WAUKESHA COUNTY

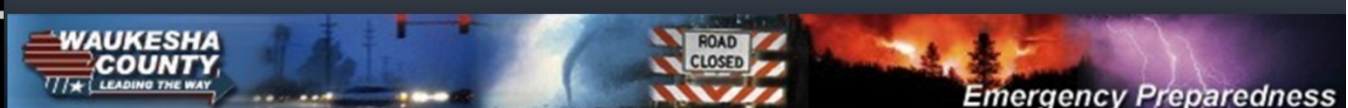
ALL HAZARD MITIGATION PLAN

2021

WAUKESHA COUNTY
ALL HAZARD MITIGATION PLAN

DRAFT

Public Version



WAUKESHA COUNTY, WISCONSIN
HAZARD MITIGATION PLAN

PREPARED BY:
WAUKESHA COUNTY HAZARD MITIGATION STEERING COMMITTEE
WAUKESHA COUNTY OFFICE OF EMERGENCY MANAGEMENT
WAUKESHA COUNTY COMMUNITIES

Public Review Comment Instructions:

This plan was developed using the County's online planning system, and the most complete and updated version of the plan resides on the system. County and municipality stakeholders and representatives have been granted access to the system and can make comments and provide feedback, as appropriate. (**https://waukeshacounty.isc-cemp.com**)

This version was adapted and modified to provide a PDF version of the plan for those who do not have access to the online planning system.

Pursuant to Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process

Feedback and Comments can be directed to:

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ggoodchild@waukeshacounty.gov

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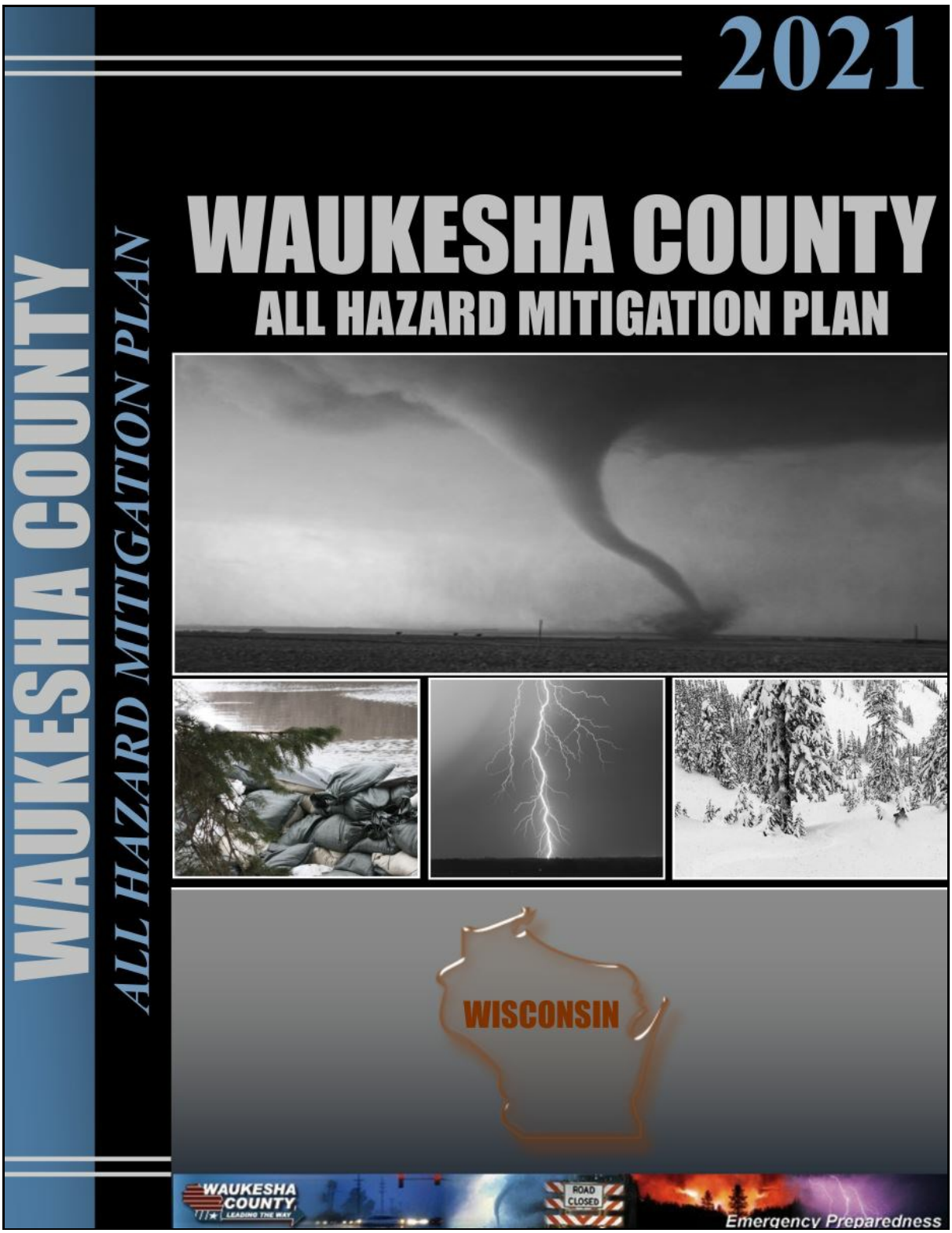
1 Volume 1: Waukesha County Hazard Mitigation Plan 2021



1.1 Introduction and Overview

WAUKESHA COUNTY, WISCONSIN

HAZARD MITIGATION PLAN

PREPARED BY:

WAUKESHA COUNTY HAZARD MITIGATION STEERING COMMITTEE

WAUKESHA COUNTY OFFICE OF EMERGENCY MANAGEMENT

WAUKESHA COUNTY COMMUNITIES

ADOPTED [INSERT DATE]

BY THE WAUKESHA COUNTY BOARD OF SUPERVISORS

I. Introduction and Overview

The Waukesha County Hazard Mitigation Plan is intended to provide strategies for reducing susceptibility to future damage to public and private infrastructure in the county. The procedures utilized in preparing this plan are based on guidance provided by FEMA and WEM and should therefore be considered consistent with the requirements and procedures in the Disaster Mitigation Act of 2000.

Section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (P.L. 93-228, as amended) is the impetus for involvement of state and local governments in evaluating and mitigating natural hazards as a condition of receiving federal disaster assistance. The Federal Emergency Management Agency (FEMA) has rules in 44 CFR Part 206 Subpart M for implementing Section 409.

Section 409 states that the county is obligated to try to reduce any hazard that has received relief funding in the past. Developing a hazard mitigation plan provides an opportunity for communities to meet this requirement by developing strategies for the reduction of potential losses from future natural disasters. Hazard mitigation planning is the process of developing a set of actions designed to reduce or eliminate long-term risk to people and property from hazards and their effects. Completion of this plan should put Waukesha County in an advantageous position when competing for pre-and post-disaster mitigation project dollars because projects have been pre-identified. The cooperation of government, private and volunteer agencies is essential in mitigation efforts and over the long term it is hoped that implementation of this plan will save taxpayer dollars because less money is needed for post-disaster recovery activities. Furthermore, mitigation planning measures incorporated in economic or community development goals support more comprehensive and effective government. This plan evaluates the risks that all natural hazards pose to the citizens and property of Waukesha County by presenting:

- A profile and analysis of past hazardous events
- An assessment of vulnerability of community assets
- Potential hazard mitigation strategies
- Methods for building community support and ensuring plan adoption

Plan Overview

The Waukesha County Hazard Mitigation Plan provides background information on Waukesha County and identifies those hazards that have occurred or could occur in the county. It includes a description of each hazard, its frequency of occurrence, appropriate actions in case of emergency and possible steps to mitigate the hazard. These hazards are the basis for the development of all county emergency plans.

A well-prepared plan allows emergency management to act swiftly and efficiently in the event of a hazard, reducing the damage and the cost incurred from displacing residents and businesses. Hazard mitigation activities will be emphasized in the plan as a major component of overall emergency management. The plan is intended to provide strategies for reducing future damages to public and private infrastructure in the county, including flood damage.

Standard:

- Wisconsin Emergency Management (WEM) Mitigation Standard 2015; Element D Plan Review, Evaluation, and Implementation (UPDATES ONLY)
  - D1. Was the Plan revised to reflect changes in development? 44 CFR 201.6(d)(3)
    - D1.1. Changes in development in hazard prone areas that increased or decreased the vulnerability of each jurisdiction
    - D1.2. If no changes in development impacted the jurisdiction's vulnerability, validate the information in the previous plan

1.2 Plan Adoption

II. Plan Adoption

Waukesha County, Wisconsin

All Hazard Mitigation Plan

Plan Update:

Year: 2021

Prepared for:

Waukesha County Office of Emergency Management

1621 Woodburn Road

Waukesha, WI 53188

Standard:

- ***Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element E: Plan Adoption***
  - ***After FEMA issues their "meets requirements" letter, each participating jurisdiction must adopt the Plan within one year and submit an adoption resolution to WEM and FEMA for final plan approval.***
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Prerequisites
  - 1. Adoption by the Local Governing Body; Requirement §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).
    - 1.A. Has the local governing body adopted new or updated plan?
    - 1.B. Is supporting documentation, such as a resolution, included?

1.2.1 Promulgation and Adoption

Promulgation and Adoption will be added upon FEMA approval and formal adoption by each participating jurisdiction.

No	Jurisdiction	Date of Signed HMP Ordinance/Resolution Received by County Emergency Management	FEMA Approved	Documentation
01	Waukesha County		Date	Waukesha County Ordinance

Waukesha County Office of Emergency Management
1621 Woodburn Road, Waukesha, WI 53188
Telephone (262) 548-7580 | emergencymanagement@waukesha.gov

1.3 Plan Development & Planning Process

III. Plan Development & Planning Process

All citizens and businesses of Waukesha County are the ultimate beneficiaries of this hazard mitigation plan update. The plan reduces the risk for those who live in, work in, and visit the County. It provides a viable planning framework for the foreseeable hazards that may impact the County. Participation in the development of the plan by key stakeholders in the County helped ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable countywide, and the plan's goals and recommendations can lay the groundwork for the development and implementation of local mitigation activities and partnerships.

This section provides the efforts undertaken to develop/update the Plan, and a detailed description of the process.

Standard:

- Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element A: Planning Process
  - A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? 44 CFR 201.6(c)(1). Involved in the process means engaged as participants and given the chance to provide input affecting the Plan's content; plan updates must include documentation of the current planning process.
    - A1.1. Schedule or timeframe of activities that made up the Plan's development

- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Planning Process; §201.6(b): An open public involvement process is essential to the development of an effective plan.
  - 4. Document the Planning Process; Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved
    - 4.A. Does the plan provide a narrative description of the process followed to prepare the new or updated plan?
    - 4.F. Does the updated plan document how the planning team reviewed and analyzed each section of the plan and whether each section was revised as part of the update process?

1.3.1 The Previous Plan

2011 and 2016 Hazard Mitigation Plan

The Waukesha County All Hazard Mitigation Plan was updated, approved, and adopted in 2011 and 2016. It contains information relative to the hazards and vulnerabilities facing Waukesha County, Wisconsin. The jurisdictions participating in this previous Plan included those incorporated jurisdictions within the County.

As a requirement of the Disaster Mitigation Act of 2000, this plan is updated every five years.

Ongoing Planning Efforts

The Waukesha County Emergency Management has completed and regularly updates the Waukesha County Hazard Analysis. This Hazard Analysis identifies all likely natural and technological hazards that might or have occurred within the County.

1.3.1.1 Why Update

Title 44 of the Code of Federal Regulations (44 CFR) stipulates that hazard mitigation plans must present a schedule for monitoring, evaluating, and updating the plan. This provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and determine if there is a need to change the focus of mitigation strategies. A jurisdiction covered by a plan that has expired is not able to pursue elements of federal funding under the Robert T. Stafford Act for which a current hazard mitigation plan is a prerequisite.

1.3.1.2 The Updated Plan and the Key Differences

The previous plan has been improved for Waukesha County using the best available data and from feedback by key stakeholders. All participating municipalities were fully involved in the preparation of the plan. The updated plan includes an updated hazard analysis. Mitigation initiatives were reviewed and amended, as appropriate. Emphasis was placed on reducing redundancy and to include those initiatives that were deemed feasible, practical and implementable.

Key changes include, but are not limited to:

- The update recommends **108** new mitigation initiatives and **88** updated mitigation actions that are either in-progress or are ongoing.
- The plan also documents **23** completed mitigation actions since the last update.

1.3.2 Plan Organization

This plan includes all federally required elements of a disaster mitigation plan:

- A description of the planning process
- The public involvement strategy
- A list of goals and objectives
- A countywide hazard risk assessment
- Countywide mitigation initiatives
- A plan maintenance strategy

This plan has been set up in two volumes so that elements that are jurisdiction-specific can easily be distinguished from those that apply to the whole planning area:

- **Volume 1** includes all federally required elements of a disaster mitigation plan that apply to the entire planning area. This includes the description of the planning process, public involvement strategy, goals and objectives, countywide hazard risk assessment, mitigation strategy, and a plan maintenance strategy. The following appendices at the end of Volume 1 include information or explanations to support the main content of the plan:
  - Appendix A - Notice of Endorsement & Adoption
  - Appendix B - Public Outreach & Participation
  - Appendix C - Mitigation Project Examples
  - Appendix D - Federal Funding Sources and Programs
  - Appendix E - Benefit-Cost Analysis Guidance
  - Appendix F - Acronyms and Definitions

- **Volume 2** includes all federally required jurisdiction-specific elements, in annexes for each participating jurisdiction.

All planning partners will adopt Volume 1 in its entirety and their respective jurisdiction-specific annex within (Volume 2).

1.3.3 Plan Use

The Plan should be used to help County and participating City officials plan, design, and implement programs and projects that will help reduce the jurisdictions vulnerability to natural, technological, and man-made hazards. The Plan should also be used to facilitate inter- jurisdiction coordination and collaboration related to all hazard mitigation planning and implementation within the County and at the Regional level. Lastly, the Plan should be used to develop or provide guidance for local emergency response planning. If adopted, this Plan will achieve compliance with the Disaster Mitigation Act of 2000 (DMA 2000).

1.3.4 Plan Purpose

The primary focus of the Plan is to evaluate the County's potential exposure to natural and manmade disasters and identify appropriate mitigation strategies.

The purposes of this Plan are to:

- Fulfill Federal and local mitigation planning responsibilities
- Promote pre- and post-disaster mitigation measures with short/long range strategies to minimize suffering, loss of life, impact on traditional culture, and damage to property and the environment
- Eliminate or minimize conditions that would have an undesirable impact on the people, culture, economy, environment, and well-being of the County at large.
- Enhance elected officials', departments', and the public's awareness of the threats to the community's way of life, and of what can be done to prevent or reduce the vulnerability and risk.

1.3.5 Scope

Although DMA 2000 only requires local governments to address natural hazards, the County decided it was imperative to address all hazards, including technological and political hazards.

1.3.6 Legal Authority

Federal legislation has historically provided funding for disaster relief, recovery, and some hazard mitigation planning. The Disaster Mitigation Act of 2000 (DMA 2000) is the latest legislation to improve this planning process (Public Law 106-390). The new legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. As such, DMA 2000 establishes a pre-disaster hazard mitigation program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP).

Section 322 of DMA 2000 specifically addresses mitigation planning at the state and local levels. It identifies new requirements that allow HMGP funds to be used for planning activities, and increases the amount of HMGP funds available to states that have developed a comprehensive, enhanced mitigation plan prior to a disaster. States and communities must have an approved mitigation plan in place prior to receiving post-disaster HMGP funds. Local and tribal mitigation plans must demonstrate that their proposed mitigation measures are based on a sound planning process that accounts for the risk to and the capabilities of the individual communities.

FEMA prepared an Interim Final Rule, published in the Federal Register on February 26, 2002 (44 CFR Parts 201 and 206), which establishes planning and funding criteria for states and local communities. For disasters declared after November 1, 2004 a local government must have a Local Hazard Mitigation Plan (LHMP) approved per section 201.6, in order to receive Federal HMGP project grants.

1.3.7 The Planning Area: Participating Jurisdictions and Organizations

The Waukesha County Hazard Mitigation Plan is a multi-jurisdictional plan that encompasses all incorporated and unincorporated jurisdictions within the County.

All participating jurisdictions in Waukesha County were actively involved in the planning process.

- The steering committee included representation from the different jurisdictions in the County.
- Invitations and meeting notices were sent to representatives from participating jurisdictions
- Jurisdictional representatives were given the opportunity to comment real-time with the plan development process via the online planning system
- Additional follow-up contacts were made with local jurisdictions and their representatives, as needed. In the Summer and Fall of 2021, a request to review mitigation actions/projects was issued to the various jurisdictions and their representatives.

The planning area was defined to consist of all of Waukesha County. All partners to this plan have jurisdictional authority within this planning area. Adopting resolutions for all of the jurisdictions are in Appendix A: Notice of Endorsement & Adoption. Specific plan participation activities for each jurisdiction are documented in Volume II.

Participating Jurisdictions			
No	**Jurisdiction**	**Involvement**	**Authority to Regulate Development**
01	Waukesha County	Meetings; Mitigation Steering Committee Leadership; Mitigation Actions/Projects	Yes
02	Brookfield City	Meetings; Mitigation Actions/Projects	Yes
03	Delafield City	Meetings; Mitigation Actions/Projects	Yes
04	Muskego City	Meetings; Mitigation Actions/Projects	Yes
05	New Berlin City	Meetings; Mitigation Actions/Projects	Yes
06	Oconomowoc City	Meetings; Mitigation Actions/Projects	Yes
07	Pewaukee City	Meetings; Mitigation Actions/Projects	Yes
08	Waukesha City	Meetings; Mitigation Actions/Projects	Yes
09	Big Bend Village	Meetings; Mitigation Actions/Projects	Yes
10	Butler Village	Meetings; Mitigation Actions/Projects	Yes
11	Chenequa Village	Meetings; Mitigation Actions/Projects	Yes
12	Dousman Village	Meetings; Mitigation Actions/Projects	Yes
13	Eagle Village	Meetings; Mitigation Actions/Projects	Yes
14	Elm Grove Village	Meetings; Mitigation Actions/Projects	Yes
15	Hartland Village	Meetings; Mitigation Actions/Projects	Yes
16	Lac La Belle Village	Meetings; Mitigation Actions/Projects	Yes
17	Lannon Village	Meetings; Mitigation Actions/Projects	Yes
18	Menomonee Falls Village	Meetings; Mitigation Actions/Projects	Yes
19	Merton Village	Meetings; Mitigation Actions/Projects	Yes
20	Mukwonago Village	Meetings; Mitigation Actions/Projects	Yes
21	Nashotah Village	Meetings; Mitigation Actions/Projects	Yes
22	North Prairie Village	Meetings; Mitigation Actions/Projects	Yes
23	Oconomowoc Lake Village	Meetings; Mitigation Actions/Projects	Yes
24	Pewaukee Village	Meetings; Mitigation Actions/Projects	Yes
25	Summit Village	Meetings; Mitigation Actions/Projects	Yes
26	Sussex Village	Meetings; Mitigation Actions/Projects	Yes
27	Vernon Village	Meetings; Mitigation Actions/Projects	Yes
28	Wales Village	Meetings; Mitigation Actions/Projects	Yes
29	Waukesha Village	Meetings; Mitigation Actions/Projects	Yes
30	Brookfield Town	Meetings; Mitigation Actions/Projects	Yes
31	Delafield Town	Meetings; Mitigation Actions/Projects	Yes
32	Eagle Town	Meetings; Mitigation Actions/Projects	Yes
33	Genesee Town	Meetings; Mitigation Actions/Projects	Yes
34	Lisbon Town	Meetings; Mitigation Actions/Projects	Yes
35	Merton Town	Meetings; Mitigation Actions/Projects	Yes
36	Mukwonago Town	Meetings; Mitigation Actions/Projects	Yes
37	Oconomowoc Town	Meetings; Mitigation Actions/Projects	Yes
38	Ottawa Town	Meetings; Mitigation Actions/Projects	Yes
39	Lake Country Fire Dept	Meetings; Mitigation Actions/Projects	Yes
40	Eagle Springs Lake Management District	Meetings; Mitigation Actions/Projects	Yes
41	Western Lakes Fire District	Meetings; Mitigation Actions/Projects	Yes

Standard:

- Wisconsin Emergency Management (WEM) Mitigation Standard; Element A: Planning Process
  - A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? 44 CFR 201.6(c)(1). Involved in the process means engaged as participants and given the chance to provide input affecting the Plan's content; plan updates must include documentation of the current planning process.
    - A1.3. List of participating jurisdictions
    - A1.5. How each jurisdiction was involved
  - A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? 44 CFR 201.6(b)(2)
    - A2.1. List of stakeholders: local and regional agencies that take part in hazard mitigation activities

        - A2.2. List of stakeholders: agencies that have the authority to regulate development
        - A2.3. List of stakeholders: neighboring communities
        - A2.5. How each stakeholder was involved
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Prerequisites
    - 2. Multi-Jurisdictional Plan Adoption; Requirement §201.6(c)(5): For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.
        - 2.A. Does the new or updated plan indicate the specific jurisdictions represented in the plan?
    - 3. Multi-Jurisdictional Planning Participation; Requirement §201.6(c)(5): For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.
        - 3.A. Does the new or updated plan describe how each jurisdiction participated in the plan's development?
        - 3.B. Does the updated plan identify all participating jurisdictions, including new, continuing, and the jurisdictions that no longer participate in the plan?
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Planning Process; §201.6(b): An open public involvement process is essential to the development of an effective plan.
    - 4. Document the Planning Process; Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved
        - 4.D. Does the new or updated plan discuss the opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?

1.3.8 The Steering Committee

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. A steering committee was formed to oversee all phases of the plan. The members of this committee included key members from the participating jurisdictions, planning partner staff, and other stakeholders from within the planning area. The table below lists the committee members.

Hazard Mitigation Steering Committee Membership			
No	**Jurisdiction**	**Name**	**Title**
01	Waukesha County	Lisa Panas	Captain
02	Waukesha County	Rob Rauchle	Highway Manager
03	Waukesha County	Gary Bell	Director
04	Waukesha County	Jason Fruth	Planning and Zoning Manager
05	Waukesha County	Paul Decker	Chairman
06	Waukesha County	Gail Goodchild	Coordinator
07	Waukesha County	Kevin Kober	Program Analyst
08	Waukesha County	Alex Freeman	Planner
09	Town of Brookfield	Tom Hagie	Village Administrator
10	Town of Delafield	Matt Fennig	Fire Chief
11	Town of Eagle	Scott Kugel	Deputy
12	Town of Genesee	Joseph Osterman	Administrator
13	Town of Genesee	Tim Klink	Chairperson
14	Town of Mukwonago	Jeff Stien	Chief
15	Town of Oconomowoc	James Wallace	Chief
16	Town of Ottawa	Cheryl Rupp	Chairperson
17	Village of Big Bend	Donald Gaglione	Chief
18	Village of Butler	Patricia Tiarks	President
19	Village of Chenequa	Dan Neumer	Chief
20	Village of Dousman	Jack Nissen	President
21	Village of Dousman	Tim Meyer	Deputy Chief
22	Village of Eagle	Bruce Hein	Chief
23	Village of Elm Grove	David DeAngelis	Manager
24	Village of Hartland	Torin Misko	Chief
25	Village of Lac La Belle	George Stumpf	Administrator
26	Village of Lannon	Dan Bell	Chief
27	Village of Menomonee Falls	Eugene Neyhart	Captain
28	Village of Merton	Bruce Blawat	Trustee
29	Village of Mukwonago	Jeff Stien	Chief
30	Village of Nashotah	Matt Fennig	Chief
31	Village of North Prairie	Rhoda Bagley	Clerk
32	Village of Oconomowoc Lake	Andrew Helwig	Chief
33	Village of Pewaukee	Mark Garry	Lieutenant
34	Village of Pewaukee	Scott Gosse	Administrator
35	Village of Summit	Brian Wraalstad	Sergeant
36	Village of Sussex	Kris Grod	Chief
37	Village of Vernon	Alex Felde	Chief
38	Village of Wales	Gail Tamez	Clerk
39	Village of Waukesha	Kathy Nickolaus	Clerk
40	City of Brookfield	Robert Scott	Emergency Manager
41	City of Delafield	Tom Hafner	Administrator
42	City of Muskego	Rick Rens	Chief

43	City of New Berlin	Jim Burns	Emergency Manager
44	City of Oconomowoc	James Pfister	Chief
45	City of Pewaukee	Kevin Pierce	Chief
46	City of Waukesha	Dan Baumann	Captain
47	City of Waukesha	Joe Hoffman	Deputy Chief
48	City of Waukesha	Shawn Reilly	Mayor
49	Eagle Springs Lake Management District	Peter Jensen	Administrator

Additional Jurisdiction Representatives:

A list of the jurisdiction representatives is found in Volume II.

Standard:

- Wisconsin Emergency Management (WEM) Mitigation Standard; Element A: Planning Process
  - A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? 44 CFR 201.6(c)(1). Involved in the process means engaged as participants and given the chance to provide input affecting the Plan's content; plan updates must include documentation of the current planning process.
    - A1.2. List of individuals involved
    - A1.4. List of representatives from each jurisdiction (person's position/title and agency)
  - A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? 44 CFR 201.6(b)(2)
    - A2.1. List of stakeholders: local and regional agencies that take part in hazard mitigation activities
    - A2.4. List of representatives for each stakeholder involved (person's position/title and agency or organization)
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Planning Process; §201.6(b): An open public involvement process is essential to the development of an effective plan.
  - 4. Document the Planning Process; Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved
    - 4.B. Does the new or updated plan indicate who was involved in the current planning process? (For example, who led the development at the staff level and were there any external contributors such as contractors? Who participated on the plan committee, provided information, reviewed drafts, etc.?)
    - 4.D. Does the new or updated plan discuss the opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?

1.3.9 Organization/Agency Coordination and Participation

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.6(b)(2)). This task was accomplished by the planning team as follows:

Steering Committee Involvement — Agency representatives were invited to participate on the Steering Committee.

Key Stakeholder Interviews -- The stakeholder interviews obtained input from many local stakeholders with insight into hazards and potential projects. See The Steering Committee for a list of stakeholders interviewed. Agency representatives (see list of agencies below) were also contacted and interviewed/consulted regarding specific flooding, planning and zoning, transportation, and community-related questions.

Agency Notification — Agencies and organizations throughout the County were invited to participate in the plan development process from the beginning and were kept apprised of plan development milestones. Specifically, meeting invitations were sent via the listserve which includes key agency and organizational leaders within the County.

The following agencies/organizations were informed of key planning meetings and were invited to participate in the hazard mitigation questionnaire. Private citizens and businesses were also encouraged to participate in the hazard mitigation questionnaire (373 completed questionnaires and over 622 residents enter the survey), but because the questionnaire promised confidentiality, a complete list of participating businesses and organizations is not available. Agency/organization representatives (except for those on the Waukesha Cooperation Council) were also invited to participate via the online planning system and were given the opportunity to review, comment and suggest revisions to the plan.

- Waukesha Cooperation Council (a list serve of all chief elected officials in Waukesha County)
- Waukesha County Emergency Management
- Waukesha County Department of Public Works
- Waukesha County Highway Operations Division
- Waukesha County Planning and Zoning
- Waukesha County Public Health
- Waukesha County Health and Human Services
- Waukesha County Transit Services
- Waukesha County Environmental Health
- Waukesha Fire Department
- Waukesha County Sheriff's Department
- Waukesha County Board
- Waukesha County LEPC
- Menomonee Falls Police Department
- Village of Pewaukee Police Department
- Village of Pewaukee Fire
- Lake Country Fire
- Mutwonago Fire Department
- City of Muskego Police Department
- Waukesha City Police Department
- Waukesha City Fire Department
- Village of Dousman Fire Department
- Vernon Fire Department
- Pewaukee Fire Department
- Oconomowoc City Fire Department
- Village of Lannon Police Department
- Village of Big Bend Police Department
- New Berlin Emergency Management
- New Berlin Police Department
- Oconomowoc Fire Department
- Menomonee Falls Fire Department
- Sussex Fire Department

Input from Neighboring Jurisdictions -- Emergency managers from surrounding counties were granted access to the online planning system, and were invited to review and provide any additional feedback to the plan. To date, no comments were received. The following is a list of neighboring jurisdictions invited to review the plan: Kenosha County, Walworth County, Milwaukee County, Jefferson County, Ozaukee County, Racine County, Washington County.

Pre-Adoption Review

Key agencies and stakeholders were provided an opportunity to review and comment on this plan, primarily through the hazard mitigation plan website and Online Planning System. Each agency was sent an e-mail message (or invite to the Online Planning System) informing them that draft portions of the plan were available for review.

Standard:

- Wisconsin Emergency Management (WEM) Mitigation Standard; Element A: Planning Process
  - A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? 44 CFR 201.6(b)(2)
    - A2.1. List of stakeholders: local and regional agencies that take part in hazard mitigation activities

- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Planning Process; §201.6(b): An open public involvement process is essential to the development of an effective plan.
  - 4. Document the Planning Process; Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved
    - 4.D. Does the new or updated plan discuss the opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?

1.3.10 Stakeholder and Public Involvement

Updating this Plan involved assistance in identifying and evaluating hazards and mitigation initiatives from five (5) key groups: core planning team, steering committee, local planning team/community representatives, general public, and other stakeholders.

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1)). The Community Rating System expands on these requirements by making CRS credits available for optional public involvement activities. The strategy for involving the public in this plan emphasized the following elements:

- Use a questionnaire to determine the public's perception of risk and support of hazard mitigation
- Attempt to reach as many planning area citizens as possible using multiple media.
- Identify and involve planning area stakeholders.

Standard

Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element A: Planning Process

- A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? 44 CFR 201.6(c)(1). Involved in the process means engaged as participants and given the chance to provide input affecting the Plan's content; plan updates must include documentation of the current planning process.
  - A1.5. How each jurisdiction was involved
  - A1.A Recommended documentation: narrative description, meeting agendas and sign-in sheets, meeting minutes, newspaper articles, copies of letters or surveys distributed.

- A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? 44 CFR 201.6(b)(2)
  - A2.5. How each stakeholder was involved

- A3. Does the Plan document how the public was involved in the planning process during the drafting stage? 44 CFR 201.6(b)(1) and (c)(1)
  - A3.1. How the public was given the opportunity to be involved (must be prior to final approval/adoption)
  - A3.2. How public feedback was incorporated into the Plan

Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Prerequisites

- 3. Multi-Jurisdictional Planning Participation; Requirement §201.6(c)(5): For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.
  - 3.A. Does the new or updated plan describe how each jurisdiction participated in the plan's development?

Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Planning Process; §201.6(b): An open public involvement process is essential to the development of an effective plan.

-
  - *4.C. Does the new or updated plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)*

- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Planning Process; §201.6(b): An open public involvement process is essential to the development of an effective plan.
  - ***3. For multi-jurisditctional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.***
    - ***3.A. Does the new or updated plan describe how each jurisdiction participated in the plan's development?***
    - ***3.B. Does the updated plan identify all participating jurisdictions, including new, continuing, and the jurisdictions that no longer participate in the plan?***
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Planning Process; §201.6(b): An open public involvement process is essential to the development of an effective plan.
  - 4. Document the Planning Process; Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved
    - 4.C. Does the new or updated plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Plan Maintenance Process
  -
    - 18. Monitoring, Evaluating, and Updating the Plan; Requirement §201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
      - 18.A. Does the new or updated plan describe the method and schedule for monitoring the plan, including the responsible department?
      - 18.B. Does the new or updated plan describe the method and schedule for evaluating the plan, including how, when and by whom (i.e. the responsible department)?
      - 18.C. Does the new or updated plan describe the method and schedule for updating the plan within the five-year cycle?
    - 19. Incorporation into Existing Planning Mechanisms; Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

- 19.A. Does the new or updated plan identify other local planning mechanisms available for incorporating the mitigation requirements of the mitigation plan?
- 19.B. Does the new or updated plan include a process by which the local government will incorporate the mitigation strategy and other information contained in the plan (e.g., risk assessment) into other planning mechanisms, when appropriate?
- 19.C. Does the updated plan explain how the local government incorporated the mitigation strategy and other information contained in the plan (e.g., risk assessment) into other planning mechanisms, when appropriate?

- 20. Continued Public Involvement; Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.
  - 20.A. Does the new or updated plan explain how continued public participation will be obtained? (For example, will there be public notices, an on-going mitigation plan committee, or annual review meetings with stakeholders?)

1.3.10.1 Stakeholder and the Steering Committee

The core planning team consisted of key members from Waukesha County Emergency Management. The core planning team also served on the steering committee and helped to guide the process. The Core Planning Team met bi-weekly.

Stakeholders are the individuals, agencies and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan, including planning partners. The effort to include stakeholders in this process included stakeholder participation on the Steering Committee. Stakeholders were encouraged to attend and participate in all committee meetings.

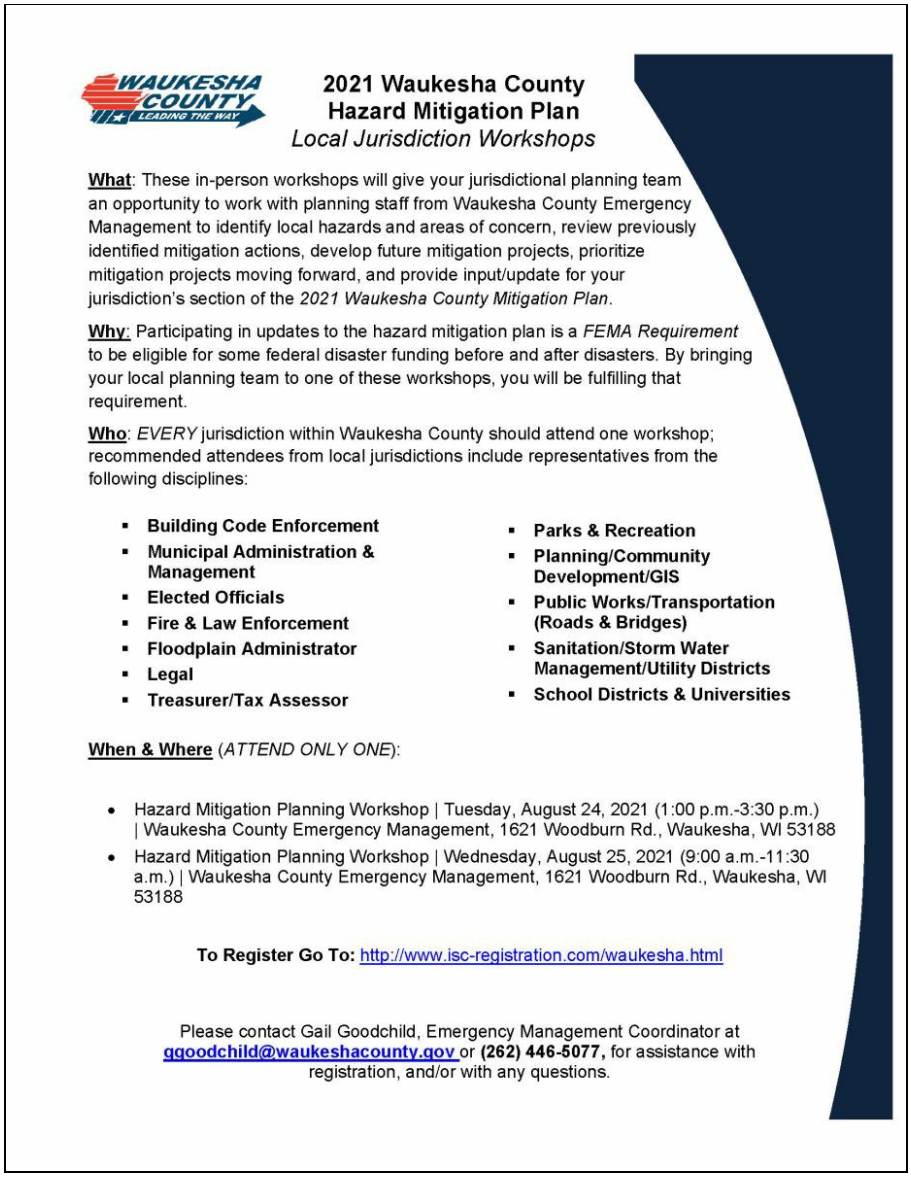
The Steering Committee agreed to meet three (3) times or as needed throughout the course of the plan's development. Meetings were facilitated at each Steering Committee meeting, which addressed a set of objectives based on the work plan established for the plan. Every jurisdiction was followed up through the process for any additional information. The final planning meeting was held on December 13, 2021 to review the plan. Each representative of every jurisdiction was invited to use the online planning system for them to review their respective section in Volume II.

Image: Hazard Mitigation Planning Workshop

The Steering Committee and Jurisdictional Stakeholders met on the following dates:

- **Webinar** | Tuesday, June 22, 2021: 10:00 a.m. – 11:00 a.m.
- **Webinar** | Monday, June 28, 2021: 1:00 p.m. – 2:00 p.m.
- **Hazard Mitigation Planning Workshop** | Tuesday, August 24, 2021 (1:00 p.m.-3:30 p.m.) | Waukesha County Emergency Management, 1621 Woodburn Rd., Waukesha, WI 53188
- **Hazard Mitigation Planning Workshop** | Wednesday, August 25, 2021 (9:00 a.m.-11:30 a.m.) | Waukesha County Emergency Management, 1621 Woodburn Rd., Waukesha, WI 53188
- **Final Planning Meeting** | Mon, December 13, 2021: 1:00 p.m. - 2:00 p.m.

Meeting agendas and sign-in sheets can be found in Appendix B of this document. All Steering Committee meeting times and locations were sent via e-mail with follow-up phone calls, as needed.



2021 Waukesha County Hazard Mitigation Plan

Local Jurisdiction Workshops

What: These in-person workshops will give your jurisdictional planning team an opportunity to work with planning staff from Waukesha County Emergency Management to identify local hazards and areas of concern, review previously identified mitigation actions, develop future mitigation projects, prioritize mitigation projects moving forward, and provide input/update for your jurisdiction's section of the *2021 Waukesha County Mitigation Plan*.

Why: Participating in updates to the hazard mitigation plan is a *FEMA Requirement* to be eligible for some federal disaster funding before and after disasters. By bringing your local planning team to one of these workshops, you will be fulfilling that requirement.

Who: *EVERY* jurisdiction within Waukesha County should attend one workshop; recommended attendees from local jurisdictions include representatives from the following disciplines:

- **Building Code Enforcement**
- **Municipal Administration & Management**
- **Elected Officials**
- **Fire & Law Enforcement**
- **Floodplain Administrator**
- **Legal**
- **Treasurer/Tax Assessor**
- **Parks & Recreation**
- **Planning/Community Development/GIS**
- **Public Works/Transportation (Roads & Bridges)**
- **Sanitation/Storm Water Management/Utility Districts**
- **School Districts & Universities**

When & Where (*ATTEND ONLY ONE*):

- Hazard Mitigation Planning Workshop | Tuesday, August 24, 2021 (1:00 p.m.-3:30 p.m.) | Waukesha County Emergency Management, 1621 Woodburn Rd., Waukesha, WI 53188
- Hazard Mitigation Planning Workshop | Wednesday, August 25, 2021 (9:00 a.m.-11:30 a.m.) | Waukesha County Emergency Management, 1621 Woodburn Rd., Waukesha, WI 53188

To Register Go To: http://www.isc-registration.com/waukesha.html

Please contact Gail Goodchild, Emergency Management Coordinator at ggoodchild@waukeshacounty.gov or **(262) 446-5077,** for assistance with registration, and/or with any questions.

Standard

Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element A: Planning Process

- A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? 44 CFR 201.6(c)(1). Involved in the process means engaged as participants and given the chance to provide input affecting the Plan's content; plan updates must include documentation of the current planning process.
  - A1.1. Schedule or timeframe of activities that made up the Plan's development

1.3.10.2 Public Participation and Questionnaire and Key Findings

The general public must be given an opportunity to be involved in the planning process. As such, a number of public outreach activities were organized to ensure public participation and input was obtained. This section describes those efforts.

Public Open House

A public meeting was held on August 24, 2021. The meeting provided the public an opportunity to review the potential hazards that could occur within the County and gave the planning team an opportunity to request input for the various mitigation measures intended to eliminate or reduce the negative impact of those hazards. See Appendix B for meeting details.

Hazard Questionnaire

A hazard mitigation and preparedness questionnaire was developed to gauge household preparedness for all hazards and the level of knowledge of tools and techniques that assist in reducing risk and loss. This questionnaire was designed to help identify areas vulnerable to one or more hazards. The answers to its questions helped guide the Steering Committee in prioritizing hazards of impact and in selecting goals, objectives and mitigation strategies.

373 questionnaires were completed during the course of this planning process, and 622 residents entered the survey. The average completion time for the questionnaire was 16 minutes and 42 seconds. The complete questionnaire and a summary of its findings can be found in Appendix B.

Link: Appendix B: Hazard Mitigation Questionnaire and Results

Specifically, the questionnaire results were used to help the planning team and steering committee to separate perception versus actual threats to life safety and property.

For example, one of the questions asked: “Do you believe that your household and/or place of business might ever be threatened by the following hazards?” Top hazards reported by the public included:

- Severe Winter Storm/Heavy Snowfall
- Tornadoes

While these hazards pose a significant risk the county, the steering committee designated flooding and dam failure as the hazard with the highest risk rating after considering frequency, magnitude and vulnerability.

Interestingly, open-ended responses from the questionnaire resulted in validation that flooding posed a major risk to the County. One question asked: “If you have experienced any damage(s) or injury(ies) from a disaster, please list the hazard(s) that caused the damages/losses and/or injuries.” The top hazard identified by participants was flooding.

The questionnaire helped to provide validation for mitigation actions identified in the plan. For example, some open-ended comments on how the county could better prepare residents suggested the use of the following:

- Cell phone alerts
- More information on hazards to the general public

Additionally, when the participants were asked what hazards should be mitigated, this provided additional guidance to the steering committee in an effort to align county and municipal priorities with those of the general public.

18. Based on YOUR PERCEPTION of your jurisdiction's hazards, to what degree of emphasis would you expect your jurisdiction to mitigate the following hazards? Mitigation definition: The purpose of mitigation planning is to identify policies and actions that can be implemented over the long term to reduce risk and future losses. Mitigation forms the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. No Mitigation Needed = No mitigation on this hazard is expected or needed Low Priority = This hazard should be mitigated, but is not a high priority compared to other hazards Medium Priority = It is important to mitigate this hazard High Priority = It is a high priority to emphasize mitigation for this hazard

	No Mitigation Needed	Low Priority	Medium Priority	High Priority	Responses
Severe Temperatures					
Count	103	125	111	34	373
Row %	27.6%	33.5%	29.8%	9.1%	
Earthquakes					
Count	221	125	11	15	372
Row %	59.4%	33.6%	3.0%	4.0%	
Severe Winter Storm/Heavy Snowfall					
Count	11	39	152	173	375
Row %	2.9%	10.4%	40.5%	46.1%	
Tornado and High Winds					
Count	10	46	151	169	376
Row %	2.7%	12.2%	40.2%	44.9%	
Forest and Wildfires					
Count	102	186	62	25	375
Row %	27.2%	49.6%	16.5%	6.7%	
Fog					
Count	178	143	47	7	375
Row %	47.5%	38.1%	12.5%	1.9%	
Thunderstorms					
Count	46	113	145	71	375
Row %	12.3%	30.1%	38.7%	18.9%	
Drought and Dust Storms					
Count	148	170	49	7	374
Row %	39.6%	45.5%	13.1%	1.9%	
Flooding					
Count	53	125	134	62	374
Row %	14.2%	33.4%	35.8%	16.6%	

	No Mitigation Needed	Low Priority	Medium Priority	High Priority	Responses
Flash Flooding					
Count	56	102	144	71	373
Row %	15.0%	27.3%	38.6%	19.0%	
Dam Failure					
Count	182	118	47	25	372
Row %	48.9%	31.7%	12.6%	6.7%	
Utility Failure					
Count	12	42	144	176	374
Row %	3.2%	11.2%	38.5%	47.1%	
Total					
Total Responses					376

1.3.10.3 Online Planning System and Workgroup Management Tool

Online Planning System

Local Planning Team members were invited to participate via the online planning system (https://waukeshacounty.isc-cemp.com), known as the Waukesha County Knowledge Management System (KMS).

One of the key features of the Online Planning System was the ability to provide real-time access to the Plan and to allow stakeholders to comment on key sections. Steering committee members and Local Planning Team members were given access to the system. The comments tool was used to encourage collaboration. The comments tool allowed the user to make comments on any page within the manual and mark the comment as an observation or feedback. Comments for pages were visible to all administrators and users who had editing privileges for the specific page.

To make a comment, users were instructed to click on the Comment link on the bottom of the content page and a pop-up box would appear. The person used the drop-down box to designate whether the comment was a Feedback or an Observation. After entering the comment, they clicked the Send Comments button to submit.

The comment would appear after the page refreshes (if user is allowed to view comments). An email notification was sent to users who were designated to receive comment notification.

Documentation of Participation

Local jurisdiction and Local Planning Team Participation was documented as described in the tables below:

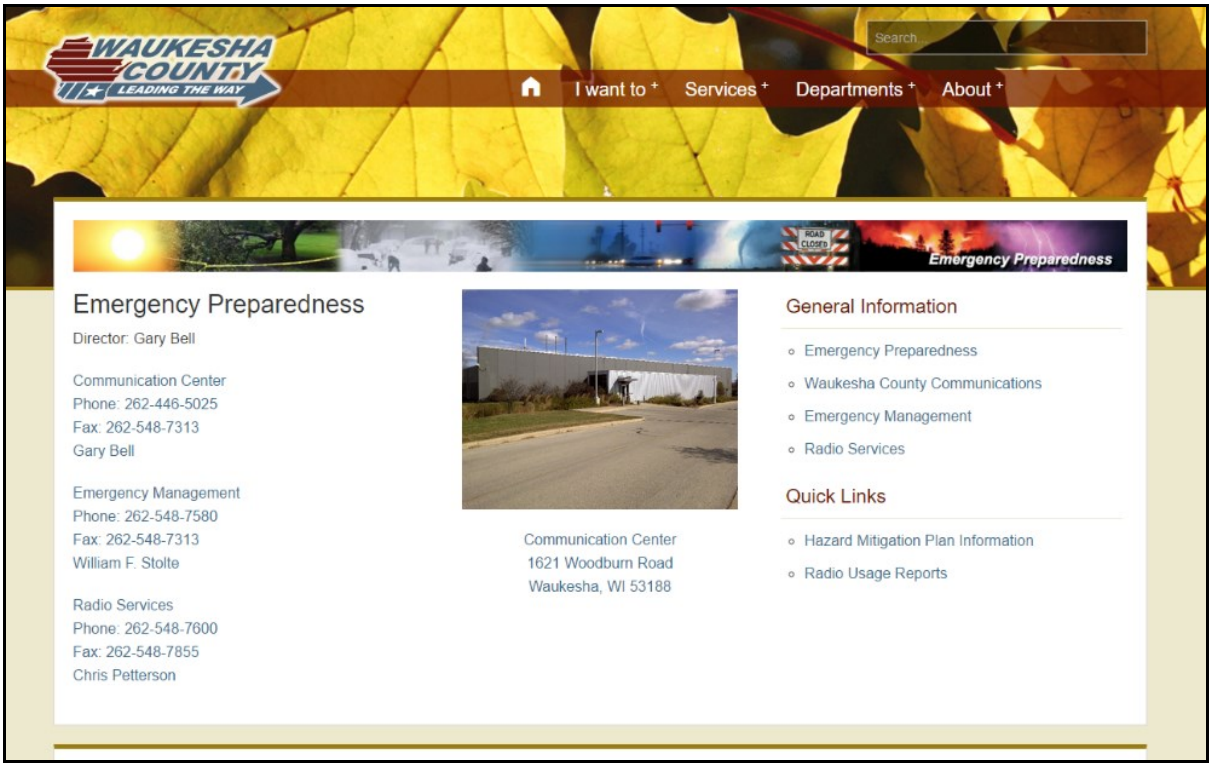
Table. Documentation of Participation in the 2021 Hazard Mitigation Plan Update

2021 Jurisdiction Participation Checklist						
Jurisdiction	Community Mitigation Survey Participation (includes participation from general public)	Represented at a Webinar	Represented at a Workshop/Meeting(s)	Submitted a Hazard Analysis for the Jurisdiction	Submitted at least one (1) New Mitigation Project	Reviewed/Updated Past Mitigation Project(s), as applicable
	Yes or No (# of participants)	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No

2021 Plan Participation and Involvement					
Name	Webinar	Workshop/Meeting(s) Attendance	Registered and Accessed the KMS (Online Planning System)	Provided Feedback on the Plan (via the KMS comment tool or other mechanism)	Other Participation Activities
[Individual Planning Team Member]	Date of Participation	Date of Participation	Yes or No	Yes or No	Description of Activity

1.3.10.4 Web site

The Waukesha County Web site was utilized to make the Hazard Mitigation Plan available to key stakeholders. The link on the Web site "Hazard Mitigation Plan Information" took users directly to the online planning system housing the hazard mitigation plan.



1.3.11 Review of Existing Programs and Plans

Local comprehensive plans, ordinances, and other pertinent planning documents were reviewed by the planning consultant and discussed with the steering committee when available and pertinent. During stakeholder interviews and meetings, participants were asked to identify and consider related plans and ordinances. The results of these discussions were integrated into the appropriate assessment section or recommended strategies which were reviewed by the steering committee, communities, and other stakeholders. A few examples of other planning efforts considered and integrated into this plan include the State Hazard Mitigation Plan and recent studies conducted by the County and its respective departments.

Plan Name	How the Document was Used
2016 Wisconsin Hazard Mitigation Plan	Risk assessment data
National Climatic Data Center	Historical data for natural hazards
2016 Waukesha County Hazard Mitigation Plan	Served as the primary framework for the 2021 update
2020-22 Waukesha County Department Strategic Plans	Provided valuable data for the Community Profile
2019-2021 Growth Strategy	Community/Business Profile data

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports, and technical information (44 CFR, Section 201.6(b)(3)). This Plan provides a review of the laws and ordinances in effect within the planning area that can affect hazard mitigation initiatives.

Additionally, there have been plans and ordinances completed by individual Waukesha County departments or municipalities that are directly and/or indirectly related to the County's overall mitigation efforts. Some of these initiatives were used as reference materials for this plan, and include the following:

Waukesha County Code of Ordinances

http://www.waukeshacounty.gov/page.aspx?SetupMetaId=11982&id=11986

- Chapter 14 - Parks and Land Use
- Chapter 15 - Public Works
- Appendix A - Basic Zoning Ordinance
- Appendix B - Shoreland and Floodland Protection
- Appendix D - Shoreland and Floodland Subdivision Control

City of Brookfield Municipal Code

http://www.codepublishing.com/wi/brookfield/

- Title 15 - Building and Construction
- Title 16 - Subdivisions
- Title 17 - Zoning

City of Brookfield Ordinances

http://www.ci.brookfield.wi.us/Archive.asp?AMID=83

- Temporary Moratorium on Land Divisions of Platted Residential Lots
- Plus other ordinances with regard to specific lots.

City of Delafield Municipal Code

http://http://www.municode.com/Resources/gateway.asp?pid=12542&sid=49

Chapter 8 - Public Works

Chapter 13 - Municipal Utilities

Chapter 14 - Building Code

Chapter 17 - Zoning Code

Chapter 18 - Subdivision Control Code

Chapter 20 - Floodplain Zoning Code

Chapter 23 - Construction Site Erosion Control and Storm Water Management

City of Muskego Municipal Code

http://http://www.ci.muskego.wi.us/Government/MunicipalCodes/tabid/391/Default.aspx

Chapter 14 - Floodplain Zoning Ordinance

Chapter 17 - Zoning Ordinance

Chapter 18 - Land Division Ordinance

Chapter 19 - Minimum Housing Code

Chapter 29 - Erosion Control

Chapter 30 - Building Code

Chapter 34 - Storm Water Management

Chapter 38 - Non Metallic Mining

City of New Berlin Municipal Code

http://www.ecode360.com/?custId=NE1873

Chapter 65 - Water Resource Management

Chapter 80 - Building Construction

Chapter 110 - Erosion Control

Chapter 198 - Property, Abandoned and Obsolete

Chapter 226 - Storm Water Runoff

Chapter 235 - Subdivision of Land

Chapter 275 - Zoning

City of Oconomowoc Municipal Code

http://library6.municode.com/default-test/home.htm?infobase=19978&doc_action=whatsnew

City of Oconomowoc Zoning Code

http://http://www.ci.oconomowoc.wi.us/Zoningordinance/tableofcontents.htm

Sub-chapter 17-1 - Establishment of Zoning Districts

Sub-chapter 17-2 - Land Use Regulations

Sub-chapter 17-3 - Density and Intensity Regulations

Sub-chapter 17-4 - Bulk Regulations

Sub-chapter 17-5 - Natural Resource Protection Regulations

Sub-chapter 17-6 - Landscape and Buffer-Yard Regulations

City of Pewaukee Ordinances

http://www.cityofpewaukee.us/pewaukee_ordinances_02.php

Chapter 10 - Land, Streets, Right of Ways

Chapter 14 - Building Code

Chapter 16 - Municipal Water and Wellhead Protection

Chapter 17 - Zoning

Chapter 18 - Land Division

Chapter 19 - Storm Water/Erosion Control

City of Waukesha Code Book

http://http://www.ci.waukesha.wi.us/web/guest/codebook

Chapter 16 - Building

Chapter 22 - Zoning

Chapter 23 - Subdivision and Platting

Chapter 24 - Floodland Zoning

Chapter 32 - Storm Water Management and Erosion Control

Village of Chenequa Code

http://www.chenequa.wi.us/village1.html

Chapter 3 - Land

Chapter 5 - Building Code

Chapter 6 - Zoning Code

Village of Elm Grove Code of Ordinances

http://www.ecode360.com/?custId=EL1841

Chapter 106 - Building Construction

Chapter 305 - Land Division

Chapter 330 - Floodplain Zoning

Chapter 335 - Zoning

Village of Hartland Municipal Code

http://www.municode.com/resources/gateway.asp?sid=49&pid=13361

Chapter 18 - Building and Building Regulations

Chapter 46 - Land Development

Chapter 50 - Land Subdivision

Chapter 76 - Storm Water Management

Village of Menomonee Falls Code of Ordinances

http://www.municode.com/resources/gateway.asp?pid=13290&sid=49

Chapter 18 - Building and Building Regulations

Chapter 38 - Environment

Chapter 58 - Manufactured Homes and Trailers

Chapter 59 - Non-Metallic Mining Reclamation

Chapter 94 - Subdivisions and Other Divisions of Land

Chapter 122 - Zoning

Village of Mukwonago Municipal Code

http://www.villageofmukwonago.com/municipal_code.htm

Chapter 18 - Buildings and Building Regulations

Chapter 45 - Land Division

Chapter 50 - Mobile Homes and Trailers

Chapter 62 - Planning

Chapter 100 - Zoning

Village of Nashotah Municipal Code

http://www.municode.com/resources/gateway.asp?pid=12609&sid=49

Chapter 14 - Building Code

Chapter 16 - Shoreland-Wetland Zoning

Chapter 17 - Zoning Code

Chapter 18 - Subdivision and Platting

Chapter 23 - Storm Water Runoff

Village of North Prairie Municipal Code

http://www.northprairie.net/Municipal%20Codes,%20Ordinances%20and%20Polices.html

Chapter 14 - Building and Building Regulations

Chapter 22 - Manufactured Homes

Village of Oconomowoc Lake Zoning Code and Land Division Ordinances

http://www.oconlake.com/zonefile.html

Chapter 17 - Zoning Code

Chapter 18 - Subdivision and Platting

Village of Sussex Municipal Code and Newly Enacted Ordinances

http://www.village.sussex.wi.us/Ordinances.php

Chapter 14 - Stormwater Runoff

Chapter 17 - Zoning Code

Chapter 18 - Land Development Code

Chapter 26 - Non-metallic Mining Reclamation

Chapter 27 - Environmental Enhancement and Protection

Chapter 30 - Building Code

Ordinance No 711 - Floodplain Management

Ordinance No 716 - Land Suitability - Floodlands

Town of Brookfield Zoning Code

http://www.townofbrookfield.com/buildinginspection.html

Chapter 17 - Zoning Code

Town of Delafield Municipal Code

http://www.townofdelafield.org/towninfo_codes.htm

Chapter 14 - Building and Mechanical Code

Chapter 17 - Zoning Code

Chapter 18 - Land Division and Development Control

Town of Mukwonago Municipal Code

http://www.townofmukwonago.us/Town_Ordinances.htm

Chapter 14 - Buildings and Building Regulations

Chapter 82 - Zoning

Town of Ottawa Ordinances

http://www.townofottawa.com/ordinances.asp

Chapter 14 - Building Code

Chapter 18 - Land Division and Development

Town of Vernon Municipal Code

http://www.ecode360.com/?custId=VE2182

Chapter 125 - Building Construction

Chapter 144 - Commercial and Industrial Development

Standard

Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element A: Planning Process

- A4. Does the Plan document the review and incorporation of existing plans, studies, reports, and technical information? 44 CFR 201.6(b)(3).
  - A4.1. List of existing plans, studies, reports, and technical information that were reviewed
  - A4.2. How relevant information was incorporated into the Plan

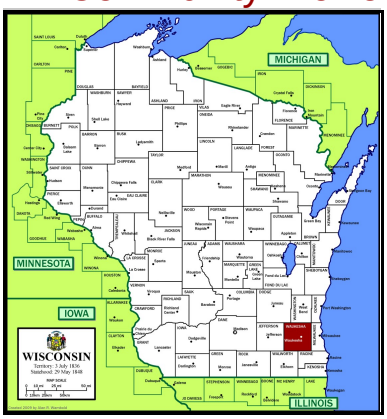
Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element C: Mitigation Strategy

- C1. Does the Plan document each jurisdiction's existing authorities, policies, programs, and resources, and its ability to expand on and improve these existing policies and programs? 44 CFR 201.6(c)(3)
  - C.1.1. Description of each jurisdiction's existing authorities, policies, programs, and resources available to accomplish hazard mitigation
- C2. Does the Plan address each jurisdiction's participation in the National Flood Insurance Program (NFIP) and continued compliance with NFIP requirements as appropriate? 44 CFR 201.6(c)(3)(ii)
  - C2.2. Description of floodplain management programs/activities that contribute to continued compliance for each NFIP-participating jurisdiction

Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Planning Process; §201.6(b): An open public involvement process is essential to the development of an effective plan.

- 4. Document the Planning Process; Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved
  - 4.E. Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?

1.4 Community Profile



IV. Community Profile

The Community Profile is an important component of the Hazard Mitigation Plan, and should be utilized to provide valuable intelligence and situational awareness. The Community Profile is an overview of the political governance, economy, geography, climate, population, community assets, future development and trends, and commercial and industrial make-up of Waukesha County.

The Community Profile provides Waukesha County with a solid foundation for developing a common operational picture for all programmatic, planning, and operational needs.

1.4.1 Physical and Natural Characteristics of Waukesha County

This section describes the geology, topography, climate, hydrology, soil, wetlands, vegetation and land use considerations for Waukesha County.

1.4.1.1 General Community Introduction

A drive through Waukesha County uncovers evidence of the great glaciers that once covered the area. Lush rolling hills, abundant lakes and limestone quarries are just some of the natural wonders. Many of Waukesha County's parks feature the lakes and hills created by the glacier.

Waukesha County was home to prehistoric Native Americans, including the Effigy Mound Builders and Potawatomi people and was prized by fur traders in the 1700s. When settlers from the east arrived in the mid-1800s, they found four to six-foot earthen mounds in the shape of birds and turtles, along with conical and linear mounds. Three conical mounds are visible today in front of the City of Waukesha Library. Increase Lapham, considered founder of the U.S. Weather Bureau, surveyed the mounds. The highest point in Waukesha County is named for him.

As far back as the 1700s, the native people told fur traders about the area's mineral springs. In 1868 Col. Richard Dunbar promoted what he believed were healing properties of Waukesha's water, which launched Waukesha County's “Springs Era”. Through 1910, people traveled cross-country to drink the water. Accounts tell us that up to 25 passenger trains arrived daily. Elaborate “springhouses” were built above the natural springs. Today's visitors can see the last of the original springhouses on the Moor Downs Golf Course, Frame Park and Springs Park.

Farming and manufacturing were also influential in the development of Waukesha County. Waukesha limestone was used for many local buildings and shipped beyond county borders to build public and private structures. Manufacturing foundries created useful products for farming, railroad, automotive, and other industries. These industries were aided by major rail lines connecting Waukesha to the rest of the United States.

In the late 1800s, many cities experienced devastating fires that destroyed early wood frame buildings. Waukesha County's quarries provided the stone for rebuilding, and railroads transported the stone to Chicago and other cities with fire damage.

Some of the famous people that called Waukesha County home include Les Paul, the inventor of the electric guitar and 1930's Broadway stars Alfred Lunt and Lynn Fontanne.

Once dubbed “Cow County USA”, Waukesha County has developed a diverse industrial base. Some of the world's leading manufacturers and businesses have corporate facilities located in the area.

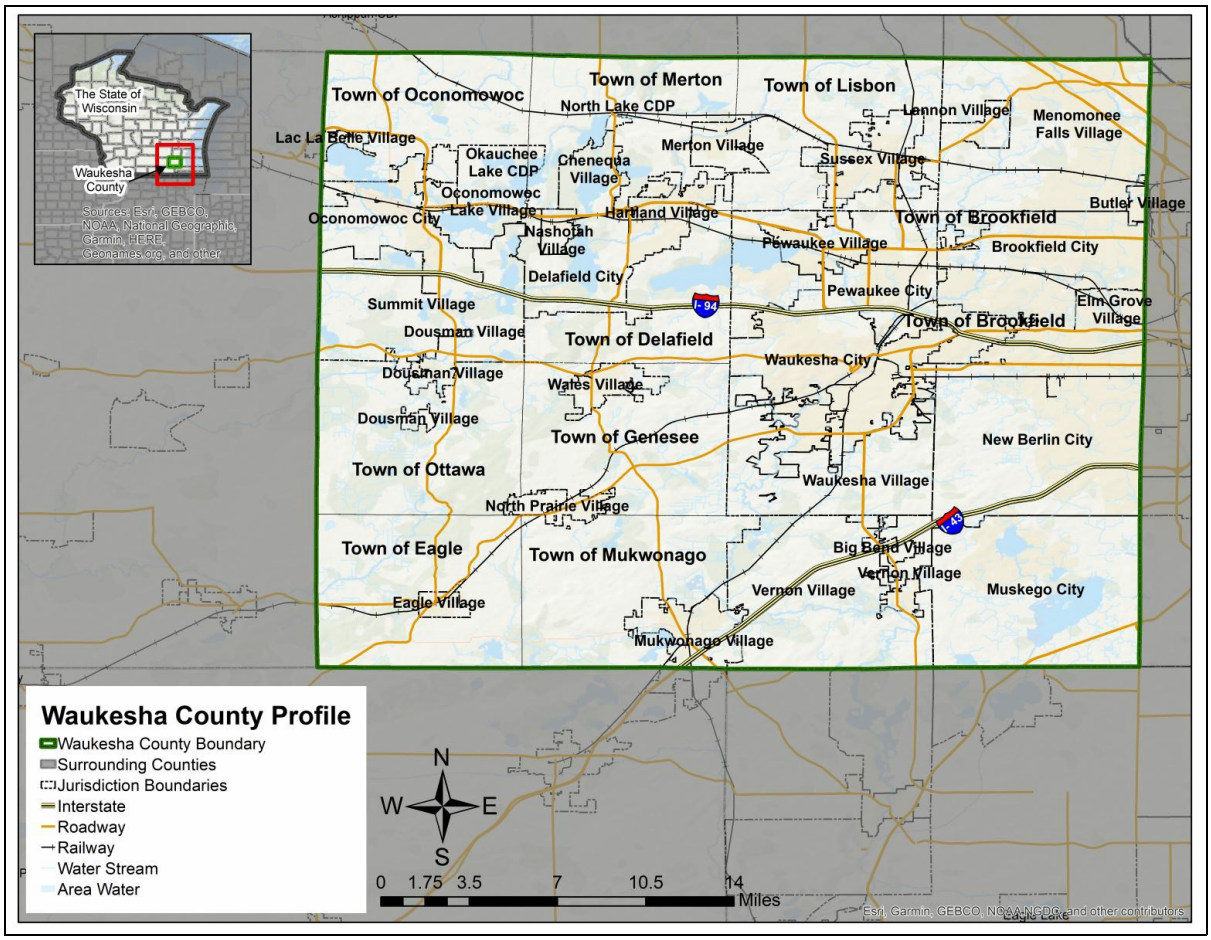
1.4.1.2 Plan Area

Waukesha County covers approximately 576 square miles or 371,600 acres with rivers, streams and creeks accounting for about 31 square miles of the total. Since 2019, Waukesha County is home to approximately 404,198 people.

Waukesha County lies within the Eastern Ridges and Lowlands geographical province. Topographic features are distinct, but they are low. Alternate weak and resistant rock layers are carved by streams and weather into a belted plain. This plain has parallel strips of upland and lowland corresponding to the more important resistant and weak strata. The uplands are called cuestas. A cuesta is a ridge that has a steep escarpment on one side and a long gentle slope of the other. The topography of the Eastern Ridges and Lowlands is controlled by cuestas. The Niagara Cuesta runs through Waukesha County. The upland on the back slope of the Niagara cuesta is a region of very moderate relief, with glacial deposits forming the greatest irregularities. The erosion of the largest streams, like the Milwaukee River, results in a maximum relief of only 100 to 120 feet by cutting into the glacial drift and the rock.

Waukesha County is bordered on the east by Milwaukee, on the south by Walworth County and Racine County, on the west by Jefferson County and on the north by Dodge and Washington Counties.

In Wisconsin, there are three types of sub-county, full-service local government units: towns, which are unincorporated, and villages and cities, which are incorporated. Waukesha County contains the Cities of Brookfield, Delafield, Muskego, New Berlin, Oconomowoc, Pewaukee and Waukesha; the Villages of Big Bend, Butler, Chenequa, Dousman, Eagle, Elm Grove, Hartland, Lac La Belle, Lannon, Menomonee Falls, Merton, Mukwonago, Nashotah, North Prairie, Oconomowoc Lake, Pewaukee, Summit, Sussex, Vernon, Wales, Waukesha, and the Towns of Brookfield, Delafield, Eagle, Genesee, Lisbon, Merton, Mukwonago, Oconomowoc, and Ottawa.



1.4.1.3 Geology

The combined thickness of unconsolidated glacial deposits, alluvium, and marsh deposits overlying bedrock exceed 100 feet throughout most of the county. Thicknesses are greatest where glacial materials fill the bedrock valleys and in areas of topographic highs formed by end moraines. The most substantial glacial deposits, from 300 to 500 feet thick, are located in the northwestern part of the County in the lakes area and in portions of the Towns of Mukwonago and Vernon. The thinnest glacial deposits, 20 feet thick or less, are found along an approximately six-mile-wide band traversing the county in a northeasterly direction from the Village of Eagle to the Villages of Lannon and Menomonee Falls.

Bedrock topography was shaped by preglacial and glacial erosion of the exposed bedrock. The consolidated bedrock underlying Waukesha County generally dips eastward at a rate of about 10 feet per mile. The bedrock surface ranges in elevation from about 900 feet above mean sea level, at Lapham Peak, to approximately 500 feet above mean sea level in the eastern portion of the County. The bedrock formations underlying the unconsolidated surficial deposits of Waukesha County consist of Precambrian crystalline rocks; Cambrian sandstone; Ordovician dolomite, sandstone, and shale; and Silurian dolomite. The uppermost bedrock unit throughout most of the County is Silurian dolomite, primarily Niagara dolomite, underlaid by a relatively impervious layer of Maquoketa shale, which acts as an aquitard – minimizing groundwater movement into the underlying materials. In some of the pre-Pleistocene valleys in the southwestern and central portions of the County, however, the Niagara dolomite is absent and the uppermost bedrock unit is the Maquoketa shale. (Waukesha Land and Water Resource Management Plan, 2006)

1.4.1.4 Topography

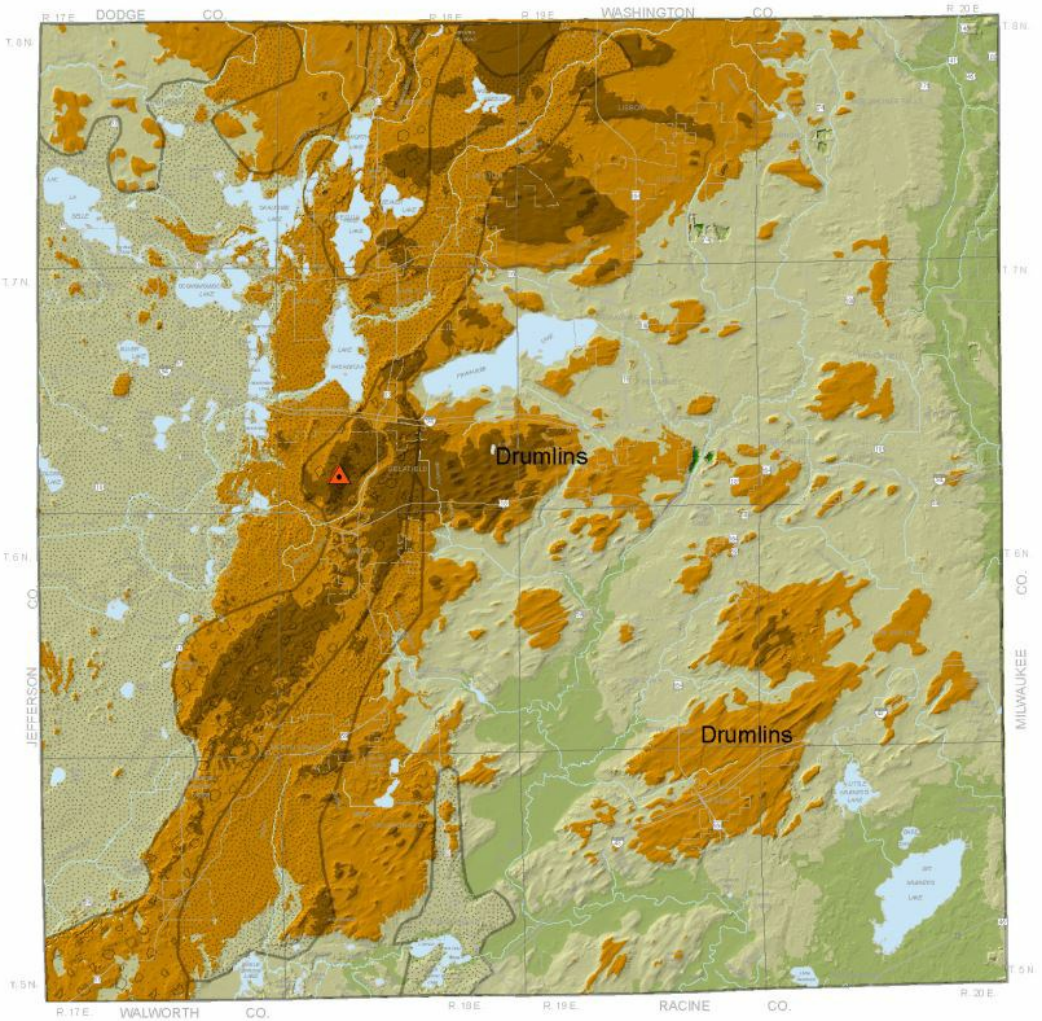
Wisconsin lies in the upper Midwest between Lake Superior, the upper peninsula of Michigan, Lake Michigan and the Mississippi and Saint Croix Rivers. Its greatest length is 320 miles and greatest width 295 miles for a total area 56,066 square miles. Glaciation has largely determined the topography and soils of the state, except for the 13,360 square miles of driftless area in southwestern Wisconsin. The various glaciations created rolling terrain with nearly 9,000 lakes and several areas of marshes and swamps. Elevations range from about 600 feet above sea level along the Lake Superior and Lake Michigan shores and in the Mississippi floodplain in southwestern Wisconsin to nearly 1,950 feet at Rib and Strawberry Hills.

The Northern Highlands, a plateau extending across northern Wisconsin, is an area of about 15,000 square miles with elevations from 1,000 to 1,800 feet. This area has many lakes and is the origin of most of the major streams in the state. The slope down to the narrow Lake Superior plain is quite steep. A comparatively flat, crescent-shaped lowland lies immediately south of the Northern Highlands and embodies nearly one-fourth of Wisconsin. The eastern ridges and lowlands to the southeast of the Central Plains are the most densely populated and have the highest concentration of industry and farms. The uplands of southwestern Wisconsin west of the ridges and lowlands and south of the Central Plains make up about one-fourth of the state. This is the roughest section of the state, rising 200 to 350 feet above the Central Plains and 100 to 200 feet above the Eastern Ridges and Lowlands. The Mississippi River bluffs rise 230 to 650 feet.

Topographic elevation in Waukesha County ranges from approximately 730 feet above mean sea level in the extreme eastern portions of the county along tributaries of the Menomonee River in Brookfield, Elm Grove and Menomonee Falls to 1,233 feet at Lapham Peak in the Town of Delafield, a variation of over 500 feet. Most of the high points in the county are located along the Kettle Moraine in three distinct areas: the southern half of the Town of Delafield near Lapham Peak, the southwestern quarter of the Town of Lisbon, and between State Highways 59 and 67 in the Towns of Genesee and Ottawa.

Four major stages of glaciation, the last of which was the Wisconsin stage, ending approximately 10,000 years ago in the state, have largely determined the physiography, topography, and soils of Waukesha County. The dominant physiographic and topographic feature in Waukesha County is the Kettle Moraine, an interlobate glacial deposit formed between the Green Bay and Lake Michigan lobes of the continental glacier that moved in a generally southerly direction from its origin in what is now Canada. The Kettle Moraine, which is oriented in a general northeast-southwest direction across western Washington, Waukesha, and Walworth Counties, is a complex system of kames, or crudely stratified conical hills; kettle holes formed by glacial ice blocks that became separated from the ice mass and melted to form depressions and small lakes as the meltwater deposited material around the ice blocks; and eskers, long, narrow ridges of drift deposited in abandoned drainage ways. The remainder of the county is covered by a variety of glacial landforms and features, including various types of moraines, drumlins, kames, outwash plains, and lake basin deposits. (Waukesha Land and Water Resource Management Plan, 2006)

Topographic & Physiographic Features of Waukesha County



Source: Waukesha County

1.4.1.5 Climate

The Wisconsin climate is typically continental with some modification by Lakes Michigan and Superior. Winters are generally cold and snowy and summers are warm. About two-thirds of the annual precipitation falls during the growing season; this is normally adequate for vegetation although there are occasional droughts. The climate favors dairy farming and the primary crops are corn, small grains, hay and vegetables. Storm tracks generally move from west to east and southwest to northeast.

The average annual temperature varies from 36 degrees F in the north to about 56 degrees F in the south with statewide extreme records of 114 degrees F (Wisconsin Dells, 7/13/1936) and minus 55 degrees F (Couderay, 2/2/1996 & 2/4/1996). During more than one-half of the winters, temperatures fall to minus 40 degrees F or lower and almost every winter temperatures of minus 30 degrees F or colder are reported from northern stations. Summer temperatures above 90 degrees F average two to four days in northern counties and about 14 days in southern districts, including Waukesha County. During marked cool outbreaks in summer months, the central lowlands occasionally report freezing temperatures.

The freeze-free season ranges from around 80 days per year in the upper northeast and north-central lowlands to about 180 days in the Milwaukee area. The pronounced moderating effect of Lake Michigan is well-illustrated by the fact that the growing season of 140 to 150 days along the east-central coastal area is of the same duration as in the southwestern Wisconsin valleys. The short growing season in the central portion of the state is attributed to a number of factors, among them an inward cold air drainage and the low heat capacities of the peat and sandy soils. The average date of last spring freeze ranges from early May along the Lake Michigan coastal area and southern counties to early June in the northernmost counties. The first autumn freezes occur in late August and early September in the northern and central lowlands and in mid-October along the Lake Michigan coastline, however a July freeze is not entirely unusual in the north and central Wisconsin lowlands.

The long-term mean annual precipitation ranges from 30 to 34 inches over most of the Western Uplands and Northern Highlands, then diminishes to about 28 inches along most of the Wisconsin Central Plain and Lake Superior Coastal area. The higher average annual precipitation coincides generally with the highest elevations, particularly the windward slopes of the Western Uplands and Northern Highlands. Thunderstorms average about 30 per year in northern Wisconsin to about 40 per year in southern counties and occur mostly in the summer. Occasional hail, wind and lightning damage are also reported.

The average seasonal snowfall varies from about 30 inches at Beloit to well over 100 inches in northern Iron County along the steep western slope of the Gogebic Range. Greater average snowfall is recorded over the Western Uplands and Eastern Ridges than in the adjacent lowlands. The mean dates of first snowfall of consequence (an inch or more) vary from early November in northern localities to early December in southern Wisconsin counties. Average annual duration of snow cover ranges from 85 days in southernmost Wisconsin to more than 140 days along Lake Superior. The snow cover acts as protective insulation for grasses, autumn seeded grains, alfalfa and other vegetation.

The average growing season is defined as the number of days following the last 32 degrees F freeze in the spring through the beginning of fall. Waukesha County's growing season averages 145 days. Shallow lakes normally freeze in late November and remain frozen until late March or early April.

Waukesha County experiences a broad range of highs and lows in temperature and precipitation during the course of a year. Average daily high temperature range from a low of 24.3 degrees in January to a high of 82.6 degrees in July. The yearly average for precipitation is 35 inches and the average snowfall is 43 inches. There are about 190 sunny days per year in the county of Waukesha. (https://www.waukeshacounty.gov/about)

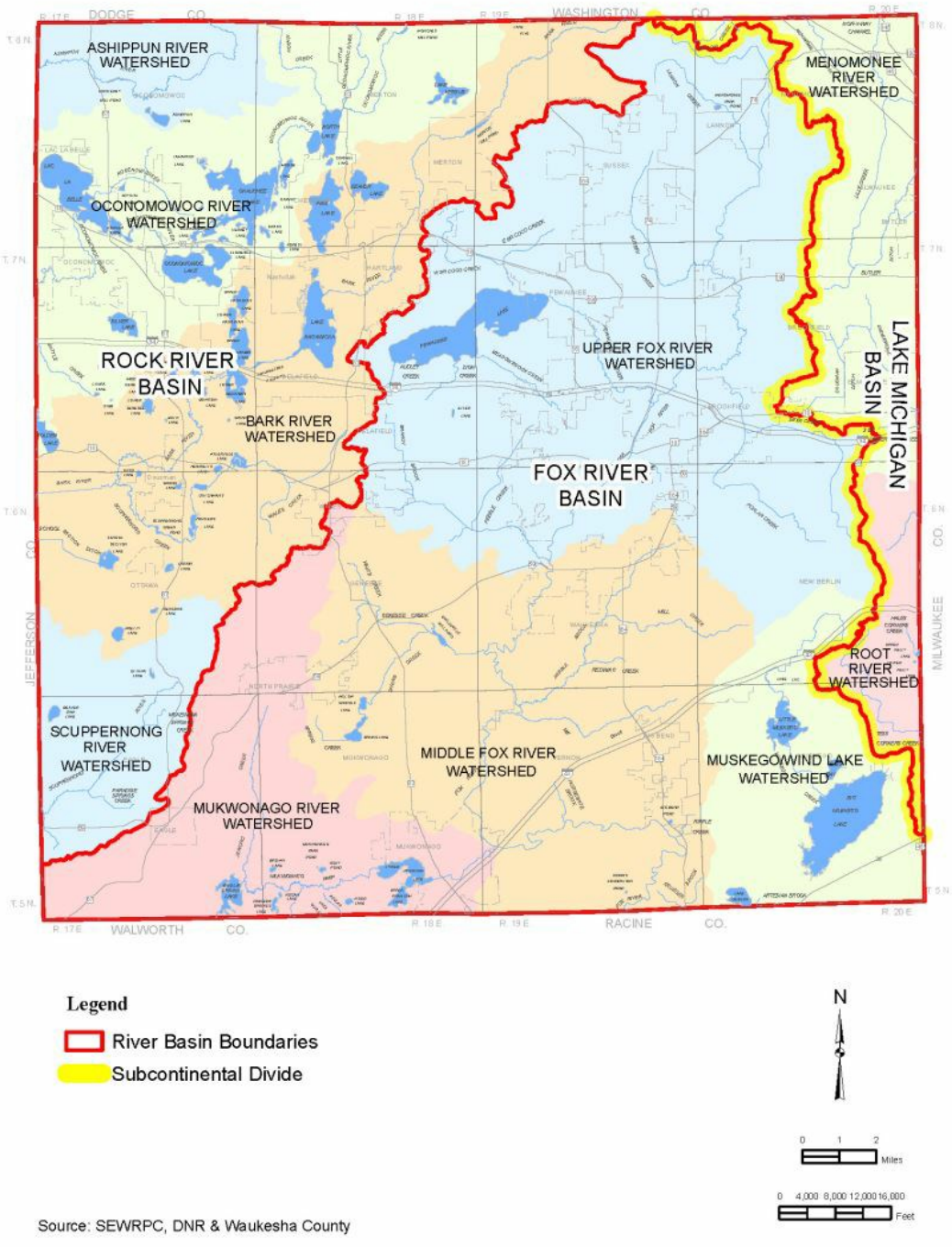
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average High (degrees F)	28	32	43	56	68	78	82	80	73	60	45	31
Average Low (degrees F)	11	14	24	35	45	55	60	59	50	38	28	15
Average Precipitation (inches)	1.46	1.42	1.77	3.39	3.5	4.37	3.86	4.57	3.39	2.6	2.48	1.81
Average Snowfall (inches)	12	8	6	2	0	0	0	0	0	0	2	10

1.4.1.6 Hydrology

The land in Wisconsin drains into Lake Superior, Lake Michigan and the Mississippi River. The Mississippi and St. Croix Rivers form most of the western boundary. About one-half of the northwestern portion of the state is drained through the Chippewa River, while the remainder of this region drains directly into the Mississippi or St. Croix Rivers and into Lake Superior. The Wisconsin River has its source at a small lake nearly 1,600 feet above mean sea level on the Upper Michigan boundary and drains most of central Wisconsin. Most of its tributaries also spring from the many lakes in the north. Except for the Rock River, a Mississippi River tributary that flows through northern Illinois, eastern Wisconsin, drains into Lake Michigan. The subcontinental divide traverses the county in a north-south direction in the eastern tier of communities, separating the county between the Mississippi River and the Great Lakes-St. Lawrence River drainage systems.

