goals Addressed</td>
<td>Estimated Cost</td>
<td>Coordinating Department</td>
<td>Implementation Schedule</td>
<td>Priority Level</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------------------------------------</td>
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</tr>
<tr>
<td>12</td>
<td>Install fire suppression/sprinkler system</td>
<td>Chem-Sci Building</td>
<td>Major Structural Fire, Hazardous Materials Incident</td>
<td>1,2</td>
<td>$500,000</td>
<td>Facilities</td>
<td>Contingent upon funding: Unknown</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>Install fire suppression/sprinkler system</td>
<td>Administration Building</td>
<td>Major Structural Fire</td>
<td>1,2</td>
<td>$250,000</td>
<td>Facilities</td>
<td>Contingent upon funding: Unknown</td>
<td>13</td>
</tr>
<tr>
<td>14</td>
<td>Install fire suppression/sprinkler system</td>
<td>Forestry Building</td>
<td>Major Structural Fire, Hazardous Materials Incident</td>
<td>1,2</td>
<td>$300,000</td>
<td>Facilities</td>
<td>Contingent upon funding: Unknown</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>Install fire suppression/sprinkler system</td>
<td>ME-EM</td>
<td>Major Structural Fire, Hazardous Materials Incident</td>
<td>1,2</td>
<td>$500,000</td>
<td>Facilities</td>
<td>Contingent upon funding: Unknown</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>Investigate securing and sealing telecommunication manholes on Campus</td>
<td>Main Campus-Wide</td>
<td>Sabotage/ Terrorism</td>
<td>2,6</td>
<td>$82,500</td>
<td>Public Safety &amp; Police Services</td>
<td>Contingent upon funding: 6 months</td>
<td>16</td>
</tr>
<tr>
<td>#</td>
<td>Proposed Activity</td>
<td>Site/ Location</td>
<td>Hazard(s) Addressed</td>
<td>Goals Addressed</td>
<td>Estimated Cost</td>
<td>Coordinating Department</td>
<td>Implementation Schedule</td>
<td>Priority Level</td>
</tr>
<tr>
<td>----</td>
<td>-----------------------------------------------------------------------------------</td>
<td>------------------------</td>
<td>------------------------------------------</td>
<td>-----------------</td>
<td>---------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>1</td>
<td>Conduct a new Critical Infrastructure Vulnerability and Risk Assessment</td>
<td>University-wide</td>
<td>All</td>
<td>All</td>
<td>Staff Time/ $125,000</td>
<td>Facilities</td>
<td>Contingent upon funding: 12-24 months</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Develop and implement a water (flood) mitigation plan for Mont Ripley Ski Hill</td>
<td>Mont Ripley</td>
<td>1,2,5,6</td>
<td>Urban Flooding/ Severe Weather</td>
<td>$100,000</td>
<td>Facilities/ Mont Ripley</td>
<td>Contingent upon funding: 12-24 months</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Evaluate bio-hazard levels, storage and handling practices on campus</td>
<td>University-wide</td>
<td>Hazardous Materials Incidents/ Major Structural Fire</td>
<td>1,2,6</td>
<td>Staff Time</td>
<td>Environmental Health &amp; Safety</td>
<td>Continuous</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Integrate the Crisis Management Plan with Hazard Mitigation Plan</td>
<td>University-wide</td>
<td>All</td>
<td>5,6</td>
<td>Staff Time</td>
<td>Incident Command Team</td>
<td>Contingent upon funding: 12-18 months</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Develop university-wide business continuity plan</td>
<td>University-wide</td>
<td>All</td>
<td>5,6</td>
<td>Staff Time</td>
<td>Incident Command Team</td>
<td>Contingent upon funding: 12-24 months</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Develop university-wide Post Disaster Recovery Plan</td>
<td>University-wide</td>
<td>All</td>
<td>5,6</td>
<td>Staff Time</td>
<td>Incident Command Team</td>
<td>Continuous</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Integrating hazard mitigation into Michigan Tech Master Plan</td>
<td>University-wide</td>
<td>All</td>
<td>5</td>
<td>Staff Time/ $200,000 (updated master plan)</td>
<td>Facilities Administration &amp; Planning</td>
<td>Contingent upon funding: 24 months</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Creation of university/ community Hazardous Materials Response Team</td>
<td>Regional</td>
<td>Hazardous Materials Incident</td>
<td>1,3</td>
<td>Staff Time</td>
<td>Local Fire Departments and Michigan Tech</td>
<td>Contingent upon funding: 12-24 months</td>
<td>8</td>
</tr>
</tbody>
</table>
The following projects were proposed in the 2008 plan, and have been completed:

