Marquette Area Climate and Health Adaptation Guidebook

Volume III: Prioritizing and Implementing Recommendations

Marquette County, MI

MICHIGAN STATE
U N I V E R S I T Y

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*All photos, unless otherwise noted, are courtesy of the MSU SPDC

Preface

Purpose

The Marquette Area Climate and Health Adaptation Guidebook (the Guidebook) is the result of a pilot project to build climate adaptive capacity at the local level by integrating public health considerations into existing community and climate adaptation planning initiatives. Though the Guidebook is focused on Marquette County, the innovative process was developed with the goal to be replicated by other rural communities, wholly or in part, depending on their resources and needs.

Volume Structure

The Guidebook is structured in three volumes. Each is intended to stand alone as a resource but also build upon each other to provide a detailed accounting of the process and results.

Volume I: Stakeholder Engagement and Visual Design Imaging

Establishes the community's concerns and priorities related to climate and health as expressed by community stakeholder groups. Uses current and potential future images of vulnerable locations in Marquette County to visualize how the built environment could be redesigned to address these climate-related public health concerns.

Volume II: Policy Recommendations for Enacting Adaptive Built Environment Changes

A comprehensive reference guide for community leaders and technical decision makers describing potential policy tools that could stimulate adaptive community planning and the implementation of the built environment design changes developed in Volume I. Includes health-related metrics associated with each policy tool for users to track and evaluate their own planning activities.

Volume III: Prioritizing and Implementing Recommendations

Outlines action steps and further stakeholder engagement to prioritize the recommendations from Volume II and establish ownership for implementation. Provides further refined guidance for implementing priority policies and built environment design changes.

Acknowledgements

Introduction

Overview

The three volume Marquette Area Climate & Health Adaptation Guidebook (the Guidebook) is the product of a pilot project demonstrating how local adaptive capacity can be built to reduce or prevent the health impacts from climate change. The project is novel in the field of climate and health adaptation in that it utilizes a multi-disciplinary approach to conduct stakeholder education and engagement through a health and equity lens, provides experts and the public an opportunity to establish their vision of a climate adapted community, and then connects the health and built environment components through policy analysis, community planning, and visual design. Although Marquette is the primary audience for this Guidebook, it is intended that the process, some of the results, and lessons learned can be applied to other rural communities across the state and region.

Being the largest county in Michigan covering 1,873 square miles of land area, and sitting along the shores of Lake Superior, Marquette boasts urban, rural, and wilderness settings as shown in Figure 1. Each area faces unique, though not always exclusive, challenges from climate change, such as increased extreme precipitation events and periods of drought. Fortunately, community leaders are addressing many of the issues through multiple climate adaptation initiatives across varying scales from the local to Lake Superior watershed level.

Though these plans are extensive in their assessment of environmental and economic impacts from climate change, a gap was identified concerning health. This was recognized by community leaders and became a catalyst for their involvement to develop this Guidebook. It examines the health impacts from climate change and how built environment adaptations could address them.

Fig. 1 Marquette County Generalized Land Use 2005

Map Source: Marquette County, www.co.marquette.mi.us/departments/planning/land_use_land_value_and_land_ownership_maps.php#.W9HYuZNKi70
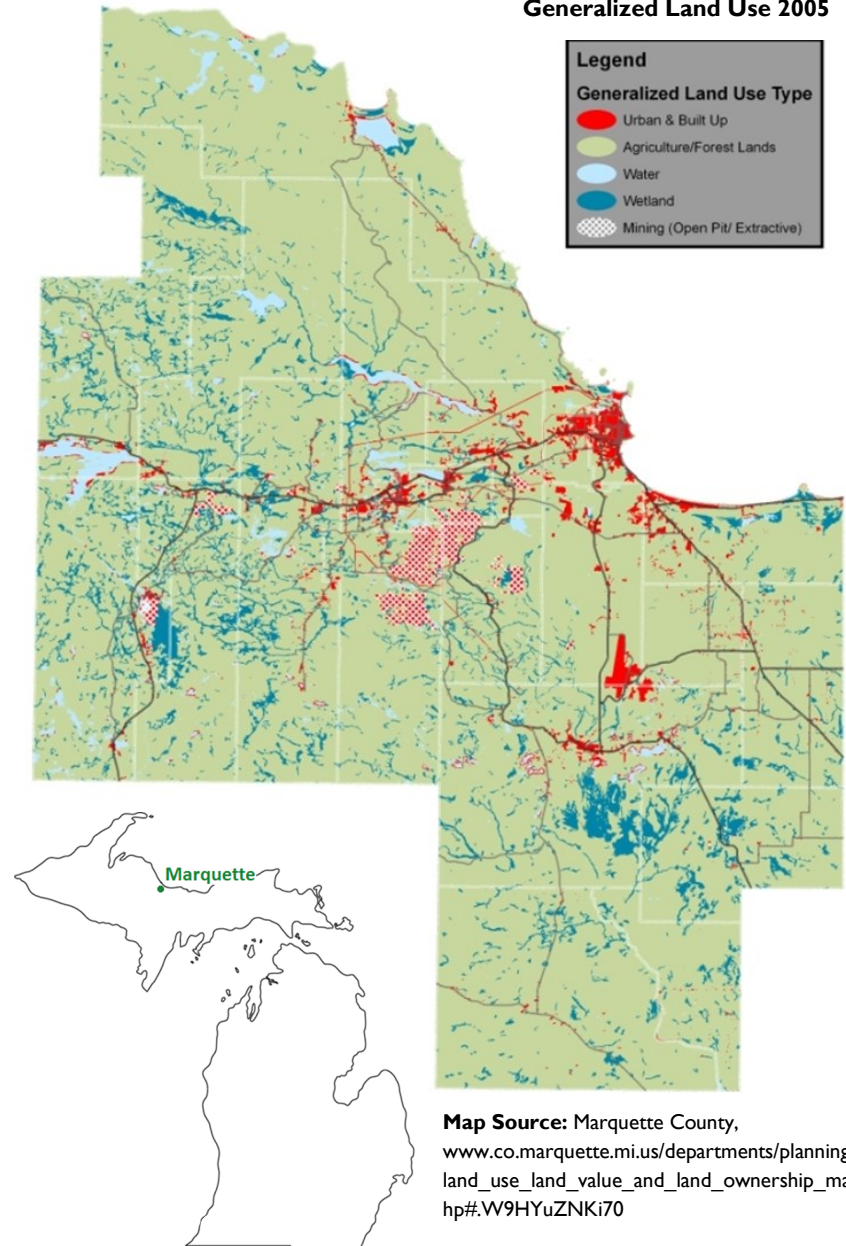
Project Background

Following the CDC's Building Resilience Against Climate Effects framework (BRACE), shown in Figure 2, MICHAP is building a climate-resilient public health system for Michigan at the state and local levels by following three main principles: 1. Climate change is recognized as a public health issue and is integrated into public health practice, 2. Public health agencies and stakeholder organizations have the tools, resources and activities to respond to climate change impacts within existing programs, and 3. Vulnerable populations are explicitly considered in programs and policies addressing climate change impacts.

This Guidebook project is part of MICHAP's larger state-wide Climate and Health Adaptation Plan (MDHHS, 2016) to develop, pilot, and evaluate activities that increase the adaptive capacity of communities to prevent or reduce the health effects of climate change. Four types of adaptive strategies were identified in the state-wide plan and used to frame the Guidebook development process and its recommendations. Those are: 1. Education and inclusion: Ensure diverse stakeholders including representatives of vulnerable populations and social service providers are engaged when identifying issues and developing solutions. 2. Landscape actions: Work with land use and built environment decision makers to consider the climate and health impacts and benefits of the action. 3. Policy: Coordinate climate adaptation and public health best practices and metrics by tying them into a community's existing planning initiatives or ordinances. 4. Surveillance and tracking: Increase capacity for collection and analysis of local environmental health and climate related data. Develop local indicators for a community to track impacts over time and incorporate into cost/benefit risk analyses or health impact assessments.

Fig. 2. Centers for Disease Control and Prevention- Climate and Health Program BRACE Framework
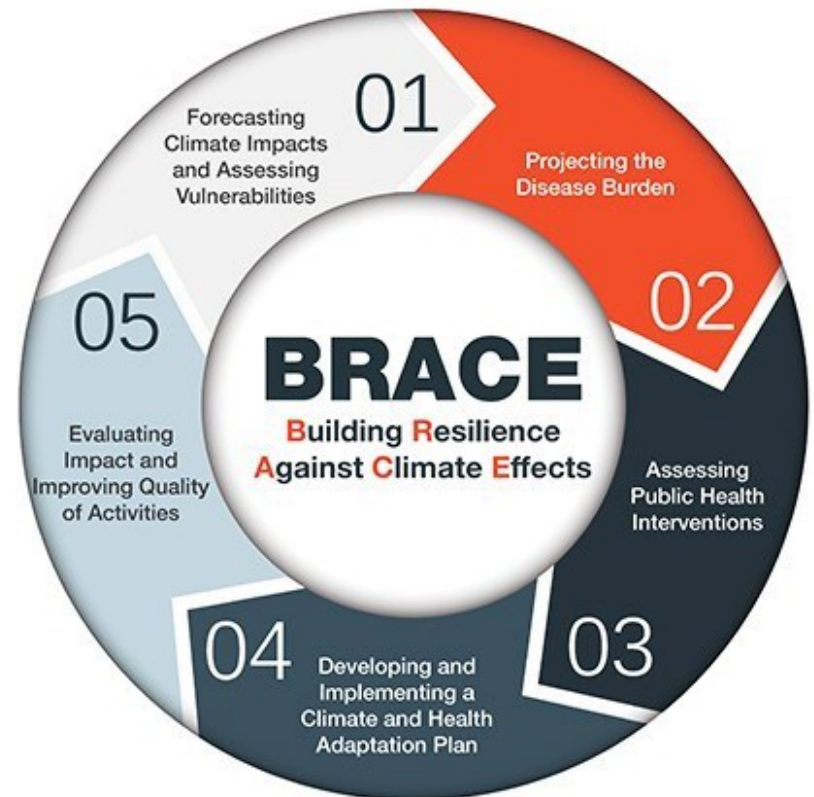
The BRACE framework is a five-step process laid out by the CDC to help states and community health departments address the public health concerns of climate change in their communities. As part of the CDC's Climate-Ready States and Cities Initiative (CRSCI) MICHAP uses this framework to address climate health concerns in Michigan.

Project Partners

Developing this Guidebook was a collaborative effort requiring diverse perspectives from the technical to local. The project was led by the Michigan Climate and Health Adaptation Program (MICHAP), the Michigan State University (MSU) School of Planning, Design and Construction (SPDC), and the MSU Extension (MSUE) program. However, the success of the project was largely dependent upon the existing capacity, knowledge, and networks of several local groups including the Marquette County Health Department (MCHD) and the Marquette Climate Adaptation Task Force (CATF). Through this process a diverse group of stakeholders, including vulnerable populations, had multiple opportunities to indicate their priority climate related health concerns and a chance to visualize potential adaptive built environment design changes. That feedback led to four major themes which guided further engagement and recommendation development: 1. Vector Awareness, 2. Air Quality, 3. Emergency Response/Extreme Events, and 4. Water Related issues.

MSU School of Planning, Design and Construction and MSU Extension

To address the built environment concerns related to climate change, the Michigan State University (MSU) School of Planning, Design and Construction (SPDC) offers the Sustainable Built Environment Initiative (SBEI) in partnership with MSU Extension (MSUE). The SBEI provides planning and design assistance to communities within a sustainability framework focused on resiliency and climate adaptation. The program helps build local consensus and generate physical design plans to address challenging sustainability concerns. The partnership allows for an integrated approach to solving complex community problems through the diverse expertise found within the SPDC along with MSUE's institutes and Extension educators.

Marquette County Health Department

The MCHD is Marquette's local health authority. It works to enrich lives in the community by preventing disease, promoting healthy lifestyles, and protecting the environment. Its vision is a community where people achieve the highest quality of life through healthy living by caring for themselves, one another and the environment. MCHD worked with the local MSUE office to bring key local representatives from the medical/health field and from vulnerable populations into the project discussions, as well as contributing its own expertise.

Marquette Climate Adaptation Task Force

The CATF based in Marquette was created to help local leaders and the public think proactively about the effects of climate change and develop strategies that will make the Upper Peninsula more resilient. The seventeen members are drawn from a diverse group of current and former elected and appointed city, township and county leaders, representatives of energy and industry, university officials and environmental groups. CATF proceeds on the assumption that climate change and extreme weather events are occurring and that they will have an impact on the local area. Its members help to coordinate ongoing assessments of how climate change will affect their communities and have a focus on implementation of recommendations from the various climate planning initiatives that are ongoing in the area.