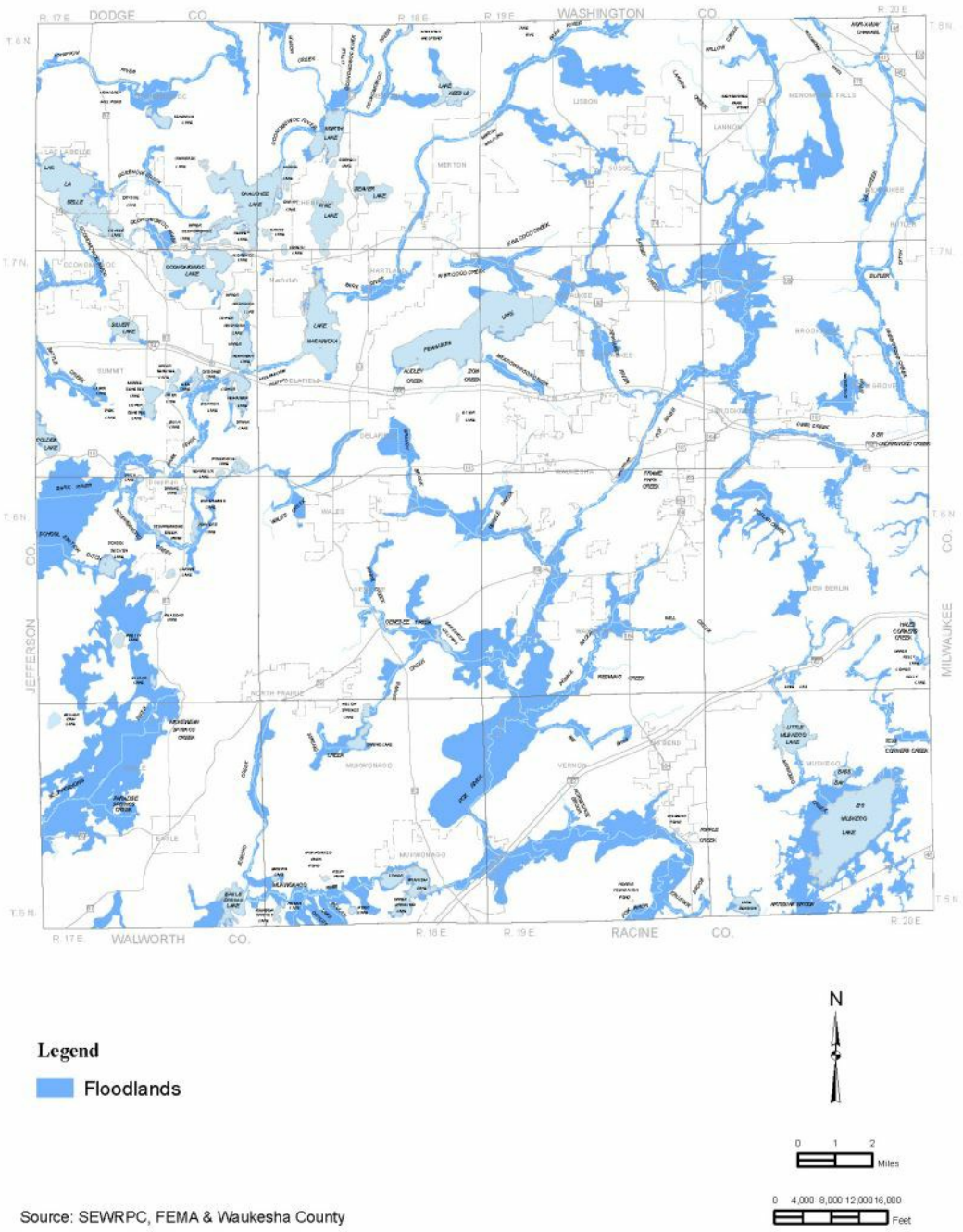
Most of the streams and lakes in the state are ice-covered from late November to late March. Snow covers the ground in practically all the winter months except in extreme southern areas. Flooding is most frequent and most serious in April due to the melting of snow and spring rains. During this period, flood conditions are often aggravated by ice jams that back up the floodwaters. Excessive rains of the thunderstorm type sometimes produce tributary flooding or flash flooding along the smaller streams and creeks.

Watersheds of Waukesha County



Source: SEWRPC, DNR & Waukesha County

General Floodlands of Waukesha County



Groundwater

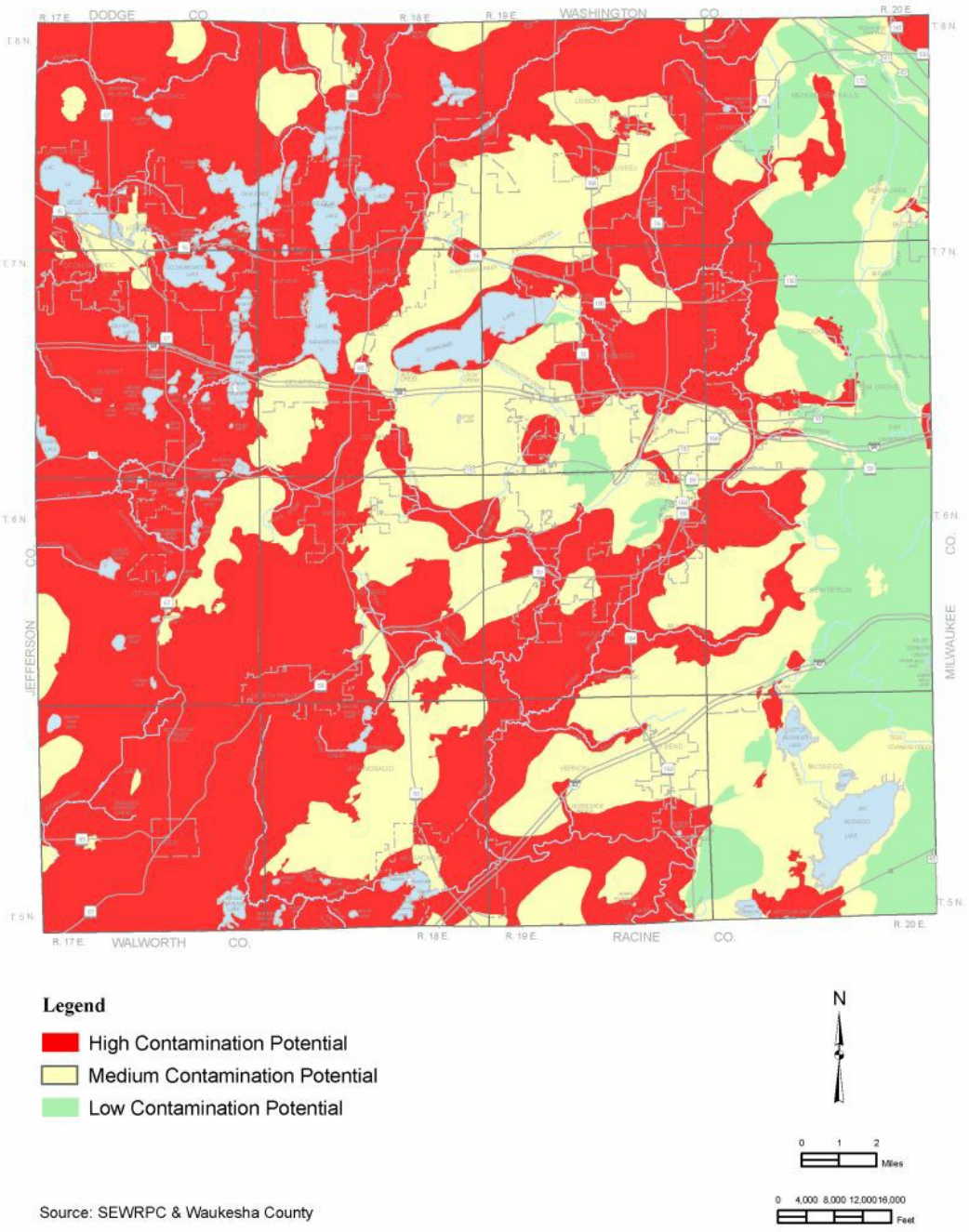
Groundwater reservoirs are recharged by direct precipitation. Spring is a prime time for recharge because evapotranspiration is low and melting snow and rainfall infiltrate and percolate the water table on unfrozen ground. Fall is another prime time for high recharge. During the summer, groundwater levels drop because precipitation is lower causing losses to evaporation and transpiration to exceed precipitation. In addition, groundwater is lost to surface waters by discharge in the form of springs (DeVaul, 1967.) The winter period normally lacks infiltration because of frozen ground.

Groundwater is a vital natural resource of Waukesha County, which not only sustains lake levels and wetlands and provides the perennial base flow of the streams, but also is a major source of water supplies. In general, the county has an adequate supply of groundwater to support its growing population, agriculture, commerce and a viable, diverse industry. However, overproduction and water shortages may occur in areas of concentrated development and intensive water demand, especially in the sandstone aquifer and in selected areas served by the shallow aquifers. The amount, recharge, movement and discharge of the groundwater is controlled by several factors, including precipitation, topography, drainage, land use, soil and the lithology and water-bearing properties of rock units ranging in age from Quaternary to Precambrian. In 2002, the Southeastern Wisconsin Regional Planning Commission (SEWRPC) published Technical Report 37 entitled, Groundwater Resources of Southeastern Wisconsin. The Report provided baseline information regarding groundwater availability and use in southeastern Wisconsin.

Groundwater occurs within three major aquifers that underlie the county. From the land's surface downward, they are: 1) the sand and gravel deposits in the glacial drift; 2) the shallow dolomite strata in the underlying bedrock and 3) the deeper sandstone, dolomite, siltstone and shale strata. Because of their proximity to the land's surface and hydraulic interconnection, the first two aquifers are commonly referred to collectively as the "shallow aquifer" while the latter is referred to as the deep aquifer. Within most of the county, the shallow and deep aquifers are separated by the Maquoketa shale, which forms a relatively impermeable barrier between the two aquifers. That shale layer is absent in the far western portion of the county.

Recharge to groundwater is derived almost entirely from precipitation. Much of the groundwater in shallow aquifers originates from precipitation that has fallen and infiltrated within a radius of about 20 or more miles from where it is found. The deeper sandstone aquifers are recharged by downward leakage of water through the Maquoketa Formation from the overlying aquifers or by infiltration of precipitation in western Waukesha County where the sandstone aquifer is not overlain by the Maquoketa Formation and is unconfined. On the average, precipitation annually brings about 32 inches of water to the surface area of the county. It is estimated that approximately 80 percent of that total is lost by evapotranspiration. Of the remaining water, part runs off in streams and part becomes groundwater. It is likely that the average annual groundwater recharge to shallow aquifers is 10 to 15 percent of annual precipitation.

Groundwater Contamination Potential in Waukesha County



Water Wells

According to the Private Water Supply Wells Program described on the county website, Waukesha County has over 40,000 private wells. Regular testing and cleaning is held upon each individual municipality to ensure the drinking water supply is safe for consumption. It is noted that most of the private wells are not tested for coliform bacteria and other contaminants on the recommended annual basis.

Surface Water

Surface water resources constitute an extremely valuable part of the natural resource base of Waukesha County. Surface waters are a focal point of water-related recreational activities and provide an attractive setting for properly planned residential development. Surface waters, particularly the major lakes, also provide substantial economic benefits. Expenditures by boaters and other recreational users of surface waters benefit the owners of restaurants, grocery and convenience stores, service stations and sporting goods stores in the county. Lakeshore properties, which generally have high-assessed valuations, also serve to enhance the property tax base of the county. In addition, when viewed in the context of open space areas, surface waters greatly enhance the aesthetic and scenic characteristics of the natural environment. Because surface water quality is highly susceptible to deterioration from pollutant runoff, both urban and rural land uses must be carefully managed to achieve a balance between level and extent of use and the maintenance of water quality.

Major inland lakes are defined as those with a surface area of 50 acres or larger, a size capable of supporting reasonable recreational use with minimal degradation of the resource. Waukesha County contains all or portions of 33 major lakes with a combined surface area of approximately 14,000 acres or 21.9 square miles, which is also about 3.8 percent of the total area of the county. This represents about 38 percent of the combined surface area of the 101 major lakes in the seven-county Southeastern Wisconsin Region, more than any other county in the Region. Thirty of the major lakes are located entirely within the county, while three major lakes (Lake Denoon, Golden Lake and Lake Five) are located only partly within the county. Seven lakes in the county have a surface area exceeding 640 acres or one square mile. In addition to the major lakes, there are 45 other water bodies with lake characteristics referenced in the DNR publication, “Wisconsin Lakes”, PUBL-FM-800 91.

For flood control and water quality planning purposes, the Southeastern Wisconsin Regional Planning Commission has divided the Region into 11 major watersheds, four of which are located wholly or partially in Waukesha County. The subcontinental divide traverses the county in a north-south direction in the eastern tier of communities, separating the county between the Mississippi River and the Great Lakes-St. Lawrence River drainage systems. Two of the major watersheds, the Menomonee River and Root River watersheds, lie east of the subcontinental divide and are part of the Great Lakes-St. Lawrence River drainage system. The other two watersheds, the Fox (Illinois) and Rock River watersheds, lie west of the sub-continental divide and are part of the Mississippi River drainage area. The watershed covering the largest area of Waukesha County is that of the Fox River, encompassing about 58 percent of the total area of the county. Major streams are perennial streams, which maintain, at a minimum, a small contiguous flow throughout the year except under unusual drought conditions. Waukesha County contains approximately 268 miles of perennial streams. The longest major streams are the Fox (Illinois) and Bark Rivers, with 46.1 and 31.8 stream miles, respectively, in the county. (Draft Comprehensive Development Plan – Waukesha County)

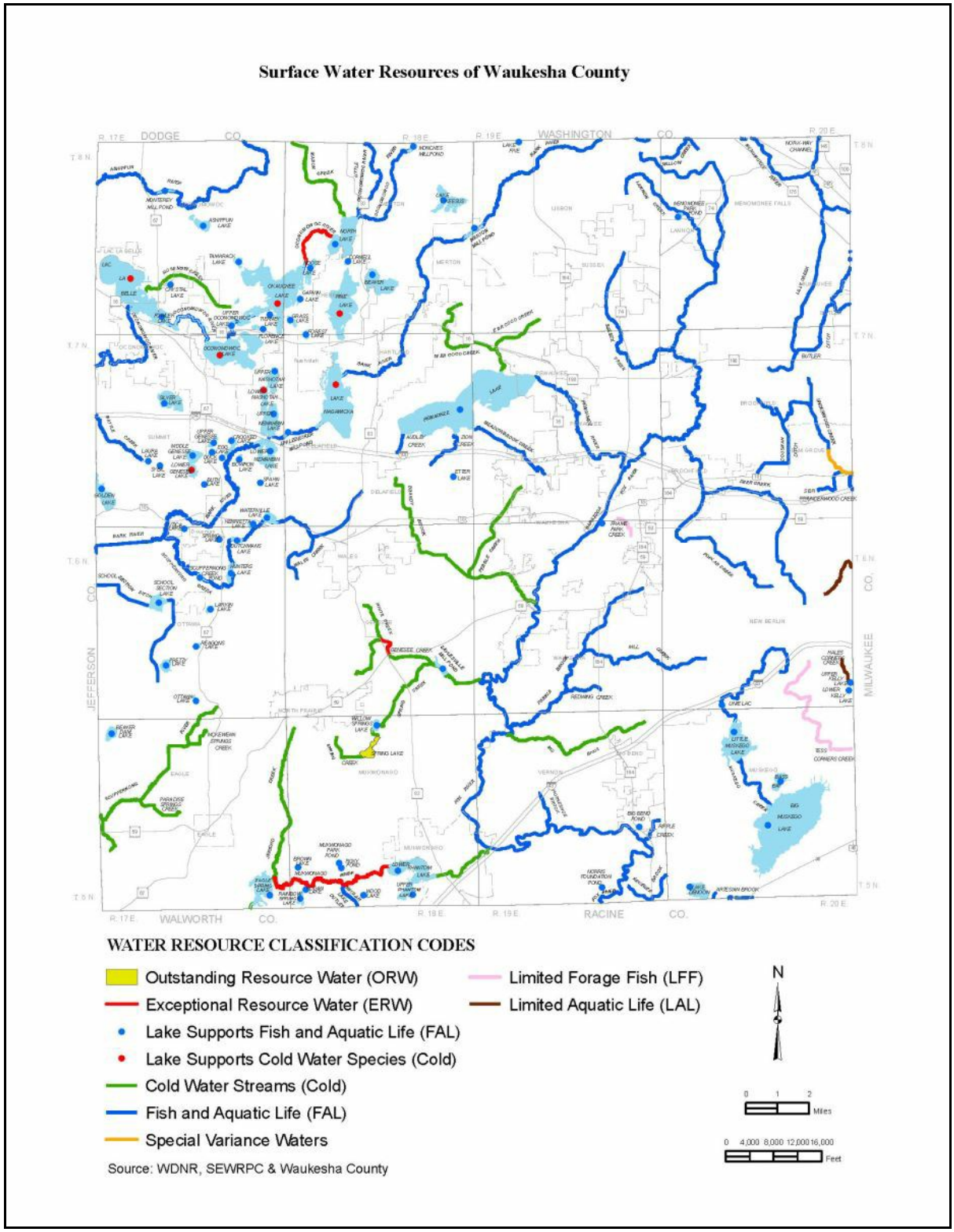
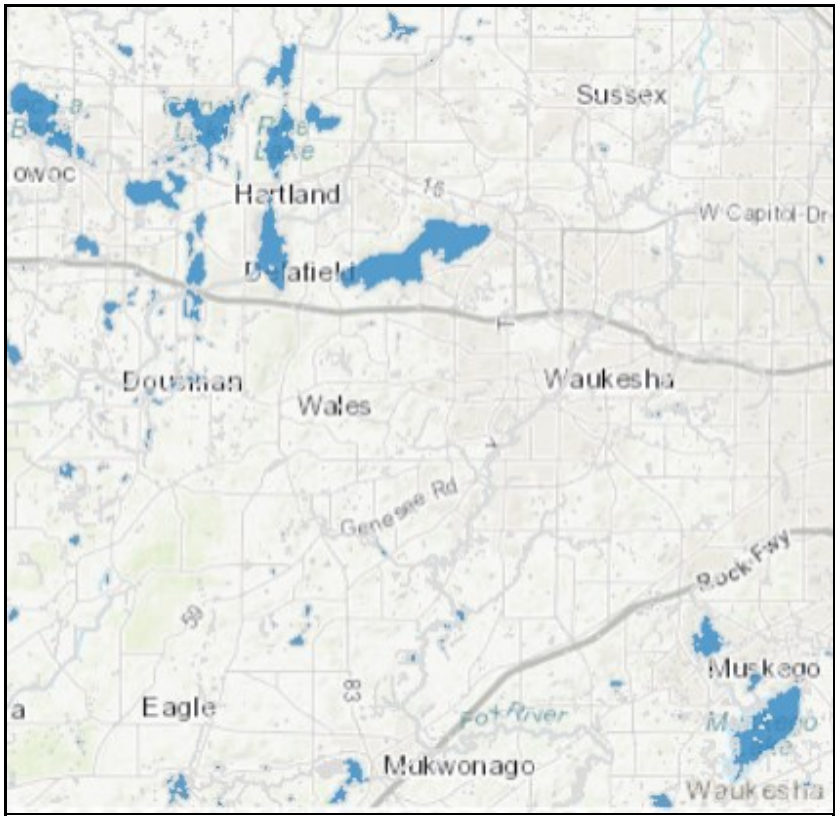


Figure: Water Body Area in Waukesha County

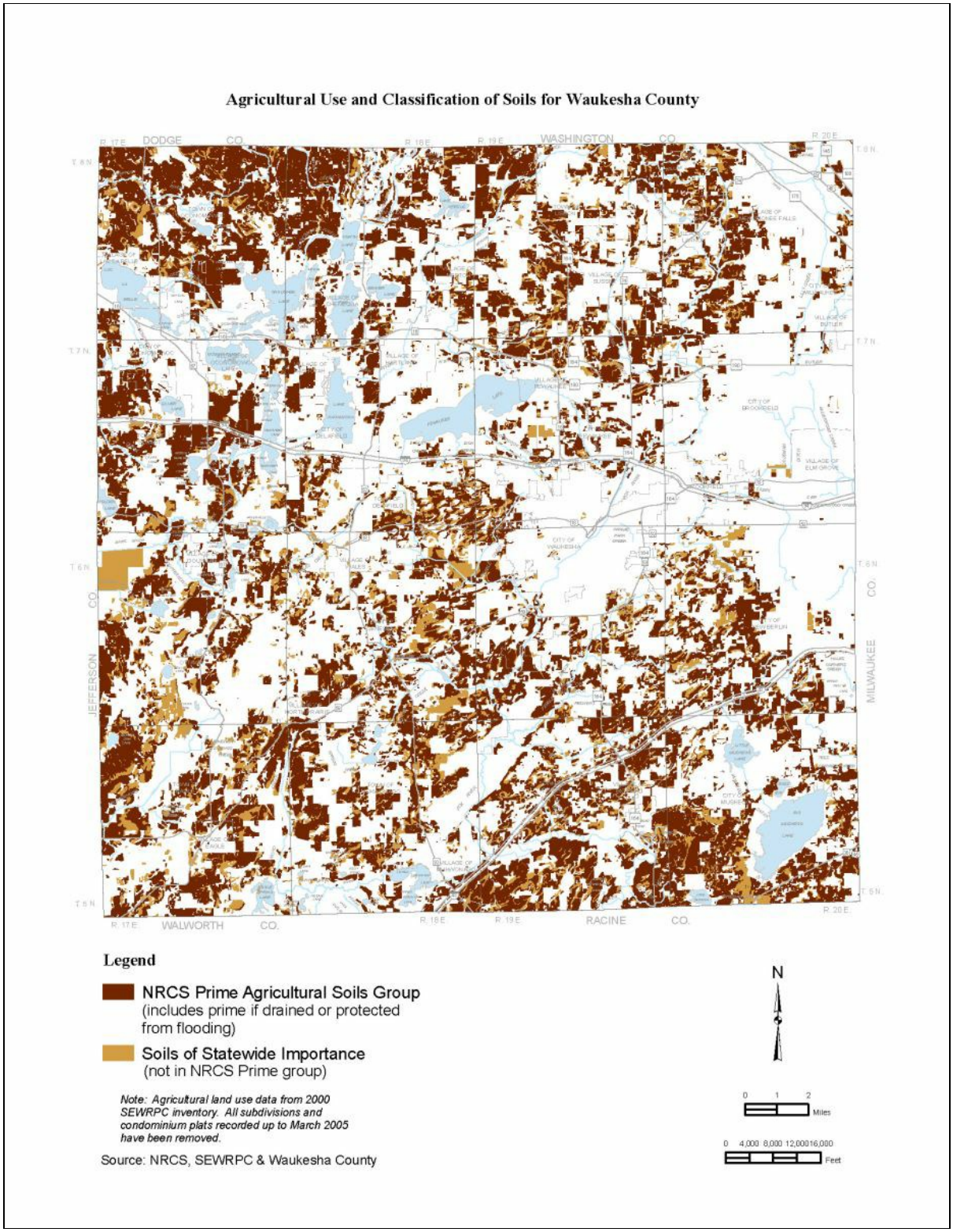


Source: Waukesha County Land Information System Division

1.4.1.7 Soil Types

Soils vary dramatically across the landscape. In Waukesha County nearly 150 different soil map units have been identified. Soils also vary in their individual susceptibility to erosion depending on a number of factors including: parent material, vegetative cover, and position on the landscape. (Waukesha Land and Water Resource Management Plan, 2006)

The soils in Waukesha County range from very poorly drained organic soils to excessively drained mineral soils. General grouping of these soils into soil associations is useful for comparing the suitability of relatively large areas of the county for various land uses. A soil association is defined as a landscape with a distinctive proportional pattern of soils, typically comprised of one or more major soil types and at least one minor soil type, as identified by the S. Department of Agriculture, Natural Resources Conservation Service, and named after the major soils. Nine soil associations are found in the county.



1.4.1.8 Wetlands

Because wetlands provide many benefits to the environment, several municipal, state and federal ordinances/regulations protect wetland areas. The basic concept associated with these laws is that wetland areas on any property cannot be disturbed without a permit. Wetlands store floodwaters and filter water from precipitation before it enters lakes and streams. Some wetlands also recharge local groundwater aquifers. By slowing water movement, wetlands reduce the likelihood that heavy rainfall or spring snowmelt will cause erosion and flooding. Wetlands retain eroded soil and hold nutrients that would otherwise promote excessive weed growth and algae blooms in lakes and streams. These nutrients, when held in the wetlands, produce a heavy growth of vegetation that provides nesting sites, food and cover for waterfowl, small mammals and many other types of wildlife. Wetlands also provide recreational opportunities for humans (wildlife observation, hiking, hunting, etc).

There are three basic factors in determining whether or not a property is a wetland:

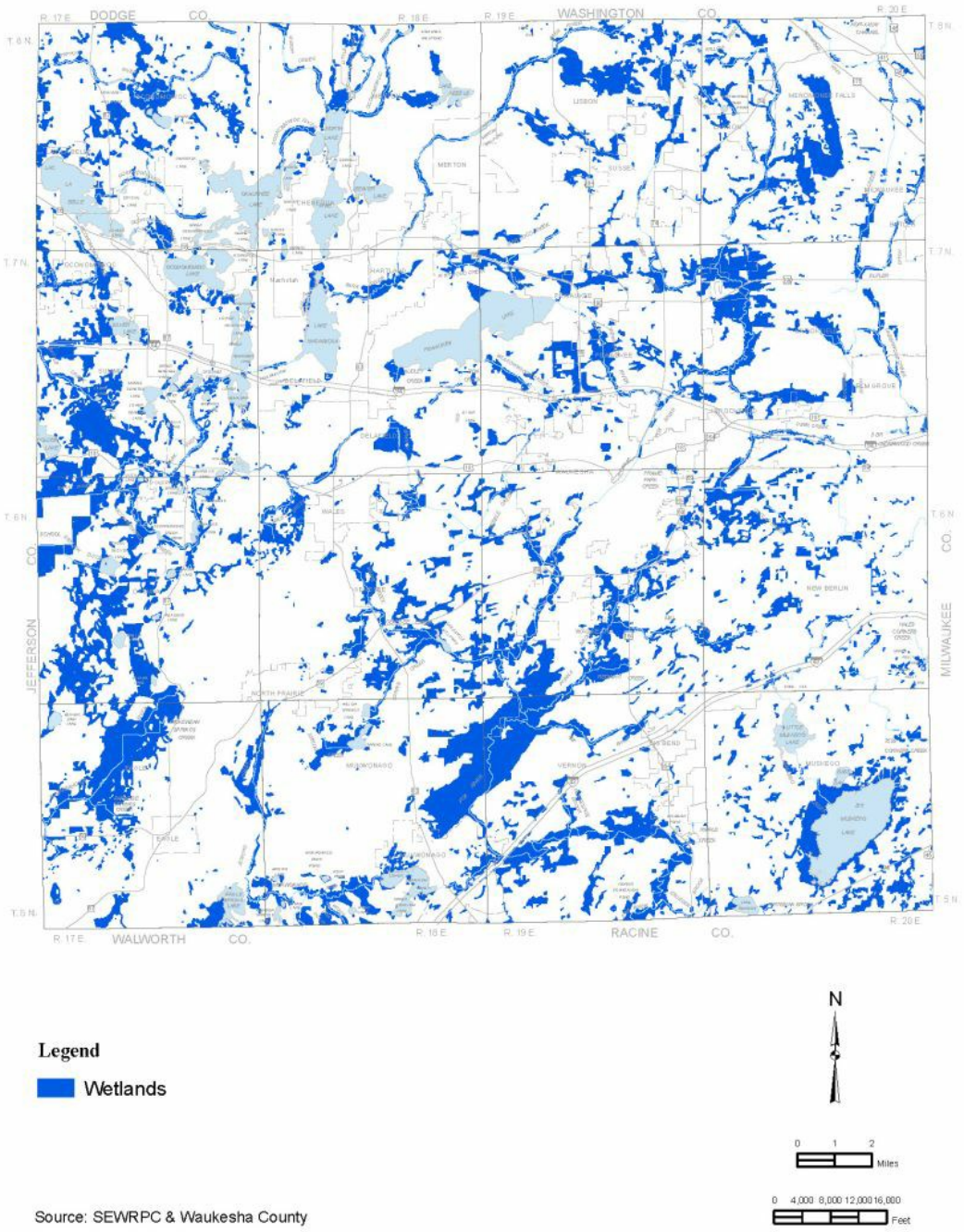
- The presence of water at, near or above the surface (hydrology).
- Water present long enough to sustain aquatic plant life (hydrophytic vegetation).
- Soils indicative of wet conditions (hydric soils).

Wetlands perform an important set of natural functions, which make them particularly valuable resources lending to overall environmental health and diversity. Some wetlands provide seasonal groundwater recharge or discharge. Those wetlands that provide groundwater discharge often provide base flow to surface waters. Wetlands contribute to the maintenance of good water quality, except during unusual periods of high runoff following prolonged drought, by serving as traps, which retain nutrients and sediments, thereby preventing them from reaching streams and lakes. They act to retain water during dry periods and hold it during flooding events, thus keeping the water table high and relatively stable. They provide essential breeding, nesting, resting, and feeding grounds and predator escape cover for many forms of fish and wildlife. These attributes have the net effect of improving general environmental health; providing recreational, research and educational opportunities; maintaining opportunities for hunting and fishing and adding to the aesthetics of an area.

Wetlands pose severe limitations for urban development. In general, these limitations are related to the high water table and the high compressibility and instability, low bearing capacity and high shrink-swell potential of wetland soils. These limitations may result in flooding, wet basements, unstable foundations, failing pavements and failing sewer and water lines. Moreover, there are significant and costly onsite preparation and maintenance costs associated with the development of wetland soils, particularly in connection with roads, foundations and public utilities.

According to the Wisconsin Department of Natural Resources, Waukesha County has approximately 54,913 acres of wetlands (approximately 15.4% of its total area). This is 1% of the total statewide acreage of wetlands.

General Wetlands of Waukesha County



1.4.1.9 Land Use

The land in Waukesha County consists of farmland, shoreland and forests as well as commercial, residential and industrial land. The total land area is 556 square miles. The total water area is 25 square miles.

According to the Waukesha County Land Information System Division, in 2015, land use was divided as follows:

Urban

- Residential – 86,007 acres
- Commercial – 6,780 acres
- Communications and Utilities – 902 acres
- Landfills & Dumps – 889 acres
- Industrial – 5,945 acres
- Transportation – 31,760 acres
- Government – 5,840 acres
- Recreational – 9,359 acres
- Unused Urban – 7,806 acres

Non-Urban

- Surface Water – 18, 069 acres
- Wetlands – 57,518 acres
- Woodlands – 31,826 acres
- Agricultural – 76,028 acres
- Unused Rural – 23,391 acres

Unused or Open – 36,711 acres

Natural Areas:

A comprehensive inventory of natural areas within the county was conducted by the Southeastern Wisconsin Regional Planning Commission in 1994 as part of the natural areas and critical species habitat protection and management plan being prepared by the commission. The inventory systematically identified all remaining high quality natural areas and critical species habitat then existing within the region.

Natural areas were classified based upon the natural area classification system developed by the Wisconsin Department of Natural Resources. Three classification categories are used: NA-1, natural areas of statewide or greater significance, which contain nearly complete and relatively undisturbed plant and animal communities which are believed to resemble closely those of presettlement times; NA-2, natural areas of countywide or regional significance, which contain native biotic communities judged to be of lower than NA-1 significance, either because of evidence of a limited amount of human disturbance or because of limited size; and NA-3, natural areas of local significance, which have been substantially altered by human activities but which provide refuge for native plant and animal species that no longer exist in the surrounding area because of land uses and associated activities. A total of 105 natural areas, encompassing about 13,710 acres, or about 4 percent of the county, were identified by the Regional Planning Commission in Waukesha County in 1994. Of the 105 identified sites, nine were classified as NA-1 sites and encompass about 1,775 acres, 30 were classified as NA-2 sites and encompass about 4,890 acres, and 66 were classified as NA-3 sites and encompass about 7,045 acres.

The inventory also identified a total of 77 critical species habitat sites within Waukesha County, including 22 critical bird habitat sites, one critical mammal habitat site, and 54 critical plant habitat sites. Of the total sites, 12 critical bird habitat sites, one critical mammal habitat site, and 23 critical plant habitat sites were located outside an identified natural area, for a total of 36 critical species habitat sites located outside natural areas.

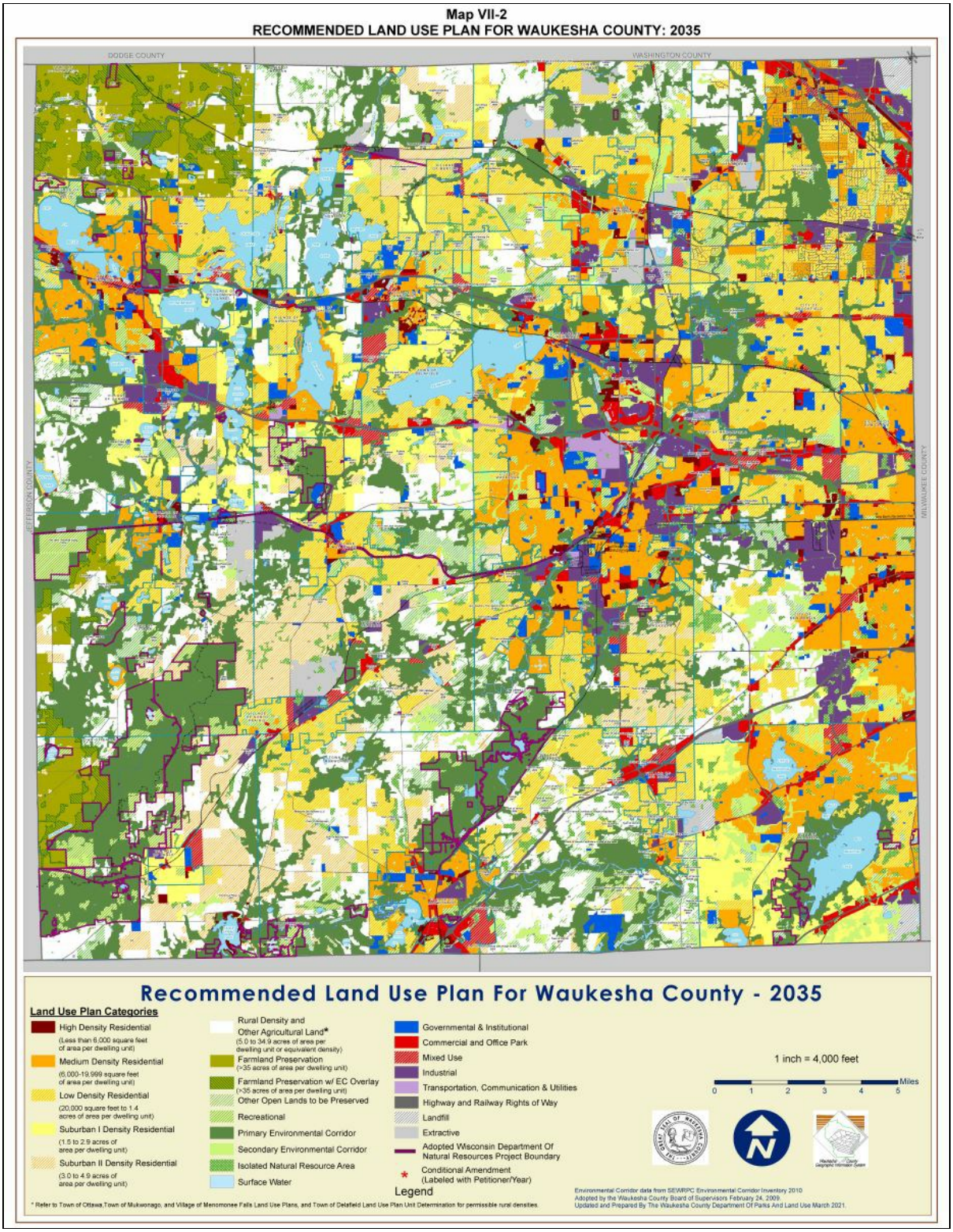
Waukesha County's state and county many natural areas include:

- **Fox Brook Park**, Located in the City of Brookfield, is a 173- acre park site consists of 128 acres of wetlands, which will be preserved and protected as a natural habitat and open space area. This habitat allows for many species of birds; gold finches and indigo buntings to name a few.
- **Fox River Park** is a 262-acre park and represents an outstanding area for providing a feeling of wilderness and solitude. The abundance of wildlife provides great opportunities for nature study and the exploration of the natural world. Many wildflowers and bird species can be viewed along the trails that wind through the park.
- **Menomonee Park** is located within the Villages of Menomonee Falls and Lannon. Menomonee Park totals 394 acres of rolling field, high-quality maple woods, cattail marsh, wetlands, and a 16-acre quarry lake.
- **Minooka Park** is located approximately 2 miles southeast of the City of Waukesha at the corner of Racine Avenue and Sunset Drive. This 580-acre park is the largest park in the Waukesha County Park System
- **Mukwanago Park** is a 222-acre park site that includes a high ridge formed during the last glacial period, which stretches nearly the length of the park. The oak opening ridge is covered with presettlement vegetation including Burr Oak, Shagbark Hickory and ground cover of prairie plants.
- **Muskego Park** - The State of Wisconsin Scientific Area Preservation Council named the 60 acres of hardwoods that inhabit the park a State Scientific Area. This area is to preserve valuable plant communities, teach conservation practices and study the area's natural history. Many trails wind through Muskego Park Hardwoods offering a tranquil atmosphere and home to abundant wildlife.
- **Naga-Waukee Park and Golf Course** are located north of I-94, spanning the lands between the shores of Nagawicka Lake and Pewaukee Lake. This 416-acre parcel consists of a regional park, a championship 18-hole golf course and 2 lake access sites. The diverse topographical features were

created during the glacial age, which enhances the beauty of the site.

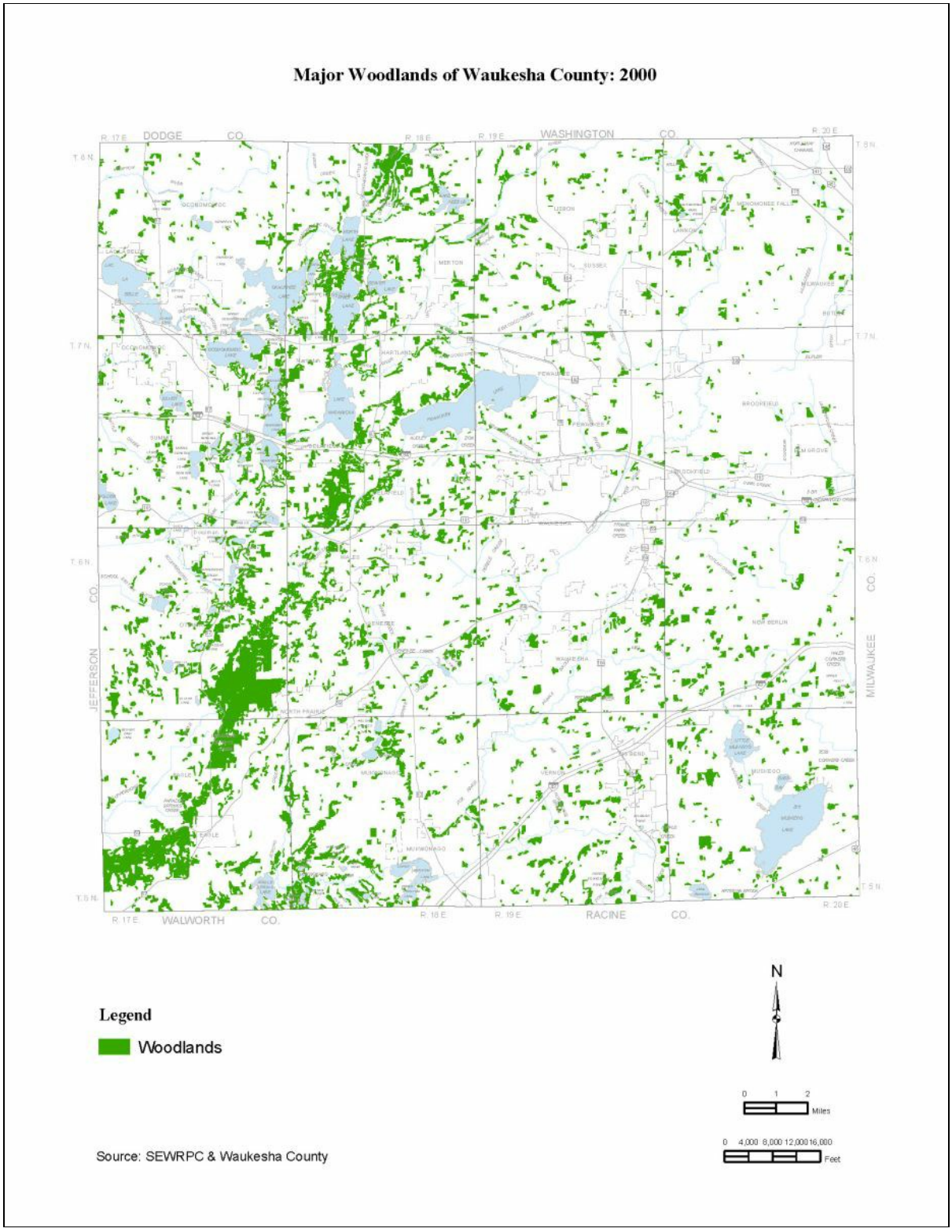
- **Nashotah Park** is located between the communities of Oconomowoc and Hartland, 1/2 mile north of U.S.H. 16 on the west side of C.T.H. C. This 443-acre park is nestled among rolling hills, woodlands, wetlands and grasslands, offering habitat for deer, waterfowl and a variety of songbirds.
- **Old World Wisconsin** in Eagle is one of the country's finest outdoor living history museums and offers 576 acres to explore with over 55 historic structures moved from around the state of Wisconsin, telling the history of Wisconsin's earliest settlers.
- **Kettle Moraine State Forest – Southern Unit** is more than 20,000 acres of glacial hills, kettles, lakes, prairie restoration sites, pine woods and hardwood forests making this a popular area for a wide variety of visitors. The 3,500-acre Scuppernong River Habitat Area is the largest wet prairie east of the Mississippi River.
- **Kettle Moraine State Forest – Lapham Peak Unit.** The Kettle Moraine and Lapham Peak were formed 10,000 years ago when a glacier covered much of Wisconsin. More than 1,000 acres of this hilly terrain are within the Lapham Peak boundaries. Lapham Peak has a variety of sights and activities to offer. (http://www.waukeshacountywi.com)

Map VII-2
RECOMMENDED LAND USE PLAN FOR WAUKESHA COUNTY: 2035



1.4.1.10 Vegetation

Sugar maple, basswood and elm dominate in the east and northwest portions of the county. In the central part of the county there is a large area of oak savanna. In the south part of the county there are a few areas of sugar maple.



1.4.2 Demographics and Infrastructure

Waukesha County contains the Cities of Brookfield, Delafield, Muskego, New Berlin, Oconomowoc, Pewaukee and Waukesha; the Villages of Big Bend, Butler, Chenequa, Dousman, Eagle, Elm Grove, Hartland, Lac La Belle, Lannon, Menomonee Falls, Merton, Mukwonago, Nashotah, North Prairie, Oconomowoc Lake, Pewaukee, Summit, Sussex, Vernon, Wales, and Waukesha; and the Townships of Brookfield, Delafield, Eagle, Genesee, Lisbon, Merton, Mukwonago, Oconomowoc, and Ottawa.

1.4.2.1 Human Settlement Patterns

The first evidence of human settlement in the Mississippi River Region was approximately 11,000 years ago, following closely the withdrawal of the Wisconsin glacier. These earliest known “Paleo- Indians” were hunter-gatherers that traveled in small nomadic family groups. This Ice Age era was known geologically as the Pleistocene period.

Between 1670 and 1680, the first Europeans to visit this land were the French traders to establish trading and military posts in the name of France, and the Jesuits to bring Christianity to the native inhabitants. Because the French made no definite settlement of the territory they yielded their rights to the English in 1761, who claimed possession until after the Revolutionary War. By the Treaty of 1835, the Indian tribes gave up their homeland and were moved to the country west of the Mississippi.

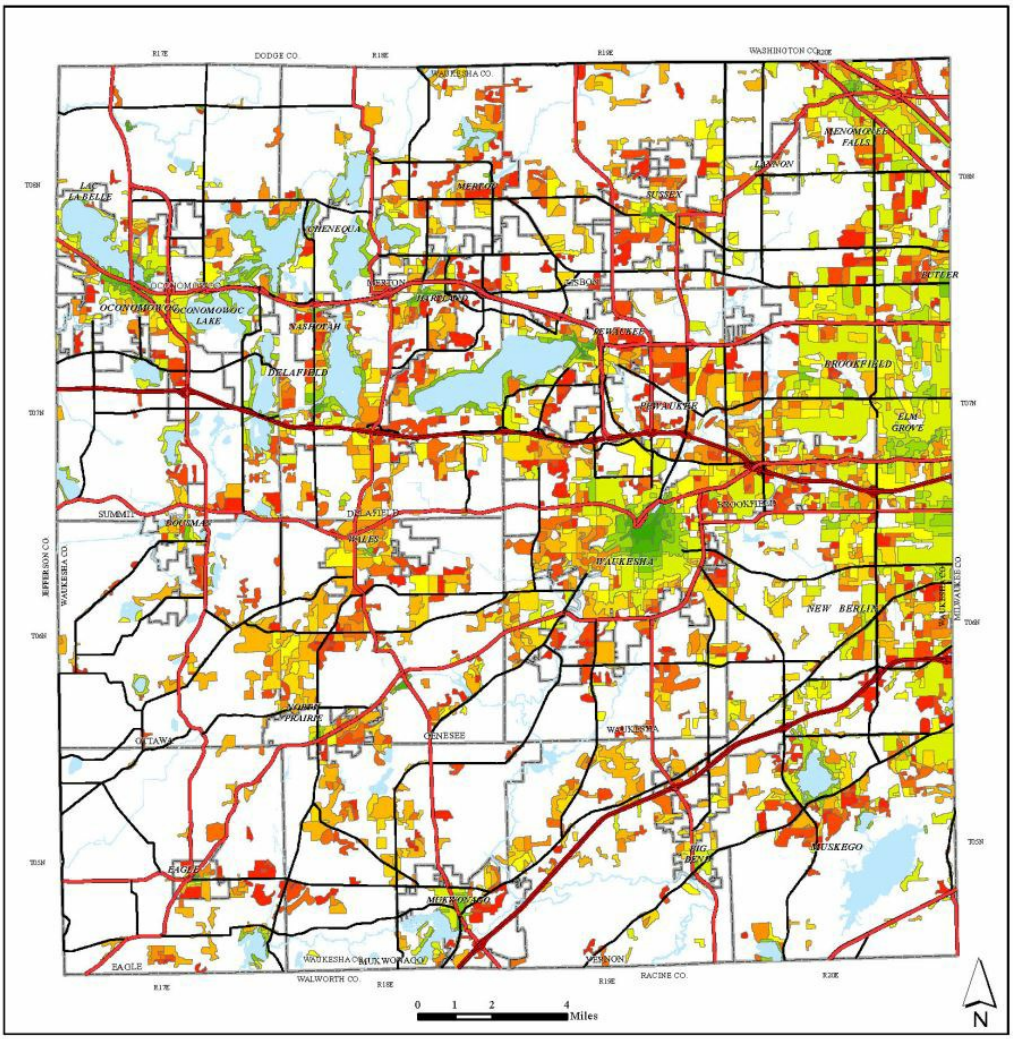
Waukesha County was home to prehistoric Indians, including the Effigy Mound Builders and Potawatomi people and was prized by fur traders in the 1700s. When settlers from the east arrived in the mid-1800s, they found four to six-foot earthen mounds in the shape of birds and turtles, along with conical and linear mounds. Three conical mounds are visible today in front of the City of Waukesha Library. Increase Lapham, considered founder of the U.S. Weather Bureau, surveyed the mounds. The highest point in Waukesha County is named for him. (www.waukeshacounty.gov)

In January of 1846, the Territorial Legislature voted to separate Waukesha County from Milwaukee. There was a strong popular desire for an Indian name. Waukt-shaw was suggested as being the Potawatomi form of fox, because the waters of the lower part of the county drain into Fox River of Illinois, which is named for the Fox tribe of Indians not for the animal.

In April of 1846, Waukesha County was formed with sixteen townships. Supervisors representing each of the sixteen towns were elected to organize a county board, elect officers and to provide for and build necessary county buildings.

HISTORIC GROWTH RING ANALYSIS IN WAUKESHA COUNTY: 1850-2000

Historic Urban Growth in Waukesha County: 1850-2000



Legend

- Civil Division Boundary
- Interstate
- US
- State
- County

Historic Urban Growth

Year

- 1850
- 1880
- 1900
- 1920
- 1940
- 1950
- 1963
- 1970
- 1975
- 1980
- 1985
- 1990
- 1995
- 2000

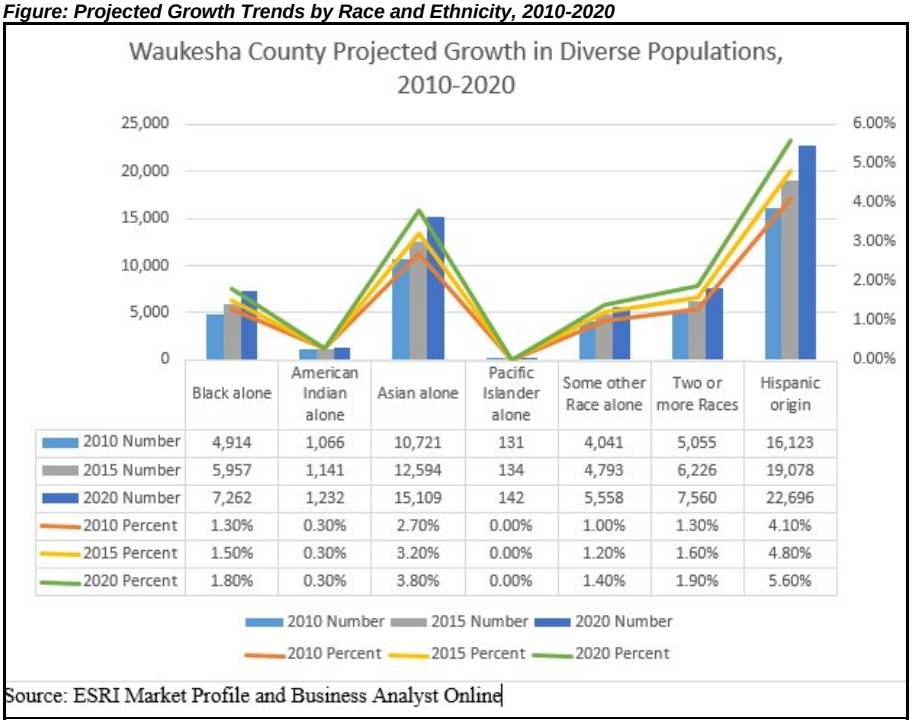
Source: SEWRPC and Waukesha County Civil Divisions as of 5/31/08
Prepared by Waukesha Co. Dept. of Parks and Land Use

1.4.2.2 Population

In recent decades, Waukesha County has experienced rapid development. The development has been accompanied by a population increase of 35% in 27 years. In 1980, the county was home to nearly 280,326 people; in 2001, there were 360,767 and according to the 2010 U.S. Census Bureau estimate, there are 389,981 people residing in Waukesha County. According to the U.S. Census 2019 estimations, the population of Waukesha County had an increase in population by 3.7% from April 2010 to July 2019. The population now is around 404,198, but the projected population growth shows that by 2035 Waukesha County will have nearly 450,000 residents. The estimated report also states there are 167,951 households, the median household income is $282,300, and that the per capita income is $46,043 in Waukesha County. (U.S. Census). Compared to the state of Wisconsin, Waukesha County's population growth is slightly faster with an almost 1% faster growth from 2010-2017 (Waukesha County by the Numbers).

Race and Ethnicity: According to the U.S. Census 2019 estimations, the overwhelming majority of people in Waukesha County reported are white. People of Hispanic or Latino origin totaled 6.4% and Black or African American people totaled 4.6% of the population. The other demographics of people, such as Asians, Native Americans, or those of to or more races only accounted for almost 10% of the total County population. (Data USA).

Figure: Projected Growth Trends by Race and Ethnicity, 2010-2020



	Black alone	American Indian alone	Asian alone	Pacific Islander alone	Some other Race alone	Two or more Races	Hispanic origin
2010 Number	4,914	1,066	10,721	131	4,041	5,055	16,123
2015 Number	5,957	1,141	12,594	134	4,793	6,226	19,078
2020 Number	7,262	1,232	15,109	142	5,558	7,560	22,696
2010 Percent	1.30%	0.30%	2.70%	0.00%	1.00%	1.30%	4.10%
2015 Percent	1.50%	0.30%	3.20%	0.00%	1.20%	1.60%	4.80%
2020 Percent	1.80%	0.30%	3.80%	0.00%	1.40%	1.90%	5.60%

Source: ESRI Market Profile and Business Analyst Online

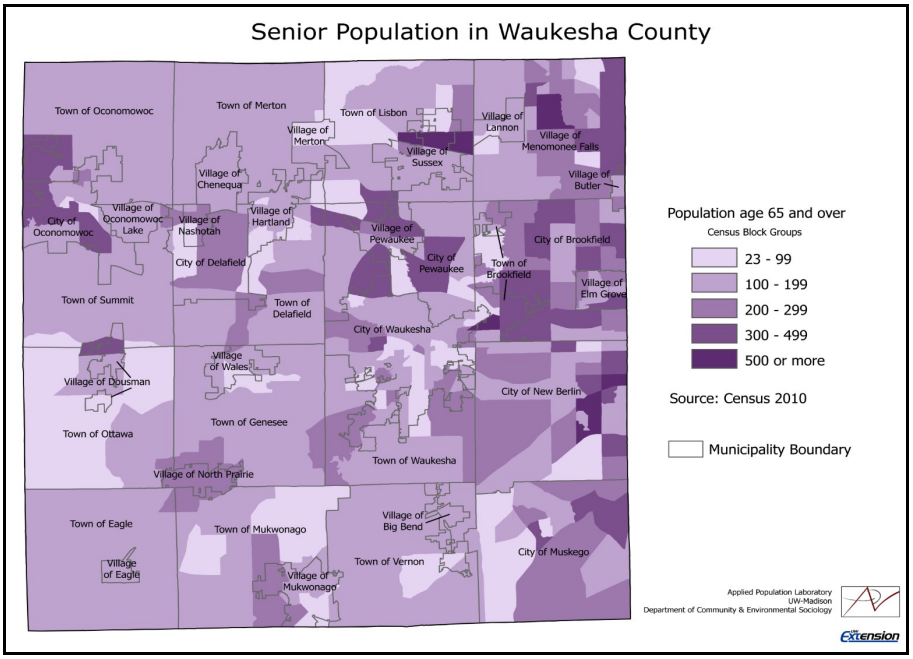
Source: Waukesha County Department of Health and Human Services, Environmental Scan, 2015

Home Ownership and Home Rent: According to the 2019 American Community Survey 5-Year Estimates, roughly 76% of the households in Waukesha County were rental households, with that percentage much higher for Latino and African Americans. Based on 2019 City Data, there are roughly 32,312 housing units with a mortgage and 39,328 without in Waukesha County.

Poverty: The poverty rate has increased in Waukesha County and according to the 2019 American Community Survey 5-Year Estimates, over 5% of children under the age of 18 are living in poverty. This percentage, however, is considerably lower than the national average of 18%. According to the same data, close to 60% of those living in poverty are white, followed by Latino/Hispanic with 17%, and African American with 10% living in poverty.

Population Age: The median age in Waukesha County, according to the 2019 American Community Survey 5-Year Estimates, is 42 years of age, which is older than the national average of 38 years. Wisconsin counties. Around 19% of the entire population in Waukesha County are 65 years and older. The portion of people 65 years and older is greater the portion of people under the age of 18 by 14 %, however people under the age of 18 is only 3% more. Projected age group trends state that people over the age 85 will count for the majority of the population by the year 2050 (Waukesha County by the Numbers).

Figure: Concentration of Senior Population in Waukesha County, 2010

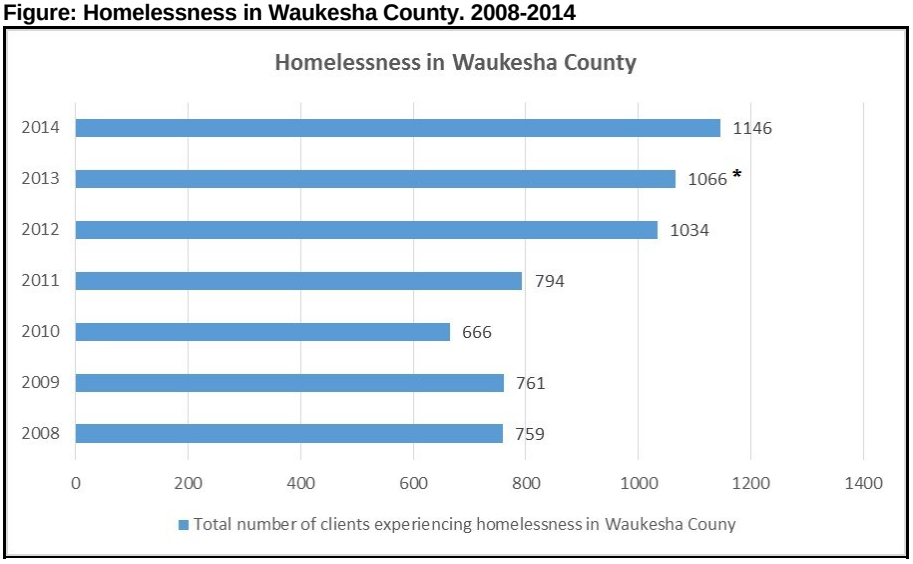


Source: Waukesha County Department of Health and Human Services, Environmental Scan, 2015

Alcohol and Drug Use: The residents in Waukesha County, based on CDC Behavioral Risk Factor Surveillance System Survey Questionnaires from 2013 to 2019, adult residents consume alcohol less than the average amount per 30 days. Also, 44.5% of residents smoked 100 cigarettes in their lives which follows about the national average of cigarette use trends. A previous Community Health Assessment in 2014 indicated that alcohol and other drug use was the third highest health priority for both men and women in the County. Older data also suggested a slight decline in alcohol use among youth.

Homeless: According to the Environmental Scan, Waukesha County had 1,078 clients who were experiencing homelessness in 2013 and children made up 23% of the total homeless population in the County. From 2010 to 2014 there has been a 72% increase in homelessness in the County. There are resources for those who are homeless, such as the Continuum of Care community group which delivers services and housing and others such as Rapid Rehousing, Eviction Prevention, Transitional Housing, and Supportive Services for Veteran Families.

Figure: Homelessness in Waukesha County. 2008-2014



Transportation and Population: According to City Data, about 84% of the population in Waukesha County rely on driving a car alone as their means of transportation. However, less than 1% of the population rely on all other forms of transportation, such as carpooling, public transportation, bus system, taxicabs, or bicycling (City Data). These transportation trends mirror that of the other counties in the state of Wisconsin since 2019 (Waukesha County by the Numbers).

Transit-dependent population characteristics include: seniors (ages 75 and older), people in low-income households, disabled individuals and households with no vehicles. Based on a report on transportation access and equity in Wisconsin, transportation agencies such as Waukesha Metro, the Waukesha County Aging, Disability Resource Center, and Interfaith Caregiving Network offer transportation services for medical appointments, shopping, employment and other personal needs for Transit-dependent groups in the Waukesha county. Such transportation services are used for These programs are essential, especially in the more rural parts of Waukesha County that do not have the population density to support a bus system.

The following table below illustrates functional access needs populations in Waukesha County that are most likely to be dependent upon transit. According to the Environmental Scan, in 2010, higher concentrations of people dependent on transit lived in the Cities of Waukesha, New Berlin, Brookfield and the Village of

Menomonee Falls. Isolated areas of need exist in smaller concentrations of population located within the City of Oconomowoc and the Villages of Dousman and Hartland.

Table: Trends in Transit-Dependent Population Groups in Waukesha County

Transit-Dependent Population Group	1990		2000		2010	
	Number	% of Total Population/Households	Number	% of Total Population/Households	Number	% of Total Population/Households
Seniors (75 & older)	12,240	4	19,980	6	25,286	6
Persons in Low-income Households	31,395	10	32,997	9	48,177	12
Disabled Persons	5,164	2	12,978	4	32,258	8
Households with No Vehicle Available	3,969	4	5,689	4	5,956	4
Total County Population	**304,715**	**-**	**360,767**	**-**	**389,891**	**-**
Total Number of Households	**105,990**	**-**	**135,229**	**-**	**151,161**	**-**

Source: Waukesha County Department of Health and Human Services, Environmental Scan, 2015

1.4.2.3 Transportation Network

Waukesha County has over 2,917 miles of federal, state, county and local roads within the county and over 373,000 registered automobiles, trucks, semi-trailers and motorcycles. Four freeways, Interstate Highway 43, Interstate Highway 94, State Highway 16 and U.S. Highway 41/45 serve Waukesha County. In addition, the county is served by State Highways 36, 59, 67, 74, 83, 100, 145, 164, 175 and 190. The County Trunk System includes over 391 miles of roads. Over 78 percent of road miles in Waukesha County are local village, town or city roads.

This street and highway system within the county serves several important functions; including providing movement of vehicular traffic; providing access for vehicular traffic to abutting land uses; providing for the movement of pedestrians and bicycles and serving as a location for utilities and stormwater drainage facilities.

An arterial is a high-volume street that functions to conduct traffic between communities and activity centers and to connect communities to interstate highways. Arterial streets are defined by as streets and highways which are principally intended to provide a high degree of travel mobility, serving the through movement of traffic and providing transportation service between major sub-areas of an urban area or through an area. In a rural area, an arterial is a high-volume street that functions to conduct traffic between communities and activity centers and to connect communities to interstate highways. Together, arterial streets should form an integrated, area-wide system. The most heavily traveled arterial streets and highways in the County are Interstate Highway 94, Bluemound (US Highway 18), Capitol Drive (State Trunk Highway 190), Moorland Road (County Trunk Highway O), Cleveland Avenue (County Highway D), Interstate Highway 43, State Highway 164, U.S. Highway 41/45, State Highway 16, State Highway 59, County Highway F, County J (Pewaukee Road) and State Highway 74.

In addition to their functional classification, arterial streets and highways are also classified by the unit of government that has the responsibility, or jurisdiction, over the facility. The Wisconsin Department of Transportation (WisDOT) has jurisdiction over the state trunk highway system, Waukesha County has jurisdiction over the county trunk highway system and each local government unit has jurisdiction over local arterial streets within their community. The state trunk highway system, which includes interstate highways, U.S.–numbered highways and state highways, generally carry the highest traffic volumes, provide the highest traffic speeds, have the highest degree of access control and serve land uses of statewide or regional significance. State trunk highways serve the longest trips, principally carrying traffic traveling through Waukesha County and between Waukesha County and surrounding counties. County trunk highways should form an integrated system together with the state trunk highways and principally serve traffic between communities in the county and land uses of countywide importance. Local arterial streets and highways would serve the shortest trips, serve locally-oriented land uses, carry the lightest traffic volumes on the arterial system, carry traffic at lower speeds, have the least access control and predominately serve traffic within a community. (Draft Comprehensive Development Plan – Waukesha County)

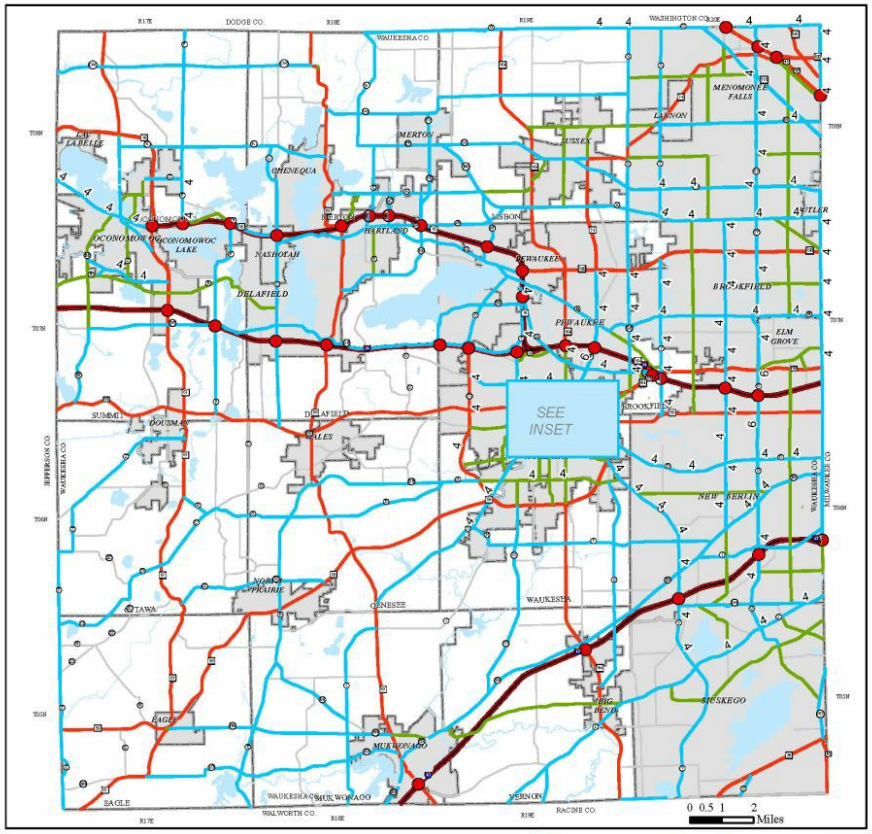
Waukesha County has a good transportation network. Waukesha County has maintained these roads along with others to provide a safe and efficient transportation system. With continued maintenance, these roads will continue to serve the population effectively.

According to the Waukesha County Environmental Scan, over 389,000 people in the County were Transit Dependent. This population includes seniors, people in low-income households, disabled individuals, and households with no vehicles.

For the general public, principal transportation services include the Waukesha Metro Transit and the Waukesha County Transit System.

There are several specialized transportation services available for special populations, such as disabled or elderly riders.

Waukesha County Recommended Functional Improvements to the Arterial Street & Highway System Under the 2035 Regional Transportation System Plan

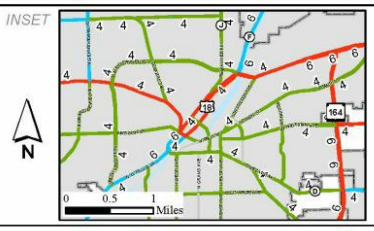


Legend

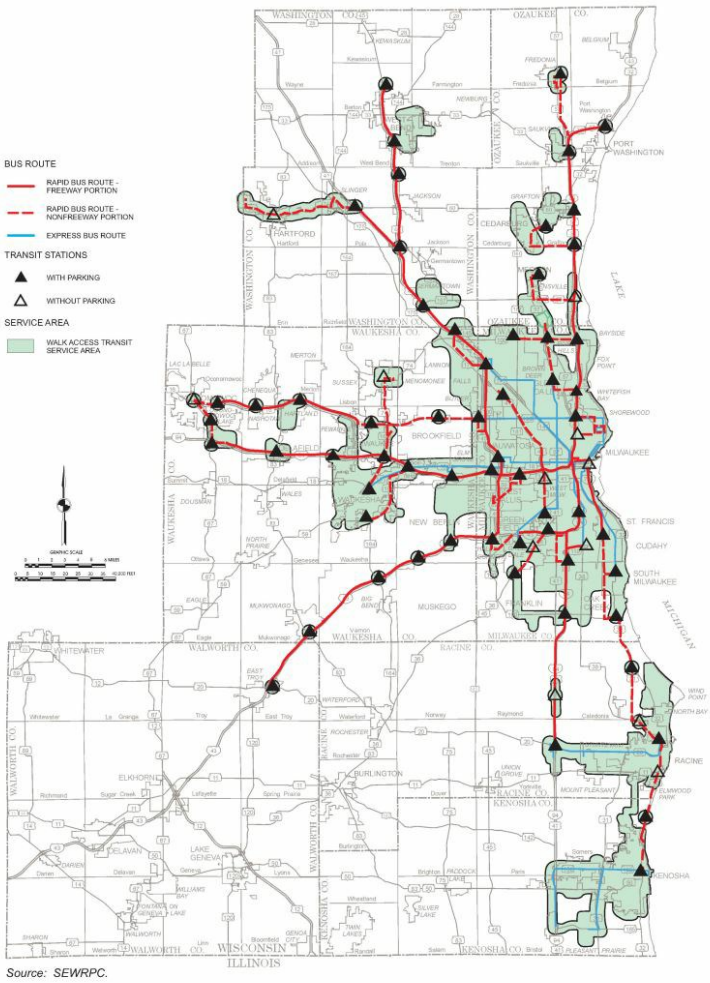
- Major Water Body
- Town
- City or Village
- Interchange
- Half Interchange
- 4 Number of Traffic Lanes (2 Where Unnumbered)
- Other Major Roads
- County Trunk Highway
- Local Trunk Highway
- State Trunk Highway - Freeway
- State Trunk Highway - Standard

Source: SEWRPC

Civil Divisions as of 12/31/07
Prepared by Waukesha Co. Dept. of Parks and Land Use

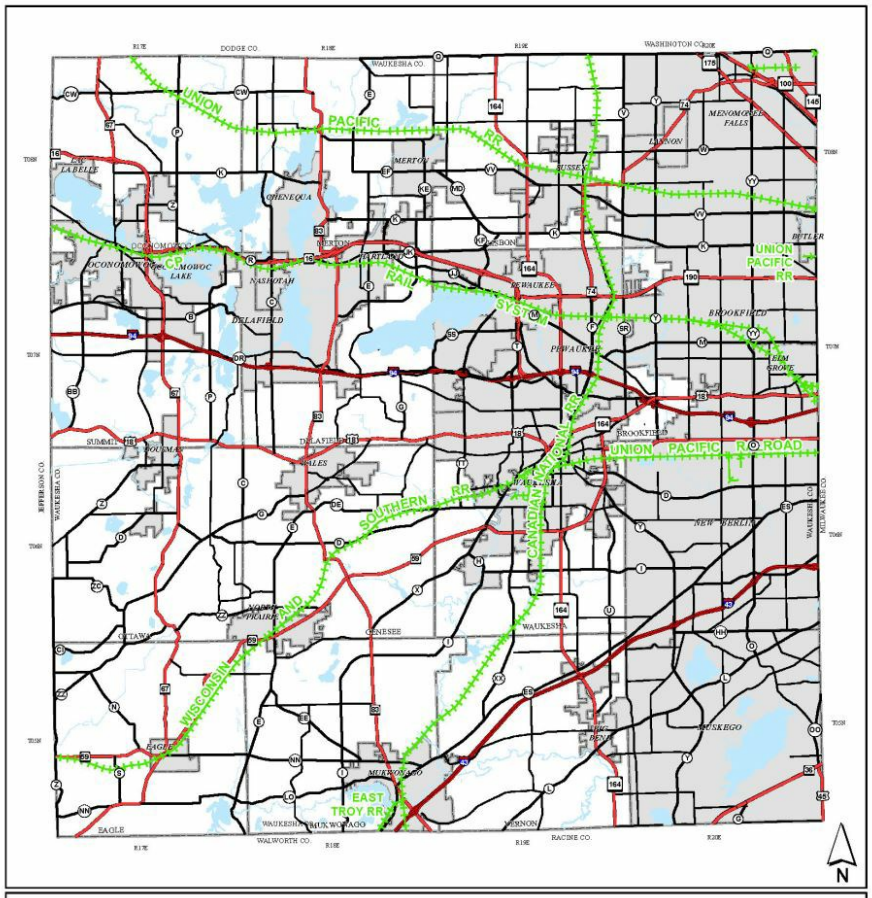


Recommended Public Transit Element of the
2035 Regional Transportation System Plan for Waukesha County



Source: SEWRPC.

Existing Railroad Routes in Waukesha County: 2007

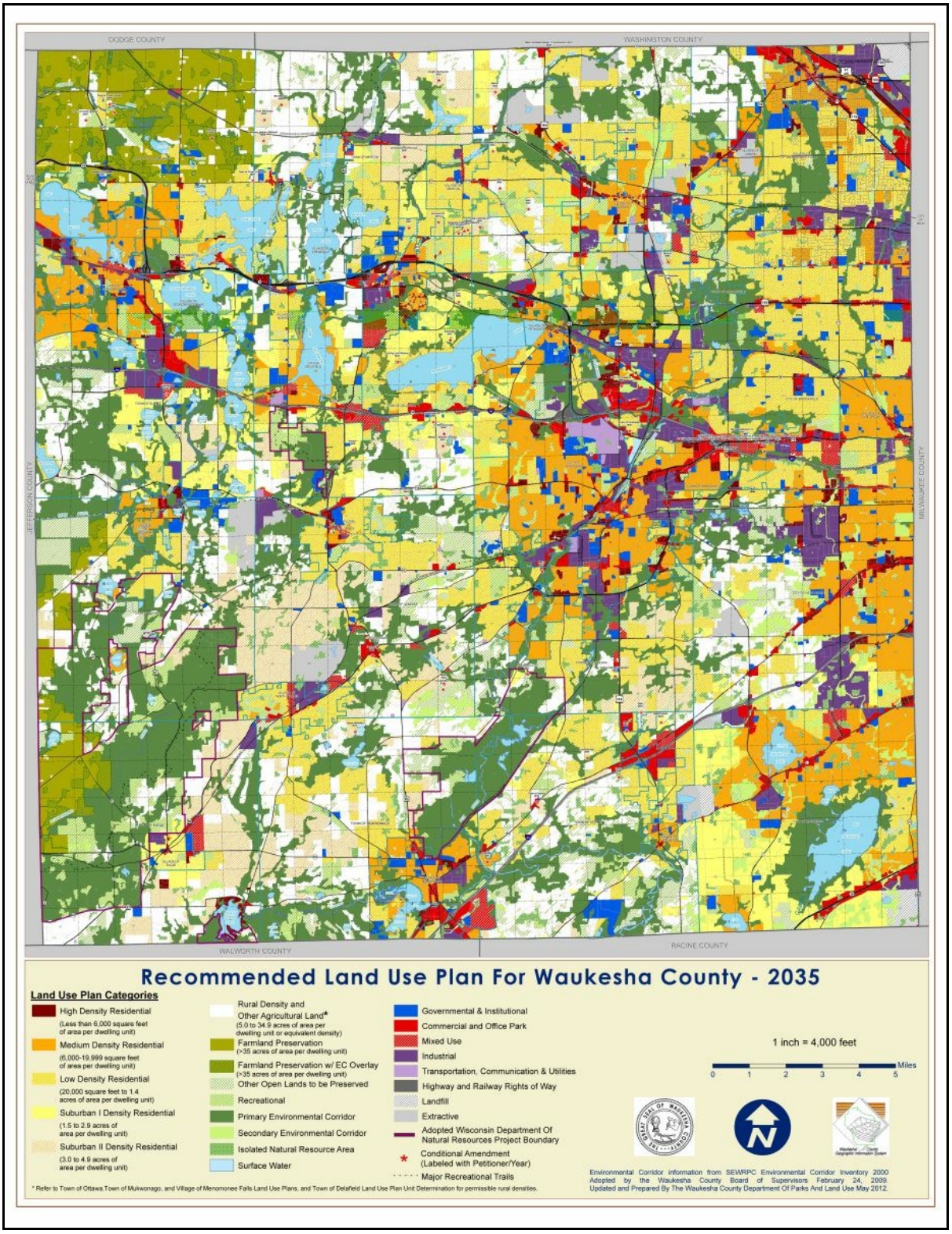


1.4.2.4 Land Use and Development Trends

Waukesha County is a mixed-use community. It is in the highly-populated southeastern corner of the state. Waukesha County has some natural areas that will not be developed and some rural farming areas. At the other extreme, its close proximity to Milwaukee County means that many people who work in the City and/or County of Milwaukee live in Waukesha County and commute. Some light manufacturing and other industrial businesses have chosen to locate in Waukesha County because of its well-developed transportation network and close proximity to the urban amenities offered in Milwaukee. There is also, of course, all of the retail and service industry that is required to provide goods, support and services required by the county's residents. The county was growing on pace with the rest of the southeastern corridor until the economic "Great Recession" that began in 2008, which has dampened growth. As of the time of this plan, it is expected that growth trends will mirror the recovery of the general national, state and regional economy, which is difficult to predict at this time.

Future Land Use Recommendations:

Based on the SEWRPC Planning Report No. 48, A Regional Land Use Plan for Southeastern Wisconsin: 2035, the recommended land use plan anticipates a 51% increase, or 190,978 acres in urban land use within the County by 2035. The plan also anticipates an increase of recreational land use from 8416 acres in 2000 to 15,548 acres and an increase of urban residential land use about 70 percent, from 76,075 acres in 2000 to about 129,346 acres, and commercial land use is to increase to about 8,897 acres all by the year 2035. Governmental and institutional land use is planned will increase from 4,900 acres in year 2000 to 8,354 acres in year 2035. Given the foreseen increase of urban development the plan envisions, non urban land use is anticipated to decrease from about 241,112 acres in 2000 to the planned 180,567 acres by the year 2035.


DODGE COUNTY
WASHINGTON COUNTY
JEFFERSON COUNTY
MILWAUKEE COUNTY
WALWORTH COUNTY
RACINE COUNTY
Recommended Land Use Plan For Waukesha County - 2035
Land Use Plan Categories
High Density Residential
(Less than 6,000 square feet of area per dwelling unit)
Medium Density Residential
(6,000-19,999 square feet of area per dwelling unit)
Low Density Residential
(20,000 square feet to 1.4 acres of area per dwelling unit)
Suburban I Density Residential
(1.5 to 2.9 acres of area per dwelling unit)
Suburban II Density Residential
(3.0 to 4.9 acres of area per dwelling unit)
Rural Density and Other Agricultural Land*
(5.0 to 34.9 acres of area per dwelling unit or equivalent density)
Farmland Preservation
(>35 acres of area per dwelling unit)
Farmland Preservation w/ EC Overlay
(>35 acres of area per dwelling unit)
Other Open Lands to be Preserved
Recreational
Primary Environmental Corridor
Secondary Environmental Corridor
Isolated Natural Resource Area
Surface Water
Governmental & Institutional
Commercial and Office Park
Mixed Use
Industrial
Transportation, Communication & Utilities
Highway and Railway Rights of Way
Landfill
Extractive
Adopted Wisconsin Department Of Natural Resources Project Boundary
Conditional Amendment (Labeled with Petitioner/Year)
Major Recreational Trails
* Refer to Town of Ottawa,Town of Mukwonago, and Village of Menomonee Falls Land Use Plans, and Town of Delafield Land Use Plan Unit Determination for permissible rural densities.
1 inch = 4,000 feet
Miles
0 1 2 3 4 5
Environmental Corridor information from SEWRPC Environmental Corridor Inventory 2000 Adopted by the Waukesha County Board of Supervisors February 24, 2009. Updated and Prepared By The Waukesha County Department Of Parks And Land Use May 2012.

1.4.2.5 Archaeological and Historical Resources

Historic structures, sites, and districts are sometimes targeted for hazard mitigation strategies due to their unique, often irreplaceable, social value.

The Wisconsin Historical Society has a listing of archaeological sites that have been identified in Waukesha County; this list is available to governmental agencies upon request. The National Register of Historic Places also includes a listing of 168 locations in Waukesha County. As mitigation projects are considered, the county is committed to ensuring that archaeological and historical sites are preserved.