<table>
<thead>
<tr>
<th># in 2008</th>
<th>Proposed Activity–Facilities Based</th>
<th>Site/ Location</th>
<th>Hazard(s) Addressed</th>
<th>Goals Addressed</th>
<th>Cost</th>
<th>Coordinating Department</th>
<th>Implementation Schedule</th>
<th>Priority Level in 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Address cracked storm sewer</td>
<td>Near Rosza Center along US-41</td>
<td>Urban Flooding</td>
<td>1,2,6</td>
<td>$340,000</td>
<td>Facilities/ Grounds</td>
<td>Contingent upon funding: 2 months</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td>Upgrade fire alarm system in Dillman Building</td>
<td>Dillman (Civil Engineering) Building</td>
<td>Major Structural Fire, Hazardous Materials Incident</td>
<td>1,2</td>
<td>$122,750</td>
<td>Facilities</td>
<td>Contingent upon funding: 6 months</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>Upgrade water based fire suppression system in the Network Operations Center.</td>
<td>Data Center-EERC Building</td>
<td>Major Structural Fire, Hazardous Materials Incident</td>
<td>1,2</td>
<td>$26,550</td>
<td>Facilities</td>
<td>Contingent upon funding: 9 months</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>Upgrade fire alarm system in ME-EM Building</td>
<td>ME-EM Building</td>
<td>Major Structural Fire, Hazardous Materials Incident</td>
<td>1,2</td>
<td>$197,000</td>
<td>Facilities</td>
<td>Contingent upon funding: 1 month</td>
<td>16</td>
</tr>
<tr>
<td>23</td>
<td>Replace current halon gas fire suppression system in 11 labs with human friendly system</td>
<td>M &amp; M Building</td>
<td>Major Structural Fire, Hazardous Materials Incident</td>
<td>1,2</td>
<td>$137,713</td>
<td>Facilities</td>
<td>Contingent upon funding: 3 months</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Proposed Activity–Facilities Based</td>
<td>Site/ Location</td>
<td>Hazard(s) Addressed</td>
<td>Goals Addressed</td>
<td>Cost</td>
<td>Coordinating Department</td>
<td>Implementation Schedule</td>
<td>Priority Level in 2008</td>
</tr>
<tr>
<td>1</td>
<td>Crisis management education, tabletops, &amp; exercises</td>
<td>University-wide</td>
<td>All</td>
<td>1,2,4</td>
<td>Staff Time</td>
<td>Crisis Management Team</td>
<td>Continuous</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Train appropriate university staff in compliance with NIMS</td>
<td>University-wide</td>
<td>All</td>
<td>4,6</td>
<td>Staff Time</td>
<td>Occupational Health &amp; Safety Office</td>
<td>Continuous</td>
<td>2</td>
</tr>
</tbody>
</table>
There were also several projects that were explored further and have since been determined to no longer meet the mitigation needs of the university as technology and communication equipment has advanced considerably since the original plan.

