COMMUNITY ASSISTANCE
PLANNING REPORT NO. 332

OZAUKEE COUNTY HAZARD MITIGATION PLAN UPDATE: 2020-2025

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Daniel Birenbaum.....Fire Chief and Department of Public Works, Village of Belgium

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John Hanan.....Emergency Preparedness Coordinator, Washington Ozaukee Public Health Department

Laura Herrick.....Chief Environmental Engineer, Southeastern Wisconsin Regional Planning Commission

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Terry Hoffman.....Staff, WE Energies

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Rich Mueller.....Emergency Manager, Town of Fredonia

Aaron Owens.....Senior Planner, Southeastern Wisconsin Regional Planning Commission

Christina Richards.....Land Information Coordinator, Ozaukee County

Patty Ruth.....Emergency Preparedness Coordinator (retired), Washington Ozaukee Public Health Department

Ben Schliesman.....Southeast Regional Director, Wisconsin Emergency Management

Justin Schoenemann.....Assistant City Administrator, City of Mequon

Roger Strohm.....Director of Public Works, Village of Fredonia

Mario Valdes.....Director of Campus Safety, Concordia University

Sarah Viera.....Executive Director of Business, Mequon-Thiensville School District

Dawn Wagner.....Administrator, Village of Saukville

Patrick Wester.....Assistant Fire Chief and Department of Public Works Director, Village of Belgium

Brian Weyker.....Fire Chief, Village of Fredonia

Tom Zajdel.....Volunteer Emergency Manager, Village of Newburg

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Prepared by the
Southeastern Wisconsin Regional Planning Commission
W239 N1812 Rockwood Drive
P.O. Box 1607
Waukesha, Wisconsin 53187-1607
www.sewrpc.org

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INTRODUCTION AND BACKGROUND 1

1.1 INTRODUCTION

In April 2017, the Southeastern Wisconsin Regional Planning Commission (SEWRPC) and the Ozaukee County Division of Emergency Management agreed to cooperatively prepare an update to the all hazards mitigation plan for Ozaukee County. The plan was designed to be consistent with the guidelines of the Wisconsin Department of Military Affairs, Division of Emergency Management (DMA, DEM), and the Federal Emergency Management Agency (FEMA).[1] The plan was directed to the "all hazards" mitigation approach which the Wisconsin Division of Emergency Management (WEM) and FEMA recommend as an alternative to single hazard mitigation planning. As such, the plan is consistent with the requirements and procedures defined in the Disaster Mitigation Act of 2000. The analysis includes three components: 1) profile and analysis of past hazard events, 2) inventory and vulnerability assessment of community assets, and 3) development of hazard mitigation strategies. Natural hazard conditions, which include flooding; Lake Michigan coastal hazards; severe weather conditions, including wind storms, tornadoes, periods of extreme heat or cold, and winter storms; and hazardous materials situations were specifically considered for the preparation of this hazard mitigation plan. While the plan considered all of the potential hazards, it must be recognized that only limited mitigated actions were feasible for some of these hazards, since they are not site-specific or repetitive in nature.

The Disaster Mitigation Act of 2000[2] (DMA 2000) provides an opportunity for States, Tribes, and local governments to take a new and revitalized approach to mitigation planning. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by repealing the previous Mitigation Planning section (409) and replacing it with a new Mitigation Planning section (322). This new section emphasizes the need for State, Tribal, and local entities to closely coordinate mitigation planning and implementation efforts. Moreover, The Disaster Mitigation Act of 2000 requirements call for local hazard mitigation plans to be reviewed; updated to reflect changes in development, progress in local mitigation efforts, and changes in priorities; and reapproved every five years for local jurisdictions to be able to receive hazard mitigation funding.

The plan was developed as a multi-jurisdictional plan, covering Ozaukee County and all of the municipalities located within the County, including all of the Village of Newburg, which falls within both Washington and Ozaukee Counties. The mitigation planning requirements identified in 44 *Code of Federal Regulations,* Section 201.6 (44 CFR 201.6) call for all jurisdictions participating in a multi-jurisdictional hazard mitigation plan to participate in the planning process. Examples of participation include, but are not limited to, attending planning meetings; contributing research, data, or other information; and commenting on drafts of the plan.

The Ozaukee County Emergency Management Office initially applied for, and received, a hazard mitigation planning grant in 2003. In 2008, Ozaukee County and its municipalities adopted the original Ozaukee County All-Hazards Mitigation Plan. The Ozaukee County Flood Hazard Mitigation Plan,[3] along with other County and municipal plans and ordinances, was used as reference material for the initial Ozaukee County hazard mitigation plan. The initial Hazard Mitigation Plan was approved as both a pre-disaster mitigation plan and a flood mitigation plan. In October of 2013, Ozaukee County updated and adopted the initial Hazard Mitigation Plan. Both the initial Plan and the Plan Update were prepared by Emergency Planning, Training