Climate and Health Connection

Climate change can affect public health in numerous ways. With changing temperature and precipitation patterns also come changes to extreme weather, such as increases in heavy precipitation and higher temperatures. Combined, they can lead directly to several negative health impacts, including injury, waterborne diseases and heat related illnesses (CDC, 2014). Indirectly, health can be impacted by increases in drought, flooding, wildfires, expansion of vector borne disease habitats and more, as shown in Figure 3. Volume I discusses these connections in depth.

Marquette County residents are experiencing higher overall temperatures, with most dramatic increases occurring in the winter. However, unlike most of the region, Marquette has seen decreased levels of annual precipitation driven primarily by drier springs and summers. At the same time the Great Lakes region has experienced more frequent and intense extreme weather events like heavy rains and periods of drought (Great Lakes Integrated Sciences and Assessments (GLISA), n.d.). Those events have contributed to damaging infrastructure and impacting health.

Climate vulnerability is a measure of a community's risk of being negatively impacted by climate change. The degree to which it is vulnerable depends on three variables. 1) Exposure is the severity and types of changes to an area's climate. 2) Sensitivity considers the population and their health and living conditions. 3) Adaptive capacity is the expertise, plans, programs, or resources a community has in place to prevent or reduce negative impacts (Managan et al., 2014).

In Marquette the groups considered particularly sensitive include the aging, young children, those in poverty, the homeless, those without access to health care or other essential services, people with chronic diseases and mental stress, and socially isolated individuals and towns.
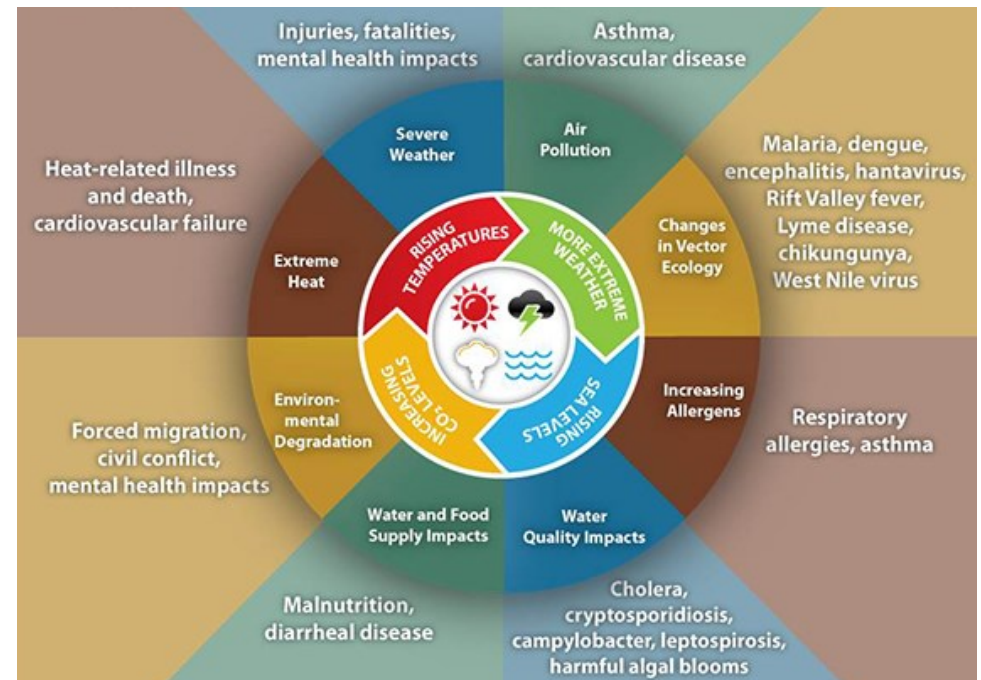
Fig. 3. Climate related health outcomes causal pathway diagram

Image Source: Centers for Disease Control and Prevention, http://www.cdc.gov/climateandhealth/effects/default.htm

"**Adaptation** refers to actions taken at the individual, local, regional, and national levels to reduce risks from even today's changed climate conditions and to prepare for impacts from additional changes projected for the future" (Lempert et al., 2018).

Methods

Process

This multi-year project is being executed in three phases. Each phase has different objectives that move the project toward the larger goal of preventing or reducing human health impacts from climate change in Marquette County.

Phase I

2017 Identify potential partner communities and establish a foundation for intervention by engaging stakeholders and understanding concerns

Phase II

2018 Develop interventions, recommendations, and metrics; obtain feedback; and develop guidebook

Phase III

2019 Engage community to prioritize recommendations and establish ownership for implementing the recommendations

Project Timeline

Phase I

Spring 2017
MSU & MICHAP Partnership Established

Spring 2017
Identify Partner Community and Key Stakeholders

Summer 2017
Stakeholder Meetings

Summer 2017
CATF Meeting to Identify Key Issues

Phase II

Fall 2017
Kickoff Meeting: Community Visioning

Spring 2018
Meeting 2: Design Input

Summer 2018
CATF Technical Review of Guidebook

Fall 2018
Final Presentation: Marquette County Commissioners & Health Department

Phase III

Winter 2019
Prioritization Workshop

Spring 2019
Intervention Workgroups

Summer 2019
CATF Technical Review of Prioritized Goals

Fall 2019
Pilot Communities Selected for Implementation

Phase I, II, and III Summary

In the summer of 2017, the team met stakeholders at various locations throughout the county, in the field when possible.

Community members listen to stakeholder input and provide further input at Meeting 1 on November 2, 2017.

Community members engage with adaptation designs at Meeting 2 on March 26, 2018.

To develop recommendations that accurately address the climate related public health concerns of the community, the team conducted an iterative input and feedback process including a series of focus groups followed by two community meetings and a final presentation held over the first two phases of the project. A detailed description of this process can be found in Volume I.

During Phase I, beginning in July of 2017, the project team conducted focus groups with 23 stakeholder groups representing a range of perspectives. The information gathered at the meetings was synthesized and presented to CATF to identify the priority climate and health issues of the community. A list of example sites around Marquette identified as having been impacted by climate related events was also generated from those meetings. The sites were photographed and used to develop before and after design renderings of potential built environment adaptations.

On November 2, 2017, kicking off Phase II, the first community meeting was held as an initial opportunity for the residents to review the priority issues and discuss their vision for climate adaptation in the area. At the second community meeting on March 26, 2018, the team presented the before and after design renderings along with preliminary policy and health metric recommendations. With feedback from those meetings and further interaction with CATF the design images were finalized, and Volume I was developed. From there a literature review of climate and health adaptation policies, best practices, and evaluation metrics was conducted and Volume II was drafted. After additional technical review from CATF Volume II was prepared for a final presentation to stakeholders held on January 29, 2019. During that final meeting the goals and steps for Phase III were outlined.

*More detailed information on Volumes I and II can be found in Appendix A or online at https://www.canr.msu.edu/climatehealthguide.

Phase I, II, and III Summary Continued

Phase III began with an Implementation Prioritization Workshop on Tuesday, January 29, 2019 from 2:30-5:00pm at the Marquette Township Hall. Fifty public officials from around Marquette County, representing local units of government, the County, and the Region, and at least 28 organizations, convened to discuss implementation of the recommendations listed in Volume II. A full list of representation at the Implementation Prioritization Workshop can be found in Appendix B.

In the evening, a community open house was held at the same location to gather further input.

Informational posters were placed around the room highlighting the project, how adaptation designs can impact health, before and after imaging of sites throughout Marquette County, and the project goals for voting. Participants were asked to:

1. Individually prioritize the climate and health adaptation goals for Marquette County through dot voting;
2. In groups, consider how strategies addressing the priority goals can be implemented including who can contribute, timelines, funding strategies, and opportunities for implementation; and
3. Provide input for Marquette area specific adaptation projects needing technical assistance.

Implementation Action Plan

Prioritization Process

At the Implementation Prioritization Workshop in January 2019, public officials and community members individually ranked priority climate and health goals, and then in groups provided the details necessary for their implementation. Following the meeting, working groups were formed to provide the full details needed for implementing the top three prioritized goals within each health category of concern (Vector Awareness, Air Quality, Emergency Response/Extreme Events, and Water Related issues). Led by CATF, these groups worked together to provide the details necessary to ensure the implementation of these goals within the Marquette Area. A full list of each working groups' members can be found in Appendix C. The details provided for implementation included:

1. Short term (1-year) steps;
2. Medium term (2-3 years) steps;
3. Long term (4+ years) steps;
4. Parties responsible;
5. Potential upcoming opportunities;
6. Resources needed;
7. Possible funding strategies; and
8. Additional metrics.

The details provided in the meeting and subsequent working groups' efforts informed the implementation action steps. As an evolving document informed by continuous community input, the action steps in Volume III include additional details, such as metrics, not previously suggested in Volumes I and II. These steps can be used by public officials throughout the county to coordinate actions and ensure effective implementation of strategies that address the top priority climate and health concerns of Marquette County. References in Appendix D and expert resources in Appendix E complement these charts and assist the community in taking action.

Priority Goals

At the Implementation Prioritization Workshop the top three voted goals for each of the priority climate and health categories of concern are highlighted below. A full list of the vote counts of the goals presented at the Implementation Prioritization Workshop is listed in Appendix B.

Priority goals by climate and health category of concern with corresponding climate drivers and impacts

Vector Awareness

Climate Driver: Ticks
Impact: Lyme Disease and other emerging tick-borne disease
Goal 1: Increase awareness of tick exposure risk and prevention measures through outreach

Climate Driver: Ticks
Impact: Lyme Disease and other emerging tick-borne disease
Goal 2: Improve understanding of the risk and ability to coordinate a response through data collection and monitoring

Climate Driver: Ticks
Impact: Lyme Disease and other emerging tick-borne disease
Goal 3: Reduce human exposure to ticks through local regulations

Air Quality

Climate Driver: Wildfire
Impact: Smoke
Goal 1: Engage residents' participation in wildfire prevention

Climate Driver: Air Pollutants
Impact: Energy
Goal 2: Reduce greenhouse gas emission through encouragement of renewable energy sources and energy efficiency

Climate Driver: Air Pollutants
Impact: Ozone & Particulates
Goal 3: Reduce pollutant emissions throughout region through supporting Smart Growth

PRIORITY GOALS

Climate Driver: Flooding
Impact: Access
Goal 1: Reduce the impact of flooding on population health and reduce the increased risk of roads flooding due to runoff

Climate Driver: Flooding
Impact: Access
Goal 2: Ensure road construction appropriately manages storm water to allow for road access through countywide planning

Climate Driver: Storm Surge
Impact: Shoreline Flooding
Goal 3: Use flooding data to guide infrastructure investment through infrastructure mapping

Emergency Response/Extreme Events

Climate Driver: Flooding
Impact: Water Quality
Goal 1: Protect well-sourced drinking water from increased risk of groundwater contamination through protection and mapping/local codes

Climate Driver: Flooding
Impact: Water Quality
Goal 2: Protect water quality by reducing runoff pollutants through Green Infrastructure/Low Impact Design

Climate Driver: Drought
Impact: Depleting Aquifers
Goal 3: Increase water conservation behaviors among residents, local government, and businesses

Water Related

Vector Awareness Action Steps

Vector Awareness

Issues relating to the increased prevalence of vectors (specifically ticks) and vector-borne diseases throughout Marquette County due to a changing climate.

Vector-borne Disease Exposure Pathway (Vector Awareness)

- Increased Temperatures
- Changing Seasonal Patterns

Climate Drivers

Exposure Pathways

- Increased Tick Population

- Lyme Disease

Health Outcomes

Ticks

Vector Awareness
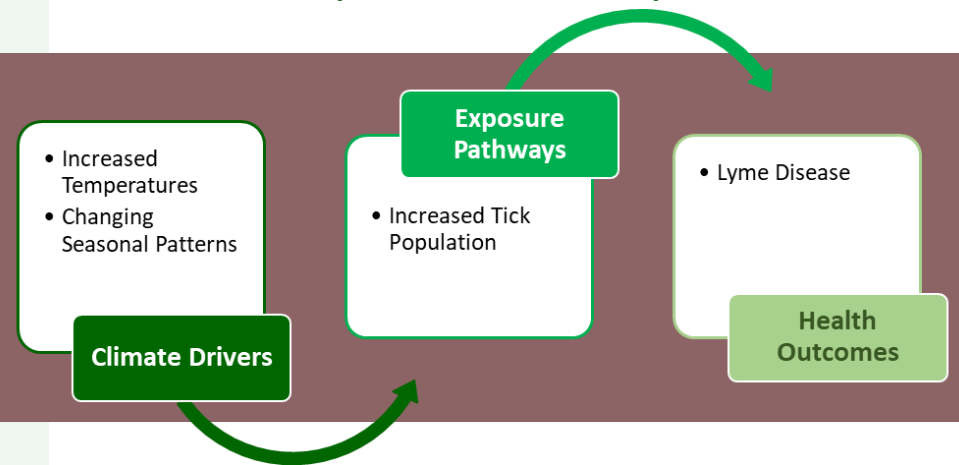
Stakeholder groups and community members voiced concerns about how prolonged increased temperatures from climate change have expanded vector-borne disease carrying insect habitats to the Marquette area. While mosquitos and mosquito-borne viruses were brought up as concerns, ticks, and tick-borne illnesses were the main issue heard at the meetings.