<table>
<thead>
<tr>
<th>2008 Proposed Activity</th>
<th>Site/ Location</th>
<th>Hazard(s) Addressed</th>
<th>Goals Addressed</th>
<th>Reason for removal from proposed activity in 2019 mitigation plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve radio communication system through implementing UHF radio frequency system</td>
<td>Main Campus-wide</td>
<td>All</td>
<td>1,2,3,6</td>
<td>Did testing of a UHF system to improve non-public safety communications, but determined that the best means for increasing the campus coverage for Public Safety is with an 800MHz connection and we are moving forward with installing a new 800MHz radio communication tower on campus.</td>
</tr>
<tr>
<td>Investigate further enhancements to Carillon System</td>
<td>Main Campus-wide</td>
<td>All</td>
<td>1,2,3</td>
<td>Determined to be ineffective at being a public PA notification system. Audio is garbled and difficult to understand and didn’t penetrate throughout the buildings.</td>
</tr>
<tr>
<td>A 6-12 portable radio set for communications use in Alberta and in the field</td>
<td>Ford Center</td>
<td>Wildfires, Severe Weather</td>
<td>1,3</td>
<td>Radio communication may not be the most effective option</td>
</tr>
<tr>
<td>Implement off-site datacenter as a primary datacenter, using existing center as a secondary location</td>
<td>TBD</td>
<td>Most Hazards</td>
<td>2,6</td>
<td>Have placed back-ups on the database system as well as cloud back-up for daily Banner data.</td>
</tr>
<tr>
<td>Digital Video Conversion of the Electronic Display System (EDS) from Analog Cable TV to MPEG Video to integrate into an university-wide emergency message system</td>
<td>Main Campus-wide</td>
<td>All</td>
<td>3</td>
<td>We have transitioned to a digital system for EDS, but did not integrate with emergency messaging. Prevalence of cellphones makes EDS less optimal as a communications mechanism.</td>
</tr>
</tbody>
</table>
Potential Funding Sources

Potential funding sources for mitigation projects can be found from a variety of sources. The following list (Table 5.4) is intended to provide examples of funding sources for both current and future mitigation projects and should not be considered comprehensive. Potential new sources for mitigation funding should be added as identified. Most mitigation funding sources recur through legislation or government support, but may also be from an isolated instance of financial support. Creative financing is encouraged and is made possible when partnering with other agencies or businesses to achieve common or complementary goals. Additionally, many opportunities for mitigation funding exist in both the public and private sectors through foundations or philanthropic organizations. Self-funding through operational budgeting and/or deferred maintenance is also a source of funding for mitigation projects.

Table 5.4: Potential Funding Sources

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Managing Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americorps</td>
<td>Provide funding for volunteers to serve communities, including disaster prevention.</td>
<td>• Corporation for National &amp; Community Service</td>
</tr>
<tr>
<td>Assistance to Firefighters Grants</td>
<td>Provides funding for fire prevention and safety activities and firefighting equipment.</td>
<td>• US Department of Homeland Security (DHS)</td>
</tr>
<tr>
<td>Community Development Block Grant (CDBG)</td>
<td>Provides funding for sustainable community development, including disaster mitigation projects. Also runs the Disaster Recovery Assistance program.</td>
<td>• US Housing and Urban Development</td>
</tr>
<tr>
<td>Economic Development Administration (EDA)</td>
<td>Invests and provides grants for community construction projects, including mitigation activities.</td>
<td>• US Economic Development Administration</td>
</tr>
<tr>
<td>Flood Mitigation Assistance (FMA) Program</td>
<td>Provides pre-disaster flood mitigation funding (with priority for repetitive flood loss properties under the National Flood Insurance Program).</td>
<td>• Michigan State Police Emergency Management and Homeland Security Division • FEMA—Region V</td>
</tr>
</tbody>
</table>
## Plan Maintenance Procedures