[1] *Federal Emergency Management Agency, State and Local Mitigation Planning How-to-Guide,* "Understanding Your Risks: Identifying Hazards and Estimating Losses," *Publication No. FEMA 386-2, September 3, 2015; Federal Emergency Management Agency,* Multi-jurisdictional Mitigation Planning*, March 10, 2009; Federal Emergency Management Agency,* Local Mitigation Planning Handbook*, March 2013.*

[2] *Disaster Mitigation Act of 2000. Public Law 106-390, 114 Stat. 1552, October 30, 2000.*

[3] *In December 1995, Ozaukee County completed a Flood Hazard Mitigation Plan, that plan was revised and finalized on September 10, 2001.*

and Exercise Consulting (EPTEC, Inc.). The participating municipalities included the Cities of Cedarburg, Mequon, and Port Washington; the Villages of Bayside, Belgium, Fredonia, Grafton, Newburg, Saukville, and Thiensville; and the Towns of Belgium, Cedarburg, Grafton, Port Washington, and Saukville. In preparing the updated plan, the County involved all appropriate County departments as needed. In addition, the planning was coordinated with the related activities of other concerned units and agencies of government and was developed under the guidance of the Ozaukee County Hazard Mitigation Committee, which was created by the County specifically for plan development purposes and was comprised of elected and appointed officials, agency and business representatives, and citizens from throughout the County knowledgeable in hazard mitigation matters. Both plans were prepared under the requirements identified in 44 *Code of Federal Regulations,* Section 201.6 (44 CFR 201.6), The Disaster Mitigation Act of 2000.

In February 2018, Ozaukee County, in cooperation with its 16 municipalities (including the Village of Newburg) and the Southeastern Wisconsin Regional Planning Commission, began preparation of a third update, making it the second update of the County's hazard mitigation plan. The participating municipalities include the Cities of Cedarburg, Mequon and Port Washington; the Villages of Bayside, Belgium, Fredonia, Grafton, Newburg, Saukville, and Thiensville; and the Towns of Belgium, Cedarburg, Fredonia, Grafton, Port Washington, and Saukville. The participating jurisdictions and their contributions to the planning effort are listed in Table 1.1. This updated plan was prepared by the staffs of the Ozaukee County Department of Emergency Management and the Southeastern Wisconsin Regional Planning Commission. In addition, the planning was coordinated with the related activities of other concerned units of government and was developed under the guidance of the Ozaukee County Hazard Mitigation Local Planning Team (LPT),[4] which was formed by the County specifically for plan update development purposes and is comprised of elected and appointed officials; agency, business, and non-profit representatives; and citizens from throughout the County knowledgeable in hazard mitigation matters.

1.2 OVERVIEW OF STUDY AREA

Ozaukee County is located in Southeastern Wisconsin and bordered on its east by 26 miles of Lake Michigan coastline, on the north by Sheboygan County, on the west by Washington County, and on the south by Milwaukee County.

Ozaukee County was home to approximately 88,429 residents in 2017.[5] It is the second-smallest county in the State, by land area, covering 235 square miles, and about 1,116 square miles when taking into account Lake Michigan area under County jurisdiction. The County contains all or parts of three cities, seven villages, and six townships as shown on Map 1.1. There are parts of five watersheds and a total of 881 square miles of rivers, stream, and lakes within the County. Approximately 71,000 people reside in incorporated cities and villages, while about 17,000 live in unincorporated towns. The majority of the population resides in the southern and central portions of the County, within the Cities of Cedarburg, Mequon and Port Washington. In addition, population centers are also found in the Villages of Belgium, Fredonia, Grafton, and Saukville.

Nonurban and agriculture are the primary land uses within the unincorporated parts of Ozaukee County. Ozaukee County values its rural character and farming tradition and is working to preserve farmlands with its Working Lands Initiative and through various conservation programs directed towards agricultural practices. The County also has some natural areas that will not be developed, streams and rivers, environmental corridors, light industry, residential, and business land uses. The impacts of urbanization from the greater Milwaukee metropolitan area are gradually affecting the County with incorporated areas of the County increasingly being developed for commercial and residential uses. With the impacts of urbanization and increase in population, hazard mitigation planning is an important topic for the County to address.

[4] *For the development of the initial plan and the 2013 plan update, this group was referred to as the Ozaukee County Hazard Mitigation Committee and Workgroup. For the current plan update, the name of this group has been changed to reflect the current terminology used by FEMA.*

[5] *Based on U.S. Census Bureau estimates.*

Table 1.1
Participation in the Ozaukee County All Hazards Mitigation Plan Update Planning Process