To address these concerns and limit the increased risk of human exposure to ticks, policies focus broadly on enhancing and maintaining buffers between humans and tick habitats, educating the public on tick-exposure risk and prevention, and expanding vector management and monitoring.

Vector Awareness

Goals 1 & 2: - Increase awareness of tick exposure risk and prevention measures through outreach
- Improve understanding of the risk and ability to coordinate a response through data collection and monitoring
Recommendation: - Enhance public awareness and simplify reporting and tracking process

Short-term (1 year)

- Focus on public awareness and increased tick surveillance and reporting
- Utilize data and mapping available through MDHHS MiTracking and MDHHS Disease Mapper websites
- Educate through press and social media releases. Include pictures of the effects of Lyme and tick-borne diseases. Target veterinarians, physicians, and public. Education should include awareness of existing tick kit.
- Hold seminar for physicians on Lyme including data on countywide prevalence

Medium-term (2-3 years)

- Develop and/or adapt existing MDHHS vector-borne disease outreach materials to educate physicians throughout the county regarding Lyme/tick borne disease prevalence and symptomatology to be aware of
- Develop educational materials for the public and disseminate through social media, health care providers, and public buildings (e.g. government offices and public libraries)
- Develop permanent signage and public postings on tick education in high risk areas including at local businesses, schools, and organizations

Long-term (4+ years)

- Develop and/or adapt existing MDHHS vector-borne disease outreach materials to educate physicians throughout the county regarding Lyme/tick borne disease prevalence and symptomatology to be aware of
- Work with public property managers, such as parks and recreation authorities, to inform landscaping decisions and maintenance that reduces tick habitat near high-use areas
- Develop communication strategy to ensure continuous feedback to the public about the state of what's been learned, tick monitoring, disease prevalence, etc. to support messaging
- Develop a simple metric/index for the public for tick and disease prevalence/severity in the County (i.e. June might end up being a 10 July an 8 (out of 10))

Responsible Party
- County Health Department
- Planning Departments

Partners:
- Local media
- Michigan State University and MSU Extension
- Local healthcare providers
- Michigan Department of Natural Resources (MDNR)
- Community Foundation
- Schools
- Local businesses and sports clubs (hunting, fishing, rec leagues, etc.)
- Municipal parks and recreation departments/ authorities

Upcoming opportunities
- Potential grant opportunities – MDHHS vector unit will be offering funding in the near future that can be taken advantage of
- Potential for collaboration with area groups
- Strong media outreach through Mining Journal
- Municipal parks and recreation plan updates

Resources Needed
- Staff time
- Money
- Signage
- Public Outreach

Funding Mechanisms
- MDNR funding, resources and volunteers
- MDNR recreational grants
- Local Parks and Rec funding
- Community Foundation grants
- Superior Health Foundation grants

Other Considerations
- Vector message should be broadened to integrate tick and mosquito info thereby reducing the future workload and maximizing the benefits

Metrics
- Number of cases of tick borne diseases
- Number and species of ticks counted by using tick drags
- Number of local trainings completed
- Number of ticks sent by citizens and identified and/or tested by MDHHS
- Number of sites with integrated pest management strategies
- Number of individuals reached by public education campaign
- Number of trainings for clinic and health care providers
- Number of tick-specific educational signs in public places
- Number of people participating in new vector communication and management plan via website

Vector Awareness

Goal 3: - Reduce human exposure to ticks through local surveillance and risk communications
Recommendation: - Increase local surveillance for ticks and tick borne diseases and communicate that risk to the public

Short-term (1 year)

- Attend available Michigan Department of Health and Human Services (MDHHS) trainings regarding tick surveillance and field sampling
- Seek available funding to support local tick surveillance and field sampling
- Educate the public regarding options to submit ticks to MDHHS labs for testing
- Maintain a supply of tick submission kits available to the public.
- Educate local physicians regarding tick borne disease diagnosis and reporting through the Michigan Disease Surveillance System (MDSS)

Medium-term (2-3 years)

- Conduct local field sampling for disease carrying tick prevalence (funding dependent)
- Track trends in tick occurrence through MiTracking
- Track trends in occurrence of tick borne diseases through MDSS
- Educate the public regarding tick and tick borne disease prevalence and risk to health.
- Educate the medical community regarding tick and tick borne disease prevalence and risk to health.

Long-term (4+ years)

- Continue to monitor tick and tick borne disease occurrence and prevalence trends
- Continue to keep the public and the medical community current regarding tick and tick borne disease occurrence and prevalence trends

Responsible Party
- County Health Department
- The Michigan Department of Health and Human Services (MDHHS)
- Medical providers within the community

Upcoming opportunities
- Upcoming MDHHS trainings regarding vector borne diseases and tick field sampling and surveillance to local health departments (2019)
- MDHHS is considering potential funding to support field sampling and reporting of tick prevalence by local public health departments.
- Increased attention at the State level to tick borne disease and prevalence and occurrence of disease vectors
- MDHHS MiTracking web based interface continues to improve. MiTracking allows public health and members of the public to view current disease and environmental health trends through an online interface and to map these trends. This includes the occurrence of any ticks submitted to MDHHS for testing or identification
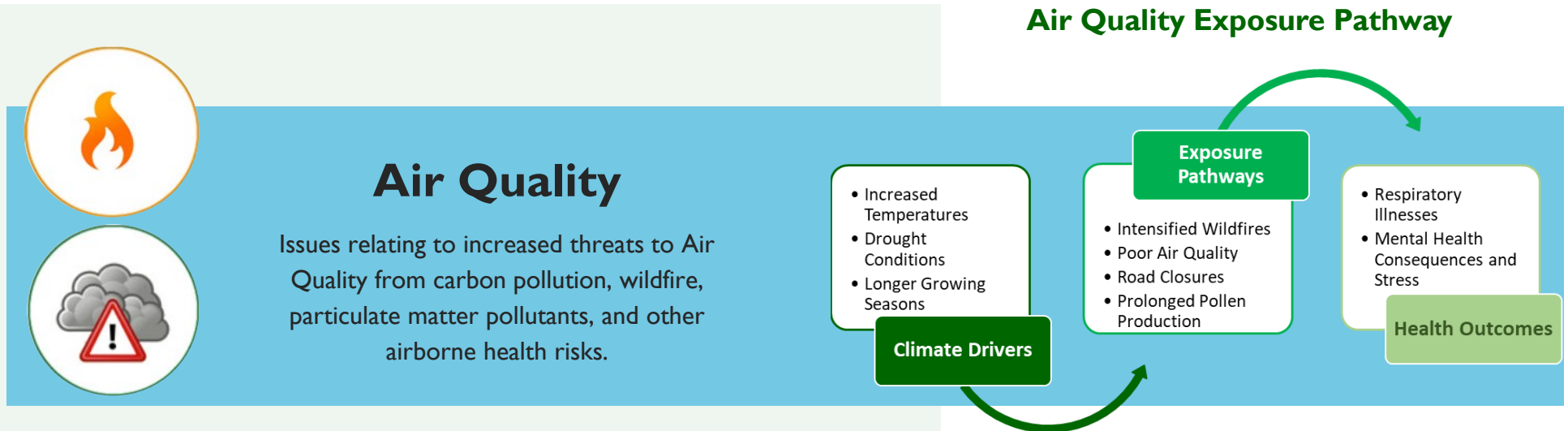
Resources Needed
- Funding to cover staff time and associated expenses

Metrics
- Number of cases of tick borne diseases
- Number and species of ticks counted by using tick drags
- Number of local trainings completed
- Number of ticks sent by citizens and identified and/ or tested by MDHHS

Air Quality Action Steps

Air Quality

Issues relating to increased threats to Air Quality from carbon pollution, wildfire, particulate matter pollutants, and other airborne health risks.

Air Quality Exposure Pathway

- Increased Temperatures
- Drought Conditions
- Longer Growing Seasons

Climate Drivers

- Intensified Wildfires
- Poor Air Quality
- Road Closures
- Prolonged Pollen Production

Exposure Pathways

- Respiratory Illnesses
- Mental Health Consequences and Stress

Health Outcomes

Stakeholder groups and community members voiced concerns about impacts to air quality from wildfire smoke, increased pollen, ozone and particulates. Increasing average annual temperatures and shifting seasonal precipitation patterns that have at times led to drought conditions can lead to intensified wildfires, poorer air quality, and increased pollen counts. This can impact health by causing or exacerbating respiratory illnesses as well as mental health consequences and stress.

To address these concerns, policies focus broadly on preventing wildfires, expanding clean energy, encouraging low-pollen and high pollutant-absorptive vegetation use, and enhancing air quality monitoring and communication.

Air Quality

Wildfires

Air Quality

Goal 1: Engage residents' participation in wildfire prevention
Recommendations: - Encourage large landowners to complete a forest management plan through the U.S. Forest Service's Northern Institute of Applied Climate Science
- Encourage residential adoption of Firewise standards through public information campaigns and grant programs

**Short-term
(1 year)**

- Promote awareness of Marquette County's Community Wildfire Protection Plan (CWPP)
- Continue presenting Firewise programs to the public (from County CWPP)
- Use social media and other outlets to promote Marquette County Wildfire Hazard map (Figure 7 of County CWPP)
- Continue cooperation on mapping of fire hazards and structures (from County CWPP)
- Promote MSUE Sample Wildfire Hazard Zoning to municipalities
- Work with the County Building Department to create a practice of handing out Firewise educational materials for all building permits in the county wildfire hazard area
- Work with townships to create a practice of handing out Firewise educational materials for all zoning permits in wildfire hazard areas

**Medium-term
(2-3 years)**

- Identify large landowners in the county for whom to prioritize wildfire protection education
- Encourage large landowners to implement best forest management practices to reduce hazardous fuels
- Assist landowners in pursuing funding opportunities to reduce hazardous fuels
- Inventory and educate subdivisions and Homeowners Associations (HOAs) at the wildland-urban interface about Firewise techniques
- Conduct forestry discussion sessions with the Sawyer Community Alliance and Dead River Campers Association, along with a discussion of Firewise techniques (from County CWPP)
- Write a "So You Want to Live in the Woods" pamphlet for distribution with township zoning compliance permits (from County CWPP)

**Long-term
(4+ years)**

- Pursue a grant to support on-site Firewise assessment of individual properties, particularly in the Sands Plains and 581 Corridor zone dispatch areas (from County CWPP)
- Assist large landowners in implementing best forest management practices with funding and technical assistance
- Provide technical assistance to townships in adopting standards and/ or incentives for inclusion of Firewise techniques in subdivisions and residential development in the wildland-urban interface

Responsible Party
- County Planning Department
- County Building Department
- Marquette County townships
- Local fire departments
- MSU Extension
- Conservation District
- Michigan Department of Natural Resources (MDNR)
- U.S. Forest Service

Upcoming opportunities
- Township master plan updates
- Township zoning ordinance amendments
- Township subdivision ordinance amendments
- Regional Prosperity Initiative plan updates

Resources Needed
- Department staff time for promotion and mapping
- Funding for continuation of Firewise education

Funding Mechanisms
- US Forest Service and/or MDNR grant funding for hazardous fuel reduction

Metrics
- Number of large landowners who have completed a forest management plan
- Number of sites in Marquette County listed on the Firewise USA map

Air Quality

Goal 2: Reduce greenhouse gas emission through encouragement of renewable energy sources and energy efficiency
Recommendations: - Invest in efficiency of built environment and renewable energy harvesting
- Increase capacity for collection and analysis of local air quality and respiratory disease data

Short-term (1 year)