Historic Site Name	Address	Municipality
Andrews, Sewall, House	103 Main St.	Mukwonago
Arcadian Bottling Works	900 N. Hartwell Ave.	Waukesha
Arlington Apartments	309 Arlington St.	Waukesha
Baer, Albert R., House	W166 N8990 Grand Ave.	Menomonee Falls
Bailie, Ralph C., House	530 North Ave.	Hartland
Bank of Hartland	112 E. Capitol Dr.	Hartland
Barfoth-Blood Mound Group (47 WK 63)	Address Restricted	Wukwonago
Barnes, Andrew, House	N89 W16840 Appleton Ave.	Menomonee Falls
Barney House	W264 S3641 Saylesville Rd.	Waukesha
Barrett, Everett P., House	120 S. Porter Ave.	Waukesha
Beaumont Hop House	Address Restricted	Hartland
Becker and Schafer Store Building	1002--1004 White Rock Ave.	Waukesha
Big Bend Mound Group No. 2	Address Restricted	Big Bend
Bishopstead	153 W. Oakwood Dr.	Delafield
Blair, Sen. William, House	434 Madison St.	Waukesha
Block C Historic District	Roughly bounded by W. Main St., Gaspar St. and Broadway	Waukesha
Booth, J. C., House	About 1 mi. SW of Saylesville on Saylesville Rd.	Waukesha
Buchner, John P., House	609 E. Broadway Ave.	Waukesha
Buckley, Patrick J., House	1101 Buckley St.	Waukesha
Burr Oak Tavern	315--317 E. Capitol Dr.	Hartland
Camp, Thomas, Farmhouse	W204 N8151 Lannon Rd.	Menomonee Falls
Caples' Park Historic District	Roughly bounded by E. Newhall Ave., S. Hartwell Ave., Windsor Dr. and Oxford Rd., and S. East Ave.	Waukesha
Carroll, William, House	142 W. Main St.	Waukesha
Castleman, Dr. Alfred L., House	975 S. Waterville Rd.	Summit
Chandler, Walter S., House	151 W. College Ave.	Waukesha
Chandler--Blair House	1942 Madison St.	Waukesha
Chapel of St. Mary the Virgin	2 mi. SW of Nashotah on Nashotah House Rd.	Nashotah
Chicago and Northwestern Railroad Passenger Depot	319 Williams St.	Waukesha
Clarke, George Lawrence Jr., House	12810 W. Hampton Ave.	Butler
Cobb, George N., House	S of Oconomowoc at 1505 N. Golden Lake Rd.	Oconomowoc
College Avenue Historic District	Fountain St., S. East and College Aves.	Waukesha
Cook, Alexander, House	600 E. North St.	Waukesha
Cutler Mound Group	Cutler Park	Waukesha
Cutler, Morris, House	401 Central Ave.	Waukesha
Dansk Evangelical Lutheran Kirke	400 W. Capitol Dr.	Hartland
Davis, Cyrus, Farmstead	W204 N7776 Lannon Rd.	Menomonee Falls
Davis, Cyrus--Davis Brothers Farmhouse	W204 N7818 Lannon Rd.	Menomonee Falls
Delafield Fish Hatchery	Main St.	Delafield
Dewey Mound Group	Address Restricted	Big Bend
Dousman Inn	15670 Blue Mound Rd.	Brookfield
Downtown Historic District	Roughly bounded by Broadway, Grand Ave., Clinton and South Sts.	Waukesha
Dwinnell, George, House	442 W. College Ave.	Waukesha
East Broadway Historic District	Roughly, Broadway from Fisk Ave. to Morningside Dr.	Waukesha
East Capitol Drive Historic District	337--702 E. Capitol Dr.	Hartland
Elliot, Dr. F. C., House	501Dunbar Ave.	Waukesha
Fabacker, Joseph, House	341 NW. Barstow St.	Waukesha
First Baptist Church	247 Wisconsin Ave.	Waukesha
First Congregational Church	214 E. Capitol Dr.	Hartland
First Congregational Church	100 E. Broadway	Waukesha
First German Reformed Church	413 Wisconsin Ave.	Waukesha
First Methodist Church	121 Wisconsin Ave.	Waukesha
Frame, Andrew, House	507 N. Grand Ave.	Waukesha
Freewill Baptist Church	W19750 W. National Ave.	New Berlin
Friederich Farmstead Historic District	N96 W15009 County Line Rd.	Menomonee Falls
Genesee Town Hall	Genesee St.	Genesee Depot
Goodwin-McBean Site (47 WK 184)	Address Restricted	Big Bend
Grace, Perry, House	307 N. West Ave.	Waukesha
Grand View Health Resort	500 Riverview Ave.	Waukesha
Gredler-Gramins House	20190 Davidson Rd.	Brookfield
Hadfield Company Lime Kilns	N of Waukesha	Waukesha
Hadfield, Joseph Jackson, House	710--712 N. East Ave.	Waukesha

Hartland Railroad Depot	301 Pawling Ave.	Hartland
Haseltine Cobblestone House	N of Big Bend on Big Bend Dr.	Big Bend
Hawks Inn	428 Wells St.	Delafield
Hemlock, David, J., House	234 Carroll St.	Waukesha
Henze, LeRoy A., House	N89 W15781 Main St.	Menomonee Falls
Hinkley, Ahira R., House	NE of Eagle off WI 59	Eagle
Hoeltz, Herbert, House	N87 W15714 Kenwood Blvd.	Menomonee Falls
Hoos, Elizabeth, House	W164 N9010 Water St.	Menomonee Falls
Hoos--Rowell House	W164 N8953 Water St.	Menomonee Falls
Hornburg, Harold, House	213 Warren Ave.	Hartland
Howitt, John, House	407 N. Grand Ave.	Waukesha
Jackson House	235 North Ave.	Hartland
James Store Building	129--131 W. Broadway	Waukesha
James, Samuel D., House	726 N. East Ave.	Waukesha
Johnston, William, Lime Kiln	E of Genesse Depot	Saylesville
Jones, Robert O., House	501 W. College Ave.	Waukesha
Kelliher, Michael, House	407 N. Grand Ave.	Waukesha
Koehler, Frank, House and Office	N88 W16623 Appleton Ave.	Menomonee Falls
Koepsel House	Old World Wisconsin, off WI 59	Eagle
Laflin Avenue Historic District	W. Laflin and Garfield Aves.	Waukesha
Lain-Estburg House	229 Wisconsin Ave.	Waukesha
Lepper, M. F., House	N88 W16596 Main St.	Menomonee Falls
Lincoln High School	N88 W16913 Main St.	Menomonee Falls
Mace, Garwin A., House	W166 N8941 Grand Ave.	Menomonee Falls
Mace, Garwin, Lime Kilns	LimeKiln Park	Menomonee Falls
Madison Street Historic District	Jct. of Madison, Randall, and Third Sts.	Waukesha
Main Street Historic District	Main and Appleton Sts.	Menomonee Falls
Mann, William G., House	346 Maple Ave.	Waukesha
McCall Street Historic District	McCall and James Sts., and N. East and Hartwell Aves.	Waukesha
McCall Street Historic District (Boundary Increase)	Roughly, Charles and James Sts. from College Ave. to McCall St. and Hartwell Ave. from College to Grove St.	Waukesha
Menomonee Falls City Hall	N88 W16631 Appleton Ave.	Menomonee Falls
Menomonee Golf Club	N73 W13430 Appleton Ave.	Menomonee Falls
Merten, Charles, House	929 Rosemary St.	Waukesha
Miller-Davidson House	On County Line Rd., E of U.S. 41	Menomonee Falls
Moore, Dr. Volney L., House	307 E. Main St.	Waukesha
Moreland Boulevard Pump House and Reservoir	413 Moreland Blvd.	Waukesha
Morey--Andrews House	704 Westowne Ave.	Waukesha
Morey--Lewis House	1312 Pleasant View Ave.	Waukesha
Morey--Markham House	1017 Westowne Ave.	Waukesha
Morey--Seidens House	2020 Easy St.	Waukesha
Mukwonago High School	308 Washington Ave.	Mukwonago
National Guard Armory 127th Regiment Infantry Company G	103 E. Jefferson at Main St.	Oconomowoc
National Hotel	235 W. Main St.	Waukesha
Needham, Enoch Gardner and Mary Caroline Koch, House	12713 W. Greenfield Ave.	New Berlin
Nelson, Charles E., Sr., House	520 N. Grand Ave.	Waukesha
Newhall Avenue Pump House and Reservoir	445 W. Newhall Ave.	Waukesha
Nickell, William, A., House	511 Lake St.	Waukesha
Northwestern Hotel	322 Williams St.	Waukesha
Oconomowoc City Hall	174 E. Wisconsin Ave.	Oconomowoc
Oconomowoc Depot	115 Collins St.	Oconomowoc
Oconomowoc Public Library and Museum	212 N. Lake Rd.	Oconomowoc
Okauchee House	34880 Lake Dr.	Okauchee
Old Waukesha County Courthouse	101 W. Main St.	Waukesha
Pabst, Gustave, Estate	36100 Genesee Lake Rd.	Summit
Pearl and Grand Avenue Historic District	Pearl Avenue generally bounded by Grand Avenue and Franklin Street and portions of Pleasant and Divsion streets	Mukwonago
Peck, Clarence, Residence	430 and 434 N. Lake Rd.	Oconomowoc
Peck, Walter L., House	38928 Islandale Dr.	Oconomowoc
Peterson Site (47 WK 199)	Address Restricted	Big Bend
Philadelphia Toboggan Company Carousel No. 15	Janesville Rd.	Muskego
Pix Theater	264 West Main Street	Waukesha
Pokrandt Blacksmith Shop	128 E. St. Paul Ave.	Waukesha
Pratt, Hannah, House	501 Barney St.	Waukesha
Pratt, John A., House	N88 W15634 Park Blvd.	Menomonee Falls
Putney Block	301 W. Main St., 816 and 802 Grand Ave.	Waukesha
Putney, Frank H., House	223 Wisconsin Ave.	Waukesha
Reformed Presbyterian Church of Vernon	W234 S7710 Big Bend Rd.	Vernon
Rest Haven Hotel	915 N. Hartwell Ave.	Waukesha
Saint Joan of Arc Catholic Church	N50 W34851 Wisconsin Ave., NW of jct. with US 16	Oconomowoc
Sanger, Casper M., House	507 E. College Ave.	Waukesha
Saylesville Historic District	Saylesville Road from west bank of Genesee Creek to S52 W28731 Saylesville Road	Genesee

Schauwitzer, Carl and Therese, House	S84 W17698 Woods Rd.	Muskego
Schuttler, Henry and Mary, House	371 E. Lisbon Rd.	Oconomowoc
Sign of the Willows	122 E. Capitol Dr.	Hartland
Silurian Mineral Springhouse	Post Office Circle	Waukesha
Sloan, William P., House	912 N. Barstow St.	Waukesha
Smith, Camillia, House	603 N. West Ave.	Waukesha
St. Anthony's Catholic Church and Cemetery	N74 W13604 Appleton Ave.	Menomonee Falls
St. James Catholic Church and Cemetery	W220 N6588 Town Line Rd.	Menomonee Falls
St. John Chrysostom Church	1111 Genesee St.	Delafield
St. John's Military Academy	Genessee St.	Delafield
St. Joseph's Catholic Church Complex	818 N. East Ave.	Waukesha
St. Mary's Catholic Church	N89 W16297 Cleveland Ave.	Menomonee Falls
St. Matthias Episcopal Church	111 E. Main St.	Waukesha
Statesan Historic District	Boys School Rd.	Menomonee Falls
Sussex Lime Kiln	E of SR 164	Sussex
Ten Chimneys	S42 W31610 Depot Rd.	Genesee
Third Street Bridge	Roosevelt Dr.	Menomonee Falls
Totten-Butterfield House	515 N. Grand Ave.	Waukesha
Trapp Filling Station	252--256 W. Capitol Dr.	Hartland
Turck, Christian, House	Off WI 59 in Old World Wisconsin	Eagle
United Unitarian and Universalist Church	216 Main St.	Mukwonago
Van Buren, Sarah Belle, House	128 Hill St.	Hartland
Village Park Bandstand	Village Park on Garfield Dr.	Menomonee Falls
Visitation Convent Complex	13105 Watertown Plank Rd.	Elm Grove
Ward District No. 3 Schoolhouse	WI 67 and Betts Rd.	Eagle
Warren, Stephen, House	235 E. Capitol Dr.	Hartland
Waukesha County Airport Hangar	24151 W. Bluemound Rd.	Waukesha
Waukesha Post Office	235 W. Broadway Ave.	Waukesha
Waukesha Pure Food Company	550 Elizabeth St.	Waukesha
Welch, C. A., House	1616 White Rock Ave.	Waukesha
West, Deacon, Octagon House	370 High St.	Pewaukee
Weston's Antique Apple Orchard	19760 W. National Ave.	New Berlin
White Elm Nursery	621 W. Capitol Dr.	Hartland
White Rock Mineral Spring Company	1702 White Rock Ave.	Waukesha
Wick, Michael, Farmhouse and Barn	N72 W13449 Good Hope Rd.	Menomonee Falls
Wisconsin Avenue Historic District	Wisconsin	Waukesha
Wisconsin Industrial School for Boys	621 and 627 W. College Ave.	Waukesha
Yanke, Louis, Saloon	200 Madison Ave.	Waukesha
Zimmer, Johann, Farmhouse	W156 N9390 Pilgrim Rd.	Menomonee Falls
Zion Evangelical Lutheran Church	403 W. Capitol Dr.	Hartland

All of these sites have been reported to the State Historical Society of Wisconsin and are protected sites. If there is concern that a mitigation project will impact one of these or any other identified or suspected archeological site, the county will work with the proper authorities to ensure that all applicable laws and regulations are followed.

The above list is not inclusive of all sites of historic and cultural significance.

1.4.3 Community Capabilities

Even in communities where the potential risks from hazards are acknowledged, and support for disaster-related policies are high, a jurisdiction's preparedness, response, and recovery abilities may still be limited. One reason may be due to the lack of capacity and limited capabilities of that community. While the two terms, capacity and capability, are oftentimes used interchangeably in the disaster literature, it is useful to conceptually delineate the two terms. Capacity, in reference to disaster management planning, can be broadly defined as the amount of resources available to an organization to execute or carry out certain functions to promote the safety and well-being of a community. Although very similar to capacity, capability, with regards to disaster management, can be defined as the actual ability of an institution or individual to perform actions necessary to anticipate, prevent, prepare for, cope with, respond to, or recover from the impact of a hazard. The purpose of delineating the two concepts is simply to show that having capacity, or the essential resources in-hand, does not necessarily translate into being capable of executing those actions. Capacity simply expresses the potential to act accordingly based on the availability of resources, which can be both tangible and intangible. Capability, then, could be considered the sum total of the knowledge, support, and experience required to perform or accomplish a certain task. With respect to disaster management, it is important to have both capacity and capability.

This section discusses "Public Safety" related capabilities within Waukesha County.

1.4.3.1 Public Safety Support

This section provides Public Safety information regarding: Medical, Fire Service, Ambulance Service, Law Enforcement, and Special Teams

1.4.3.1.1 Medical

The Waukesha County Office of Emergency Management, municipal and county emergency services responders, hospital emergency staff and various departments have developed medical and mass casualty plans. These plans will be used in the event of a disaster. Waukesha County communities are served by a complete range of health facilities and health professionals.

Waukesha County has five operating hospitals and two small community hospitals that provide care to county residents. Additionally, the county's healthcare and community support infrastructure is made up in part of approximately 510 Public Health Personnel, 17,100 workers critical to the provision of inpatient health care, 1,200 outpatient and home health providers, and 2,900 providers in Long Term Care facilities

The following hospitals are in Waukesha County:

- Ascension Elmbrook Hospital – 132 beds
- Aurora Medical Center Summit – 99 beds
- Froedtert Community Hospital New Berlin – 8 beds
- Froedtert Community Hospital Pewaukee – 8 beds
- Froedtert Menomonee Falls Hospital - 242 beds
- ProHealth Care Waukesha Memorial - 237 beds
- ProHealth Care Oconomowoc Memorial - 48 beds

Additionally, Waukesha County is part of the Southeast Wisconsin Healthcare Emergency Readiness Coalition (HERC) Region 7, which is comprised of nine counties in Southeast Wisconsin, and whose mission is to utilize an efficient, coordinated approach to providing healthcare in a critical incident that extends beyond normal operations of its stakeholders. The HERC region contains 33 hospitals and emergency departments with a total of 2,754 staffed medical/surgical beds, providing for a robust regional surge capacity. Regional capabilities also include 11 specialty hospitals with 136 staffed medical/surgical beds and five mental health facilities with 149 psychiatric beds.

The Waukesha County Communications Center (WCC) is the primary Public Safety Answering Point (PSAP) for Waukesha County, handling all wireless 911 calls for the county, as well as most landline 911 calls and non-emergency calls, and providing dispatch services for police and fire in the majority of Waukesha County communities. The communications center is staffed by 49 Telecommunicators and 7 Communications Center Supervisors and overseen by an Operations Manager. The Communications Center falls under the County's Department of Emergency Preparedness whose structure is illustrated below. Co-located with the Communications Center is the County's Emergency Operations Center, which is utilized by Waukesha County Emergency Management as a support and coordination hub during large scale incidents. The new EOC was officially opened in 2017, has a capacity of 68 people, and is rated to withstand severe weather conditions up to and including an EF2 tornado.

Other active PSAPs in Waukesha County include:

- City of Muskego Police
- City of Oconomowoc Police
- City of Waukesha Police
- Village of Elm Grove
- Village of Mukwonago

1.4.3.1.2 Fire Service

Thirty-seven municipalities and an area of 581 sq. miles are served. Approximately 1,400 personnel staff the 23 fire departments in Waukesha County. Response infrastructure and apparatus include approximately 50 fire stations, 60 fire engines, 22 trucks and 71 ambulances. There are 20 municipal fire departments, 3 private departments, 6 volunteer departments, 14 combination fire departments and 3 career departments. This information should be considered a snapshot of current capabilities. Of the 1,417 personnel, 372 are career personnel, 843 are paid volunteers, and 199 are administrative, EMS, or auxiliary staff.

A-level hazardous materials (Hazmat) response is sponsored by the State of Wisconsin and is provided by Milwaukee Regional Response Team #4. The City of Waukesha Fire Department provides B-level hazardous materials (Hazmat) response for the county. Some county departments also feature specialized skills such as water rescue/dive, high angle rescue and confined space entry.

1.4.3.1.3 Ambulance Service

The following departments in Waukesha County provide ambulance service:

Emergency Medical Technician:

- Big Bend (Village of) Fire Department
- Butler Volunteer Fire Department, Inc.
- Merton Community Fire Department, Inc.

Advanced Emergency Medical Technician:

- Eagle Fire Department
- North Prairie Fire Department

EMT-Intermediate:

- Tess Corners Volunteer Fire Department
- Waukesha (Village of) Fire Department

Paramedic:

- Brookfield (City of) Fire Department
- Brookfield (Town of) Fire Department
- Elm Grove Emergency Medical Service
- Menomonee Falls (Village of) Fire Department
- Pewaukee (City of) Fire Department
- Sussex Fire Department
- Vernon Fire Department EMS
- Waukesha (City of) Fire Department

Paramedic with Critical Care Endorsement:

- Flight for Life Transport System
- Lake Country Fire and Rescue
- Lisbon Fire Department
- Mukwonago Fire Department
- New Berlin (City of) Fire Department
- Western Lakes Fire District

https://www.dhs.wisconsin.gov/ems/provider/waukesha.htm

1.4.3.1.4 Law Enforcement

The sheriff is the chief law enforcement officer in the county and is responsible for the protection of life and property within the boundaries of Waukesha County. The Sheriff's Office provides law enforcement service to unincorporated areas of the county or to those jurisdictions that do not maintain full-time police service. The department also provides security for the County Courthouse and the twelve Circuits Court branches and five Court Commissioners. The Department also staffs and maintains a 469-bed County Jail and a 330-bed Huber Law work-release facility. In addition, the department provides the following specialized services:

- Drug Enforcement
- Canine Support
- Identification
- Crime Prevention
- Tactical Enforcement
- Underwater Search and Rescue
- Computer Forensic/High Tech Crimes
- Polygraph
- Civil Process Service
- Accident Reconstruction
- Crime Scene Documentation
- Clerical Services

Today the department is comprised of more than 330 sworn and non-sworn personnel and provides direct police services to over 400,000 residents. (http://www.waukeshacounty.gov)

A large number of local law enforcement departments are also responsible for protecting and serving the citizens of the many municipalities within the county. Some are large, municipal departments with full-time officers, many with special trainings such as Dive, Investigations and Tactical/SWAT and functions such as bicycle units, school resource officers, neighborhood watch, gangs/special crimes, Drug Abuse Resistance Education (D.A.R.E.), Crime Stoppers, Neighborhood Watch etc. Other departments are smaller and may have part-time staffing but all proudly serve as law enforcement professionals. Municipalities with departments are listed below:

- City of Brookfield http://www.cityofbrookfield.com
- City of Delafield http://www.cityofdelafield.com
- City of Muskego http://www.ci.muskego.wi.us
- City of New Berlin http://www.newberlin.org/
- City of Oconomowoc http://www.ci.oconomowoc.wi.us
- City of Pewaukee http://www.cityofpewaukee.us
- City of Waukesha http://www.ci.waukesha.wi.us
- Village of Big Bend http://www.villageofbigbend.com
- Village of Butler http://www.butlerpolice.org
- Village of Chenequa http://www.chenequa.wi.us
- Village of Eagle http://www.eaglepolicedepartment.com
- Village of Elm Grove http://www.elmgrovewi.org
- Village of Hartland http://www.villageofhartland.com
- Village of Lannon http://www.villageoflannon.com
- Village of Menomonee Falls http://www.menomonee-falls.org
- Village of Mukwonago http://www.villageofmukwonago.com
- Village of Nashotah http://www.nashotah-wi.gov
- Village of North Prairie http://www.northprairie.net
- Village of Oconomowoc Lake http://oconlake.com
- Village of Pewaukee www.villageofpewaukee.com
- Town of Brookfield http://www.townofbrookfield.com
- Town of Mukwonago http://www.townofmukwonago.us
- Town of Oconomowoc http://www.topdonline.com
- Town of Summit http://www.summittown.org

1.4.3.1.5 Special Teams

- Citizens and Organizations Active in Disasters (COAD) is an association of individuals and organizations in Waukesha County and Milwaukee County interested in disaster preparedness and response.
- The Sheriff's Department's Underwater Search and Rescue (Dive Team) consists of a Captain and a Lieutenant (Both Certified Divers), seven Certified Divers and two surface operators. All divers are highly trained and have completed certification in Open Water diving, Rescue diving, Ice diving, Navigation and Deep Water diving. Several are also certified as Equipment Specialists and Master Divers. The demand for this team is approximately 20 dives per year including training. The Dive Team has assisted other agencies with a variety of tasks including, search and recovery operations, helping to recover a drowning victim and assist in the recoveries of evidence. (www.waukeshacounty.gov)
- The City of Waukesha Fire Department provides Level B or Type II hazardous materials response in the County.
- There are four tactical teams in the County. All are multi-jurisdictional including the Sheriff's Tactical Enforcement Unit.
- City of Waukesha has a Special Services Team for confined space and elevated rescue.
- The Suburban Critical Incident Team is a multijurisdictional Tactical unit which serves nine municipalities in Waukesha County. The team is made up of 35 tactical operators and 15 negotiator/Investigators.

1.5 Risk Assessment

V. Risk Assessment

Waukesha County recognizes that a community's All Hazard Risk Assessment is the fundamental building block of the four core functions of emergency management: prepare, respond, recover, and mitigate. In today's hazard environment, emergency management is the crux of solving the complex challenges that face our communities during an emergency or following a disaster. The disaster activity over the past several years has re-emphasized the importance for communities to invest in creating thorough strategies to develop comprehensive emergency plans and to test, train, and exercise all emergency operations.

The objective of the risk methodology is to devise a process to compare and evaluate which natural, technological, and political hazards are the greatest threats to the County and where mitigation actions should be focused to provide the best value to Waukesha. The All-Hazard Risk Assessment describes, analyzes, and assesses the risks facing Waukesha County from three categories of hazards: Natural, Technological, and Political. Natural hazards are those events that are a result of our surrounding environment, such as wildfires, flooding, or hurricanes. Technological hazards are events that are a result of the failure of infrastructure and systems that we have become dependent on for daily activities, such as transportation networks or utilities. Political hazards are those events that are a result of local, national, or international societal interactions, such as terrorism or civil disturbances.

Each hazard category will elaborate upon and define the different types of hazards that are associated with each, identify historical events that have occurred locally and/or regionally, define the hazard profiles, parameters, and characteristics; assess possible vulnerabilities; determine probable scenarios; and model select hazards. The hazards investigated were identified through extensive research that utilized input from Waukesha County, Federal Emergency Management Agency (FEMA), Department of Homeland Security (DHS), hazard experts, historical occurrences, Geographic Information System databases, and hazard-specific data such as Flood Insurance Maps.

Scope of Analysis

The following is a list of the hazards investigated in this study.

Natural Hazard	Technological Hazards	Political Hazards
Drought & Dust Storms	Utility Failure	Civil Disturbances
Earthquakes	Hazard Materials Release	Labor Disputes
Flooding & Dam Failure	Rail Transportation Incident	Protests
Fog		Terrorism:
Forest & Wildfires		Explosive Devices (bombs)
Severe Temperatures		Airline Attacks
Hail		Chemical/Biological/Nuclear Attacks
Lightning		Hostage Taking
Thunderstorms		Infrastructure Attacks
Tornadoes & High Winds		Active Assailant Attacks
Winter Storms		Home Grown Violent Extremists

Note: Political Hazards were added as part of the 2021 update/review process

Many of the hazards in the Risk Assessment do not pose a significant risk because of their low probability of occurring or minimal impact; however, these hazards are still addressed in this report. Hazards that were determined to not occur in Waukesha County (e.g. hurricanes) were removed from the Risk Assessment. Several hazard types (e.g. hazardous materials release) transcend hazard categories (i.e., natural, technological, and political).

Hazard Loss Modeling

To supplement the impact analysis and risk determination, a hazard loss model and analysis was performed for select scenarios of each hazard category. The scenarios selected were based on historical occurrences of disasters, availability of data, and the severity of the hazard risk. The hazard loss analysis process utilized Hazards U.S. Multi Hazard (HAZUS-MH) modeling, Geographic Information Systems (GIS) analysis, and historical disaster data and information to conduct quantitative analysis to estimate the loss due to the selected natural, technological and political hazard events. HAZUS-MH is a powerful risk assessment software program for analyzing potential losses from floods and earthquakes. In HAZUS-MH, current scientific and engineering knowledge is

coupled with the latest (GIS) technology to produce estimates of hazard-related damage before, or after, a disaster occurs. The analysis reports obtained from the HAZUS-MH model includes the following:

- Estimation of the losses to structures and contents
- Estimation of the losses to structure use and function
- Projection of human losses
- Estimation of the primary direct and indirect loss

HAZUS-MH and GIS analysis was used to determine which individual assets were vulnerable to the largest potential losses; by adding the structure loss, content loss, and function loss for each asset to determine the total loss. This process produced the following:

- Calculation of the losses to each asset
- Calculation of the estimated damages for each hazard event
- Creation of a map that shows a composite of the areas of highest loss

Many of the human-induced hazards provide some unique implications for loss estimation because these events can take place with different magnitudes, in any location, at any time, and under various circumstances. Because the characteristics of many of the human-induced events are not definitive, a generalized loss analysis was conducted. The HAZUS-MH model was utilized when the human-induced hazard has geographic characteristics. When HAZUS-MH data was not relevant to the particular event, the best available historical data was used to provide a generalized loss estimate. The following scenarios were assessed and analyzed utilizing GIS data and HAZUS-MH modeling.

They are provided in the relevant section of this report.

Hazard Risk Determination

The determination of the risks associated with each hazard were not based on empirical values, but instead based on a function of the probability of the event occurring and its potential impact. This approach was necessary due to the complexities of a uniformed all-hazard approach and the numerous direct and indirect factors for a unique community like Waukesha County. To remain consistent, a color-coded scale was utilized to provide a descriptive assessment or each risk. An example of the risk scale is provided. Each hazard risk assessment will go through a review process involving the Waukesha County Steering Committee.

Standard

- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Risk Assessment; §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.
    - 5. Identify Hazards: Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type … of all natural hazards that can affect the jurisdiction.
        - 5. Does the new or updated plan include a description of the types of all natural hazards that affect the jurisdiction?
    - 6. Profiling Hazards;Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
        - 6.A. Does the risk assessment identify the location (i.e., geographic area affected) of each natural hazard addressed in the new or updated plan?
        - 6.B. Does the risk assessment identify the extent (i.e., magnitude or severity) of each hazard addressed in the new or updated plan?
        - 6.C. Does the plan provide information on previous occurrences of each hazard addressed in the new or updated plan?
        - 6.D. Does the plan include the probability of future events (i.e., chance of occurrence) for each hazard addressed in the new or updated plan?
    - 7. Assessing Vulnerability: Overview; Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.
        - 7.B. Does the new or updated plan address the impact of each hazard on the jurisdiction?
    - 8. Assessing Vulnerability: Addressing Repetitive Loss Properties; Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.
        - 8.A. Does the new or updated plan describe vulnerability in terms of the types and numbers of repetitive loss properties located in the identified hazard areas?
    - 9. Assessing Vulnerability: Identifying Structures; Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area …
        - 9.A. Does the new or updated plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?
        - 9.B. Does the new or updated plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?
    - 10. Assessing Vulnerability: Estimating Potential Losses; Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate … .
        - 10.A. Does the new or updated plan estimate potential dollar losses to vulnerable structures?
        - 10.B. Does the new or updated plan describe the methodology used to prepare the estimate?
    - 11. Assessing Vulnerability: Analyzing Development Trends; Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.
        - 11.A. Does the new or updated plan describe land uses and development trends
    - 12. Multi-Jurisdictional Risk Assessment; Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.
        - 12.A. Does the new or updated plan include a risk assessment for each participating jurisdiction as needed to reflect unique or varied risks?

1.5.1 Hazard Summary

Hazard Analysis

The following sections identify those hazards that have occurred or could occur in Waukesha County. Each includes a description of a hazard and its frequency of occurrence. Also included is a section that describes the general vulnerabilities of the community and its infrastructure to each particular type of hazard.

Wisconsin Emergency Management (WEM) completed and regularly updates the State Hazard Mitigation Plan, which was last revised in 2016. This plan describes the hazards that have occurred or are most likely to occur within the state and includes the frequency of occurrence, potential impacts and suggested actions to mitigate the hazard. This plan is the basis for the development of all emergency management plans and is distributed upon revision to county emergency government directors and other stakeholder agencies.

The Waukesha County Emergency Management Coordinator develops and annually updates a listing of all hazards that have occurred or could occur within the county. This listing includes the definition, frequency of occurrence and actions to mitigate the hazard. In general, the threat of most hazards is consistent throughout the county. The only hazard where there were differences identified within the county was for flooding and for that hazard, specific locations are identified.

Due to the geographic location of Wisconsin and/or Waukesha County, volcanoes, landslides, hurricanes, and tsunamis were not considered to be a risk and will not have mitigation strategies associated with them.

Wisconsin Emergency Management (WEM) Hazard Matrix						
No.	**Hazard**	**Location (if the risk is not equal for the entire jurisdiction)**	**Frequency/Probability (i.e. Future Probability)**	**Magnitude/Extent (i.e. Strength or Magnitude)**	**Vulnerability (i.e. Consequence and Impact)**	**Overall Risk Rating**
01	Droughts and Dust Storms	Droughts will primarily impact the agricultural community of Waukesha County.	Medium	Low	Low	Low
02	Earthquakes	Countywide	Low	Low	Medium	Low
03	Flooding and Dam Failure	Historically, flooding has most significantly affected communities such as the villages of Elm Grove and Pewaukee; the cities of Brookfield, New Berlin, Muskego and Waukesha; and the unincorporated portions of Waukesha County.	High	High	High	High
04	Fog	Countywide	Medium	Low	Low	Low
05	Forest and Wildfires	As illustrated on the plan's wildfire maps, the highest risk areas are the areas where wildland is in close proximity to urban settlements. Communities adjacent to and surrounded by wildlands (e.g. areas of grassland, woodlands, bushland, scrubland) are most at risk of wildfires.	Low	Low	Low	Low
06	Hail	Countywide	High	Medium	Low	Medium
07	Lightning	Countywide	High	Medium	Medium	Medium
08	Severe Temperatures	Countywide	Medium	Medium	Medium	Medium
09	Thunderstorms	Countywide	High	Medium	Low	Medium

10	Tornadoes and High Winds	The highest risks associated with tornadoes and severe winds are within the urban areas of the County. The larger cities—Waukesha, New Berlin, Brookfield, Muskego, Oconomowoc, and Pewaukee and the Village of Menomonee Falls will suffer the greatest losses if a tornado touches down in one of these communities.	Medium	Medium	Medium	Medium
11	Winter Storms	Countywide	Medium	Medium	Low	Medium
12	Hazardous Materials Release	Near transit hubs, rail, or large industrial facilities that store or produce hazardous materials	Medium	Medium	Medium	Medium
13	Utility Failure	The highest risks associated with power failures and utility failures are in communities with hospitals, nursing homes, care facilities, elderly housing facilities and other housing/care facilities occupied by vulnerable populations.	Medium	Medium	Medium	Medium
14	Rail Transportation Incident	Countywide; Specifically near major rail lines and routes.	Low	Low	Medium	Low

Standard

- Wisconsin Emergency Management (WEM) Mitigation Standard 2015; Element B: Hazard Identification and Risk Assessment (see the end of this element for a checklist to use in reviewing each hazard section)
  - B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction? 44 CFR 201.6(c)(2)(i) and (iii)
    - B1.1. Description of natural hazards[1] that affect jurisdictions in the planning area
    - B1.2. Rationale for any omitted natural hazards that affect jurisdictions in the planning area
    - B1.3. Location (geographic areas in planning area) of each hazard; for multi-jurisdictional plans: description of hazards for participating jurisdictions that are unique or varied from those affecting the overall planning area (flooding, dam failure, wildfire)
    - B1.4. Extent (strength or magnitude) of each hazard
  - B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? 44 CFR 201.6(c)(2)(ii)
    - B.3.1 Potential impacts of each identified hazard for each participating jurisdiction
    - B.3.2 Vulnerability of each participating jurisdiction to the identified hazards
  - B5. Hazard Matrix
    - B5.2. Location (if the risk is not equal for the entire jurisdiction)
    - B5.3. Extent (strength or magnitude)
    - B5.5. Future Probability
    - B5.7. Vulnerability
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Risk Assessment; §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.
  - 7. Assessing Vulnerability: Overview; Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.
    - 7.A. Does the new or updated plan include an overall summary description of the jurisdiction's vulnerability to each hazard?

1.6 Drought and Dust Storms

Two types of drought occur in Wisconsin: agricultural and hydrologic. Agricultural drought is a dry period that reduces crop yields. Hydrologic drought is a dry period of sufficient length and intensity to affect lake and stream levels and the height of the groundwater table. These two types of drought may, but do not necessarily, occur together.

Dust storms result from a combination of high winds and dry, loose soil conditions. While high winds and periods of drought have each occurred in Waukesha County, there has never been a recorded dust storm event. Since natural hazards that have occurred in the past are more likely to occur in the future, it is unlikely that a dust storm event will occur in Waukesha County. This assertion is further bolstered by the fact that there is very little irrigation done within the county and that the soils in Waukesha County are not prone to blowing. While there are concerns about topsoil erosion and some mitigation activities may be planned that would reduce the effects of these types of events, they will not be a major focus of this plan.

1.6.1 Drought and Dust Storms Hazard Profile

Hazard Profile

A drought is characterized as an extended period of time with persistent dry weather conditions in a geographic area that typically has rain fall. In essence, droughts are water deficits that have harmful consequences for people, animals and plants. Droughts can also negatively impact the environment by depleting the moisture from soil ruining crop production; water levels can decrease in streams, rivers, lakes and reservoirs; and wildfires can result from extended or severe droughts. Other climatic factors such as high temperatures, high winds, and low humidity can significantly worsen a drought's severity. A drought can however be defined in several different ways depending on the geographical region and situation:

- Meteorological drought: When the normal level of precipitation has a significant measurable drop.
- Agricultural drought: When the level of soil moisture drops below the suitable range for agricultural growth.
- Hydrological drought: When the surface water and underground water supply falls below normal.
- Socioeconomic drought: When water shortages seriously interferes with human activity.
- What constitutes as a drought in one region may not qualify in another.

The understanding that a deficit of precipitation has different impacts on groundwater, reservoir storage, soil moisture, snowpack and streamflow led to the development of the Standardized Precipitation Index (SPI) in 1993. The SPI quantifies the precipitation deficit for multiple time scales. These time scales reflect the impact of drought on the availability of the different water resources. Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow, and reservoir storage reflect longer-term precipitation anomalies. For these reasons, the SPI is calculated for 3-, 6-, 12-, 24- and 48-month time scales.

The SPI calculation for any location is based on the long-term precipitation record for a desired period. This long-term record is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero. Positive SPI values indicate greater than median precipitation and negative values indicate less than median precipitation. Because the SPI is normalized, wetter and drier climates can be represented in the same way and wet periods can also be monitored using the SPI.

The classification system shown in the SPI values table (below) defines drought intensities resulting from the SPI. The criteria for a drought event are also defined for any of the time scales. A drought event occurs any time the SPI is continuously negative and reaches an intensity of -1.0 or less. The event ends when the SPI becomes positive. Each drought event, therefore, has a duration defined by its beginning and end and an intensity for each month that the event continues. The positive sum of the SPI for all the months within a drought event can be termed the drought's "magnitude." Current SPI maps for the United States can be found at http://www.drought.unl.edu/monitor/spi.htm.

SPI Values	Description
2.0	Extremely Wet
1.55 - 1.99	Very Wet
1.0 - 1.49	Moderately Wet
-0.99 - 0.99	Near Normal
-1.0 to -1.49	Moderately Dry
-1.5 to -1.99	Severely Dry
-2.0 and less	Extremely Dry

Palmer Drought Index

The Palmer Index, developed by Wayne Palmer in the 1960s, uses temperature and rainfall information to formulate dryness. It has become the semi-official drought index. The index is effective in determining long term drought conditions of several months. The index sets normal conditions at 0 with drought conditions in negative values. The index can also be reversed showing the excess of precipitation where the normal conditions at 0 and positive values for amount of rainfall. The advantage of the Palmer Index is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions.

The National Integrated Drought Information System (NIDIS) provides alerts when conditions are favorable for drought. The following table provides information on the different alerts for the National Weather Service:

Alert	Criteria	Palmer Drought Index
D0 Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.	-1.0 to -1.9
D1 Moderate Drought	Some damage to crops, pastures, streams, reservoirs, or wells low, some water shortages developing or imminent, and voluntary water-use restrictions requested.	-2.0 to -2.9
D2 Severe Drought	Crop or pasture losses are likely, water shortages common and water restrictions imposed.	-3.0 to -3.9
D3 Extreme Drought	Major crop and pasture losses with widespread water shortages or restrictions.	-4.0 to -4.9
D4 Exceptional Drought	Exceptional and widespread crop and pasture loss, shortages of water in reservoirs, streams, and wells creating water emergencies.	-5.0 or less

The Palmer Index is an older scale and is used more often by governmental organizations. It is effective in determining long-term drought (i.e., over several months) and is not as good with short- term forecasts (i.e., weeks.) It uses a zero as normal; drought is shown in terms of negative numbers and excess moisture is reflected by positive figures. The future incidence of drought is highly unpredictable and may also be localized, making it difficult to determine probability with any accuracy.

Drought conditions may vary from below-normal precipitation for a few weeks to a severe lack of normal precipitation for several months. Drought primarily affects agricultural areas because the amount and timing of rainfall has a significant impact on crop production. The severity of a drought cannot therefore be completely measured in terms of precipitation alone but must include crop yields.

Hazard Considerations

The following is a list of potential impacts and planning considerations for a drought event.

Area Impacted:

- Regional and Statewide

Duration of the event:

- Droughts can occur over a period of weeks, months and years.

Essential Service Disruption:

- Water shortages force government officials to order water restrictions

Special Needs:

- Agriculture (farming and ranching) community most affected.
- Rural populations

Direct Damage:

- Farming/Ranching business interruption due to agricultural losses
- Lower water levels in reservoirs, lakes, and ponds
- Government officials forced to spend millions in emergency or non-budgeted funds to ensure adequate ground water supplies for residents.

Economic Damage:

- Agricultural losses – fields, crops, pastures and livestock can be devastated for months and even years resulting in severe economic hardship in these industries.
- Loss to industries directly dependent on agricultural production (e.g., machinery and fertilizer manufacturers, food processors, dairies, fishery, timber etc.)
- Reduction of economic development
- Rural population loss

Environmental Damage:

- Migration and concentration of wildlife
- Effect on water quality (e.g., salt concentration, increased water temperature, pH, dissolved oxygen, turbidity)
- Prolonged drought over a number of years could have long-term environmental impacts on the area, such as species endangerment and changes to agriculture.
- Increased risk of sinkhole formation.

Emergency Services:

- Inadequate water supply to effectively manage fire

Social Factors:

- Practicing water conservation that protects the environment while supplying residents with adequate amounts of drinking and irrigation water supplies
- Increased respiratory ailments and disease caused by wildlife concentrations
- Reduced quality of life and changes in lifestyle (population migrations, social values, disruption of cultural beliefs, etc.)

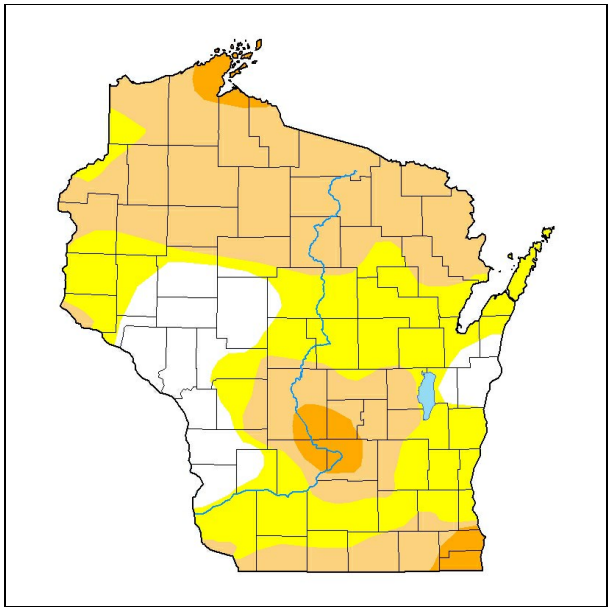
1.6.2 Location and Extent

Droughts can be devastating for the host community. Direct impacts of a drought can include reduced crop, rangeland, and forest productivity; increased fire hazards; reduced water levels; increased livestock and wildlife mortality rates; damage to wildlife and fish habitat; increased problems with insects and diseases to forests and reduce growth. Indirect results can lead to financial hardships for farmers and increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime, foreclosures on bank loans to farmers and businesses, migration, and disaster relief programs.

In addition to the impacts of a drought on farming and agriculture, a drought can be related to other hazards. Extreme weather can complicate droughts because high temperatures increase the amount of evapotranspiration that occurs in plants. Increased evapotranspiration results in higher water loss rates and increases plant damage. The probability of landscape plants loss and extreme crop losses can be increased during a drought if high temperatures are also experienced.

Dead and dry vegetation caused by droughts also provide fuel for wildfires. Heavy accumulation of fuels, lack of strategic management programs, and inadequate fire-fighting infrastructure has further complicated Waukesha County's risk to wildland urban interface fires. Drought-related wildfires should be monitored closely by the County to ensure the protection of commercial, industrial, agricultural, and residential regions. Additionally, with the onset of Climate Change, the County may begin to see more severe droughts.

Wisconsin Drought Index

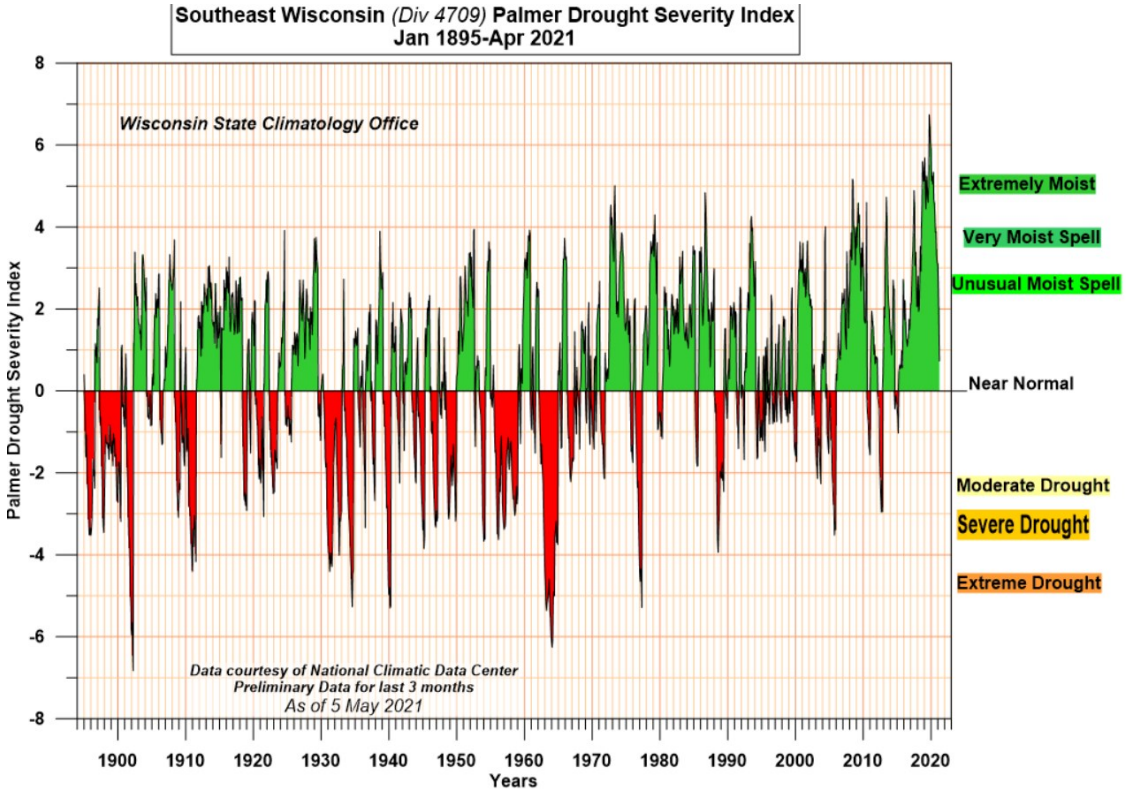


December 2021

1.6.3 Frequency and Probability

Drought is a relatively common phenomenon in Wisconsin and has occurred statewide in 1895, 1910, 1939, 1948, 1958, 1976, 1988, 1992, 2003, 005 and 2012. The 1976 drought received a Presidential Emergency Declaration with damage to 64 Wisconsin counties, including Waukesha. Estimated losses of $624 million primarily affected the agricultural sector. Reports show that Waukesha County was as affected as the rest of the state in this drought, receiving money for emergency feed programs for livestock and for increased fire protection of its wilderness areas. It should be noted that only 19% ($119,434,924) of this loss was compensated by any federal program.

The for the years between January 1895 and February 2021 in Southeastern Wisconsin, which includes Waukesha County follows:



Source: http://www.aos.wisc.edu/~sco/clim-watch/graphics/pdsi-ts-09-l.gif

The Governor declared a drought emergency for 42 counties in the state of Wisconsin in July 2012. This declaration, the first since August 2003, allowed farmers access to additional water for crop irrigation. The National Weather Service has 18 recorded drought events for Waukesha County between 1 January 1950 and February 2021.

County	Date	Death	Injury	Property Damage	Crop Damage
Waukesha County	8/1/2002	0	0	0	$4.4M
Waukesha County	8/1/2003	0	0	0	0
Waukesha County	9/1/2003	0	0	0	0
Waukesha County	10/1/2003	0	0	0	0
Waukesha County	11/1/2003	0	0	0	0
Waukesha County	12/1/2003	0	0	0	0
Waukesha County	7/1/2005	0	0	0	0
Waukesha County	8/1/2005	0	0	0	0
Waukesha County	9/1/2005	0	0	0	0
Waukesha County	10/1/2005	0	0	0	0
Waukesha County	11/1/2005	0	0	0	0
Waukesha County	7/1/2007	0	0	0	$50K
Waukesha County	6/26/2012	0	0	0	0
Waukesha County	7/1/2012	0	0	0	0
Waukesha County	8/1/2012	0	0	0	0
Waukesha County	9/1/2012	0	0	0	0
Waukesha County	10/1/2012	0	0	0	0
Waukesha County	11/1/2012	0	0	0	0
Waukesha County	7/2014	0	0	0	0
Waukesha County	8/2014	0	0	0	0
Waukesha County	11/2014	0	0	0	0
Waukesha County	7/2015	0	0	0	0
Waukesha County	8/2015	0	0	0	0
Waukesha County	11/2015	0	0	0	0
Waukesha County	6/2016	0	0	0	0
Waukesha County	7/2016	0	0	0	0
Waukesha County	8/2016	0	0	0	0
Waukesha County	11/2016	0	0	0	0

Considering past occurrences, it can be surmised that Waukesha County has a medium probability of drought occurrence in the future and the likelihood of damage due to drought is considered medium for agricultural losses and low for other types of losses.

1.6.4 Vulnerability

Hazard Impacts

Drought generally impacts farm output by reducing crop yields and the health and product output (e.g., milk) of livestock. As a result, a drought will seriously impact the economy of the entire county. Dust storms impact farms in the long term by blowing away the top levels of soil, which are the richest. This could economically impact the county by reducing its long-term viability for farming. Drought is also a major risk factor for wildfire.

Drought can reduce the amount of surface water available for recreational activities (e.g., boating, fishing, water skiing) and for wildlife. This is important because, for example, low water levels can lead to an outbreak of disease (e.g., botulism) in migratory bird pools.

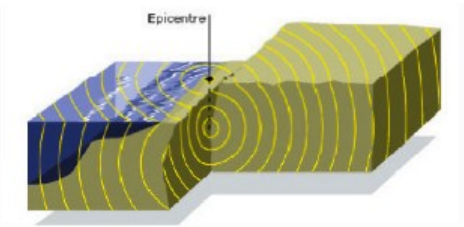
Prolonged drought can also impact the groundwater reserves. This can reduce the ability of the municipal water services and rural individuals on wells to draw adequate fresh water. This may especially impact rural homeowners who tend to have wells that are not drilled as deeply as municipal wells. In Waukesha County, the population that lives outside of the cities and villages are generally on well water. There could also be a safety risk during dust storms if they are severe enough to reduce the visibility of the roadways for drivers.

The impacts of many droughts are not felt in urban areas where their impacts are usually limited to the inconvenience of ordinances and regulations to conserve water. However, in rural communities droughts can be devastating. Losses from droughts are typically underestimated and inaccurate. Indirect losses form impacts such as farm foreclosures are not often accounted, and direct crop or livestock losses are typically difficult to evaluate due to fluctuations in the commodity markets.

Hazard Assessment		
Drought and Dust Storms		
Frequency/Probability (i.e. Future Probability)	▶	Medium
Magnitude/Extent (i.e. Strength or Magnitude)	▶	Low
Vulnerability (i.e. Consequence and Impact)	▶	Low
Overall Risk Rating	▶	Low

1.7 Earthquakes

An earthquake is a shaking or sometimes violent trembling of the earth which results from the sudden shifting of rock beneath the earth's crust. This sudden shifting releases energy in the form of seismic waves (wave-like movement of the earth's surface).



Source: http://news.bbc.co.uk/2/shared/bsp/hi/pdfs/earthquake_guide.pdf

1.7.1 Earthquakes Hazard Profile

Hazard Profile

Earthquakes (also known as 'seismic events') are sudden slippages or movements in a portion of the earth's crust accompanied by a series of vibrations. The ground shaking is caused by the sudden release of accumulated strain by an abrupt shift of rock along a fracture or fault in the earth, by volcanic or magmatic activity, or by other sudden stress changes in the earth's crust. The hypocenter of an earthquake is the location beneath the earth's surface where the rupture of the fault begins. The epicenter of an earthquake is the location directly above the hypocenter on the surface of the earth.

Earthquakes occur on faults. A fault is a fracture or zone of fractures between two blocks of rock. Faults allow the blocks to move relative to each other. This movement occurs rapidly during an earthquake. Faults may range in length from a few millimeters to thousands of kilometers. Most faults produce repeated displacements or repeated earthquakes over long time periods. During an earthquake, the rock on one side of the fault suddenly slips with respect to the other. The fault surface can be horizontal or vertical or some arbitrary angle in between. Geologists use the angle of the fault with respect to the surface (known as the dip) and the direction of slip along the fault to classify faults.

Faults which move along the direction of the dip plane are dip-slip faults and described as either normal or reverse (thrust), depending on their motion. Faults which move horizontally are known as strike-slip faults and are classified as either right-lateral or left-lateral. Faults which show both dip-slip and strike-slip motion are known as oblique-slip faults. Normal faults are a dip-slip fault in which the block above the fault has moved downward relative to the block below. This type of faulting occurs in response to extension and is often observed in the Western United States Basin and Range Province and along oceanic ridge systems. Thrust fault is a dip-slip fault in which the upper block, above the fault plane, moves up and over the lower block. This type of faulting is common in areas of compression, such as regions where one plate is being sub-ducted under another as in Japan. When the dip angle is shallow, a reverse fault is often described as a thrust fault. Strike-slip fault is a fault on which the two blocks slide past one another. The San Andreas Fault is an example of a right lateral fault. A left-lateral strike-slip fault is one on which the displacement of the far block is to the left when viewed from either side. A right-lateral strike-slip fault is one on which the displacement of the far block is to the right when viewed from either side.

Aftershocks are earthquakes that follow the largest shock of an earthquake sequence. They are smaller than the main shock and within 1-2 rupture lengths distance from the main shock. Aftershocks can continue over a period of weeks, months, or years. In general, the larger the main shock, the larger and more numerous the aftershocks, and the longer they will continue.

Earthquakes and seismic activity has a very rapid and unpredictable onset. Current technology cannot predict an earthquake and is limited to real-time seismic surveillance. The duration of an earthquake is related to its magnitude but not in a perfectly strict sense. There are three ways to think about the duration of an earthquake. The first is the length of time it takes for the fault to fully rupture. The second is the length of time shaking is felt at any given point. Earthquakes can last from seconds to minutes. The third way to think about duration is the aftershock period after the main seismic event. Aftershocks can continue over a period of weeks, months, or years. In general, the larger the main shock, the larger and more numerous the aftershocks, and the longer they will continue.

Richter Scale

Earthquake strength has traditionally been measured using the Richter scale, developed by Charles Richter in 1935. The Richter scale went through numerous adjustments since its conception, and was eventually replaced by the "Moment Magnitude Scale" for earthquakes larger than 3.5; however, most still refer to both scales as the Richter scale. The Richter magnitude scale, used as an indicator of the force of an earthquake, measures the magnitude, intensity, and energy released by an earthquake with seismographs. Each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value. It is important to note that the Richter Magnitude Scale is not used to express damage.

Magnitude	Earthquake
< 2.0	Micro earthquakes, not felt.
2.0 - 2.9	Minor earthquakes, generally not felt, but are recorded.
3.0 - 3.9	Minor earthquakes, often felt, but rarely causes damage.
4.0 - 4.9	Light earthquakes, noticeable shaking of indoor items, rattling noises, and significant damage is unlikely.
5.0 - 5.9	Moderate earthquakes, can cause major damage to poorly constructed buildings over small regions, and possible slight damage to well-designed buildings.
6.0 - 6.9	Strong earthquakes, can be destructive in areas up to about 99 miles across in populated regions.
7.0 - 7.9	Major earthquakes, can cause serious damage over larger regions.
8.0 - 8.9	Great earthquakes, can cause serious damage in regions several hundred miles across.
9.0 - 9.9	Great earthquakes, devastating in areas several thousands of miles across.
10 <	Massive earthquakes, never recorded, widespread devastation across vast regions.

Source: United States Geological Survey

Modified Mercalli Intensity Scale

The effect of an earthquake on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally - total destruction. The Modified Mercalli (MM) Intensity Scale is the common intensity scale used in the United States. This scale is composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction. It does not have a mathematical basis; instead it is an arbitrary ranking based on observed effects. The Modified Mercalli Intensity value assigned to a specific site after an earthquake has a more meaningful measure of severity to the non-scientist than the magnitude because intensity refers to the effects actually experienced at that place. The following is an abbreviated description of the 12 levels of Modified Mercalli Intensity:

Level of Intensity	Observed Earthquake Effects
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Source: United States Geological Survey

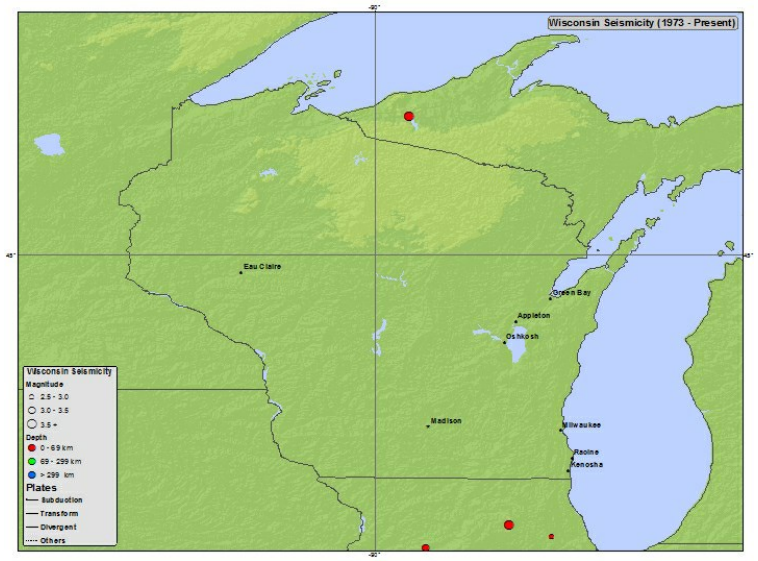
1.7.2 Location and Extent

Physical Characteristics

There are a few fault lines that run through Wisconsin. These include the Douglas Thrust Fault in the NW corner of the state, the Pine Fault found in Burnett and Polk Counties, the Lake Owens Thrust Fault that extends into western Ashland County, and the Dutchman Creek Fault near Green Bay. There are additional fault lines in southern Wisconsin from near Madison to the suburbs of Milwaukee and further south from New Diggings to Milton.

The nearest major active fault is the New Madrid Fault, stretching along the central Mississippi River Valley in Missouri. In recent years, considerable attention has focused on seismic activity in the New Madrid seismic zone that lies within the central Mississippi Valley, extending from northeast Arkansas through southeast Missouri, western Tennessee and western Kentucky to southern Illinois. Scientists at the Center for Earthquake Information have computed a set of probabilities that estimates the potential for different magnitude earthquakes to occur at the New Madrid Fault. Even an 8.3 magnitude earthquake at the New Madrid Fault, however, corner of would cause only minor damage in the southeastern Wisconsin. At this time it is not possible to predict the exact date, duration or magnitude of an earthquake.

Most of Wisconsin's occurrences have not been severe, with only one registering 5.1 on the Richter Scale.



1.7.3 Frequency and Probability

Earthquakes that have affected Wisconsin from 1899 to 1987 are listed in the table that follows. The most severe earthquake in Wisconsin was the record earthquake of 1811, centered along the New Madrid Fault. An earthquake on May 6, 1947, apparently centered just south of Milwaukee near the shore of Lake Michigan, caused only minor damage. There were no reports of injuries. The tremor shook buildings and rattled windows in many communities in a 7770 square kilometer area of southeastern Wisconsin. The shock was felt in a 160-kilometer wide strip from Sheboygan to the Wisconsin - Illinois border and extended from the lakeshore to Waukesha, 40 kilometers inland.

Most earthquakes that do occur in Wisconsin are very low in intensity and can hardly be felt. These very minor earthquakes are fairly common, occurring every few years. Events of moderate magnitude have occurred in locations in Illinois and Michigan. Those and other stronger earthquakes centered in other parts of the country have been felt primarily in Southern Wisconsin.

Date	Location	Latitude North	Longitude West	Maximum Intensity	Magnitude
10/12/1899	Kenosha	42o 34’	87o 50’	II	3
3/13/1905	Marinette	45o 08’	87o 40’	V	3.8
4/22/1906	Shorewood	43o 03’	87o 55’	II	3
4/24/1906	Milwaukee	43o 03’	87o 55’	III	--
1/10/1907	Marinette	45o 08’	87o 40’	III	--
5/26/1909	Beloit	42o 30’	89o 00’	VII	5.1 (max)
10/7/1914	Madison	43o 05’	89o 23’	IV	3.8
5/31/1916	Madison	43o 05’	89o 21’	II	3
7/7/1922	Fond du Lac	43o 47’	88o 29’	V	3.6
10/18/1931	Madison	43o 05’	89o 23’	III	3.4
12/6/1933	Stoughton	42o 54’	89o 15’	IV	3.5
11/7/1938	Dubuque	42o 30’	90o 43’	II	3
11/7/1938	Dubuque	42o 30’	90o 43’	II	3
11/7/1938	Dubuque	42o 30’	90o 43’	II	3
2/9/1943	Thunder Mountain	45o 11’	88o 10’	III	3.2
5/6/1947	Milwaukee	43o 00’	87o 55’	V	4
1/15/1948	Lake Mendota	43o 09’	89o 41’	IV	3.8
7/18/1956	Oostburg	43o 37’	87o45’	IV	3.8
7/18/1956	Oostburg	43o 37’	87o45’	IV	3.8
10/13/1956	South Milwaukee	42o 55’	87o52’	IV	3.8
1/8/1957	Beaver Dam	42o 32’	98o48’	IV	3.6
2/28/1979	Bill Cross Rapids	45o 13’	89o46’	--	<1.0 MoLg
1/9/1981	Madison	43o 05’	87o55’	II	--
3/13/1981	Madison	43o 37’	87o45’	II	--
6/12/1981	Oxford	43o 52’	89o39’	IV-V	--
2/12/1987	Milwaukee	42o 95’	87o84’	IV-V	--
2/12/1987	Milwaukee	43o 19’	87o28’	IV-V	--
6/28/2004	Troy Grove, IL	41o 46’	88o91’	IV	4.2

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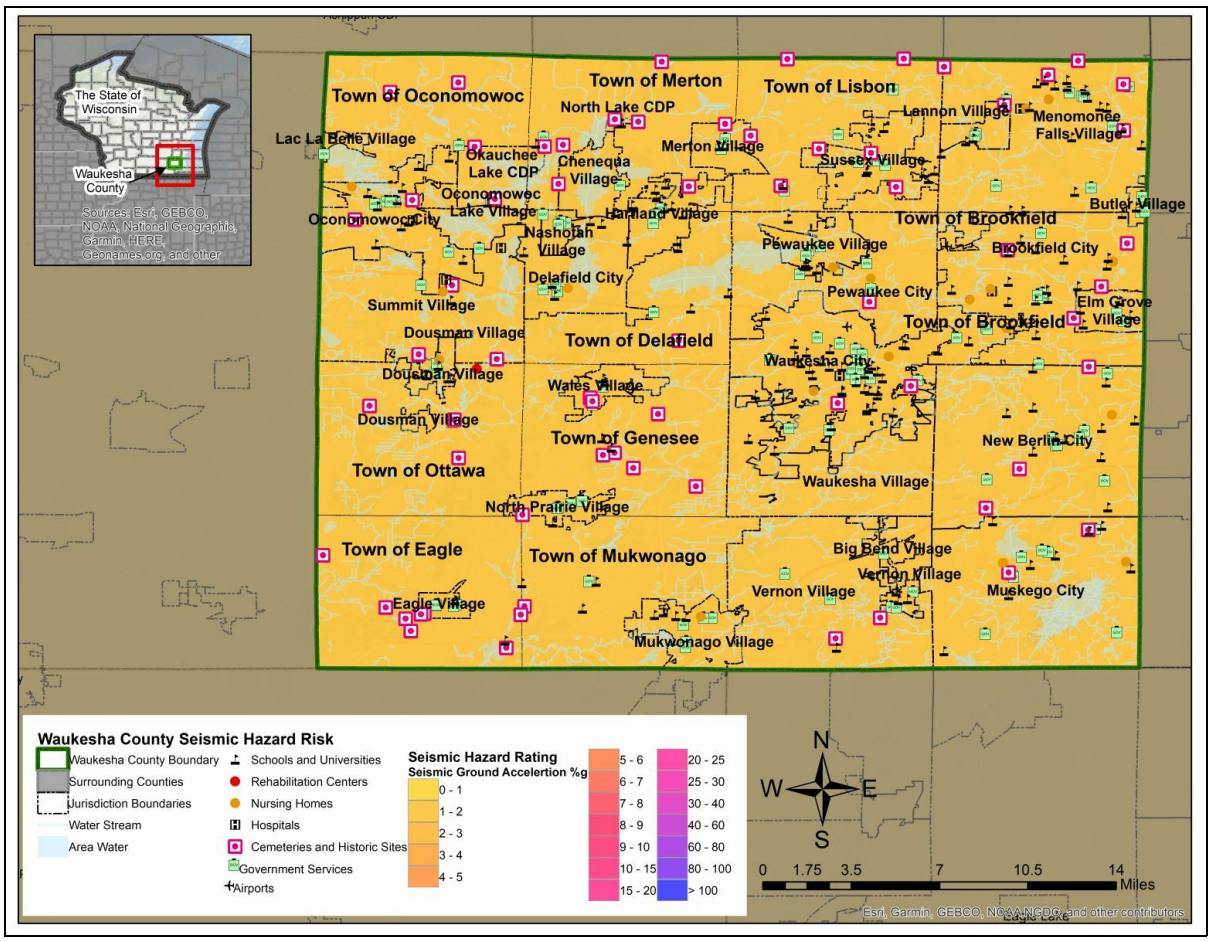
The earthquake threat to Waukesha County is considered low (the 50-year acceleration probability is 4%.) Minor damage (e.g., cracked plaster, broken windows) from earthquakes has occurred in Wisconsin but most often the results have been only rattling windows and shaking ground. There is little risk except to structures that are badly constructed. Most of the felt earthquakes reported have been centered in other nearby states. The causes of these local quakes are poorly understood and are thought to have resulted from the still-occurring rebound of the earth’s crust after the retreat of the last glacial ice. The likelihood of damage from an earthquake is also very low.

1.7.4 Vulnerability

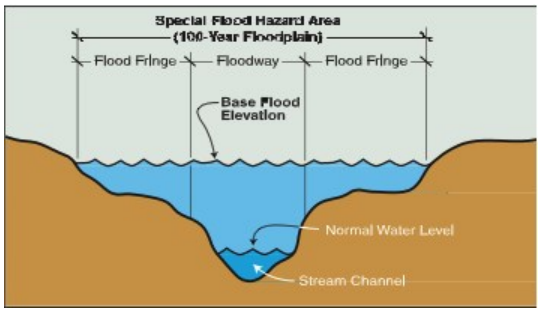
Any impact in the community from earthquake would likely be due to a few broken windows and personal effects that fell in the earthquake. The damage to critical infrastructure and buildings would be negligible.



Hazard Assessment		
Earthquakes		
Frequency / Probability (i.e. Future Probability)	▶	**Low**
Magnitude / Extent (i.e. Strength or Magnitude)	▶	**Low**
Vulnerability (i.e. Consequence and Impact)	▶	**Medium**
Overall Risk Rating	▶	**Low**

1.8 Flooding and Dam Failure

Flooding is defined as a general condition of partial or complete inundation of normally dry land (i.e., the floodplains) caused by the overflow of inland waters or the unusual and rapid accumulation or runoff of surface waters from any source. Floodplains are the lowlands next to a body of water that are susceptible to recurring floods.



FEMA, August 2001

Floods are common in the United States, including Wisconsin, and are considered natural events that are hazardous only when adversely affecting people and property. Floods are common in the United States, including Wisconsin, and are considered natural events that are hazardous only when adversely affecting people and property. Floods are the most frequently recorded destructive events and account for about 30% of the world's disasters each year, according to global statistics. There are many different factors that contribute to flooding. Flooding is an overflowing of water onto land that is normally dry. It can happen during heavy rains, when ocean waves come onshore, when snow melts too fast, or when dams or levees break. Flooding may happen with only a few inches of water, or with several feet of water. Flooding can affect many different communities covering several states during a single event.

1.8.1 Flooding and Dam Failure Hazard Profile

Hazard Profile

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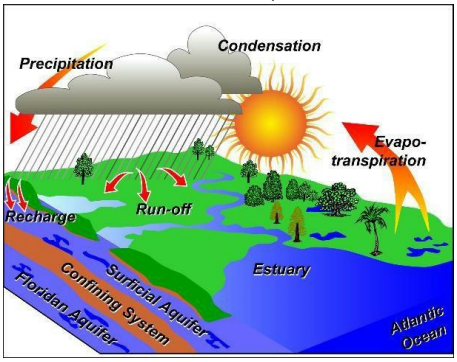


Floods are a part of the earth's natural hydrologic cycle. The cycle circulates water throughout the environment, maintaining an overall balance between the water in the air, on the surface, and in the ground. Sometimes the hydrologic cycle gets out of balance, sending more water to an area than it can normally handle – inundating a floodplain. There are different types of floodplains and they are based on the type of flooding that forms them. During the 20th century, floods were the number one natural disaster in the United States in terms of the number of lives loss and property damage. Development has exacerbated this situation by creating impermeable surfaces that were once permeable - increasing the amount of stormwater runoff while also decreasing the floodplain area.

A warmer atmosphere holds more water vapor and, therefore, can result in heavier and more long-lasting rainfall events. The expected global pattern is for arid areas to get drier and moist areas to get wetter. Where precipitation is enhanced, strong storms are expected to get stronger with the result that rainfall events with a given recurrence frequency, e.g. the 25-year storm, will happen more often. Detecting the influence of changing climate on flooding trends requires isolating the effects of increased rainfall intensity and frequency from the other factors that influence the areal extent and depth of floods, including land use, changes to drainage infrastructure, and changes in the extent of impervious surfaces.

The type of flooding that threatens a community is dependent on a variety of factors including terrain, geologic conditions, watershed characteristics, natural features, and human interaction. The characteristics of flooding events differ dramatically in a controlled engineered urban community from that of the more natural rural environment.

- **Urban flooding** is a result of a community's stormwater infrastructure being exceeded by a storm or series of storms. An urban drainage system is comprised of altered natural channels and engineered ditches, storm sewers, retention ponds, and other facilities constructed to store runoff or carry it to a receiving stream or lake. Most stormwater infrastructure systems are designed to handle the amount of water expected during a 10-year storm. Larger storms typically overload the stormwater system producing shallow flooding.
- **Overbank Flooding** occurs when downstream channels receive more rain from their watershed than it can handle, or a channel is blocked by debris. Excess water overloads the channels and flows out onto the floodplain. Flood depths and duration are dependent on the watershed and riverine system. Generally, the larger the river, the deeper the flood and the longer the duration of the flood.
- **Ponding** is attributed to the high groundwater table and flat terrain. In flat areas, runoff collects in depressions and cannot drain out, creating a ponding effect. Ponding floodwaters do not move or flow away. Floodwaters will remain in the temporary ponds until they infiltrate the soil, evaporate, or are pumped out.
- **Lake Flooding** is a result of large bodies of water behaving more like small oceans – generating large waves that cause damage and shoreline erosion from severe storms.

100 Year Flood

Terms commonly used when referring to flooding are "100-year flood" and "flood plain." A "100-year flood" is defined as the flood water level that can be expected to occur or to be exceeded in a given location once every 100 years. There is a one percent chance of a flood of such magnitude or greater occurring in any given year. The DNR, working with local zoning offices, has designated flood plain areas as those places where there is the greatest potential for flooding.

A 100-year storm does not always result in a 100-year flood. Flooding magnitude varies extensively depending on region, soil conditions, weather, and a large host of manmade factors such as dams and levees among others. Several factors can independently influence the cause-and-effect relation between rainfall and stream flow:

- **Extent of rainfall in the watershed:** When rainfall data are collected at a point within a stream basin, it is highly unlikely that this same amount of rainfall occurred uniformly throughout the entire basin. During intensely localized storms, rainfall amounts throughout the basin can differ greatly from the rainfall amount measured at the location of the rain gage. Some parts of the basin may even remain dry, supplying no additional runoff to the stream flow and lessening the impact of the storm.
- **Soil saturation before the storm:** Existing conditions prior to the storm can influence the amount of stormwater runoff into the stream system. Dry soil allows greater infiltration of rainfall and reduces the amount of runoff entering the stream. Conversely, soil that is already wet from previous rains has a lower capacity for infiltration, allowing more runoff to enter the stream.
- **Relation between the size of the watershed and duration of the storm:** Another factor to consider is the relation between the duration of the storm and the size of the stream basin in which the storm occurs. For example, a 100-year storm of 30-minutes duration in a 1-square-mile basin will have a more significant effect on stream flow than the same storm in a 50-square-mile basin. Generally, streams with larger drainage areas require storms of longer duration for a significant increase in stream flow to occur. These and other factors determine whether or not a 100-year storm will produce a 100-year flood.

The 100-year flood level can fluctuate. The 100-year flood level is statistically computed using past and existing data, and therefore as more data is collected, the level of the 100-year flood will change. For example, as a river basin is altered in a way that affects the flow of water in the river, scientists re-evaluate the frequency of flooding. Dams and urban development are examples of some man-made changes in a basin that affect floods.

The following table provides information on the different flooding alerts for the National Weather Service:

Alert	Criteria
Flood Watch	Atmospheric conditions over a large area, varying in size from multiple counties to multiple states, support the development of heavy rain and/or thunderstorms that are capable of producing flooding. A flood watch implies a longer period of relatively lighter rains, adding up to a large amount of rain. Longer-term flooding implies a slower or steadier rise in the water levels of creeks, streams and larger rivers. Roads can also become flooded, but it is usually more gradual, allowing motorists to monitor conditions more closely.
Flood Warning	A Flood Warning is issued by the National Weather Service when heavy rain has been occurring, and flooding is either occurring or will occur within a specified time, usually within 60 minutes.
Flash Flood Watch	Implies a shorter period of heavier rain. Generally, if flooding is expected within six hours of the onset of rain, a Flash Flood Watch is most appropriate. Flash flooding by definition suggests rapidly rising water, such as a surge of water heading rapidly downstream in a creek or small river. It could also be rapidly rising water on roadways, which can cause motorists to become stranded in vehicles, or even worse, washed into creeks and small rivers due to rapid runoff.
Flash Flood Warning	Atmospheric conditions over a large area, varying in size from multiple counties to multiple states, support the development of heavy rain and/or thunderstorms that are capable of producing flash flooding: A Flash Flood Warning is issued by the National Weather Service when heavy rain has been occurring, and flash flooding is either occurring or will occur within a specified time, usually within 60 minutes.
Urban and Small Stream Flooding	Flooding of small streams, streets and low-lying areas, such as railroad underpasses and urban storm drains is occurring.

Hazard Considerations

The following is a list of potential impacts and planning considerations for a flooding event.

Area Impacted:

- People, facilities, and infrastructure located within the floodplains are susceptible to flood impacts.
- Areas with poor drainage are more susceptible to short-term effects of flash flooding.

Duration of the event:

- Floods typically last for several days to a week, as waters rise and then recede. Typically ponding and overbank flooding can be predicted with some form of accuracy based on hydrologic conditions and weather predictions. Recovery from all flooding events would last several weeks to several months.

Essential Service Disruption:

- Disruption of essential government services (schools, operations, etc.)

Special Considerations:

- No Special Needs considered

Direct Damage:

- The cost of cleanup and structural damage repairs of personal property are often borne by the tribal government responsible, resulting as a potential significant hardship for households without flood insurance coverage.
- Hazardous Material Release – Both transportation and fixed facilities have the potential to be located within a flooded area. If this occurs, flooding can cause the release of hazardous materials, as well as facilitate the spread of these materials.
- Mold can cause further damage to building materials and is considered a public health risk. The longer you allow mold to grow, the greater the risk and the harder the cleanup.
- Loss incurred from damages of public property owned and operated by Waukesha County could be extensive within the reservation. Section 406 (d) of the Stafford Act requires a limit of disaster assistance for insurable facilities that do not carry or carry inadequate flood insurance. Section 311 of the Stafford Act requires an applicant to purchase and maintain insurance where insurance is reasonably available, as a condition for receiving disaster assistance.
- The rapid waters that are typical of overbank flooding and dam/dike failure can cause significant damage to infrastructure such as roadways, utilities, etc. Damages to infrastructure from ponding and urban flooding will be less extensive.
- Injuries and deaths can result during flooding events.
- Flash flooding can cause traffic accidents and congestion, resulting in short-term impacts on transportation infrastructure.

Economic Damage:

- Flooding of agricultural fields and pastures can last for months and result in significant damage to the farming community. Emergency protective measures implemented to protect agricultural fields and pastures is not considered improved property and therefore not reimbursed under federal programs.

Emergency Services:

- Warning for a levee/dike failure may be less; however, due to the constant inspections, monitoring and maintenance of the Dam/Dike will enable the identification of problem areas prior to failure.
- Ponding and overbank flooding is typically gradual, allowing local government to implement emergency protective measures such as sandbagging, evacuation, etc.
- Flooding often leads to the closures of roads or other transportation routes when these routes are washed away or simply under water. This can interrupt transportation corridors and hamper emergency response vehicles.
- Disease/Epidemics – Flooding can produce ponding in areas, resulting in stagnant water. Stagnant water can be a breeding ground for diseases. Among other things, stagnant water is necessary for the breeding of mosquitoes. This in turn influences the prevalence of West Nile virus.
- First responders are often put at risk during flood events when they respond to calls for assistance. These risks can range from dangerous rescue operations to exposure to extreme weather.

Social Factors:

- The cost for flood insurance may be expensive and therefore can pose significant hardship for households without flood insurance coverage.

1.8.2 Location and Extent

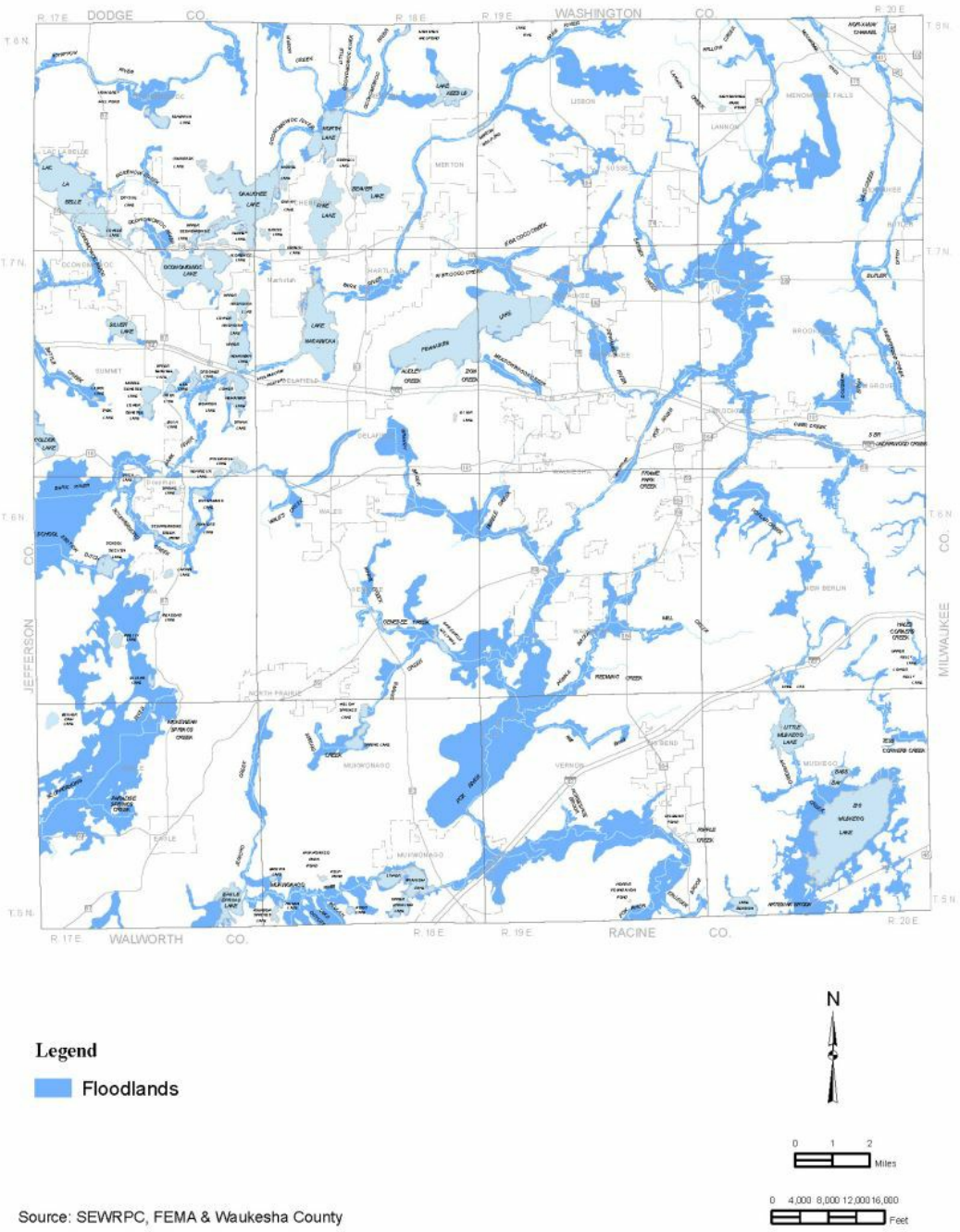
Physical Characteristics

Wisconsin is prone to experiencing flash floods, ice jam floods, local drainage floods, and high groundwater floods. Flash floods are most notable as they occur with little to no warning. Flash floods occur within 6 hours of heavy rains, ice jams or dam failures. Major floods in Wisconsin have usually been confined either to specific streams or to locations that receive intense rainfall in a short period of time. Flash floods usually involve a rapid rise in water level, high velocity, and large amounts of debris, which can lead to significant damage including the tearing out of trees, undermining of buildings and bridges, scouring of new channels, and creation of sink holes. The intensity of flash flooding is dependent upon the intensity and duration of rainfall, steepness of the watershed, stream gradients, watershed vegetation, natural and artificial flood storage areas, and configuration of the streambed and floodplain. Urban areas are increasingly subject to flash flooding due to the removal of vegetation, installation of impermeable surfaces, and construction of drainage systems.