Civil Division	Attendance at Local Planning Team Meetings				Provision of Data[a]	Review of Report
	February 13, 2018	August 28, 2018	May 16, 2019	May 5, 2020		
Cities						
Cedarburg	--	--	--	--	X	X
Mequon	X	--	--	X	X	X
Port Washington	--	--	--	--	X	X
Villages						
Bayside[b]	--	--	--	--	X	X
Belgium	X	--	--	--	X	X
Fredonia	X	X	--	X	X	X
Grafton	--	--	--	--	X	X
Newburg	X	--	--	--	X	X
Saukville	X	X	X	X	X	X
Thiensville	X	X	--	--	X	X
Towns						
Belgium	--	--	--	--	X	X
Cedarburg	X	--	--	--	X	X
Fredonia	--	--	--	--	X	X
Grafton	--	--	--	--	X	X
Port Washington	--	--	--	--	X	X
County						
Ozaukee County	X	X	X	X	X	X
Other						
Concordia University	X	--	--	--	--	--
State of Wisconsin	X	--	--	--	X	X
SEWRPC	X	X	X	X	X	X
Mequon-Thiensville School District	X	X	--	--	X	X
Ozaukee County Amateur Radio Emergency Service (OZARES)	X	X	X	--	X	X
Ozaukee Washington Public Health	X	X	X	X	X	X
We Energies	X	--	--	X	X	X

Note: X indicates participation by at least one representative of the municipality or organization.

[a] *Provision of data includes providing information on hazards experienced, projects undertaken, and outreach efforts as well as sharing of relevant plans, reports, and concerns.*

[b] *The Village of Bayside is covered under Milwaukee County's hazard mitigation plan.*

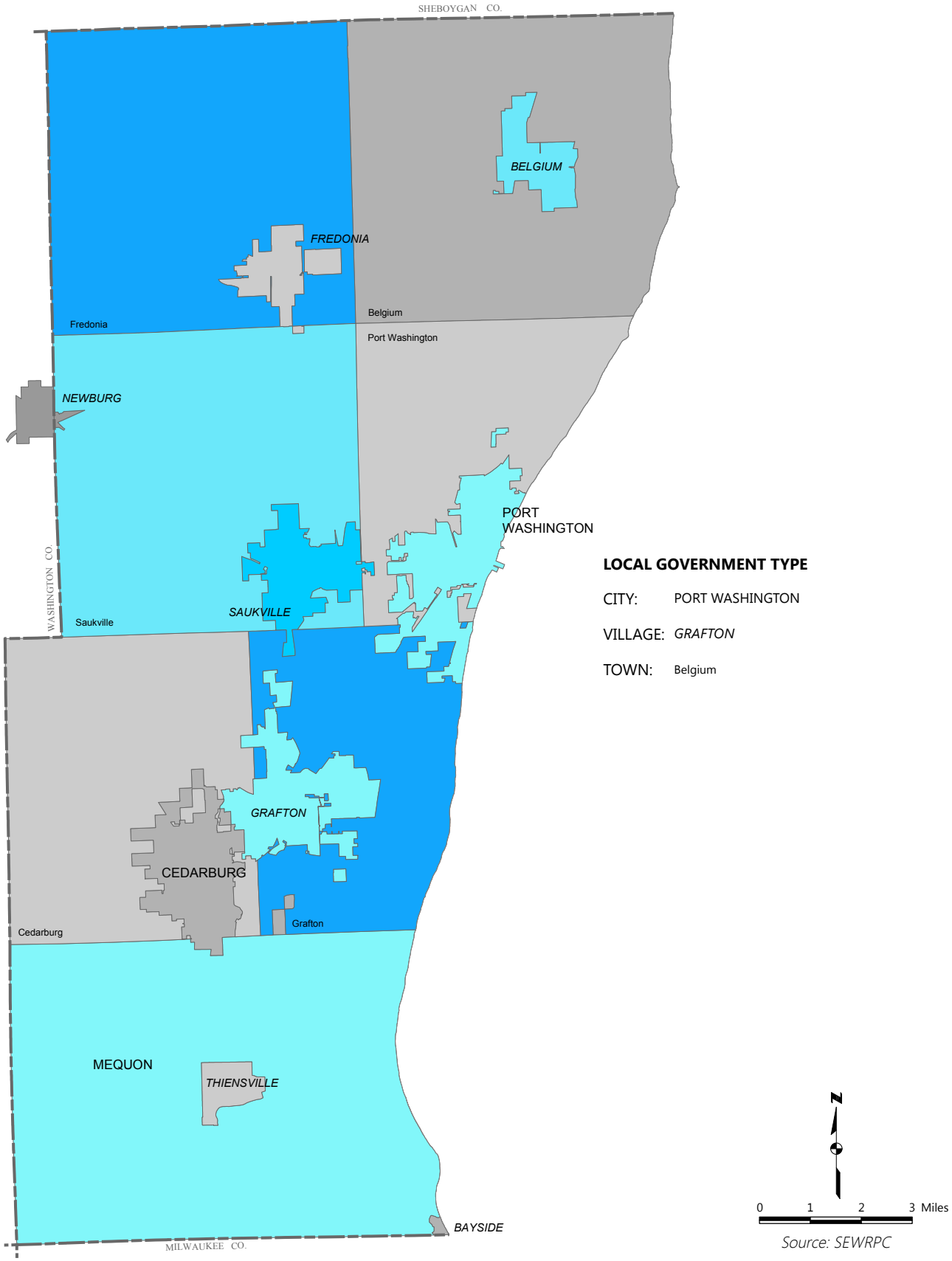
Source: SEWRPC

1.3 RELATIONSHIP OF HAZARD MITIGATION PLANNING TO EMERGENCY OPERATIONS PLANNING

The focus of this planning effort is on hazard mitigation measures. Such measures generally involve lasting, often permanent, strategies designed to reduce the exposure to, probability of, or potential loss from hazardous events. Such measures tend to focus on actions related to where and how to build structures, education to reduce losses or injury, and programs to improve the safety of identified hazard areas. A hazard mitigation plan outlines the strategy for mitigating the hazards potentially impacting a county or community.