- Review local government policies, plans, and ordinances related to renewable energy and recommend amendments that support use/development of renewable energy for on-site use, community energy projects, and utility-scale applications
- Deliver local government education on planning and zoning for renewable energy
- Develop simple educational materials on conservation practices and energy financing programs for end users
- Promote Marquette County's participation in the Property Assessed Clean Energy Act, which allows commercial property owners to undertake energy efficiency, water efficiency, and renewable energy upgrades with payment via a special assessment on property tax bills

Medium-term (2-3 years)

- Increase capacity for collection and analysis of local air quality and respiratory disease data
- Promote installation of smart meters throughout county
- Develop/adapt and share case studies on new energy technology and financing, including distributed solar/wind, storage, and microgrids
- Develop a case study of the City of Marquette's experience paying for energy efficiency improvements at municipal buildings through Tax Exempt Lease Purchase

Long-term (4+ years)

- Upgrade all municipal buildings in the county with energy efficiency improvements
- Work with the City of Marquette and the Board of Light and Power to develop a community-driven energy plan (from Marquette Master Plan)
- Work with local governments and electrical energy providers to understand future energy needs and plan for meeting those needs with distributed renewable sources

Responsible Party
- County Planning Department
- Marquette County townships
- Cities of Marquette, Ishpeming, Negaunee
- County Health Department
- MSU Extension
- Michigan Energy Options
- State of Michigan Energy Office
- Marquette Board of Light and Power
- Central Upper Peninsula Planning and Development Regional Commission (CUPPAD)

Upcoming opportunities
- Municipal master plan updates
- Municipal zoning ordinance amendments
- Preparation of and updates to electric utility Integrated Resource Plans

Resources Needed
- Staff time
- Technical assistance staffing and funding

Funding Mechanisms
- Michigan Energy Office funding opportunities

Metrics
- Number of emergency centers with onsite renewable energy systems
- Number of new wind energy installations
- Number of properties with onsite community-based energy systems
- Number of structures assessed for energy efficiency and renewable energy adaptation

Air Quality

Goal 3: Reduce pollutant emissions throughout region through supporting Smart Growth

Recommendations: - *Promote Placemaking and incentivize market-supported, mixed-use development that includes businesses that meet the basic needs of the community residents (e.g. grocery stores, health centers, etc.) within walking distance*
- *Expand the development of walkable and bikeable options throughout county*

Short-term (1 year)
- Implement the City of Marquette On-Street Bicycle Route System with pavement markings and signage and integrate those routes with the extensive paved path network (from Marquette Master Plan)
- Encourage all local units of government to adopt the Smart Growth Tenets as planning principles in their master plans
- Further promote Placemaking as an economic development tool
- Deliver local government education on creating Place through adoption of form-based codes for key redevelopment areas

Medium-term (2-3 years)
- Provide technical assistance to cities of Negaunee and Ishpeming to develop pedestrian and bicycle plans
- Provide technical assistance to municipalities to amend zoning ordinances to allow for mixed-use, greater density, waive off-street parking requirements in certain districts, etc.
- Assist municipalities in preparation of public participation plans to help foster community and stakeholder collaboration
- Conduct a countywide bicycle promotion and safety educational campaign
- Develop a green infrastructure pilot project at a highly-visible, publicly-owned site

Long-term (4+ years)
- Create regular and efficient public transportation within the City of Marquette (from Marquette Master Plan)
- Develop city and county road commission policies that prioritize snow removal from bike and pedestrian ways
- Expand the network of multi-purpose trails throughout the county

Responsible Party
- County Planning Department
- County Road Commission
- Marquette County townships
- Cities of Marquette, Ishpeming, Negaunee
- County Health Department
- MSU Extension
- Superior Watershed Partnership
- Iron Ore Heritage Recreation Authority
- Central Upper Peninsula Planning and Development Regional Commission (CUPPAD)
- Marquette County Transit Authority (Marq-Tran)
- Community groups related to vulnerable populations such as homeless, aging, veterans, etc.

Upcoming opportunities
- Municipal master plan updates
- Municipal zoning ordinance amendments
- Municipal tax increment financing plan and expenditures
- Street and road reconstruction
- Recreation Authority plans

Resources Needed
- Staff time
- Technical assistance staffing and funding
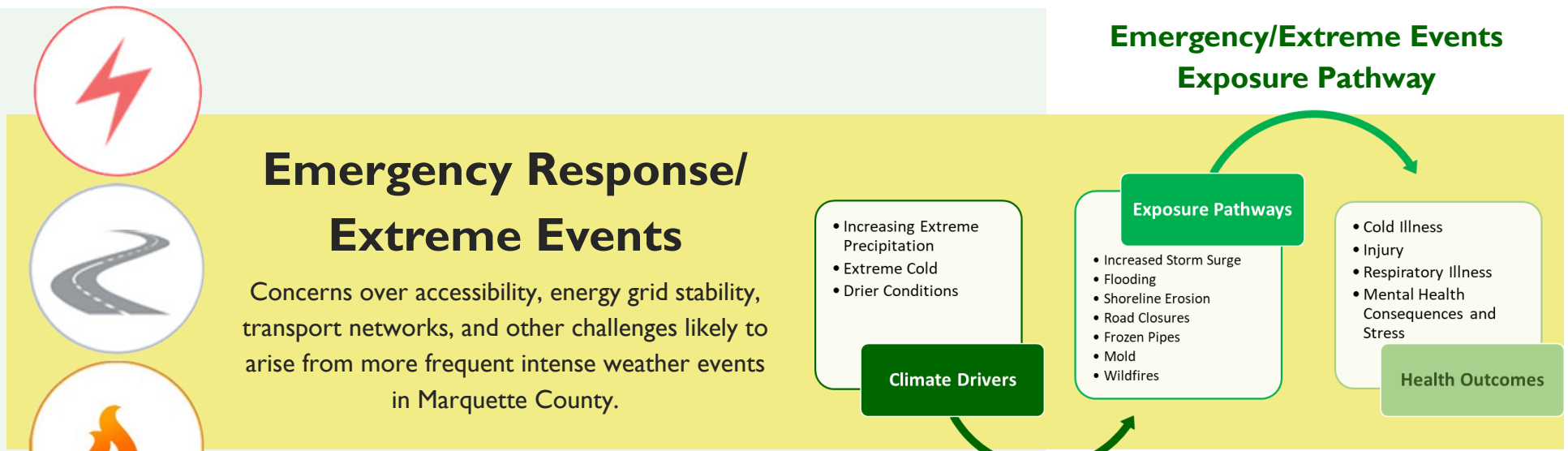
Funding Mechanisms
- Michigan Department of Transportation (MDOT) Transportation Alternatives Program (TAP) funding
- Local government millage expenditures
- Local government Capital Improvements Program (CIP) funding

Metrics
- Number of residents within one-mile of vital-needs businesses
- Miles of bike lanes and safely bikeable and walkable routes throughout county

Emergency Response/Extreme Events Action Steps

Emergency Response/ Extreme Events

Concerns over accessibility, energy grid stability, transport networks, and other challenges likely to arise from more frequent intense weather events in Marquette County.

Emergency/Extreme Events Exposure Pathway

Climate Drivers
- Increasing Extreme Precipitation
- Extreme Cold
- Drier Conditions

Exposure Pathways
- Increased Storm Surge
- Flooding
- Shoreline Erosion
- Road Closures
- Frozen Pipes
- Mold
- Wildfires

Health Outcomes
- Cold Illness
- Injury
- Respiratory Illness
- Mental Health Consequences and Stress

Stakeholder groups and community members voiced concerns about how extreme weather events and wildfires from climate change along with the challenges of infrastructure, transportation, residential isolation, and others can lead to increased health dangers in the community, such as injury, respiratory illnesses, cold-related illness, and mental health consequences.

To address these concerns, policies focus broadly on enhancing green and gray infrastructure, promoting extreme weather preparedness, promoting accessible living patterns and improved transportation networks, and limiting people's exposure to the dangers of extreme weather.

Energy

Road Access

Wildfires

Emergency Response/Extreme Events

Goal 1: - Reduce the impact of flooding on population health and reduce the increased risk of roads flooding due to runoff
Recommendation: - Develop policies that facilitate increased implementation of Green Infrastructure (GI) and Low Impact Development (LID)

Short-term (1 year)

- Maintain storm drains and culverts to keep from filling up with sand
- Educate homeowners and municipalities on GI and LID techniques to minimize runoff
- Educate homeowners on the risk of drinking water contamination resulting from flooded wells
- Inventory and map infrastructure most prone to flooding
- Develop a public health response plan to climate change induced flooding

Medium-term (2-3 years)

- Assist municipalities in preparing capital improvements plans that commit funds to replace poor and aging storm water infrastructure
- Designate alternate transportation routes in the event of road closures due to flooding

Long-term (4+ years)

- Put capital improvements project (budget) on a 5-year scale in order to get matching funds
- Assist municipalities in amending plans and ordinances to require GI and LID as part of new development
- Update municipal capital improvements plans to include GI as storm water infrastructure to minimize runoff and flooding
- Assist municipalities in designating floodplain overlay zones that limit new development
- Assist municipalities in exploring the creation of storm water utilities

Responsible Party
- County Road Commission
- Michigan Department of Environment, Great Lakes and Energy (EGLE)
- City/County Township Planning Departments
- Superior Watershed Partnership

Upcoming opportunities
- State Revolving Fund loan for storm water improvements
- State Revolving Fund loan for drinking water
- Guidelines for water preservation at the township level
- Guidelines for green areas for water preservation
- New alternate bridge routes
- Michigan Dept. of EGLE's Asset Management program (resource for CIP related to water infrastructure)

Resources Needed
- State Revolving Fund loan for storm water improvements

Funding Mechanisms
- State Revolving Fund loan for storm water improvements

Metrics
- Number of new developments using LID
- Number of LID practices on publicly-owned properties
- Gallons of runoff diverted by GI/LID

Emergency Response/Extreme Events

Goal 2 : - Ensure road construction appropriately manages storm water to allow for road access through countywide planning
Recommendation: - Bring local units together to identify routes at risk – gather existing data to identify existing problem areas

Short-term (1 year)

- Approach the Marquette County Road Commission, Drain Commissioner, Superior Watershed Partnership (SWP), and local government entities to conduct a table-top planning exercise

Medium-term (2-3 years)

- Establish drainage map using GIS for county identifying water drainage and water accumulation areas

Long-term (4+ years)

- Strengthen collaboration with county planning in future road construction, identifying areas needing improved connectivity
- Use GIS and local and regional data to establish an asset management plan for county roads

Responsible Party
- Marquette County Road Commission
- Marquette County Drain Commissioner
- Marquette County Emergency Management
- Michigan Department of Transportation
- Local governments
- Engineers – available data collection
- Citizens Action Group/Partnerships
- Fire Departments/County Associations
- Superior Watershed Partnership

Upcoming opportunities
- County master plan update (ongoing)
- Local government master plan updates
- Local/State Representatives and Community members
- Outreach via social media or PSAs
- Upfront engagement with the Public and those affected – Informational meetings

Resources Needed
- Establish Capitol Improvements Project money or millage through Townships
- Coordinate single purpose funding sources to direct future projects

Funding Mechanisms
- State Revolving Fund loan for storm water improvements

Other Considerations
- Enhanced effort to build partnerships to achieve larger goals. This will include gathering and compiling data for establishing a management plan

Metrics
- Number and location of repeated road closures due to flooding

Emergency Response/Extreme Events

Goal 3 : - Use flooding data to guide infrastructure investment through infrastructure mapping
Recommendation: - Map and inventory the infrastructure damages caused by extreme weather and identify areas subject to repeated damages

Short-term (1 year)

- Utilize National Oceanic and Atmospheric Administration (NOAA) Lake Level Viewer (https://coast.noaa.gov/llv/) to identify coastal areas potentially impacted by flooding due to high Great Lakes levels in combination with coastal storms
- Build upon Marquette County Health Department GIS of residences and infrastructure potentially at risk during flooding events
- Conduct a multijurisdictional planning workshop focused on land use and infrastructure planning along Lake Superior shoreline and larger county rivers (Chocolay, Carp, Dead)

Medium-term (2-3 years)

- Identify undeveloped coastal properties to target for preservation to avoid development and property/infrastructure loss
- Identify developed coastal properties to target with investments/assistance in Green Infrastructure (GI) to mitigate flooding impacts
- Develop a countywide web-based GIS of riverine and coastal flood hazards and the infrastructure and residential, commercial, and/or industrial structures at risk

Long-term (4+ years)