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Managing Agencies</th>
</tr>
</thead>
</table>
| Hazard Mitigation Grant Program (HMGP)    | Provides post-disaster mitigation funding.                                                            | ● Michigan State Police Emergency Management and Homeland Security Division  
|                                           |                                                                                                       | ● FEMA—Region V                                                                                       |
| Hazardous Fuels Mitigation Program        | Provides funding for the reduction of hazardous fuels for wildfires.                                   | ● US Bureau of Land Management                                                                         |
| Homeland Security Grants                  | Multiple grants that provide funding for homeland security activities.                                  | ● US Department of Justice                                                                            
|                                           |                                                                                                       | ● US Department of Homeland Security (DHS)                                                            |
| KCF Field of Interest Grants              | Provides funding to support specific areas of need and interest to meet the changing conditions and enhance the quality of life in the Keweenaw. | ● Keweenaw Community Foundation                                                                       |
| National Fire Plan (NFP)                  | Provides funding for pre-disaster wildfire mitigation.                                                 | ● US Forest Service                                                                                   |
| PHF Gives                                 | Provides funding opportunities that vary depending on the needs of the community.                      | ● Portage Health Foundation                                                                           |
| Pre-Disaster Mitigation (PDM) Program     | Provides grants through a competitive process for specific mitigation projects, including planning.    | ● Michigan State Police Emergency Management and Homeland Security Division  
|                                           |                                                                                                       | ● FEMA-Region V                                                                                       |
| Rural Development Grants                  | Provides grants and loans for infrastructure and public safety development and enhancement in rural areas | ● US Department of Agriculture, Rural Development                                                       |
| Rural Fire Assistance Grants (RFA)        | Funds fire mitigation activities in rural communities.                                                 | ● National Interagency Fire Center                                                                     |
Plan Maintenance Procedures

Section 6: Plan Maintenance Procedures
- Adoption & Implementation
- Monitoring, Reviewing, & Amending
- Continued Public Involvement

Adoption & Implementation

By adopting the Michigan Tech Multi-Hazard Mitigation Plan, the University recognizes the need to incorporate hazard mitigation activities into everyday decisions for all University campuses and holdings. This adoption commits Michigan Tech to working on mitigation efforts within its boundaries and in cooperation with neighboring jurisdictions when opportunities arise.

Every mitigation action proposed in the mitigation strategy in Section 7 is assigned a coordinating department responsible for facilitating implementation. In addition, a timeframe is provided to ensure that the projects are being implemented in a timely manner. Michigan Tech’s Facilities Administration & Planning Department has the overall responsibility for implementing the Michigan Tech Multi-Hazard Mitigation Plan. This includes monitoring the coordinating departments, their assigned tasks, and project implementation.

Michigan Tech will integrate this Multi-Hazard Mitigation Plan into other University plans and processes where appropriate. Opportunities to incorporate the requirements of this plan into other planning tools will continue to be identified through the annual and five year review periods. The Facilities Department will ensure that the plan is being considered during implementation of current and development of new University planning mechanisms.

As stated previously, Michigan Tech will seek funding from a variety of outside sources to implement mitigation projects in both the pre-disaster and post-disaster environments. The Facilities Administration & Planning Department will be responsible for coordinating funding applications and proposals for proposed mitigation actions.
Plan Maintenance Procedures

**Monitoring, Reviewing, & Amending**

**IMPROVE DATA COLLECTION SYSTEMS**
Immediately, Facilities Administration & Planning will method for collecting and documenting incidents for inclusion in future plan updates.

**ANNUAL PLAN REVIEW**
The plan will be reviewed annually by the Facilities Administration & Planning Department in coordination with other University operations plan updates to determine if revisions are needed. Annual Review will provide an opportunity to document successful mitigation implementation and learn how to improve in the future. At each annual review, an annual action schedule will be created that will include prioritizing projects, monitoring project implementation, and developing funding proposals.