The mitigation plan should be distinguished from, but compatible with, an emergency operations plan. An emergency operations plan is defined as a plan which describes how people and property will be protected in disaster and disaster threat situations; details who is responsible for carrying out specific actions; identifies the personnel, equipment, facilities, supplies, and other resources available for use in the disaster; and outlines how all actions will be coordinated. Numerous such plans have been developed at the jurisdictional

Map 1.1
Civil Division Boundaries in Ozaukee County: 2018



Source: SEWRPC

level, and often involve mutual assistance and cooperation agreements between local units of government in adjoining municipalities, both within and outside of Ozaukee County. Plans for mitigating hazards are related to emergency operation activities involving short-term recovery decision-making, since such recovery activities may highlight prospects for implementation of a mitigation strategy aimed at reducing long-term risk to human life and property.

1.4 SCOPE AND PURPOSE OF PLAN

This plan updates the 2013 hazard mitigation plan which was an update of the initial 2008 County Hazard Mitigation plan. The scope of this plan is countywide, and is intended to set forth the most appropriate, feasible, and effective hazard mitigation strategy for Ozaukee County and the local units of government within the County. The plan complements, refines and focuses the *State Hazard Mitigation Plan of Wisconsin*[6] on local conditions and hazards likely to occur or be experienced within Ozaukee County and Southeastern Wisconsin. The plan development process is intended to encourage innovative programming and leadership and to build constructive partnerships with local units of government, business, and other stakeholders with a shared interest and obligation in protecting the safety and economic stability of Ozaukee County, and to provide information and guidance to neighboring communities as they develop jurisdictional hazard mitigation plans at the local and subregional levels.

While it is acknowledged that the County can be affected by hazardous incidents that occur outside of the County jurisdiction, the degree of impact—in terms of property damage, injury and loss of life, and ability of the County to respond, is significantly limited, and frequently unquantifiable. Thus, while some hazards, such as weather-related events, can extend over a wide area, most affect Ozaukee County only tangentially, and many result in site specific impacts. Those that are site-specific in their impact may be best addressed within local level hazard mitigation plans and through local action. Nevertheless, where appropriate, areas of cooperation between jurisdictions have been noted, especially with respect to hazards such as flooding, which commonly affect entire river basins as well as the specific communities located within them. Generally, hazard mitigation and emergency response planning at the local and subregional levels are beyond the scope of this plan.

Development of the Ozaukee County Hazard Mitigation Plan and of subsequent updates was a collective effort involving a number of agencies, organizations, and business representatives. These efforts were conducted under the guidance of the Ozaukee County Local Planning Team which was created by the County specifically for plan development purposes. That group is comprised of elected and appointed officials and business representatives knowledgeable about, and directly involved in, hazard mitigation matters. The membership, formation, and active participation of the Local Planning Team is documented in Appendix A of this Report. In addition to formation and active participation of the Local Planning Team, the development of the plan update included the following steps:

- Collation and review of all pertinent reports relating to the hazard mitigation activities in Ozaukee County
- Review of materials developed as a part of the multi-jurisdictional comprehensive planning process for Ozaukee County[7]
- Review and updating of hazard risk assessments
- Review of implementation activities completed or underway since the last plan update
- Inventory mapping and analysis of hazards pertinent to Ozaukee County
- Identification of the facilities and ongoing programs related to hazard mitigation

[6] *Wisconsin Emergency Management, State Hazard Mitigation Plan of Wisconsin, December 2016, amended January 2017.*

[7] *SEWRPC Community Assistance Planning Report No. 285,* A Multi-Jurisdictional Comprehensive Plan for Ozaukee County: 2035, *May 2008, amended April 2009.*

- Assessment of the vulnerability of the County assets to each hazard
- Identification, and prioritization, of needed facilities and programs
- Consideration of issues relating to neighboring municipalities and units of government likely to be affected or influenced by natural hazards within Ozaukee County
- Development and evaluation of alternatives to address the identified needs
- The development of plan recommendations and an implementation plan
- Development of a public informational and educational program and program of public consultation to guide the plan development and implementation program, including a prioritization of the recommended plan elements
- Adoption of a strategy for monitoring and refining the plan

1.5 PLAN MAINTENANCE AND IMPLEMENTATION ACTIVITIES

Outreach Activities

Since the adoption of the initial hazard mitigation plan, local municipalities in Ozaukee County have conducted outreach activities to educate the public about emergency preparedness, including hazard mitigation. The most recent activities are summarized in Table 1.2. The most common methods used by the communities include making information available through posting on the municipality's website and mailing or emailing periodic newsletters to residents. These methods have been used to distribute information on hazard awareness and preparedness related to topics such as flooding, winter weather awareness, tornado awareness, hazardous materials awareness, heat awareness, pandemic influenza, fire safety, and family preparedness. In recent years, local municipalities have also begun reaching the public through social media sites such as Facebook® and Twitter®. Throughout the County, residents can sign up to receive text message alerts through MyState USA public emergency notification system. Additionally, the Ozaukee County Division of Emergency Management, and municipal emergency responders meet on a quarterly basis with American Red Cross and other non-governmental organizations as part of their review process of plans pertaining to mass care. Ozaukee County continues to participate in public outreach efforts pertaining to flood mitigation efforts such as informing citizens about the National Flood Insurance Program (NFIP).