- Update local government Capital Improvements Programs (CIP) to include:
- Replacement of previously identified vulnerable infrastructure with more resilient designs and materials
- Purchase and protection of priority properties at risk of riverine and coastal flooding
- Construction of green infrastructure enhancements on local government properties vulnerable to riverine and coastal flooding
- Develop a multijurisdictional asset management plan for municipal infrastructure along Lake Superior shoreline and rivers at risk of flooding throughout county
- Develop a landowner campaign to encourage donation of conservation easements for properties at risk of riverine and coastal flooding

Responsible Party
- Marquette County Health Department
- Marquette County Planning Department
- Local units of government
- Superior Watershed Partnership
- UP Land Conservancy

Upcoming opportunities
- County master plan update
- Annual local government Capital Improvements Projects (CIP) adoption
- Municipal master plan updates
- Municipal zoning ordinance amendments
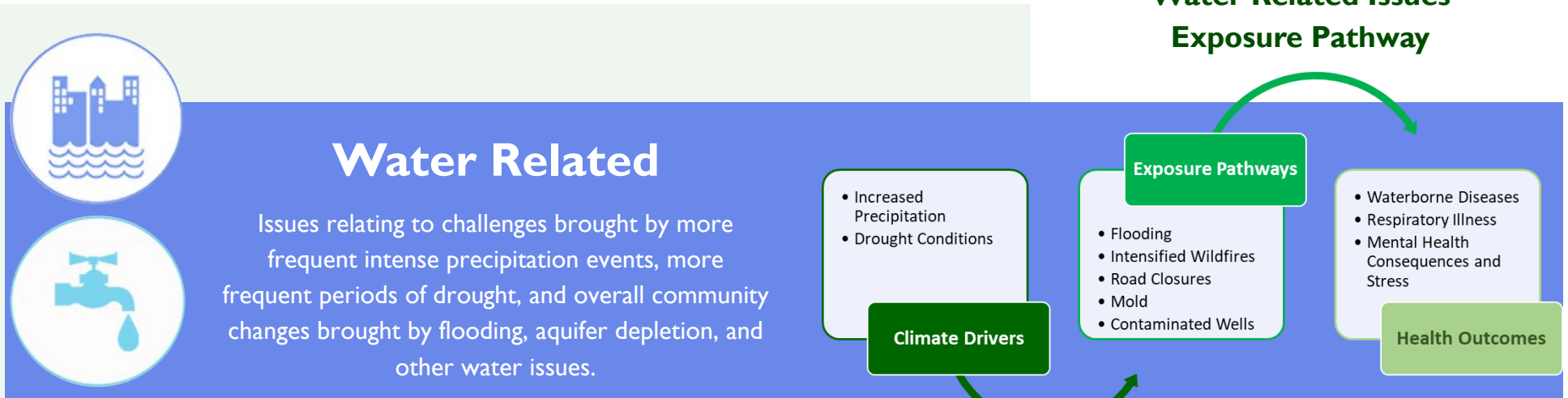
Resources Needed
- Staff time

Funding Mechanisms
- Grant funding
- Michigan Dept. of EGLE's Office of the Great Lakes Coastal Management Program funding and technical assistance opportunities
- Local government funding through CIP spending or millage collection
- Landowner donations of conservation easements

Metrics
- Number and location of repeated road closures due to flooding

Water Related Action Steps

Water Related

Issues relating to challenges brought by more frequent intense precipitation events, more frequent periods of drought, and overall community changes brought by flooding, aquifer depletion, and other water issues.

Water Related Issues Exposure Pathway

Climate Drivers
- Increased Precipitation
- Drought Conditions

Exposure Pathways
- Flooding
- Intensified Wildfires
- Road Closures
- Mold
- Contaminated Wells

Health Outcomes
- Waterborne Diseases
- Respiratory Illness
- Mental Health Consequences and Stress

Stakeholder groups and community members voiced concerns about increased flooding events and resulting damage and runoff, drought conditions, concerns over water sources, and contaminated water. More frequent extreme rain events and drought conditions as well as prolonged increased temperatures from climate change can lead to intensified flooding, road closures, mold, contaminated water, and intensified wildfires, among other dangers. This can impact health by limiting road access, increasing chances for waterborne disease, causing respiratory illnesses, and leading to mental health consequences and stress.

To address these concerns, policies focused broadly on reducing runoff, enhancing green and gray infrastructure, encouraging conservation practices, and reducing risks of contamination.

Flooding

Water Quality

Water Related

Goal 1 : - Protect well sourced drinking water from increased risk of groundwater contamination
Recommendation: - Conduct a baseline assessment of water systems and aquifers across Marquette County
- Develop a public health response plan to flooding events addressing water supply protection

**Short-term
(1 year)**

- Identify a county-wide network to address this – a "Regional Water Authority"
- Identify specific contaminants to be monitored
- Start drafting consistent local units of government (LUGs) written policy
- Develop public health response plan to flooding to address water supply protection identification of contamination instances and mitigation strategies

**Medium-term
(2-3 years)**

- Prioritize aquifer protection areas using EGLE and County Health Department data
- Conduct a homeowner survey to ensure community engagement on issues such as drinking water concerns; knowledge about source water protection, well testing and monitoring; etc.
- Seek continued funding to ensure monitoring is being done consistently countywide

**Long-term
(4+ years)**

- Develop public education on residential contamination
- Seek continue funding to ensure monitoring is done consistently countywide
- Create a standard for number of times monitoring of private wells should occur - twice per year is suggested as seasons may affect levels
- Create an Adaptive Management Plan

Responsible Party
- County Health Department
- County Planning Department
- LUGs Planning Departments
- Fire Departments

Upcoming opportunities
- New Governor in 2019 who has water as a priority could mean potential funding
- Discussions have already begun around creating a regional water authority

Resources Needed
- Ground water monitoring tools

Funding Mechanisms
- Michigan Tech University
- Northern Michigan University
- Superior Watershed Partnership
- Marquette Conservation District

Other Considerations
- Community education and buy-in is low

Metrics
- Number of people contacted by outreach programs
- Number of ordinances amended to comply with new groundwater contamination reduction principles

Water Related

Goal 1 : - Protect well sourced drinking water from increased risk of groundwater contamination
Recommendation: - Promote riparian buffers, retention/detention ponds, rain gardens and storm water management (Green Infrastructure)

Short-term (1 year)

- Inventory current and potential flooding issues
- Perform a baseline assessment of the quality and extent of county aquifers
- Seek funding (e.g. for baseline assessment and/or awareness campaign)
- Collaborate with the Great Lakes One Water Partnership under the leadership of the Community Foundation of Marquette County to advance awareness of strategies that private and public entities can take to minimize impacts of extreme precipitation events and coastal storms

Medium-term (2-3 years)

- Include maps that illustrate drainage in Master Plans (County and local units of government (LUGs) Master Plans)
- Draft model ordinances of best practices including riparian overlay zones requiring natural buffers, increased setbacks, larger lot sizes, impervious surface maximums, and net-zero runoff site plan requirements
- Support demonstration projects that utilize GI and LID techniques to manage storm water onsite

Long-term (4+ years)

- Document before and after examples of best practices
- Educate shoreline property owners about the importance of protecting and restoring vegetated buffers on lakes, streams, and wetlands
- Provide technical assistance to local governments to assist in the adoption of model ordinances
- Work with local governments to educate their constituents on the updated best practice ordinances
- Assist a city in the county with piloting variable storm water rates where properties are billed based on the amount of impervious surface onsite

Responsible Party
- CATF can act as conduit for disseminating information to LUGS county wide (via Marquette County Townships Association (MCTA))
- Township Planning Commission and Staff for Public Hearings education along with changes to text in ordinances.
- Critical to have supportive political leadership

Upcoming opportunities
- Marquette County in the process of updating their Master Plan
- Multiple LUGs are updating their Master Plans (this should be done every 5 years)
- The Community Foundation of Marquette County's Great Lakes One Water Partnership (GLOW) initiative is focusing on climate resiliency and extreme weather events directly in relation to water impacts. Implementation as well as education and outreach to various sectors can be funneled through this initiative
- Discussions began years ago around creating a regional water authority through CATF, SWP and Marquette County and resurfaced in recent months. This goal can be housed as a goal of the regional water authority

- Supporting a local water plan has recently been added to CATF 2019 work plan. CATF can assist with public education and LUG outreach

Resources Needed
- Public and political awareness, interest, and willingness to change
- Dedicated volunteers
- Dedicated staff in municipalities for planning/ordinance changes as well as educating their constituents
- GIS maps for drainage in municipalities- Green Infrastructure areas/ overlay districts

Funding Mechanisms
- MICHAP Phase III funding may be available for a demonstration site
- Regional Prosperity Initiative possible funding
- Community Foundation grants
- The Superior Watershed Partnership completes GI and LID projects; some local projects may qualify for match funding

Metrics
– Number of developers implementing LID practices
– Number of people utilizing LID/GI incentives for their private properties
– Gallons of runoff diverted by GI/ LID
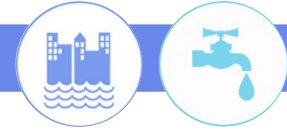
Water Related

Goal 2 : - Protect water quality by reducing runoff pollutants through Green Infrastructure/Low Impact Design
Recommendation: - Tax incentives for implementing Green Infrastructure and Low Impact Design

Short-term (1 year)

- Educate local units of government (LUGs) on why Green Infrastructure and Low Impact Design is important
- Write up ordinances and set up fee structure at LUG level

Planning activities:
- Identify locations to distribute rain barrels - potentially at Township Halls
- Develop site plan and building code requirements- Communicate with other LUG departments to ensure GI improvements will be up to code in other departments
- Education- Assist LUGs to disseminate information plan to constituents (mailing, flier, social media, etc)

Medium-term (2-3 years)

- Adopt policies at the local level
- Adopt fee structure at the local level
- Educate public on why GI and LID is the right thing to do, and how to go through process with your local LUG to ensure you follow local ordinances to implement your project in the proper way to receive a tax credit

Long-term (4+ years)

- Continue education with LUGS (especially if there is staff turnover) and with public to ensure sustainability of implementation among landowners
- Monitor the impact of the GI and LID projects; before and after photos (seasonally), use this information to encourage additional LUGs to implement similar tax incentives

Responsible Party
- LUGs Planning and Zoning Departments, LUG Managers and Supervisors for public input, site plan review process
- LUGs Assessors
- List of resources for contractors who can help implement GI and LID projects

Upcoming opportunities
- The Community Foundation of Marquette County's Great Lakes One Water Partnership (GLOW) initiative is focusing on climate resiliency and extreme weather events directly in relation to water impacts. Implementation as well as education and outreach to various sectors can be funnelled through this initiative
- Philanthropic funding

Funding Mechanisms
- MICHAP Phase III funding may be available for a demonstration site
- GLISA funding opportunity
- Regional Prosperity Initiative possible funding
- Community Foundation grants
- The Superior Watershed Partnership completes GI and LID projects; some local projects may be good match sources to apply for additional funding

Other Considerations
- Look into state policy and code requirements
- Look into best practices- examples of this in comparable locations

Metrics
- Number of people utilizing LID/GI incentives for their private properties
- Gallons of runoff diverted by GI/LID

Water Related

Goal 3 : - Increase water conservation behaviors among residents, local government and businesses
Recommendation: - Outreach and education to entire county, with focus on areas with most need

Short-term (1 year)

- Identify areas within county that will be most impacted by extended periods of drought
- Develop a communications plan for outreach and education to county residents and businesses; with a focus on current and historical high water users
- Encourage public spaces (businesses and LUG buildings) to set the example for others to implement these practices at home

Medium-term (2-3 years)

- Develop location specific materials for outreach and education (Use maps containing an easy to interpret color coding...red, orange, yellow for areas in most need of water conservation behaviors)
- Distribute materials county wide
- Survey residents on what they think are the most important water conservation behaviors, to get buy in

Long-term (4+ years)

- Continue to distribute materials county wide
- Monitor usage and conservation behaviors via surveys and water meters, wells, etc.