Flooding on rivers usually occurs over 6 hours after an event. This event not only affects large rivers, but small streams and low areas outside of the flood plains.

Generally the amount of damage from flooding is a direct consequence of land use. If the ground is already saturated, stripped of vegetation or paved, the amount of run-off increases, adding to the flooding. There is also a concern regarding the loss of topsoil and erosion due to flooding. As Waukesha continues to develop, urbanization will decrease the ability of natural systems to absorb rainfall because of the increase in impervious surfaces and runoff.

General Floodlands of Waukesha County



Dams

Flooding may also occur due to a dam breach or overflow. Dams are barriers built across a waterway to store, control or divert water; a dam failure is a failure of the dam that causes downstream flooding. Failures may be caused by technological events (e.g., materials failure) or by natural events (e.g., landslide, earthquake) with flooding being the most common result.

According to the Wisconsin Department of Natural Resources (WDNR) Dam Safety Program here are approximately 3,800 dams in existence in the State of Wisconsin. Since the late 19th century, more than 700 dams have been built, then washed out or removed. Since 1967, approximately 100 dams have been removed. Almost 60% of the dams in Wisconsin are owned by a former company or private individual, 9% by the State of Wisconsin, 17% by a municipality such as a township or county government and 14% by other ownership types.

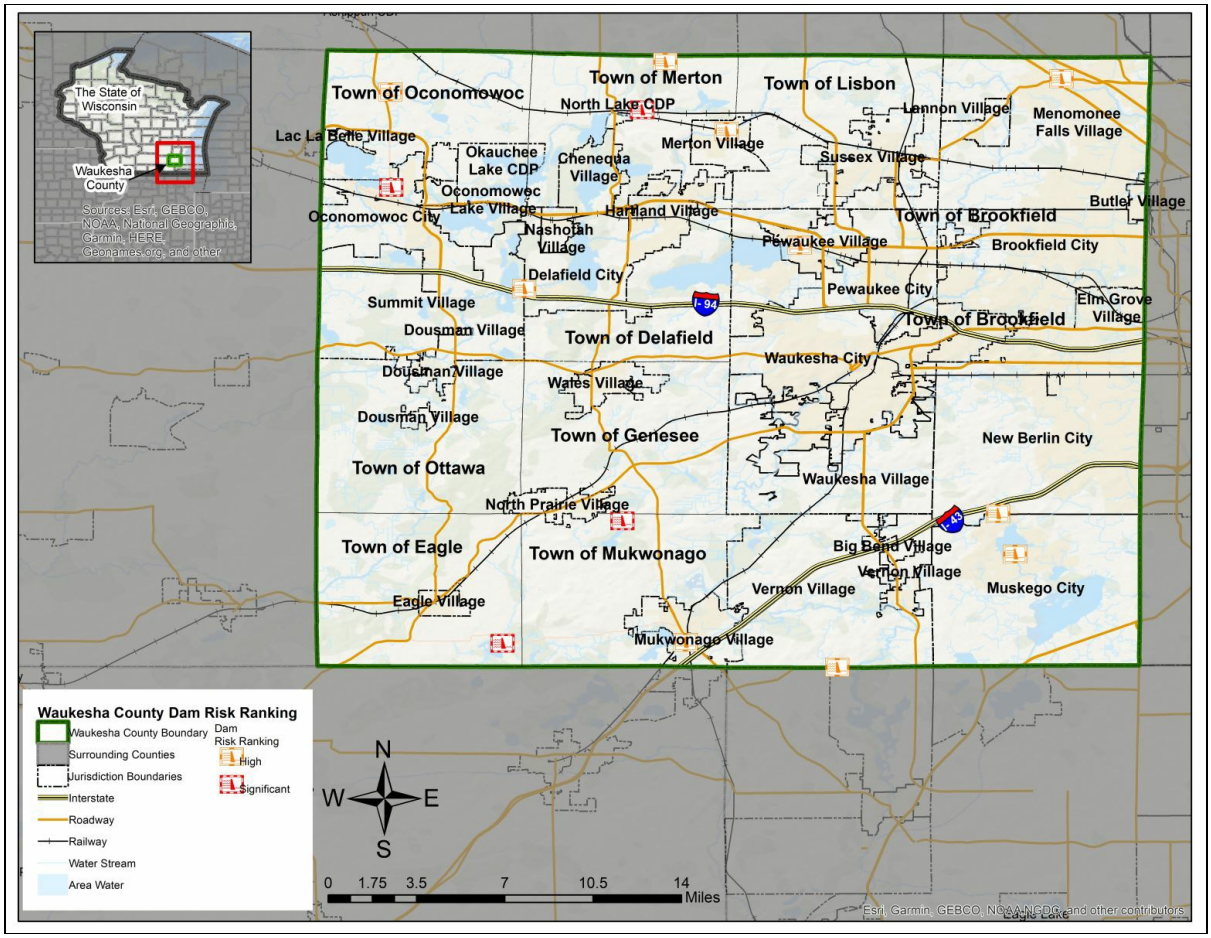
The federal government has jurisdiction over most large dams in Wisconsin that produce hydroelectricity - approximately 5% or nearly 200 dams. The

Wisconsin Department of Natural Resources regulates the rest of the dams. A dam with a structural height of over 6 feet and impounding 50 acre-feet or more, or having a structural height of 25 feet or more and impounding more than 15 acre-feet is classified as a large dam. There are approximately 1,160 large dams in the State of Wisconsin.

Waukesha County has 79 small, uncontrolled agricultural dams included in the Wisconsin Department of Natural Resources (DNR) database:

Dam Official Name	Size	Latitude	Longitude	Owner Type	Waterway Name (Downstream City)
MONTEREY	LARGE	43.1720279	-88.4994749	PRIVATE	DRAINAGE DITCH- TR FOX R.
OKAUCHEE LAKE	LARGE	43.1085361	-88.4538685	TOWN	OCONOMOWOC
WATERVILLE	LARGE	43.02112	-88.43633	PRIVATE	SCUPPERNONG CREEK
BISCHEL	LARGE	42.9970597	-88.4781377	TOWN	UPPER SCUPPERNONG CR
WAMBOLD	LARGE	42.8559601	-88.4351349	LAKE ASSOCIAT ION	MUKWONAGO R
SAYLESVILLE ROLLER MILL	LARGE	42.948759	-88.3232668	PRIVATE	WHITE CREEK
MERTON ROLLING MILL	LARGE	43.1494041	-88.3066177	VILLAGE	BARK
MUKWONAGO	LARGE	42.85603	-88.33244	VILLAGE	MUKWONAGO
MONCHES	LARGE	43.1890942	-88.3417375	PRIVATE	OCONOMOWOC
PEWAUKEE	LARGE	43.0842232	-88.2646316	VILLAGE	PEWAUKEE
WILLOW SPRINGS LAKE	LARGE	42.9261265	-88.3664107	LAKE ASSOCIAT ION	SPRING CREEK
SARATOGA MILL	LARGE	43.01355	-88.22893	CITY	FOX
DELAFIELD FISH HATCHERY	LARGE	43.06304	-88.40215	CITY	BARK
LITTLE MUSKEGO	LARGE	42.9071	-88.1411	CITY	MUSKEGO CREEK
PEACOCK	LARGE	43.11724	-88.49899	CITY	OCONOMOWOC
UPPER NASHOTAH	LARGE	43.082284	-88.4324509	LAKE ASSOCIAT ION	OUTLET UPPER NASHOTAH LAKE
REISCHL	LARGE	42.8422122	-88.2430921	PRIVATE	TR-FOX RIVER
HIDDEN LAKES	LARGE	42.8817102	-88.3041344	PRIVATE	TR-FOX RIVER
SALOW LAKE	LARGE	43.0448541	-88.3315677	PRIVATE	ZION CREEK
VERNON MARSH-REF.FLOWAGE	LARGE	42.9280951	-88.2862511	DNR	DRAINAGE DITCH- TR FOX R.
VERNON MARSH-MID.FLOWAGE	LARGE	42.9204792	-88.2846198	DNR	MILL BROOK
VERNON MARSH-N.FLOWAGE	LARGE	42.9234789	-88.2842347	DNR	PEBBLE BROOK
LOWER LAKE NEMAHBIN	LARGE	43.0561637	-88.4421597	PRIVATE	BARK
SCHOOL SECTION LAKE	LARGE	42.98282	-88.50884	COUNTY	SCHOOL SECTION LAKE OUTLET
OCONOMOWOC LAKE	LARGE	43.10445	-88.46946	VILLAGE	OUTLET OCONOMOWOC LAKE
FUNKS	LARGE	43.1617749	-88.3551328	PRIVATE	OCONOMOWOC RIVER
SOUTHWEST FLOWAGE	LARGE	42.88708	-88.31844	DNR	NON-NAV DITCH TO FOX RIVER
LEPPER	SMALL	43.1796589	-88.1144981	VILLAGE	MENOMONEE RIVER
FRASER	SMALL	42.8768781	-88.2064092	PRIVATE	TR FOX
MUSKEGO	SMALL	42.85222	-88.13085	CITY	MUSKEGO CREEK
BLOTT	LARGE	42.93033	-88.15086	LAKE ASSOCIAT ION	MUSKEGO CREEK
NEMAHBIN ROLLER MILL	LARGE	43.05926	-88.42266	PRIVATE	BARK
MOREY	SMALL	42.9562358	-88.3543353	PRIVATE	WHITE CREEK
BEAVER LAKE OUTLET	SMALL	43.1253972	-88.3686475	PRIVATE	OUTLET BEAVER LAKE
LAKE KEESUS	SMALL	43.1617789	-88.3274178	PRIVATE	OUTLET LAKE KEESUS
NORTH HILLS COUNTRY CLUB	SMALL	43.1586721	-88.0784026	PRIVATE	MENOMONEE
LAKE LABELLE	SMALL	43.1195256	-88.5165265	CITY	OCONOMOWOC
JENSEN	SMALL	42.9558529	-88.1995617	PRIVATE	MILL CREEK
AGNEW,DONALD P.	SMALL	43.1713657	-88.4584187	PRIVATE	TR-ASHTPPUN RIVER
CZERWINSKI,LEROY M.	SMALL	43.1778493	-88.2661951	PRIVATE	TR-BARK RIVER
GIRL SCOUTS CAMP CHINOOK	SMALL	42.9391359	-88.2496218	PRIVATE	NOT ON A STREAM
MINOOKA PARK	SMALL	42.9862514	-88.1990917	PRIVATE	TR-PEBBLE BROOK
REGAL MANORS III	SMALL	42.9683604	-88.0987427	PRIVATE	NOT ON A STREAM
SCUPPERNONG SPRINGS	SMALL	42.9344865	-88.4673018	DNR	SCUPPERNONG SPRINGS
ABENDROTH AND ASSOC. NO 1	SMALL	42.999272	-88.2551574	PRIVATE	TR-FOX RIVER
ABENDROTH AND ASSOC. NO 2	SMALL	42.9992941	-88.2551385	PRIVATE	TR-FOX RIVER
DUNLOP, DOUGLAS	SMALL	42.9212884	-88.3672788	PRIVATE	UNNAMED

HUBERTY, ROBERT L.	SMALL	42.8742883	-88.2101299	PRIVATE	TR-FOX RIVER
HASS,HOWARD	SMALL	42.981859	-88.2009633	PRIVATE	TR-PEBBLE CREEK
MCCLINTOCK SPRINGS	SMALL	42.9008751	-88.4758962	DNR	TR-SCUPPERNONG RIVER
PARADISE SPRINGS	SMALL	42.8863161	-88.4941086	DNR	TR-SCUPPERNONG RIVER
WEST ALLIS KENNEL CLUB	SMALL	42.9167323	-88.2335973	PRIVATE	MILL BROOK
GENESEE ROLLER MILL	SMALL	42.9623034	-88.3585139	PRIVATE	WHITE CREEK
DONNELLY	SMALL	42.8386733	-88.4558673	PRIV	NON-NAV
FOUNTAIN/SQUARE	SMALL	42.9905079	-88.0807048	CITY	TRIBUTARY TO ROOT RIVER
HOGAN'S DAMS		42.8582099	-88.4223737		
STONE BANK MILL DAM		43.1358619	-88.4082568		
BARK RIVER DAM		43.1001411	-88.3474471		
MANN DAM		43.1573792	-88.2928541		
WRIGHT'S DAM		42.9552245	-88.2229382		
COUNSEL DAM		43.179986	-88.4449451		
STEWART (JANES) DAM		42.9132236	-88.2427062		
R. ORMAND DAM		43.0663225	-88.1161648		
S. BAKER DAM		43.1936754	-88.4426433		
KELLOG'S GRIST MILL DAM		42.9180871	-88.2661026		
VAN BUREN DAM		42.9187734	-88.2995717		
HUMPHREY DAM		43.0630391	-88.4021526		
PROCTOR DAM		42.9578289	-88.359203		TRIB TO WHITE CREEK
OLD OKAUCHEE DAM		43.1115481	-88.4474149		
SCHNEIDER DAM		43.159581	-88.3707366		
DEISSNER'S DAM		43.0438871	-88.2103001		OUTLET OF PEWAUKEE LAKE
WEBER BREWING COMPANY DAM		43.0085875	-88.2387524		
YOUMAN DAM		43.0080415	-88.2393451		TRIB TO FOX RIVER
WISCONSIN SUGAR COMPANY DAM		43.1844511	-88.1159401		
WAUKESHA STATE STREET DAM		43.0097038	-88.2374451		
SILVER LAKE		43.0729623	-88.5057114		
CALHOUN PARK	SMALL	42.9466063	-88.1281444	CITY	
E.S.Kellog Est. Dam Highway 67	SMALL	42.9249192	-88.4689061	DNR	TR SCUPPERNONG RIVER

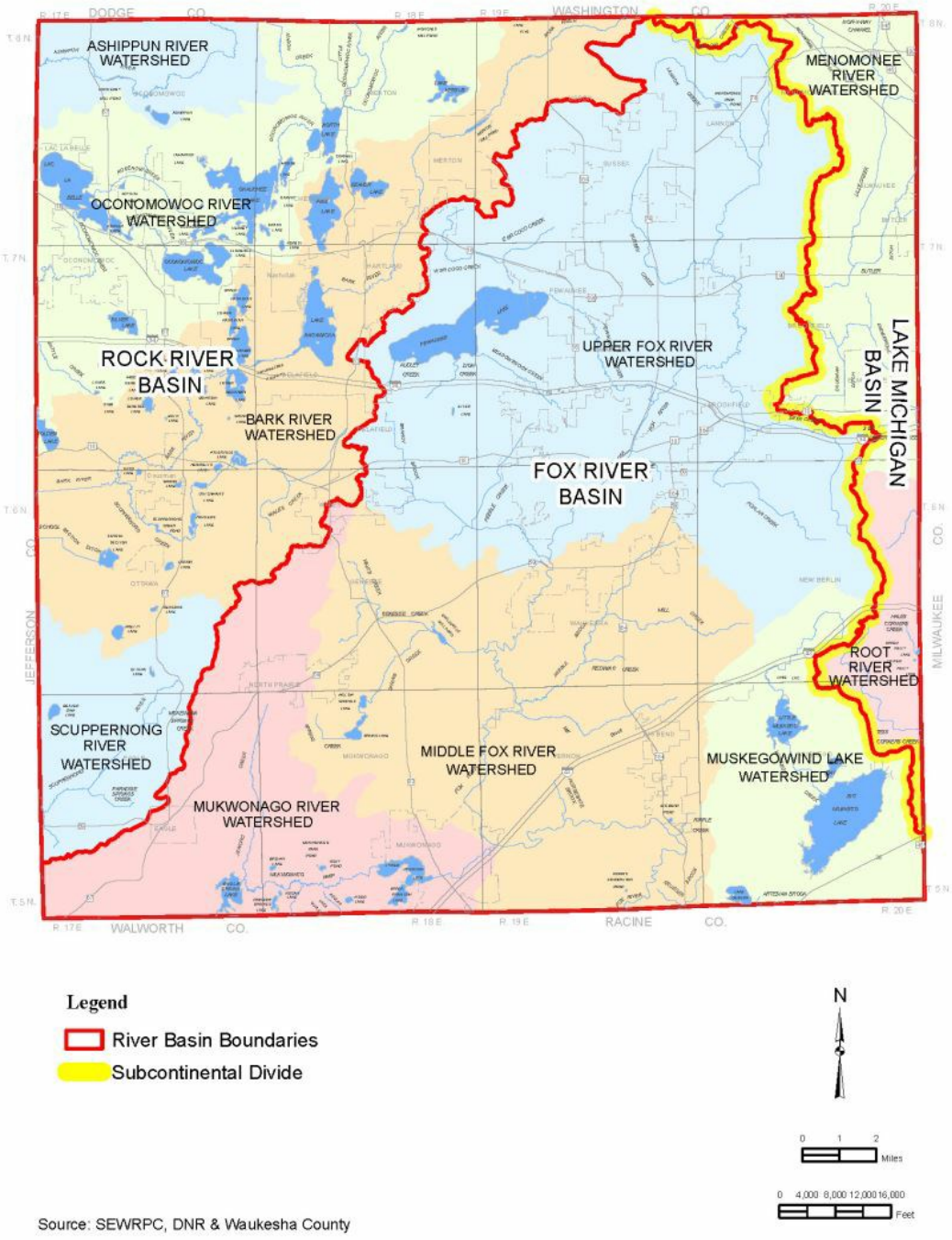


Most of these dams are small, mill-type dams under the jurisdiction of the DNR and are also privately owned. None of these dams could handle the volume of water generated by a 100- or 500-year flood without overtopping. These dams are inspected by the Wisconsin Department of Natural Resources (DNR) and the largest are required to have an Emergency Action Plan (EAP) and failure analysis on them. There are no dams in other counties that pose a significant flooding risk to the citizens of Waukesha County.

One potential effect of flooding is erosion. Erosion is defined as the removal of soil by the force of waves, currents and/or ice at a lakeshore or streambank or by the power of wind or water on open land. Erosion is a natural process that can be accelerated by natural disasters (e.g., flooding, heavy rains, strong winds, drought) or by human activity (e.g., removal of plants/trees, tilling.) Because of the many waterways in Waukesha County, there is concern about ensuring the stabilization of the shorelines.

Watersheds

Watersheds of Waukesha County



Waukesha County has 10 watersheds. The maps in the Community Profile show the watershed boundaries and 100-year floodplains for the entire county. Waukesha County river systems drain to three major basins, the Rock River Basin on the western side of the county, the Fox River Basin in the center and the Lake Michigan Basin on the eastern part of the county. The Fox River Basin covers the largest area of the county, encompassing about 58 percent of the total surface area. The Rock River Basin encompasses approximately 34 percent and the Lake Michigan Basin accounts for the remaining eight percent of the county surface area. The Rock and Fox River Basins both lie west of the sub-continental divide and are part of the Mississippi River drainage area. Everything east of the sub- continental divide, including the Menomonee and Root River Watersheds, are part of the Great Lakes-St. Lawrence River drainage system. The sub-continental divide is critical to the water supply issue noted earlier and sanitary sewer planning. This is because water that is pumped from the Great Lakes system is generally required to be returned after use. For water resource planning purposes, each river basin is further divided into watersheds. There are 10 major watersheds in Waukesha County. The following sections provide additional detail on the watersheds within each basin. Most of the information presented has been compiled from DNR “State of the Basin” reports.

Rock River Basin

Ashippun River Watershed

The Ashippun River Watershed lies in Dodge, Washington and Waukesha Counties. It covers 69 square miles, of which approximately 16 square miles or 23 percent of the total watershed is located in northwestern Waukesha County. Agriculture is the primary land use and accounts for 66 percent of the land use in the Waukesha County portion of the watershed, according to the Year 2000 SEWRPC land use inventory. The water is stained light brown by tannic acid and the bottom is largely silt. The Ashippun River is classified as a warm water sport fishery.

Bark River Watershed

This 186-square mile watershed drains portions of Washington, Waukesha and Jefferson Counties and has many natural lakes, some of them large. About 47 percent of the area is in Waukesha County, 45 percent in Jefferson County and the remainder is in Washington County. Many of the watershed's lakes are experiencing heavy development pressure or have extensive development around them. While some wetlands have been drained or filled, a significant amount of wetland remains. The greatest threat to the basin's wetlands is rapid development in Waukesha County. The watershed is about 44 percent agricultural but significant rural subdivision development occurs in the Waukesha County portion of the watershed. Of the agricultural lands, about seven percent have high soil erosion potential. Thus, agriculture use and rural development degrade local surface water quality.

Major streams in the Waukesha County portion of the Bark River watershed include the Bark River, Scuppernong Creek and Wales Creek. The Bark River is classified as a warm water sport fishery. There are currently two municipal sewage treatment plants that discharge to the Bark River within Waukesha County, the Village of Dousman and the Delafield-Hartland facility, which discharges just downstream from Nagawicka Lake.

Oconomowoc River Watershed

The Oconomowoc River Watershed drains approximately 128 square miles encompassing portions of Dodge, Jefferson, Washington and Waukesha Counties. The Waukesha County portion of the watershed is approximately 63 square miles in size representing 49 percent of the watershed. According to the Year 2000 SEWRPC land use inventory, nearly 35 percent of the Waukesha County portion of the watershed is agricultural. There is one sewage treatment plant discharge in the Oconomowoc River from the City of Oconomowoc, approximately 2 miles downstream of Lac Labelle.

Major lakes in the Waukesha County portion of the watershed include Beaver, Fowler, Lac LaBelle, Keesus, Moose, North, Oconomowoc, Okauchee, Pine and Silver Lakes. In addition to the Oconomowoc River, major streams in the Waukesha County portion of the watershed include Battle Creek, Little Oconomowoc River, Mason Creek and Rosenow Creek. Rosenow Creek is a designated trout stream and the location of a recent stream restoration project.

Scuppernong River Watershed

The Scuppernong River is a tributary of the Bark River in Jefferson County. The watershed is bordered on the southeast by the Kettle Moraine State Forest and lies with in portions of three counties: Jefferson, Walworth and Waukesha. The predominant land use is agricultural though there is significant public ownership in the state forest and two state wildlife areas with large forested tracts and wetland areas. Other wetland areas have been drained for agriculture. Substantial low-density residential and industrial development is occurring throughout the watershed. According to the Year 2000 SEWRPC land use inventory, approximately 5,723 acres or 38 percent of the Waukesha County portion of the watershed is agricultural. Another 4,416 acres or 29 percent is considered wetland and 3,429 acres or 22 percent is classified as woodland.

Major streams found in the Waukesha County portion of the watershed include the Scuppernong River and Paradise Springs Creek. The Scuppernong River rises at the edge of the interlobate moraine in the Kettle Moraine State Forest.

Fox River Basin

Upper Fox River Watershed

The Upper Fox River Watershed is a 151 square mile drainage area located almost entirely in Waukesha County, with a very small portion (1%) located in Washington County. The Upper Fox River is the principal perennial stream in the watershed. Other significant perennial streams include Brandy Brook, Deer Creek, Pebble Creek, Pewaukee River, Poplar Creek and Sussex Creek.

According to the Year 2000 SEWRPC land use inventory, nearly 24 percent of the watershed is mapped as residential land use. Other land use categories include agricultural (23%), wetlands (13%) and transportation related (11%). Commercial and industrial land uses account for another six percent of the land area. There are many incorporated municipalities within the watershed including the Cities of Brookfield, Delafield, New Berlin, Pewaukee and Waukesha. Also included are the Villages of Hartland, Lannon, Menomonee Falls, Pewaukee, Sussex and Wales. There are three sewage treatment plants in the City of Brookfield and the City of Waukesha.

The Upper Fox River contains over 80 miles of perennial streams exhibiting a wide range of quality. At nearly 2500 acres, Pewaukee Lake is the only lake of significant size in the watershed with a maximum depth of 45 feet and an average depth of 15 feet. It is also one of the largest lakes in southeastern Wisconsin and recognized as one of the top musky lakes in the state. The lake level was naturally controlled until 1838 when a dam was constructed at the lake outlet to power a mill. This resulted in lake levels rising about six feet and the surface area of the lake doubling. Present levels are artificially controlled by a dam at the outlet of the Lake to the Pewaukee River, which then flows about 4.4 miles to its confluence with the Fox River.

Mukwonago River Watershed

The Mukwonago River Watershed covers approximately 86 square miles in Jefferson, Waukesha and Walworth Counties. Approximately 52 square miles or 61 percent of the watershed area lies within Waukesha County. The Villages of Eagle, Mukwonago, North Prairie and Wales are found within the watershed boundary. The Village of Mukwonago has a wastewater treatment plant discharging into the Mukwonago River. Rural uses cover most of the land area in the watershed. Agriculture is dominant even in the Waukesha County portion where, according to the Year 2000 SEWRPC land use inventory, agriculture accounts for approximately 36 percent of the land use. Residential land use accounts for another 19 percent of the watershed area in Waukesha County followed by woodlands (15%) and wetlands (9%). There are nearly 50 miles of perennial streams in the watershed.

The Mukwonago River is one of the cleanest streams in southeastern Wisconsin and provides important habitat for rare fish and mussels. The Mukwonago River is home to over 50 different species of fish.10 of the state's 11 species of Sunfish (including the threatened Longear Sunfish) live in the Mukwonago

River. All three species of Killifish (or Topminnows) found in Wisconsin, including the federally endangered Starhead Topminnow, live in the Mukwonago River. This is the only stream in the state where this occurs. The Mukwonago supports numerous species of Shiners and Darters, fish species that are not necessarily unique, but are indicators of good water quality and habitat. The Mukwonago River contains 15 different species of freshwater mussels, including the endangered Rainbow Shell and the threatened Slippershell and Ellipse mussels. Mussels are the most threatened family of animals in North America, due principally to water quality deterioration in most of the nation's freshwater bodies. The Mukwonago River watershed features a diverse and extensive system of intact wetlands that help support its high water quality and species diversity. These wetlands are one of the important reasons explaining why the Mukwonago River is known as one of the most biologically diverse and highest quality rivers in the state.

The surrounding landscape is home to a wide array of native plants and wildlife, including sandhill cranes, tree frogs, mink, red fox, butterflies and dragonflies. The Mukwonago, for example, supports one of the last and largest stands of wild rice in Southeastern Wisconsin. Due in large part to the glacial soils found throughout most of the watershed, and combined with the fact that the watershed is relatively undeveloped, groundwater recharge rates in the watershed are significant. Much of the life described above relies heavily on the consistent inflow of groundwater for its survival. The human communities in the watershed also rely on the groundwater aquifers supplied by this recharge. Today, those aquifers are being pumped excessively potentially threatening the future economic viability of the region – maintaining groundwater recharge wherever possible is more important than ever.

Due to the factors listed above, the Wisconsin Chapter of The Nature Conservancy has designated the Mukwonago River watershed one of its four "Last Great Places" in Wisconsin. Because of its high quality waters and wetlands, the Mukwonago River watershed was selected in the early 2000's as one of three focal sites globally to be reviewed by the international Nature Conservancy Wetlands Network. The Conservancy owns 1,718 acres at five preserves in the Mukwonago Watershed. As of March 27, 2015, the Conservancy has helped protect a total of 2,144 acres in the Mukwonago Watershed. This figure includes lands owned and managed by the Conservancy, conservation easements, government co-ops and assists.

Middle Fox River Watershed

The Middle Fox River Watershed is the largest of the Fox River Basin watersheds (248 square miles), encompassing portions of Racine and Waukesha Counties, along with small portions of Milwaukee and Walworth Counties. The Waukesha County portion of the watershed covers 86,175 acres or approximately 134 square miles. In Waukesha County, portions of the Cities of Muskego, New Berlin and Waukesha lie within the watershed, along with the Villages of Big Bend, Mukwonago, North Prairie and Wales. Agriculture dominates the rural land use, accounting for over 40 percent of the area. Other rural uses include grasslands (18%), wetlands (14%), and forests (13%). Urban areas comprise nearly four percent of the land cover in the watershed.

There are about 40 miles of major perennial streams in this watershed within Waukesha County. Genesee Creek, Mill Brook, Spring Creek and White Creek are listed as cold-water communities.

Muskego/Wind Lakes Watershed

The Muskego/Wind Lakes Watershed is actually a small portion (41 square miles) of the Middle Fox River Watershed located in Waukesha, Racine and Milwaukee Counties. The Waukesha County portion of the watershed encompasses approximately 36 square miles and includes portions of the Cities of Muskego and New Berlin. Big Muskego Lake is the largest lake in this watershed covering 2,260 acres but averages only 2.5 feet deep. This lake is undergoing intensive management following the principles of "biomanipulation" to improve water quality not only within the lake but further downstream to Wind Lake and the Fox River.

Lake Michigan Basin

Menomonee River Watershed

The Menomonee River Watershed covers 136 square miles in portions of Washington, Waukesha and Milwaukee Counties. The Waukesha County portion of the watershed covers about 37 square miles and includes portions of the City of Brookfield as well as the Villages of Butler, Menomonee Falls, and Elm Grove. The Menomonee River originates in wetlands near the Village of Germantown in Washington County and runs southeasterly for 32 miles before meeting the Milwaukee and Kinnickinnic Rivers in the Milwaukee Harbor. Nearly all of the land area in the watershed is within incorporated municipalities. According to the Year 2000 SEWRPC land use inventory, nearly 42 percent of the Waukesha County portion of the watershed is residential. Other land uses in Waukesha County include: transportation-related (15%), wetlands (8%) and agriculture (7%). Commercial and industrial land uses each contribute another six percent of the total land uses respectively.

Ninety-six miles of streams are found within the watershed. Flooding continues to be a major concern in this watershed. Following the recent removal of the Falk Corporation Dam and concrete drop structure on the Menomonee River, seasonal runs of Lake Michigan trout and salmon create fishing opportunities in publicly-accessible areas

Root River Watershed

The Root River Watershed is located in portions of Waukesha, Milwaukee and Racine counties and encompasses 197 square miles. Only about 13 square miles are within Waukesha County covering portions of the Cities of Muskego and New Berlin. According to the Year 2000 SEWRPC land use inventory, residential land use accounts for 46 percent of the land use in the Waukesha County portion of the watershed. Another 15 percent is agricultural and 14 percent is transportation related. Water quality of the 117 miles of rivers and streams in the Root River Watershed ranges from severely degraded to good.

Floodplain Regulations

Floodplain regulations have been in place in the cities, towns and villages of Waukesha County for many years. The Department of Natural Resources requires that each municipality approve regulations that meet DNR guidelines. These regulations and guidelines result from the value of Wisconsin lakes and waterways and a desire to preserve them and to protect the people who reside near them. Unregulated development can lead to loss of lives and property during floods.

Chapter 614, Laws of Wisconsin 1965, requires counties to adopt regulations giving all lands within 300 feet of navigable rivers or streams protection from haphazard development. Under this legislation, Waukesha County has adopted a zoning ordinance which gives a measure of protection to watersheds. The law protecting flood plains was created to meet the following objectives:

- Reduce the hazards to life and property from flooding
- Protect floodplain occupants from a flood which is or may be caused by their own land use, which is or may be undertaken without full realization of the danger.
- Protect the public from the burden of extraordinary financial expenditures for flood control and relief.

Encroachment on flood plains, including structures or fill, reduces the flood-carrying capacity.

1.8.3 Frequency and Probability

Wisconsin has experienced several major floods during the last two decades. The 1973 and 1986 floods revealed that no flood plains or urban areas in Wisconsin can be considered safe from damages. Mill-dams have developed leaks on occasion but have not caused any flooding problems.

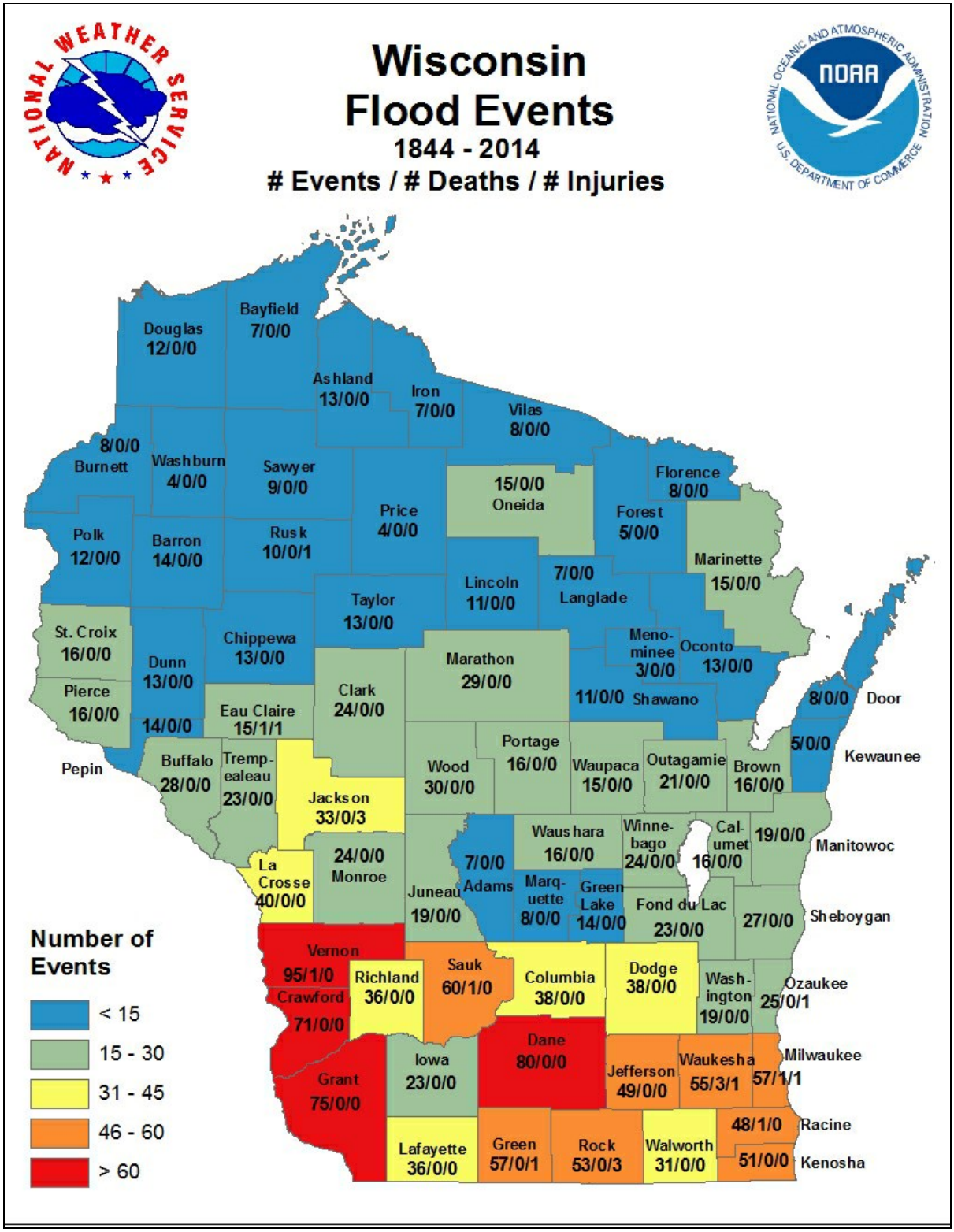
Waukesha County does have a history of flooding problems, especially along the Mississippi River. Waukesha County has been included in nine Presidential Disaster Declarations requests for flooding, the most recent of which are detailed below:

- FEMA-912-DR-WI: On August 6, 1991, the President declared a major disaster as a result of high winds and severe storms that occurred July 7, 1991.
- FEMA-1180-DR-WI: On July 7, 1997, the President declared a Major Disaster as a result of flooding that occurred on June 21-23. The declaration was granted for both Public and Individual Assistance as well as Hazard Mitigation.
- FEMA 1526-DR-WI: On June 18, 2004, the President declared a major disaster as a result of severe storms and flooding that began on May 19th. Waukesha County was eligible for both Public and Individual Assistance as well as Hazard Mitigation.
- FEMA 1768-DR-WI: On June 14, 2008, the President declared a major disaster as a result of severe storms, tornadoes and flooding. Waukesha County was eligible for both Public and Individual Assistance as well as Hazard Mitigation.

Following is a table with the 48 flood events recorded by the National Weather Service between 1 January 1950 and February 2021:

Location	Date	Type	Death	Injury	Property Damage	Crop Damage
Pewaukee	2/21/1994	Flood	0	0	0	0
Oconomowoc	8/9/1995	Urban Flood	0	0	0	0
Waukesha County	8/16/1995	Flash Flood	0	0	0	0
Waukesha County	8/19/1995	Urban Flood	0	0	0	0
Waukesha County	6/17/1996	Flood	0	0	25K	1.0M
Brookfield	6/17/1996	Flash Flood	0	0	50K	0
Menomonee Falls	6/21/1997	Flash Flood	0	0	5.4M	1.2M
Big Bend	8/5/1998	Flash Flood	0	0	40K	0
Brookfield	8/6/1998	Flash Flood	2	1	17.3M	0
Hartland	2/11/1999	Urban/sml Stream Fld	0	0	1K	0
Elm Grove	4/23/1999	Urban/sml Stream Fld	0	0	0	0
Brookfield	5/16/1999	Urban/sml Stream Fld	0	0	0	0
Waukesha County	6/13/1999	Flood	0	0	900K	0
Waukesha	7/9/1999	Urban/sml Stream Fld	0	0	0	0
Pewaukee	7/20/1999	Flash Flood	0	0	10K	0
Waukesha County	5/11/2000	Urban/sml Stream Fld	0	0	0	0
Mapleton	5/17/2000	Flash Flood	0	0	50K	0
Mukwonago	7/2/2000	Urban/sml Stream Fld	0	0	0	0
Hartland	7/2/2000	Flash Flood	0	0	200K	0
Waukesha	7/14/2000	Urban/sml Stream Fld	0	0	0	0
Waukesha	9/11/2000	Flash Flood	0	0	50K	0
Waukesha County	2/9/2001	Flood	0	0	325K	0
Menomonee Falls	6/3/2002	Urban/sml Stream Fld	0	0	0	0
Waukesha	7/27/2002	Urban/sml Stream Fld	0	0	0	0
Waukesha	8/12/2002	Flash Flood	0	0	20K	0
Waukesha	8/13/2002	Urban/sml Stream Fld	0	0	0	0
Waukesha	8/21/2002	Urban/sml Stream Fld	0	0	0	0
Waukesha County	6/1/2004	Flood	0	0	35.6M	216.0M
Oconomowoc	8/3/2004	Flash Flood	0	0	50K	0
Mukwonago	9/25/2005	Flash Floo	0	0	50K	0
Sussex	11/5/2005	Flash Flood	0	0	10K	0
Brookfield	7/9/2006	Flash Flood	0	0	2K	0
Waukesha	7/27/2006	Flash Flood	0	0	3.0M	500K
Brookfield	9/12/2006	Flash Flood	0	0	100K	0
Mukwonago	8/19/2007	Flash Flood	0	0	100K	200K
Big Bend	6/7/2008	Flash Flood	0	0		0K
Oconomowoc	6/7/2008	Flash Flood	0	0		10K
Waukesha Co Arpt	6/7/2008	Flash Flood	0	0	0K	10K
North Prairie	6/8/2008	Flash Flood	0	0	63.0M	1.0M
Wales	6/12/2008	Flash Flood	1	0	25K	0K
Downtown Waukesha	6/19/2009	Flash Flood	0	0	120K	0K
Downtown Waukesha	6/19/2009	Flash Flood	0	0	10K	0K
Elm Grove	7/15/2010	Flash Flood	0	0	5k	0K
Menomonee Falls	7/22/2010	Flash Flood	0	0	2.9M	50K
Menomonee Falls	7/22/2010	Flash Flood	0	0	2.9M	50K
Mukwonago	10/5/2013	Flash Flood	0	0	14K	0K
Elm Grove	5/12/2014	Flash Flood	0	0	0K	0K
Bethseda	5/12/2014	Flash Flood	0	0	0K	0K
Duplainville	7/12/2017	Flash Flood	0	0	0K	0K
Wauesha Co Arpt	7/12/2017	Flash Flood	0	0	5K	0K
Monterey	02/19/2018	Flood	0	0	10K	0K
Waukesha Downtown	09/15/2018	Flood	0	0	1K	0K
Georkes Corner	03/13/2019	Flood	0	0	2K	0K
Durham	9/12/2019	Flash Flood	0	0	0K	0K
New Berlin	05/17/2020	Flash Flood	0	0	15K	0K

Below is a map of Flood Events in Wisconsin from 1844 - 2014.



A careful review of the geography and history of flooding in Waukesha County leads to the conclusion that there is a very high probability of flooding in the future and a very high probability of damage and losses due to flooding. This flooding could occur due to urban stream flooding, flash flooding or, less likely, due to a dam failure.

Standard:

- Wisconsin Emergency Management (WEM) Mitigation Standard 2015; Element B: Hazard Identification and Risk Assessment (see the end of this element for a checklist to use in reviewing each hazard section)
  - B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? 44 CFR 201.6(c)(2)(i)
    - B2.1. History of previous hazard events for each identified hazard; for plan updates: include hazard events that have occurred since the previous plan was developed

1.8.4 Vulnerability

After flooding, whether caused by a storm or dam failure, there is often damage. Potential vulnerabilities due to flooding events can include flooded public facilities and schools, many of which are the community's shelters needed when individual housing is uninhabitable. Utilities are also vulnerable in floods, which can bring down electric lines/poles/transformers, telephone lines and can disrupt radio communications. The loss of communications can impact the effectiveness of first response agencies, which need to communicate via two-way radio to mount emergency response and recovery activities. The public media communications utilized by emergency managers to provide timely and adequate emergency public information can also be impacted.

Residential structures may suffer from flooded basements, damaged septic systems and damaged functionals (e.g., HVAC systems, clothes washers and driers). Homes may also be impacted by sewer back-up and, if the home is not properly cleaned after a flood, bacterial growth and mold may impact the home's air quality and cause illness among the occupants.

Businesses can suffer building and equipment damage similar to homes. Businesses may lose expensive product stored in basement or other low areas as well as the ability to operate from their facility. If the facility must close, its owners and employees will most likely suffer economic hardships beyond what their personal losses may have entailed. Agricultural business losses involve the loss of standing crops and harvests that are damaged by flooded storage facilities in the immediate time period. On a longer time scale, the erosion of rich topsoil by floodwaters can degrade the land and impact future crop yields.

Perhaps one of the most expensive types of flood damage is that to roadways, which are washed out, inundated and/or covered by debris, blocking access to emergency and general public traffic.

As noted in the demographics section, Waukesha County has experienced rapid development in recent decades. With this increase in population there has been an increase in physical structures (e.g., roadways, driveways, homes, parking lots, businesses), all of which increase the total area covered by impermeable surfaces. All of these impermeable surfaces have created a higher volume of run-off and a greater potential for flooding. That increased volume coupled with increased population and number of structures means that there are more lives and improved property at risk for flooding.

A recent example of Waukesha County's vulnerability to flood damages was seen after the 2008 Flooding incident. Waukesha County was one of 34 Wisconsin communities that shared $39,220,410 in federal supplemental funds under the Community Development Block Grant (CDBG) Program to help them recover from the substantial damage sustained by county facilities, nine towns, twelve villages and seven cities. Of the $3,024,938.10 requested, $2,700,265.72 was approved by FEMA. The non- reimbursed figures range from a low of $55.57 to a high of $33,986.65 that the local units of government will have to bear. In addition, Waukesha County estimates that there are 438 low-to- middle income (LMI) households that needed additional assistance. With an average repair cost of $7,500, that translated to an unmet need for over $3,000,000 in housing assistance. In addition to $2,200,000 in residential rehabilitation the funding included:

- Mukwonago Pump Station $506,000
- Pewaukee Springdale Road $256,000
- City of Waukesha A/D $406,000
- Oconomowoc Community Center $506,000
- Summit Lake Outlet Project $506,000

According to the Wisconsin Hazard Mitigation Plan, Waukesha County flood loss estimations for residential, commercial and government structures in Special Flood Hazard Areas [SFHA] for a two-foot flood are:

	Residential	Commercial	Government
Number of Structures	9331	154	5
Average Value	$199,922	$2,080,181	$1,033,592
Total Potential Loss	$373,076,383	$64,265,106	$1,033,592

This data was gathered with the use of Digital FIRMS or Q3 data, which is available for Waukesha County.

Another way to look at vulnerability is to look at the number of claims against the National Flood Insurance Program (NFIP) over the last thirty years. Waukesha County has had 158 claims (including 22 properties with repetitive losses) with $1,531,588 in building claims and $605,118 in contents claims for a total of $2,136,706. The Wisconsin Hazard Mitigation Plan lists Waukesha County 2nd (of 72 possible counties) when losses claimed were ranked according to claim amount. The county places 4th when ranked according to the number of claims submitted.

The Wisconsin Hazard Mitigation Plan also projects future risk for Waukesha County based on a 30-year horizon. The results show annual claims averaging $71,224 and future risk at $883,884. When ordered by projected future flood risk, Waukesha County ranks 2nd in Wisconsin.

It should be noted that several hazard mitigation projects have reduced the vulnerability to flooding in Waukesha County including:

- The Village of Elm Grove reduced the number from an initial 51 parcels to 40 parcels that exist in the 100-year floodplain. These 11 parcels were purchased and converted to greenspace with assistance from the Hazard Mitigation Grant Program (HMGP) and FEMA funding. Those properties include: the former Legion Post property (1195 Legion Drive – this property has been taken off the repetitive loss list), 1160 Legion Drive (a residential property) and the Villager Apartments (included six separate buildings). The Village also purchased 13555 Juneau Boulevard with HMGP funds. The Sleepy Hollow (hotel) site, which is included as part of the Village's final flood management plan, was purchased without any state/federal funding.

Hazard Assessment		
Flooding and Dam Failure		
Frequency/Probability (i.e. Future Probability)	▶	High
Magnitude/Extent (i.e. Strength or Magnitude)	▶	High
Vulnerability (i.e. Consequence and Impact)	▶	High
Overall Risk Rating	▶	High

HAZUS

Waukesha County is located in southeastern Wisconsin where its total land mass is approximately 554 square miles. Waukesha County's history signals a geography that may produce a flood at any time regardless of season. However, the majority of the largest floods have occurred in the early spring, typically due to spring rains or snowmelt. The largest floods in the past have been to the Fox River, Bark River, Mukwonago River, and the Oconomowoc River. Since the installation of a gaging station on the Fox River in the City of Waukesha it has recorded major flood in 1965, 1973, 1974, and 1979.

Principle sources of flooding:

1. Fox River – The Fox River flows southwesterly, stretching 225 miles from its mouth at the Illinois River to the northeastern boundary of Waukesha County. The drainage area of the Fox River encompasses 2,658 square miles.
2. Bark River – The Bark River flows southwesterly through the cities of Merton, Hartland, and Oconomowoc East
3. Mukwonago River – The Mukwonago River flows easterly through the city of Mukwonago where it drains into the Fox River.
4. Oconomowoc River – The Oconomowoc River flows southwesterly through the cities of Merton and Oconomowoc. The river has flooded in the city of Oconomowoc during the years of 1943, 1959, and 1974; all of which were early spring floods.

This data was gathered from the Federal Emergency Management Agency's (FEMA) Flood Insurance Study.

HAZUS-MH Aggregate Loss Analysis HAZUS-MH was used to estimate the damages for a **100-year flood event** in Waukesha County. For the 500-year flood event report, please click the following: 500-year flood event.

General Building Stock Damage

HAZUS estimates that about 239 buildings will be at least moderately damaged.

Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	3	20	10	67	1	7	1	7	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	4	40	6	60	0	0	0	0	0	0	0	0
Industrial	2	50	2	50	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	190	46	172	42	38	9	7	2	2	0	0	0
Total	199	-	190	-	39	-	8	-	2	-	0	-

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 423.93 million dollars. 1% of the estimated losses were related to the business interruption of the county. The residential occupancies made up 28.31% of the total loss.

Building-Related Economic Loss Estimates

(Millions of Dollars)

	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	49.58	22.24	14.05	5.32	91.19
	Content	27.04	67.24	35.89	31.01	161.17
	Inventory	0.00	1.56	4.53	0.26	6.35
	Subtotal	76.62	91.03	54.47	36.58	258.70
Business Interruption						
	Income	3.07	49.92	3.20	8.02	64.20
	Relocation	17.61	15.29	2.03	7.52	42.44
	Rental Income	8.11	10.85	0.48	2.20	21.64
	Wage	7.25	50.76	2.39	122.84	183.24
	Subtotal	36.04	126.81	8.09	140.57	311.51
All	Total	112.66	217.84	62.56	177.15	570.21

Expected Damage to Essential Facilities

		# of Facilities		
	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operations Center	3	0	0	0
Fire Stations	53	2	0	1
Hospitals	9	0	0	0
Police Stations	30	0	0	0
Schools	187	0	0	0

HAZUS also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 1,091 households will be displaced due to the flood. Displacement includes households evacuated from within or very near the inundated area. Of these, 123 people (out of a total population of 389,891) will seek temporary shelter in public shelters.

CIKR/Essential Facilities that may be most susceptible to flooding in the County

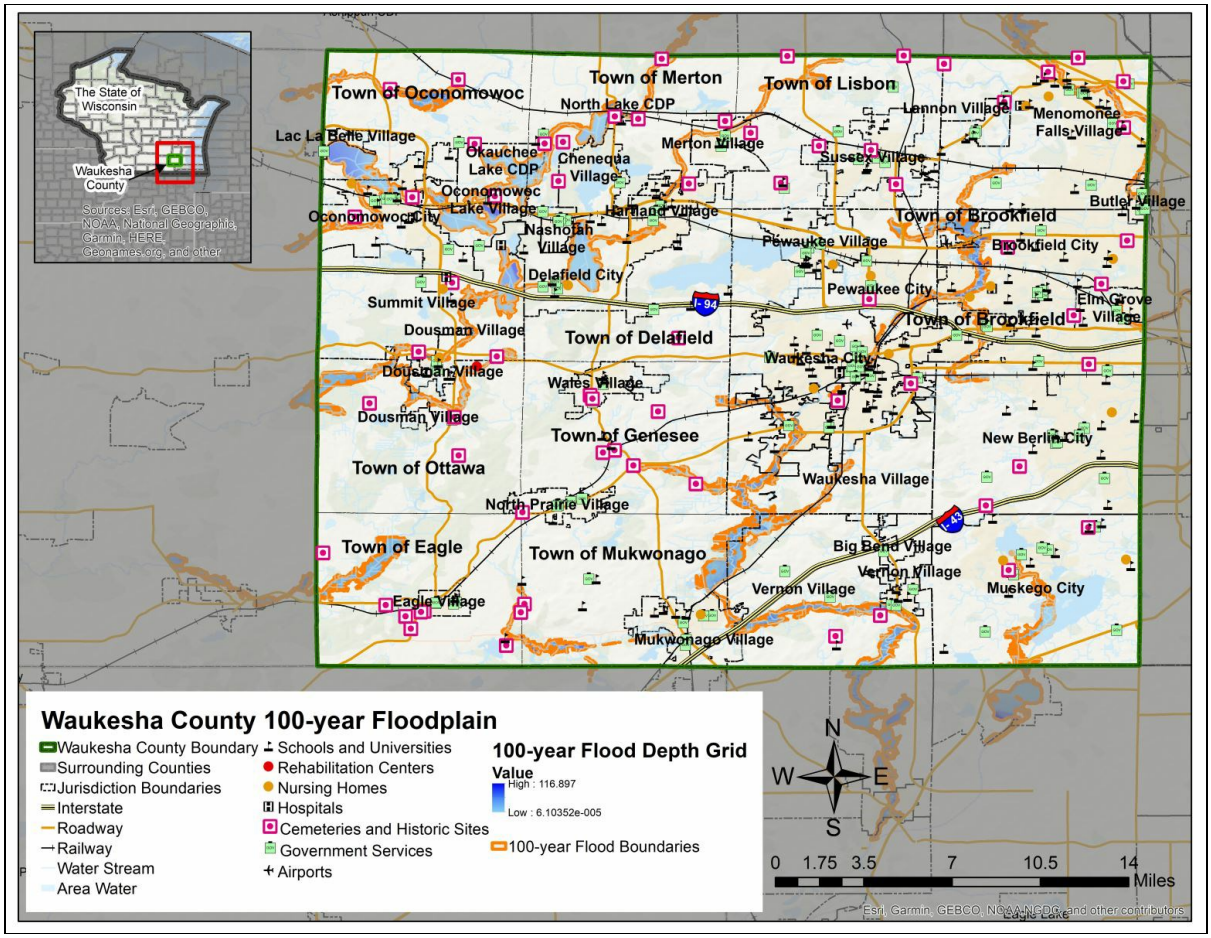
Note: Future updates will focus on specific mitigation activities for each facility that are most susceptible to flooding in the County.

Facility Name	Address
Care-Age of Brookfield Healthcare and Rehabilitation	1755 N Barker Rd, Brookfield, WI 53045
Lindengrove - New Berlin Campus	13755 W. Fieldpointe Dr., New Berlin, WI 53151
Hartland Volunteer Fire Department	150 Lawn Street, Hartland, WI 53029
Elm Grove Volunteer Fire Department	13600 Juneau Blvd., Elm Grove, WI 53122
Elm Grove Police Department	13600 Juneau Blvd, Elm Grove, WI 53122
Pewaukee Police Department	235 Hickory Street, Pewaukee, WI 53072
Pewaukee High School	510 Lake St, Pewaukee, WI 53072
ASA Clark Middle School	472 Lake Street, Pewaukee WI 53072
Pewaukee Lake Elementary School	436 Lake Street, Pewaukee, WI 53072
Saint Anthony Grade School	W280N2101 Prospect Ave, Pewaukee, WI 53072
Arrowhead Union High School	700 North Ave, Hartland, WI 53029
Shady Lane Elementary School	W172 N8959 Shady Lane, Menomonee Falls, WI 53051
Queen of Apostles School	449 W Wisconsin Ave, Pewaukee, WI 53072
Waukesha County Tech College	800 Main St, Pewaukee, WI 53072

Roadways that may be most susceptible to flooding in the County

Road Name
Country Bliss subdivision in the Town of Mukwonago (S. Oak Tree Dr is the main roadway that gets flooded)
River Rd at Barker Rd in the City of Brookfield
Delafield Rd and Venice Beach Road in the Village of Summit

Flood and Dam-related Maps:


The State of Wisconsin
Waukesha County
Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other
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Waukesha County 100-year Floodplain
Waukesha County Boundary
Surrounding Counties
Jurisdiction Boundaries
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Roadway
Railway
Water Stream
Area Water
Schools and Universities
Rehabilitation Centers
Nursing Homes
Hospitals
Cemeteries and Historic Sites
Government Services
Airports
100-year Flood Depth Grid
Value
High : 116.897
Low : 6.10352e-005
100-year Flood Boundaries
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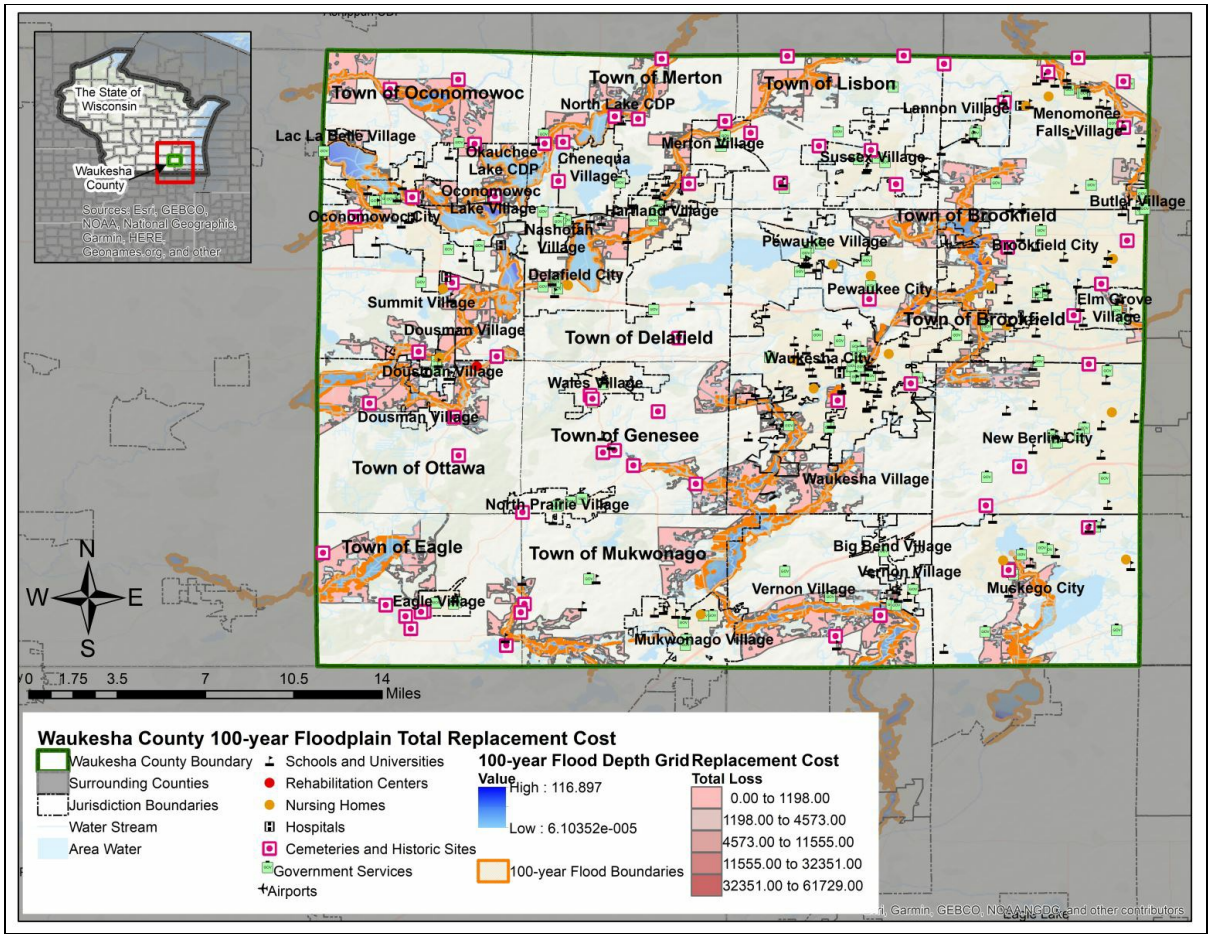
Miles
Esri, Garmin, GEBCO, NOAA, NGDC, and other contributors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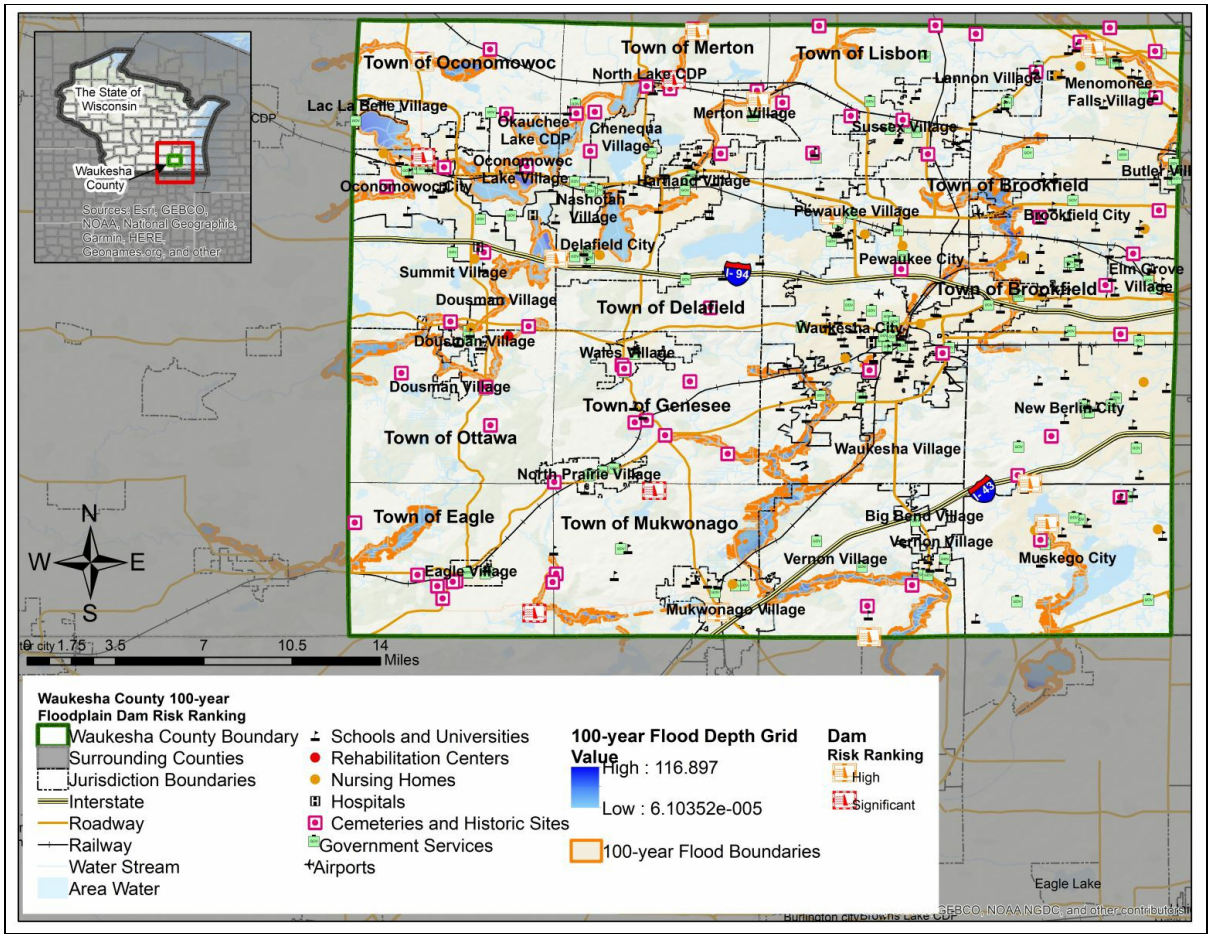
100-year Flood Depth Grid Value
High : 116.897
Low : 6.10352e-005
100-year Flood Boundaries
Replacement Cost Total Loss
0.00 to 1198.00
1198.00 to 4573.00
4573.00 to 11555.00
11555.00 to 32351.00
32351.00 to 61729.00
Garmin, GEBCO, NOAA, NGDC, and other contributors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Railway
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Hospitals
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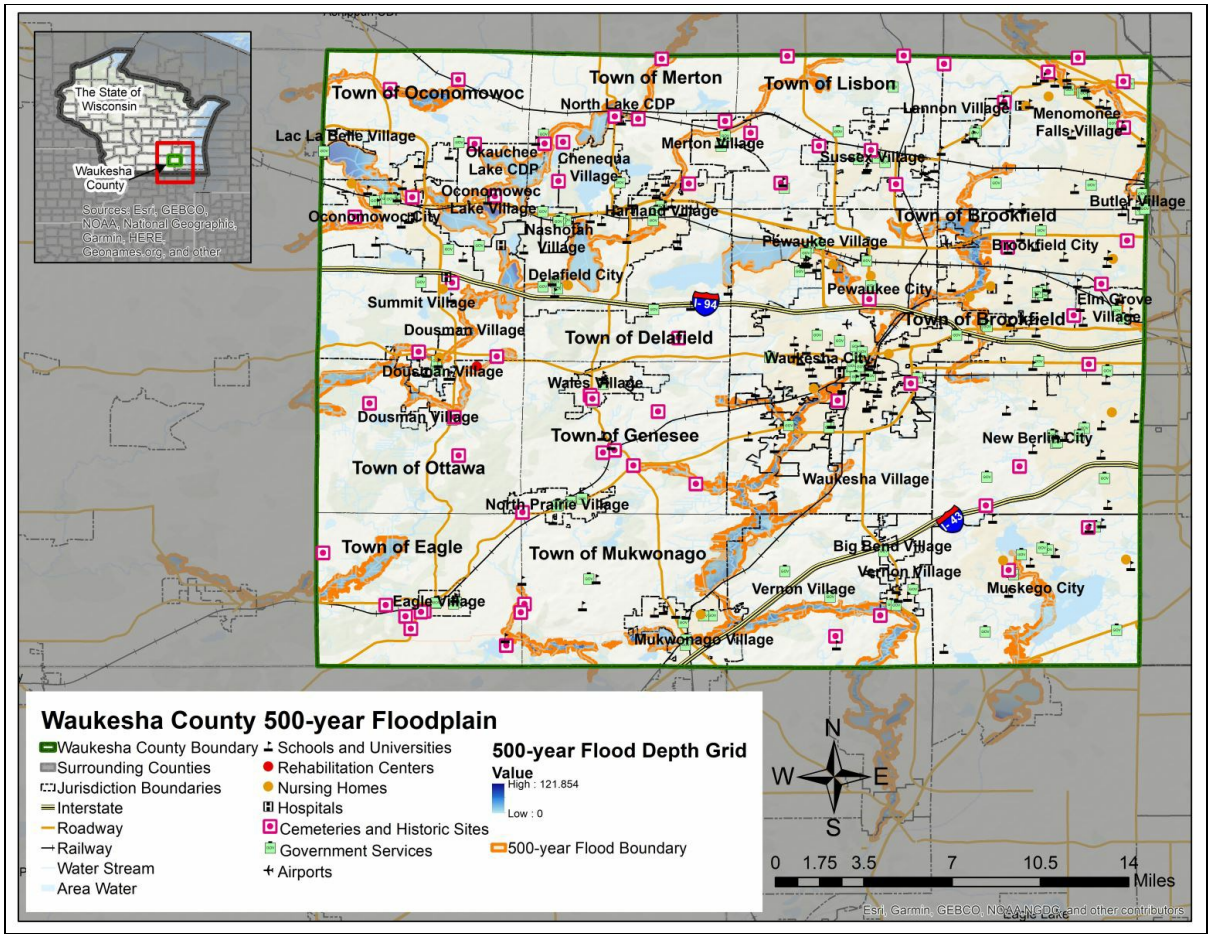
Airports
100-year Flood Depth Grid Value
High : 116.897
Low : 6.10352e-005
100-year Flood Boundaries
Dam Risk Ranking
High
Significant
GEBCO, NOAA NGDC, and other contributors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Hospitals
Cemeteries and Historic Sites
Government Services
Airports
500-year Flood Depth Grid
Value
High : 121.854
Low : 0
500-year Flood Boundary
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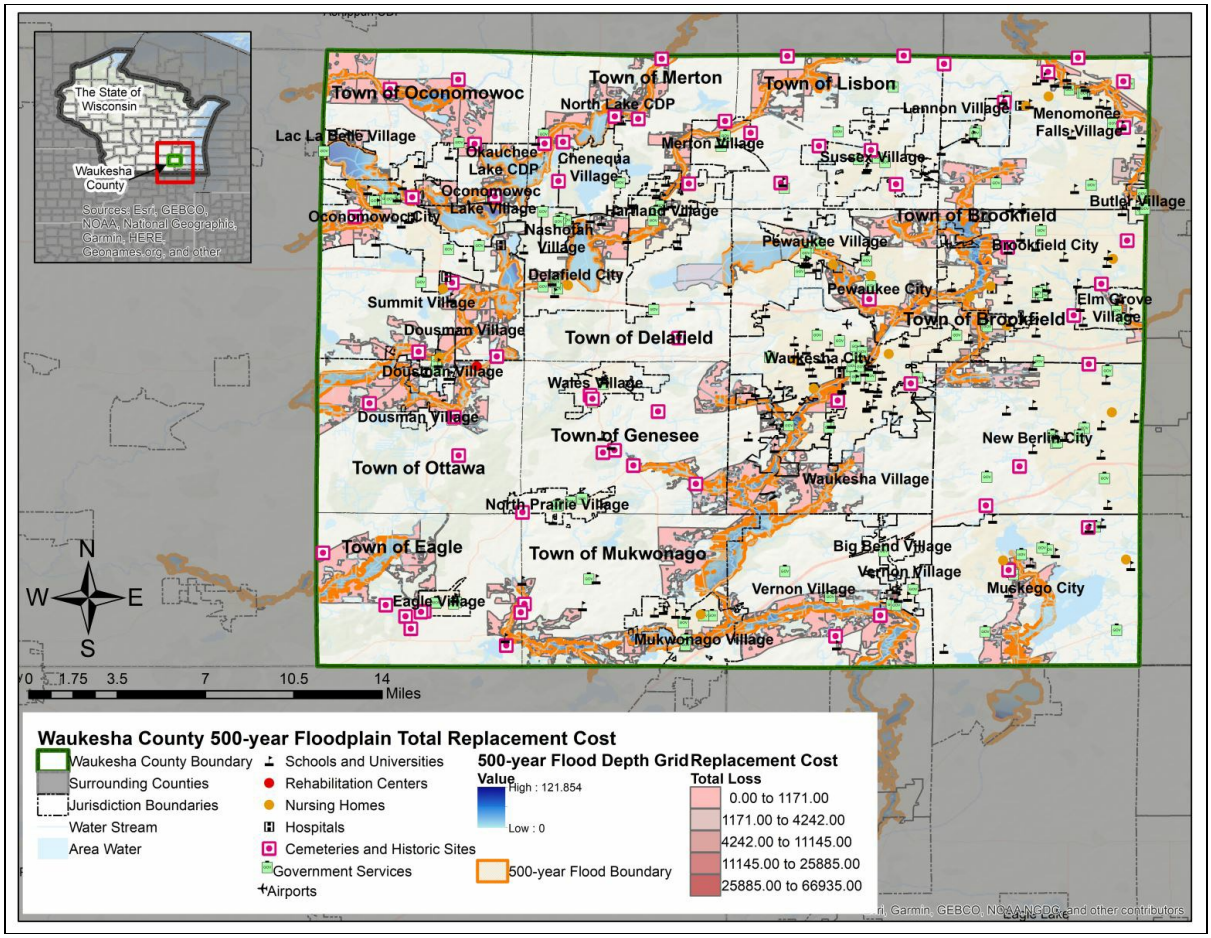
Miles
Esri, Garmin, GEBCO, NOAA, NGDC, and other contributors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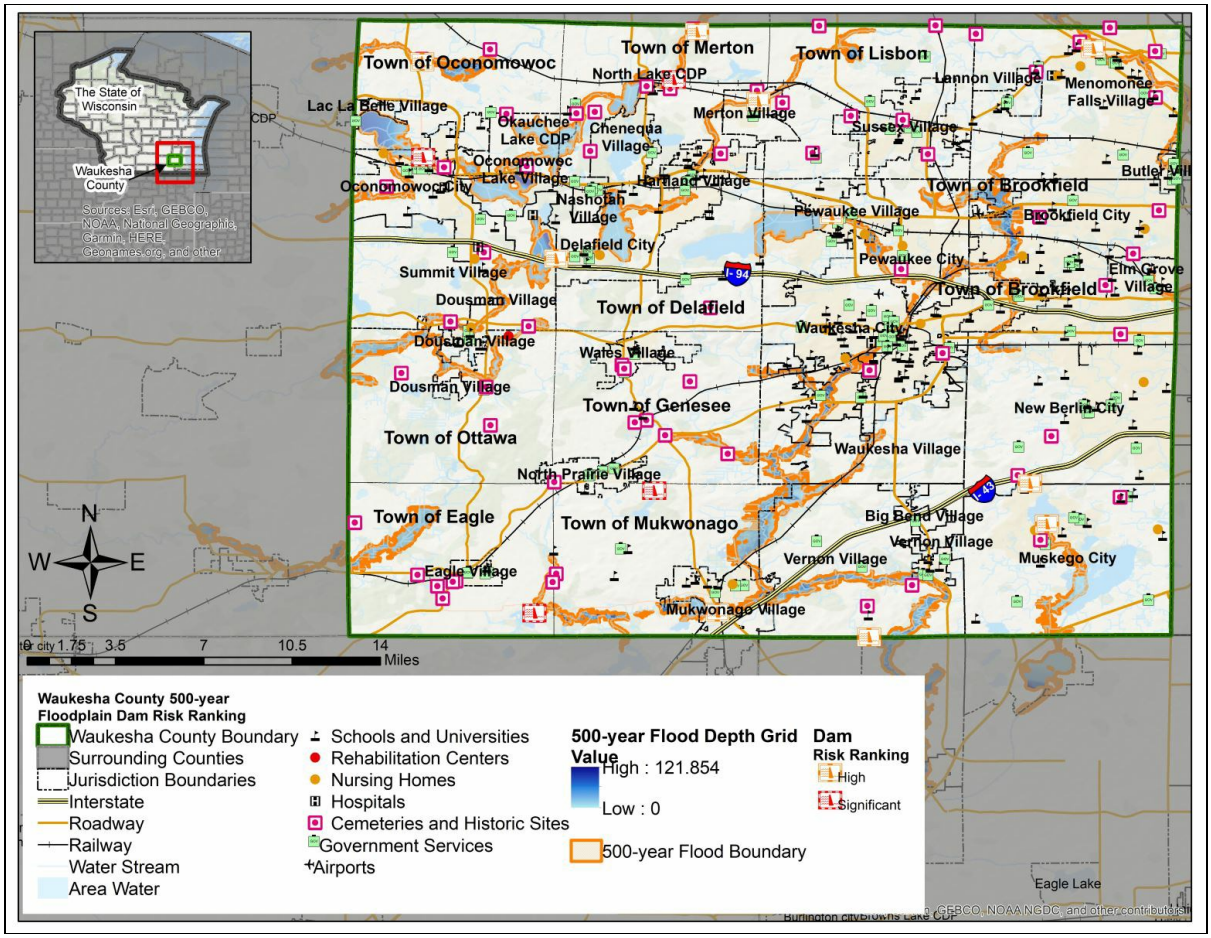
Government Services
Airports
500-year Flood Depth Grid Value
High : 121.854
Low : 0
500-year Flood Boundary
Replacement Cost Total Loss
0.00 to 1171.00
1171.00 to 4242.00
4242.00 to 11145.00
11145.00 to 25885.00
25885.00 to 66935.00
Garmin, GEBCO, NOAA, NGDC, and other contributors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High : 121.854
Low : 0
500-year Flood Boundary
Dam Risk Ranking
High
Significant

1.8.5 National Flood Insurance Program (NFIP)

Jurisdictions:	National Flood Insurance Program (NFIP) Status:*			
	Yes	No	N/A	Community Rating System (CRS) Class
Waukesha County	Y			
City of Brookfield	Y			
City of Delafield	Y			
City of Muskego	Y			
City of New Berlin	Y			Yes; Class 6
City of Oconomowoc	Y			
City of Waukesha	Y			
Village of Big Bend	Y			
Village of Butler	Y			
Village of Dousman	Y			
Village of Elm Grove	Y			Yes; Class 5
Village of Hartland	Y			
Village of Lannon	Y			
Village of Menomonee Falls	Y			
Village of Mukwonago	Y			
Village of Pewaukee	Y			
Village of Sussex	Y			
Village of Summit	Y			
City of Pewaukee	Y			
Village of Chenequa		N (Mapped)		
Village of Merton	Y			
Village of Nashotah		N (Mapped)		
Village of Oconomowoc Lake		N (Mapped)		
Village of Wales	Y			
Village of Eagle			N/A	
Village of Lac La Belle	Y			
Village of North Prairie			N/A	

***Notes:** **Y = Participating** **N = Not Participating** **N/A = Not Mapped**

Reason for Non-Participation (Mapped Communities)

Community	Reason
Village of Nashotah	The village is currently looking into the NFIP program and weighing the pros and cons of the program for their residents.
Village of Chenequa	The Village considered NFIP, but determined that there were little to no structures that would be impacted by major flooding. So, although the jurisdiction is mapped, the village currently does not see the need.
Village of Oconomowoc Lake	State regulations currently do not allow for wet boathouses with a residence above it, so they have opted not to be part of NFIP.

NFIP Policies in Force

Community Name	Total Policy Count	Total Coverage $	Direct Losses	Total Losses	Total Net Dollars Paid $
BIG BEND, VILLAGE OF	1	350,000	2	2	13,455
BIG BEND, VILLAGE OF	1	100,000	0	2	17,479
BROOKFIELD, CITY OF	5	1,453,100	12	12	143,840
BROOKFIELD, CITY OF	76	22,870,500	0	39	475,736
BUTLER, VILLAGE OF	1	350,000	0	3	266,235
BUTLER, VILLAGE OF	0	-	6	6	47,894
DELAFIELD, CITY OF	9	2,660,000	0	3	12,945
DELAFIELD, CITY OF	1	350,000	3	3	17,287
DOUSMAN, VILLAGE OF	2	700,000	0	1	1,551
ELM GROVE, VILLAGE OF	31	11,067,800	0	34	463,450
ELM GROVE, VILLAGE OF	5	1,330,000	15	15	629,938
HARTLAND, VILLAGE OF	0	-	1	1	-
HARTLAND, VILLAGE OF	2	385,000	0	1	28,519
LANNON, VILLAGE OF	1	110,000	0	0	-
LANNON, VILLAGE OF	0	-	1	1	1,750
MENOMONEE FALLS, VILLAGE OF	50	15,043,700	0	18	220,348
MENOMONEE FALLS, VILLAGE OF	3	1,050,000	10	10	55,486
MERTON, VILLAGE OF	1	175,000	0	0	-
MILWAUKEE, CITY OF	0	-	0	1	625
MILWAUKEE, CITY OF	0	-	3	3	1,099
MUKWONAGO, VILLAGE OF	1	175,000	0	0	-
MUKWONAGO, VILLAGE OF	8	2,120,000	0	0	-
MUSKEGO, CITY OF	3	717,300	4	4	8,800
MUSKEGO, CITY OF	44	11,267,600	0	20	245,834
NEW BERLIN, CITY OF	61	20,457,500	0	30	361,849
NEW BERLIN, CITY OF	10	2,446,800	9	9	7,337
OCONOMOWOC, CITY OF	5	1,658,000	0	1	-
OCONOMOWOC, CITY OF	0	-	2	2	2,551
PEWAUKEE, CITY OF	21	5,815,800	0	1	2,925
PEWAUKEE, CITY OF	2	700,000	0	0	-
PEWAUKEE, VILLAGE OF	4	992,400	1	1	-
PEWAUKEE, VILLAGE OF	30	6,276,800	0	15	254,498
SAUKVILLE, VILLAGE OF	0	-	1	1	-
SUMMIT, VILLAGE OF	1	60,000	1	1	4,413
SUMMIT, VILLAGE OF	14	3,298,000	0	2	16,707
SUSSEX, VILLAGE OF	0	-	1	1	-
SUSSEX, VILLAGE OF	4	1,272,000	0	0	-
UNKNOWN	0	-	8	8	36,537
WALES, VILLAGE OF	2	700,000	0	0	-
WAUKESHA COUNTY*	82	22,682,800	0	56	721,504
WAUKESHA COUNTY*	14	3,796,900	17	17	275,675
WAUKESHA, CITY OF	7	2,088,900	5	5	2,526
WAUKESHA, CITY OF	44	12,649,100	0	23	184,675

Current as of 10/31/2021

Source: Fema.gov

Community Rating System

Community Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
Village of Elm Grove	05/1/01	05/1/12	5	25	10	Current
City of New Berlin	10/1/05	10/1/21	6	20	10	Current

Current as of 10/1/2021

Source: Fema.gov

List of Communities with Repetitive Loss Properties

The following list summarizes damages attributed to flooding in Waukesha by the National Flood Insurance Program through 2021.