Implementation Activities

Since the adoption of the first update to the hazard mitigation plan (2013), Ozaukee County and the local municipalities have conducted several projects intended to implement recommendations of the plan. These projects are summarized in Table 1.3. One implementation activity the County recently participated in was incorporating LiDAR into their GIS mapping systems for better digital terrain mapping to help with flood modeling and projections.

1.6 REVIEW OF PLAN DEVELOPMENT EFFORTS, PROCESS AND ADOPTION

As previously noted, the first edition of the Ozaukee County all hazards mitigation plan was prepared under the guidance of a Hazard Mitigation Committee comprised of elected officials from all of the incorporated communities within the County, as well as County businesses and agency representatives. That Committee met several times during the plan preparation period to incorporate input on the types of hazards to be considered, the appropriate mitigation strategies, and to review the draft Report chapters with each Report chapter then being refined to reflect the comments and recommendations of the Committee and other public, local officials, academia, and business and industry leaders.

The Ozaukee County Hazard Mitigation Committee reviewed past hazard events and a consensus was reached on the anticipated probability of future events as either "high," "medium," or "low." After the draft plan review, the Committee selected potential mitigation projects based on a "high," "medium," or "low"

Table 1.2
Outreach Activities by Local Communities in Ozaukee County Related To Hazard Mitigation

Community	Activity
Ozaukee County	County Website Twitter account Facebook page Department of Emergency Management webpage Department of Land and Water Management webpage – "Flood Protection" link Department of Land Information – "Interactive Map" link Email and text message information and alert system "Notify Me" Public alert emergency notification system County Police, Fire, and EMS Live audio radio online "Nextdoor" social networking service County meets with American Red Cross and other NGO's as part of their planning efforts for mass care along with public health and human services County Fair safety and mitigation Emergency Preparedness Day Ozaukee County Amateur Radio Emergency Service (OZARES) and Radio Amateur Civil Emergency Service (RACES)
City of Cedarburg	City website Department of Emergency Management webpage Seasonal Newsletter "The Post" Facebook page Fire Department Twitter account Fire Department Facebook page Engineering and Public Works Facebook page
City of Mequon	City website "Hyper-Reach" emergency telephone notification system Fire Department Facebook page
City of Port Washington	City website Integrated Nowcast/Forecast Operation System Email alert system Seasonal email Newsletter Facebook page Fire Department Facebook page Police Department Facebook page Police Department Twitter account
Village of Bayside	Village website Monthly newsletter "*Scene*" Weekly email newsletter "*Bayside Buzz*" Weekly newsletter "*Tuesday Talk*" Email and text message information and alert system "Notify Me" Facebook page Twitter account
Village of Belgium	Village website Seasonal newsletter Facebook page
Village of Fredonia	Village website Quarterly Newsletter Twitter account
Village of Grafton	Village website E-newsletter Facebook page Twitter account Email and text message information and alert system "Notify Me"

Table continued on next page.

Table 1.2 (Continued)

Community	Activity
Village of Newburg	Village website Board of Emergency Management Monthly Newsletter Fire Department Facebook page Police Department Facebook page
Village of Saukville	Village website Department of Emergency Management webpage Seasonal Newsletter Email and text message information and alert system "Notify Me" Facebook page Fire Department Facebook page Police Department Facebook page Department of Public Works Facebook page Twitter account
Village of Thiensville	Village website Department of Emergency Government webpage Seasonal Newsletter "*The Village Voice*" Email and text message information and alert system "Notify Me" Facebook page Twitter account
Town of Belgium	Town website
Town of Cedarburg	Town website Email notification of timely news and upcoming meetings E-Notify Seasonal Newsletters Cedarburg TV governmental access channel
Town of Fredonia	Town website Seasonal Newsletter
Town of Grafton	Town website Email and text updates River Monitoring link on town website
Town of Port Washington	Town website Seasonal Newsletters Facebook page
Town of Saukville	Town website

Source: Community Websites, Ozaukee County, and SEWRPC

priority. This plan followed the Disaster Mitigation Act of 2000, meaning that it was designed to be a "living" document that would be reviewed and updated every five years at a minimum.