Responsible Party
- County Health Department
- County Drain Commissioner
- Local government water departments and authorities

Upcoming opportunities
- The Community Foundation of Marquette County's Great Lakes One Water Partnership (GLOW) initiative is focusing on climate resiliency and extreme weather events directly in relation to water impacts. Implementation as well as education and outreach to various sectors can be funneled through this initiative
- Discussions have already begun around creating a regional water authority through CATF, SWP and Marquette County. This Goal can be housed as a goal of the regional water authority
- Supporting a local water plan was recently added to CATF 2019 work plan. CATF can assist with public education and LUG outreach

Resources Needed
- Dedicated staff in municipalities to implement conservation measures at their buildings and educate their constituents
- GIS maps of high risk aquifer depletion areas
- Graphics person to create materials for LUG specific water conservation measures

Funding Mechanisms
- Regional Prosperity Initiative Grant funding potential
- Local Community Foundation funding potential

Metrics
- Number of households contacted via new communication outreach plans
- Number of households that took action following audits

Implementation Project Ideas

At the Implementation Prioritization Workshop, participants also suggested projects to address the priority climate and health adaptation goals which could be implemented in their communities with technical or financial assistance. Nearly fifty climate and health adaptation projects were suggested. Common project themes, with examples of suggested project ideas, is summarized below.

Adaptation Project Ideas by Common Theme with Examples of Suggested Projects

Project theme	Example Suggested Projects
Education and Outreach	– Educate community on vector awareness/surveillance – Expand vector-awareness signage – Inform public on the hazards of wood burning outdoor boilers - especially burning construction materials – Develop energy efficiency programs for residential dwellings
Data and Monitoring	– Complete a baseline water aquifer study – Participate in county wide effort to share and gather resources for other municipalities – Develop a GIS inventory of water systems, fire hazards, etc. – Create county wide water authority
Green Infrastructure/ Low Impact Development	– Develop guidelines to promote water preservation and green development on public land. Encourage use on private land – Use the township office and recreation complex to implement design elements as a model for the township – Ensure appropriate planting and invasive species remediation on vacant industrial property
Plan/Ordinance Updates	– Implement Firewise for park management and city owned acres – Develop a shoreline climate resiliency overlay – Provide education and assistance with ordinance adoption
Maintenance/Engineering	– Look at roads, trails, power lines, rail lines for clearance and access for fire apparatus – Reorient the mouth of the Chocolay River to minimize ice dams
Funding/upport	– Expand building weatherization/efficiency projects for homes and business

Moving Forward

By participating in the development of this Climate and Health Adaptation Guidebook, the Marquette Community has established a solid foundation for building resilience and adaptive capacity. However, this Volume III represents the beginning of an ongoing process that requires a number of considerations to be successful. To ensure this climate and health adaptation plan remains relevant, up-to-date, and active, some further considerations for implementation are listed below.*

- **Measure impact**—Use baseline metrics to assess the performance and success of the actions taken. If new indicators become available for tracking success, include them in the evaluation process. Collecting and measuring data is vital for later reflection on whether actions are having their intended impact.

- **Establish targets**—While the goals and action steps laid out in this document act as a starting place for action in Marquette County, defining clear targets for each step along the way can help keep the project on track. These targets are best established from the beginning and can later be amended if necessary.

- **Track actions and share progress**—Consider a way to track actions that are happening throughout the county and to communicate this information with agencies and residents throughout the county. Tracking actions provides a platform for collaboration across agencies and organizations, and creates a network of experts and resources upon which other communities can draw. Regularly communicating these actions to the public and public officials keeps community momentum alive.

- **Maintain engagement**—The process of this plan involved explicitly engaging numerous vulnerable populations in a deep and meaningful way. Capitalize on this inclusion by ensuring these community members continue to be part of the conversation and action.

- **Stay connected**—The success of this plan relies on public officials from numerous agencies at various levels throughout the county working together. Action on the larger scale depends on daily actions by health professionals, planners, engineers, non-profits, faith-based workers, social service professionals, and more. Keeping the larger team connected and up-to-date keeps momentum going.

- **Evaluate progress**—With measurable actions and established targets, it is important to take time to assess whether actions are having their intended impact and if targets need adjustment. Regional bodies may play an important role in this reflection.

- **Stay up-to-date and relevant**—Establish a method for revisiting and updating recommendations as new climate information becomes available. This involves being informed on up-to-date climate and demographic information for the area, and ensuring the strategies and priorities reflect any changes.

- **Connect to other climate and health initiatives**—Develop methods for sharing this story and supporting other communities interested in developing similar plans. This pilot project is unique in the emerging field of climate adaptation in that public health is at its forefront, and sharing Marquette County's story can inspire and guide other communities through similar, public health led climate adaptation projects.

*This list is adapted from the United States Global Change Research Program's (USGCRP) U.S. Climate Resilience Toolkit

Appendices

Appendix A: Volume I Overview

Volume I: Stakeholder Engagement and Visual Design Imaging of the Marquette Area Climate and Health Adaptation Guidebook includes the project overview and background, details about the stakeholder engagement process, the identification of the four overarching health categories (Vector Awareness, Air Quality, Emergency Response/Extreme Events, and Water Related issues), the development of each category's causal pathway, and the utilization of original imagery to create the before and after design renderings of potential built environment adaptations. Volume 1 aims to help community residents and leaders visualize and better connect with potential climate adaptations that could address the climate related public health concerns they previously identified.

The *Design Recommendations* portion of Volume I includes two different sets of before and after imagery. The first set, as demonstrated by Figure 8, incorporates a list of the physical adaptations displayed in the image, symbology that indicates which of the four overarching health categories that adaptation is meant to address, sample policies that could enable the adaptive design concept to be implemented, and health measures that could be adopted as metrics in the various stakeholders' plans and evaluations. The second set of images, as shown in Figure 9, offer a more detailed explanation of how the adaptation concepts pictured in the after images address the climate and health concerns presented in the before image. Additional information is also provided in pop-out boxes containing tips, case studies, and quotes from the community stakeholders. A copy of Volume I can be found at https://www.canr.msu.edu/climatehealthguide.

Fig. 1 Design and Policy Sample Page from Volume I of the Guidebook

Fig. 2. Design and Adaptation Explanation Page from Volume I of the Guidebook

Appendix A: Volume II Overview

Volume II: Policy and Metric Recommendations of the Marquette Area Climate and Health Adaptation Guidebook includes the project overview and background, a process summary and project recap, and charts of policy and metric recommendations for addressing climate and health concerns of the county. The policy recommendations, developed after reviewing many of the existing plans and reports for the Marquette area as well as climate adaptation best practices from around the country and world, are categorized by the priority climate and health concerns identified by the county in Phase I (Vector Awareness, Air Quality, Emergency Response/Extreme Events, and Water Related issues).

Each section of recommendations introduces the climate health pathway of each category, explaining the issues and policies encompassed within. The 140 policy options and corresponding metrics are organized in charts and act as a menu of relevant options for community leaders to draw from for climate and health adaptation action. The metrics act as a means for measuring the success of the adaptations in protecting the public from the health impacts of climate change. A copy of Volume II can be found at https://www.canr.msu.edu/climatehealthguide.

Phase III built upon these recommendations, using the charts as a resource for public officials to select relevant strategies for priority goals. Figures 10 and 11 show examples of the recommendations in Volume II.

Fig. 3 Vector Awareness Climate Health Pathway Page from Volume II of the Guidebook

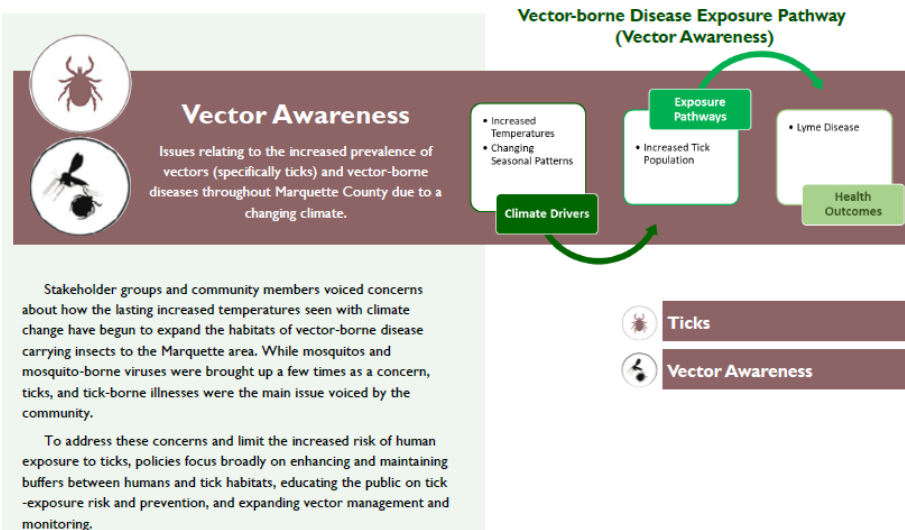**Fig. 4 Policy and Metric Recommendations Page from Volume II of the Guidebook**

Appendix B: Implementation Prioritization Workshop Results

Figure 1: Representatives of the following organizations and jurisdictions participated in the Phase III Implementation Prioritization Workshop

Organizations

Marquette County Health Department

Marquette Township

Central Upper Peninsula Planning and Development Regional Commission

City of Marquette

Community Foundation

Chocolay Township

City of Negaunee

Marquette Board of Light and Power

Marquette County Road Commission

Sands Township

Climate Adaptation Task Force

County Planning Commission

Drain Commissioner

Governor's Northern Michigan Office

Ishpeming City

Ishpeming Township

Ishpeming Wastewater

Marquette County Solid Waste Management Authority

Marquette Conservation District

Marquette County Planning Department

Marquette Township Fire and Rescue

Michigan Department of Environmental Quality (now EGLE)

National Weather Service

Negaunee Township

Northern Michigan University

Richmond Township

Superior Watershed Partnership

The Mining Journal

Jurisdictions

Marquette County

Regional

Marquette Township

City of Marquette

Chocolay Township

City of Negaunee

Ishpeming City

Sands Township

Neguanee Township

Richmond Township

Note:

"Marquette County" includes representation from the Marquette Community Foundation, Marquette Board of Light and Power, The Mining Journal, and the Marquette Conservation District

"Regional" includes representation from Superior Watershed Partnership, National Weather Service, Central Upper Peninsula Planning and Development Regional Commission (CUPPAD), Governor's Northern Michigan Office, Northern Michigan University, and the Michigan Department of Environmental Quality

Appendix B: Implementation Prioritization Workshop Results

Below is the full vote results from the prioritization exercise by public officials and the community at the Implementation Prioritization Workshop and Community Open House on January 29, 2019.

Figure 2: Full dot vote count for climate and health adaptation goals presented at January 29, 2019 Workshops

Vector Awareness

	Goal	Votes
Climate Driver: Ticks; Impact: Lyme Disease and other emerging tick-borne disease	Reduce human exposure to ticks through Green Infrastructure/Low Impact Development	3
	Reduce human exposure to ticks through local regulations	3
	Increase awareness of tick exposure risk and prevention measures through outreach	14
	Improve understanding of the risk and ability to coordinate a response through data collection and monitoring	13
	Total	33

Air Quality

	Goal	Votes
Climate Driver: Air Pollutants; Impact: 03 (Ozone) and PM2.5 (particulate matter)	Promote protective behaviors through public outreach	0
	Remove pollutants from county through urban tree canopy investments	6
	Increase capacity for collection and analysis of local air quality and respiratory disease data	6
	Develop regional strategy with cross-sectoral partners to address air pollutants	2
	Reduce pollutant emissions throughout region through supporting Smart Growth	9
Climate Driver: Air Pollutants; Impact: Energy	Reduce greenhouse gas emissions through encouragement of renewable energy sources and energy efficiency	17
Climate Driver: Allergens; Impact: Pollen	Manage for low-pollen production where possible through urban landscape	2
	Raise awareness of low-pollen alternatives and protective behaviors	0
	Track and communicate pollen levels	0
	Ensure ordinance reflect changes in pollen and allergen risk due to changing climate	0
Climate Driver: Wildfire; Impact: Smoke	Prevent wildfires at campsites through public outreach	1
	Promote education on smoke danger precautions through public outreach	3
	Engage residents' participation in wildfire prevention though thinning/pruning/tree removal/brush clearing on private property	21
	Ensure infrastructure safety to prevent electrical fires through modernizing infrastructure and modern operational practices	3
	Total	70

Appendix B: Implementation Prioritization Workshop Results

Figure 2: Full dot vote count for climate and health adaptation goals presented at January 29, 2019 Implementation Prioritization Workshop