Community Name	Mitigated	Type	Total Losses	Is NFIP Repetitive Loss	Is NFIP Severe Repetitive Loss
City of Brookfield	No	Single Family	2	Yes	No
City of Brookfield	No	Non-Residential	3	Yes	No
City of Brookfield	No	Single Family	2	Yes	No
City of Brookfield	Yes	Single Family	2	Yes	No
City of Brookfield	No	Single Family	3	Yes	No
City of Brookfield	Yes	Single Family	2	Yes	No
City of Brookfield	No	Single Family	2	Yes	No
City of Brookfield	No	Single Family	3	Yes	No
City of Brookfield	No	Family Housing Unit	2	Yes	No
City of Brookfield	No	Single Family	2	Yes	No
City of Brookfield	No	Single Family	3	Yes	No
City of Delafield	No	Family Housing Unit	2	Yes	No
City of Muskego	No	Single Family	3	Yes	No
City of Muskego	No	Single Family	2	Yes	No
City of Muskego	No	Single Family	2	Yes	No
City of Muskego	No	Single Family	2	Yes	No
City of New Berlin	Yes	Single Family	2	Yes	No
City of New Berlin	Yes	Single Family	3	Yes	No
City of New Berlin	No	Single Family	2	Yes	No
City of New Berlin	Yes	Single Family	2	Yes	No
City of Waukesha	No	Non-Residential	2	Yes	No
City of Waukesha	No	Single Family	2	Yes	No
UNKNOWN	No	Single Family	4	Yes	No
Village of Butler	Yes	Non-Residential	3	Yes	No
Village of Butler	No	Non-Residential	3	Yes	No
Village of Elm Grove	No	Single Family	2	Yes	No
Village of Elm Grove	Yes	Non-Residential	2	Yes	No
Village of Menomonee Falls	No	Single Family	2	Yes	No
Village of Pewaukee	No	Non-Residential	2	Yes	No
Waukesha County	No	Single Family	2	Yes	No
Waukesha County	No	Single Family	2	Yes	No
Waukesha County	No	Single Family	3	Yes	No
Waukesha County	Yes	Single Family	2	Yes	No
Waukesha County	No	Single Family	2	Yes	No
Waukesha County	No	Single Family	2	Yes	No

Standard:

- Wisconsin Emergency Management (WEM) Mitigation Standard 2015; Element B: Hazard Identification and Risk Assessment (see the end of this element for a checklist to use in reviewing each hazard section)
  - B4. Does the Plan address NFIP-insured structures within each jurisdiction that have been repetitively damaged by floods? (Contact Wisconsin Emergency Management to obtain this information for your jurisdiction.) 44 CFR 201.6(c)(2)(ii)
    - B4.1. Estimate of the numbers of repetitive loss properties located in identified flood hazard areas
    - B4.2. Description of the types (residential, commercial, industrial, etc.) of repetitive loss properties identified above
- Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element C: Mitigation Strategy
  - C2. Does the Plan address each jurisdiction's participation in the National Flood Insurance Program (NFIP) and continued compliance with NFIP requirements as appropriate? 44 CFR 201.6(c)(3)(ii)
    - C2.1. List of jurisdictions and their NFIP participation status
    - C2.2. Description of floodplain management programs/activities that contribute to continued compliance for each NFIP-participating jurisdiction
    - C2.3. Reasons for non-participation for any jurisdictions that do not participate in the NFIP
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014
-
  - National Flood Insurance Program (NFIP) Status
    - Jurisdictions
    - Participating (Y/N)
    - Community Rating System (CRS) Class
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Mitigation Strategy; §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.
  - 15. Identification and Analysis of Mitigation Actions: National Flood Insurance Program (NFIP) Compliance; Requirement: §201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

- 15.A. Does the new or updated plan describe the jurisdiction (s) participation in the NFIP?
- 15.B. Does the mitigation strategy identify, analyze and prioritize actions related to continued compliance with the NFIP?

1.9 Fog

Fog, at its basic definition, is a cloud based on the ground rather than in the atmosphere.

Source: http://www.fi.edu/weather/events/fog.html

1.9.1 Fog Hazard Profile

Hazard Profile

Fog occurs when the air near the ground is saturated with moisture and condenses on tiny particles suspended in the air. These particles are called cloud condensation nuclei and actually attract water vapor molecules to their surfaces. Once condensation occurs on these tiny surfaces, the resulting liquid drops can remain suspended in the air because their weight causes them to descend slowly to the ground or be carried around by wind. The dew-point temperature, or saturation vapor pressure, can be reached by either adding more water vapor to the air or cooling the air down to the dew-point temperature. Fog is classified by the dominant formation process and exists as long as processes continue to maintain saturated conditions. There are several basic types of fog:

Radiation Fog is caused by cooling close to the earth's surface. The earth gives off long-wave radiation which on a clear night travels out into space. If the temperature drops to the dew point close to the ground, radiation fog can form. Radiation fog is also known as ground fog. The fog normally disappears soon after sunrise as the sun's warmth evaporates it.

Valley Fog is one type of Radiation Fog that forms in mountain valleys during winter and can be more than 1,500 feet thick. Often, the winter sun is not strong enough to evaporate the fog during the day. When the air cools again the following night, the fog often becomes thicker, which makes it even harder for the sun to burn it off the following day. These fogs can last for several days until strong winds blow the moist air out of the valley. The tendency for cool, dense air to pool at the bottom of valleys also enhances valley fog.

- **Advection Fog** results from the movement (advection) of warm, moist air from the south over a colder landmass. During the winter this is common when snow covers much of the Midwest. The snow cools the bottom portion of the moist airmass often resulting in condensation. The thickest advection fog usually forms during nights with light winds because humid air near the ground is not mixed with the drier air above. With light winds, the fog near the ground can become thick and reduce visibilities to zero; usually the fog burns off during the day but it can last many days if it is thick enough to block out the sun’s light. This type of fog can occur almost anywhere in the United States, especially during winter warm-ups and early spring thaws. It can be widespread and very dangerous to commuters and aircraft travel.
- **Evaporation Fog** around Wisconsin is caused by cold air crossing over warmer bodies of water. The water evaporates its moisture into the colder air which immediately condenses it into clouds and fog. This is what looks like steam over Lake Michigan, inland lakes and rivers on a cold autumn or winter day. This rising fog can be found above thermal pools in Yellowstone National Park and is what you see when cool rain hits hot pavement. This may also be called “steam fog” or “sea smoke” when it forms over oceans. Sometimes this fog is lifted quickly and forms rotating whirls of fog known as steam devils.
- **Upslope Fog** is common near the Rockies, including the Denver area. If the winds are out of the east, the air flows up as it rises in elevation approaching the mountains. This can cool the air to its dew point and result in widespread fog.
- **Rain Fog** is created when late afternoon or evening showers and thunderstorms during the spring and summer leave the ground soaked just as the sun sets. Though the rain usually stops overnight, the high humidity level created by the rainfall will not allow the moisture to evaporate and as a result, fog forms. This occurs especially at times when there are light winds. As the air warms up the next morning, this rain-enhanced fog will usually burn off by midday.
- **Precipitation Fog** forms when rain or snow falls. As precipitation falls into drier air below the cloud, the liquid drops or ice crystals evaporate or sublimate directly into water vapor. The water vapor increases the moisture content of the air while cooling the air. This often saturates the air below the cloud and allows fog to form.

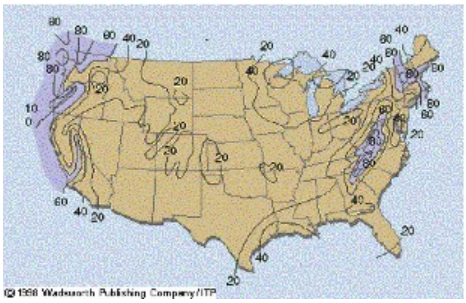
1.9.2 Location and Extent

Some locations on this planet have weather conditions that are conducive to making fog frequently such as:

- San Francisco, California has an average of 18 days of heavy fog each year.
- Cape Disappointment, Washington is the foggiest place on the western U.S. coast with an average of 106 days of heavy fog per year.
- The foggiest area on the east coast of the United States is found along the rockbound coast of Maine. Moose Peak Lighthouse on Mistake Island, at an elevation of 72 feet, averages 1580 hours of heavy fog each year. Many other locations have problems with fog, such as Eastport, Maine with 65 days annually and Portland, with 55 days of heavy fog each year.
- Inland areas with regular heavy fog include parts of the Appalachian Mountains such as a peak area in West Virginia that averages over 100 days each year. Elkins, at an elevation of 1948 feet has about 81 days annually with heavy fog.
- Milwaukee averages about 26 days with some heavy fog and this is comparable to the fog seen in Waukesha County.

Source: http://www.jsonline.com/weather/wtmj/fogplaces.stm

Average Annual Number of Days with Heavy Fog in the United States



1.9.3 Frequency and Probability

The National Weather Service reports 71 fog events in the county between 1 January 1950 and October 1, 2021. The most recent fog events include:

Location	Date	Death	Injury	Property Damage	Crop Damage
Waukesha County	9/12/2009	0	0	0	0
Waukesha County	3/7/2010	0	0	0	0
Waukesha County	3/10/2010	0	0	0	0
Waukesha County	5/21/2010	0	0	0	0
Waukesha County	12/30/2010	0	0	0	0
Waukesha County	2/15/2012	0	0	0	0
Waukesha County	3/24/2012	0	0	0	0
Waukesha County	10/2/2012	0	0	0	0
Waukesha County	10/22/2012	0	0	0	0
Waukesha County	10/23/2012	0	0	0	0
Waukesha County	11/17/2012	0	0	0	0
Waukesha County	11/20/2012	0	0	0	0
Waukesha County	12/3/2012	0	0	0	0
Waukesha County	12/3/2013	0	0	0	0
Waukesha County	08/03/2018	0	0	0	0

Considering its geographical location and history, Waukesha County has a high probability of fog occurrence in the future and the likelihood of damage (i.e., death and/or injury) due to fog is considered moderate.

1.9.4 Vulnerability

Perhaps the largest vulnerability to fog is due to automobile traffic crashes. According to the Wisconsin Department of Transportation, dense fog contributes to hundreds of car accidents per year in the state. Following are the Wisconsin Department of Transportation's statistics for fog-related traffic crashes from 1999-2004:

Death and Injury Statistics for Fog-Related Traffic Crashes

	1999	2000	2001	2002	2003	2004
Total Crashes	1,259	1,008	1,066	595	772	1,141
Fatal Crashes	14	12	19	12	11	16
People Killed	15	13	22	22	11	19
Injury Crashes	528	445	425	238	274	423
People Injured	777	643	593	372	391	615
Property Damage Crashes	717	551	622	345	487	702

Traffic Conditions at the Time of Fog-Related Traffic Crashes

	1999	2000	2001	2002	2003	2004
Total Crashes	1,259	1,008	1,066	595	772	1,141
Daylight	467	340	295	158	257	398
Dark/Lighted	130	107	130	324	80	140
Dark/Unlit	547	439	491	46	343	456
Dusk	9	18	16	56	7	16
Dawn	99	101	126	9	77	122
Unknown Light Conditions	7	3	8	2	8	9

Some notable fog-related traffic crashes in the area of southeastern Wisconsin (which includes Waukesha County) follow:

- On the morning of Friday, October 11, 2002, 50 vehicles were involved in a massive vehicle accident on Interstate 43 in Sheboygan County near Cedar Grove, Wisconsin just north of Waukesha County. This accident was the deadliest pile-up in Wisconsin history with ten individuals killed and over 40 people injured. Of the injured, seven were in critical condition and one was in serious condition at area hospitals immediately after the incident; 28 other people were treated and released for injuries ranging from burns to broken bones. The accident occurred as cars heading south collided into one another as some vehicles slowed down in a dense fog. This led to a chain reaction as numerous cars were unaware of the scene hidden behind a veil of fog. Chad Kruse, a driver interviewed after the accident, described it by saying, "I entered the wall of fog, like someone took a blanket and threw it over the windshield." At the same time but separate from this incident, four other accidents occurred nearby on the interstate; all the individuals involved with these accidents survived.

Source: http://www.stoutonia.uwstout.edu/2002- 2003/stories/021024/ne_04.html

The Fog, The Deadliest Traffic Crash in Wisconsin History; Trooper Tim Austin; Wisconsin Trooper, Callan Publishing Ins., Minneapolis, MN; Spring 2003.

- Fourteen people were injured in January 1996 in a 26-car pileup on southbound I-43 near Ozaukee County Highway KK. The first driver struck said he had missed his exit because of heavy fog and had slowed down to look for another when he was hit from behind.
- In March 1990, three people were killed and 31 injured in a 52-vehicle pileup on the Tower Drive Bridge in Green Bay after dense fog and smoke from nearby paper mills created a "white wall" that reduced visibility to less than 10 feet. The accident was believed to be triggered when a tanker truck overturned and a ruptured gas tank ignited. Vehicles following too closely on the fog-shrouded bridge slammed into the tanker and were engulfed by a sheet of flames. http://http://www.jsonline.com/news/state/oct02/87083.asp

As seen in the true examples above, fog-related incidents can cause death, injury and property loss to the vehicle owners and occupants and their insurance companies. Responding governmental agencies also may suffer losses due to the cost of response, for damage done to roadways and structures due to fires and for potential injuries to responders working in a reduced- visibility zone. Citizens may be impacted by the closure of roadways and delay of activities; businesses may suffer losses due to the absence of workers due to delay, injury and/or death and because of the delay of product on the roadways and direct loss of product in the crash (e.g., due to fire).

Hazard Assessment		
Fog		
Frequency / Probability (i.e. Future Probability)	▶	Medium
Magnitude / Extent (i.e. Strength or Magnitude)	▶	Low
Vulnerability (i.e. Consequence and Impact)	▶	Low
Overall Risk Rating	▶	Low

1.10 Forest and Wildfires

The forest fire and wildfire (fires on open or agricultural land) season in Waukesha County begins in March and continues through November, although fires can occur at any time during any month of the year. Generally speaking, however, fires are more likely to occur whenever vegetation is dry as a result of a winter with little snow or a summer with sparse rainfall.

The Wisconsin Department of Natural Resources is responsible for forest fire protection on approximately 18 million acres of forest and wild land in Wisconsin. The U.S. Forest Service maintains forest fire protection on two million acres of this land while local fire departments retain responsibility for the remaining wooded acreage.

1.10.1 Forest and Wildfires Hazard Profile

Hazard Profile

A wildfire is a naturally occurring event, often ignited by lightning and fueled by grasses, brush, and trees. Wildfires help to control the buildup of woody debris, improve soil conditions, reduce weedy and invasive plants, reduce plant disease, and maintain the habitat conditions thus providing a healthy ecosystem. The wildland-urban interface describes the area of transition between non-human inhabited areas and the built environment. This zone is best described as a set of conditions; according to the National Fire Protection Association, conditions include (but are not limited to): amount, type, and distribution of vegetation; flammability of structures (homes, businesses, outbuildings, decks, fences) in the area, and proximity to fire-prone vegetation and to other combustible structures; weather patterns and general climate conditions; topography; hydrology; average lot size; and road construction.

According to FEMA, a wildland-urban interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels. An urban-wildland interface fire is typically ignited by human activities including campfires, uncontrolled burns, smoking, vehicles, trains, equipment use, and arsonists. People start more than four out of every five wildfires, usually through debris burns, arson, or carelessness.

Wildfire behavior is based on three primary factors: fuel, topography, and weather. The type and amount of fuel, as well as its burning qualities and level of moisture affect wildfire potential and behavior. Topography affects the movement of air and fire over the ground surface. Slope and terrain can change the rate of speed at which fire travels. Temperature, humidity, and wind (both short and long term) affect the severity and duration of wildfires. Weather phenomena such as El Nino and La Nina events further complicate the delicate balance of these three essential components to wildfire. The deluge of rainfall that occurs during El Nino events creates excessive vegetative growth. El Nino is followed by La Nina, which creates drought conditions and excessive heat. As a result, the abundant vegetative growth dies off and provides ample fuel for wildfires.

Fire Danger Levels

The National Fire Danger Rating System (NFDRS) allows local agencies to estimate today's or tomorrow's fire danger. It integrates the effects of existing and expected fire danger factors into one or more qualitative values that reflect an area's fire protection needs. It links local agencies' readiness level to the potential fire problems for that particular day.

Level	Criteria
Low	Ignition: Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires. Spread: Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. Spotting: There is little danger of spotting. Control: Easy
Moderate	Ignition: Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Spread: Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Spotting: Short-distance spotting may occur, but is not persistent. Control: Fires are not likely to become serious and control is relatively easy.
High	Ignition: All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Spread: Fires spread rapidly. High-intensity burning may develop on slopes or in concentrations of fine fuels. Spotting: Short-distance spotting is common. Control: Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High	Ignition: Fires start easily from all causes. Spread: Immediately after ignition, spread rapidly and increase quickly in intensity. Fires burning in light fuels may quickly develop high-intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels. Spotting: Spot fires are a constant danger; long distance spotting likely. Control: Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
Extreme	Ignition: Fires start quickly and burn intensely. All fires are potentially serious. Spread: Furious spread likely, along with intense burning. Development into high-intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Spotting: Spot fires are a constant danger; long-distance spotting occurs easily. Control: Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

Source: National Fire Danger Rating System

The National Weather Service provides alerts when conditions are favorable for Wildfires.

Alert	Criteria
Fire Weather Watch	Conditions are favorable for red flag conditions in and close to the watch area in the next 12 to 48 hours.
Red Flag Warning	Issued for weather events that may result in extreme fire behavior that will occur within 24 hours. Red Flag criteria occurs whenever a geographical area has been in a dry spell for a week or two, or for a shorter period, and the National Fire Danger Rating System (NFDRS) is high to extreme and if there is a sustained wind average 15 mph or greater, a relative humidity less than or equal to 25 percent, and a temperature of greater than 75ºF.

Hazard Consequence

Area Impacted:

- High-risk ecosystems
- Urban-Wildland Interface

Duration of the event:

- Wildfires can occur instantly and spread extremely quickly if conditions (fuel, heat, oxygen) are right.
- Although most fires are small and last only a few hours, some fires can last for several days if large enough.
- Essential Service Disruption
- Disruption of essential government services

Special Needs:

- None

Direct Damage:

- The presence of combustible or vulnerable building material, dense vegetation within 30 feet of structures, and potential losses to physical structures and equipment
- Wildfire events cause a release of certain emissions into the surrounding air. The major emissions include: particulate, carbon dioxide, and carbon monoxide. All of these can affect the local environment.
- Hazardous Material Release – Both transportation and fixed facilities have the potential to be at risk to wildfires.
- Potential risks include destruction of land, property, and structures, as well as injuries and loss of life.

Economic Damage:

- Business interruption
- Decreases in tourism and gaming
- Loss agricultural fields and crops or pastures and livestock can last for months and result in significant damage to the farming community.

Emergency Services:

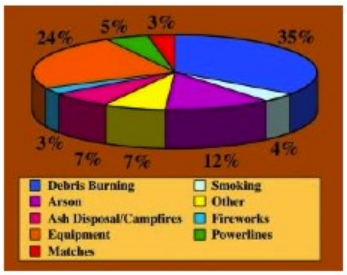
- Fire suppression costs.
- Inadequate water supply to effectively manage fire.
- Large areas that lack wildland maintenance (prescribed burn).
- Evacuation of gaming facilities and residents of reservation property.
- Emissions can cause a decrease in visibility, which can become of great concern with respect to road rights-of-way and traffic hazards.
- Inadequate service roads to remote locations.
- Major fires have the ability to disrupt transportation.

Social Factors:

- Many of the rural communities of Wisconsin do not have adequate management of wildlands nor equipment and supplies to suppress wildfires.
- Urban sprawl into once uninhabitable areas will continue.

1.10.2 Location and Extent

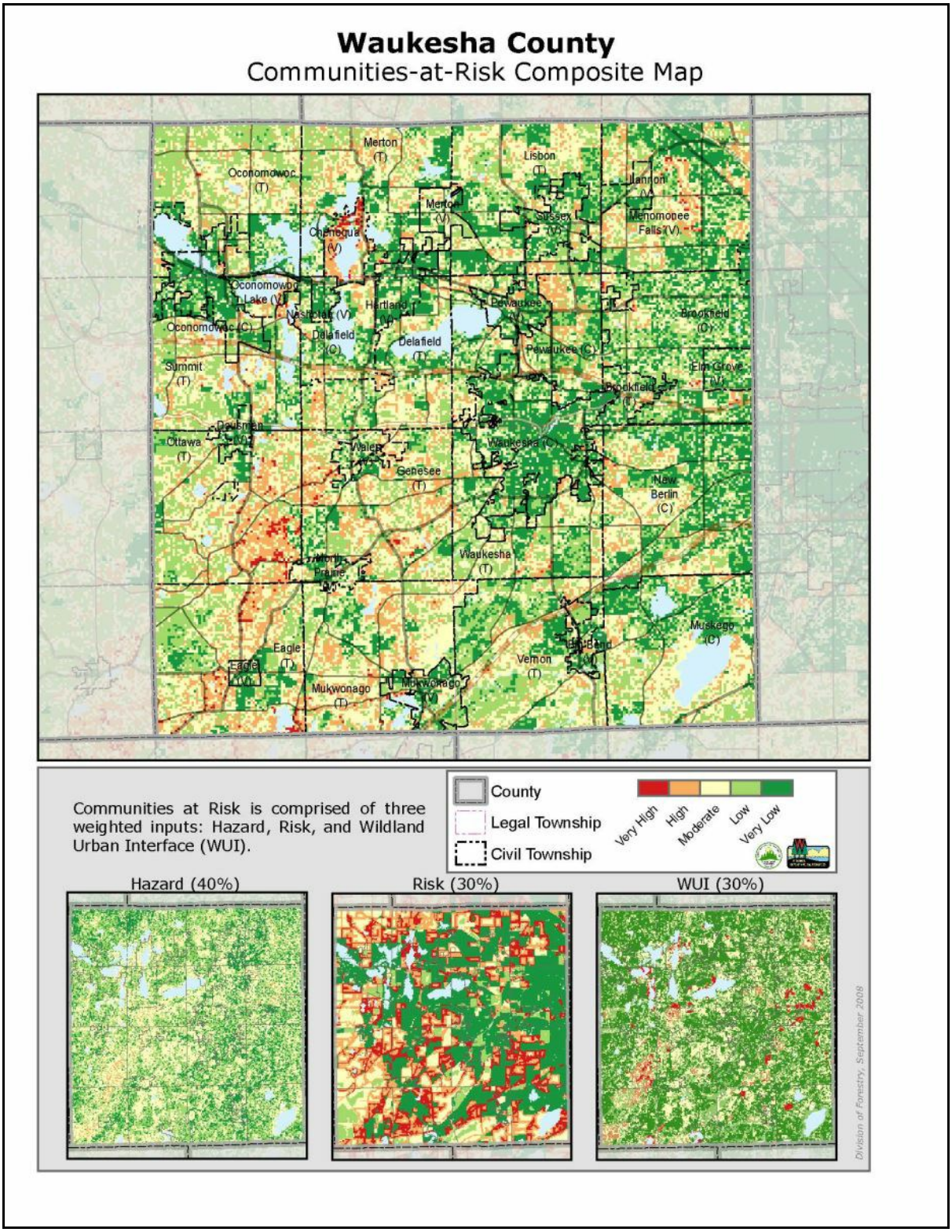
According to the Wisconsin Department of Natural Resources, there are approximately 1,500 fires annually that burn over 5,000 acres of the land that they protect; over 90% of these fires are human-caused. It should be noted that these figures do not include areas of the state where a local fire department has primary responsibility for service.



Source: Department of Natural Resources

Fox Brook Park, Fox River Park, Menomonee Park, Minooka Park, Mukwanago Park, Muskego Park, Naga-Waukee Park, Nashotah Park, Old World Wisconsin, the Kettle Moraine State Forest– Southern Unit and the Kettle Moraine State Forest–Lapham Peak Unit are the natural areas in Waukesha County. Local fire departments are responsible for fire protection in these open acreage areas although state firefighting assets would provide mutual aid assistance in the state-owned lands.

The following map shows the communities in Waukesha County at risk of wildfire.

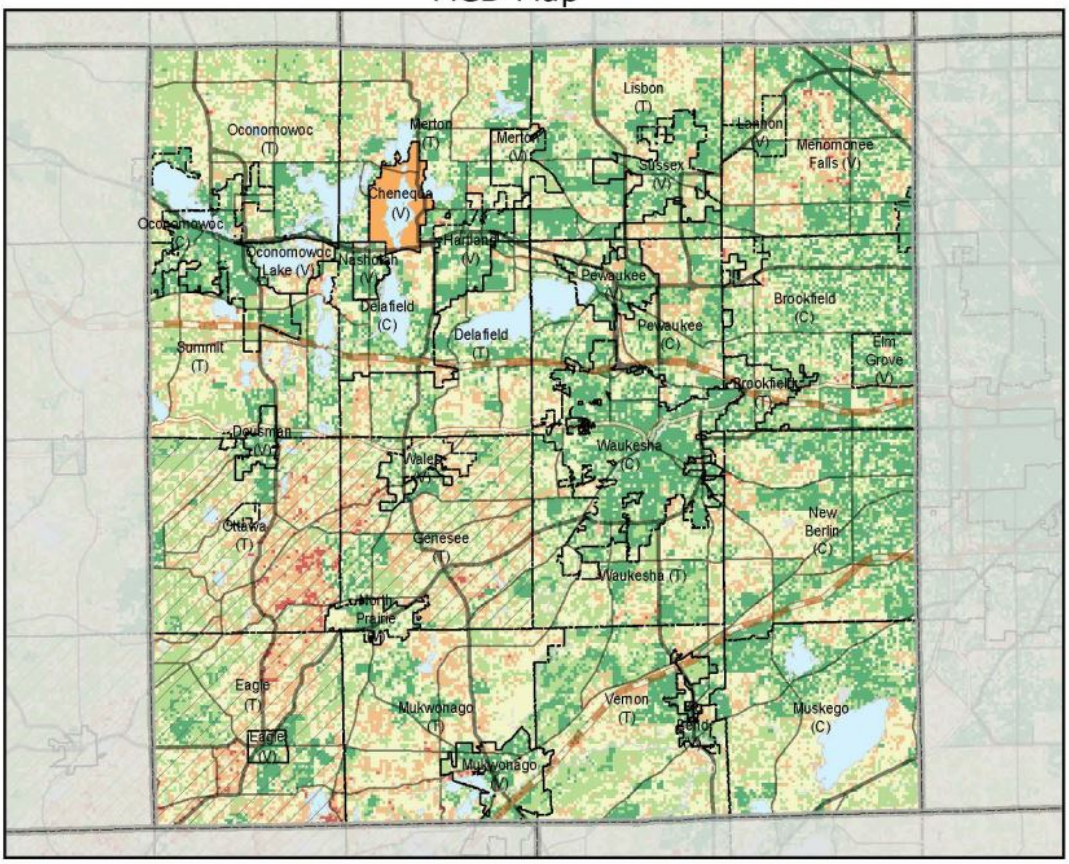


Source: WI Department of Natural Resources

In Wisconsin, Communities-at-Risk are defined at the minor civil division (MCD) or town level. Those MCD's determined to have a high or very high threat of wildfire are considered Communities-at-Risk.

Waukesha County

MCD Map



Communities-at-Risk

MCD Name	Hazard (40%)	Risk (30%)	WUI (30%)
Chenequa (V)	M	VH	H

1:278,746

Communities-of-Concern

- Eagle (T)
- Genesee (T)
- Ottawa (T)

Community-of-Concern
Communities-at-Risk, Very High
Communities-at-Risk, High

Division of Forestry, September 2008

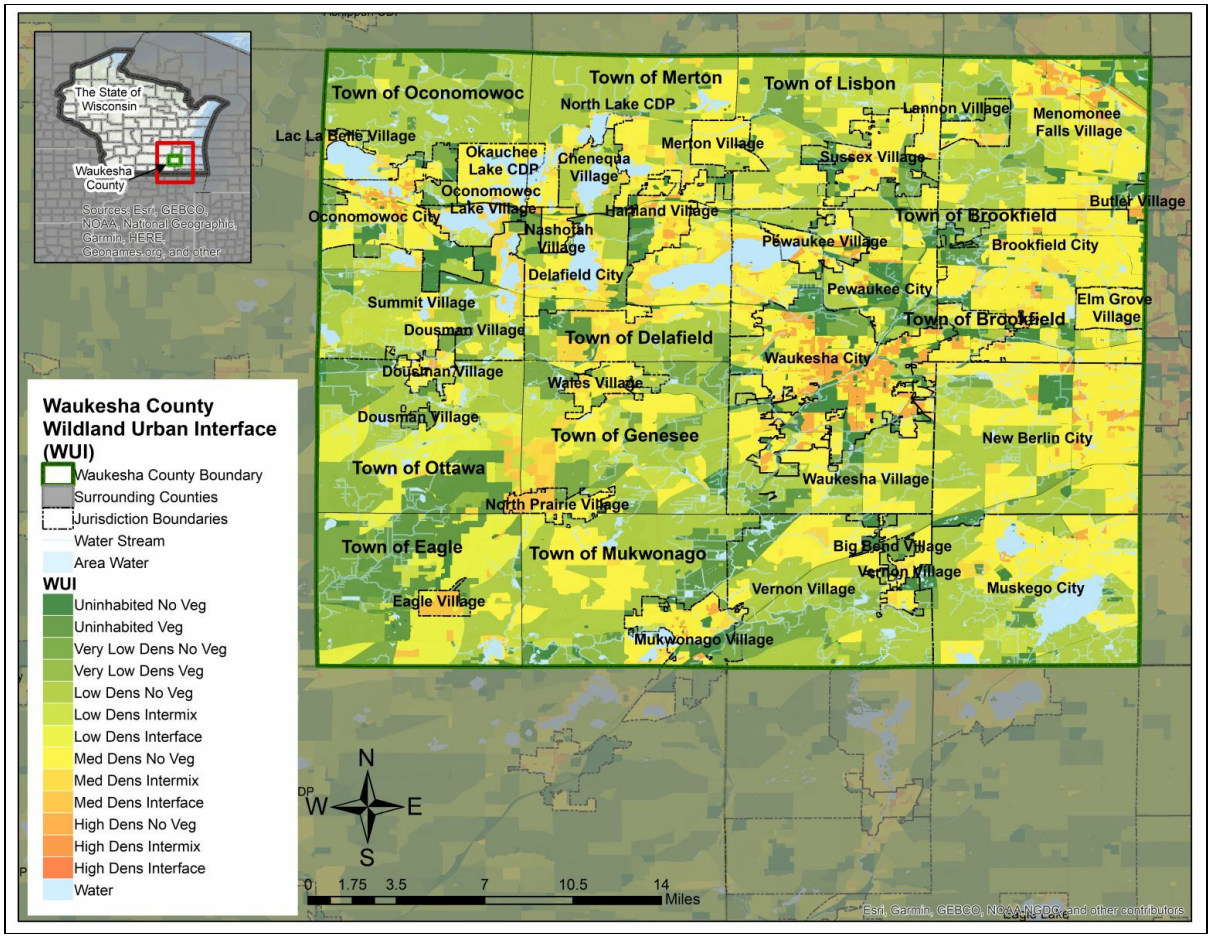
Source: WI Department of Natural Resources

1.10.3 Frequency and Probability

While the total number of open fires in Wisconsin has decreased over the years, the potential danger to lives and property remains due to the increased encroachment of development into previously open lands. Overall, the probability for a forest fire in Waukesha County is very low and the probability of a wildfire is low. The probability of damage from forest or wildfire is also considered low. There has been 19 statewide wildfire events recorded since 1950 by the National Weather Service. These events caused a total of 3 injuries, 1 death, and approximately $1.81 million of property damage.

1.10.4 Vulnerability

Forest and wildfires can impact the ecology of the open lands. Waukesha County, which has two state forest areas and several county and municipal parks, would be impacted by a wildfire since a disruption from fire could erase the usability of this habitat for wildlife and/or recreational purposes for many years.



Hazard Assessment		
Forest and Wildfires		
Frequency/Probability (i.e. Future Probability)	▶	**Low**
Magnitude/Extent (i.e. Strength or Magnitude)	▶	**Low**
Vulnerability (i.e. Consequence and Impact)	▶	**Low**
Overall Risk Rating	▶	**Low**

1.11 Severe Temperatures

Temperature extremes can cause disruption of normal activities for the population, property loss and even the loss of life, especially among the more vulnerable members of our population such as children and the elderly.

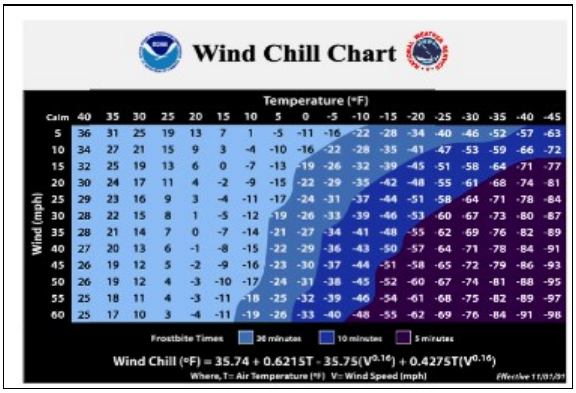
1.11.1 Severe Temperature Hazard Profile

Hazard Profile

Extreme Cold

Extreme cold consisting of long periods of below freezing temperatures sometimes accompany a winter storm. Prolonged exposure to the cold can cause frostbite or hypothermia and become life threatening. Frostbite occurs when the extremities become excessively cold, and hypothermia is a serious health condition where a person's body temperature falls below 90 degrees. Both conditions are influenced by wind conditions. Various wind chill indices have been developed to predict cold temperature's effect on humans. For instance, a temperature of 5 degrees will have a wind chill of -19 degrees if the wind is blowing 30 mph.

Wind chill is a relationship between wind and cold that is based on the rate of heat loss from exposed skin. As the wind speed increases, heat is drawn from the body, driving down skin temperature and eventually core body temperature table illustrates this relationship.



Source: National Weather Service

The major risks to people due to extreme cold are:

- Hypothermia - occurs when, due to exposure to cold, the body is unable to maintain its proper core temperature. It may occur in temperatures above freezing and may lead to death.
- Frostbite - describes local cooling, usually to an extremity, which occurs when exposure to cold air or liquid causes constriction of the blood vessels. There are three degrees of frostbite:
  - Frostnip - brought on by direct contact with a cold object or exposure to cold air or water. Tissue damage is minor and response to treatment is usually very good.
  - Superficial frostbite - involves the skin and subcutaneous layers.
  - Freezing - is deep frostbite in which the skin, subcutaneous layers and deeper structures (e.g., muscles, bone, deep blood vessels, organ membranes) of the body are affected and can become frozen.
  - Chilblains - lesions that occur from repeated/chronic exposure of bare skin to temperatures of 60°F or lower.
  - Trenchfoot - a condition that occurs when the lower extremities remain in cool water for a prolonged period of time.

Extreme Heat

Extreme heat is defined as temperatures that are approximately 10 degrees or more above the average high temperature for a given region lasting a prolonged period of time, usually several weeks. Extreme heat occurs when a layer of high atmospheric pressure descends over a geographical area. High pressure causes the air normally located high in our atmosphere to descend, compress, and increase in temperature. This leads to hazy, humid, and muggy air. High pressure systems can reside in an area for weeks as they are resistant to being moved by other weather systems. In addition, high pressure inhibits wind and clouds which normally mitigates the effects of the sun.

Every year, most municipalities experience periods in which the air temperature and humidity creates conditions that could potentially harm human health. Urban areas in particular experience a "heat island" effect. Urban heat island is when an urban area experiences warmer temperatures than its surrounding rural areas. This is caused by large amounts of concrete absorbing heat from the sun during the day. The heat releases at night keeping temperatures high and allowing little time for cooling. This can lead to increased energy demands and stress at-risk populations, especially those without access to air conditioning.

Although extreme heat conditions may not be as notable as other hazards, its consequences can still be devastating. Between 1992 and 2001, deaths from extreme heat in the United States numbered 2,190, compared to 880 deaths from floods and 150 from hurricanes. The average annual number of fatalities directly attributed to extreme heat in the United States is approximately 400.

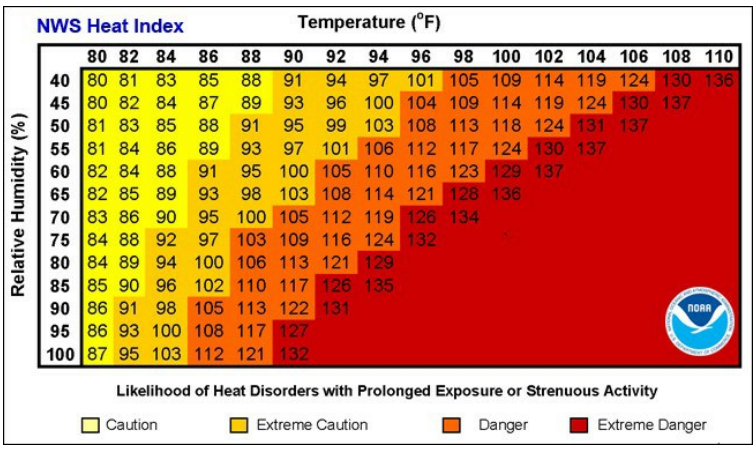
Extreme heat is typically seasonal in nature with heat waves occurring in the summer months. However, heat waves are associated with high pressure systems and can occur in late spring and early fall as well. For regions in southern latitudes, extreme heat events can occur any time of the year. High pressure systems associated with heat waves can move into an area within a matter of days. These systems are resistant to being moved by other systems and can affect a region for days, weeks, or months. The frequency of extreme heat is dependent on weather patterns within a particular region. Weather patterns are affected by many variables including ocean currents, jet streams, and man's footprint on the environment.

Extreme heat is correlated to high-pressure weather systems and can occur several times a season. High pressure systems associated with heat waves can move into an area within a matter of days. These systems are resistant to being moved by other systems and can affect a region for days, weeks, or months.

The frequency of extreme heat is dependent on weather patterns within a particular region. Weather patterns are affected by many variables including ocean currents, jet streams, and man's footprint on the environment. Extreme heat is correlated to high-pressure weather systems and can occur several times a season. The magnitude of the hot weather is also affected by many variables including where the system originates, strength and size of the system, the relative humidity and precipitation in the area, and whether another system forms that will push the existing system out. The magnitude of the hot weather is also affected by many variables including where the system originates, strength and size of the system, the relative humidity and precipitation in the area, and whether another system forms that will push the existing system out.

Heat Index

Heat index is created by the National Weather Service. It is the apparent temperature (i.e. the temperature the human body generally feels) when the air temperature is combined with the relative humidity. The heat index is generally used to determine the effects the temperature and humidity can have on the population. Heat index values are reduced by shady, light wind conditions. Full sunshine conditions can increase heat index values by up to 15 degrees.



Source: NOAA

In the event of extreme heat, the National Weather Service will issue heat advisories based on heat indices through media messages. The National Weather Service provides assistance to state and local health officials in preparing civil emergency messages in severe heat waves in addition to issuing special weather statements such as who are at most risk, safety rules, and the severity of the hazard. The National Weather Service will also aid state and local authorities on issuing warnings and survival tips. State and local health officials will be responsible to check on vulnerable populations such as the disabled and the elderly. Residents will be notified to remain indoors and refrain from strenuous activities. They will also be reminded to consume fluids often throughout the day and to stay near air conditioning, fans, and so forth. Exposure to extreme heat can result in various health issues such as sunburn, dehydration, heat cramps, heat exhaustion, and heat stroke. The following table lists some common health hazards that correspond to a certain range of heat index and how dangerous the conditions may be:

Category	Heat Index	Possible Heat Disorders for people in high risk groups
Extreme	130 degrees F or higher	Heat stroke or sun stroke likely.
Danger	105-129 degrees F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Extreme Caution	90-105 degrees F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Caution	80-90 degrees F	Fatigue possible with prolonged exposure and/or physical activity.

Source: National Weather Service

Conditions that can induce heat-related illnesses include stagnant atmospheric conditions and poor air quality. Urban areas may be at greater risk from the effects of a prolonged heat wave than rural areas. Asphalt and concrete store heat longer and gradually release heat at night, which can produce higher nighttime temperatures known as the "urban heat island effect. Heat causes more fatalities than all weather related fatalities in the US."

Heat exceeding 100 degrees is generally considered dangerous; however, lower temperatures coupled with high humidity are also considered dangerous. Heat indices have been developed to account for this interaction. At 80 degrees, a heat index of 101 degrees is reached if the humidity is 90percent. At 90 degrees, a heat index of 106 degrees is reached if the humidity is 70 percent.

Extreme heat can pose a significant risk to all populations but especially the elderly. Extreme heat also has the potential to result in other related hazards. The severity of a drought is directly related to the temperature extreme. Very hot conditions can dry out plant life making it much more susceptible to fire. Heat waves can also cause massive amounts of energy to be consumed. Maximum energy use days all occur on days of extreme heat. Rolling blackouts are not unusual due to the large demand from the power grid.

Hazard Considerations

Area impacted:

- Regional or statewide

Duration of the event:

- Extreme temperatures can last days, weeks or months. Essential Service Disruption
- Excessive power use results in power disruption or outages.
- Transportation – Severe winter storm conditions present a significant transportation hazard. These conditions slow down and hurt the transportation infrastructure. Depending on the intensity of the storm event, the impacts on transportation can range from a system wide delay to a major breakdown of the infrastructure.

Special Considerations:

- The elderly are particularly susceptible to heat and cold waves; young adults participating in sports or recreational outdoor activities during heat waves are also susceptible to fatigue, heat stroke and death.
- Elderly persons and small children, or persons who are on certain medications or overweight are vulnerable to heat stress.

Direct Damage:

- Individual can die from excessive heat. Heat waves can impact the human body in the following adverse ways: sunstroke, muscle cramps, and/or heat exhaustion likely; heatstroke possible with prolonged exposure and/or physical activity.

Economic Damage:

- Business interruption, e.g., airports can be closed and transportation systems shutdown for extended periods of time during periods of extreme heat or cold.
- Decreases in tourism and gaming
- Severe drought combined with heat waves can cause significant losses to agricultural-related industries, e.g., the drought/heat wave of 2000 is estimated to have caused over $4.0 billion in damages and 140 deaths nationwide.

Emergency Services:

- EMS transports to medical facilities and well-being checks will increase dramatically.
- Emergency shelters for special populations
- Heat waves and drought can cause severe dry conditions which can fuel wildfires.

Social Factors:

- The lack of insulation and adequate heating can lead to serious consequences for residents such as hypothermia and death. During heat waves, individuals need to stay hydrated and avoid outdoor activity from the hours of 10 a.m. to 4 p.m. to avoid excessive sun exposure, which can cause heat stroke and death.

1.11.2 Location and Extent

Wisconsin is well known for its frigid winters and its extreme heat. In 1995, at least 68 people died during an extreme heat event when temperatures remained over 90˚F for seven consecutive days. The characteristics of extreme heat will fluctuate dependent on the region. Therefore, extreme heat in Wisconsin may not qualify for extreme heat in Louisiana. Extreme heat health problems are also related to urbanization and social, economic, and physiological vulnerability. According to research conducted by the Wisconsin Initiative on Climate Change Impacts, extreme heat events are projected to become more frequent, longer-lasting, and geographically widespread. By the middle of the century, Wisconsin residents are projected to experience 1.5 to 4 more weeks of daytime temperatures exceeding 90 ºF. Public health officials and concerned citizens will be charged with the task of protecting the most vulnerable populations in the face of these changes.

Another dangerous winter weather situation is the combination of extremely cold temperatures and strong winds that can result in wind chills that cause bodily injury such as frostbite and death due to exposure (hypothermia). Despite the fact that Wisconsin's harsh winter temperatures have become slightly milder over the past couple of decades, the number of severe winter storms shows an increasing trend. This may be partially related to better documentation generated by the NWS, but may also be related to the fact that warmer air can hold more moisture which ultimately can fall as snow.

1.11.3 Frequency and Probability

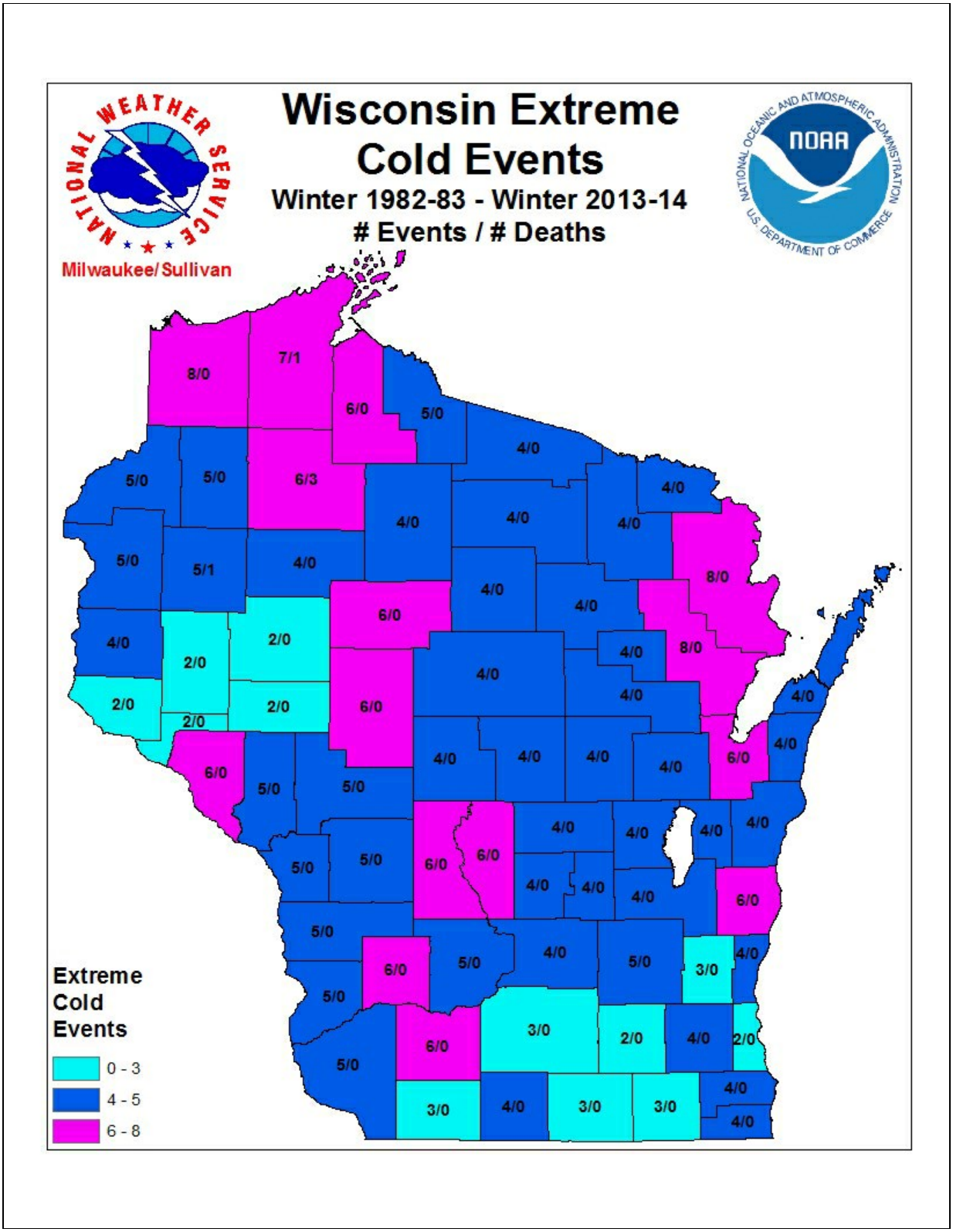
Temperature extremes, both cold and hot, have a medium likelihood of occurrence in any given year. Excessive heat events recorded by the National Weather Service between 1950 and 2021 are outlined below:

Location	Date	Type	Death	Injury	Property Damage	Crop Damage
Statewide	6/4/1994	Heat Wave	0	0	0	0
Waukesha County	10/12/1995	Record Warmth	0	0	0	0
Waukesha County	9/27/1998	Record Heat	0	0	0	0
Waukesha County	9/13/1998	Excessive Heat	0	0	0	0
Waukesha County	11/23/1998	Excessive Heat	0	0	0	0
Waukesha County	12/1/1998	Excessive Heat	0	0	0	0
Waukesha County	7/4/1999	Excessive Heat	0	0	0	0
Waukesha County	7/29/1999	Excessive Heat	8	0	0	0
Waukesha County	7/21/2001	Extreme Wind Chill / Cold	2	0	0	0
Waukesha County	7/31/2001	Excessive Heat	0	0	0	0
Waukesha County	8/6/2001	Excessive Heat	4	0	0	0
Waukesha County	4/15/2002	Excessive Heat	1	0	0	0
Waukesha County	6/20/2002	Excessive Heat	1	0	0	0
Waukesha County	6/22/2002	Excessive Heat	1	0	0	0
Waukesha County	6/30/2002	Excessive Heat	0	0	0	0
Waukesha County	7/1/2002	Excessive Heat	0	0	0	0
Waukesha County	7/8/2002	Excessive Heat	0	0	0	0
Waukesha County	7/21/2002	Excessive Heat	0	0	0	0
Waukesha County	7/24/2005	Excessive Heat	0	0	0	0
Waukesha County	7/3/2012	Excessive Heat	0	0	0	0
Waukesha County	7/16/2006	Heat	0	0	0	0
Waukesha County	7/30/2006	Heat	0	40	0	0
Waukesha County	8/1/2006	Heat	2	0	0	0
Waukesha County	7/3/2012	Heat	0	0	0	0
Waukesha County	11/2014	Heat	0	0	0	0
Waukesha County	7/21/2016	Heat	0	0	0	0
Waukesha County	6/17/2018	Heat	0	0	0	0
Waukesha County	6/29/2018	Excessive Heat	0	0	0	0
Waukesha County	7/04/2018	Heat	0	0	0	0
Waukesha County	7/19/2019	Heat	0	0	0	0

Following is a chart that outlines severe cold events that have been recorded by the National Weather Service in Waukesha County between 1 January 1950 and 28 February 2021:

Location	Date	Type	Death	Injury	Property Damage	Crop Damage
Statewide	1/13/1994	Cold	0	0	0	0
Waukesha County	12/9/1995	Cold	2	21	0	0
Waukesha County	1/30/1996	Extreme Wind Chill	2	0	0	0
Waukesha County	1/31/1996	Extreme Cold	0	10	0	0
Waukesha County	2/1/1996	Extreme Cold	4	18	0	0
Waukesha County	1/17/1997	Extreme Cold	0	3	20	0
Waukesha County	1/5/1999	Extreme Cold	0	0	0	0
Waukesha County	12/18/2005	Extreme Wind Chill / Cold	0	0	0	0
Waukesha County	2/17/2006	Extreme Wind Chill / Cold	0	0	0	0
Waukesha County	2/18/2006	Extreme Wind Chill / Cold	0	0	0	0
Waukesha County	2/3/2007	Extreme Wind Chill / Cold	0	0	0	0
Waukesha County	1/6/2014	Extreme Wind Chill / Cold	0	0	0	0
Waukesha County	1/28/2014	Extreme Wind Chill / Cold	0	0	0	0
Waukesha County	2/5/2007	Cold / Wind Chill	0	0	03	0
Waukesha County	1/30/2008	Cold / Wind Chill	0	0	0	0
Waukesha County	12/15/2008	Cold / Wind Chill	0	0	0	0
Waukesha County	1/21/2013	Cold / Wind Chill	0	0	0	0
Waukesha County	1/7/2015	Cold / Wind Chill	0	0	0	0
Waukesha County	1/9/2015	Cold / Wind Chill	0	0	0	0
Waukesha County	12/14/2016	Cold / Wind Chill	0	0	0	0
Waukesha County	12/18/2016	Cold / Wind Chill	0	0	0	0
Waukesha County	12/25/2017	Cold / Wind Chill	0	0	0	0
Waukesha County	1/01/2018	Cold / Wind Chill	0	0	0	0
Waukesha County	1/29/2019	Extreme Wind Chill / Cold	0	0	0	0

Below is a map of Extreme Cold events in Wisconsin from Winter 1982-83 to Winter 2013-14.



The loss of property due to temperature extremes is not likely but loss of life or injury to people has a medium likelihood of occurrence. Extreme temperatures marked by heat and cold waves can adversely affect the environment causing deaths in the population, drought, wildfires and economic losses for the agricultural-based industries. However, the economic impact upon Waukesha County because of extreme temperatures would be minimal. Other potential impacts could be felt in higher energy costs, e.g., most record energy-use days occur on days of extreme heat. Excessive energy-use during a heatwave can cause serious energy hazards, such as rolling blackouts.

1.11.4 Vulnerability

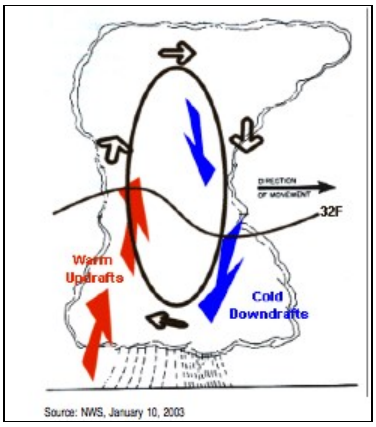
Vulnerability to temperature extremes is generally assessed on an individual basis with the most vulnerable sections of our community's population having the greatest risk. These people may include the elderly, the very young and the chronically ill. People from economically disadvantaged backgrounds, especially those listed in the categories above, are even more vulnerable since they are least able to afford the cost of adequate heating or air conditioning systems.

The Waukesha County social services agencies are aware of many of these people who reside in our communities and they, along with the public health department, have plans and access to economic assistance programs to help these people in times of concern.

Hazard Assessment		
Severe Temperatures		
Frequency/Probability (i.e. Future Probability)	▶	Medium
Magnitude/Extent (i.e. Strength or Magnitude)	▶	Medium
Vulnerability (i.e. Consequence and Impact)	▶	Medium
Overall Risk Rating	▶	Medium

1.12 Hail

Studies of thunderstorms indicate that two conditions are required for hail to develop: sufficiently strong and persistent up-draft velocities and an accumulation of liquid water in a super-cooled state in the upper parts of the storm. Hailstones are formed as water vapor in the warm surface layer rises quickly into the cold upper atmosphere. The water vapor is frozen and begins to fall; as the waterfalls, it accumulates more water vapor. This cycle continues until there is too much weight for the updraft to support and the frozen waterfalls too quickly to the ground to melt along the way. The graphic below depicts hail formation:



Injury and loss of life are rarely associated with hailstorms, however extensive property damage is possible, especially to crops.

1.12.1 Hail Hazard Profile

Hail is a form of solid precipitation. Hail may be spherical, conical or irregular in shape and can range in size from barely visible in size to grapefruit-sized dimensions. Hailstones equal to or larger than a penny are considered severe.

Hail Size Estimates	
Size	**Inches in Diameter**
Pea	1/4 inch
Marble/mothball	1/2 inch
Dime/Penny	3/4 inch
Nickel	7/8 inch
Quarter	1 inch
Ping-Pong Ball	1 1/2 inch
Golf Ball	1 3/4 inches
Tennis Ball	2 1/2 inches
Baseball	2 3/4 inches
Tea cup	3 inches
Grapefruit	4 inches
Softball	4 1/2 inches

Source: NSW, January 10, 2003

Hail falls in swaths that can be from twenty to one hundred miles long and from five to thirty miles wide. A hail swath is not a large continuous path of hail but generally consists of a series of hail cells that are produced by individual thunderstorm clouds traveling in the same area.

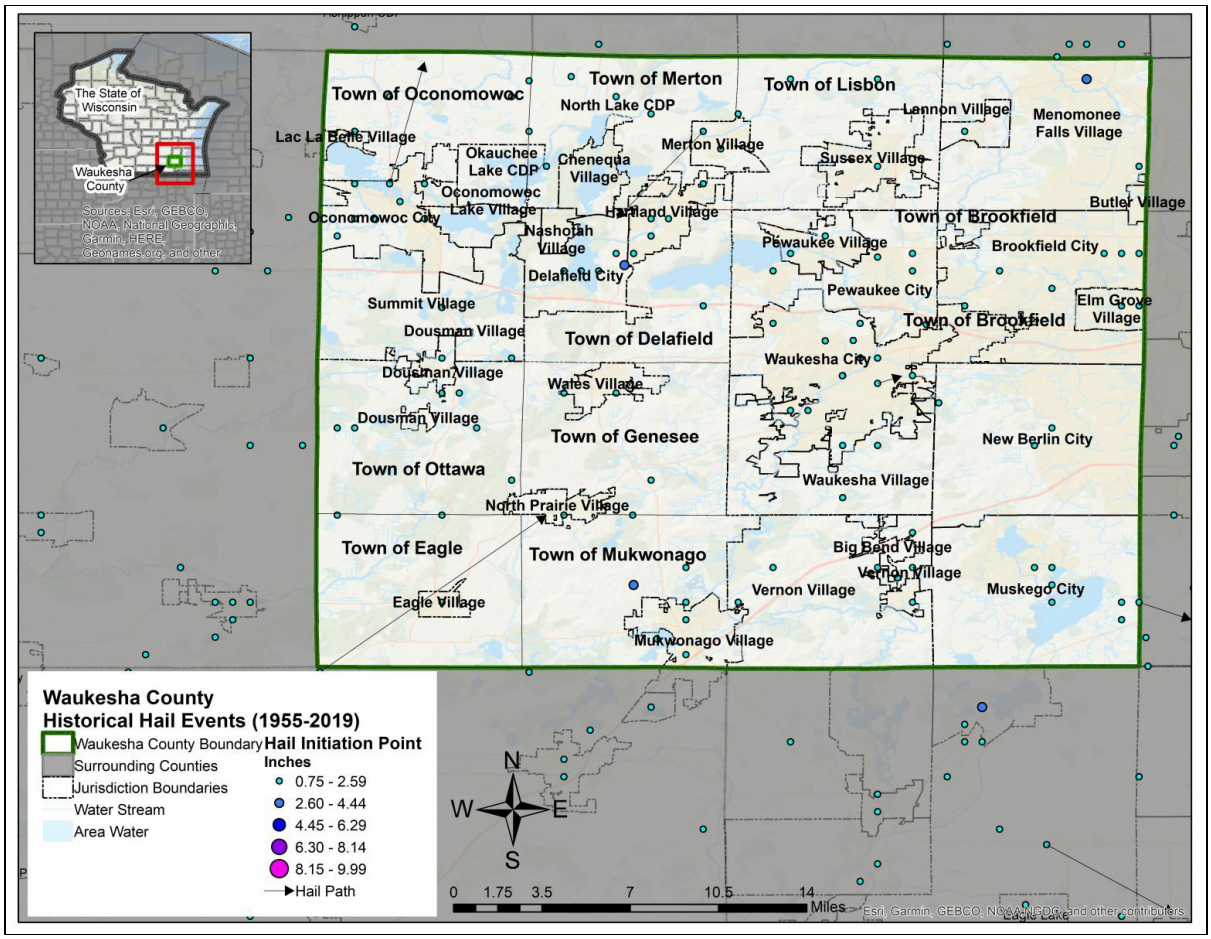
There are methods available to detect hail-producing thunderstorms using weather satellites and weather radar imagery. Hailstones generally fall at higher speeds as they grow in size, though complicating factors such as melting, friction with air, wind, and interaction with rain and other hailstones can slow their descent through Earth's atmosphere. Severe weather warnings are issued for hail when the stones reach a damaging size, as it can cause serious damage to human-made structures and, most commonly, farmers' crops.

The size of hailstones is best determined by measuring their diameter with a ruler. In the absence of a ruler, hailstone size is often visually estimated by comparing its size to that of known objects, such as coins.

1.12.2 Location and Extent

Hailstorms usually occur from May through August and Wisconsin averages two or three hail days per year. According to the Wisconsin State Hazard Mitigation Plan, from 1982 – 2003, Waukesha County reported 50 hail events but fortunately none have led to loss of life and one led to injury. Waukesha County has a high probability of hail occurrence in Wisconsin. The likelihood of damage due to hail is therefore considered high.

Most hail damage occurs in rural areas because maturing crops are particularly susceptible to bruising and other damage caused by hailstones. The four months of hailstorm activity correspond to the growing and harvesting seasons for most crops.



1.12.3 Frequency and Probability

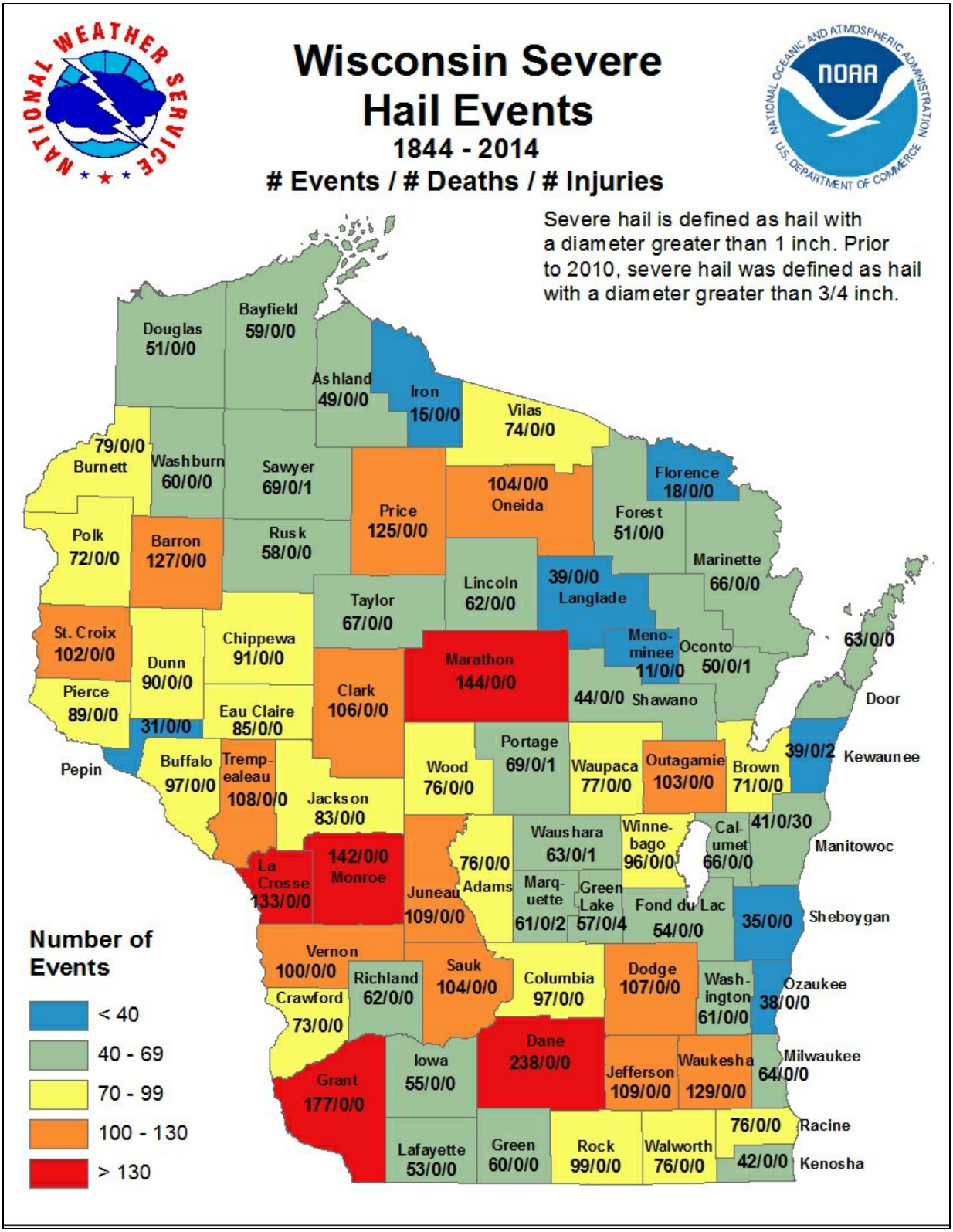
There have been 145 hail events recorded by the National Weather Service between 1950 and 2021.

Location	Date	Size	Death	Injury	Property Damage	Crop Damage
Waukesha County	5/14/1957	1.75 in.	0	0	0	0
Waukesha County	7/11/1969	1.75 in.	0	0	0	0
Waukesha County	6/23/1973	2.00 in.	0	0	0	0
Waukesha County	8/30/1973	0.75 in.	0	0	0	0
Waukesha County	7/3/1975	1.75 in.	0	0	0	0
Waukesha County	7/3/1975	1.75 in.	0	0	0	0
Waukesha County	4/2/1977	0.75 in.	0	0	0	0
Waukesha County	6/20/1979	1.75 in.	0	0	0	0
Waukesha County	6/20/1979	1.75 in.	0	0	0	0
Waukesha County	5/28/1980	1.00 in.	0	0	0	0
Waukesha County	5/30/1980	0.75 in.	0	0	0	0
Waukesha County	5/30/1980	1.00 in.	0	0	0	0
Waukesha County	6/5/1980	1.75 in.	0	0	0	0
Waukesha County	8/4/1980	0.75 in.	0	0	0	0
Waukesha County	6/26/1984	1.75 in.	0	0	0	0
Waukesha County	5/26/1985	0.75 in.	0	0	0	0
Waukesha County	5/21/1987	1.75 in.	0	0	0	0
Waukesha County	5/21/1987	1.75 in.	0	0	0	0
Waukesha County	5/21/1987	1.75 in.	0	0	0	0
Waukesha County	8/8/1988	1.00 in.	0	0	0	0
Waukesha County	7/27/1989	0.75 in.	0	0	0	0
Waukesha County	9/9/1991	0.75 in.	0	0	0	0
Oconomowoc	3/23/1994	1.00 in.	0	0	0	0
Brookfield	7/11/1994	1.00 in.	0	0	0	0
Waukesha	7/11/1994	0.75 in.	0	0	0	0
Hartland	4/18/1995	0.75 in.	0	0	0	0
Dousman	6/7/1995	0.75 in.	0	0	0	0
Hartland	8/28/1995	0.75 in.	0	0	0	0
Mukwonago	10/29/1996	2.00 in.	0	0	1.2M	0
New Berlin	10/29/1996	0.75 in.	0	0	0	0
Eagle	5/5/1997	0.75 in.	0	0	0	0
Dousman	6/21/1997	0.88 in.	0	0	0	0
Delafield	7/20/1998	100 kts.	0	0	6K	0
Dousman	8/24/1998	0.75 in.	0	0	0	0
Waukesha	9/1/1998	0.75 in.	0	0	0	0
Dousman	6/28/1999	0.75 in.	0	0	0	0
Waukesha	7/9/1999	0.75 in.	0	0	0	0
Muskego	8/10/1999	1.00 in.	0	0	0	0
Muskego	3/8/2000	0.75 in.	0	0	0	0
Eagle	3/8/2000	1.00 in.	0	0	0	0
Wales	3/8/2000	1.00 in.	0	0	0	0
Mukwonago	5/8/2000	1.00 in.	0	0	0	0
Mukwonago	5/18/2000	1.25 in.	0	0	0	0
Waukesha	5/18/2000	1.00 in.	0	0	0	0

Menomonee Falls	5/18/2000	0.75 in.	0	0	0	0
Delafield	5/18/2000	1.25 in.	0	0	5K	0
Waukesha	5/18/2000	0.75 in.	0	0	0	0
Waukesha	5/18/2000	1.00 in.	0	0	0	0
Merton	5/18/2000	1.75 in.	0	0	0	0
Delafield	7/2/2000	0.88 in.	0	0	0	0
Eagle	5/14/2001	1.00 in.	0	0	0	0
Oconomowoc	5/14/2001	1.75 in.	0	0	0	0
North Prairie	5/14/2001	1.75 in.	0	0	0	0
New Berlin	5/14/2001	1.00 in.	0	0	0	0
Sussex	6/18/2001	1.00 in.	0	0	0	0
Stonebank	6/18/2001	0.88 in.	0	0	0	0
Eagle	7/31/2003	1.00 in.	0	0	0	0
Merton	8/1/2003	1.00 in.	0	0	0	25K
Oconomowoc	3/1/2004	1.00 in.	0	0	0	0
Waukesha	5/8/2004	0.75 in.	0	0	0	0
Delafield	5/23/2004	1.00 in.	0	0	0	0
Oconomowoc	5/23/2004	0.88 in.	0	0	0	0
Menomonee Falls	5/23/2004	1.00 in.	0	0	0	0
Oconomowoc	7/16/2004	0.75 in.	0	0	0	0
Delafield	7/16/2004	0.75 in.	0	0	0	0
Muskego	3/30/2005	1.00 in.	0	0	0	0
Oconomowoc	5/6/2005	0.75 in.	0	0	0	0
Dousman	5/6/2005	0.88 in.	0	0	0	0
North Prairie	5/6/2005	1.00 in.	0	0	0	0
Mukwonago	5/6/2005	0.88 in.	0	0	0	0
Mukwonago	11/5/2005	0.75 in.	0	0	0	0
Big Bend	11/5/2005	0.75 in.	0	0	0	0
Brookfield	11/5/2005	0.75 in.	0	0	0	0
Hartland	4/13/2006	1.75 in.	0	0	4.4M	0
Merton	4/13/2006	2.00 in.	0	0	4.4M	0
Sussex	4/13/2006	2.00 in.	0	0	4.4M	0
Sussex	4/13/2006	2.00 in.	0	0	4.4M	0
Menomonee Falls	4/13/2006	2.75 in.	0	0	4.4M	0
Waukesha	4/13/2006	0.88 in.	0	0	0	0
Hartland	5/17/2006	1.00 in.	0	0	0	0
Oconomowoc	6/28/2006	0.88 in.	0	0	0	0
Brookfield	7/9/2006	1.25 in.	0	0	0	0
Elm Grove	7/9/2006	0.75 in.	0	0	0	0
Brookfield	7/9/2006	0.75 in.	0	0	0	0
Brookfield	7/9/2006	0.75 in.	0	0	0	0
Brookfield	7/9/2006	1.00 in.	0	0	0	0
North Prairie	7/9/2006	0.75 in.	0	0	0	0
North Prairie	7/9/2006	1.75 in.	0	0	0	0
Big Bend	8/24/2006	1.00 in.	0	0	0	0
Lannon	9/6/2006	1.00 in.	0	0	0	0
Delafield	9/8/2006	0.88 in.	0	0	0	0
Duplainville	9/8/2006	0.75 in.	0	0	0	0
Eagle	10/2/2006	0.75 in.	0	0	0	0
Oconomowoc	3/21/2007	0.75 in.	0	0	0	0
Pewaukee	3/21/2007	0.75 in.	0	0	0	0
Menomonee Falls	3/21/2007	0.75 in.	0	0	0	0
Hartland	3/22/2007	1.75 in.	0	0	0	0
Mukwonago	3/22/2007	0.88 in.	0	0	0	0
Hartland	7/9/2007	0.75 in.	0	0	0	0
Wales	9/27/2007	0.75 in.	0	0	0	0
Waukesha	4/25/2008	0.75 in.	0	0	0	0
Waukesha Co Arpt	6/7/2008	2.00 in.	0	0	0	0
Oconomowoc	6/7/2008	1.75 in.	0	0	0	0
Waukesha	6/7/2008	1.00 in.	0	0	0	0
Hartland	6/7/2008	3.00 in.	0	0	0	0
Dousman	6/28/2008	0.75 in.	0	0	0	0
Mukwonago	6/8/2009	1.50 in.	0	0	0	0
Downtown Waukesha	9/27/2009	1.00 in	0	0	0	0
Eagle	6/21/2010	1.50 in.	0	0	0	0
Lannon	6/23/2010	0.75 in.	0	0	0	0

Muskego	7/10/2010	0.75 in.	0	0	0	0
Oconomowoc	9/2/2010	0.88 in.	0	0	0	0
Oconomowoc	9/2/2010	0.88 in.	0	0	0	0
Downtown Waukesha	9/6/2010	1.75 in.	0	0	0	0
Downtown Waukesha	9/6/2010	0.75 in.	0	0	0	0
Hartland	5/11/2011	2.00 in.	0	0	0	0
Hartland	5/11/2011	1.00 in.	0	0	0	0
Hartland	5/11/2011	1.25 in.	0	0	0	0
Eagle	5/22/2011	1.75 in.	0	0	0	0
Oconomowoc	5/1/2012	0.75 in.	0	0	0	0
Oconomowoc	5/1/2012	1.50 in.	0	0	0	0
Oconomowoc	5/1/2012	1.00 in.	0	0	0	0
Stonebank	5/28/2012	0.88 in.	0	0	0	0
North prairie	7/30/2012	1.00 in.	0	0	0	0
Brookfield	8/16/2012	0.88 in.	0	0	0	0
Mukwonago	5/28/2013	1.25 in.	0	0	0	0
Eagle	7/21/2013	0.75 in.	0	0	0	0
Bethesda	8/21/2013	0.88 in.	0	0	0	0
Vernon	8/21/2013	0.75 in.	0	0	0	0
Delafield	8/30/2013	1.00 in.	0	0	0	0
Merton	8/30/2013	1.00 in.	0	0	0	0
Buena vista	8/30/2013	1.00 in.	0	0	0	0
Waukesha co arpt	8/30/2013	0.88 in.	0	0	0	0
Hartland	8/30/2013	1.00 in.	0	0	0	0
Waukesha co.	4/12/2014	0.75 in.	0	0	0	0
Waukesha co.	4/12/2014	0.75 in.	0	0	0	0
Waukesha co.	4/12/2014	1.00 in.	0	0	0	0
Brookfield	5/7/2014	1.00 in.	0	0	0	0
Downtown Waukesha	5/7/2014	1.00 in.	0	0	0	0
Elm grove	6/17/2014	1.25 in.	0	0	0	0
Brookfield	6/17/2014	1.75 in.	0	0	0	0
Brookfield	6/18/2014	0.75 in.	0	0	0	0
Hartland	8/1/2014	1.00 in.	0	0	0	0
New berlin	8/1/2014	1.00 in.	0	0	0	0
Phantom lake	8/1/2014	0.75 in.	0	0	0	0
Downtown Waukesha	8/02/2015	0.88 in.	0	0	0	0
Wukwonago	8/02/2015	3.75 in.	0	0	3K	0
Wukwonago	8/02/2015	1.75 in.	0	0	0	0
Big Bend	8/02/2015	0.2 in.	0	0	0	0
Muskego	8/02/2015	2.50 in.	0	0	0	0
Downtown Waukesha	8/14/2015	1.00 in.	0	0	0	0
Edgewood	8/14/2015	0.88 in.	0	0	0	0
Edgewood	8/14/2015	1.00 in.	0	0	0	0
Big Bend	11/11/2015	1.00 in.	0	0	0	0
Mukwonago	04/25/2016	0.75 in.	0	0	0	0
Phantom Lake	3/23/2017	0.88 in.	0	0	0	0
Mukwonago	3/23/2017	0.75 in.	0	0	0	0
Pewaukee	6/19/2017	1.00 in.	0	0	0	0
Merton	7/01/2017	0.75 in.	0	0	0	0
Merton	7/07/2017	0.75 in.	0	0	0	0
Okauchee	7/15/2017	1.00 in.	0	0	0	0
Dousman	7/15/2017	0.88 in.	0	0	0	0
Dousman	7/15/2017	0.75 in.	0	0	0	0
Oconomowoc Lake	5/02/2018	1.25 in.	0	0	0	0
Bethesda	5/02/2018	1.00 in.	0	0	0	0
Downtown Waukesha	5/02/2018	1.00 in.	0	0	0	0
Lannon	4/07/2020	1.00 in.	0	0	0	0
Merton	6/10/2020	1.00 in.	0	0	0	0
Oconomowoc Lake	6/10/2020	0.75 in.	0	0	0	0
Summit Corners	6/10/2020	1.00 in.	0	0	0	0

Below is a map of Hail Events in Wisconsin from 1844 - 2014.



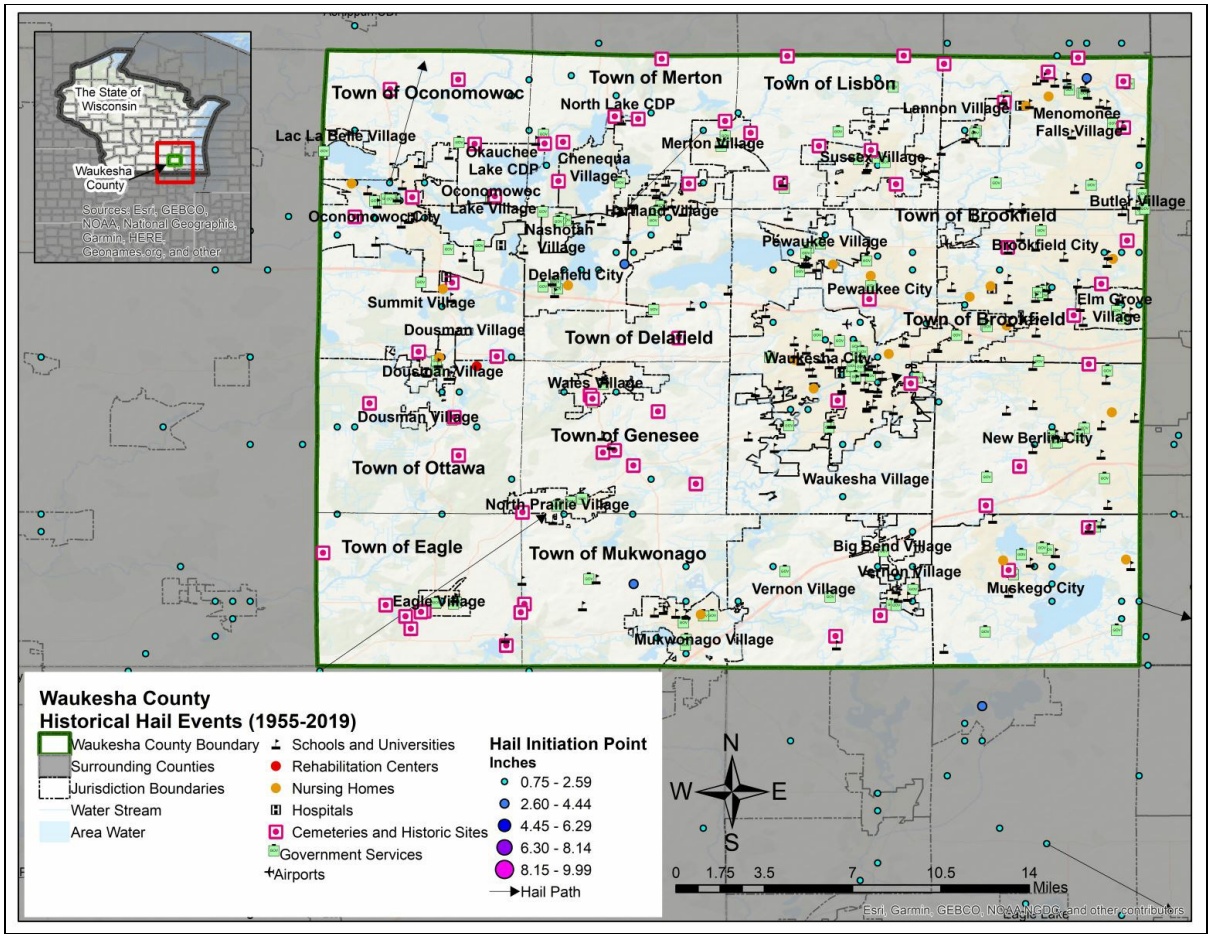
1.12.4 Vulnerability

Hail, typically occurring in conjunction with thunderstorms and lightning, can damage many types of infrastructure. Public and private vehicles (e.g., campers, boats, cars, trucks) are liable to have their windshields cracked, bodies dented and paint damaged as a result of hail. This damage can occur, depending on the size of the hail, whether the vehicle is moving through the storm or is stationary. Hail on the roadway can also cause vehicles to slide off the road. Vehicle damage and iced roadways are of particular concern when you consider the need for emergency vehicles such as police cars, fire trucks and ambulances to quickly move to assist victims in a disaster.

Hail can also damage critical infrastructure such as street signs, electric lines/poles/transformers, telephone lines and radio communication equipment. These pieces of infrastructure are needed by both first response agencies and the general community to ensure safe transport; warm, safe homes and good internal and external communications abilities.

Residential and business properties are liable to receive damage to signs, siding, billboards, trees and windows. Manufactured housing is particularly vulnerable to damage due to its lower construction standards.

Hail can be particularly damaging to agricultural concerns, including farm buildings, standing crops and livestock.



Hazard Assessment		
Hail		
Frequency / Probability (i.e. Future Probability)	▶	**High**
Magnitude / Extent (i.e. Strength or Magnitude)	▶	**Medium**
Vulnerability (i.e. Consequence and Impact)	▶	**Medium**
Overall Risk Rating	▶	**Medium**

1.13 Lightning

Lightning is a phenomenon associated with thunderstorms; the action of rising and descending air separates and builds-up positive and negative charge areas. When the built-up energy is discharged between the two areas, lightning is the result.

Formation of Lightning

University Corporation for Atmospheric Research [UCAR]

Lightning may travel from cloud to cloud, cloud to ground, or if there are high structures involved, from ground to cloud.

1.13.1 Lightning Hazard Profile

The temperatures in a lightning stroke rise to 50,000°F (Fahrenheit). The sudden and violent discharge which occurs in the form of a lightning stroke is over in one-millionth of a second.

Lightning damage occurs when humans and animals are electrocuted, fires are caused by a lightning stroke, materials are vaporized along the lightning path or sudden power surges cause damage to electrical or electronic equipment. Lightning, an underestimated hazard, kills more people in an average year than do hurricanes or tornadoes.