The first update to the original Ozaukee County All Hazards Mitigation Plan (2013) was again prepared under the guidance of a Hazard Mitigation Committee. The Ozaukee County Division of Emergency Management completed (and regularly updated) the Ozaukee County Hazard Analysis. This Hazard Vulnerability Analysis (HVA) identifies likely natural and technological hazards that have occurred or may occur in the future within the County based on the State of Wisconsin's HVA. The HVA served as the starting point for the first plan update along with historical events, recent news reports, local resources, and FEMA Region V mitigation survey, and knowledge of the local planning team members. Team members (see Appendix B) ranked their concern (likelihood of future occurrences and amount of disruption/damage should it occur) on a five-point scale of "very high," "high," "medium," "low," or "very low." From those rankings, planning team members determined hazard mitigation strategies that might benefit their communities.

This 3rd plan update of the Ozaukee County Hazard Mitigation Plan was prepared under the guidance of a Local Planning Team comprised of representatives of all of the incorporated communities within the County[8]

[8] *Except the Village of Bayside, which is located in both Milwaukee and Ozaukee Counties, and is covered under the Milwaukee County hazard mitigation plan.*

Table 1.3
Hazard Mitigation Activities in Ozaukee County: 2013-2019

Community	Project	Cost	Funding Source	Completion Date
Ozaukee County	Ozaukee Fish Passage Program. Ulao Creek, Little Menomonee River, and Mole Creek habitat enhancement and restoration projects helped to restore floodplains along the waterways which help with flood control	$10.5 million	Ozaukee County Planning and Parks Department awarded over 10.5 million dollars in Federal, State, Local, and Private Funds for the various stream restoration projects throughout the County	2015-2017
	9-1-1 Emergency Medical Dispatch program training	$56,000[a]	Aurora Foundation (Aurora Medical Center- Grafton) Cities of Mequon and Cedarburg	2016
	Light Detection and Ranging (LiDAR) surveying program	$60,252	State grant and local levy dollars	2015
	Flood Control Project- Buyout, 1.53 acre parcel (partnership with Town of Grafton)	$222,075	FEMA, WEM, WDNR Municipal Flood Control Grant	2015
	Flood Control Project-Buyout, 0.5-acre parcel (partnership with Town of Grafton)	$232,755	FEMA, WEM, WDNR Municipal Flood Control Grant	2017
	Flood Control Project-Buyout, 0.46 acres and 0.42 acres (partnership with Town of Grafton)	$219,974	FEMA, WEM, WDNR Municipal Flood Control Grant	2018
	Flood Control Project-Buyout, 0.77-acre parcel (partnership with Town of Grafton)	$105,237	FEMA, WEM, WDNR Municipal Flood Control Grant	2018
	Flood Inundation Maps for potions of the Milwaukee River and all of Cedar Creek	Funded by FEMA	FEMA, NWS, and WDNR	2019
City of Port Washington	Replacement of one Outdoor Warning Siren	$25,000[b]	City of Port Washington	2018
	Harbor breakwater wall restoration and renovation project	$3 million spent during draft phase of this plan	Partial City Costs and Grants provided	2019-2020
	City of Port Washington wastewater treatment plant on-site backup generator(s) installation project	$700,000	City of Port Washington wastewater treatment plant	2019
	Trash rack installation on culvert in Canyon Creek	$14,359	City of Port Washington Public Works Department	2018
Village of Saukville	Replaced all 4 Outdoor Warning Sirens	$20-25,000[b]	Village of Saukville	2016

[a] *$500.00 per dispatcher training*

[b] *Per siren*

Source: Ozaukee County Division of Emergency Management and SEWRPC

including elected officials, law enforcement and fire personnel, engineering and public works departments, and planning departments. In addition, the Local Planning Team included representatives from utilities, a university and school districts. The Local Planning Team met four times during the plan update preparation period to provide input on the types of hazards to be considered, the appropriate mitigation strategies, and to review the draft Report chapters. Those chapters were then refined to reflect the comments and recommendations of the Team (see Appendix A).

As draft chapters of this 3rd update of the plan were completed, copies were placed in downloadable form on the SEWRPC website and a webpage was available on which members of the public could ask questions and submit comments. Following completion of updates to the community profiles and the risk and vulnerability assessments sections of the plan and review of drafts of the corresponding chapters by the Local Planning Team, a public informational meeting was held to review these sections of the plan with

local officials, business and industry, and citizens and solicit their input. Copies of the draft plan were made available at the Ozaukee County Division of Emergency Management and on the SEWRPC website.

Following a finding by FEMA that the plan was approvable after adoption, the plan was brought to the Ozaukee County Board for adoption (a copy of the adopted resolution approving the plan is included in Appendix H).Copies of the plan were also sent to each of the local units of government requesting that they adopt the plan in order to retain future eligibility for mitigation funding for the FEMA Hazard Mitigation Grant, Flood Mitigation Assistance, and Pre-Disaster Mitigation programs administered by the Wisconsin DMA, DEM. In addition, County and SEWRPC staffs were available to meet with communities on an individual basis to review the plan update and consider adoption and implementation steps.