Emergency Response/Extreme Events		
		Votes
Climate Driver: Storm Surge; Impact: Shoreline Flooding	Reduce road access barriers and property damage along Lake Michigan	2
	Reduce shoreline flooding through green infrastructure development	2
	Use flooding data to guide infrastructure investments through infrastructure mapping	13
Climate Driver: Wildfire; Impact: Access	Encourage more accessible living patterns to ensure access to residences in cases of major wildfires through supporting Smart Growth	7
	Reduce the risk present to homeowners from the growth in wildfire activities	1
	Track wildfires and assess wildfire risk across the county	6
	Prepare residents for wildfires through public outreach	0
Climate Driver: Wildfire; Impact: Property Damage	Reduce the risk present to homeowners from the increasing number of wildfires through private property maintenance	3
	Promote and incentivize fire safe practices and behaviors through public outreach	2
Climate Driver: Flooding; Impact: Access	Understand where greatest risk to transport networks exist and address vulnerabilities through tracking vulnerabilities	3
	Reduce road use and development along coast through Green Infrastructure/Low Impact Design	6
	Ensure road construction appropriately manages storm water to allow for road access through countywide planning	19
	Reduce coastal development to protect properties from flood damage through countywide planning	4
	Reduce the increased risk of roads flooding due to runoff through Green Infrastructure/Low Impact Design and mapping/local codes	21
Climate Driver: Flooding; Impact: Property Damage	Maintain accurate flood-risk information	2
Climate Driver: Flooding; Impact: Injury and Death	Increase awareness of dangers of flooding	2
Climate Driver: Extreme Cold; Impact: Cold Illness	Increase awareness of impacts of extreme cold events on resident health	1
	Enhance stability of energy service during cold weather through energy system enhancements	11
	Increase availability of warming centers during extreme cold events	11
	Reduce exposure to extreme cold temperatures inside homes through weatherization	6
Climate Driver: Extreme Cold; Impact: Frozen Pipes	Increase residential awareness of pipes freezing	5
	Total	127

Appendix B: Implementation Prioritization Workshop Results

Figure 2: Full vote count for climate and health adaptation goals presented at January 29, 2019 Implementation Prioritization Workshop

Water Related		
	Goal	Votes
Climate Driver: Flooding; Impact: Water Quality	Protect water quality by reducing runoff pollutants through Green Infrastructure/Low Impact Design	20
	Protect well-sourced drinking water from increased risk of groundwater contamination through mapping/local codes	24
	Reduce beach contamination by reducing contamination sources upstream	9
	Protect surface and groundwater from septic contamination though strengthening septic systems and countywide coordination	7
Climate Driver: Flooding; Impact: Environmental Exposures	Educate public on how to avoid exposure to mold and waterborne diseases through outreach	5
Climate Driver: Drought; Impact: Depleting Aquifers	Increase water conservation behaviors among residents, local government and businesses	12
	Amass information needed to craft policies to address depleted aquifers from drought conditions	3
	Utilize low cost infrastructure measures to reduce loss of water in drinking water sources	3
	Increase higher density living options through supporting smart growth	6
	Total	89

	Total Votes	**319**

Appendix C: Working Group Members

Working groups of experts from the community worked together to complete the details of the Implementation Action Plan. Below are the members of each working group.

Vector Awareness

Group Leader: Patrick Jacuzzo

Members:

Cecelia Brown – Mining Journal

David Nelson – City of Negaunee

Patrick Jacuzzo – Marquette County Health Department

Judy Vonck – Community Foundation Marquette County

Teresa Frankovich – Marquette County Health Department

Michela Morgan – City of Marquette Township

Robert Kulisheck – CATF and Marquette Board of Health

Scott Erbisch – Marquette County and CATF

Air Quality

Group Leader: Brad Neumann

Members:

Izaak Peterson - Marquette Township

Jes Thompson—NMU

Kevin L. Piggott

Nich Leach

Nate Heffrow—City of Negaunee

Kirk Page—Marquette Township

Dave Stensaas—City of Marquette

Emergency Response/ Extreme Events

Group Leader: Jerry Messana

Members:

Joe Valente—Marquette County Road Commission

Matt Zika—National Weather Service

Emily Stack—Marquette County Health Department

Jenn Hill—City of Marquette

Lowell Larson—Marquette Community Foundation

Darlene Walch—Sands Township

Water Related

Group Leader: Emily Leach

Members:

Gail Anthony- Community Foundation of Marquette County

Greg Seppanen- CATF, Marquette County Planning Commission

Dotti LaJoy- CUPPAD

Ryan Soucy- CUPPAD

Lauren Luce– Marquette County Planning staff

Char Spruce– Marquette County Planning staff

Sean Soucy-DEQ Staff

Jim Iwanaki- Rd. Commission

Dale Thornton- Chocolay Township Planner

Jaimi Cawley– Marquette County Conservation District Manager

Mike Ferrell- Drain Commissioner

Katie Barglind- Gov. Whitmer Representative

Curt Goodman- City of Marquette

Mike Springer- Marquette Township

Appendix D: References

Throughout the development of this document, the following publicly available local plans, current practices guides, comparable community plans, and national guidelines were referenced in order to create the recommendations and policy interventions noted in this guidebook.

Nationwide

- American Planning Association (APA) (Healthy Plan Making, American Planning Association (APA) (n.d.) *Healthy Plan Making*. Washington, D.C.: American Planning Association. Available at https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/Healthy-Plan-Making.pdf (Accessed 27 July 2018).

- Anderson H, Brown C, Cameron LL, Christenson M, Conlon KC, Dorevitch S, Dumas J, Eidson M, Ferguson A, Grossman E, Hanson A, Hess JJ, Hoppe B, Horton J, Jagger M, Krueger S, Largo TW, Losurdo GM, Mack SR, Moran C, Mutnansky C, Raab K, Saha S, Schramm PJ, Shipp-Hilts A, Smith SJ, Thelen M, Thie L, Walker R. BRACE Midwest and Southeast Community of Practice. (2017) *Climate and Health Intervention Assessment: Evidence on Public Health Interventions to Prevent the Negative Health Effects of Climate Change. Climate and Health Technical Report Series. Climate and Health Program, Centers for Disease Control and Prevention.* Available at https://www.cdc.gov/climateandhealth/docs/ClimateAndHealthInterventionAssessment_508.pdf (Accessed 27 July 2018).

- Brown, I. Martin-Ortega, J., Waylen, K. & Blackstock, K. (2016) Participatory scenario planning for developing innovation in community adaptation responses: three contrasting examples from Latin America. *Regional Environmental Change*, 16, 1685-1700

- Centers for Disease Control and Prevenion (CDC) (2010) *Community Gardens*. Available at https://www.cdc.gov/healthyplaces/healthtopics/healthyfood/community.htm (Accessed 25 August 2018).

- Centers for Disease Control and Prevenion (CDC) (2014) *Climate Effects on Helth*. Available at https://www.cdc.gov/climateandhealth/effects/default.htm (Accessed 20 May 2019).

- Centers for Disease Control and Prevention (CDC) (2018) *Ticks: Preventing Ticks in the Yard*. Available at https://www.cdc.gov/ticks/avoid/in_the_yard.html (Accessed 27 July 2018).

- City of Philadelphia (2014) *Green Streets Design Manual*. Available at http://www.phillywatersheds.org/img/GSDM/GSDM_FINAL_20140211.pdf (Accessed 16 August 2018).

- The Connecticut Agricultural Experiment Station (2007) *Tick Management Handbook*. New Haven: Connecticut Agricultural Experiment Station. Available at http://www.ct.gov/caes/lib/caes/documents/publications/bulletins/b1010.pdf (Accessed 27 July 2018).

- Crawford, P., Beyea, W., Bode, C., Doll, C. & Menon, R. (2018) 'Creating climate change adaptation plans for rural coastal communities using Deliberation and Analysis as public participation for social learning', *The Town Planning Review,* 89(3), 283-304.

- European Climate Adaptation Platform (Climate-ADAPT) (2018) *Urban Farming and Gardening*. Available at https://climate-adapt.eea.europa.eu/metadata/adaptation-options/urban-farming-and-gardening (Accessed 17 August 2018).

- Few, R., Brown, K., & Tompkins, E. (2007) 'Public Participation and climate change adaptation: avoiding the illusion of inclusion', *Climate Policy*, 7, 46-59

- Firth, C., Maye, D. & Pearson, D. (2011) 'Developing "community" in community gardens', *Local Environment,* 16(6), 555-568.

Appendix D: References

Nationwide

- Gray, S., Jordan, R., Crall, A., Newman, G., Hmelo-Silver, C., Huang, J., Novak, W., Mellor, D., Frensley, T., Prysby, M., & Singer, A. (2017) 'Combining participatory modelling and citizen science to support volunteer conservation action', *Biological Conservation*, 2008, 76-86

- Henly-Shepard, S. Gray, S., & Cox, L. (2015) 'The use of participatory modeling to promote social learning and facilitate community disaster planning', *Environmental Science and Policy*, 45, 109-122

- International Renewable Energy Agency (2017). *Renewable Power: Sharply Falling Generation Cost*. Available at https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Nov/%20IRENA_Sharply_falling_costs_2017.pdf (Accessed August 15, 2018).

- Lempert, R., J. Arnold, R. Pulwarty, K. Gordon, K. Greig, C. Hawkins Hoffman, D. Sands, and C. Werrell, 2018: Reducing Risks Through Adaptation Actions. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 1309–1345. doi: 10.7930/NCA4.2018.CH28 (Accessed May 24, 2019)

- Manangan AP, Uejio CK, Saha S, Schramm PJ, Marinucci GD, Brown CL, Hess JJ, Luber G. "Assessing health vulnerability to climate change: A guide for health departments" Climate and Health Technical Report Series, 2014. https://www.cdc.gov/climateandhealth/pubs/AssessingHealthVulnerabilitytoClimateChange.pdf (Accessed September 12, 2019).

- National Association of City Transportation Officials (NACTO)(n.d.) *Urban Bikeway Design Guide*. Available at https://nacto.org/publication/urban-street-design-guide/ (Accessed 28 July 2018).

- National Association of City Transportation Officials (NACTO)(n.d.) *Urban Street Design Guide: Speed Management*. Available at https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/speed-management/ (Accessed 17 August 2018).

- National Association of City Transportation Officials (NACTO)(n.d.) *Urban Street Storm water Guide: Hybrid Bioretention Planter* Available at https://nacto.org/publication/urban-street-stormwater-guide/stormwater-elements/green-stormwater-elements/hybrid-bioretention-planter/ (Accessed 17 August 2018).

- National Fire Protection Association (2018) *Firewise USA*. Available at https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA (Accessed 17 August 2018).

- National Oceanic and Atmospheric Administration (NOAA) (2018) *Storm Events Database*. Available at https://www.ncdc.noaa.gov/stormevents/ (Accessed 29 August 2018).

- Roseen, R, Ballestero, P, Houle, K, Heath, D, & Houle, J, (2014) 'Assessment of Winter Maintenance of Porous Asphalt and Its Function for Chloride Source Control', *Journal of Transportation Engineering*, 140. (Accessed August 15, 2018).

- State of Oregon Department of Environmental Quality (2017) *Drinking Water Protection: Using an Ordinance or Overlay*. Available at http://www.oregon.gov/deq/FilterDocs/DWPOrdinanceOverlay.pdf (Accessed 26 August 2018).

- U.S. Department of Energy Better Buildings Solution Center (2017) *On-Site Energy Storage Decision Guide*. Available at https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/BB%20Energy%20Storage%20Guide.pdf (Accessed August 17, 2018).

- United States Environmental Protection Agency (USEPA) (2009) *Managing Stormwater with Low Impact Development Practices: Addressing Barriers to LID*. New England: USEPA. Available at https://www3.epa.gov/region1/npdes/stormwater/assets/pdfs/AddressingBarrier2LID.pdf (Accessed 26 July 2018).

Appendix D: References

Nationwide

- United States Environmental Protection Agency (USEPA) (2012a) *Benefits of Low Impact Development: LID can protect your community's resources*. Washington, D.C.: USEPA. Available at https://www.epa.gov/sites/production/files/2015-09/documents/bbfs1benefits.pdf (Accessed 16 August 2018).

- United States Environmental Protection Agency (USEPA) (2012b) *Costs of Low Impact Development: LID saves money and protects your community's resources*. Washington, D.C.: USEPA. Available at https://www.epa.gov/sites/production/files/2015-09/documents/bbfs3cost.pdf (Accessed 30 July 2018).

- United States Environmental Protection Agency (USEPA) (2012c) *Encouraging Low Impact Development*. Washington, D.C.: USEPA. Available at https://www.epa.gov/sites/production/files/2015-09/documents/bbfs7encouraging.pdf (Accessed 26 July 2018).

- United States Green Building Council (2016) *Benefits of Green Building*. Available at https://www.usgbc.org/articles/green-building-facts (Accessed 17 August 2018).