1.13.2 Location and Extent

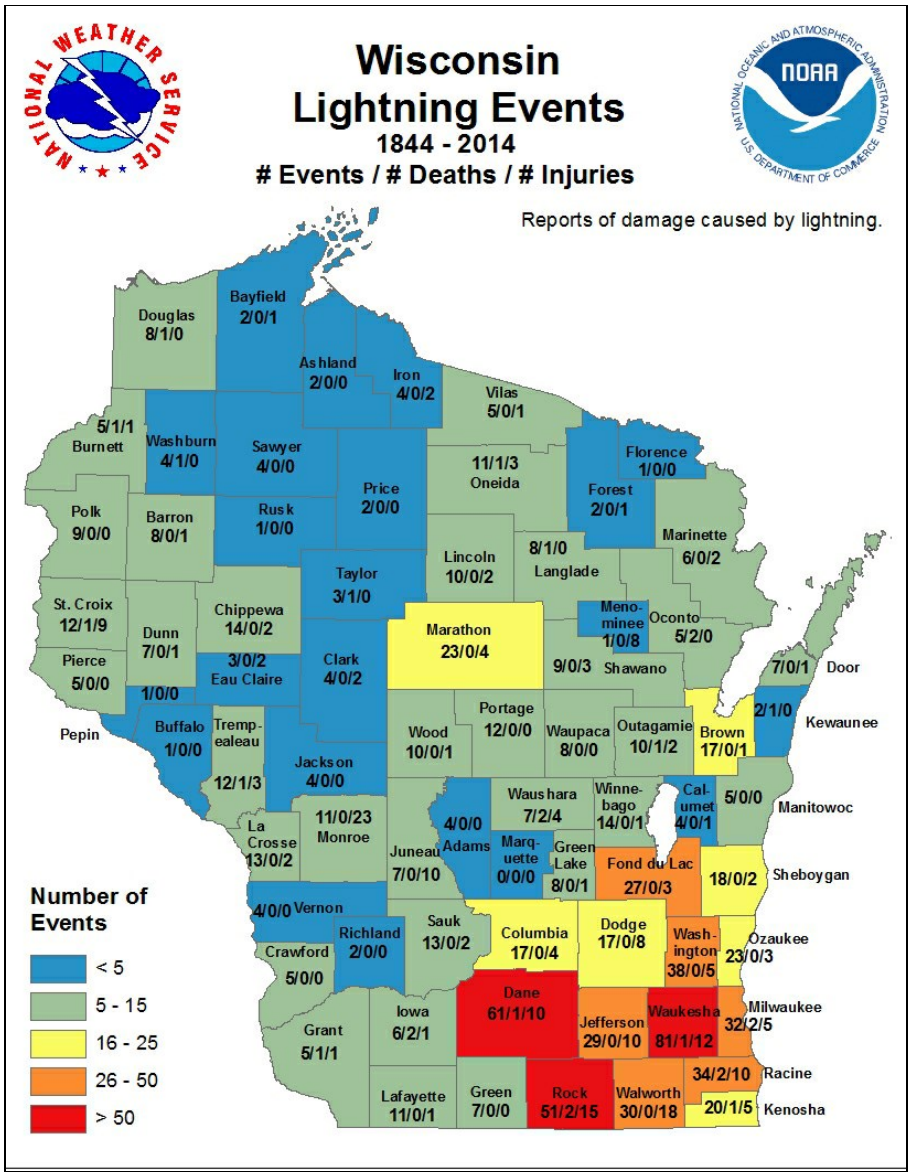
Nationwide, forty-five percent of the people killed by lightning have been outdoors, about sixteen percent were under trees, six percent were on heavy road equipment and thirty-three percent were at various unknown locations. Less than ten percent of the deaths involved individuals inside buildings; these deaths were primarily due to lightning-caused fires.

Wisconsin has a high frequency of property losses due to lightning. Insurance records show that annually one out of every fifty farms has been struck by lightning or had a fire that may have been caused by lightning. Generally, rural fires are more destructive than urban fires because of limited lightning protection devices, isolation, longer response times and inadequate water supplies.

1.13.3 Frequency and Probability

Waukesha County has a high probability of lightning occurrence; the likelihood of damage due to lightning is considered medium for the more rural areas of the county and low for the more urban areas of the county.

Below is a map of Lightning events in Wisconsin from 1844 - 2014.



The following table shows the lightning events recorded by the National Weather Service between 1 January 1950 and 28 February 2021.

Location	Date	Death	Injury	Property Damage	Crop Damage
Merton	7/4/1995	0	0	0	0
Delafield	7/25/1995	0	0	0	0
Dousman	8/9/1995	0	0	0	0
Dousman	8/9/1995	0	0	85K	0
Merton	8/9/1995	0	0	0	0
Brookfield	8/9/1995	0	0	12K	0
Mukwonago	8/9/1995	0	0	100K	0
Sussex	8/14/1995	0	0	0	0
Hartland	8/19/1995	1	0	0	0
Muskego	8/19/1995	0	1	0	0

Waukesha	8/19/1995	0	0	0	0
Merton	1/17/1996	0	0	15K	0
Elm Grove	6/2/1996	0	0	10K	0
Oconomowoc	6/2/1996	0	0	30K	0
Sussex	7/15/1996	0	1	0	0
New Berlin	8/5/1996	0	0	150K	0
Menomonee Falls	8/5/1996	0	0	25K	0
Chenequa	10/6/1996	0	1	10K	0
Hartland	6/20/1997	0	0	5K	0
Sussex	6/21/1997	0	1	0	0
Brookfield	7/2/1997	0	0	105K	0
Pewaukee	7/21/1997	0	0	12K	0
Muskego	9/16/1997	0	0	5K	0
Muskego	9/16/1997	0	0	1K	0
Muskego	9/16/1997	0	0	1K	0
Muskego	9/16/1997	0	0	1K	0
Sussex	5/12/1998	0	0	2K	0
Delafield	5/28/1998	0	0	20K	0
Delafield	5/31/1998	0	0	4K	0
Delafield	5/31/1998	0	0	10K	0
Pewaukee	5/31/1998	0	0	3K	0
Nashotah	6/18/1998	0	0	5K	0
Waukesha	6/24/1998	0	0	6K	0
Elm Grove	6/28/1998	0	0	10K	0
Oconomowoc	7/20/1998	0	0	4K	0
Oconomowoc	5/17/1999	0	0	2K	0
New Berlin	7/9/1999	0	0	2K	0
Pewaukee	8/26/2000	0	0	210K	0
Hartland	8/26/2000	0	0	10K	0
Brookfield	5/14/2001	0	0	3K	0
Elm Grove	8/12/2002	0	0	250K	0
Delafield	8/21/2002	0	0	3K	0
Hartland	8/21/2002	0	0	5K	0
Waukesha	8/3/2004	0	0	100K	0
Hartland	11/5/2005	0	0	1.1M	0
Brookfield	5/24/2006	0	0	1K	0
Waukesha	7/27/2006	0	1	0	0
Muskego	8/24/2006	0	1	0	0
Waterville	8/22/2007	0	0	200K	0
Waukesha	3/31/2008	0	0	25K	0
New Berlin	3/31/2008	0	0	10K	0
Oconomowoc	7/10/2008	0	0	50K	0
Oconomowoc	7/10/2008	0	0	100K	0
Mukwonago	8/4/2008	0	0	25K	0
North Prairie	8/4/2008	0	0	150K	0
New Berlin	8/9/2009	0	0	50K	0
Marcy	9/18/2010	0	0	100K	0
Merton	7/11/2011	0	0	1.00K	0
Hartland	7/11/2011	0	0	1.00K	0
Downtown Waukesha	9/25/2011	0	0	2.00K	0
Merton	4/9/2013	0	0	20.00K	0
New Berlin	4/9/2013	0	0	5.00K	0
Eagle	7/21/2013	0	1	0K	0
Hartland	3/15/2016	0	0	1K	0
Oconomowoc	6/10/2016	0	0	100K	0
Hales Corner	6/18/2018	0	0	20K	0
Downtown Waukesha	9/12/2019	0	0	2.5M	0

1.13.4 Vulnerability

Lightning, which often occurs in conjunction with thunderstorms and hail, can damage many types of infrastructure, including electric lines/poles/transformers, telephone lines and radio communication equipment. These pieces of infrastructure are needed by both first response agencies and the general community to ensure safe transport; warm, safe homes and good internal and external communications abilities.

Residential and business properties are liable to receive damage either as a result of a lightning strike causing a fire or other type of direct damage or by overloading electronic equipment (e.g., computers, televisions) that have not been properly connected to a surge protector. The latter concern is especially important to business and government, which in modern America rely on computers and other electronic equipment to manage the large amounts of data manipulated in our information-based economy.

Lightning can damage agricultural assets including farm buildings, standing crops and livestock. It is also one of the major sources of ignition for forest and wildfires.

Hazard Assessment		
Lightning		
Frequency/Probability (i.e. Future Probability)	▶	High
Magnitude/Extent (i.e. Strength or Magnitude)	▶	Medium
Vulnerability (i.e. Consequence and Impact)	▶	Low
Overall Risk Rating	▶	Medium

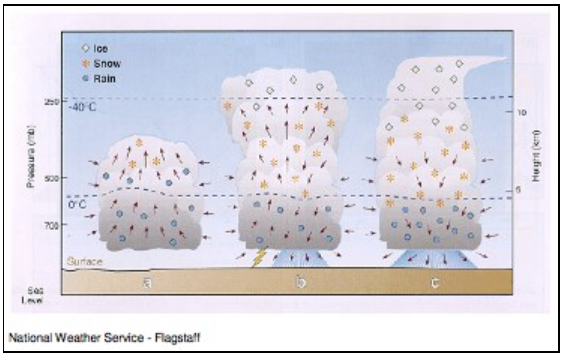
1.14 Thunderstorms

There are three distinct stages of development for thunderstorms (birth, growth, maturity), each of which can be seen in the following schematic.

In the first stage of development, an updraft drives warm air up beyond condensation levels where clouds form.

The second stage of development occurs as levels of water vapor in the expanding cloud rise past saturation and the air cools sufficiently to form solid and liquid particles of water. At this point, rain or snow begins to fall within the cloud.

A thunderstorm's mature stage is marked by a transition of wind direction within the storm cells. The prevailing updraft which initiated the cloud's growth is joined by a downdraft generated by precipitation. Lightning may occur soon after precipitation begins. Hail and tornadoes may also develop during this stage.



National Weather Service - Flagstaff

1.14.1 Thunderstorms Hazard Profile

A thunderstorm often is born, grows, reaches maturity and dies in a thirty-minute period. The individual thunderstorm cell often travels between thirty and fifty miles per hour. Strong frontal systems may create one squall line after another, each composed of many individual thunderstorm cells. These fronts can often be tracked across the state from west to east with a constant cycle of birth, growth, maturity and death of individual thunderstorm cells.

Summers are generally rainy in Wisconsin, and the state experiences about 30 to 40 thunderstorms per year, with occasional hail and lightning. Precipitation is usually higher in areas with the highest elevations, such as the Northern Highlands and Western Uplands. Annual precipitation figures range from approximately 28 to 34 inches, depending on the region.

1.14.2 Location and Extent

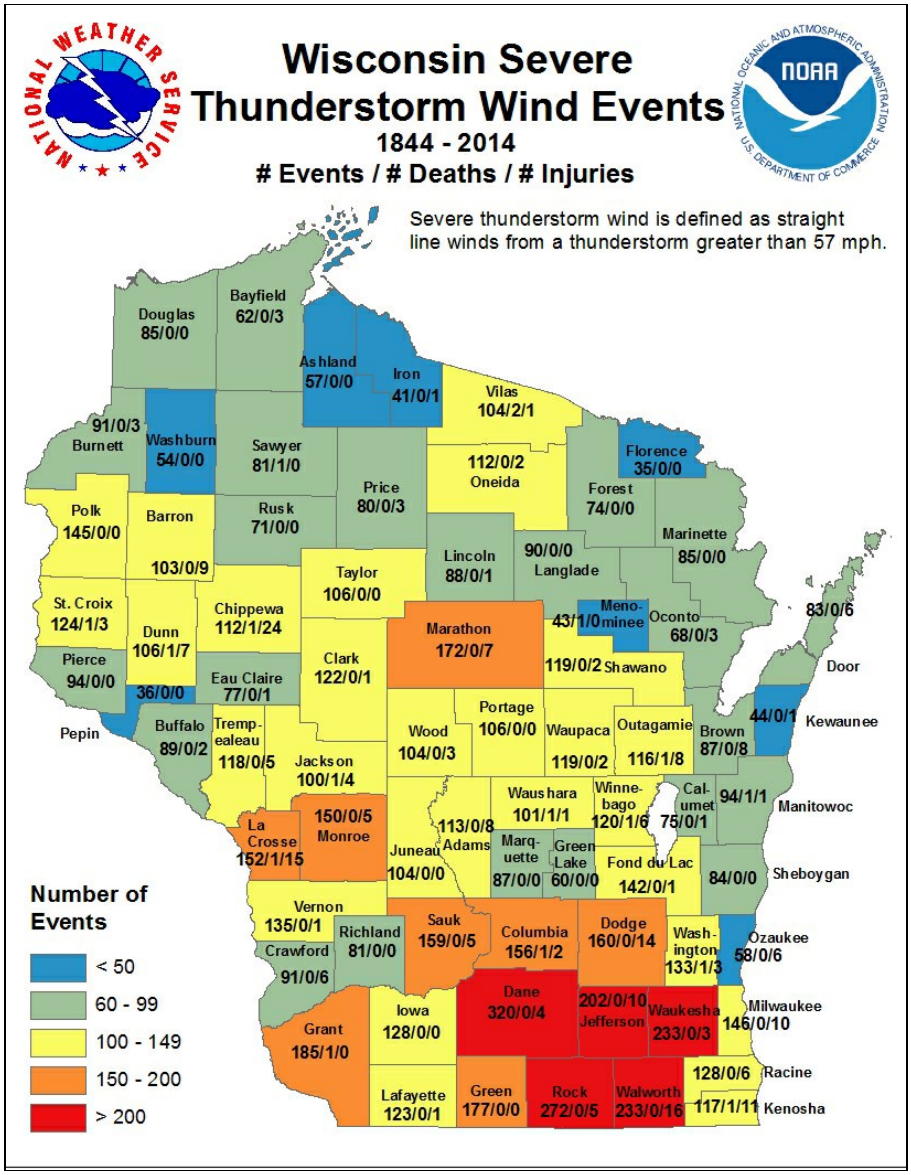
There are approximately 100,000 thunderstorms in the United States every year and approximately 10% of those are considered severe (i.e., has at least ¾" hail, winds of at least 58 mph or a tornado). Most Wisconsin counties, including Waukesha County, average between 30 and 40 thunderstorm days per year although a portion of southwestern and south-central Wisconsin average 40 to 50 thunderstorm days per year. In Waukesha County there are typically several severe thunderstorms per year. In Wisconsin, Waukesha County has the highest incidence of hurricane-force thunderstorm winds, with 15 events documented between 1970 and 2001. Hurricane-force winds are greater than or equal to 75 miles per hour. Thunderstorms can occur throughout the year with the highest frequency during the months of May through September. The majority of storms occur between the hours of noon and midnight.

1.14.3 Frequency and Probability

Thunderstorm frequency is measured as the number of days per year with one or more incidents. There are approximately 100,000 thunderstorms in the United States every year and approximately 10% of those are considered severe (i.e., has at least 3⁄4" hail, winds of at least 58 mph or a tornado). Most Wisconsin counties, including Waukesha County, average between 30 and 40 thunderstorm days per year although a portion of southwestern and south-central Wisconsin average 40 to 50 thunderstorm days per year. In Waukesha County there are typically several severe thunderstorms per year. In Wisconsin, Waukesha County has the highest incidence of hurricane-force thunderstorm winds, with 15 events documented between 1970 and 2001. Hurricane-force winds are greater than or equal to 75 miles per hour. Thunderstorms can occur throughout the year with the highest frequency during the months of May through September. The majority of storms occur between the hours of noon and midnight.

The probability of thunderstorms occurring in Waukesha County is high. Damage from thunderstorms usually is a result of the hail, lightning, winds and/or flash flooding that can occur as part of the storm. The likelihood of damage from these causes is in discussed in the appropriate chapters.

Below is a map of Thunderstorm Wind Events in Wisconsin from 1844 - 2014.



The following table lists the thunderstorms and high wind events that have been recorded in Waukesha County by the National Weather Service between 1 January 1950 and February 2021.

Location	Date	Wind Speed	Death	Injury	Property Damage	Crop Damage
WAUKESHA CO.	7/31/1955	0 kts.	0	0	0.00K	0.00K

WAUKESHA CO.	6/17/1957	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	10/8/1959	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/10/1961	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/29/1962	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	4/11/1965	70 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/20/1965	55 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	9/9/1965	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/10/1966	61 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/10/1968	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/14/1972	65 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	4/21/1973	60 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/16/1973	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/9/1974	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/6/1977	50 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/6/1977	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/18/1978	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/15/1978	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/29/1979	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/5/1980	56 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/16/1980	52 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/29/1980	61 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/4/1980	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/4/1980	75 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/4/1980	65 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/24/1981	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/12/1981	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/12/1981	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/31/1981	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/3/1982	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/19/1983	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/19/1983	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/19/1983	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/19/1983	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/19/1983	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/10/1983	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/6/1984	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/26/1984	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/9/1984	69 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/9/1984	69 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/23/1984	57 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	10/16/1984	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	5/12/1985	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/11/1986	60 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/27/1986	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/27/1986	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	5/21/1987	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/25/1987	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/6/1987	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/20/1987	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/29/1987	65 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	5/8/1988	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	5/8/1988	55 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/4/1988	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/8/1988	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/8/1988	52 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	11/16/1988	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	5/24/1989	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/27/1989	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/27/1989	56 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/4/1989	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/4/1989	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/4/1989	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	8/18/1990	50 kts.	0	0	0.00K	0.00K

WAUKESHA CO.	3/27/1991	54 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	4/29/1991	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/1/1991	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/7/1991	52 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/7/1991	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/7/1991	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	7/7/1991	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	5/11/1992	70 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/17/1992	0 kts.	0	0	0.00K	0.00K
WAUKESHA CO.	6/17/1992	0 kts.	0	0	0.00K	0.00K
Oconomowoc	8/9/1993	0 kts.	0	0	5.00K	5.00K
Hartland	8/9/1993	0 kts.	0	0	50.00K	50.00K
Pewaukee	8/9/1993	0 kts.	0	0	50.00K	50.00K
Dousman	4/18/1994	52 kts.	0	0	0.00K	0.00K
Waukesha	4/18/1994	61 kts.	0	0	50.00K	0.00K
Oconomowoc	7/4/1994	61 kts.	0	0	0.00K	5.00K
Delafield	7/4/1994	50 kts.	0	0	0.00K	0.00K
Hartland	7/4/1994	0 kts.	0	0	5.00K	5.00K
Waukesha	7/11/1994	52 kts.	0	0	0.00K	0.00K
Eagle	8/9/1995	0 kts.	0	0	0.00K	0.00K
North Prairie	8/9/1995	52 kts.	0	0	0.00K	0.00K
Hartland	8/9/1995	0 kts.	0	0	0.00K	0.00K
Butler	8/28/1995	0 kts.	0	0	0.00K	0.00K
Muckwanogo	8/28/1995	0 kts.	0	0	0.00K	0.00K
OCONOMOWOC	8/5/1996		0	0	15.00K	0.00K
BROOKFIELD	8/19/1996		0	0	10.00K	0.00K
WALES	10/29/1996		0	0	20.00K	0.00K
MUKWONAGO	4/5/1997		0	0	12.00K	0.00K
CHENEQUA	6/15/1997		0	1	3.00K	0.00K
HARTLAND	6/21/1997	52 kts.	0	0	0.50K	0.00K
MUKWONAGO	6/24/1997	54 kts.	0	0	1.00K	0.00K
WAUKESHA	6/24/1997		0	0	3.00K	0.00K
OCONOMOWOC	7/26/1997		0	0	15.00K	0.00K
MUSKEGO	8/3/1997		0	0	200.00K	0.00K
EAGLE	5/15/1998		0	0	1.00K	0.00K
MUSKEGO	5/15/1998		0	0	1.00K	0.00K
DOUSMAN	5/28/1998		0	0	8.00K	0.00K
WAUKESHA	5/28/1998	61 kts.	0	0	15.00K	0.00K
COUNTYWIDE	5/31/1998	70 kts.	0	0	6.700M	50.00K
DOUSMAN	6/18/1998		0	0	30.00K	0.00K
HARTLAND	2/11/1999	55 kts.	0	0	3.00K	0.00K
MUKWONAGO	6/6/1999	70 kts.	0	0	40.00K	0.00K
BROOKFIELD	6/6/1999		0	0	15.00K	0.00K
OCONOMOWOC	6/10/1999		0	0	1.00K	0.00K
WAUKESHA	6/10/1999		0	0	1.00K	0.00K
WAUKESHA	6/10/1999		0	0	1.00K	0.00K
BROOKFIELD	6/11/1999	51 kts.	0	0	0.00K	0.00K
SUSSEX	6/11/1999	56 kts.	0	0	0.00K	0.00K
DOUSMAN	6/11/1999		0	0	1.00K	0.00K
DELAFIELD	5/8/2000		0	0	1.00K	0.00K
DELAFIELD	5/11/2000	52 kts. E	0	0	1.00K	0.00K
HARTLAND	5/11/2000	65 kts. E	0	0	100.00K	0.00K
GENESEE	6/1/2000		0	0	2.00K	0.00K
WAUKESHA	7/2/2000	68 kts. M	0	0	100.00K	0.00K
DOUSMAN	7/2/2000	61 kts. M	0	0	150.00K	0.00K
BROOKFIELD	7/2/2000		0	0	200.00K	0.00K
WAUKESHA	7/2/2000		0	0	2.00K	0.00K
WALES	8/26/2000		0	0	2.00K	0.00K
WAUKESHA	9/11/2000		0	0	3.00K	0.00K
COUNTYWIDE	6/11/2001	52 kts. M	0	0	75.00K	0.00K

WAUKESHA	8/9/2001	52 kts. E	0	0	0.00K	0.00K
DOUSMAN	9/3/2001	50 kts. E	0	0	0.00K	0.00K
BIG BEND	9/3/2001	56 kts. E	0	0	0.00K	0.00K
OCONOMOWOC	9/7/2001	52 kts. E	0	0	0.00K	0.00K
SUSSEX	6/10/2002	56 kts. E	0	0	0.00K	0.00K
PEWAUKEE	7/8/2002	52 kts. M	0	0	0.00K	0.00K
WAUKESHA CO ARPT	8/21/2002	87 kts. E	0	0	2.000M	0.00K
WAUKESHA	8/21/2002	56 kts. M	0	0	0.00K	0.00K
NORTH LAKE	9/2/2002	58 kts. M	0	0	0.00K	0.00K
EAGLE	10/4/2002	61 kts. E	0	0	50.00K	0.00K
OCONOMOWOC	10/4/2002	64 kts. M	0	0	300.00K	0.00K
WAUKESHA	7/4/2003	55 kts. MG	0	0	0.00K	0.00K
EAGLE	7/4/2003	56 kts. EG	0	0	5.00K	0.00K
WAUKESHA	7/6/2003	56 kts. MG	0	0	0.00K	0.00K
OCONOMOWOC	7/15/2003	61 kts. EG	0	0	0.00K	0.00K
ELM GROVE	7/30/2003	54 kts. MG	0	0	0.00K	0.00K
MERTON	8/1/2003	56 kts. EG	0	0	0.00K	0.00K
OCONOMOWOC	3/1/2004	52 kts. EG	0	0	1.00K	0.00K
OCONOMOWOC	4/18/2004	57 kts. MG	0	0	50.00K	0.00K
PEWAUKEE	5/21/2004	56 kts. MG	0	0	0.00K	0.00K
EAGLE	6/23/2004	56 kts. EG	0	0	0.00K	0.00K
NEW BERLIN	6/23/2004	56 kts. EG	0	0	0.00K	0.00K
WAUKESHA	8/3/2004	45 kts. EG	0	0	20.00K	0.00K
MERTON	6/30/2005	56 kts. EG	0	0	0.00K	0.00K
EAGLE	6/30/2005	56 kts. EG	0	0	0.00K	0.00K
GENESEE	6/30/2005	52 kts. EG	0	0	0.00K	0.00K
BROOKFIELD	6/30/2005	52 kts. EG	0	0	0.00K	0.00K
NEW BERLIN	7/21/2005	59 kts. MG	0	0	5.00K	0.00K
WAUKESHA	7/21/2005	61 kts. EG	0	0	10.00K	0.00K
HARTLAND	7/23/2005	52 kts. EG	0	0	1.00K	0.00K
DOUSMAN	7/23/2005	52 kts. EG	0	0	1.00K	0.00K
MUKWONAGO	7/23/2005	52 kts. EG	0	0	1.00K	0.00K
NORTH PRAIRIE	7/25/2005	56 kts. EG	0	0	5.00K	0.00K
MUKWONAGO	9/13/2005	58 kts. MG	0	0	0.00K	0.00K
DOUSMAN	9/13/2005	56 kts. EG	0	0	0.00K	0.00K
SUSSEX	9/13/2005	61 kts. EG	0	0	0.00K	0.00K
PEWAUKEE	9/13/2005	61 kts. EG	0	0	0.00K	0.00K
HARTLAND	9/13/2005	56 kts. EG	0	0	0.00K	0.00K
DELAFIELD	5/24/2006	50 kts. EG	0	0	10.00K	0.00K
BROOKFIELD	6/21/2006	56 kts. EG	0	0	10.00K	0.00K
BROOKFIELD	6/21/2006	52 kts. EG	0	0	0.00K	0.00K
DELAFIELD	6/28/2006	52 kts. EG	0	0	0.00K	0.00K
NEW BERLIN	7/9/2006	57 kts. MG	0	0	0.00K	0.00K
SUSSEX	7/9/2006	56 kts. EG	0	0	75.00K	0.00K
DOUSMAN	7/20/2006	52 kts. EG	0	0	0.00K	0.00K
BROOKFIELD	7/20/2006	52 kts. EG	0	0	10.00K	0.00K
EAGLE	7/27/2006	52 kts. EG	0	0	0.00K	0.00K
PEWAUKEE	7/27/2006	56 kts. EG	0	0	20.00K	0.00K
WAUKESHA	7/27/2006	61 kts. EG	0	0	0.00K	0.00K
BIG BEND	7/27/2006	52 kts. EG	0	0	5.00K	0.00K
MUSKEGO	8/2/2006	50 kts. EG	0	0	0.00K	0.00K
DOWNTOWN WAUKESHA	10/2/2006	56 kts. EG	0	0	0.00K	0.00K
NEW BERLIN	10/2/2006	51 kts. MG	0	0	0.00K	0.00K
HARTLAND	10/4/2006	50 kts. EG	0	0	0.00K	0.00K
MUSKEGO	6/7/2007	52 kts. EG	0	0	0.00K	0.00K
BROOKFIELD	6/18/2007	52 kts. EG	0	0	2.00K	0.00K
MENOMONEE FALLS	6/18/2007	52 kts. EG	0	0	2.00K	0.00K
OCONOMOWOC	8/22/2007	52 kts. EG	0	0	25.00K	0.00K
SUSSEX	8/22/2007	52 kts. EG	0	0	75.00K	0.00K
PEWAUKEE	8/22/2007	56 kts. EG	0	0	25.00K	0.00K
SUSSEX	4/25/2008	52 kts. EG	0	0	1.00K	0.00K
DOUSMAN	4/25/2008	56 kts. EG	0	0	30.00K	0.00K
EAGLE	6/6/2008	50 kts. EG	0	0	0.00K	0.00K

LANNON	6/6/2008	50 kts. EG	0	0	0.00K	0.00K
LANNON	6/6/2008	50 kts. EG	0	0	0.00K	0.00K
WAUKESHA CO ARPT	6/7/2008	61 kts. EG	0	0	0.00K	0.00K
DOUSMAN	6/8/2008	50 kts. EG	0	0	0.00K	0.00K
OCONOMOWOC	6/28/2008	61 kts. EG	0	0	0.00K	0.00K
DOWNTOWN WAUKESHA	6/28/2008	50 kts. EG	0	0	0.00K	0.00K
HARTLAND	7/2/2008	56 kts. EG	0	0	10.00K	0.00K
DOWNTOWN WAUKESHA	7/7/2008	50 kts. EG	0	0	0.00K	0.00K
DOWNTOWN WAUKESHA	7/7/2008	56 kts. EG	0	0	15.00K	0.00K
EAGLE	7/10/2008	56 kts. EG	0	0	10.00K	0.00K
STONEBANK	7/16/2008	56 kts. EG	0	0	0.00K	0.00K
NEW BERLIN	7/16/2008	65 kts. EG	0	0	15.00K	0.00K
DOWNTOWN WAUKESHA	6/18/2009	56 kts. EG	0	0	5.00K	0.00K
MUSKEGO	8/9/2009	61 kts. EG	0	0	10.00K	0.00K
EAGLE	8/9/2009	56 kts. EG	0	0	0.00K	0.00K
DOWNTOWN WAUKESHA	8/9/2009	52 kts. EG	0	0	0.00K	0.00K
DELAFIELD	9/27/2009	56 kts. EG	0	0	0.00K	0.00K
MUKWONAGO	6/18/2010	66 kts. MG	0	0	0.00K	0.00K
MUSKEGO	6/18/2010	65 kts. EG	0	0	0.00K	0.00K
DOUSMAN	6/21/2010	60 kts. EG	0	0	0.00K	0.00K
MUSKEGO	6/21/2010	65 kts. EG	0	0	0.00K	0.00K
OCONOMOWOC	6/23/2010	56 kts. EG	0	0	0.00K	0.00K
LANNON	7/14/2010	52 kts. EG	0	0	0.00K	0.00K
DOWNTOWN WAUKESHA	7/22/2010	59 kts. MG	0	0	0.00K	0.00K
DOUSMAN	8/9/2010	56 kts. EG	0	0	0.00K	0.00K
STONEBANK	8/20/2010	50 kts. EG	0	0	0.00K	0.00K
PEWAUKEE	8/20/2010	56 kts. MG	0	0	0.00K	0.00K
NASHOTAH	9/2/2010	70 kts. EG	0	0	0.00K	0.00K
MUSKEGO	4/10/2011	70 kts. EG	0	0	0.00K	0.00K
MUSKEGO	6/8/2011	65 kts. EG	0	0	0.00K	0.00K
EAGLE	6/21/2011	96 kts. EG	0	1	276.00K	0.00K
EAGLE	6/21/2011	69 kts. MG	0	0	0.00K	0.00K
MUKWONAGO	6/21/2011	61 kts. EG	0	0	0.00K	0.00K
DOUSMAN	7/11/2011	56 kts. EG	0	0	0.00K	0.00K
DOWNTOWN WAUKESHA	7/11/2011	56 kts. MG	0	0	0.00K	0.00K
MONTEREY	9/3/2011	56 kts. EG	0	0	2.00K	0.00K
MUKWONAGO	5/6/2012	56 kts. EG	0	0	2.00K	0.00K
STONEBANK	5/28/2012	61 kts. EG	0	0	5.00K	0.00K
DOWNTOWN WAUKESHA	5/28/2012	56 kts. EG	0	0	5.00K	0.00K
NEW BERLIN	5/28/2012	52 kts. EG	0	0	20.00K	0.00K
OCONOMOWOC	7/26/2012	61 kts. EG	0	0	0.00K	0.00K
DELAFIELD	7/26/2012	61 kts. EG	0	0	25.00K	0.00K
BIG BEND	7/26/2012	56 kts. EG	0	0	0.00K	0.00K
WAUKESHA CO ARPT	7/26/2012	51 kts. MG	0	0	0.00K	0.00K
MUSKEGO	7/30/2012	52 kts. EG	0	0	0.00K	0.00K
EAGLE	9/4/2012	56 kts. EG	0	0	3.00K	0.00K
OCONOMOWOC	5/14/2013	59 kts. MG	0	0	30.00K	0.00K
PEWAUKEE	6/12/2013	56 kts. EG	0	0	10.00K	0.00K
BROOKFIELD	6/12/2013	56 kts. EG	0	0	25.00K	0.00K
BROOKFIELD	6/27/2013	56 kts. EG	0	0	1.00K	0.00K
DOUSMAN	8/22/2013	50 kts. EG	0	0	0.50K	0.00K
NASHOTAH	8/22/2013	50 kts. EG	0	0	0.50K	0.00K
NASHOTAH	8/30/2013	56 kts. EG	0	0	0.00K	0.00K
DOWNTOWN WAUKESHA	8/30/2013	58 kts. MG	0	0	0.00K	0.00K
NORTH PRAIRIE	8/30/2013	52 kts. EG	0	0	1.50K	0.00K
WAUKESHA COUNTY	2/2014		0	0	0	0.00K
DOUSMAN	5/12/2014	58 kts. EG	0	0	2.00K	0.00K
DOUSMAN	5/12/2014	50 kts. EG	0	0	2.00K	0.00K
BROOKFIELD	6/17/2014	60 kts. EG	0	0	10.00K	0.00K
DOWNTOWN WAUKESHA	6/17/2014	55 kts. EG	0	0	5.00K	0.00K
EAGLE	6/17/2014	50 kts. EG	0	0	1.00K	0.00K
OCONOMOWOC LAKE	6/18/2014	50 kts. EG	0	0	15.00K	0.00K
UTICA	6/18/2014	50 kts. EG	0	0	2.00K	0.00K

NEW BERLIN	6/18/2014	50 kts. EG	0	0	2.00K	0.00K
BETHESDA	6/30/2014	57 kts. EG	0	0	10.00K	0.00K
MENOMONEE FALLS	6/30/2014	51 kts. EG	0	0	1.00K	0.00K
WAUKESHA CO ARPT	7/29/2014	55 kts. EG	0	0	5.00K	0.00K
WAUKESHA COUNTY	5/2014		0	0	0K	0.00K
WAUKESHA COUNTY	6/2014		0	0	0K	0.00K
WAUKESHA COUNTY	7/2014		0	0	0K	0.00K
WAUKESHA COUNTY	8/2014		0	0	0K	0.00K
WAUKESHA COUNTY	9/2014		0	0	0K	0.00K
WAUKESHA COUNTY	10/2014		0	0	0K	0.00K
WAUKESHA COUNTY	11/2014		0	0	0K	0.00K
WAUKESHA COUNTY	12/2014		0	0	0K	0.00K
WAUKESHA COUNTY	4/2015		0	0	0K	0.00K
DOWNTOWN WAUKESHA	6/22/2015	52 kt. EG	0	0	.50K	0.00K
MUSKEGO LAKE	6/22/2015	52 kt. EG	0	0	.50K	0.00K
EAGLE	7/13/2015	65 kt. EG	0	0	25K	0.00K
EAGLE	7/18/2015	50 kt. EG	0	0	10K	0.00K
VERNON	8/02/2015	50 kt. EG	0	0	1K	0.00K
WAUKESHA COUNTY	2/2016		0	0	0K	0.00K
WAUKESHA COUNTY	3/2016		0	0	0K	0.00K
MENOMONEE FALLS	5/28/2016	70 kt. EG	0	0	51K	0.00K
LANNON	5/28/2016	50 kt. EG	0	0	5K	0.00K
WAUKESHA CO ARPT	6/05/2016	61 kt. EG	0	0	5K	0.00K
NORTH PRAIRIE	6/05/2016	64 kt. EG	0	0	10K	0.00K
DOUSMAN	6/05/2016	57 kt. EG	0	0	2K	0.00K
UTICA	6/05/2016	61 kt. EG	0	0	5K	0.00K
NEW BERLIN	6/05/2016	61 kt. EG	0	0	10K	0.00K
NORTH PRAIRIE	6/05/2016	56 kt. EG	0	0	10K	0.00K
JERICHO	6/05/2016	61 kt. EG	0	0	6K	0.00K
DOWNTOWN WAUKESHA	7/21/2016	52 kt. EG	0	0	6K	0.00K
TESS CORNERS	9/07/2016	55 kt. EG	0	0	10K	0.00K
WAUKESHA COUNTY	12/2016		0	0	0K	0.00K
DOWNTOWN WAUKESHA	4/20/2017	52 kt. EG	0	0	.50K	0.00K
SUMMIT CORNERS	5/15/2017	50 kt. EG	0	0	2K	0.00K
OCONOMOWOC LAKE	5/17/2017	61 kt. EG	0	0	1K	0.00K
SUMMIT CORNERS	5/17/2017	61 kt. EG	0	0	3K	0.00K
LANNON	6/28/2017	52 kt. EG	0	0	10K	0.00K
UTICA	5/02/2018	50 kt. EG	0	0	2K	0.00K
DOWNTOWN WAUKESHA	5/02/2018	52 kt. EG	0	0	0K	0.00K
MAPLETON	5/27/2018	50 kt. EG	0	0	1K	0.00K
PHANTOM LAKE	6/18/2018	50 kt. EG	0	0	3K	0.00K
DELAFIELD	7/01/2018	50 kt. EG	0	0	4K	0.00K
BROOKFIELD	7/01/2018	50 kt. EG	0	0	3K	0.00K
MENOMONEE FALLS	7/01/2018	50 kt. EG	0	0	1K	0.00K
LAC LA BELLE	8/26/2018	50 kt. EG	0	0	1K	0.00K
SUMMIT CORNERS	8/26/2018	50 kt. EG	0	0	2K	0.00K
OCONOMOWOC LAKE	8/26/2018	56 kt. EG	0	0	2K	0.00K
OCONOMOWOC LAKE	6/27/2019	53 kt. EG	0	0	4K	0.00K
OCONOMOWOC	6/27/2019	50 kt. EG	0	0	8K	0.00K
DOUSMAN	6/27/2019	50 kt. EG	0	0	1K	0.00K
BUENA VISTA	6/27/2019	61 kt. EG	0	0	5K	0.00K
DOWNTOWN WAUKESHA	6/27/2019	61 kt. EG	0	0	7K	0.00K
DOWNTOWN WAUKESHA	6/27/2019	61 kt. EG	0	0	10K	0.00K
DOWNTOWN WAUKESHA	6/27/2019	61 kt. EG	0	0	7K	0.00K
MENOMONEE FALLS	6/27/2019	50 kt. EG	0	0	7K	0.00K
LAC LA BELLE	6/30/2019	56 kt. EG	0	0	12K	0.00K
PEWAUKEE	7/02/2019	50 kt. EG	0	0	3K	0.00K
LANNON	7/02/2019	50 kt. EG	0	0	3K	0.00K
BROOKFIELD	7/02/2019	50 kt. EG	0	0	6K	0.00K
WAUKESHA CO ARPT	8/18/2019	50 kt. EG	0	0	2K	0.00K
BROOKFIELD	4/20/2020	50 kt. EG	0	0	5K	0.00K

MERTON	6/10/2020	50 kt. EG	0	0	2K	0.00K
BETHESDA	6/11/2020	50 kt. EG	0	0	1K	0.00K
FUSSVILLE	7/07/2020	50 kt. EG	0	0	6K	0.00K
UTICA	7/09/2020	50 kt. EG	0	0	3K	0.00K
LAC LA BELLE	7/09/2020	50 kt. EG	0	0	3K	0.00K
OCONOMOWOC	8/09/2020	50 kt. EG	0	0	1K	0.00K
BETHESDA	8/09/2020	50 kt. EG	0	0	3K	0.00K
BROOKFIELD	8/23/2020	50 kt. EG	0	0	5K	0.00K
SAYLESVILLE	11/10/2020	52 kt. EG	0	0	12K	0.00K
BIG BEND	11/10/2020	52 kt. EG	0	0	8K	0.00K

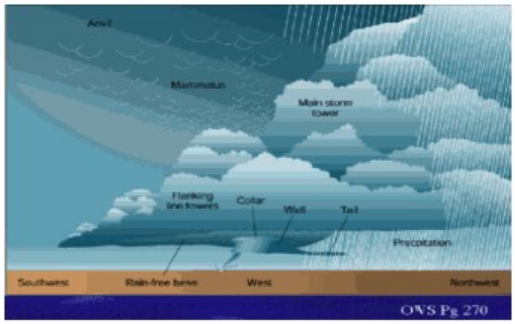
1.14.4 Vulnerability

Thunderstorms, which often produce hail and lightning and may occasionally spawn tornadoes, high wind storms or flash flooding, can damage many types of infrastructure. Waukesha County's thunderstorm vulnerabilities due to associated hail, lightning, winds and floodwaters are discussed in the other hazard chapters of this plan.

Hazard Assessment		
Thunderstorms		
Frequency/Probability (i.e. Future Probability)	▶	High
Magnitude/Extent (i.e. Strength or Magnitude)	▶	Medium
Vulnerability (i.e. Consequence and Impact)	▶	Low
Overall Risk Rating	▶	Medium

1.15 Tornadoes and High Winds

A tornado is a violently rotating funnel-shaped column of air. The lower end of the column may or may not touch the ground. Average winds in the tornado are between 173 and 250 miles per hour but winds can exceed 300 miles per hour. It should also be noted that straight-line winds may reach the same speeds and achieve the same destructive force as a tornado.

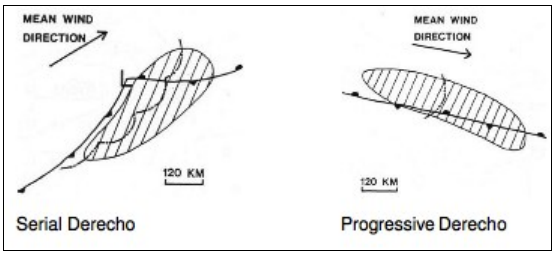


A derecho is a widespread, long-lived, violent, convectively-induced straight-line windstorm that is associated with a fast-moving band of severe thunderstorms usually taking the form of a bow echo.

Derechos blow in the direction of movement of their associated storms; this is similar to a gust front except that the wind is sustained and generally increases in strength behind the "gust" front. A warm weather phenomenon, derechos occur mostly in summer, especially July, in the northern hemisphere. They can occur at any time of the year and occur as frequently at night as in the daylight hours.

The traditional criteria that distinguish a derecho from a severe thunderstorm are sustained winds of 58 mph during the storm as opposed to gusts, high and/or rapidly increasing forward speed and geographic extent (typically 250nautical miles in length). In addition, they have a distinctive appearance on radar (bow echo); several unique features, such as the rear inflow notch and bookend vortex and usually manifest two or more downbursts. There are three types of derechos:

- Serial: Multiple bow echoes embedded in a massive squall line typically around 250 miles long. This type of derecho is usually associated with a very deep low. Also because of embedded supercells, tornadoes can easily spin out of these types of derechos.
- Progressive: A small line of thunderstorms take the bow- shape and can travel for hundreds of miles.
- Hybrid: Has characteristics of a serial and progressive derechos. Hybrid derechos are associated with a deep low like serial derechos but are relatively small in size like progressive derechos.



1.15.1 Tornadoes and High Winds Hazard Profile

Hazard Profile

Tornadoes are nature's most violent storms. Spawned from powerful thunderstorms, tornadoes can cause fatalities and devastate a neighborhood in seconds. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 250 miles per hour or more. Damage paths can be in excess of one mile wide and 50 miles long. Some tornadoes are clearly visible, while rain or nearby low-hanging clouds obscure others. A cloud of debris can mark the location of a tornado even if a funnel is not visible. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible.

Tornadoes occur as part of strong thunderstorms that develop in unstable atmospheric conditions. Tornadoes can accompany tropical storms and hurricanes that move over land, and are most common to the right and ahead of the path of the storm center as it comes ashore. The strongest tornadoes form with super cells, rotating thunderstorms with a well-defined radar circulation called a mesocyclone. One in three super cells experience a decent of clouds or funnel cloud. These thunderstorms can also produce damaging hail and severe straight-line winds even without a tornado occurrence.

Tornadoes develop under three scenarios:

- Along a squall line ahead of an advancing cold front moving from the north;
- In connection with thunderstorm squall lines during hot, humid weather; and
- In the outer portion of a tropical cyclone.

Tornadoes are visible because low atmospheric pressure in the vortex leads to cooling of the air by expansion and to condensation and formation of water droplets. They are also visible as a result of the airborne debris and dust in its high winds. Wind and pressure differential are believed to account for ninety percent of tornado damage in most cases. Because tornadoes are associated with storm systems, they usually are accompanied by hail, torrential rain and intense lightning.

Tornadoes typically produce damage in an area that does not exceed one-fourth mile in width or sixteen miles in length. Tornadoes with track lengths greater than 150 miles have been reported although such tornadoes are rare. Tornado damage severity is measured by the Fujita Tornado Scale, which assigns an "F" ("Fujita") value from 0 – 5 to denote the wind speed.

The Fujita Tornado Scale		
Category	**Wind Speed**	**Description Damage**
F0	40-72 mph	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
F1	73-112 mph	Moderate damage. The lower limit is the beginning of hurricane speed. Roof surfaces peeled off; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
F2	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	158-206 mph	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
F4	207-260 mph	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off; cars thrown and large missiles generated.
F5	261-318 mph	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 100-yards; trees debarked.

Enhanced Fujita (EF) Scale

On February 1, 2007, the National Weather Service adopted "Enhanced Fujita (EF) Scale". The EF Scale evaluates and categorizes tornado events by intensity. Both the original Fujita Scale and the EF Scale estimate the intensity of a tornado (3-second gust speed) based on the magnitude of damage. The original scale had a lack of damage indicators and with the increasing standards for buildings, rating of tornadoes was becoming inconsistent. The EF Scale evaluates tornado damage with a set of 28 indicators (see NOAA website). Each indicator is a structure with a typical damage description for each magnitude of a tornado.

Fujita Scale			Derived EF Scale		Operational EF SCale	
F Number	Fastest 1/4 Mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Downburst Characteristics

Downburst damage is often highly localized but resembles damage caused by a tornado. In some cases, even an experienced investigator cannot identify the nature of a storm without mapping the direction of the damaging winds over a large area. There are significant interactions between tornadoes and nearby

downbursts.

A classic downburst example occurred on 4 July 1977 when a severe thunderstorm moved across Northern Wisconsin. Extensive areas of tree and property damage, somewhat like a tornado, were reported. After an aerial survey was completed to map both direction and F-scale intensity of the damaging winds it was determined that no evidence of a tornado was found anywhere within the path of the damage swath, which was 166 miles long and 17 miles wide. The survey revealed that there were scattered local centers from which straight-line winds diverged outward. These local wind systems were identified as downbursts with at least 25 specific locations recognized by the low-flying aircraft.

Hazard Considerations

Area Impacted:

- Damage paths can be in excess of one mile wide and 50 miles long.

Duration of Event:

- Tornados can develop with short warning and last for minutes or hours
- Tornadoes can also develop at any time of the day or night during the landfall of a hurricane.
- However, by 12 hours after landfall, tornadoes tend to occur mainly during daytime hours.

Essential Service Disruption:

- Schools may be temporarily closed after the incident due to indirect reasons (public concerns for safety or a lack of transportation) or directly because the school was damaged.
- Electricity and other essential services to local areas can be disrupted during storm events. In severe cases, power can be lost for several days or weeks.
- Continuity of government.

Special Considerations:

- Special populations i.e. the elderly, infirm, disabled, children, infants, and foreign / out-of- state guests will be a real concern during a tornado due to the size and complexity of a tornado impact.
- If a tornado occurs during school hours, children will be required to shelter-in-place. Have schools briefed parents on what to expect during this time?
- Animals and pets will be set loose by their owners or by the storm itself; conversely owners will refuse evacuation or shelter unless pets have provisions for care.

Direct Damage:

- Structural damage to buildings directly in path of tornado. High winds can also damage or destroy structurally vulnerable facilities that are constructed with materials that have low tensile strength.
- A tornado generates high winds and the debris generated by those winds may disrupt landline, cellular phone, push-to-talk, land mobile radio (LMR), and Internet communications.
- High wind speeds and the resulting debris may disrupt electrical and gas power.
- A powerful tornado, F-3 to F-5, hitting an industrialized area can also generate secondary hazards such as a hazardous materials event
- Injuries that commonly occur during or after a tornado are for example: puncture wounds and concussion injuries from flying debris, electric shock from down power lines, orthopedic trauma from falling debris and structures, burns from fires, inhalation issues from hazardous material releases, and mental trauma from the shock of the event.
- Tornadoes do not have the strength to destroy the frame of a high-rise structure but falling glass and debris continuing after the impact will make search and rescue, and evacuation difficult and dangerous.
- Facilities and residences sustaining structural damage may cause natural gas leaks.
- Damage to the supply of electricity may cause water supply, sewage treatment, and gasoline / diesel supply disruptions.
- Humans and animals are often injured or killed by severe tornado activity. Most cases involve a direct impact combined with minimal shelter or protection.

Affected Population:

- Although tornadoes typically impacted a select area, it can also generate mass casualties if it hits an urban area or during the night.
- In rural areas, tornadoes can impact a significant number of the population if it hits a developed area of the community.

Economic Damage:

- The costs of losing revenue by the temporary closure of special event and commercial sites will be directly affected by the speed and efficiency of recovery phase operations and by retaining public confidence by efficient response operations.

Emergency Services:

- Debris scattered across roads and highways will make it difficult for first responder vehicles to have a rapid ingress / egress to impact areas e.g. damage to vehicle tires can greatly inhibit Fire, EMS, and Law Enforcement response.

- Tornados can cause mass casualties that will exceed local resources and capabilities.
- The lack of emergency warning sirens may inhibit effective tornado warning. Sirens with live voice broadcasting/adjustable audio output capabilities recommended due to their versatility.
- Temporary mass sheltering may be an operational requirement at schools, hotels, museums, and exhibits i.e. owners and operators should strongly encourage their patrons to remain until the situation improves and care arrives for these patrons.

Social Factors:

- None identified

1.15.2 Location and Extent

Wisconsin lies along the northern edge of the nation's tornado belt, which extends north-eastward from Oklahoma into Iowa and across to Michigan and Ohio. Winter, spring and fall tornadoes are more likely to occur in southern Wisconsin, which includes Waukesha County, than in northern counties.

Wisconsin's tornado season runs from the beginning of April through September with the most severe tornadoes typically occurring in April, May and June. Tornadoes have, however, occurred in Wisconsin during every month except February. Many tornadoes strike in late afternoon or early evening but they do occur at other times. Deaths, injuries and personal property damage have occurred and will continue to occur in Wisconsin.

1.15.3 Frequency and Probability

The probability of Waukesha County being struck by a tornado in the future is high and the likelihood of damage from future tornadoes is also high.

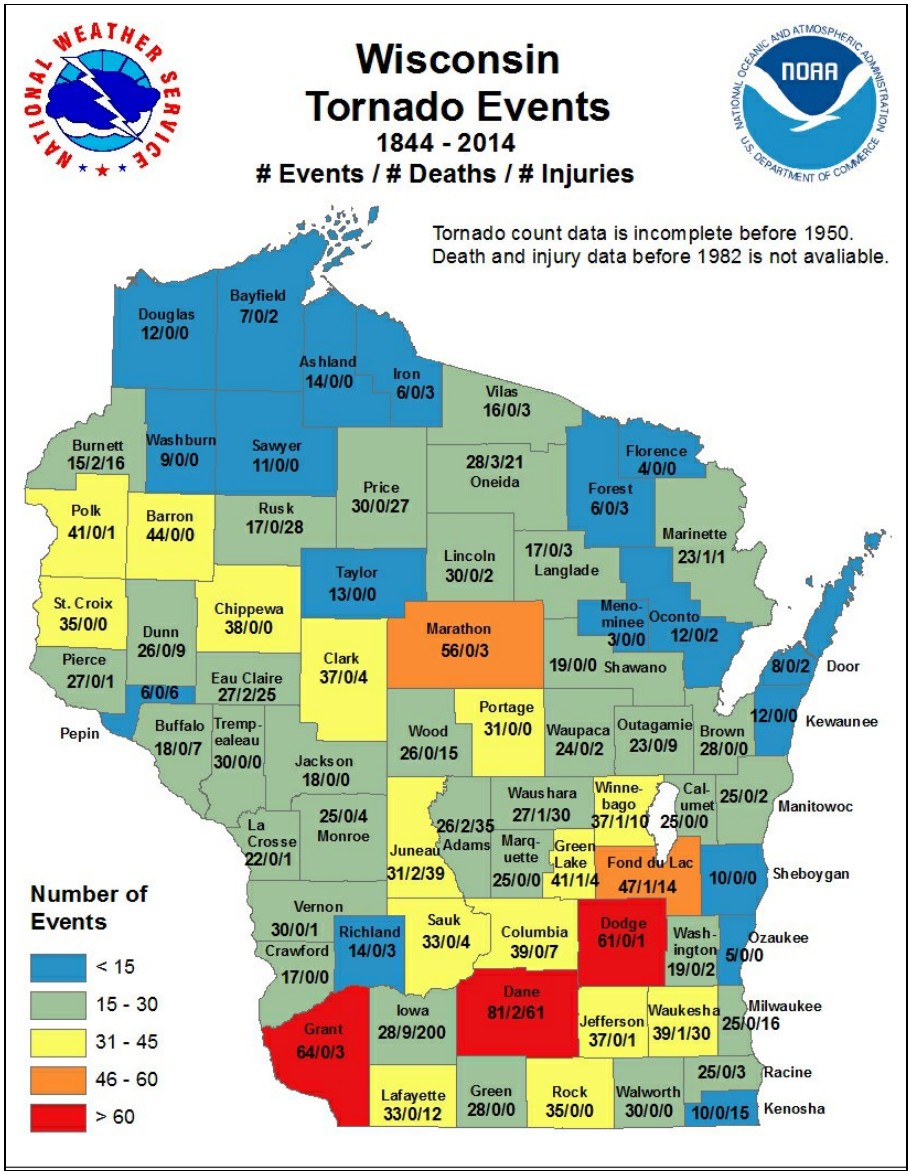
According to the National Weather Service, Waukesha County had 7 funnel clouds and 31 tornadoes between April 1954 and July 2021. The following table lists these events.

Location	Date	Type	Magnitude	Death	Injury	Property Damage	Crop Damage
Pewaukee	8/30/1993	Funnel Cloud	N/A	0	0	0	0
Pewaukee	7/11/1994	Funnel Cloud	N/A	0	0	0	0
Delafield	7/11/1994	Funnel Cloud	N/A	0	0	0	0
Hartland	7/2/1996	Funnel Cloud	N/A	0	0	0	0
Delafield	5/23/2004	Funnel Cloud	N/A	0	0	0	0
Menomonee Falls	5/23/2004	Funnel Cloud	N/A	0	0	0	0
Eagle	7/22/2010	Funnel Cloud	N/A	0	0	0	0

Location	Date	Type	Magnitude	Death	Injury	Property Damage	Crop Damage
Waukesha County	9/29/1997	Wind	N/A	0	0	N/A	N/A
Waukesha County	5/24/2000	Wind	N/A	0	0	N/A	N/A
Waukesha County	09/19/2001	Wind	N/A	0	0	N/A	N/A
Waukesha County	10/24/2001	Wind	N/A	0	0	N/A	N/A
Waukesha County	12/05/2001	Wind	N/A	0	0	5K	0
Waukesha County	11/12/2003	Wind	49 KTS. MG	0	0	3.5K	0
Waukesha County	3/7/2004	Wind	48 KTS. MG	0	0	4K	0
Waukesha County	3/14/2004	Wind	40 KTS. MG	0	0	2K	0
Waukesha County	4/18/2004	Wind	43 KTS. MG	0	0	10K	0
Waukesha County	12/12/2004	Wind	47 KTS. MG	0	0	2K	0
Waukesha County	1/24/2006	Wind	43 KTS. MG	0	0	5K	0
Waukesha County	3/13/2006	Wind	45 KTS. MG	0	0	10K	0
Waukesha County	3/31/2006	Wind	39 KTS. EG	0	0	5K	0
Waukesha County	5/11/2006	Wind	38 KTS. MG	0	0	1K	0
Waukesha County	2/22/2006	Wind	40 KTS. MG	0	0	2K	0
Waukesha County	4/04/2007	Wind	45 KTS. MG	0	0	5K	0
Waukesha County	5/24/2007	Wind	39 KTS. MG	0	0	2K	0
Waukesha County	8/27/2007	Wind	39 KTS. EG	0	0	10K	0
Waukesha County	11/05/2007	Wind	39 KTS. MG	0	0	5K	0
Waukesha County	11/27/2007	Wind	46 KTS. EG	0	0	5K	0
Waukesha County	12/23/2007	Wind	44 KTS. MG	0	0	5K	0
Waukesha County	4/26/2008	Wind	43 KTS. MG	0	0	5K	0
Waukesha County	10/26/2008	Wind	39 KTS. EG	0	0	5K	0
Waukesha County	09/27/2009	Wind	39 KTS. EG	0	0	5K	0
Waukesha County	10/06/2009	Wind	46 KTS. MG	0	0	5K	0
Waukesha County	5/05/2010	Wind	39 KTS. EG	0	0	10K	0
Waukesha County	9/07/2010	Wind	48 KTS. MG	0	0	5K	0
Waukesha County	9/24/2010	Wind	40 KTS. MG	0	0	1K	0
Waukesha County	2/18/2011	Wind	26 KTS. MG	0	0	2K	0
Waukesha County	4/15/2011	Wind	35 KTS. MG	0	0	3K	0
Waukesha County	5/15/2011	Wind	32 KTS. MG	0	0	5K	0
Waukesha County	9/29/2011	Wind	39 KTS. EG	0	0	2K	0
Waukesha County	10/19/2011	Wind	39 KTS. EG	0	0	2K	0
Waukesha County	11/13/2011	Wind	41 KTS. MG	0	0	1K	0
Waukesha County	1/01/2012	Wind	40 KTS. MG	0	0	2K	0
Waukesha County	6/18/2012	Wind	39 KTS. EG	0	0	10K	0
Waukesha County	1/18/2013	Wind	39 KTS. EG	0	0	5K	0
Waukesha County	1/19/2013	Wind	4 KTS. MG	0	0	5K	0
Waukesha County	4/11/2013	Wind	42 KTS. MG	0	0	7K	0
Waukesha County	12/23/2015	Wind	49 KTS. MG	0	0	1K	0
Waukesha County	12/04/2017	Wind	48 KTS. MG	0	0	5K	0
Waukesha County	10/20/2018	Wind	39 KTS. EG	0	0	1K	0
Waukesha County	2/24/2019	Wind	44 KTS. MG	0	0	1K	0
Waukesha County	11/27/2019	Wind	43 KTS. MG	0	0	7K	0
Waukesha County	4/30/2020	Wind	39 KTS. EG	0	0	3K	0
Waukesha County	5/01/2021	Wind	39 KTS. EG	0	0	1.5K	0

Location	Date	Type	Magnitude	Death	Injury	Property Damage	Crop Damage
Waukesha County	4/7/1954	Tornado	F1	0	0	25K	0
Waukesha County	7/16/1956	Tornado	F0	0	0	3K	0
Waukesha County	6/11/1959	Tornado	F1	0	0	3K	0
Waukesha County	10/8/1959	Tornado	F2	0	0	25K	0
Waukesha County	5/8/1959	Tornado	F1	0	0	25K	0
Waukesha County	5/8/1965	Tornado	F1	0	0	25K	0
Waukesha County	6/27/1965	Tornado	F1	0	0	25K	0
Waukesha County	7/10/1966	Tornado	F2	0	0	250K	0
Waukesha County	5/18/1967	Tornado	F2	0	0	250K	0
Waukesha County	6/29/1969	Tornado	F1	0	0	3K	0
Waukesha County	7/14/1972	Tornado	F0	0	0	2.5M	0
Waukesha County	8/30/1973	Tornado	F2	0	0	2.5M	0
Waukesha County	4/2/1977	Tornado	F3	0	2	250K	0
Waukesha County	6/5/1977	Tornado	F3	0	0	250K	0
Waukesha County	6/5/1977	Tornado	F1	0	0	25K	0
Waukesha County	7/29/1980	Tornado	F2	0	0	250K	0
Waukesha County	6/15/1981	Tornado	F1	0	0	250K	0
Waukesha County	5/15/1982	Tornado	F4	1	14	2.5M	0
Waukesha County	4/27/1984	Tornado	F1	0	0	250K	0
Waukesha County	8/17/1985	Tornado	F1	0	0	2.5M	0
Waukesha County	7/6/1987	Tornado	F1	0	1	2.5M	0
Waukesha County	5/8/1988	Tornado	F0	0	0	0	0
Waukesha County	6/6/1999	Tornado	F1	0	0	100K	0
Waukesha County	6/7/2008	Tornado	EF0	0	0	0	0
Waukesha County	6/8/2008	Tornado	EF0	0	0	0	0
Waukesha County	6/21/2010	Tornado	EF2	0	15	20.6M	0
Waukesha County	6/21/2010	Tornado	EF1	0	0	430K	0
Waukesha County	7/22/2010	Tornado	EF2	0	0	0	0
Waukesha County	8/18/2015	Tornado	EF1	0	0	45K	0
Waukesha County	8/18/2015	Tornado	EF0	0	0	10K	0
Waukesha County	10/01/2019	Tornado	EF0	0	0	0	0
Waukesha County	07/29/2021	Tornado	EF1	0	0	0	0

Below is a map of Tornado Events in Wisconsin from 1844 - 2014.


Wisconsin
Tornado Events
1844 - 2014
Events / # Deaths / # Injuries
Tornado count data is incomplete before 1950.
Death and injury data before 1982 is not avaliable.
Douglas 12/0/0
Bayfield 7/0/2
Ashland 14/0/0
Iron 6/0/3
Vilas 16/0/3
Florence 4/0/0
Burnett 15/2/16
Washburn 9/0/0
Sawyer 11/0/0
Price 30/0/27
28/3/21 Oneida
Forest 6/0/3
Marinette 23/1/1
Polk 41/0/1
Barron 44/0/0
Rusk 17/0/28
Lincoln 30/0/2
17/0/3 Langlade
Taylor 13/0/0
St. Croix 35/0/0
Dunn 26/0/9
Chippewa 38/0/0
Marathon 56/0/3
Meno-minee 3/0/0
Oconto 12/0/2
Pierce 27/0/1
Eau Claire 27/2/25
Clark 37/0/4
19/0/0 Shawano
8/0/2 Door
6/0/6
Pepin
Buffalo 18/0/7
Tremp-ealeau 30/0/0
Jackson 18/0/0
Wood 26/0/15
Portage 31/0/0
Waupaca 24/0/2
Outagamie 23/0/9
Brown 28/0/0
12/0/0 Kewaunee
Waushara 27/1/30
Winne-bago 37/1/10
Cal-umet 25/0/0
25/0/2 Manitowoc
La Crosse 22/0/1
25/0/4 Monroe
26/2/35 Adams
Juneau 31/2/39
Marq-uette 25/0/0
Green Lake 41/1/4
Fond du Lac 47/1/14
10/0/0 Sheboygan
Number of Events
< 15
15 - 30
31 - 45
46 - 60
> 60
Vernon 30/0/1
Richland 14/0/3
Crawford 17/0/0
Sauk 33/0/4
Columbia 39/0/7
Dodge 61/0/1
Wash-ington 19/0/2
5/0/0 Ozaukee
Dane 81/2/61
Iowa 28/9/200
Grant 64/0/3
Jefferson 37/0/1
Waukesha 39/1/30
25/0/16 Milwaukee
25/0/3 Racine
Lafayette 33/0/12
Green 28/0/0
Rock 35/0/0
Walworth 30/0/0
10/0/15 Kenosha

1.15.4 Vulnerability

Injury to people is a primary concern in tornado and high wind events. Two of the highest risk places are mobile home parks and campgrounds; Waukesha County has several of each type of property. Both have high concentrations of people in a small area, generally have structures that provide less protection than standard construction homes generally do not provide storm shelters. Other places of concern during these types of events include critical emergency facilities such as hospitals and public works/highway garages, police stations and fire departments, which contain equipment and services needed by the public after a tornado.

Schools, in addition to holding children, are the major type of structure used as community disaster shelters and their loss might therefore affect the community on several levels (e.g., the death or injury of children, the loss of a community housing shelter). School gymnasiums are often the specific location of the community shelter but they are especially vulnerable in tornadoes because the large-span roof structure is often not adequately supported.

Community infrastructure such as power lines, telephone lines, radio towers and street signs are often vulnerable to damage from tornadoes and high winds and can be expensive to replace. The loss of radio towers that hold public safety communications repeaters can adversely impact the ability of first responders to mount an effective response; damage to towers that hold public media equipment may adversely impact the ability to distribute adequate public information.

Residential property is likely to have siding and roofing materials removed, windows broken from flying debris and garages blown down due to light construction techniques. Perhaps one of the largest types of loss on private property is due to tree damage, which is generally not covered by federal disaster assistance.

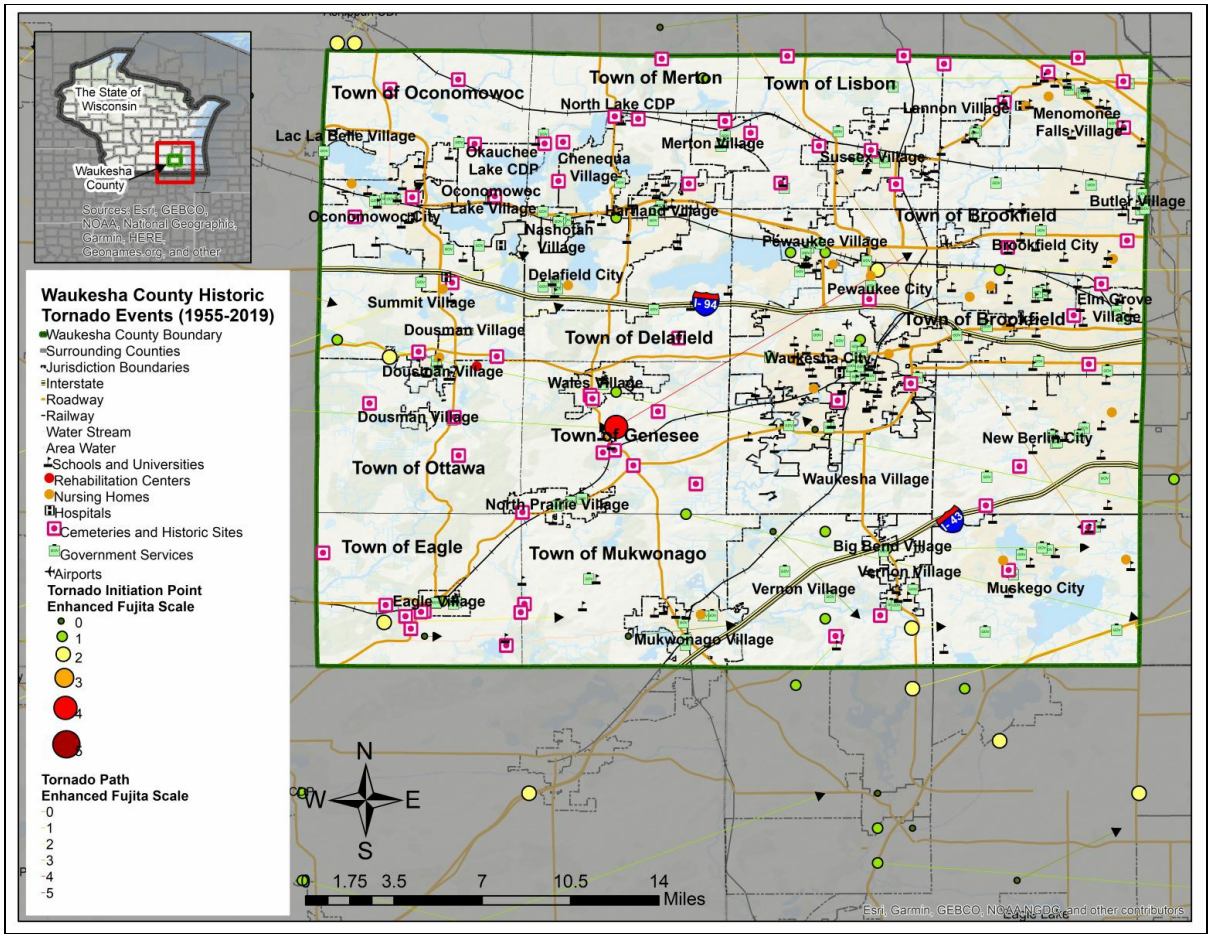
Business properties are at risk for having damage to infrastructure including signs, windows, siding and billboards. Agricultural buildings, such as barns and silos, are also generally not constructed in a manner that makes them wind resistant, which can lead to the loss of livestock and harvest. Standing crops are also at risk from high winds and tornadoes.

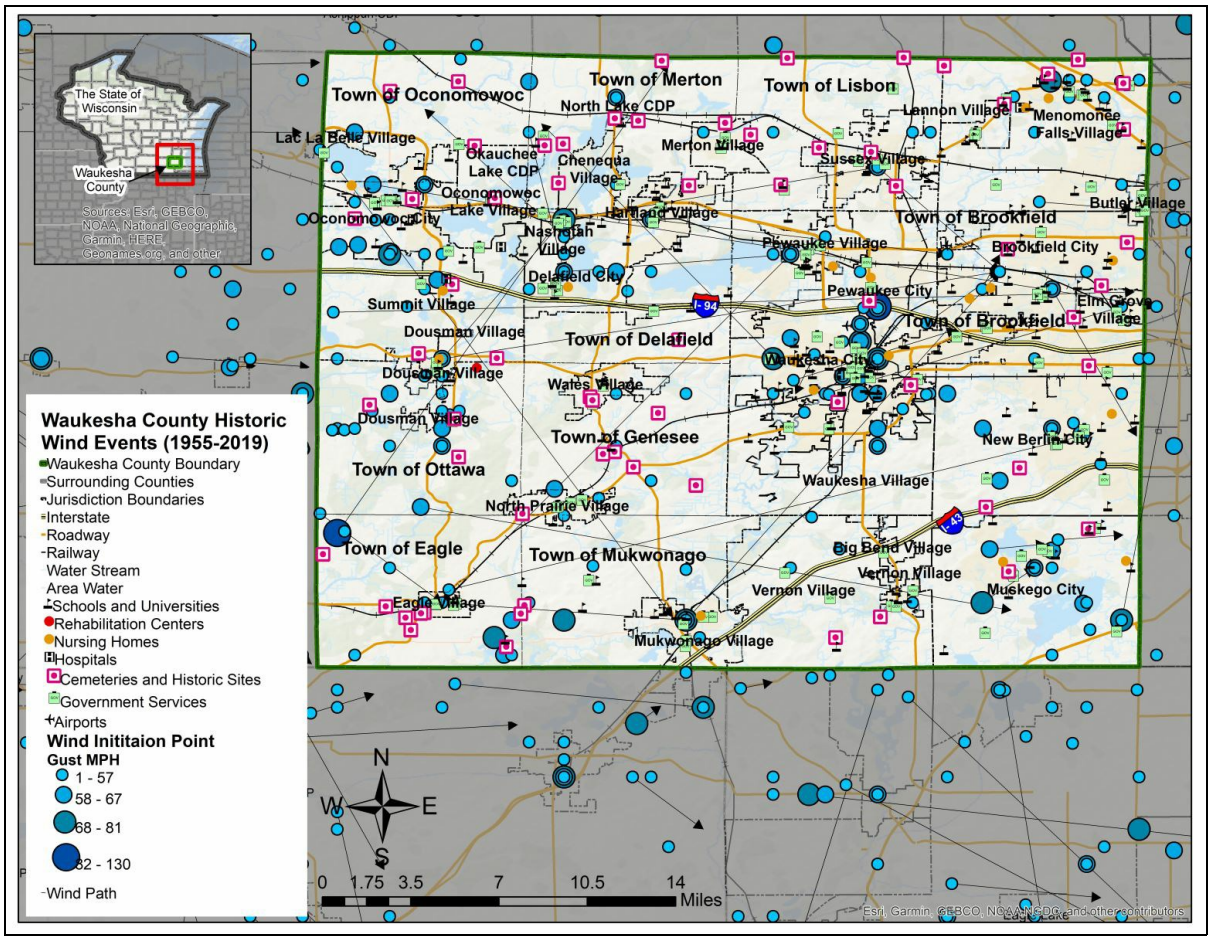
The Wisconsin Hazard Mitigation Plan estimated tornado losses for Waukesha County. The table below shows the reported costs due to tornado damages plus the state's estimates of future risk. When sorted for total future risk, Waukesha County ranks 3rd (of 72 counties in Wisconsin.) When sorted for structural and contents damages Waukesha County ranks 2nd and when sorted for injury and mortality damages Waukesha County ranks 3rd.

	Manufactured Housing	Non-Engineered Wood Frame	Combined	Total Annual Damage
Injury and Mortality Damages	$535,433	$65,733,219	$66,268,652	$67,812,413
Structural and Contents Damage	$2,597	$1,541,165	$1,543,762	$67,812,413
Total Annual Damage	$538,030	$67,274,384	$67,812,413	$67,812,413
Total Future Risk	$6,676,950	$67,274,384	$841,552,050	$841,552,050

The Wisconsin Hazard Mitigation Plan also estimated losses for Waukesha County from straight-line winds. The table below shows the reported costs due to straight-line wind damage plus the state's estimates of future risk. When sorted for total future risk, Waukesha County ranks 2nd. When sorted for either structural and contents damages Waukesha County ranks 2nd and when sorted for injury and mortality damages, Waukesha County ranks 3rd.

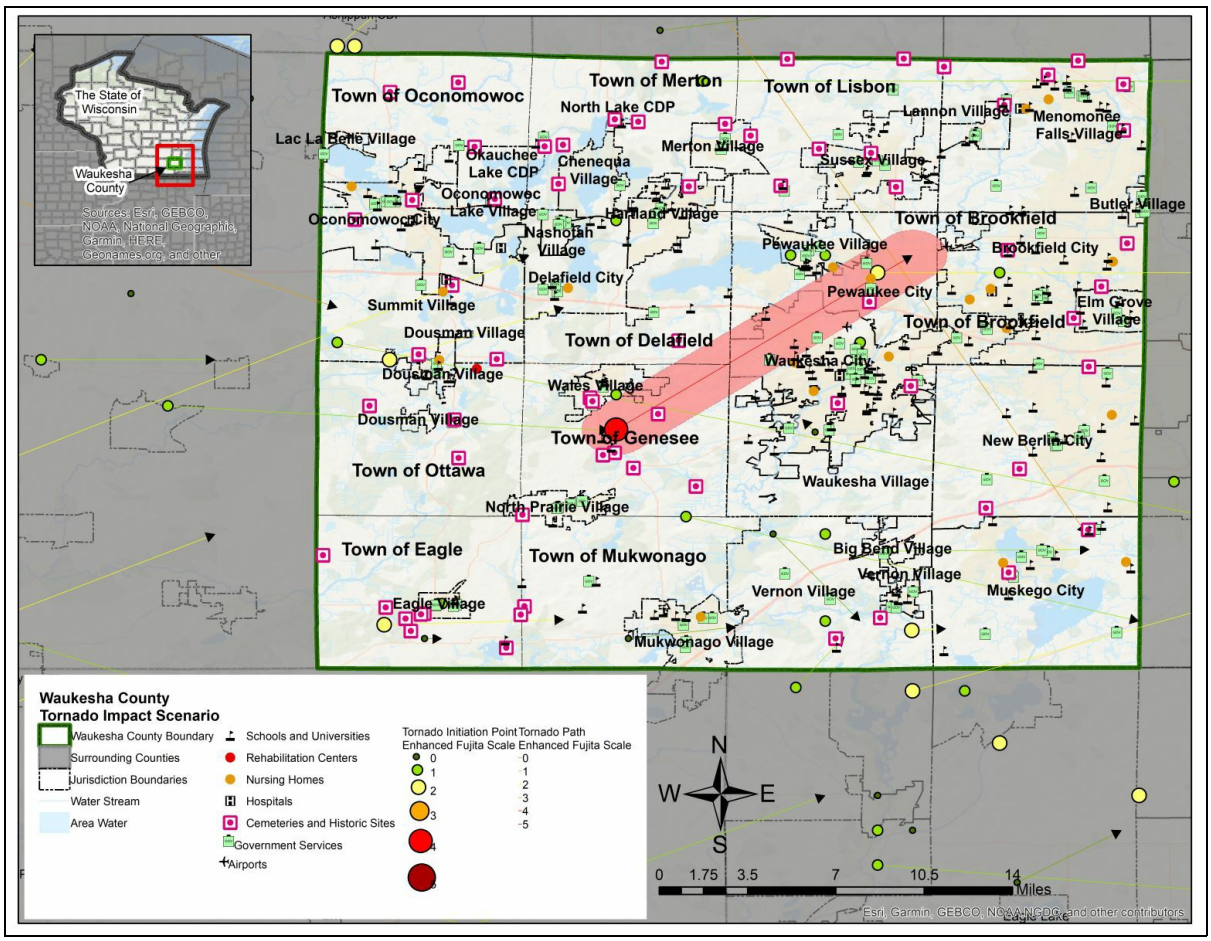
	Manufactured Housing	Non-Engineered Wood Frame	Combined	Total Annual Damage
Injury and Mortality Damages	$124,975	$8,170,465	$8,295,440	$152,810,667
Structural and Contents Damage	$196,281	$144,318,945	$144,515,227	$152,810,667
Total Annual Damage	$321,257	$152,489,410	$152,810,667	$152,810,667
Total Future Risk	$3,986,794	$1,892,393,581	$1,896,380,375	$1,896,380,375


The State of Wisconsin
Waukesha County
Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other
Waukesha County Historic Tornado Events (1955-2019)
Waukesha County Boundary
Surrounding Counties
Jurisdiction Boundaries
Interstate
Roadway
Railway
Water Stream
Area Water
Schools and Universities
Rehabilitation Centers
Nursing Homes
Hospitals
Cemeteries and Historic Sites
Government Services
Airports
Tornado Initiation Point
Enhanced Fujita Scale
0
1
2
3
4
5
Tornado Path
Enhanced Fujita Scale
0
1
2
3
4
5
Town of Oconomowoc
Town of Merton
Town of Lisbon
North Lake CDP
Lannon Village
Menomonee Falls Village
Lac La Belle Village
Okauchee Lake CDP
Merton Village
Chenequa Village
Sussex Village
Oconomowoc Lake Village
Oconomowoc City
Hartland Village
Nashotah Village
Butler Village
Town of Brookfield
Pewaukee Village
Brookfield City
Delafield City
Pewaukee City
Summit Village
Elm Grove Village
Dousman Village
Town of Delafield
Waukesha City
Wales Village
New Berlin City
Town of Genesee
Town of Ottawa
Waukesha Village
North Prairie Village
Town of Eagle
Town of Mukwonago
Big Bend Village
Vernon Village
Muskego City
Eagle Village
Mukwonago Village
N
W
E
S
0 1.75 3.5 7 10.5 14
Miles
Esri, Garmin, GEBCO, NOAA, NGDC, and other contributors


The State of Wisconsin
Waukesha County
Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other
Waukesha County Historic Wind Events (1955-2019)
Waukesha County Boundary
Surrounding Counties
Jurisdiction Boundaries
Interstate
Roadway
Railway
Water Stream
Area Water
Schools and Universities
Rehabilitation Centers
Nursing Homes
Hospitals
Cemeteries and Historic Sites
Government Services
Airports
Wind Inititaion Point
Gust MPH
1 - 57
58 - 67
68 - 81
82 - 130
Wind Path
Town of Oconomowoc
Town of Merton
Town of Lisbon
North Lake CDP
Lannon Village
Menomonee Falls Village
Lac La Belle Village
Okauchee Lake CDP
Merton Village
Chenequa Village
Sussex Village
Oconomowoc Lake Village
Oconomowoc City
Hartland Village
Nashotah Village
Butler Village
Town of Brookfield
Pewaukee Village
Brookfield City
Delafield City
Pewaukee City
Summit Village
Elm Grove Village
Dousman Village
Town of Delafield
Waukesha City
Wales Village
New Berlin City
Town of Genesee
Town of Ottawa
Waukesha Village
North Prairie Village
Town of Eagle
Town of Mukwonago
Big Bend Village
Vernon Village
Muskego City
Eagle Village
Mukwonago Village
N
W
E
S
0 1.75 3.5 7 10.5 14
Miles
Esri, Garmin, GEBCO, NOAA, NGDC, and other contributors

Hazard Assessment		
Tornadoes and High Winds		
Frequency/Probability (i.e. Future Probability)	▶	Medium
Magnitude/Extent (i.e. Strength or Magnitude)	▶	Medium
Vulnerability (i.e. Consequence and Impact)	▶	Medium
Overall Risk Rating	▶	Medium

1.15.5 Waukesha County Tornado Scenario Map



1.16 Winter Storms

Due to its position along the northern edge of the United States, Wisconsin, including Waukesha County, is highly susceptible to a variety of winter weather storm phenomena.

1.16.1 Winter Storms Hazard Profile

A winter storm is an event in which the varieties of precipitation are formed that only occur at low temperatures, such as snow or sleet, or a rainstorm where ground temperatures are low enough to allow ice to form (i.e. freezing rain). In temperate continental climates, these storms are not necessarily restricted to the winter season, but may occur in the late autumn and early spring as well.

A winter storm can range from a moderate snow over a few hours to blizzard conditions with blinding wind-driven snow that lasts several days. Some winter storms may be large enough to affect several states, while others may affect only a single community. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely reduce visibility.

The National Weather Service descriptions of winter storm elements are:

- Heavy snowfall - Accumulation of six or more inches of snow in a 12-hour period or eight or more inches in a 24-hour period.
- Blizzard - An occurrence of sustained wind speeds in excess of 35 miles per hour (mph) accompanied by heavy snowfall or large amounts of blowing or drifting snow.
- Ice storm - An occurrence of rain falling from warmer upper layers of the atmosphere to the colder ground, freezing upon contact with the ground and exposed objects near the ground.
- Freezing drizzle/freezing rain - Effect of drizzle or rain freezing upon impact on objects with a temperature of 32 degrees Fahrenheit or below.
- Sleet - Solid grains or pellets of ice formed by the freezing of raindrops or the refreezing of largely melted snowflakes. This ice does not cling to surfaces.
- Wind chill - An apparent temperature that incorporates the combined effect of wind and low air temperatures on exposed skin.

A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. People can become trapped at home, without utilities or other services. Heavy snowfall and blizzards can trap motorists in their cars. Attempting to walk for help in a blizzard can be a deadly decision.

Winter storms can make driving and walking extremely hazardous. The aftermath of a winter storm can have an impact on a community or region for days, weeks, or even months. Storm effects such as extremely cold temperatures and snow accumulation, and sometimes coastal flooding, can cause hazardous conditions and hidden problems for people in the affected area.

Hazard Considerations

Area Impacted:

- Region and Statewide

Duration of Event

- Severe winter storms can last anywhere from several hours to several days.

Essential Service Disruption

- Disruption of utilities (i.e. power, telephone, etc.) may last for days.
- Continuity of government.

Special Considerations:

- Preservation of cultural and historical locations, facilities, and artifacts.