BASIC STUDY AREA INVENTORY AND ANALYSIS 2

2.1 INTRODUCTION

Information on pertinent natural and built features of the study area is an important consideration in sound hazard mitigation planning. Accordingly, the collection and collation of definitive information regarding basic demographic characteristics, existing and planned land use, surface water and Lake Michigan shoreline system characteristics, transportation and utility systems, critical community facilities, and existing hazard management programs constitute important steps in the planning process. The following in-depth information regarding the relevant conditions in the study area is useful in formulating and evaluating sound mitigation approaches.

2.2 CIVIL DIVISIONS

The geographic extent and functional responsibilities of civil divisions and special-purpose units of government are important factors to be considered in hazard mitigation planning, since these local units of government provide the basic structure of the decision-making framework within which such planning must be addressed. The boundaries of the civil divisions in Ozaukee County are shown on Map 1.1 in Chapter 1 of this Report. There are six towns in Ozaukee County, including Belgium, Cedarburg, Fredonia, Grafton, Port Washington, and Saukville. In addition, there are seven villages located partially or completely within the County, including Bayside (partial), Belgium, Fredonia, Grafton, Newburg (partial), Saukville, and Thiensville. The Cities of Cedarburg, Mequon, and Port Washington are also within Ozaukee County. The total land area and proportion of the County within each civil division is presented in Table 2.1. Note, because the Village of Newburg is participating in the adoption of this hazard mitigation plan the entire Village area will be shown on all maps and inventoried in some of the tables throughout this Report.

2.3 DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS

Population

Historical population levels in Ozaukee County are provided in Table 2.2. In 1860, Ozaukee County had a resident population of about 15,682. After three decades of slight population decreases from 1860 through 1890, the County's population generally steadily increased from 1890 through 1940. Starting in 1940, the County saw more rapid population growth with a high of 64.6 percent growth in the decade of the 1950s. Population growth slowed slightly in the 1980s, though continuing to increase through 2010. As of 2010, the date of the most recent existing census data, there were an estimated 86,400 individuals residing in the County. The population in Ozaukee County is projected to increase by 26.3 percent from 2010 through the year 2050.[9]

Mequon, incorporated as the City of Mequon in 1957, is geographically the third largest city in Wisconsin, measuring over 47 square miles. Because of its large area, Mequon is home to a major portion of Ozaukee County's population, with an estimated 23,132 residents, accounting for 27 percent of the County's population in 2010. The next most populous communities are the Village of Grafton, with 11,459 residents, and the Cities of Cedarburg with 11,412 citizens and Port Washington with 11,250 citizens. Based upon the 2010 census data, the Village of Belgium experienced a 33.8 percent increase in population from the prior decade, more than any community in the County.

Households

Trends in the number of households in Ozaukee County are shown in Table 2.3. The County experienced significant gains in the number of new households in each decade from 1950 through 2010. Since 1980, the rate of increase in the number of households has exceeded the rate of population increase. Between

[9] *Projected levels of population for the Southeastern Wisconsin Region can be found in SEWRPC Planning Report No. 55,* Vision 2050 Volume I: Groundwork for Vision and Plan Development*, July 2017.*

1950 and 2010, the number of households increased by about 419 percent, compared to a population increase of about 270 percent during the same time period. Because the number of households increased at a faster rate than the population, the number of persons per household has decreased.

Employment

Trends in job growth in the County are set forth in Table 2.4. The jobs are enumerated at their location and the data thus reflect the number of jobs within the County, including both full- and part-time jobs. A significant increase in the number of jobs may be expected to attract additional residents to the County, thus influencing population growth. As indicated in Table 2.4, employment growth was significant in the County from 1950 through 2000, with an increase of 44,173 jobs, or 669 percent. This large increase in jobs was driven by an increase in non-agricultural jobs after 1950. The County experienced a slowdown in job growth from 2000 to 2010, gaining only 1,727 jobs, likely an effect of the nation-wide recession that was experienced in the late 2000s. Furthermore, about half of Ozaukee County's employed residents worked within the County, and the other half worked outside the County.

Table 2.1
Areal Extent of Civil Divisions in Ozaukee County: 2018

Civil Division	Area		Percent of County Area
	Acres	Square Miles	
Cities			
Cedarburg	3,127	4.9	2.1
Mequon	30,072	47.0	20.0
Port Washington	3,756	5.8	2.5
Villages			
Bayside[a]	58	0.1	0.0
Belgium	1,382	2.2	0.9
Fredonia	1,343	2.1	0.9
Grafton	3,286	5.1	2.2
Newburg[b]	55	0.1	0.0
Saukville	2,287	3.6	1.5
Thiensville	693	1.1	0.5
Towns			
Belgium	22,790	35.6	15.1
Cedarburg	15,926	24.9	10.6
Fredonia	22,026	34.4	14.6
Grafton	11,398	17.8	7.6
Port Washington	11,418	17.9	7.6
Saukville	21,039	32.9	14.0
Total	150,656	235.4	100.0

[a] *An Additional 1,480 acres, or 2.3 square miles, of the Village of Bayside is located within Milwaukee County.*

[b] *An additional 521 acres, or 0.91 square miles, of the Village of Newburg is located in Washington County.*

Source: SEWRPC

Property Value

The value of the real estate and personal property in a community reflects the upper end of the potential for property damages in each community. The equalized value of the real estate and personal property in Ozaukee County and each of the general-purpose units of government in the County for the years 2013 (date of previous edition of this plan) and 2017 is shown in Table 2.5. The Villages of Grafton and Thiensville have shown the most significant increase in property values as of 2017.