- United States Environmental Protection Agency (USEPA) (2016) *Strategic Plan for School Integrated Pest Management*. Available at https://www.epa.gov/sites/production/files/2016-02/documents/2016-2017_school_ipm_strategic_plan.pdf (Accessed 27 July 2018).

- United States Environmental Protection Agency (USEPA) (2018a) *Green Infrastructure*. Available at https://www.epa.gov/green-infrastructure. (Accessed August 17, 2018).

- United States Global Change Research Program (USGCRP) (2018) *U.S. Climate Resilience Toolkit*. Available at https://toolkit.climate.gov/ (Accessed May 23, 2019).

- United States Environmental Protection Agency (USEPA) (2018b) *Smart Growth and Climate Change*. Available at https://www.epa.gov/smartgrowth/smart-growth-and-climate-change (Accessed 27 July 2018).

- United States Office of Energy Efficiency & Renewable Energy (EERE) (2017). *Let it Snow: How Solar Panels Can Thrive in Winter Weather*. Available at https://www.energy.gov/eere/articles/let-it-snow-how-solar-panels-can-thrive-winter-weather (Accessed August 15, 2018).

- Washington State Department of Ecology (2005). *Critical Aquifer Recharge Areas Guidance Document*. Available at https://fortress.wa.gov/ecy/publications/documents/0510028.pdf Accessed August 31, 2018).

- Wyckoff, M. A., Neumann, B., Pape, G., Schindler, K., Michigan State University., & MIplace (Organization) (2015). *Placemaking as an economic development tool: A placemaking guidebook*. Available at http://www.canr.msu.edu/resources/pmedtguidebook (Accessed August 15, 2018).

Regional/Statewide/Michigan Case Studies

- Adamus, Anne (2008) 'The A. Alfred Taubman Student Services Center at Lawrence Technological University', The Review (Michigan Municipal League) 81(3). May/June, p. 23.

- City of Bay City (2017) *City of Bay City, Michigan Master Plan 2017*. Available at https://www.baycitymi.org/DocumentCenter/View/1639/Bay-City-Master-Plan (Accessed 27 July 2018).

- City of Flint (2013) *Imagine Flint: Master Plan for a Sustainable Flint*. Flint: City of Flint. Available at http://imagineflint.com/Documents.aspx (Accessed 27 July 2018).

- City of Hancock (2017) *Hancock Master Plan*. Available at http://www.cityofhancock.com/docs/City_of_Hancock_Master_Plan.pdf (Accessed 27 July 2018).

- City of Trenton (2017) *Trenton Coast Resilience Master Plan*. Available at http://www.trentoncoast.bria2.net/wp-content/uploads/2018/01/Trenton-Coast-Resiliency-Master-Plan-FINAL-DRAFT-09112017_small.pdf (Accessed 27 July 2018).

Appendix D: References

Regional/Statewide/Michigan Case Studies

- Delta Institute (2017) *Muskegon Lake Resiliency Plan.* Available at https://muskegonlake.org/documents/Muskegon-Lake_Resiliency-Plan.pdf (Accessed 27 July 2018).

- Fair, David (Host). (August 28, 2015). Issues Of The Environment: Ecological Benefits Of Washtenaw County Rain Gardens [Radio Broadcast Episode]. Available at http://www.wemu.org/post/issues-environment-ecological-benefits-washtenaw-county-rain-gardens (Accessed 17 August 2018).

- Great Lakes Integrated Sciences and Assessments (GLISA), Extreme Precipitation. Available at http://glisa.umich.edu/climate/extreme-precipitation (Accessed 30 November 2018).

- Great Lakes Integrated Sciences and Assessments (GLISA) (Great Lakes Climate Divisions), Wester Upper Michigan. Available at http://glisa.umich.edu/division/mi01 (Accessed 19 September 2018).

- Land Information Access Association (LIAA) and Beckett & Raeder, Inc. (2017) *Planning for Community Resilience in Michigan: A Comprehensive Handbook*. Available at http://www.resilientmichigan.org/downloads/michigan_resiliency_handbook_web.pdf (Accessed 28 July 2018).

- Land Policy Institute (2012) *Rural Water Quality Protection Guidebook: A Planning & Zoning Guidebook for Local Officials*. East Lansing: Michigan State University. Available at http://www.canr.msu.edu/landpolicy/uploads/files/Resources/Publications__Presentations/Books/GLRI/2012/Rural_Water_Quality_Protection_Guidebook/ruralwaterqualityprotection_glrigdbk_lpi_december2012_chapter1intro.pdf (Accessed 27 July 2018).

- Michigan Department of Health and Human Services (MDHHS) (2018) Michigan Behavioral Risk Factor Surveillance System. Available at http://www.michigan.gov/brfs (Accessed August 28, 2018)

- Michigan Department of Health and Human Services (MDHHS) (2016) Michigan Climate and Health Adaptation Program (MICHAP) Strategic Plan Update: 2016-2021. Available at https://www.michigan.gov/documents/mdhhs/MICHAP_Strategic_Plan_update_final_10_4_537461_7.pdf (Accessed 7 December 2018).

- Michigan Department of Health and Human Services (MDHHS) & Great Lakes Integrated Sciences Assessment Program (GLISA) (2015) *Michigan Climate and Health Profile Report 2015: Building Resilience Against Climate Effects on Michigan Health*. Available at https://www.michigan.gov/documents/mdhhs/MI_Climate_and_Health_Profile_517517_7.pdf (Accessed 27 July 2018).

- National Oceanic and Atmospheric Administration (NOAA) (2013) *Great Lakes Coastal Resilience Planning Guide.* Available at http://greatlakesresilience.org/ (Accessed 27 July 2018).

- Office of the Washtenaw County Water Resources Commissioner (2018) *Rain Gardens.* Available at https://www.washtenaw.org/647/Rain-Gardens (Accessed 17 August 2018).

- Southeast Michigan Council of Governments (2008) *Low Impact Development: A Design Guide for Implementers and Reviewers*. Available at https://semcog.org/Reports/LID/files/assets/basic-html/page-1.html (Accessed August 17, 2018),

- Village of Sebewaing (2017) *Village of Sebewaing Resiliency Plan*. Sebewaing: Village of Sebewaing

Appendix D: References

Marquette Area (Local)

- Central Upper Peninsula Planning and Development (n.d.) *Priorities in Climate Adaptation Plans 2011-2016*. Available at http://www.centralupdashboard.org/wp-content/uploads/2017/04/ClimateAdaptationCentralUP.pdf (Accessed 28 July 2018).

- City of Marquette, MI (2015) *City of Marquette Community Master Plan*. Available at https://marquettemi.gov/wp-content/uploads/2017/07/master_plan.pdf (Accessed 28 July 2018).

- County of Marquette (n.d.) *Marquette County Hazard Mitigation* Plan. Available at http://www.co.marquette.mi.us/departments/planning/hazard_mitigation_plan.php (Accessed 28 July 2018).

- King, H., & Thaler, T., Griffith, G., Crossett, T., Rasker, R. (Eds). (2013) *Forest and Water Climate Adaptation: A Plan for Marquette County, Michigan*. Sagle: Model Forest Policy Program in association with Common Waters Partnership, Pinchot Institute for Conservation the Cumberland River Compact and Headwaters Economics. Available at http://www.superiorwatersheds.org/images/Marquette_CAP.pdf (Accessed 28 July 2018).

- Marquette County Community Health Assessment Team (2012) *Marquette County Community Health Assessment & Improvement Process*. Available at http://www.co.marquette.mi.us/departments/health_department/community_health/docs/Comm_Health_Assessment___Improvement_Process.pdf (Accessed 28 July 2018).

- Marquette County Forestry Commission (2011) *Marquette County Forest Management Plan*. Available at http://www.co.marquette.mi.us/departments/planning/docs/FMP_adopted_10_05_11.pdf (Accessed 28 July 2018).

- Marquette County Health Department (2013) *Health Department*. Available at http://www.co.marquette.mi.us/departments/health_department/index.php (Accessed 28 July 2018).

- Marquette County Health Department (2013) *Maternal/Infant Health Program*. Available at http://www.co.marquette.mi.us/departments/health_department/community_health/family_support_services/maternal_infant_health_program.php (Accessed 28 July 2018).

- Marquette County Resource Management Department, Planning Division (2014) *Marquette County Community Wildfire Protection Plan*. Available at http://www.co.marquette.mi.us/departments/planning/docs/Marquette_County_Community_Wildfire_Protection_Plan__revised.pdf (Accessed 28 July 2018).

- Michigan State University Extension (2013) *Adaption to Climate Change and Variability*. Available at http://www.superiorwatersheds.org/images/City_Marquette_Climate_Plan.pdf (Accessed 31 July 2018).

- Resource Management and Development Department, Planning, Community Development, Forestry, & Recreation Division, Marquette County, MI. (2010) *Zoning Plan: Chapter of the Marquette County Comprehensive Plan*. Available at http://www.co.marquette.mi.us/departments/planning/docs/Local_Zoning_Analysis.pdf (Accessed 28 July 2018).

- Superior Watershed Partnership (2013) *Climate Adaptation Plan for Marquette County, Michigan*. Available at http://www.superiorwatersheds.org/images/Marquette_CAP.pdf Accessed 31 July 2018).

- Superior Watershed Partnership (2012) *Lake Superior Climate Adaptation Mitigation and Implementation Plan*. Available at http://www.superiorwatersheds.org/images/climate-jan.pdf (Accessed 28 July 2018).

Appendix E: Expert Resources for Further Information

Overall
- Planning for Community Resilience in Michigan: A Comprehensive Handbook - http://www.resilientmichigan.org/downloads/michigan_resiliency_handbook_web.pdf

- NOAA: Great Lakes Coastal Resilience Planning Guide - http://greatlakesresilience.org/

- Urban Sustainability Directors Network Innovation Products on Climate Change Resilience - https://www.usdn.org/public/page/18/Climate-Change-Resilience

Regional Climate Change Predictions
- Great Lakes Integrated Science and Assessment Center (GLISA)—http://glisa.umich.edu/

- National Oceanic and Atmospheric Administration (NOAA)—http://www.noaa.gov/

Vector-Borne Disease
- Center for Disease Control and Prevention (CDC) National Center for Emerging and Zoonotic Infectious Disease (NCEZID) Division of Vector-Borne Diseases (DVBD)—https://www.cdc.gov/ncezid/dvbd/index.html

Wildfires
- National Fire Protection Association - Firewise - https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA

- US Forest Service - https://www.fs.fed.us/

Air Quality
- Michigan Department of the Environment, Great Lakes and Energy - Air Quality - https://www.michigan.gov/egle/0,9429,7-135-3310---,00.html

Extreme Rainfall
- Naturally Resilient Communities - http://nrcsolutions.org/strategies/?fwp_hazards=coastal#solutions

- USEPA Green Infrastructure - https://www.epa.gov/green-infrastructure

Extreme Heat
- USEPA Reduce Urban Heat Island Effect - https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect#resources

- USEPA Green Infrastructure - https://www.epa.gov/green-infrastructure

Water Quality
- Michigan Department of the Environment, Great Lakes and Energy Wellhead Protection Zones - https://www.michigan.gov/egle/0,9429,7-135-3313_3675_3695---,00.html and SepticSmart - https://www.michigan.gov/egle/0,4561,7-135-3313_71618_51002-455688--,00.html
- Michigan Climate and Health Adaptation Program Managing Water for Health in a Changing Climate - https://www.managingwaterforhealth.org/wp-content/uploads/Managing_Water_for_Health_March-5.pdf
- USEPA Green Infrastructure - https://www.epa.gov/green-infrastructure

- NACTO Urban Street Stormwater Guide - https://nacto.org/publication/urban-street-stormwater-guide/stormwater-elements/green-infrastructure-configurations/

- MSU Land Policy Institute: Rural Water Quality Protection, A Planning and Zoning Guide for Local Officials - http://www.canr.msu.edu/landpolicy/uploads/files/Resources/Publications__Presentations/Books/GLRI/2012/Rural_Water_Quality_Protection_Guidebook/ruralwaterqualityprotection_glrigdbk_lpi_december2012_chapter1intro.pdf

Energy
- Michigan Energy Office community energy guidance and funding opportunities - https://www.michigan.gov/energy/0,4580,7-364-85452_86924_86925---,00.html

- Planning for Community Resilience in Michigan: A Comprehensive Handbook - http://www.resilientmichigan.org/downloads/michigan_resiliency_handbook_web.pdf

Placemaking
- Michigan Municipal League - http://placemaking.mml.org/

- Michigan State University - https://www.canr.msu.edu/resources/pmedtguidebook

- Project for Public Spaces - https://www.pps.org/