Direct Damage

- Ice storms may disrupt power lines.

Affected Population

- Winter storms can impact a significant number of the population.

Economic Damage

- Loss of revenue by the temporary closure of roads, special event and commercial sites.

1.16.2 Location and Extent

In Wisconsin, the winter storm season generally runs from November through March and Wisconsin residents are most familiar with heavy snowstorms, blizzards, sleet and ice storms. The majority of Wisconsin snowfalls are between one and three inches per occurrence, although heavy snowfalls that produce at least ten inches may occur four or five times per season. Northwestern Wisconsin encounters more blizzards than the southeastern portions of the state.

Damage from ice storms can occur when more than half an inch of rain freezes on trees and utility wires, especially if the rain is accompanied by high winds. Another danger comes from accumulation of frozen rain pellets on the ground during a sleet storm, which can make driving hazardous.

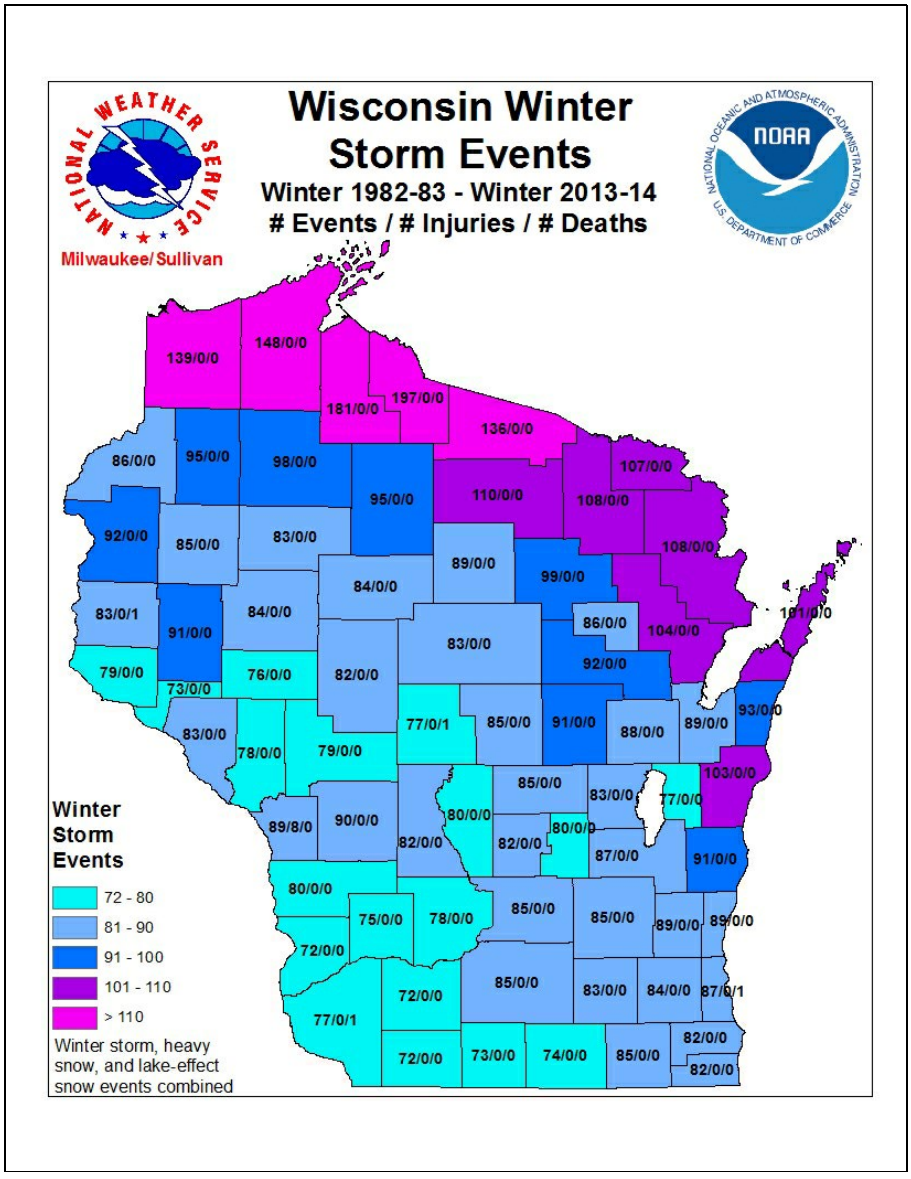
1.16.3 Frequency and Probability

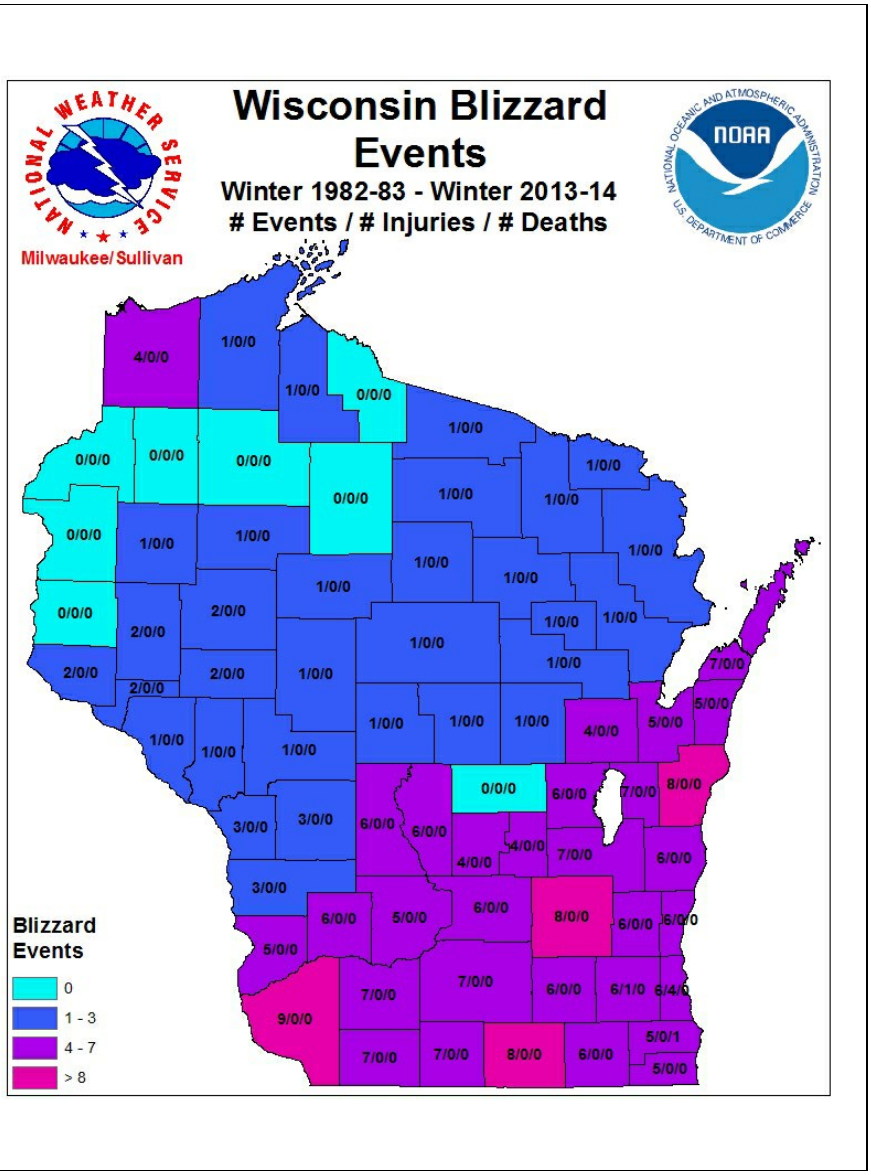
Annual snowfall in Wisconsin varies between thirty inches in southern counties to one hundred inches in the north. Waukesha County averages approximately 38 inches of snow annually. Storm tracks originating in the southern Rockies or Plains states that move northeastward produce the heaviest precipitation, usually six to twelve inches. Low-pressure systems originating in the northwest (Alberta) tend to produce only light snowfalls of two to four inches. Snowfalls associated with Alberta lows occur more frequently with colder weather.

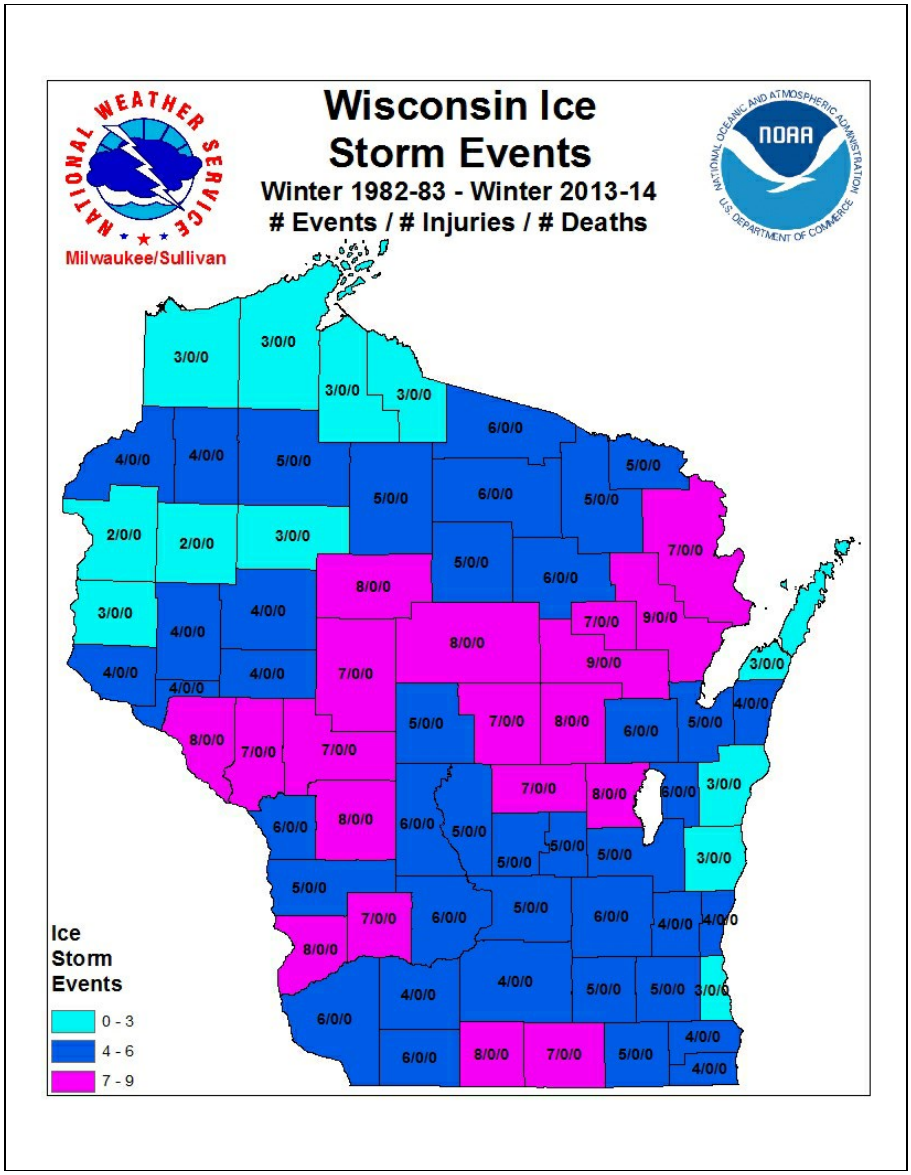
Although massive blizzards are rare in Wisconsin, blizzard-like conditions often exist during heavy snowstorms when gusty winds cause blowing and drifting of snow. Near blizzard conditions existed in Wisconsin in January 1979 when record snowfalls were recorded in many areas and wind speeds gusted to over thirty miles per hour.

Both ice and sleet storms can occur at any time throughout the winter season from November to April. Ice storms of disastrous proportions occurred in central Wisconsin in February 1922 and in southern Wisconsin in March 1976. A Presidential Disaster Declaration occurred as a result of the 1976 storm. Utility crews from surrounding states were called in to restore power, which was off for up to ten days in some areas. Other storms of lesser magnitude caused power outages and treacherous highway conditions.

Below are maps demonstrating the frequency of Winter Storms, Blizzards, and Ice Storms in Wisconsin from Winter 1982-83 to Winter 2013-14.




Wisconsin Blizzard Events
Winter 1982-83 - Winter 2013-14
Events / # Injuries / # Deaths
NATIONAL WEATHER SERVICE
Milwaukee/Sullivan
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
Blizzard Events
0
1 - 3
4 - 7
> 8



The probability that there will be severe winter storms in Waukesha County is medium and the likelihood that those storms will cause significant damage is also medium. The following table details Waukesha County's 70 winter storm statistics (i.e., snow and ice events) as reported by the National Weather Service including human loss and injury and property damage estimates from 1 January 1950 through 28 February 2021:

Location	Date	Type	Death	Injury	Property Damage	Crop Damage
Statewide	1/13/1993	Heavy Snow	0	0	0	0
Central And Southern	1/5/1994	Heavy Snow	0	0	0	0
All But Far Northwest	1/26/1994	Heavy Snow/ice Storm	0	0	0	0
Southern And Eastern	2/7/1994	Heavy Snow	0	0	0	0
Southeast Wisconsin	2/12/1994	Heavy Snow	0	0	0	0
Southern Half Of Wisc	2/22/1994	Heavy Snow	0	0	0	0
Southern Half Of Wisc	2/25/1994	Heavy Snow	0	0	0	0
Southern Wisconsin	4/30/1994	Heavy Snow	0	0	0	0
Waukesha County	12/5/1994	Heavy Snow	0	0	0	0
Waukesha County	1/19/1995	Heavy Snow	0	0	0	0
Southeast Wisconsin	11/11/1995	Heavy Snow	0	0	0	0
Central And Southern	11/26/1995	Heavy Snow	0	1	0	0
Southern Wisconsin	12/13/1995	Glaze	0	0	0	0
Waukesha County	1/26/1996	Heavy Snow	0	0	0	0
Waukesha County	3/17/1997	Ice Storm	0	0	0	0

Waukesha County	4/11/1997	Winter Storm	0	0	0	0
Waukesha County	1/8/1998	Winter Storm	0	0	0	0
Waukesha County	3/9/1999	Winter Storm	0	0	0	0
Waukesha County	4/7/2000	Winter Storm	0	0	0	0
Waukesha County	12/11/2000	Heavy Snow	0	0	0	0
Waukesha County	12/18/2000	Heavy Snow	0	0	0	0
Waukesha County	3/2/2002	Heavy Snow	0	0	0	0
Waukesha County	2/3/2003	Winter Weather/mix	0	0	0	0
Waukesha County	2/11/2003	Winter Storm	0	0	0	0
Waukesha County	3/4/2003	Heavy Snow	0	0	0	0
Waukesha County	4/4/2003	Winter Weather/mix	0	0	0	0
Waukesha County	4/7/2003	Winter Weather/mix	0	0	0	0
Waukesha County	1/4/2004	Winter Weather/mix	0	0	0	0
Waukesha County	1/16/2004	Weather/mix	0	0	0	0
Waukesha County	1/26/2004	Heavy Snow	0	0	0	0
Waukesha County	2/8/2004	Winter Weather/mix	0	0	0	0
Waukesha County	11/30/2004	Winter Weather/mix	0	0	0	0
Waukesha County	12/18/2004	Winter Weather/mix	0	0	0	0
Waukesha County	1/1/2005	Winter Weather/mix	0	0	0	0
Waukesha County	1/6/2005	Winter Storm	0	0	0	0
Waukesha County	1/22/2005	Winter Storm	0	0	0	0
Waukesha County	2/16/2006	Winter Storm	0	0	0	0
Waukesha County	12/1/2006	Winter Storm	0	0	0	0
Waukesha County	2/25/2007	Winter Storm	0	0	0	0
Waukesha County	12/11/2007	Ice Storm	0	0	0	0
Waukesha County	12/15/2007	Winter Weather	0	0	0	0
Waukesha County	1/21/2008	Heavy Snow	0	0	0	0
Waukesha County	1/29/2008	Winter Storm	0	0	0	0
Waukesha County	2/5/2008	Winter Storm	0	0	0	0
Waukesha County	2/17/2008	Ice Storm	0	0	20K	0
Waukesha County	11/30/2008	Winter Storm	0	0	0	0
Waukesha County	12/1/2008	Winter Storm	0	0	0	0
Waukesha County	12/8/2008	Winter Storm	0	0	0	0
Waukesha County	12/21/2008	Winter Storm	0	0	0	0
Waukesha County	12/27/2008	Winter Storm	0	0	0	0
Waukesha County	1/3/2009	Winter Weather	0	0	0	0
Waukesha County	1/9/2009	Winter Weather	0	0	0	0
Waukesha County	1/13/2009	Winter Weather	0	0	0	0
Waukesha County	3/28/2009	Winter Weather	0	0	0	0
Waukesha County	12/23/2009	Winter Storm	0	0	0	0
Waukesha County	1/7/2010	Winter Storm	0	0	0	0
Waukesha County	2/9/2010	Winter Storm	0	0	0	0
Waukesha County	3/19/2010	Winter Weather	0	0	0	0
Waukesha County	12/9/2010	Winter Weather	0	0	0	0
Waukesha County	12/20/2010	Winter Weather	0	0	0	0
Waukesha County	2/6/2011	Winter Weather	0	0	0	0
Waukesha County	2/20/2011	Winter Storm	0	0	0	0
Waukesha County	3/9/2011	Winter Weather	0	0	0	0
Waukesha County	12/20/2012	Winter Storm	0	0	0	0
Waukesha County	2/7/2013	Winter Storm	0	0	0	0
Waukesha County	2/26/2013	Winter Storm	0	0	0	0
Waukesha County	3/5/2013	Winter Storm	0	0	0	0
Waukesha County	12/22/2013	Winter Storm	0	0	0	0
Waukesha County	2/17/2014	Winter Storm	0	0	0	0
Waukesha County	2/1/2015	Winter Storm	0	0	0	0
Waukesha County	1/2014	Winter Weather	0	0	0	0
Waukesha County	2/2014	Winter Weather	0	0	0	0

Waukesha County	3/2014	Winter Weather	0	0	0	0
Waukesha County	2/2015	Winter Weather	0	0	0	0
Waukesha County	11/20/2015	Winter Storm	0	0	0	0
Waukesha County	12/28/2015	Winter Storm	0	0	0	0
Waukesha County	02/29/2016	Winter Weather	0	0	0	0
Waukesha County	3/01/2016	Winter Weather	0	0	0	0
Waukesha County	3/24/2016	Winter Weather	0	0	0	0
Waukesha County	4/02/2016	Winter Weather	0	0	0	0
Waukesha County	4/08/2016	Winter Weather	0	0	0	0
Waukesha County	12/04/2016	Winter Weather	0	0	0	0
Waukesha County	12/10/2016	Winter Storm	0	0	0	0
Waukesha County	12/16/2016	Winter Storm	0	0	0	0
Waukesha County	1/03/2017	Winter Weather	0	0	0	0
Waukesha County	1/10/2017	Winter Weather	0	0	0	0
Waukesha County	1/11/2017	Winter Weather	0	0	0	0
Waukesha County	1/16/2017	Winter Weather	0	0	0	0
Waukesha County	2/24/2017	Winter Weather	0	0	0	0
Waukesha County	1/10/2018	Winter Weather	0	0	0	0
Waukesha County	1/14/2018	Winter Weather	0	0	0	0
Waukesha County	1/22/2018	Winter Weather	0	0	0	0
Waukesha County	2/03/2018	Winter Weather	0	0	0	0
Waukesha County	2/05/2018	Winter Weather	0	0	0	0
Waukesha County	2/08/2018	Winter Weather	0	0	0	0
Waukesha County	2/11/2018	Winter Weather	0	0	0	0
Waukesha County	3/05/2018	Winter Weather	0	0	0	0
Waukesha County	4/03/2018	Winter Weather	0	0	0	0
Waukesha County	4/14/2018	Winter Weather	0	0	0	0
Waukesha County	4/18/2018	Winter Weather	0	0	0	0
Waukesha County	11/25/2018	Winter Weather	0	0	0	0
Waukesha County	12/28/2018	Winter Weather	0	0	0	0
Waukesha County	12/29/2018	Winter Weather	0	0	0	0
Waukesha County	1/18/2019	Winter Weather	0	0	0	0
Waukesha County	1/22/2019	Winter Storm	0	0	0	0
Waukesha County	1/27/2019	Winter Storm	0	0	0	0
Waukesha County	2/05/2019	Winter Weather	0	0	0	0
Waukesha County	2/07/2019	Winter Weather	0	0	0	0
Waukesha County	2/09/2020	Winter Storm	0	0	0	0
Waukesha County	2/11/2019	Winter Storm	0	0	0	0
Waukesha County	2/17/2019	Winter Weather	0	0	0	0
Waukesha County	2/23/2019	Winter Weather	0	0	0	0
Waukesha County	2/26/2019	Winter Weather	0	0	0	0
Waukesha County	3/09/2019	Winter Weather	0	0	0	0
Waukesha County	4/14/2019	Winter Weather	0	0	0	0
Waukesha County	4/27/2019	Winter Weather	0	0	0	0
Waukesha County	10/30/2019	Winter Weather	0	0	0	0
Waukesha County	11/06/2019	Winter Weather	0	0	0	0
Waukesha County	11/10/2019	Winter Weather	0	0	0	0
Waukesha County	12/14/2019	Winter Weather	0	0	0	0
Waukesha County	12/30/2019	Winter Weather	0	0	0	0
Waukesha County	1/10/2020	Winter Weather	0	0	0	0
Waukesha County	1/17/2020	Winter Weather	0	0	0	0
Waukesha County	1/24/2020	Winter Weather	0	0	0	0
Waukesha County	1/31/2020	Winter Weather	0	0	0	0
Waukesha County	2/12/2020	Winter Weather	0	0	0	0
Waukesha County	2/17/2020	Winter Weather	0	0	0	0
Waukesha County	11/24/2020	Winter Weather	0	0	0	0

1.16.4 Vulnerability

Winter storms present a serious threat to the health and safety of affected citizens and can result in significant damage to property. Heavy snow or accumulated ice can cause the structural collapse of homes, commercial buildings and agricultural structures; down power lines or isolate people from assistance or services by impeding transportation by the general public, emergency responders and public transportation resources.

The loss of electrical service and/or the blocking of transportation routes can adversely affect the ability of commercial enterprises to conduct business. This economic injury may be felt by both the business owner and employees unable to work during this period.

Hazard Assessment		
Winter Storms		
Frequency/Probability (i.e. Future Probability)	▶	Medium
Magnitude/Extent (i.e. Strength or Magnitude)	▶	Medium
Vulnerability (i.e. Consequence and Impact)	▶	Low
Overall Risk Rating	▶	Medium

1.17 Hazardous Materials Release

Hazardous materials are materials that if released, can pose a threat to human health or the environment. Hazardous material releases can cause long/short term health effects, damage to property, expensive cleanup/contractor costs, serious injury, and even death.

1.17.1 Hazards Materials Release Hazard Profile

Hazard Profile

There are as many as 500,000 different products that qualify as a hazardous material. Hazardous materials are stored and transported throughout the Waukesha area in various quantities. The storage of hazardous materials ranges from residential storage of household products to bulk storage of large volumes for industrial purposes. Hazardous materials are transported by various methods such as railcars, barges, and trucks. A “release” may occur by spilling, leaking, emitting toxic vapors, or any other process that enables the material to escape its container, enter the environment, and create a potential hazard. Hazards are classified in many different ways.

Hazard Classes:

Class 1: Explosives

Class 2: Gases

Class 3: Flammable Liquids

Class 4: Other Flammable Substances

Class 5: Oxidizing Substances and Organic Peroxides

Class 6: Toxic (Poisonous) & Infectious Substances

Class 7: Radioactive Materials

Class 8: Corrosives

Class 9: Miscellaneous Dangerous Goods

A material is classified as hazardous when it is corrosive, explosive, toxic, ignitable, biologically irritating, radioactive, or packaged in a dangerous container. Hazardous material spills involving vehicles provide unique challenges for personnel working to protect the public and the environment. When hazardous materials spill on roadways, personnel may have to negotiate traffic snarls that prevent emergency equipment and ambulances from getting to the scene, flammable and explosive materials, or toxic fumes which may require evacuations.

Hazard Considerations

Area Impacted:

- General hazard material releases are confined to several hundred to a thousand feet from the source

Population Exposed:

- Events at facilities in urban areas can result in mass casualties due to condensed community.

Duration of the Event:

- Hazardous material can pose a risk immediately after release
- Fixed facility events can last as long as several days if the substance released is extremely hazardous (i.e. radioactive material) or emergency response is complicated (i.e. large• scale fire at refinery)

Essential Service Disruption:

- Disruption of transportation networks
- Possibly disruption of water/wastewater service if source of release

Special Considerations:

- Evacuation of elderly from gaming facilities

Direct Damage:

- Contaminated material.
- Health effects from exposure.
- Infrastructure damage includes water/wastewater infrastructure and utilities
- Structural failure or damage if release causes a fire.

Economic Damage:

- Minimal economic damage unless release directly impacts a facility or Seminole HQ.

Emergency Services:

- Possible fire services

Social Factors:

- The release of hazardous materials can result in acute or chronic health problems.

1.17.2 Location and Extent

Hazardous materials can be released into the environment because of an accident, a natural event such as an earthquake, or an act of terrorism. Rail traffic accidents are less common than roadway spills, however their consequences can be greater simply because of the volume of toxic materials a train can transport. Hazardous material releases are rarely intentional, but terrorist or vandalism releases are possible. Once a hazardous material release is recognized, immediate action must be taken to respond to the release to preserve health and safety and reduce the impact to the neighboring community and the environment. Hazardous material releases in highly populated areas could result in evacuation or “shelter-in-place” situations.

Fixed Facilities

Hazardous materials being used or stored at industrial facilities and in buildings is defined as a fixed facility hazardous material release hazard. Fixed facilities include industrial facilities that store hazardous materials required for their processing or facilities that store hazardous materials that result from an industrial process. An uncontrolled release or mishandling of hazardous materials from a fixed facility may result in possible injury or fatality, severe financial loss or liability, contamination, and disruption of critical infrastructure.

The Emergency Planning and Community Right-to-Know Act (EPCRA), also known as SARA Title III, was enacted in November 1986 to enable state and local governments to adequately prepare and plan for chemical emergencies. Facilities that have spilled hazardous substances, or that store, use, or release certain chemicals are subject to various reporting requirements. Common EPCRA topics include: emergency planning; hazardous chemical inventory reporting; chemical information; toxic chemical release reporting; risk management plans, and the Toxics Release Inventory (TRI) database. The TRI database includes facilities that manufacture (including importing), process, or otherwise use a listed toxic chemical above threshold quantities. Facilities covered by EPCRA must submit an emergency and hazardous chemical inventory form to the Local Emergency Planning Committee (LEPC), the State Emergency Response Commission (SERC) and the local fire department annually. This report, also called a Tier I or Tier II, includes basic information including facility identification; employee contact information for emergencies and non-emergencies; and site-specific information including facility description, chemical types and descriptions, releases or incidents, and chemical storage capacity, capabilities, and locations.

Transport

A 1998 report by the U.S. Department of Transportation entitled Hazardous Materials Shipments states that over 800,000 shipments of hazardous materials are estimated to occur within the United States per day, resulting in a total of 3.1 billion tons shipped annually. Of the 3.1 billion tons shipped annually, 42.9% is transported by truck, 4.4% by rail, 37.9% by pipeline, 14.7% by water, and 0.05% by air.

Truck

Although rail transports larger gross tonnage of hazardous materials, the number of truck traffic counts carrying hazardous materials shipments is greater. This is due to the larger volumes involved in a single rail shipment.

Railway

Because rail is the primary means for shipping crude, and Wisconsin railroads lie between the massive oil reserve and East Coast refineries, the state has seen its share of the growth in crude-by-rail traffic. Crude oil shipments by rail gained attention after a string of accidents, including an explosion in a small town in Quebec that killed 47 people in July 2013. The U.S. Department of Transportation issued an emergency order requiring railroads to notify states of large shipments of Bakken crude oil. The order will apply to shipments containing more than 1 million gallons of crude, or about 35 tank cars, and railroads will have to disclose volumes, frequencies of anticipated train traffic and routes.

Transporting crude on the country's railroads grew from just 9,500 carloads in 2008 to more than 400,000 carloads in 2013, according to the Association of American Railroads. The following railroads run through Waukesha County:

- Wisconsin and Southern Rail Road
- Canadian National Rail Road
- Union Pacific Rail Road
- CP Rail System
- Union Pacific Rail Road
- East Troy Rail Road

Even though a hazardous material spill event can occur at any time, inclement weather such as fog, smoke, and heavy rainfall can increase the likelihood of a spill event on roads and railways. High winds can increase the likelihood of accidents for high-profile vehicles such as tractor-trailers and fan flames after ignition. The duration of an incident should be thought of in two ways: emergency and long-term. The duration of the emergency may last from several hours to several days depending upon the location of the event, the quantity and type of material involved, and the preparedness of the community for an emergency. The duration of the event long-term may be decades due to long-lasting effects on the community and environment.

Toxics Release Inventory (TRI) from the Environmental Protection Agency

The Toxics Release Inventory (TRI) provides information on toxic chemical releases from certain facilities in communities across the United States, covering 20,000 facilities and more than 675 toxic chemicals. For the purposes of the below information, a “release” refers to the different ways toxic chemicals from

industrial facilities enter the air, water and land. Facilities who report to TRI:

1. Must be in a TRI-covered industry sector or category, including Manufacturing, Coal/Oil Electricity Generation, Certain Mining Facilities, Hazardous Waste Management, & Federal Facilities.
2. Facility must have the equivalent of at least 10 full-time employees.
3. Facility must manufacture, process or use more than a certain amount of a TRI-listed toxic chemical per year.

Description	Waukesha County		Wisconsin		United States
	Number	Percent of Wisconsin	Number	Percent of United States	Number
Number of TRI Facilities	0	0%	862	0%	21,598
Facilities reporting newly implemented source reduction	0	0%	119	0	3,261
Total on-site	0	0%	18,831,624 lbs	0	3,739,532,090 lbs
Air	0	0%	12,534,867 lbs	0	773,028,732 lbs
Water	0	0%	2,938,152 lbs	0	212,120,819 lbs
Land	0	0%	3,358,605 lbs	0	2,754,382,540 lbs
Total off-site	0	0%	16,865,237 lbs	0	405,418,333 lbs
Total on-site and off-site disposal or other releases	0	0%	35,696,861 lbs	0%	4,144,950,423 lbs

Source: Toxic Release Inventory, Environmental Protection Agency

1.17.3 Frequency and Probability

1276 Hazardous Materials incidents were recorded by Waukesha County Emergency Management during the five-year period from 11/01/2016 to 11/01/2021. Of these the count per material involved is as follows:

- Acetone – 1
- Acetylene – 1
- Ammonia – 8
- Asbestos – 1
- Battery Acid – 1
- Biohazard – 1
- Diesel – 74
- Explosives – 9
- Fertilizers or Herbicides – 8
- Fire with Hazmat release – 1
- Freon – 2
- Gasoline – 142
- Mercury – 4
- Muriatic/Hydrochloric Acid – 1
- Natural Gas – 742
- Oil – 20
- Automotive Oil – 37
- Heating Oil – 2
- Hydraulic Oil – 18
- Mineral Oil – 22
- Other Chemicals – 85
- Other Petroleum – 10
- Propane – 5
- Salt – 1
- Unknown Substance – 65

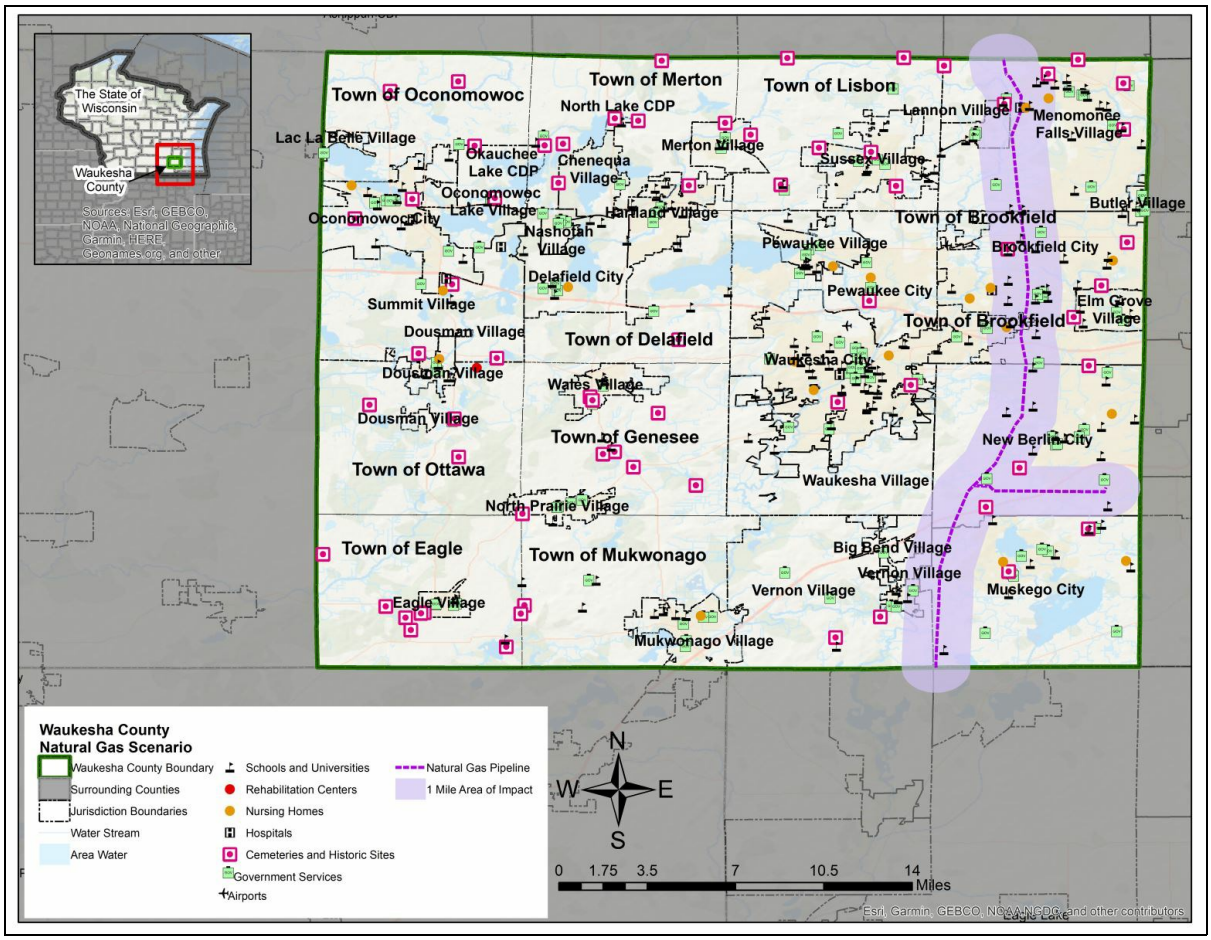
Notable Hazmat Incidents include:

- 7/31/2018 – NCL Graphics Fire - N29 W22960 Marjean Ln – Pewaukee – 2nd Alarm Fire, Hazmat response for monitoring, approx. $1million in damage
- 5/19/2020 – SW Metal Finishing Fire - 2795 S 166th St – New Berlin – 2nd Alarm Fire, Hazmat response; chemicals at the plant included copper sulfate and sulfuric acid, some in open vats with total potential quantity of 15,000 gallons. The Haz-Mat crew placed acid booms to slow down the flow, but thousands of gallons of water were involved as a result of fighting the fire. The runoff reached Deer Creek via a drainage ditch and water discoloration was observed. The nearby industrial park was also temporarily evacuated due to potentially hazardous smoke.
- The Hazmat Team also responded for three industrial incidents in which chemicals were mixed improperly (no fatalities), two completed chemical suicides in vehicles, and other small-scale incidents.

1.17.4 Vulnerability

Hazardous materials release is a low to low-moderate hazard potential of occurring for those facilities located near transit hubs or large industrial facilities that store or produce hazardous materials. Due to security concerns, the quantity and type of hazardous materials contained at neighboring facilities could not be determined. It is expected that many of these facilities are gas stations, small service stores, and commercial business and therefore designated as small quantity generators. Since a hazardous materials release is more likely to occur during handling or shipping than during storage, a hazardous materials incident is more likely to occur as a result of a transportation accident.

Hazardous materials releases have the potential to cause significant health impacts and/or structural damage. These materials have different potential impacts upon release, depending on their chemical properties. Additionally, the impact differs depending on how much material is released to the environment.



Hazard Assessment		
Hazardous Materials Release		
Frequency / Probability (i.e. Future Probability)	▶	**Medium**
Magnitude / Extent (i.e. Strength or Magnitude)	▶	**Medium**
Vulnerability (i.e. Consequence and Impact)	▶	**Medium**
Overall Risk Rating	▶	**Medium**

1.18 Utility Failure

A utility emergency usually means an electrical power or natural gas outage or a fuel shortage caused by an oil embargo, power failure or natural disaster.

1.18.1 Utility Failure Hazard Profile

Hazard Profile

An electric power outage (also power failure or power loss) is the loss of the electricity supply to a geographic area. The area of an outage (scale) can range from a single facility or neighborhood to a multi-state region. The length of the outage (scope) is determined by combination of factors to include the scale of the outage, weather, and redundant equipment and capacity.

A power outage can be described as a blackout if power is lost completely or as a brownout if the voltage level is below the normal minimum level specified for the system. The reasons for a power outage can for instance be a defect in a power station, damage to a power line or other part of the distribution system, a short circuit, or the overloading of electricity mains. 'Load shedding' is a common term for a controlled way of rotating available generation capacity between various districts or customers, thus avoiding total wide area blackouts.

Power outages are particularly serious for hospitals and other critical facilities and operations. Our society is extremely reliant upon life-critical medical devices, communications, and electronic information all of which require reliable (uninterrupted) electric power. This reliance on electric power has forced hospitals, data and telecommunications centers, and financial and trading institutions to have arrays of back-up batteries and emergency power generators. These generators, which are typically powered by diesel fuel, but should be ideally powered by natural gas where available, are configured to start automatically, as soon as a power failure occurs.

The entire energy system is complex and consists of three major parts: generation, transmission, and distribution. The control and communication between these parts are extremely important as the failure of one part could disrupt the entire system. The energy system is reliant upon the following factors: continual maintenance, equipment replacement and redundancy, and additional high-load capacity. These factors have to be carefully balanced against operating cost and profit i.e. these initiatives are expensive but the costs cannot be readily push down to the consumer due to public pressure and opinion.

Hazard Considerations

Area Impacted:

- Depending on cause, scale, and scope of the power outage one or more of the County's jurisdictions could be directly and significantly affected.

Duration of the Event:

- A power outage can last minutes to multiple days, even weeks and months.

Essential Service Disruption:

- Disruption of essential government services.
- The loss of water treatment or distribution can be lead to additional expense for citizens in buying potable water and complicated logistics for support agencies i.e. water is heavy and is bulky to transport.
- A typical family can lose hundreds of dollars in food stored in the refrigerator or freezer if the outage exceeds 36 hours. Additionally, people may unwisely eat spoiled food resulting in illness or possibly death.

Special Considerations:

- People on life support at the hospital, care facility, or at home are in possibly life threatening danger.
- People with health conditions, the elderly and infirmed are at increased risk if environmental factors such as excessive heat / humidity and cold go beyond a highly maintained comfort level.

Direct Damage:

- Millions of dollars in losses to the equipment supporting the electrical system will be eventually passed to the consumer in the form of higher rates and fees.

Affected Population:

- Depending upon a variety of factors, the better people are prepared the less the affected population.

Economic Damage:

- Economic losses occur hourly and mount exponentially as the outage impacts business and commercial enterprises that are interconnected and reliant upon each other's ability to produce goods, services, personnel, and expertise.
- Business interruption
- Decreases in tourism

Emergency Services:

- Law enforcement, fire, and emergency medical services will be impacted indirectly by a loss of systems (e.g. data and communications, street and traffic lighting, alarm) and directly by increased calls for service.
- Emergency response and evacuation and may be adversely affected due to a lack of electric power to fuel pumps at fleet operations centers and service

stations.
- Evacuation of facilities
- Burn-out of emergency service staff and wear and tear of equipment could be dramatic

Social Factors:

- The loss of alarm systems, lights, gates and other security systems will increase the likelihood of criminal and civil disturbance activity. People, particularly the elderly, will feel less secure and emotionally distressed.
- Down power lines are especially and directly dangerous during thunderstorms, winter storms, and flooding. The dangers of electrically charged lines in pools of water are a real danger to pedestrians and motorists.

1.18.2 Location and Extent

An electric power outage (also power failure or power loss) is the loss of the electricity supply to a geographic area. The area of an outage (scale) can range from a single facility or neighborhood to a multi-state region. The length of the outage (scope) is determined by combination of factors to include the scale of the outage, weather, and redundant equipment and capacity. The scale of the outage often directly affects the scope as often occurs during a severe storm; the greater number of down utility poles, wires, and transformers the longer the repair and restoration time.

Modern society is very dependent on electrical power for normal living and is therefore quite disrupted by loss of power. Most power outages last about fifteen minutes to one hour. If longer, the utilities will inform the local news media of the anticipated duration of the outage. Waukesha County is provided with electric service by WE Energies. In addition, a municipal electric power utility is operated by the City of Oconomowoc. There are no electric power generating facilities located within the county. Natural gas service is provided by WE Energies and by the Wisconsin Gas Company.

Image: Electrical substation

Thunderstorms with lightning are a possible cause of power failure. Fuel shortages can be caused by localized imbalances in supply. Labor strikes, severe cold weather or snowstorms also can cause a local shortage.

Disruptions are often sudden, and there may or may not be time to prepare for them. The two types of outages are:

- Planned Outages: An upgrade to electricity or gas infrastructure or to perform important maintenance.
- Unplanned Outages: Unplanned outages can be caused by severe weather, accidents or natural disasters.

As populations increase, severe weather becomes more common, and the electrical grid ages, there has also been an increase in the frequency and magnitude of power outages. Major power outages are defined as those affecting more than 50,000 people.

1.18.3 Frequency and Probability

Waukesha County has several short power outages (i.e., lasting less than six hours) per year but does not have a history of extended power outages. The possibility always exists that a man-made or natural disaster could affect the power system for an extended period of time.

In general, Waukesha County has a medium likelihood of utility failures with a low risk of damage, death or injury due to a loss. Obviously, power outages are more likely to occur and the severity is greater in areas of higher human population (i.e., urban areas) but the loss of power to rural customers, while affecting fewer people, generally lasts longer and can be as life-threatening, especially if a person with special needs (e.g., the elderly, the young, those on special medical equipment) is involved.

1.18.4 Vulnerability

The failure of a utility to function can have wide-ranging impact in Waukesha County. People, especially special needs populations, in residential properties may not be able to safely live in their homes because of inadequate heat, the inability to cook, etc. Businesses, including the utilities themselves, may lose money due to the inability to produce goods and services for which they can bill. While there are generally backup generators on sewage lift stations in Waukesha County, other utilities may also be non-operational due to damaged infrastructure, which can be very expensive to replace and/or repair. Critical infrastructure such as hospitals, schools and governmental facilities may not be able to operate or may have to operate at a reduced capacity due to the loss of utility services. EPCRA facilities may not be able to adequately control and contain their chemicals and there may be a release of hazardous materials that can impact people or the environment.

Agricultural assets may be impacted by the loss of utilities because extreme temperatures reduce the volume of livestock products and products such as milk may not be able to be properly stored.

Finally, transportation on roadways may become unsafe due to the loss of directional and street lights.

Hazard Assessment		
Utility Failure		
Frequency/Probability (i.e. Future Probability)	▶	Medium
Magnitude/Extent (i.e. Strength or Magnitude)	▶	Medium
Vulnerability (i.e. Consequence and Impact)	▶	Medium
Overall Risk Rating	▶	Medium

1.19 Rail Transportation Incident

The Rail Transportation system is a vast network connecting cities, producers, manufacturers, and retailers, moving substantial quantities of goods to, from, and through Wisconsin. Throughout the United States, there are hundreds of railroads, more than 143,000 route-miles of track, more than 1.3 million freight cars, and roughly 20,000 locomotives.

1.19.1 Rail Transportation Incident Hazard Profile

Bakken Formation

The Bakken Formation, located in northwest North Dakota, northeastern Montana, southern Saskatchewan, and southwestern Manitoba, is one of the largest contiguous deposits of oil and natural gas in the United States. The formation is an interbedded sequence of black shale, siltstone, and sandstone.

The Bakken Formation has only recently been tapped for oil and natural gas. As recently as 2007, the Bakken Formation was considered to be a marginal to submarginal resource because the oil and natural gas are locked in a rock formation with low permeability. However, advances in drilling and recovery technology such as horizontal drilling and hydrofracturing have allowed oil and natural gas to be extracted. In fact, the recent boom in oil production from the Bakken Formation has moved North Dakota to the second-largest oil producer in the US. The Bakken Formation resources are expected to be productive for decades.

Hazard

This new source of oil and natural gas, brings with it a new hazard, such as accidents when transporting the crude oil via railroads. In fact, in recent years, accidents involving railroads and crude oil have increased.

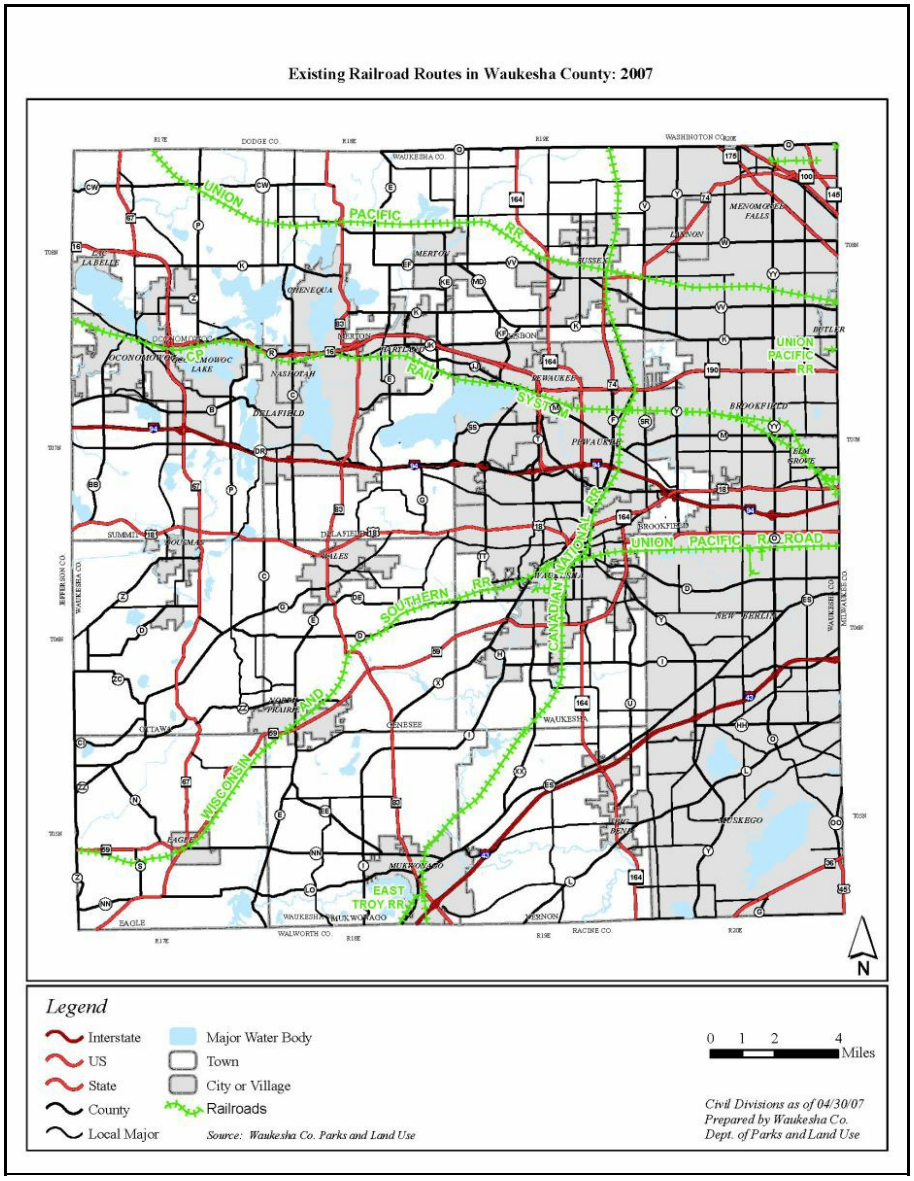
In January of 2014, the US Department of Transportation gave a "Call to Action" for those involved to work to keep crude oil shipments safe. One new emergency order by the Department of Transportation requires railroads transporting crude oil to notify state emergency response commissions.

According to Wisconsin Emergency Management, this is a multi-faceted issue, with considerations needed from Hazardous Materials professionals, Firefighters, and Environmental officials.

Source: http://geology.com/articles/bakken-formation.shtml

1.19.2 Location and Extent

Because of Waukesha County's proximity to the large transportation hub, Chicago, there are many rail routes through the state of Wisconsin. In fact, Crude Oil is transported via railroads through 47% of the counties in Wisconsin, including Waukesha.

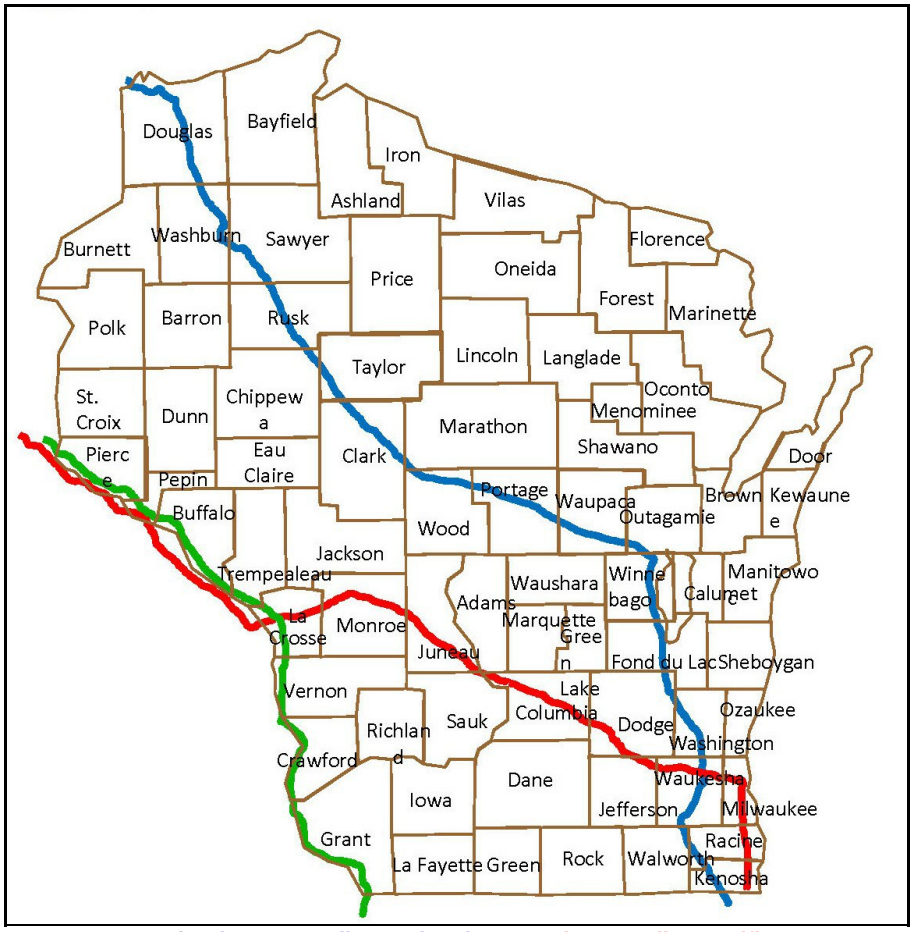


There are three main railroad companies that ship crude oil through Wisconsin:

- Canadian National RR
- Canadian Pacific RR
- Burlington Northern-Santa Fe RR

The first two listed above (Canadian National and Canadian Pacific Railroads) go through Waukesha County. This is also within the area of the state with the highest population, with Waukesha County being the third most populous county in the state.

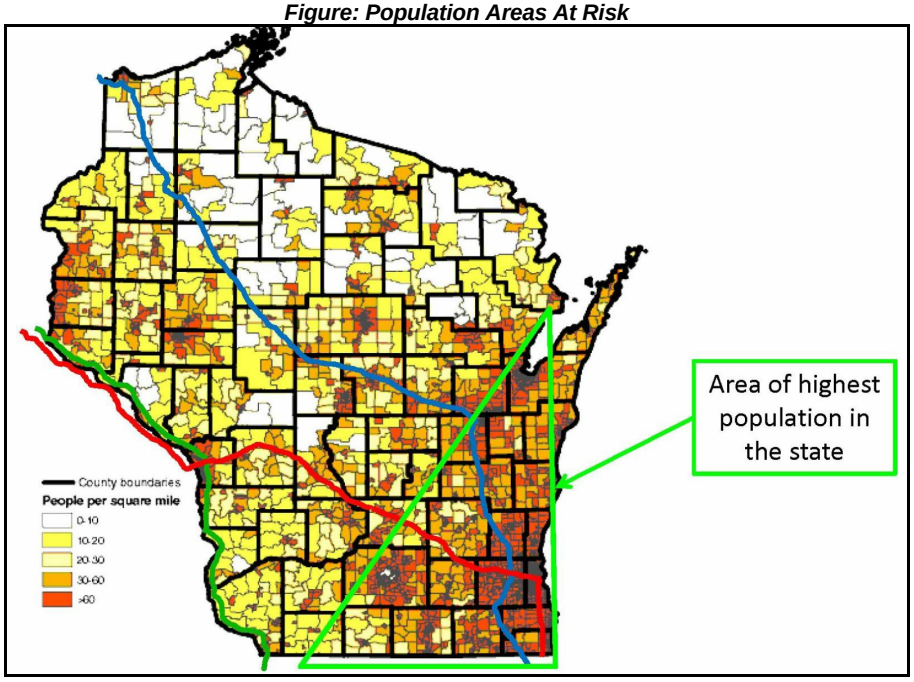
Figure: Rail Routes Transporting Crude Oil



Legend: **Blue = Canadian National RR**; **Red = Canadian Pacific RR**

Source: Wisconsin Emergency Management, Bakken Crude Oil, 2014

Figure: Population Areas At Risk



Source: Wisconsin Emergency Management, Bakken Crude Oil, 2014

1.19.3 Frequency and Probability

Crude Oil Incidents

- July 6, 2013, Lac-Megantic, Quebec, CA - unattended train, derail, fire, 47 killed, evacuation
- November 8, 2013, Aliceville, AL - 26 cars derail, fire, wetlands impacted
- December 30, 2013, Casselton, ND - 21 cars derailed, 400,000 gallons released, fire
- April 30, 2014, Lynchburg, VA - 105 cars derail, fire, 30,000 gallons into James River, evacuation
- May 6, 2015, North Dakota - 7 cars derail
- May 7, 2015 Illinois, 21 cars derail
- July 17, 2015, Montana, 20 car derail, 35,000 gallons of crude oil spilled, evacuations
- February 2, 2015 Pennsylvania, no spills
- February 16, 2015 West Virginia, 28 car derail, 30,000 crude oil gallons, evacuations
- November 8, 2015, Wisconsin, 13 cars derail, 1,000 crude oil gallons spilled
- March 7, 2015,Ontario, 0 cars derail, spilled into local river, fires
- June 3, 2016, Oregon, 11 cars derail
- July 3, 2017, Illinois, 20 cars derail, 20,000 gallons spilled
- May 3, 2017, Mississippi, 12 cars derailed, 20,000 gallons spilled, fire
- November 6, 2017, Fatal Train vs. Auto Collision – North Lake / Town of Merton – UP Rail
- June 22, 2018, Iowa, 32 cars derail, 230,000 gallons spilled into floodwaters
- March 22, 2019, Train vs Semi-Trailer Collision – Oconomowoc – Loaded Ethanol Key Train – No Derailment – Major damage to lead locomotive
- March 25, 2019, Derailment - Menominee Falls – UP Rail – 13 gondola cars of scrap metal derailed downhill onto private property north of golf course
- November 12, 2020, Loaded Car of Sodium Chlorate - Pewaukee – No Derailment – Wheel burn damage to car – able to continue to destination under movement authority

1.19.4 Vulnerability

Hazard Assessment		
Rail Transportation Incident		
Frequency/Probability (i.e. Future Probability)	▶	Low
Magnitude/Extent (i.e. Strength or Magnitude)	▶	Low
Vulnerability (i.e. Consequence and Impact)	▶	Medium
Overall Risk Rating	▶	Low

1.20 Political Hazards

Political Hazards include the following:

Civil Disturbances:

- Labor Disputes
- Protests

Terrorism:

- Explosive Devices(bombs)
- Airline Attacks
- Chemical/Biological/Nuclear Attacks
- Hostage Taking
- Infrastructure Attacks
- Active Assailant Attacks
- Home Grown Violent Extremists

1.20.1 Civil Disturbances

A civil disturbance is any act by an individual or group of persons with the intention to agitate or cause a public disruption of daily life and/or normal operations. These disturbances may come in the form of labor disputes or protests by groups on specific interests or issues.

Significant civil disturbances in Waukesha County remain a low probability hazard. Labor strikes occurred in the past but generally concluded peacefully and without hostile actions. In a pending labor situation, the sheriff and/or police chief meet with strike leaders to set up conduct guidelines for a lawful strike. Law enforcement officials maintain mutual aid pacts for additional support.

Various facilities and organizations received prank bomb threats in the past. Responders located a number of explosive type objects, such as pipe bombs, military hardware and blasting supplies. Several isolated instances of pipe bombs exploding and destroying property in close proximity occurred in Waukesha County.

Each school, hospital, business and government building should develop and maintain current bomb threat plans, policies and procedures. Waukesha County Emergency Management, the Waukesha Sheriff's Department and local police agencies assisted numerous organizations in developing and exercising these plans.

Threats against government officials and others in top positions by persons who believe they suffered unjustly or wronged in some manner occurred. So far in Waukesha County such threats remained minimal and never carried out.

Special events involving large numbers of people must obtain event permits as a mitigation strategy to minimize disturbances. Law Enforcement agencies develop and utilize intelligence information to gain advance data on potential problems and work with event organizers to minimize or eliminate disruptive behaviors whenever possible.

Notable Incidents

- June 1, 2020: Peaceful protests for George Floyd in Waukesha.

1.20.2 Terrorism

Terrorism is defined as the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population or any segment thereof, in the furthering of political or social objectives. The Federal Bureau of Investigation categorizes two types of terrorism in the United States: domestic terrorism which involves groups or individuals whose activities are directed at elements of our government or population without foreign direction; and international terrorism which involves groups or individuals who are foreign-based and/or directed by countries or groups outside the U.S. or whose activities transcend national boundaries. Additionally, some acts conducted by gangs, people involved in civil disturbances, radical splinter groups, activists and people involved in illegal drug trade could fall within the definition of terrorism.

An act of terrorism can take several forms, depending on the technological means available to the terrorist, the nature of the political issue motivating the act, and the points of weakness of the terrorism target. Terrorist actions may include:

Bombing: Most terrorist incidents in the U.S. involved explosives or incendiary devices, including detonated and undetonated explosive devices, tear gas, pipe and fire bombs and rocket attacks. Often the capacity existed for large-scale damage and/or mass casualties. The bombing of the Federal Building in Oklahoma City in August 1995 is a recent example. The type of materials and method of delivery utilized in the bombing of the Murrah Federal Building proved readily accessible to potential terrorists. Because of the ready availability of such materials, the potential for mass damage, casualties and experiences to date nationally, the United States Department of Homeland Security warns that of the various types of WMD weapons, explosive weapons remain a high potential hazard for use in the U.S.

Airline Attack: Despite efforts to improve airline security in the U.S. after the 9/11/01 attacks on the World Trade Center in New York, some note that airport security still falls short of acceptable and necessary standards. In addition to hijacked planes crashing into buildings, incidents could include airplane bombings, sabotage or hijacking, airport bombings or shootings or the tampering with air navigation and control systems, resulting in plane crashes or collisions.

Chemical/Biological/Nuclear: Terrorists may use chemical and biological agents or weapons to either extort or deliberately try to kill in order to further political goals. Toxins such as anthrax or even some radiological materials represent credible threats. From October-December 2001, emergency services responded to nearly 100 anthrax hoaxes in Waukesha County. Although these threats and letters proved to be hoaxes, first responders cannot afford to treat these types of cases lightly.

Hostage Taking: Terror groups and homegrown violent extremists believe the taking of hostages provides those groups or individuals publicity for their political or social objectives, allows negotiation for furtherance of their aims, or results in events which are designed to invoke sympathy for their causes. The main goal of response agencies is to end the incident, with the absolute minimum loss of life as possible. Despite a common belief, most response agencies will not agree to any demand to prevent endangering the safety of hostages.

Infrastructure Attack: An individual or group of terrorists could coordinate an attack against utilities and other public services such as the water supply, electric power generation, power transmission, or telephone service. Cyber-terrorism attacks computer resources such as networks, databanks and software by infiltrating computer networks and altering, stealing or destroying programs and data or implementing distributed denial of service attack. As society becomes more dependent on computers, networks, Supervisory Control and Data Acquisition (SCADA) Systems, and cell phones, this form of cyber-terrorism is an increasing concern.

Active Assailants: Recent events nationally and across the globe involved individual and groups of individuals conducting assaults on unsuspecting citizens. Weapons involved include firearms, edged weapons, improvised explosive devices, and vehicles. Psychologically impaired individuals conducted some of these attacks, while others involved radicalized persons attempting to further a political cause.

Home-Grown Violent Extremists (HVE): Positive enhancements to border security and entry visas made travel into the United States by members affiliated with organized terror groups increasingly difficult. As a result, several terror-related organizations actively promote acts of extreme violence by radicalized individuals living in the target area of the world, including the United States. Unidentified radicalized individuals already within a target area undergo far less travel scrutiny than identified terror group affiliates. This allows them to move about more freely to plan and implement attacks at various soft target venues.

Other Related Information: The emergency management community in the United States understand that national security and intelligence organizations may not always achieve success in preventing terrorist incidents. State and local emergency management systems must respond when these attacks occur. The ramifications of responding to a terrorist incident may vary from traditional large-scale emergencies. Responders must remain alert for secondary and tertiary devices intended to incapacitate or kill emergency workers responding to the initial attack or threat. The safety of emergency service providers must remain an early, primary consideration. Federal and state government agencies depend directly on local managers and emergency response personnel and their initial and follow-on actions during any terrorist incident.

When dealing with terrorist incidents, the traditional local incident command structure must adapt to include additional federal and state agencies. The potential for secondary and tertiary devices or attacks may threaten the lives of patients and emergency personnel, thus requiring the rapid evacuation of the injured from the scene even before treatment begins. In addition, chemical, biological or nuclear attacks may require mass decontamination.

Waukesha County developed a Terrorism Consequence Management Annex and a Bioterrorism Response Plan as adjunct documents supporting the Comprehensive Emergency Management Plan. The planning process identified potential targets, as well as threat and risk potentials in coordination with the Threat, Hazard Identification and Risk Analysis (THIRA) guidance and planning implemented by the State and federal governments. Potential terrorist targets include a wide variety of venues. Any type of facility or event upon which a terrorist attack could generate desired publicity or further terrorist objectives could be classified as a potential target.

Numerous first responders successfully completed Weapons of Mass Destruction (WMD) awareness and response training. Waukesha County conducted one of the first exercises in the nation to integrate civilian and military assets for response to a biological incident. Exercises and training continue to increase the readiness level of all responders to a terrorist incident while also identifying methodologies to mitigate potential attacks and the impact. Waukesha County utilized a combination of local, state, and federal funds to purchase domestic preparedness equipment to enhance local capabilities of first responders and hazardous materials teams. Waukesha County partnered in August, 2015 with the City of Waukesha, Wisconsin National Guard, Wisconsin Emergency Management, other State agencies, and the United States Department of Homeland Security to conduct a full-scale exercise integrating all levels of government and civilian and military assets in a response to a simulated event.

1.21 Hazard Mitigation Goals and Objectives

VI. Goals and Objectives

One of the bedrock principles of emergency management is to approach issues from an all-hazards perspective. This is generally very cost effective because it accomplishes preparedness and/or mitigation goals for many types of disasters with one resource. Some of the all hazards mitigation projects that Waukesha County would like to accomplish are detailed in the following sections. The planning committee also used the all hazards approach to identify mitigation goals for the county and all of its municipalities. The purpose hazard mitigation plan is to identify hazard areas, to assess the risks, to analyze the potential for mitigation and to recommend mitigation strategies where appropriate. Potential mitigation projects will be reviewed using criteria that stress the intrinsic value of the increased safety for people and property in relation to the monetary costs to achieve this (i.e., a cost-benefit analysis). With that in mind, the planning goals for this entire plan, as determined by the mitigation planning committee were:

Overall Hazard Goals and Objectives

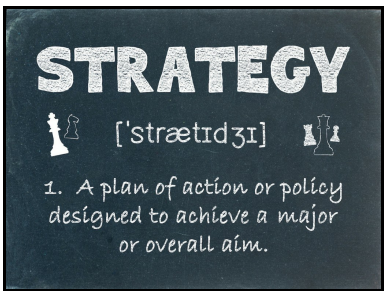
GOALS
1. To preserve life and minimize the potential for injuries or death. • Identify natural and manmade hazards that threaten life in Waukesha County.
2. To preserve and enhance the quality of life throughout Waukesha County by identifying potential property damage risks and recommending appropriate mitigation strategies to minimize potential property damage. • Implement programs and projects that assist in protecting lives by making homes, businesses, essential facilities, critical infrastructure, and other property more resistant to losses from all hazards. • Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventive measures for existing development in areas vulnerable to natural hazards. • Protect life and property by implementing state-of-the-art standards, codes and construction procedures.
3. To promote countywide coordination, planning, and training that avoids transferring the risk from one community to an adjacent community, where appropriate. • Continue developing and strengthening inter-jurisdictional coordination and cooperation in the area of emergency services. • Continue to support and develop comprehensive mutual aid agreements. • Continue providing County and City emergency services with training and equipment to address all identified hazards.
4. To identify potential funding sources for mitigation projects and form the basis for FEMA project grant applications.
5. Increase public awareness • Increase public awareness of existing threats and the means to reduce these threats by conducting educational and outreach programs to all the various community groups in the County. • Provide informational items, partnership opportunities and funding resource information to assist in implementing mitigation activities.

Standard:

- Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element C: Mitigation Strategy
  - C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? 44 CFR 201.6(c)(3)(i)
    - C3.1. General hazard mitigation goals (broad policy statements) that are consistent with the hazards identified in the Plan
- Wisconsin Emergency Management (WEM) Mitigation Standard 2015; Element D Plan Review, Evaluation, and Implementation (UPDATES ONLY)
  - D3. Was the Plan revised to reflect changes in priorities? 44 CFR 201.6(d)(3)
    - D3.2. If priorities have not changed, validate the information in the previous plan
    - D3.1. Description of whether and how priorities have changed since the previous plan
- Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Mitigation Strategy; §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

- 13. Local Hazard Mitigation Goals; Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.
  - 13.A. Does the new or updated plan include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards?

1.22 Mitigation Strategy & Initiatives



VII. Mitigation Strategy & Initiatives

The heart of the mitigation plan is the mitigation strategy, which serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The mitigation strategy describes how the community will accomplish the overall purpose, or mission, of the planning process. In this section, mitigation actions/projects were updated/amended, identified, evaluated, and prioritized.

This section is organized as follows:

- Mitigation Action Plan
- Plan Integration
- Mitigation Implementation and Progress

1.22.1 Mitigation Action Plan

The action plan helps to prioritize mitigation initiatives according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The action plan also provides the framework for how the proposed projects and initiatives will be implemented and administered over the next 5 years. It is also meant to programmatically guide the annual updates and progress for each mitigation initiative.

Each new mitigation project identified during the 2021 plan update has been organized based on the following table below.

TABLE: NEW MITIGATION ACTION FORM

Mitigation Project:							
Status	**Year Initiated**	**Applicable Jurisdiction**	**Lead Agency/Organization**	**Priority** (Low, Medium, High)	**Timeline/ Projected Completion Date** (Short, Long-term, or Ongoing)	**Est. Cost**	**Cost Analysis** (Low, Medium, High)
New	2021						
Goal		**Hazard(s) Mitigated**	**Benefits** (Description of Loss Avoided)		**Benefit Analysis** (Low, Medium, High)	**Potential Funding Source**	
Action/Implementation Plan and Project Description:							

Standard: Federal Emergency Management Agency (FEMA) 2011 Local Mitigation Plan Review Guide

ELEMENT C. MITIGATION STRATEGY

C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))

1.22.1.1 Mitigation Strategy/Action Timeline Parameters

While the preference is to provide definitive project completion dates, this is not possible for every mitigation strategy/action. Therefore, the parameters for the timeline (**Projected Completion Date**) are as follows:

- **Short Term** = to be completed in 1 to 5 years
- **Long Term** = to be completed in greater than 5 years
- **Ongoing** = currently being funded and implemented under existing programs.

1.22.1.2 Mitigation Strategy/Action Benefit Parameters

Benefit ratings were defined as follows:

- **High**—Project will provide an immediate reduction of risk exposure for life and property.
- **Medium**—Project will have a long-term impact on the reduction of risk exposure for life and property, or project will provide an immediate reduction in the risk exposure for property.
- **Low**—Long-term benefits of the project are difficult to quantify in the short term.

1.22.1.3 Mitigation Strategy/Action Estimated Cost Parameters

While the preference is to provide definitive costs (dollar figures) for each mitigation strategy/action, this is not possible for every mitigation strategy/action. Therefore, the estimated costs for the mitigation initiatives identified in this Plan were identified as high, medium, or low, using the following ranges:

- **High**—Existing funding will not cover the cost of the project; implementation would require new revenue through an alternative source (for example, bonds, grants, and fee increases).
- **Medium**—The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low**—The project could be funded under the existing budget. The project is part of or can be part of an ongoing existing program.

1.22.1.4 Mitigation Strategy/Action Prioritization Process

The action plan must be prioritized according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Building Resilient Infrastructure and Communities (BRIC) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

The priorities are defined as follows:

- **High Priority**—A project that meets multiple objectives (i.e., multiple hazards), has benefits that exceed cost, has funding secured or is an ongoing project and meets eligibility requirements for the HMGP or BRIC grant program. High priority projects can be completed in the short term (1 to 5 years).
- **Medium Priority**—A project that meets goals and objectives, that has benefits that exceed costs, and for which funding has not been secured but that is grant eligible under HMGP, BRIC or other grant programs. The project can be completed in the short term, once funding is secured. Medium priority projects will become high priority projects once funding is secured.
- **Low Priority**—A project that will mitigate the risk of a hazard, that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for HMGP or BRIC grant funding, and for which the timeline for completion is long term (1 to 10 years). Low priority projects may be eligible for other sources of grant funding from other programs.

For many of the strategies identified in this action plan, the partners may seek financial assistance under the HMGP or HMA programs, both of which require detailed benefit/cost analyses. These analyses will be performed on projects at the time of application using the FEMA benefit-cost model. For projects not seeking financial assistance from grant programs that require detailed analysis, the partners reserve the right to define “benefits” according to parameters that meet the goals and objectives of this plan.

1.22.2 Mitigation Alternatives and Strategies

Plan participants assessed and included a comprehensive range of hazard mitigation strategies/actions, including strategies from FEMA documents, strategies from the 2016 Waukesha County Hazard Mitigation Plan and suggestions from participating communities and their respective stakeholders during a series of workshops that took place throughout the County in August of 2021.

Each of the participating communities, including Waukesha County, were invited to participate in a series of workshops in which goals, objectives, and strategies were discussed, identified, updated and prioritized. Each participant in this session was provided with a number of resources to help them identify relevant mitigation strategies. These include the following documents:

- Mitigation Examples Handout (see Appendix C. Mitigation Project Examples)

All potential strategies that arose through this process are included in this Plan. A final draft of the Plan was presented to all stakeholders to allow them to provide final edits and approval of the strategies and their priority.

One of the benefits of using the Online Planning System was to ensure neighboring communities had full visibility of each other's mitigation initiatives. This was done to ensure synergies were identified, when applicable, and that mitigation actions in one community would not adversely impact another nearby community.

Standard: Federal Emergency Management Agency (FEMA) 2011 Local Mitigation Plan Review Guide
ELEMENT C. MITIGATION STRATEGY

C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))

Standard: Federal Emergency Management Agency (FEMA) 2011 Local Mitigation Plan Review Guide
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)

D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))

1.22.2.1 Mitigation Strategies by County Agencies/Departments

The mitigation strategies and actions from county departments/agencies, and those actions that are applicable to all participating jurisdictions, are included in **Volume 2**. Also included are those mitigation actions that benefit multiple jurisdictions. They can be found here:

- Countywide Mitigation Actions/Projects
- Multi-Jurisdictional Mitigation Actions/Projects

Each entities' Mitigation Strategies & Actions are organized as follows:

- **New Mitigation Actions**—New actions identified during this 2021 update process
- **Ongoing Mitigation Actions**—These ongoing actions were included in the previous update and have yet to be completed. Some of these actions have no definitive end. During the 2021 update, these "ongoing" mitigation strategies/actions were modified and/or amended, as needed, to better define the strategy/action.
- **Completed Mitigation Actions**—Completed actions since 2016. Completed actions also included a brief description of the "Resulting Reduction or Limitation of Hazard Impact(s) Achieved" in order to show the resulting benefits of implementing the mitigation initiative.

1.22.2.2 Mitigation Strategies by Community

The mitigation strategies and actions from the participating jurisdictions are included in **Volume 2**.

- Volume 2: Waukesha County Hazard Mitigation Plan 2021: Municipalities

They include:

- **New Mitigation Actions**—New actions identified during this 2021 update process
- **Ongoing Mitigation Actions**—These ongoing actions were included in the previous update and have yet to be completed. Some of these actions have no definitive end. During the 2021 update, these "ongoing" mitigation strategies/actions were modified and/or amended, as needed, to better define the strategy/action.
- **Completed Mitigation Actions**—Completed actions since 2016. Completed actions also included a brief description of the “Resulting Reduction or Limitation of Hazard Impact(s) Achieved” in order to show the resulting benefits of implementing the mitigation initiative.

1.22.2.3 Summary of Mitigation Strategies

The following table represents a summary of new and ongoing mitigation projects. For a complete and more detailed description of each mitigation project, please see Volume II.