**UPDATE CRITICAL VULNERABILITY ASSESSMENT**
The Critical Vulnerability Assessment was completed in 2001 (well before the original writing of the 2008 plan). There have been many changes to the physical campus (new buildings, renovated labs, etc.), a bigger dependence on technology, and a host of “new” potential hazards since this assessment. A new Critical Vulnerability Assessment will be completed to provide direction and priorities for the next plan update.

**CAMPUS STORM DRAINAGE ASSESSMENT**
Michigan Tech has never completed such an assessment. With urban flooding being a priority mitigation activity, an assessment of the storm water drainage system will provide us with a detailed analysis of existing systems on campus and allow us to review potential new technologies that will help us address and mitigate against future challenges.

**FIVE YEAR PLAN REVIEW**
The Multi-Hazard Mitigation Plan will be thoroughly reviewed and updated every 5 years by a committee representing the University, local agencies, and concerned parties to determine whether there have been any significant changes at Michigan Tech that would necessitate changes
in the plan. The Facilities Department will be responsible for organizing the committee and facilitating the 5 year review.

Factors that may affect changing plan content include an increased exposure to hazards, new development in identified hazard areas, and changes to Federal or State legislation relating to hazard mitigation. The plan review will also provide the University with an opportunity to measure success levels of implemented mitigation activities. It will help guide the replication of successful activities and provide evaluation of less successful mitigation activities.

Other areas that may be considered when reviewing the plan include:

- Evaluating if the goals are still consistent with current conditions and expectations;
- Assessing if the mitigation strategy is aligned with the plan goals;
- Measuring if the magnitude of risk and vulnerability have changed;
- Determining if implementation obstacles or coordination issues exist;
- Evaluating if the coordinating department/individual participated in plan implementation as assigned;
- Identifying if there are new stakeholders that should be invited to the table;
- Assessing if identified mitigation actions are still appropriate given current resources;
- Stating if Michigan Tech has been affected by any disasters since the plan was adopted.

Following the 5 year review, those revisions deemed appropriate will be made. It will be the responsibility the Facilities Department and the Advisory Committee to ensure that the appropriate stakeholders are invited to participate in plan revisions and updates.

The results of the 5 year review and subsequent recommendations will be summarized in a report which will be made available for public review before the revised plan is adopted by the University. For any changes or updates to the mitigation actions, Michigan Tech will re-assign responsibility for task completion as necessary.
AMMENDING THE PLAN
At the discretion of Michigan Tech Administration, minor updates and amendments to the plan (including the Mitigation Strategy) may not necessitate a formal updating process. For all other updates, Michigan Tech will inform all interested parties including all directly affected university departments and personnel, the greater university community (as deemed appropriate), the Houghton County Office of Emergency Measures, and the Michigan State Police—Emergency Management & Homeland Security Division, if necessary. Proposed amendments will be disseminated in order to seek comment and feedback before adoption. At the end of the declared review period, the Advisory Board will amend the plan, and recommend adoption of the revised plan to Michigan Tech’s President.

Continued Public Involvement
Public participation is a crucial component to the hazard mitigation planning process. As previously described, major amendments to the plan shall require the involvement of the general university community as deemed appropriate prior to any formal adoptions procedures. The Facilities Department will facilitate the public comment process working with the Advisory Committee, the University, and State Hazard Mitigation Office.

Solicitation of public comment on major plan amendments may include:
- Inviting the public to Advisory Board meetings;
- Submitting press releases to university and/or area media;
- Using the Michigan Tech website to announce current review activities; and
- Outreach sessions and workshops.
Section 7: Resources

The following resources were used in the development of the Michigan Tech Multi-Hazard Mitigation Plan.

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Section 10: Appendices

- Appendix A: Michigan Tech DRUAC Meeting Agendas
- Appendix B: Public Information Documentation
- Appendix C: Priority Ranking Benchmarks
- Appendix D: Building Assessment Forms
- Appendix E: Omitted Sections
- Appendix F: Vulnerability Assessment (Section 6 of 2008 Plan)