Applicable Jurisdiction	Mitigation Actions	Priority	Status
Countywide	Study and identify flood-prone areas not mapped in FEMA's maps	High	New
Countywide	Study and develop flooding map and analysis of chronic areas	Medium	New
Countywide	Procure portable generators for key assets and to use during emergency incidents	Medium	New
Countywide	Purchase All Terrain Vehicles to support incident response	Medium	New
Countywide	Purchase Hydraulic Door Spreader	Medium	New
Countywide	Continue to promote the increased use of National Oceanic and Atmospheric Administration (NOAA) weather radios	Medium	Ongoing
Countywide	Continue supporting volunteer recruitment and engagement in the County	Low	Ongoing
Countywide	Integrate the usage of AlertSense mass community notification system into emergency plans, procedures and practice in the county. Promote enrollment into Alertsense.	High	Ongoing
Countywide	Continue to add/update Emergency Management Department links on the existing county web site. Publicize the website to show the community what is there.	High	Ongoing
Countywide	Each municipality should complete a survey of the municipality's siren need and capability; and ensure that maintenance, monitoring and usage policies/procedures remain current as defined by each jurisdiction.	Low	Ongoing
Countywide	County should be prepared to provide disaster-related information to farmers (e.g., crop irrigation, crop insurance)	Low	Ongoing
Countywide	Prepare/publicize water usage information for non-farm areas during drought	Low	Ongoing
Countywide	*Continue updating GIS mapping data on regular five-year cycle.	Medium	Ongoing
Countywide	*Continue public outreach efforts for flood mitigation efforts.	Medium	Ongoing
Countywide	*Provide information to citizens about the purchase of flood insurance	Medium	Ongoing
Countywide	Provide public information via website links or brochures regarding safe driving procedures in the fog	Low	Ongoing
Countywide	Continue to provide outreach efforts to stakeholders on protecting homes and structures from wildfires and on obtaining the proper burn permits	Low	Ongoing
Countywide	Conduct outreach to stakeholders regarding wildfires caused by railroads	Low	Ongoing
Countywide	Continue public outreach and information sharing on severe temperature preparedness	Medium	Ongoing
Countywide	Continue to provide sheltering services to citizens in need during an emergency or disaster, and update the County Waukesha County Mass Care Plan.	High	Ongoing
Countywide	Place hail storm safety materials in county display rack, on the website and during severe weather week.	Medium	Ongoing
Countywide	Provide information regarding the purchase of crop insurance	Low	Ongoing
Countywide	Continue lightning awareness and safety outreach through the website and social media, especially during severe weather week	Medium	Ongoing

Countywide	Provide information regarding the use of fire-resistant materials and surge protectors.	Low	Ongoing
Countywide	Continue thunderstorm awareness and safety outreach through the website and social media, especially during severe weather week	Medium	Ongoing
Countywide	Work with local fair/ festival boards, as requested, to create emergency plans in case of inclement weather.	Medium	Ongoing
Countywide	Fund a study to revise rainfall classifications from a recurrence interval standard to a simple scale like those used for hurricanes, tornadoes and earthquakes with the goal of making it easier for the public to understand. Calling major rainstorms that have occurred multiple times in a short period of time the “100-year storm” confuses the public and misleads them into thinking they need not protect themselves against such storms since they are “rare.”	Medium	Ongoing
Countywide	Explore the feasibility of constructing tornado shelters in areas where deficient especially in mobile home parks and campgrounds.	Medium	Ongoing
Countywide	Encourage builders and owners of manufactured and mobile homes to use tie-downs with ground anchors. Procure funding sources to support implementation.	Medium	Ongoing
Countywide	Explore the feasibility of increasing the wind resistance of the roofs of community storm shelters.	Low	Ongoing
Countywide	Promote tornado awareness, including safety measures.	Medium	Ongoing
Countywide	Promote winter hazards awareness, including home and travel safety measures	Medium	Ongoing
Countywide	Maintain the proper amount of resources (e.g., salt) to properly manage winter storms.	High	Ongoing
Countywide	The County would like additional Road Weather Information System (RWIS) monitoring system stations.	Low	Ongoing
Countywide	The county would like to have AVL (automatic vehicle locator) and routing software for snowplows to increase efficiency and reduce waste.	Low	Ongoing
Countywide	Complete a survey to determine which railroad intersection safety systems do not have electrical power back-ups. Seek funding sources based on survey results.	Low	Ongoing
Countywide	Consider back-up power needs. The county purchased two large (100KW) portable generators with the major goal of providing power at any mass clinic site but can be used at shelters if not needed for a clinic. May need to evaluate if this is sufficient for sheltering operations.	High	Ongoing
Multi-Jurisdiction: Cities of Oconomowoc and Waukesha; Waukesha County, Village of Hartland	Support communities working toward and to maintain the National Weather Service “Storm Ready” designation	Low	Ongoing
Multi-Jurisdiction: Waukesha Co; Cities of Brookfield, Delafield, Muskego, New Berlin, Oconomowoc, Pewaukee, Waukesha; Villages of Big Bend, Butler, Chenequa, Dousman, Eagle, Elm Grove, Hartland, Lac La Belle, Lannon, Menomonee Falls, Merton, Mukwonago, Nashotah, North Prairie, Oconomowoc Lake, Pewaukee, Sussex, Wales; Town of Mukwonago	Look for an acceptable (environmentally, socially, cost-benefit, politically, etc.) solution for removing water from flood-prone areas, especially those areas that are basin/bowl shaped. Seek out funding sources (grants) to execute solutions.	High	Ongoing
Multi-Jurisdiction: Town & Villages of Mukwonago, Lake Nagawicka (City of Delafield and Village of Nashotah), Saylesville Lake (TN Genesee)	Work with the DNR on dam safety and flooding issues, including better communication and emergency plans.	Medium	Ongoing

Multi-Jurisdiction: Town, Village and City of Oconomowoc	Continue planning discussions regarding flooding issues caused by dam management procedures with the goal of creating agreements to reduce the flooding in downstream municipalities.	Medium	Ongoing
Multi-Jurisdiction: VI of Menomonee Falls, CI & TN of Brookfield, VI of Big Bend & VI of Vernon, TN of Genesee, VI of Summit, CI & VI of Waukesha, CI of Pewaukee	Raise floodplain county roads that get overtopped by water out of the danger zone.	High	Ongoing
Multi-Jurisdiction: Southern Kettle Moraine including the Villages of Eagle and Dousman	Provide ample training for volunteer fire fighters for larger wildfires	Medium	Ongoing
Multi-Jurisdiction: State DOT, Waukesha County Highway, VL & TN of Mukwonago, Village of Elm Grove	Create additional locations for road salt storage: The county would like one, large 15,000 lb salt dome for state and county usage. Village and Town of Mukwonago would like additional storage in a smaller salt domes.	High	Ongoing
Multi-Jurisdiction: Cities of Pewaukee and Waukesha	The Cities of Pewaukee and Waukesha would like to have truck-mounted water pumps to serve as back-ups to the stationary pumps in an electrical failure	Medium to High	Ongoing
Multi-Jurisdiction: Villages of Big Bend, Chenequa, Eagle, Hartland, Lac La Belle, North Prairie and Wales	Evaluation options for providing shelters, with back-up power generators (or panels to accept portable generators), within the municipalities.	Medium to High	Ongoing
Multi-Jurisdiction: WCTC, Village of Pewaukee	WCTC would like to add five additional storm water retention basins as part of the Master Facilities Plan.	Low to Medium	Ongoing
Multi-Jurisdiction: WCTC, Village of Pewaukee	Continue working on existing hazard mitigation activities at the Waukesha County Technical College (WCTC), including: Installing a water retention pond at the base of a hill that separates WCTC's property from the Pewaukee High School. Meeting with local residents with concerns over walking trails eroded by rain in 2008-09 and described some planned repairs.	Medium to High	Ongoing
Multi-Jurisdiction: WCTC, Village of Pewaukee	WCTC would like to add five additional storm water retention basins as part of the Master Facilities Plan.	Low to Medium	Ongoing
City of Brookfield	Study and implement strategic actions to build resiliency in utility and power infrastructure, to include, but not limited to: Burying strategic overhead powerlines, where appropriate, improving and upgrading utility infrastructure to be more resilient to wind, ice, and other natural disasters.	High	New
City of Brookfield	Floodproofing Buildings	High	New
City of Brookfield	Purchase generators and appropriate hookups	High	New
City of Brookfield	Upgrade Sanitary Sewer System	High	New
City of Brookfield	Upgrade and improve storm sewers to mitigate the effects of flooding.	Medium	New
City of Brookfield	Purchase and raze repetitive loss structures from flood prone areas or where properties are subject to surface water drainage up to and into the house. Project would also include regrading property to provide detention of runoff to reduce drainage issues elsewhere in the neighborhood.	High	Ongoing
City of Brookfield	Provide backwater valves to property owners subject to basement backups.	Medium	Ongoing
City of Muskego	Evaluate and implement hazard mitigation measures for properties that have a history of damage due to overland flooding.	Medium/High	Ongoing
City of Muskego	Upgrade the lift station to 5 million gallons per day.	High	Ongoing
City of New Berlin	Procure backup generators and appropriate hookups	High	New
City of New Berlin	Install Sprinkler System at critical city storage facilities.	High	New
City of New Berlin	Implement the mitigation measures in the City of New Berlin's Stormwater Management Plan a possible.	Medium/High	Ongoing
City of Oconomowoc	Procure generators and appropriate hookups	High	New
City of Oconomowoc	Universal Electrical Generators	Medium	New
City of Pewaukee	Study and implement alternative transportation routes to mitigate impact and safety concerns posed by rail lines.	Medium	New

City of Pewaukee	Continue exploring the feasibility of creating a Storm Water Management District in the City of Pewaukee to fund mitigation projects.	Medium	Ongoing
City of Waukesha	Study and implement flood management measures to mitigate flooding along the Fox River.	Medium	New
City of Waukesha	Study and implement flood acquisition of property impacted by repetitive flooding	Medium	New
City of Waukesha	Provide inspectors and city staff with enhanced communications devices to more efficiently conduct and communicate damages during an incident.	Low	New
City of Waukesha	Burying utility infrastructure	High	New
City of Waukesha	Provide funding to property owners in floodplains to take measures to flood-proof existing structures.	Medium	New
City of Waukesha	Provide training to city staff to become certified in floodplain management.	Medium	New
City of Waukesha	Procure generators and appropriate hookups.	Low	New
City of Waukesha	Purchase a portable generator to provide power at sewage pump stations.	High	New
City of Waukesha	Purchase and install an emergency backup generator at West Bluemound Lift Station	Medium	New
City of Waukesha	Purchase and install an emergency backup generator at Springbrook Lift Station	Medium	New
City of Waukesha	Purchase and install an emergency backup generator at East Bluemound Pump Station	Medium	New
City of Waukesha	Provide flood protection for sewer pump station at Waukesha Airport	Medium	New
City of Waukesha	Purchase a 4" Diesel Towable Trash Pump for flooding and/or sewer bypass pumping	Medium	New
City of Waukesha	Purchase a trash pump to support flood response capabilities	Medium	New
City of Waukesha	Procure and install an emergency generator to provide power to the secondary treatment train (Bldg. 220)	Medium	New
City of Waukesha	Study and procure land for a temporary debris storage and reduction site (TDSR)	High	New
City of Waukesha	Upgrade and upsize storm sewers	Medium	New
City of Waukesha	The City of Waukesha would like to upgrade its ICP: ICP - Upgrade the ICP (tear out walls, add computers, CAD station, streaming video)	High	Ongoing
City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Drainage Area 1: Rolling Ridge Dr. and N. University Dr. The stormwater infrastructure improvements resulting from the detailed modeling evaluations included a combination of additional stormwater conveyance capacity, and new pond storage. The increased conveyance capacity is to be accomplished with new storm sewers, new sewers parallel to existing sewers, replacing existing sewers with larger storm sewers, and replacing undersized culverts.	High	Ongoing
City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Drainage Area 2: N. University Dr., Darrell Dr., and Patrick Ln. The improvements resulting from the detailed modeling included a combination of additional stormwater conveyance capacity, and increased pond capacity. The increased conveyance capacity is to be accomplished with new sewers parallel to existing sewers, and replacing existing sewers with larger storm sewers.	High	Ongoing

City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Drainage Area 3: Airport Business Park and Peters Dr. The modeled improvements for Area 3 included only minor areas of increased conveyance, including new sewers north of Peters Drive and parallel sewers east of Aviation Drive.	High	Ongoing
City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Drainage Area 4: Frame Park Creek at Harding Ave. and Anoka Ave. The modeled improvement for Area 4 was the addition of below-grade storage northeast of the intersection of Harding and Anoka Avenues.	High	Ongoing
City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Drainage Area 5: Lawndale Ave. and S. Washington Ave. Stormwater infrastructure improvements for Area 5 included underground storage at Waukesha Memorial Hospital and additional stormwater conveyance in the form of new and parallel storm sewers west and south of the new storage to convey flows toward an existing pond in Woodfield Park.	High	Ongoing
City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Darien Area 6: E. Moreland Blvd . at Wolf Rd. Several alternatives were considered for Area 6, including a storage alternative that involved multiple ponds, and a conveyance alternative that increased the capacity along existing storm sewer routes. A third alternative that added additional conveyance capacity while directing the water under Moreland Boulevard to the Fox River instead of west along Greenway Terrace was also developed, and selected as the preferred alternative. This alternative included replacement sewers, parallel sewers and new sewers along Moreland Boulevard.	High	Ongoing
City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Drainage Area 7: Summit Ave. and Michigan Ave. Stormwater infrastructure improvements for Area 7 included new stormwater ponds at of UW-Waukesha, Summit View Elementary School and Lowell Park. Increases in conveyance capacity are accomplished with new, parallel, and replacement storm sewers, primarily located along Summit Avenue, Garland Avenue, Greenmeadow Drive and Michigan Avenue.	High	Ongoing
City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Drainage Area 8: S. West Ave., S. Grand Ave., and S. East Ave. at W. Sunset Dr. The modeled improvements in Area 8 included storage and conveyance alternatives. The preferred alternative was a conveyance alternative that included replacement, parallel and new storm sewers. The storm sewers generally convey flows from north to south and east to west along Tenny Avenue, Sunset Drive and East Avenue; Grand Avenue; Vitoria Drive Bard Street and West Avenue; and the former railway right-of-way.	High	Ongoing

City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Drainage Area 9: W. Newhall Ave. at S. West Ave. Stormwater infrastructure improvements for Area 9 include a combination of new storage and conveyance. Replacement sewers are to be located along Newhall Avenue west toward the treatment plant, and new storage at the former location of Department of Motor V eludes building.	High	Ongoing
City of Waukesha	Complete projects recommended in the City of Waukesha City-Wide Storm Management Plan in areas deemed vulnerable: Drainage Area 10: Merrill Crest Park. The modeled improvements in Area 10 included a combination of new storage and additional conveyance. The modifications included parallel storm sewers along Shoshone Drive that drain into new storage in Merrill Crest Park.	High	Ongoing
Village of Big Bend	Procure DPW and fire department backup generator and appropriate hookups	High	New
Bulter Village	Provide shoreline erosion control and abatement to stabilize current riverbed and surrounding shoreline to minimize flooding potential and restore/maintain the environment for natural growth of vegetation and wildlife.	Medium	New
Bulter Village	Procure generator and appropriate hookups at critical facilities.	High	New
Village of Chenequa	Conduct Tree Maintenance on all Public Roads	High	New
Village of Chenequa	Provide Employee Hazard Training	Medium	New
Village of Dousman	Study and update aging water system and main, including, but not limited to associated connections to mains and valves.	High	New
Village of Elm Grove	Study and implement mitigation measures to relocate and/or divert creek that is experiencing significant erosion.	High	New
Village of Elm Grove	Relocating flow of the creek bed for flood control	High	New
Village of Elm Grove	Monitor severe weather advisories regarding extreme dry conditions.	Low	Ongoing
Village of Elm Grove	Minor stormwater conveyance systems should be designed to provide protection from a ten-year recurrence interval event. Major stormwater conveyance systems should be designed to provide protection from a 100-year recurrence interval event.	Medium	Ongoing
Village of Elm Grove	Public and private drainage ways, both natural and man-made, should be kept free from obstructions. Easements should be obtained to protect drainage ways and allow access for maintenance. Ordinances should be adopted to enforce protection of and access to drainageways. A maintenance schedule has been developed to keep the stormwater system functioning.	High	Ongoing
Village of Elm Grove	A comprehensive process should be put in place to review filling and grading of public and private parcels to assure that all stormwater management issues are addressed. Public education needs to create an awareness of the problems that can occur with improper filling and grading by homeowners. Engineering review, permitting, inspection and enforcement will be incorporated into the development and redevelopment of property.	Medium	Ongoing
Village of Elm Grove	As private wells provide a direct channel to the community's water resource, wells should be brought into compliance with current WDNR regulations. This would include well casings that terminate at least twelve inches (12") above the ground and twenty-four inches (24") above the base flood elevations in flood hazard zones. Well caps should be sealed.	Medium	Ongoing

Village of Elm Grove	Floodplain zoning ordinances should be actively enforced. Policies should be established to address structures located in flood hazard zones. Policies could include elevation of structures, flood proofing, removal of structures, the provision of detention storage and modification of stream channels and/or bridges. If these alternatives are not feasible, the structures should be isolated from the municipal sanitary sewer system.	Medium	Ongoing
Village of Elm Grove	A comprehensive Stormwater Management Plan, including development and evaluation of alternative plans to abate problems caused by flooding, inadequate drainage, and nonpoint source pollution; development of a recommended plan; and establishment of procedures for plan implementation, should be adopted.	High	Ongoing
Village of Elm Grove	Monitor severe thunderstorm weather advisories, since hailstorms tend to occur in conjunction with severe thunderstorms.	Medium	Ongoing
Village of Elm Grove	Monitor severe thunderstorm weather advisories, since lightening tends to occur in conjunction with severe thunderstorms	Medium	Ongoing
Village of Elm Grove	Monitor severe thunderstorm weather advisories.	Medium	Ongoing
Village of Elm Grove	Monitor severe weather advisories if at risk for tornadoes.	Medium	Ongoing
Village of Elm Grove	Continue active coordination with the Waukesha County Emergency Warning System.	Medium	Ongoing
Village of Elm Grove	Monitor severe weather advisories if at risk for winter storms.	High	Ongoing
Hartland	Study and implement bank stabilization/erosion control projects	High	New
Hartland	Study and implement utility resilience measures, such as, but not limited to: burying powerlines	Medium	New
Hartland	Obtain Storm Ready designation	Medium	New
Lannon Village	Procure and/or replace generator and appropriate hookups	High	New
Village of Menomonee Falls	Study and implement appropriate improvements and repairs at Lepper Dam.	High	New
Village of Merton	Procure generator and appropriate hookups for Village Hall	High	New
Village of Mukwonago	Shore stabilization and erosion control measure	High	New
Village of Mukwonago	Develop an emergency shelter plan for the village.	Medium	New
Village of Mukwonago	Provide stormwater facilities in historic areas	High	New
Village of Mukwonago	Modify bridges to withstand flooding	Medium	New
Village of Mukwonago	Install backup generators	High	New
Village of Mukwonago	Replace water and sewer lines.	High	New
Village of Mukwonago	Install generator	High	New
Village of Mukwonago	Replace the south gate on the Phantom Lake Dam	High	New
Village of Mukwonago	Develop a hazardous materials mitigation plan	Medium	New
Village of Mukwonago	Cybersecurity response plan, procedures, and equipment	High	New
Village of Mukwonago	Bury overhead powerlines	Medium	New
Village of Mukwonago	The north bank of the Mukwonago River needs to be stabilized to control erosion from North Main (Hwy ES) to Highway 83.	High	Ongoing
Village of Mukwonago	The Village of Mukwonago would like to upgrade their old water utility pumps.	Low	Ongoing
Village of North Prairie	Procure generators and appropriate hookups for municipal buildings	High	New
Village of North Prairie	Study and procure an early warning siren to warn residents	Medium	New
Village of Pewaukee	Purchase generator and appropriate hookup at key sites, such as well #3	High	New
Village of Pewaukee	Develop COOP plan	High	New
Village of Pewaukee	Develop an All-Hazards Emergency Operations Plan (EOP)	High	New
Village of Pewaukee	Install a back-up generator at Well #3 in the Village of Pewaukee.	Medium to High	Ongoing
Village of Summit	Establish tree management program. Conduct tree pruning near power lines and removal of dead/diseased trees	Medium	New
Village of Summit	Create a hazardous materials release plan	High	New

Village of Summit	Study, develop, and implement a fuel shortage plan and strategy.	High	New
Village of Summit	Develop power outage plan/strategy and implement measures to ensure power is available at key facilities during a prolonged power outage situation. Measures include, but are not limited to: Harden utilities to ensure greater resiliency to natural and manmade hazards. Procure generators and hookups for key facilities. Study and explore sustainable microgrid alternatives to ensure continuity of power.	High	New
Village of Summit	Ongoing maintenance and enforcement of the Mitigation Handbook. Distribute handbook to residents, as needed	High	Ongoing
Village of Sussex	Study and relocate, if necessary, buildings vulnerable to flooding. Sites include, but are not limited to: Parks Buildings	Medium	New
Village of Sussex	Purchase generators and appropriate hookups	High	New
Village of Sussex	Study and implement water looping measures for certain portions of the Village.	Medium	New
Village of Sussex	Install a back-up generator in the Village of Sussex public safety building.	High	Ongoing
Village of Sussex	Generator for Public Safety Building	High	Ongoing
Village of Wales	Install generator and appropriate hookups at the community building	Medium	New
Village of Wales	Maintain and clean storm basins and implement a culvert replacement strategy to mitigate flooding	Low	New
Village of Wales	Improve public awareness and education, including, but not limited to: updating Village website to include county, state, and federal emergency management and preparedness sites, and increase presence on social media.	Low	New
Village of Wales	Procure funds and build a salt shed to increase winter weather response and safety capabilities	Medium	New
Village of Wales	Remove old, diseased or damaged trees that are a risk for damaging property in a severe storm.	Medium	Ongoing
Village of Waukesha	Establish shelter and procure equipment for extreme heat/cold and winter storms events	High	New
Village of Waukesha	Study and fix/replace undersized or failing culverts to mitigate flooding issues	High	New
Village of Waukesha	Establish emergency backup power. Procure generators and appropriate hookups, and implement mitigation measures to ensure power supply and equipment are resilient to surge and lightning.	High	New
Town of Brookfield	Study and implement electric/powerline relocation or improvements to mitigate power outages in Summit Lawn Estates/Black Forest Knoll subdivisions.	High	New
Town of Brookfield	Purchase backup generators and appropriate hookups	High	New
Town of Brookfield/City of Brookfield	Study and implement flood mitigation alternatives in high-risk areas, such as, but not limited to: Barker Rd/Poplar Creek, Deer Creek Corridor, Dousman Ditch/Underwood Creek Corridor, Briar Ridge Dr/Timberline Dr, Brook Park Subdivision, I-94/Springdale Road	Medium	New
Brookfield Town	Brook Park Pond Outlet structure emergency repair to address flood/erosion issues.	High	Ongoing
Brookfield Town	Brook Park Pond Dr/Gray Fox Drive reconstruction to address flooding issues	High	Ongoing
Brookfield Town	Poplar Creek Streambank stabilization and restoration to address erosion and flooding issues.	High	Ongoing
Town of Delafield	Study and implement improvements on Elmhurst Road, such as increasing the culvert capacity, to mitigate future flooding.	High	New
Town of Delafield	Mitigate flooding on Cushing Park Road	Medium	New
Town of Genesee	Implement measures to prepare town for tornados and high winds, such as, but not limited to: removing trees, hardening utilities, and better educating residents.	High	New

Town of Genesee	Upgrade internet wiring, routers and broadband infrastructure to build resiliency against cyberattacks	Medium	New
Town of Genesee	Purchase generators and appropriate hookups in all town buildings	High	New
Town of Genesee	Mitigate concerns and issues on Saylesville Dam	High	New
Town of Genesee	Study and improve road infrastructure (i.e. roads and culverts) to mitigate flooding and potential for washouts. Areas of concern include, but are not limited to: Grush Road, Paint Rd, Hillside Rd, Holiday Rd, Quail Run, Bartell Rd, Spring Ridge, St Davids Rd, Morris Rd, and Old Village Rd.	High	New
Town of Lisbon	Procure generators and appropriate hookups for key locations, such as, but not limited to: Mobile Home Park and Town Hall	Medium	New
Lisbon, Sussex	Update railroad crossing to ensure safety and improved access. Study and implement appropriate measures, such as consideration for a bridge.	High	New
Town of Lisbon	Continue working on the acquisition and demolition project on Maple Aveneue in the Town of Lisbon	High	Ongoing
Town of Lisbon	Property Acquisition	High	Ongoing
Town of Mukwonago	Obtain generators and provide safe rooms at town hall and elementary schools	High	New
Town of Mukwonago	Tree removal program along roadways	Medium/High	New
Town of Mukwonago	Review, replace, and assess undersized culverts	Medium/High	New
Town of Mukwonago	Pond Staging	High	New
Town of Mukwonago	Address flooding and roadway repairs associated with the Country Bliss subdivision. The preliminary solution is to install a force main and pumping station to take accumulated water out of a natural basin and pump it out.	High	Ongoing
Town of Oconomowoc	Place powerlines underground in the Okauchee area	High	New
Town of Oconomowoc	Procure generators and appropriate hookups for all town facilities	High	New
Town of Ottawa	Continue to review and monitor stop logs for damage on Mill Pond Dam	Medim	New
Town of Ottawa	Procure generator and appropriate hookups for Town Hall	Low	New
Town of Ottawa	Study and replace culverts under Gramling Lane to mitigate flooding	Medium/High	New
Town of Ottawa	Implement mitigation for undersized or clogged culverts.	Medium	New
Eagle Springs Lake Management District	Rehabilitation of existing dry hydrant system	Medium	New
Eagle Springs Lake Management District	Conduct Dam Failure Analysis	High	New
Eagle Springs Lake Management District	Repair and replace aging segments of the water control systems	High	New
Eagle Springs Lake Management District	Improve Kroll Outlet Discharge System	High	Ongoing
Western Lakes Fire District	Replace/install backup electrical generators	High	New
Western Lakes Fire District	Obtain various materials designed to contain, absorb, and slow hazardous materials from contaminating the environment	High	New
Western Lakes Fire District	Purchase towable backup electric generators	High	New
Western Lakes Fire District	Procure Portable Changeable Message (PCM) signs for public notification	High	New
Western Lakes Fire District	Identify and procure a debris removal site for the temporary holding of debris	Medium	New
Western Lakes Fire District	Establish and promote a public education program	High	New
Western Lakes Fire District	Purchase portable hazardous materials air monitors to identify air quality	High	New

1.22.3 Plan Integration Strategy

Many of the strategy recommendations in the previous section have relationships to other plans and policies for which coordination, integration and consistency is vital. These related plans tend to fall within the following general categories:

- Local capital improvements plans and other budget documents. Most notable are infrastructure projects, such as those related to stormwater systems, water supplies, warning sirens, and communications equipment, which may be considered as part of local budgets. For instance, since the 2011 Plan, significant road and flood mitigation improvements have been made in some areas which may have addressed past overland flooding concerns.
- Regulations, agreements, and related procedures. These strategies are primarily identified in the policy strategies. Amendments can often be performed in concert with other ordinance updates. Some related actions may be accomplished procedurally without an ordinance amendment.
- Existing emergency operating or response plans. Many local municipalities continue to update their emergency plans and procedures. County Emergency Management and other County offices will also work cooperatively with stakeholders regarding plans, procedures, and grant applications related to the issues identified within this plan.

Mitigation planning is on a different schedule than comprehensive planning, with most comprehensive plans likely to be updated no more frequently than once per decade.

The Environmental Scan completed by the Waukesha County Health and Human Services Department was integrated into the 2021 Hazard Mitigation Plan.

While the mitigation plan was not specifically referenced in most participant comprehensive plans, some of the mitigation recommendations are included as comprehensive plan policies. Most communities with 100-year floodplains included strategies in their comprehensive plans to discourage or not allow any floodplain development, and are implementing these policies through floodplain zoning.

Stormwater management and emergency services are other common themes in many local comprehensive plans. Even so, greater effort is needed to ensure that the hazard mitigation plan is considered during other local planning efforts, and vice versa.

As the mitigation plan strategies reflect, Waukesha County will continue to work with County Planning and Zoning Departments and local municipalities to encourage coordination and consistency between comprehensive planning and the hazard mitigation plan, and provide instruction on how to incorporate mitigation strategies into their comprehensive plans and other planning mechanisms.

Since key County staff were actively involved in the development and update of the County mitigation plan, many of the mitigation strategies are based on staff recommendations and give confidence that a high level of coordination between these various planning efforts will continue.

Plan Name	How the Document was Used
2016 Wisconsin Hazard Mitigation Plan	Risk assessment data Served as the primary framework for the 2021 update
National Climatic Data Center	Historical data for natural hazards
2020-22 Waukesha County Department Strategic Plans	Provided valuable data for the Community Profile
2019-2021 Growth Strategy	Community/Business Profile data

Standard:

Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element C: Mitigation Strategy

- C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? 44CFR 201.6 (c)(4)(ii)
  - C6.1. Description of the community's process for integrating data from the hazard mitigation plan into other planning mechanisms (for each participating jurisdiction)
  - C6.2. Identification of local planning mechanisms where hazard mitigation information may be incorporated
  - C6.3. For plan updates: explanation of how the jurisdiction(s) incorporated the previous mitigation plan, when appropriate, into other planning mechanisms

Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Plan Maintenance Process

- 19. Incorporation into Existing Planning Mechanisms; Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.
-
  - 19.A. Does the new or updated plan identify other local planning mechanisms available for incorporating the mitigation requirements of the mitigation plan?

- 19.B. Does the new or updated plan include a process by which the local government will incorporate the mitigation strategy and other information contained in the plan (e.g., risk assessment) into other planning mechanisms, when appropriate?
- 19.C. Does the updated plan explain how the local government incorporated the mitigation strategy and other information contained in the plan (e.g., risk assessment) into other planning mechanisms, when appropriate?

1.22.4 Mitigation Implementation and Progress

The emphasis in the following sections is on mitigation activities for each hazard as a major component of overall emergency management. Mitigation or prevention activities reduce the degree of long-term risk to human life and property from natural and man- made hazards. The cooperation of government, academia, the private sector and volunteer agencies is essential in mitigation efforts.

Hazard Analysis and Previous Mitigation Projects ensure that county mitigation information is shared and it is incorporated into their planning as appropriate. Each community will be given a copy of the plan to use as a reference during their own preparedness activities (i.e., planning, training, permitting, zoning). Communities that have their own comprehensive plan will reference this mitigation plan and its contents in the next scheduled plan update. Municipalities that do not have comprehensive plans either are under the purview of and request assistance from the Waukesha County Planning, Resources and Land Management Department or have their own planning departments. Members of the County Planning, Resources and Land Management Department and municipal planning departments were included on the Hazard Mitigation Workgroup and are aware of the benefits and requirements to utilizing this plan as they go about their preparedness activities.

Waukesha County and its municipalities have a considerable history of identifying, planning and completing hazard mitigation projects including these, which received supplemental funding:

Hazard Mitigation Grant Program

- City of Brookfield (1997, DR-1180) – Acquisition of one residential structure. $139, 203.
- Village of Menomonee Falls (1997, DR-1180) – Acquisition of 11 residential structures. $1,969,799.
- City of Brookfield (1998, DR-1236) – Acquisition of one residential structure. $140,060.
- Village of Elm Grove (1998, DR-1236) – Acquisition of one residential structure and one commercial structure. $921,601.
- Village of Menomonee Falls (1998, DR-1236) – Acquisition of two residential structures. This project was a continuation of the DR-1180 project for Menomonee Falls. $397,396.
- City of New Berlin (1998, DR-1236) – Acquisition of 1 residential structure. $93,947.
- Village of Elm Grove (2000, DR-1332) – Acquisition of two apartment buildings. $943,638.
- Village of Elm Grove (2002, DR-1429) – Acquisition of one commercial structure. $208,400.
- Waukesha County (2021) - Fox River Watershed Mitigation Plan

Flood Mitigation Assistance Program

- City of Brookfield (1999) – Flood Mitigation Plan approved by FEMA on 1-14-02. $10,000
- City of Brookfield (2000) – Acquisition of one repetitive loss property (Supplemented FMA 2000 funds). $46,267.
- City of Brookfield (2001) - Acquisition of one repetitive loss property (Supplemented FMA 2000 funds). $140,219.

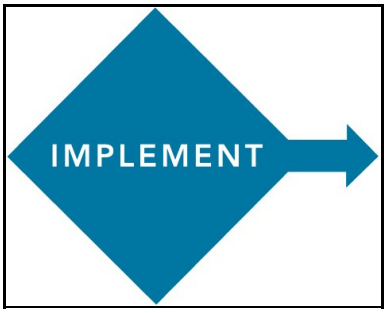
Pre-Disaster Program

- Village of Elm Grove (2002) – All-Hazards Mitigation Plan; was approved. $4,369.
- Waukesha County (2007C) - All-Hazards Mitigation Plan. $63,976.

Community Development Block Grant – Community Facilities

- Village of Menomonee Falls (FY99-0504). CDBG DRA grant to acquire two of ten floodplain properties (land and buildings). $171,261.
- WI Department of Natural Resources – Municipal Flood Control
- Village of Elm Grove (3/1/02–8/31/04, MFC-67122-A-02) – Underwood Creek Flood Control Property Acquisition. $744,678.
- City of Brookfield (3/1/02–6/30/03, MFC-67206-A-02-UNDER)
- Underwood Creek Flood Storage Property Acquisition. $257,004.
- City of New Berlin (1/1/06-12/31/07, MFC-67261-06) – U-314 Fullerton Avenue Property. $147,070.
- City of Brookfield (12/15/06-12/15/08, MFC-67206-06) – Calhoun Dam Removal and Channel Restoration. $207,922.50.

1.23 Plan Maintenance Strategy



VIII. Plan Maintenance & Implementation

The Disaster Mitigation Act of 2000 requires the monitoring, evaluation and updating of the hazard mitigation plan every five years. This hazard mitigation plan is designed to be a "living" document and therefore will be reviewed and updated within five years from its approval date. The Waukesha County Hazard Mitigation Steering Committee will provide leadership and guidance throughout the plan's life cycle (i.e., monitoring, evaluating and updating.) Updates will allow municipal leaders and the public to provide input into the process. The public will be notified of this opportunity via legal public notices.

The Waukesha County Hazard Mitigation Plan maintenance process includes a schedule for annual monitoring and evaluation of the programmatic outcomes established in the Plan and for producing a formal Plan revision every five years.

Formal Review Process

The Plan may be reviewed on an annual basis by the Emergency Management Coordinator and reviewed and revised every five years by the committee to determine the effectiveness of programs and to reflect changes that may affect mitigation priorities. The Emergency Management Coordinator or designee will be responsible for contacting the Mitigation Steering Committee members and organizing the review. Committee members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan. The Committee will review the goals and action items to determine their relevance to changing situations in the County as well as changes in Federal policy, and to ensure they are addressing current and expected conditions. The Committee will also review the risk assessment portion of the Plan to determine if this information should be updated or modified, given any new available data. The organizations responsible for the various action items will report on the status of the projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised or removed.

The Coordinator or designee will be responsible for ensuring the updating of the Plan. The Coordinator will also notify all holders of the Plan and affected stakeholders when changes have been made. Every five years the updated plan will be submitted to Wisconsin Emergency Management and to the Federal Emergency Management Agency for review.

Continued Public Involvement

Waukesha County Emergency Management is dedicated to involving the public directly in the review and updates of the Plan. The Coordinator is responsible for the review and update of the Plan. The public will also have the opportunity to provide input into Plan revisions and updates. Copies of the Plan will be kept by appropriate County departments and outside agencies.

Public meeting will be held when deemed necessary by the Coordinator. The meetings will provide a forum where the public can express concerns, opinions, or new alternatives that can then be included in the Plan. The Coordinator will be responsible for using County resources to publicize the public meetings and maintain public involvement.

To further facilitate continued public involvement in the planning process, Waukesha County will ensure that:

- The Waukesha County Office of Emergency Management will keep a copy of the plan on hand at their office for review and comment by the public.
- Waukesha County Office of Emergency Management will conduct outreach after a disaster event to remind members of the importance of mitigation and to solicit mitigation ideas to be included in the plan.

Monitoring, Evaluation, and Updating the Plan

To ensure the County Hazard Mitigation Plan continues to provide an appropriate path for risk reduction throughout the County, it is necessary to regularly evaluate and update it. The Waukesha County Office of Emergency Management will be responsible for monitoring the status of the plan and gathering appropriate parties to report of the status of Mitigation Actions. The Mitigation Steering Committee will convene on an annual basis to determine the progress of the identified mitigation actions. The Mitigation Steering Committee will also be an active participant in the next plan update. As the County Hazard Mitigation Plan matures, new stakeholders will be identified and encouraged to join the existing Mitigation Steering Committee.

The Waukesha County Office of Emergency Management is responsible for contacting committee members and organizing the annual meeting. The Committee's responsibilities include:

- Annually reviewing each goal and objective to determine its relevance and appropriateness.
- Monitor and evaluate the mitigation strategies in this plan to ensure the document reflects current hazard analyses, development trends, code changes

and risk analyses and perceptions.

- Ensure the appropriate implementation of annual status reports and regular maintenance of the plan. The committee will hear progress reports from the parties responsible for the various implementation actions to monitor progress.
- Create future action plans and mitigation strategies. These should be carefully assessed and prioritized using benefit-cost analysis (BCA) methodology that FEMA has developed.
- Ensure the public is invited to comment and be involved in mitigation plan updates.
- Ensure that the County complies with all applicable Federal statutes and regulations during the periods for which it receives grant funding, in compliance with 44 CFR.
- Reassess the plan in light of any major hazard event. The committee will convene within 45 days of any major event to review all applicable data and to consider the risk assessment, plan goals, objectives, and action items given the impact of the hazard event.
- Review the hazard mitigation plan in connection to other plans, projects, developments, and other significant initiatives.
- Coordinate with appropriate municipalities and authorities to incorporate regional initiatives that transcend the boundaries of the County.
- Update the plan every five years and submit for FEMA approval.
- Amend the plan whenever necessary to reflect changes in State or Federal laws and statutes required in 44 CFR.

The Five Year Action Plan

This section outlines the implementation agenda that the Mitigation Committee should follow five years following adoption of this plan, and then every five years thereafter. The Mitigation Steering Committee, led by the Waukesha County Office of Emergency Management, is responsible to ensure the Hazard Mitigation Plan is updated every five years.

The Committee will consider the following an action plan for the first 5-year planning cycle. It should be noted that the schedule below can be modified as necessary and does not include any meetings and/or activities that would be necessary following a disaster event (which would include reconvening the Mitigation Steering Committee within 45 days of a disaster or emergency to determine what mitigation projects should be prioritized during the community recovery). If an emergency meeting of the Mitigation Steering Committee occurs, this proposed schedule may be altered to fit any new needs.

Year 0:

- 2021/22: Update Hazards Mitigation Plan, including a series of Mitigation Steering Committee meetings & Public meetings. Submit 2021/22 Hazard Mitigation Plan for FEMA approval.
- March 2022 – December 2022: Work on Mitigation Actions, Waukesha County Office of Emergency Management to stay in contact with lead departments to keep tabs on project status.

Year 1:

- January 2023 - February 2023: Prepare for and promote first annual Plan Review and Public meetings.
- March 2023: Reconvene Committee for first annual Mitigation Steering Committee meeting. Introduce the concept of Mitigation Plan Integration with other planning documents. Host first annual Public meeting.
- April 2023 – December 2023: Work on Mitigation Actions, the Waukesha County Office of Emergency Management to stay in contact with lead departments to keep tabs on project status. Encourage plan integration efforts.

Year 2:

- January 2024 - February 2024: Prepare for and promote second annual Plan Review and Public meetings.
- March 2024: Reconvene Committee for second annual Mitigation Steering Committee meeting. Review plan integration efforts. Host second annual Public meeting.
- April 2024 – December 2024: Work on Mitigation Actions, the Waukesha County Office of Emergency Management to stay in contact with lead departments to keep tabs on project status. Encourage plan integration efforts.

Year 3:

- January 2025 - February 2025: Prepare for and promote third annual Plan Review and Public meetings.
- March 2025: Reconvene Committee for third annual Mitigation Steering Committee meeting. Review plan integration efforts. Host second annual Public meeting.
- April 2025 – December 2025: Work on Mitigation Actions, the Waukesha County Office of Emergency Management to stay in contact with lead departments to keep tabs on project status. Encourage plan integration efforts. Seek grant funding to udpate 2027 Hazard Mitigation Plan update.

Year 4:

- January 2026: Begin updating 2027 Hazard Mitigation Plan.
- February 2026 – December 2026: Update 2027 Hazard Mitigation Plan.

Year 5:

- January 2027: Submit 2027 Hazard Mitigation Plan.
- March 2027: Adopt 2027 Hazard Mitigation Plan.

Annual Mitigation Steering Committee Meetings

During each annual Mitigation Steering Committee meeting, the Committee will be responsible for a brief evaluation of the 2021/22 Hazards Hazard Mitigation Plan and to review the progress on Mitigation Actions.

Plan Evaluation

To evaluate the plan, the Mitigation Steering Committee should answer the following questions:

- Are the goals and objectives still relevant?
- Is the risk assessment still appropriate, or has the nature of the hazard and/or vulnerability changed over time?
- Are current resources appropriate for implementing this plan?
- Have lead agencies participated as originally proposed?
- Has the public been adequately involved in the process? Are their comments being heard?
- Have departments been integrating mitigation into their planning documents?

If the answer to each of the above questions is “yes,” the plan evaluation is complete. If any questions are answered with a “no,” the identified gap must be addressed.

Review of Mitigation Actions

Once the plan evaluation is complete, the Committee must review the status of the Mitigation Actions. To do so, the Mitigation Steering Committee should answer the following questions:

- Have the Mitigation Actions been implemented as planned?
- Have outcomes been adequate?
- What problems have occurred in the implementation process?

Meeting Documentation

Each annual Mitigation Steering Committee meeting must be documented, including the plan evaluation and review of Mitigation Actions. Mitigation Actions have been formatted to facilitate the annual review process.

Implementation through Existing Programs

Hazard mitigation practices must be incorporated within existing plans, projects and programs. Therefore, the involvement of all departments, private non-profits, private industry, and appropriate jurisdictions is necessary in order to find mitigation opportunities within existing or planned projects and programs. To execute this, the Waukesha County Office of Emergency Management will assist and coordinate resources for the mitigation actions and provide strategic outreach to implement mitigation actions that meet the goals and objectives identified in this plan.

Standard:

Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element A: Planning Process

- A5. Is there discussion on how the community/-ies will continue public participation in the plan maintenance process? 44 CFR 201.6(c)(4)(iii)
  - A5.1. How the jurisdiction(s) will continue to seek public participation after plan approval and during plan implementation, monitoring, and evaluation
- A6. Is there a description of the method and schedule for keeping the Plan current (monitoring, evaluating, and updating the mitigation plan within a 5-year cycle)? 44 CFR 201.6(c)(4)(i)
  - A6.1. How the Plan will be monitored (monitoring means tracking the implementation of mitigation actions over time)
  - A6.2. When the Plan will be monitored
  - A6.3. By whom the Plan will be monitored (title of individual or name of department or agency)
  - A6.4. How the Plan will be evaluated (evaluating means assessing the effectiveness of the Plan at achieving its stated purpose and goals)
  - A6.5. When the Plan will be evaluated
  - A6.6. By whom the Plan will be evaluated (title of individual or name of department or agency)
  - A6.7. How the Plan will be updated (updating means reviewing and revising the plan at least once every five years)
  - A6.8. When the Plan will be updated
  - A6.9. By whom the Plan will be updated (title of individual or name of department or agency)
- C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? 44CFR 201.6 (c)(4)(ii)
  - C6.4. For plan updates: description of how the mitigation strategy will continue to be incorporated into other planning mechanisms

Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Plan Maintenance Process

- 18. Monitoring, Evaluating, and Updating the Plan; Requirement §201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
  - 18.A. Does the new or updated plan describe the method and schedule for monitoring the plan, including the responsible department?
  - 18.B. Does the new or updated plan describe the method and schedule for evaluating the plan, including how, when and by whom (i.e. the responsible department)?

- 18.C. Does the new or updated plan describe the method and schedule for updating the plan within the five-year cycle?

- 20. Continued Public Involvement; Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.
  - 20.A. Does the new or updated plan explain how continued public participation will be obtained? (For example, will there be public notices, an on-going mitigation plan committee, or annual review meetings with stakeholders?)

1.24 Appendix A: Notice of Endorsement & Adoption

Upon formal approval, Notices of Endorsement and Adoption will be obtained and provided in this section for each jurisdiction in the County.

Notice of Endorsement and Adoption

In the Waukesha County All Hazard Mitigation Plan

I, _____, Mayor for the City/Village/Town of _____

do hereby endorse and agree to participate in the implementation of the Waukesha County

All Hazard Mitigation Plan as it applies to this jurisdiction.

DATED this _____day of _____, 2022

Signed: _____

Mayor

Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Prerequisites

- 2. Multi-Jurisdictional Plan Adoption; Requirement §201.6(c)(5): For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.
  - 2.B. For each jurisdiction, has the local governing body adopted the new or updated plan?
    - 2.C. Is supporting documentation, such as a resolution, included for each participating jurisdiction?

1.25 Appendix B: Public Outreach & Participation

Appendix B provides additional information that documents plan participation.

Standard

Wisconsin Emergency Management (WEM) Mitigation Crosswalk; Element A: Planning Process

- A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? 44 CFR 201.6(c)(1). Involved in the process means engaged as participants and given the chance to provide input affecting the Plan's content; plan updates must include documentation of the current planning process.
    - A1.5. How each jurisdiction was involved
    - A1.A Recommended documentation: narrative description, meeting agendas and sign-in sheets, meeting minutes, newspaper articles, copies of letters or surveys distributed.
- A3. Does the Plan document how the public was involved in the planning process during the drafting stage? 44 CFR 201.6(b)(1) and (c)(1)
    - A3.1. How the public was given the opportunity to be involved (must be prior to final approval/adoption)
    - A3.2. How public feedback was incorporated into the Plan

Federal Emergency Management Agency (FEMA) Local Mitigation Standard 2014; Planning Process; §201.6(b): An open public involvement process is essential to the development of an effective plan.

- 4. Document the Planning Process; Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved
    - 4.C. Does the new or updated plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)

1.25.1 Planning Meetings and Documentation

Webinar:

Link: Registration, June 22, 2021

Link: Registration, June 28, 2021

Link: Webinar Invite

Link: Webinar PowerPoint

Mitigation Workshops:

Link: Workshop Flyer

Link: Hazards Handout

Link: New Mitigation Actions Handout

Link: Mitigation Actions Handout

Link: Mitigation Workshop PowerPoint

Link: Sign-in Sheets for Workshops

1.25.2 Public Participation Documentation

Press Releases and Notices:

Multiple press releases and meeting notices were issued to encourage greater participation and input into the Hazard Mitigation Plan. Social media was leveraged to promote the survey and public meetings.

Link: Press Release - Waukesha County Residents Invited to Participate in Community Preparedness Study

Link: Press Release - Open House to Provide Input Into the Waukesha County Hazard Mitigation Plan

Handouts Used in Public Meetings:

Link: Public Meeting Agenda

Link: Public Meeting PowerPoint

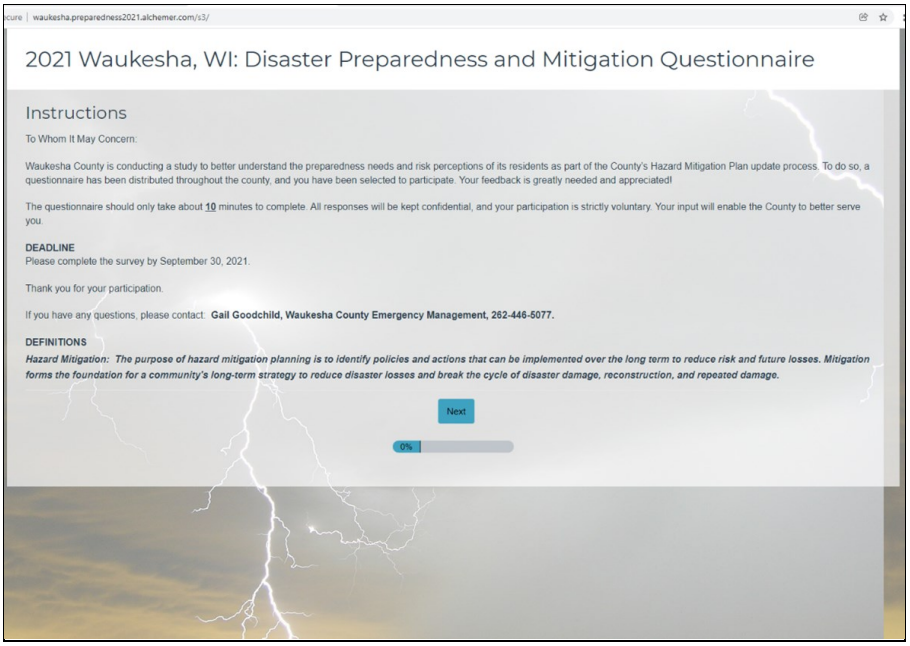
Sign-in Sheet for Public Meeting:

Link: Sign-in Sheet

1.25.3 Hazard Mitigation Questionnaire & Results

373 questionnaires were completed during the course of this planning process. In total, 622 residents entered the survey.

Please click the link to access the following: **Hazard Mitigation Questionnaire Results**



1.26 Appendix C: Mitigation Project Examples

Purpose: The following handout was provided to Steering Committee members, agency/organization representatives, and members of the public to solicit additional mitigation actions for the 2021 update.

Instructions: Please adapt the following examples to the mitigation needs of your jurisdiction and/or organization. These are only **examples**, and does not represent an all-inclusive list of potential actions.

Mitigation planning is best accomplished from a multi-hazard perspective. Reducing the level of risk involving one natural or technological hazard may increase the risk of damage from another hazard. Consequently, it is important to consider that some mitigation alternatives may not be viable given a particular set of hazard conditions.

ALL HAZARDS

MOUs and Agreements

Local governments should establish mutual aid agreements for utility and communications systems, including 9-1-1. Mutual aid or interagency agreements have value for preventing or responding to other hazard or emergency situations, as fire and police departments often do.

- Establish Mutual-Aid Memorandum of Understandings (MOUs) and agreements with key organizations [List the Organization]

Planning and Preparedness

- Continue to improve the Waukesha County Hazard Mitigation Plan through annual reviews and incorporation of incident lessons learned
- Conduct annual review of the Waukesha County Emergency Operations Plan
- Perform Continuity of Operations planning to identify critical functions, essential personnel, vital resources, and critical infrastructure within the county that is necessary to maintain public safety and services
- Expand the community cross-section and membership of the Local Emergency Planning Committee and research methods to increase its role within the county emergency management program.
- Once a community is familiar with the location of its hazardous areas; it may adopt a land use plan, or modify an existing land use plan to:
  - Encourage greater development restrictions on the property.
  - Guide developments away from hazardous areas
  - Reduce density in the hazardous area
- Site Emergency Plans or Emergency Action Plans: Communities can encourage development and testing of internal emergency plans and procedures, including COOP planning, by businesses and other organizations. Communities should develop and test site emergency plans for schools, factories, office buildings, correctional facilities, recreation areas, and other similar facilities.
- Real estate disclosure: Real estate disclosure laws are important because they force a seller to advise a potential buyer about pre-existing conditions. This allows buyers to make more informed decisions about the potential risks involved in owning property, such as whether a property is located in a floodplain or if it had been previously damaged from flood water or any other type of hazard condition.
- Family Disaster Plans and Supply Kits: Communities can encourage residents to prepare themselves by stocking up with necessary items and planning for how family members should respond if any of a number of possible emergency or disaster events strike.

Warning, Public Information and Education

- Enhance awareness and preparedness of residents through CERT and facilitate community training requests for emergency preparedness education
- Continue to enhance emergency preparedness information available to citizens and visitors through the county website and community outreach opportunities
- Make available “new resident” packets to inform residents of potential hazards and threats, and to inform them of warning and outreach tools that are available in the County.
- Develop a multi-faceted public awareness campaign to increase citizen enrollment in the Waukesha County Emergency Alert System.
- Continue to enhance the communication network related to the delay or closure of county facilities and roadways.
- Install electronic warning signage and permanent road closure barriers on key highways [List Highway or Road]
- Increase use of weather radio announcements to enhance the redundancy of public information delivery in severe weather situations throughout the county.
- Develop season-specific fliers to address hazards and ways each resident (or part-time residents) can mitigate their own risks and mail to residents with their water/utility bill.
- Update [insert community] Website with Emergency Information
- Communities can encourage the use of National Oceanic and Atmospheric Administration (NOAA) weather radios among their residents. NOAA Weather Radio continuously broadcasts National Weather Service forecasts, warnings and other crucial weather information. NOAA Weather Radio also provides direct warnings to the public for natural, man-made, or technological hazards, and it is the primary trigger for activating our country’s Emergency Alert System (EAS) on commercial radio, television, and cable systems.

NATURAL HAZARDS

Drought

- Support state and local tax credits for the installation of water-conserving plumbing and other devices as retrofits.
- Develop water conservation plans, preferably on a watershed basis, that includes emergency conservation measures or directives and the triggers for implementation of each measure or directive.

Severe Temperatures

- Ensure that local plans are in place to manage extreme heat/cold events, especially should power outages accompany the extreme temperature event.
- Ensure that local communities have adequate shelter facilities with properly trained coordinators and/or managers that can address the needs of at-risk populations such as the elderly, the homeless, the disabled and families.
- Ensure that local communities have an adequate monitoring system for housebound at-risk populations.
- Bury water/sewer lines deeper under the streets to prevent frozen main lines
- Install SCADA monitoring on City Water and Sewer Systems

Winter Storms

- Ensure local plans include preparation for and management of the response to winter storm events and especially long-term disruption of power supplies and transportation infrastructure.
- To the extent practical, utilities should be designed and built to resist damage and loss of service during winter storm events, such as placing line underground where appropriate.
- Improve the traffic control on rural roads that are subject to snow drifting and white-out driving conditions.
- Family and Traveler Emergency Preparedness: A local or state government can produce and distribute family and traveler emergency preparedness information relating to severe winter weather hazards.
- Driver Safety: Safety strategies for severe weather events can be included in driver education classes and materials.
- Animal Protection: Farmers and other animal custodians should plan for addressing livestock or other animal needs.
- Snow Fences: Using snow fences or “living snow fences” (rows of trees or other vegetation) can limit blowing and drifting of snow over critical roadway segments.

Tornado, Winds, Hail, Lightning and Severe Thunderstorms

- Identify hazard notification systems that are device-neutral or do not require a personal device to receive warnings.
- Obtain increased funding (or continued funding) for stand-alone safe rooms, safe rooms linked to schools and communities facilities, and community shelters to prevent the future loss of life.
- Require manufactured homes to use tie-downs with anchors [If applicable]
- Establish severe weather protective areas within county parks and open space.
- Develop a sign retrofitting or new sign program to decrease their vulnerability to wind hazards.
- Surge Protectors and Lightning Protection: Surge protection can be installed on critical electronic equipment. Lightning protection devices and methods, such as lightning rods and grounding, can be installed on a community’s communications infrastructure and other critical facilities.
- Construction Standards and Techniques: To strengthen public and private structures against severe wind damage, communities can require or encourage wind engineering measures and construction techniques that may include structural bracing, straps and clips, anchor bolts, laminated or impact-resistant glass, reinforced pedestrian and garage doors, window shutters, waterproof adhesive sealing strips, or interlocking roof shingles. Also, architectural design can make roofs less susceptible to uplift.
- Temporary Debris Disposal: Temporary debris disposal sites can be protected by fencing and/or located away from populated areas.
- Tree Management: Tree pruning near power lines can reduce the potential for trees falling on and breaking power lines.

Flooding

Ninety percent of federal disaster declarations are for flood events. Response and recovery costs can be extremely high, so where risks are apparent it makes sense to take actions that prevent damage from occurring. If flood damage cannot be fully prevented, there may be mitigation techniques that lessen the damage. Flooding addressed in this section can be from high ground water, overland flooding from rivers or streams, or from a dam failure.

- Support the update of out-of-date flood insurance maps, if applicable.
- Support federal action to develop and disseminate maps that show flood hazards under future conditions such as increased impervious area upstream and potential effects of climate change. To the extent practicable, maps should predict the extent of flooding at least 50 years into the future.
- Consider additional stream gauges, especially in communities with repetitive flood events or repetitive (flood) loss structures.
- Relocate, elevate, and/or floodproof flood-prone property – especially those properties identified as historically or culturally significant to the community.
- Maintain dry-access roads by elevating them above the base flood elevation [if applicable]
- Roads are needed to get people and goods from place to place. In addition to planning for traffic control during floods, there are various construction and placement factors to consider when building roads. To maintain dry access, roads should be elevated above the base flood elevation. However, if a road creates a barrier it can cause water to pond. Where ponding is problematic, drainage and flow may be addressed by making changes to culvert size and placement. In situations where flood waters tend to wash roads out, construction, reconstruction, or repair can include not only attention to drainage but also stabilization or armoring of vulnerable shoulders or embankments.
- Develop an integrated strategic flood warning plan that addresses the repair, repositioning, or upgrade of existing flood warning systems.
- Conduct channel stabilization, improvement, and restoration in [insert] to allow greater drainage and water flow capacity.

- Provide a public education program to inform residents about mitigation measures and means for them to protect themselves and their property during a flood.
- Land with structures may be purchased by and titled in the name of a local governing body that can remove structures and enforce permanent restrictions on development.
- Zoning Ordinance Adoption or Amendments: Examples of zoning methods that affect flood hazard mitigation include: 1) adopting ordinances that limit development in the floodplain; 2) limiting the density of developments in the floodplain; and 3) requiring that floodplains be kept as open space.
- Subdivision Ordinances or Amendments: Subdivision design standards can require elevation data collection during the platting process. Lots may be required to have buildable space above the base flood elevation.
- Building Code Adoption or Amendments: Requirements for building design standards and enforcement include the following possibilities: 1) that a residential structure be elevated; and 2) that a non-residential structure be elevated or floodproofed.
- Conservation Easements: Conservation easements may be used to protect environmentally significant portions of parcels from development. They do not restrict all use of the land. Rather, they direct development to areas of land that are not environmentally significant.
- Purchase of Easement/Development Rights: Compensating an owner for partial rights, such as easement or development rights, can prevent a property from being developed contrary to a community's plan to maintain open space. This may apply to undeveloped land generally or to farmland in particular.
- Stormwater Management Ordinances or Amendments: Stormwater ordinances may regulate development in upland areas in order to reduce stormwater run-off. Examples of erosion control techniques that may be employed within a watershed area include proper bank stabilization with sloping or grading techniques, planting vegetation on slopes, terracing hillsides, or installing riprap boulders or geotextile fabric.
- Storm Drainage Systems: Flood mitigation can involve installing, re-routing, or increasing the capacity of a storm drainage system that may involve detention and retention ponds, drainage easements, or creeks and streams. It can include separation of storm and sanitary sewerage systems as well as higher engineering standards for drain and sewer capacity.
- Drainage System Maintenance: At most times, a drainage system will do its job and move water to intended areas. However, if a system is not maintained, erosion, material dumping, or deterioration of man-made reinforcement materials may reduce the carrying capacity of a stream. Therefore, regular maintenance, such as sediment and debris clearance, is needed so that the stream may carry out its design function. Also important is detection and prevention/discouragement of discharges into storm-water/sewer systems from home footing drains, downspouts or sump pumps.
- Multi-Jurisdiction Cooperation Within Watershed: Forming a regional watershed council helps bring together resources for comprehensive analysis, planning, decision-making, and cooperation.
- Post-Disaster Recovery Ordinance: A post-disaster recovery ordinance regulates repair activity, generally depending on property location. It prepares a community to respond to a disaster event in an orderly fashion by requiring citizens to: 1) obtain permits for repairs, 2) refrain from making repairs, or 3) make repairs using standard methods.
- Hazardous and Buoyant Material Protection: Containers of hazardous materials such as petroleum or chemicals should not be located in a flood hazard area. If such a location is necessary, hazardous material containers need to be anchored, because the contents can contaminate water and multiply the damaging effects of flooding by causing fires or explosions, or by otherwise making structures unusable. Also, buoyant materials should be anchored, because if they float downstream, they may cause additional damage to buildings or bridges or may plug a stream resulting in higher flood heights.
- Manufactured Homes: Manufactured or mobile homes should be elevated above the base flood elevation and anchored, or more preferably, kept out of the floodplain.
- Back-up Generators: A community may consider back-up generators for pumping and lift stations in sanitary sewer systems, along with other measures (e.g., alarms, meters, remote controls, and switchgear upgrades).
- Basement Backflow Prevention: Depending on its infrastructure capabilities, a community may encourage the use of check valves, sump pumps, and backflow prevention devices in homes and buildings.

Earthquakes

- Local mapping of fault zones and liquefaction areas as a part of larger all-hazards mapping efforts.
- Local retrofit programs that use best engineering standards for structures located in seismic zones.
- Recognize the potential of earthquake-induced landslides in land-use and development plans.
- Require that local plans and codes in seismically-active areas include identification of fault zones, fault setbacks and seismic construction standards that are specific to the seismic risks faced (e.g. liquefaction vs. bedrock movement.)
- Seek grant funding and tax incentives to encourage the appropriate buy-out or retrofit of unprotected structures in seismically-active areas.
- Improve the structural integrity of essential facilities [Identify the facility]
- School Survey Procedures: Schools are critical facilities not only because of the special population they accommodate, but also because they are often identified as shelter sites for a community. Due to this sheltering role, it is essential that these buildings function after a seismic event. A community can develop a survey procedure and guidance document to inventory structural and non-structural hazards in and near school buildings. Survey results can be used to determine mitigation priorities that can be incorporated into capital improvement plans.
- Buildings as Structural Hazards: Homeowners and businesses can take simple measures to strengthen their buildings before the next earthquake. Bracing walls and bolting sill plates to the foundation are examples. Non-reinforced masonry buildings and non-ductile concrete facilities are particularly vulnerable to ground shaking. These buildings should be strengthened and retrofitted against future seismic events.
- Non-Structural Hazards: Many injuries in earthquakes are caused by nonstructural hazards, such as attachments to buildings. These include lighting fixtures, windows (glass), pictures, tall bookcases, computers, ornamental decorations on the outside of the buildings (like parapets), gas lines, etc. Activities that can reduce the risk of injury and damage include: anchoring tall bookcases and file cabinets, installing latches on drawers and cabinet doors, restraining desktop computers and appliances, using flexible connections on gas and water lines, mounting framed pictures and mirrors securely, and anchoring and bracing propane tanks and gas cylinders.
- Bridge Strengthening: State and local highway departments should review construction plans for all bridges to determine their susceptibility to collapse. Problem bridges should be retrofitted.

Wildfires

- Continue to develop and require standards for homes and other structures in the wildland-urban interface—that emphasizes fire-safe construction.
- Recognize the importance and value of vegetation management ("defensible space") in the wildland-urban interface in rural and urbanizing areas and encourage the development of incentives for creating and maintaining defensible spaces around at-risk structures, such as using the Firewise Communities program.
- Require that planning include multiple and adequate ingress and egress routes to vulnerable areas.
- Increase the number of Fire Wise Communities in the County.
- Conduct forest mitigation procedures to reduce the amount of fuel loading especially in areas that have a high residential population.
- Improve rural roads to ensure that emergency vehicles can provide a quick response to keep Wildland Fires small.
- Roads and driveways should be kept accessible to emergency vehicles and fire equipment. Driveways should be relatively straight and flat, with at least some open spaces to turn. Bridges should be strong enough to support emergency vehicles, with clearance wide and high enough for two-way traffic and emergency vehicle access. Addresses should be visible from the road, and keys to gates around property should be provided to the local fire department.
- Spotters: Early detection of wildfires, while fires are smaller, can help make fire fighting more successful. Detection can be accomplished by fire spotters who work from either towers or planes.
- Establish a large scale evacuation plan of the wildland urban interface (WUI) including a mass sheltering plan for such an incident.
- Provide for public education forums to teach residents how to build "eye-pleasing" defensible space into their property.
- Conduct an analysis identifying areas in the county that may benefit from the installation of cisterns or hydrants to provide water delivery during firefighting operations.

MANMADE HAZARDS

Power/Utility Failure

Public utilities are critical infrastructure for any community. The potential for failure needs to be reviewed, and inadequacies need to be addressed.

- Obtain Generators for Critical Infrastructure: A community may consider burying electric and telephone lines, where possible, to resist damage from severe winds, lightning, ice, and other hazards.
- System Redundancies: One place where redundancies are recommended is in utility and communications systems, especially lifeline systems, e.g., essential public utilities. The intention is that if one system fails, the other shadow system can take over.
- Lightning Protection: Electrical and communications systems should be protected from lightning strikes.
- Tree Trimming: Tree trimming and maintenance is important for preventing limb breakage and for safeguarding nearby utility lines. A model measure would be to establish a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public right-of-ways.
- Digging Hotlines: Most, if not all, states have a utility damage prevention hotline that people can call before digging.
- Vulnerable Populations: Communities can develop programs/networks for contacting and assisting elderly or homebound persons during periods of infrastructure failure.

Hazardous Materials Release (HAZMAT)

- Conduct a hazardous materials flow study for high volume road and rail ways within the county.
- Increase the number of personnel trained as HAZMAT technicians and specialists to elevate the County's response capability.
- Public Awareness and Worker Education: The Emergency Planning and Community Right-to-Know Act (EPCRA), also known as SARA Title III, provides an infrastructure at the state and local levels to plan for chemical emergencies. Facilities that store, use, or release certain chemicals may be subject to reporting requirements. Reported information is publicly available so that interested parties may become informed about potentially dangerous chemicals in their community. Employers must also communicate the hazards of workplace chemicals and ensure that workers receive education and training.
- Industrial Site Buffering: Hazardous material exposure can be prevented or reduced by separation and buffering between industrial areas and other land uses. Industrial areas should be located away from schools, nursing homes, hospitals, and other facilities with large or vulnerable populations.

1.27 Appendix D: Federal Funding Sources and Programs

Many local governments are in a quandary to implement measures to secure and protect property with today's economic constraints. Many programs, including FEMA's Pre-Disaster Mitigation Program and the Hazard Mitigation Grant Program, are the victims of budget cuts. DHS' 2006 Emergency Management Performance Grants – Program Guidance and Application Kit states that "emergency managers at all levels should leverage all available funding and resources from multiple sources wherever possible…(and)…should not restrict their activities to only Federal funding to achieve the goals outlined within their strategies. Rather, special attention should be given to leveraging relevant funding sources and resources that support"… mitigation activities.[1] In addition to federal programs, the State homeland security and preparedness programs and resources may be available to meet the objectives outlined in the All-Hazard Mitigation Plan. This section outlines potential funding sources.

FEDERAL PROGRAMS AND FUNDING

DHS: FEMA

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) administered by the Federal Emergency Management Agency (FEMA) provides grants to State, tribal, and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

Building Resilient Infrastructure and Communities (BRIC)

Beginning in 2020, the Building Resilient Infrastructure and Communities (BRIC) grant program, which was created as part of DRRA, replaced the existing Pre-Disaster Mitigation (PDM) program and is funded by a six percent set-aside from federal post-disaster grant expenditures. Through BRIC, FEMA will invest in a wide variety of mitigation activities, including community-wide public infrastructure projects. Moreover, FEMA anticipates BRIC will fund projects that demonstrate innovative approaches to partnerships, such as shared funding mechanisms and/or project design.

Flood Mitigation Assistance Grant Program

The Flood Mitigation Assistance (FMA) Grant Program provides funding to assist States and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program (NFIP). According to the FY 2015 Flood Mitigation Assistance (FMA) Grant Program Fact Sheet, $150,000,000 is available to States, Tribal, Territorial, and local governments. FEMA will prioritize eligible planning and project sub-applications as follows:

Mitigation planning sub-applications consistent with 44 CFR Part 201 up to a maximum of $100,000 federal share per applicant.

Projects that mitigate at least 50 percent of structures that meet definition part (b)(ii) of a Severe Repetitive Loss (SRL) property: At least 2 separate NFIP claim payments have been made with the cumulative amount of such claims exceeding the market value of the insured structure.

Project sub-applications that mitigate at least 50 percent of structures that meet the definition of a Repetitive Loss (RL) property: Have incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event.

Projects that mitigate at least 50 percent of structures meet definition part (b)(i) of a SRL property: 4 or more separate NFIP claims payments have been made with the amount of each claim exceeding $5,000, and with the cumulative amount of claims payments exceeding $20,000.

Projects that will reduce the risk profile in communities through mitigation of the largest number of contiguous NFIP-insured properties.

Repetitive Flood Claims and Severe Repetitive Loss Grant Program

The Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) grant programs were authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108–264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al). According to FEMA, "The SRL Grant Program makes funding available for a variety of flood mitigation activities. Under this program, FEMA provides funds to state and local governments to make offers of assistance to NFIP-insured SRL residential property owners for mitigation projects that reduce future flood losses through:

Acquisition or relocation of at-risk structures and conversion of the property to open space;

Elevation of existing structures; or Dry floodproofing of historic properties.

SRL mitigation grants are provided to eligible applicant states/tribes/territories that, in turn, provide subgrants to local governments or communities. The applicant must have a FEMA-approved mitigation program in place that includes SRL properties" (Guidance for Severe Repetitive Loss Properties, 2011). According to FEMA, "RFC funds may only be used to mitigate structures that are located within a state or community that is participating in the NFIP that cannot meet the requirements of the Flood Mitigation Assistance (FMA) program because they cannot provide the non-federal cost share, or do not have the capacity to manage the activities" (fema.gov).

Mitigation Technical Assistance Program

There are three major mitigation technical assistance programs that provide technical support to state/local communities, FEMA Regional and Headquarters Mitigation staff in support of mitigation initiatives. These programs include the Hazard Mitigation Technical Assistance Program, the National Earthquake Technical Assistance Program, and the Wind and Water Technical Assistance Program. They provide the technical support that is necessary to mitigate against potential loss of lives and minimize the amount of damage as a result of a natural disaster.

Staffing for Adequate Fire and Emergency Response Grant Program

The goal of the Staffing for Adequate Fire and Emergency Response (SAFER) Grant Program is to assist local fire departments with staffing and deployment capabilities in order to respond to emergencies, and assure that communities have adequate protection from fire and fire-related hazards. For FY 2015, an estimated $340,000,000 is set aside to assist fire departments in achieving the SAFER goal. There are two program priorities: to hire firefighters, and to recruit and retain volunteer firefighters.

Fire Prevention and Safety Grant Program

The Fire Prevention and Safety (FP&S) Grant Program had $34,000,000 available in FY 2014 in support of two activities: fire prevention and safety (including general education/awareness, code enforcement/awareness, fire & arson investigation, and national/state/regional programs and studies) and research and development (including clinical studies, technology and product development, database system development, dissemination and implementation research, and preliminary studies).

Homeland Security Grant Program

Comprised of three interconnected grant programs, the Homeland Security Grant Program (HSGP) seeks to support the building, sustainment, and delivery of core capabilities essential to achieving the National Preparedness Goal, which is “A secure a resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that post the greatest risk.” The HSGP grant programs are the State Homeland Security Program (SHSP), the Urban Areas Security Initiative (UASI), and Operation Stonegarden (OPSG).

State Homeland Security Program

In FY 2015, $402,000,000 was allocated to the State Homeland Security Program (SHSP). Although only states and territories can apply for SHSP funds, the program is directed at supporting States, Tribes, and local governments to address high-priority preparedness gaps identified in the Threat and Hazard Identification and Risk Assessment (THIRA) with relation to terrorism. Award methodology is based on the minimum amounts as legislatively mandated (0.35% of total funds for states, Washington D.C., and Puerto Rico and 0.08% of total funds for American Samoa, Guam, the Northern Mariana Islands and the U.S. Virgin Islands), DHS’ risk methodology, and the anticipated effectiveness of proposed projects.

Operation Stonegarden

Operation Stonegarden (OPSG) is designed to support cooperation and coordination between Customs and Border Protection (CBP), the United States Border Patrol (USBP), and local, Tribal, territorial, State, and Federal law enforcement agencies. In FY 2015, $55,000,000 is allocated to this program. States and territories that border Canada, Mexico, or international waters are eligible. Counties and federally-recognized Tribal governments within those states are eligible to apply for funds through their State Administrative Agency (SAA).

Cooperating Technical Partners Program

The Cooperating Technical Partners (CTP) Program seeks to strengthen and increase the effectiveness of the National Flood Insurance Program (NFIP) through fostering relationships among all levels of government to reduce flood losses and promote community resiliency. The total funding for Region 4 in FY 2015 was $12,973,272. The main focus in FY 2015 for the CTP program is to support the mission and objectives of FEMA’s Risk MAP (Mapping, Assessment, and Planning) program.

Emergency Management Performance Grant

In FY 2015, $350,100,000 was allocated to the Emergency Management Performance Grant (EMPG). This program is designed to assist state, local, territorial, and tribal governments to prepare for all hazards. The State Administrative Agency (SAA) or Emergency Management Agency (EMA) can apply for the funding. All 50 states, Washington D.C., and Puerto Rico will receive at least 0.75% of total funding. American Samoa, Guam Northern Mariana Island and the U.S. Virgin Island will each receive at least 0.25% of total funding. The balance will be distributed on a population-share basis.

Homeland Security National Training Program Continuing Training Grants Program

The Homeland Security National Training Program Continuing Training Grants Program (HSNTP/CTG) had $11,521,000 for FY 2015 to be used for training focused on cybersecurity, hazardous materials, countering violent extremism, and rural training. Eligible entities (including state, local, tribal, and territorial entities) must have existing programs or demonstrate expertise relevant to the focus areas.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Immunization Research, Demonstration, Public Information and Education Grants

The Immunization Research, Demonstration, Public Information and Education Grant program assists States, political subdivisions of States, and other public and private nonprofit entities to conduct research, demonstration projects, and provide public information on vaccine-preventable diseases and conditions. Project funds may be used for the costs associated with organizing and conducting these projects, and in certain circumstances, for purchasing vaccine. Requests for direct assistance (i.e., "in lieu of cash") for personnel, vaccines, and other forms of direct assistance will be considered. Funds may not be used to supplant existing immunization program activities.

Immunization Grants

Immunization Grants assist States and communities in establishing and maintaining preventive health service programs to immunize individuals against vaccine-preventable diseases (including measles, rubella, poliomyelitis, diphtheria, pertussis, tetanus, hepatitis B, hepatitis A, varicella, mumps, haemophilus influenza type b, influenza, and pneumococcal pneumonia). Grant funds may be used for costs associated with planning, organizing, and conducting immunization programs directed toward vaccine-preventable diseases and for the purchase of vaccine; and for the implementation of other program elements, such as assessment of the problem; surveillance and outbreak control; information and education; adequate notification of the risks and benefits of immunization; compliance with compulsory school immunization laws; vaccine storage, supply, and delivery; citizen participation; and use of volunteers. Vaccine will be available "in lieu of cash" if requested by the applicants. Requests for personnel and other items "in lieu of cash" will also be considered. Vaccine purchased with grant funds may be provided to private practitioners who agree not to charge for vaccine. Grant funds may be used to supplement (not substitute for) existing immunization services and operations provided by a State or locality.

DEPARTMENT OF THE INTERIOR

River, Trail, and Conservation Assistance Program

The goal of this program is to work with community groups and local and State governments to conserve rivers, preserve open space, and develop trails and greenways; with the goal of helping communities achieve on-the-ground conservation successes for their projects.

ENVIRONMENTAL PROTECTION AGENCY

Wetland Program Development Grants

The Wetland Program Development Grants are designed to assist state, tribal, and local government agencies in building their wetland management programs. Grant funds can be used to develop new or refine existing wetland protection, management or restoration programs. The types of projects funded through this program are very diverse. In the past, states, tribes and local governments have pursued a wide range of activities from very broad policy or regulatory projects, to development of specific technical approaches/methods for wetland health or restoration.

Nonpoint Source Implementation Grants – 319 Program

Through its 319 program, EPA provides formula grants to the states and tribes to implement nonpoint source projects and programs in accordance with section 319 of the Clean Water Act (CWA). Nonpoint source pollution reduction projects can be used to protect source water areas and the general quality of water resources in a watershed. Examples of previously funded projects include installation of best management practices (BMPs) for animal waste; design and implementation of BMP systems for stream, lake, and estuary watersheds; basinwide landowner education programs; and lake projects previously funded under the CWA section 314 Clean Lakes Program. For FY 2014, tribal base grants were from $30,000 to $50,000, and competitive grant awards could be up to $100,000.

Watershed Organizations

EPA recognizes that strong and committed watershed organizations and local governments are necessary partners to achieve the goals of the Clean Water Act and improve our nation's water quality. To support these local efforts, the EPA is working to: build the capacity of watershed organizations to develop and implement sustainable funding plans to obtain achieve environmental results; and, build the capacity of private and public funders to channel their resources towards good watershed initiatives.

US DEPARTMENT OF AGRICULTURE

Emergency Watershed Protection Program

The USDA Natural Resources Conservation Service's (NRCS) Emergency Watershed Protection (EWP) Program helps protect lives and property threatened by natural disasters such as floods, hurricanes, tornadoes, droughts, and wildfires. There are two parts of the program: EWP - Recovery and EWP - Floodplain Easement (FPE).

EWP – Recovery: The EWP Program is a recovery effort program aimed at relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. Public and private landowners are eligible for assistance, but must be represented by a project sponsor that must be a legal subdivision of the State, such as a city, county, township or conservation district, and Native American Tribes or Tribal governments. NRCS may pay up to 75 percent of the construction cost of emergency measures. The remaining 25 percent must come from local sources and can be in the form of cash or in-kind services.

EWP – Floodplain Easement: Privately-owned lands or lands owned by local and state governments may be eligible for participation in EWP-FPE. To be eligible, lands must meet one of the following criteria:

Lands that have been damaged by flooding at least once within the previous calendar year or have been subject to flood damage at least twice within the previous 10 years.

Other lands within the floodplain are eligible, provided the lands would contribute to the restoration of the flood storage and flow, provide for control of erosion, or that would improve the practical management of the floodplain easement Lands that would be inundated or adversely impacted as a result of a dam breach.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Community Development Block Grant Program

The Department of Housing and Urban Development sponsors this program, intended to develop viable communities by providing decent housing and a suitable living environment and by expanding economic opportunities primarily for persons of low and moderate income. Recipients, which include principal cities of Metropolitan Statistical Areas (MSAs), other metropolitan cities with populations of at least 50,000, and qualified urban counties with populations of at least 200,000 (excluding the population of entitled cities), may initiate activities directed toward neighborhood revitalization, economic development, and provision of improved community facilities and services. Specific activities may include public services, acquisition of real property, relocation and demolition, rehabilitation of structures, and provision of public facilities and improvements, such as new or improved water and sewer facilities.

[1] “The Subcommittee on Economic Development, Public Buildings, & Emergency Management Hearing on The National Preparedness System: What are we preparing for?” ; April 14, 2005. http://www.house.gov/transportation/pbed/04-14-05/04-14-05memo.html

1.28 Appendix E: Benefit-Cost Analysis Guidance

Benefit-Cost Analysis is an important mechanism used among local, state, tribal, and federal governments in evaluating hazard mitigation projects. It is a critical part of the hazard mitigation planning process for project development. As part of mitigation project development, strategies in the All Hazard Mitigation Plan should be assessed using a FEMA/DHS approved benefit cost method. This should be done for all projects including ones not intended to be funded by FEMA/DHS grants. This is critical to ensure that all funds, regardless of their source, are appropriately considered. The County does have funds available for mitigation projects, but they are not unlimited, and projects must demonstrate that the benefit is worth the cost.

Benefit-cost analysis compares the benefits and costs of a proposed hazard mitigation project. For example, the benefit of a tornado shelter is the reduction of injury and loss of life. This benefit is monetized using Federal guidelines for injury and loss of life. The costs considered are those necessary to implement and maintain the specific mitigation project under evaluation. The two, benefit and cost, can then be compared.

Costs are generally well determined for specific projects for which engineering design studies have been completed. Benefits, however, must be estimated probabilistically because they depend on the improved performance of the building or facility to future hazard events, the timing and severity of which are random variables. The benefits calculated by the program are expected annual benefits, which are estimated over the useful lifetime of the mitigation project. To account for the time value of money, a net present value calculation must be performed. This calculation is done automatically in the program, using the discount rate and project useful lifetime entered by the user. Results of benefit-cost calculations are presented two ways: first, the benefit-cost ratio (benefits divided by costs) and second, the net benefits (benefits minus costs).

To estimate future damages (and the benefits of avoiding them), the probabilities of future events must be considered. This profoundly affects whether or not a proposed hazard mitigation project is cost effective. Mitigation may not be cost-effective even though a particular facility experienced great damage in a past event due to an event with a low probability of occurrence (i.e., a 500- or 1000-year event). Conversely, mitigation may be cost effective even though the particular facility experienced little or no damage in a past event, due to a higher probability of occurrence.

Technical guidelines developed by FEMA for performing an approved Benefit-Cost Analysis are provided in the June, 2009 FEMA publication “Final BCA Reference Guide”, which can be found online at https://www.fema.gov/media-library/assets/documents/18870. An outline is available below:

FEMA’s Benefit-Cost Analysis (BCA) program

FEMA’s Benefit-Cost Analysis (BCA) program is a key mechanism for evaluating certain hazard mitigation projects to determine eligibility and assist in Federal funding decisions. The FEMA BCA program is comprised of methodologies and software for a range of major natural hazards.

To be eligible for Federal funding assistance, a BCA should show that the project is cost effective and will reduce future damages and losses from natural disasters. Mitigation projects can include: construction projects, education programs, publications or videos, building code enhancements, and mitigation planning activities. A reduction in losses or prevention of future damages is the benefit of the project.

Cost, as it relates to mitigation, is the price to develop and maintain a mitigation project. The project cost estimate, as used in the FEMA mitigation grant guidance, includes all costs associated with the proposed mitigation project, and represents the best estimated costs for the activity.

Estimates are required for the following cost item categories:

- Anticipated cash and in-kind Federal match
- Equipment
- Labor
- Materials
- Subcontract costs

Other costs are those that do not fall neatly into one of these categories, but must be delineated in the BCA if applicable to the project. The FEMA BCA tool utilizes a six-step cost-estimating methodology:

- Step 1: develop an estimate of pre-construction or non-construction costs
- Step 2: develop an estimate of construction costs
- Step 3: develop an estimate of ancillary costs
- Step 4: develop an estimate of annual maintenance costs
- Step 5: adjust the estimate to account for project timing and whether the data is current
- Step 6: review and confirm the cost estimate

The following descriptions cover each hazard type and potential mitigation projects associated with each.

Damage Frequency Approach (DFA)

This module is applicable to any natural hazard as long as a relationship can be established between how often natural hazard events occur and how much damage and losses occur as a result of the events. The advantage of the DFA module is its flexibility—it can be used for a wide range of hazards including

flood, landslides, snow/ice storms, and earthquake mitigation for utility projects. The module requires historical damage data for two or more events and typically provides results that are less accurate than those from the Full Data BCA modules.

Tornado

A tornado is a violent, rotating, funnel-shaped cloud that extends from a thunderstorm to the ground, with winds that can reach 300 miles per hour. A tornado is among the most destructive forces of nature. A tornado is classified by the Enhanced Fujita (EF) Scale, which not only correlates wind speeds with damage, but also takes into account the quality and type of structure that has been damaged to estimate wind speeds. The EF Scale is from EF0 (weakest) to EF5 (strongest).

The Tornado Safe Room module is used for projects providing safe room mitigation for high-wind events, and is used only to evaluate the life safety benefits of the mitigation project. Safe room projects are for tornadoes only.

Wildfire

The Wildland/Urban Interface (WUI) module takes into account LANDFIRE data, timber costs, fire suppression costs, and project effectiveness. WUI fires are essentially wildfires with additional fuel load from structures.

Possible projects include:

- Defensible Space Activities
  - Clearing out all combustibles
  - Minimizing the volume of vegetation
  - Replacing flammable vegetation with less-flammable species
- Hazardous Fuels Reduction Activities
  - Vegetation thinning or reduction of flammable vegetative materials for the protection of life and property
    - Slash removal
    - Vegetation clearing or thinning
    - Vegetation management
    - Vegetation removal
    - Vertical clearance of tree branches
- Ignition-Resistant Construction Activities
  - Involves the use of non-combustible materials and technologies on new and existing structures

Flood

A flood is a partial or complete inundation of normally dry land areas from:

- Overland flow of a lake, river, stream, creek, slough, ditch, or the ocean
- The unusual and rapid accumulation of rainfall runoff or snowmelt
- Mudflows or the collapse of shoreline land

Floods are the most common and most costly of all natural disasters. In fact, most communities throughout the United States will experience some flooding. The Flood module utilizes Flood Insurance Study (FIS) data to establish risk, while providing the most accurate BCA results. This module takes into account probabilities of flooding; building type and associated damages; and the costs of contents, displacement, and loss of function.

Possible projects include:

- Acquisition/ Demolition
- Acquisition/ Relocation
- Dry floodproofing
- Elevation
- Minor localized flood reduction projects including culverts, floodgates, minor floodwall systems, and stormwater management activities.
- Mitigation reconstruction

FEMA will only consider a subapplication for an ignition-resistant construction project when the property owner has previously created defensible space and agreed to maintain the space, or the subapplication includes both the defensible space and ignition-resistant construction project as part of the same project subapplication.

1.29 Appendix F: Acronyms and Definitions

ADA American Disabilities Act
ASFPM Association of State Floodplain Managers
BCA Benefit Cost Analysis
BCR Benefit Cost Ratio
BMPs Best Management Practices
CBP Customs and Border Protection
CDBG Community Development Block Grant
CFR Code of Federal Regulations
CRS Community Rating System
CTP Cooperating Technical Partners
DFO Disaster Field Office
DMA2K Disaster Mitigation Act of 2000
DNR Department of Natural Resources
DOT Department of Transportation
EA Environmental Assessment
EMPG Emergency Management Performance Grant
EOC Emergency Operations Center
EPA Environmental Protection Agency
EWP Emergency Watershed Protection
FCO Federal Coordinating Officer
FEMA Federal Emergency Management Agency
FIA Flood Insurance Administration
FIRM Flood Insurance Rate Map
FIS Flood Insurance Study
FMA Flood Mitigation Assistance
FP&S Fire Prevention and Safety
GIS Geographic Information System
HAZUS
HMPG Hazard Mitigation Grant Program
HMTAP Hazard Mitigation Technical Assistance Program
HSGP Homeland Security Grant Program
HUD Housing and Urban Development
IA Individual Assistance
IAP Incident Action Plan
IBC International Building Code
ICC Increased Cost of Compliance
ICS Incident Command System
LCA Local Capability Assessment
MOU Memorandum of Understanding
MSAs Metropolitan Statistical Areas
NEPA National Environmental Policy Act
NFIP National Flood Insurance Program
NFIRA National Flood Insurance Reform Act
NRCS Natural Resources Conservation Service
OMB Office of Management and Budget
OPSG Operation Stonegarden
PA Public Assistance
PAO Public Assistance Officer
PDA Preliminary Damage Assessment
PDM Pre-Disaster Mitigation
PDM-C Pre-Disaster Mitigation Competitive
RFC Repetitive Flood Claims
RL Repetitive Loss
RLP Repetitive Loss Property
RLR Repetitive Loss Report
SAFER Staffing for Adequate Fire and Emergency Response
SFHA Special Flood Hazard Area
SHMO State Hazard Mitigation Officer
SHMP State Hazard Mitigation Plan
SHS State Historical Society
SHSP State Homeland Security Program
SRL Severe Repetitive Loss
THIRA Threat and Hazard Identification and Risk Assessment
UASI Urban Areas Security Initiative
UDC Uniform Dwelling Code
USBP United States Border Patrol
USDA U. S. Department of Agriculture

UW-EXT University of Wisconsin – Extension
WEM Wisconsin Emergency Management
WIVOAD Wisconsin Volunteer Organizations Active in Disasters