2.4 LAND USE

Land use is an important determinant of the potential impact a particular hazard may have, and of the actions which may be taken to mitigate the hazard impacts. Accordingly, an understanding of the amount, type, and spatial distribution of urban and rural land uses within the County is an important consideration in the development of a sound hazard mitigation plan. This section presents a description of the land uses in the County.

Existing Land Uses

Land uses in Ozaukee County in 2015 are set forth on Map 2.1 and in Table 2.6. Urban land uses occupied about 39,475 acres, or 25.6 percent of the County in 2015. Intensive urban development, including the densest areas of commercial, industrial, and multi-family residential development, is concentrated within or near the communities of Port Washington, Grafton, Mequon, Saukville, Thiensville, Cedarburg, Belgium, and Fredonia. Much of the single-family residential development also occurred within, or surrounding, these communities, while scattered low-density development occurred outside these communities amid predominantly rural areas. Single-family residential development was the largest component of urban land uses, encompassing about 19,503 acres, or 49 percent of the urban land uses and about 13 percent of the total area of the County.

Land uses categorized as transportation, communication, and utilities constituted the second largest urban land use category in 2015, encompassing about 10,122 acres, or 25 percent of the area of all urban land and about 7 percent of the total area of the County. Major arterial highways serving the County include Interstate Highway (IH) 43, which runs along the eastern portion of the County, parallel to Lake Michigan; State Trunk Highways (STH) 32, STH 57 and STH 181, which traverse the County in a north-south direction; and STH 167, STH 60, and STH 33, which traverse the County in a generally east-west direction. Bayside, Mequon, Grafton, Cedarburg, Saukville, and Port Washington, all have close access to IH 43. With continued maintenance and capacity upgrades as recommended under the Southeastern Wisconsin Regional Planning Commission (SEWRPC) VISION 2050 regional land use and transportation plan for southeastern Wisconsin,[10] these roads will continue to serve the population effectively. Transportation within the County will be described in greater detail later in this chapter.

As previously mentioned, Ozaukee County values its rural character and farming tradition and is working to preserve farmlands. Map 2.2 shows lands in agricultural uses in the Ozaukee County planning area in 2015. Agriculture remains the principal use of land within Ozaukee County, with more than 65,000 acres, or about 43 percent of the County's land in such uses (see Table 2.7). According to the National Agricultural Statistics Service, in 2012, there were 416 farms in the County, a decrease of 19 percent from 2007.[11] The average Ozaukee County farm size was about 156 acres. The estimated value of land and farm buildings associated with these farms was about $364.4 million, in 2012 dollars. Common crops grown in the County include forage products such as hay and haylage, grass silage, and greenchop; soybeans; corn for grain and silage; and wheat. Common livestock raised in the County include cattle and calves, egg laying chickens, horses, pheasants, and goats.

Land in agricultural uses are inventoried by municipality and class of use in Table 2.7. In 2015, approximately 65,000 acres in the County were considered agricultural lands. The Towns of Belgium and Fredonia had over 11,000 acres in cropland. The remaining Towns of Cedarburg, Grafton, Port Washington, and Saukville, and the City of Mequon had between 2,500 and 8,000 acres of cropland. Croplands comprised the largest category of agricultural land uses, accounting for about 57,396 acres in the County. Pasture lands accounted

Table 2.2
Historical Resident Population Levels in Ozaukee County: 1860-2050

Year	Population	Change from Preceding Census	
		Incremental	Percent
1860	15,682	--	--
1870	15,564	-118	-0.8
1880	15,461	-103	-0.7
1890	14,943	-518	-3.4
1900	16,363	1,420	9.5
1910	17,123	760	4.6
1920	16,335	-788	-4.6
1930	17,394	1,059	6.5
1940	18,985	1,591	9.1
1950	23,361	4,376	23.0
1960	38,441	15,080	64.6
1970	54,461	16,020	41.7
1980	66,981	12,520	23.0
1990	72,831	5,850	8.7
2000	82,317	9,486	13.0
2010	86,400	4,083	5.0
2015	88,600[a]	2,200[b]	2.5[b]
2050	109,100[a]	22,700[b]	26.3[b]

[a] *Population based on projections from SEWRPC's* VISION 2050 Plan.

[b] *Relative to 2010.*

Source: SEWRPC

Table 2.3
Number of Households in Ozaukee County: 1950-2050

Year	Number of Households	Change from Preceding Census	
		Number	Percent
1950	6,591	--	--
1960	10,417	3,826	58.0
1970	14,753	4,336	41.6
1980	21,763	7,010	47.5
1990	25,707	3,944	18.1
2000	30,857	5,150	20.0
2010	34,200	3,343	10.8
2015	35,200[a]	1,000[b]	2.9[b]
2050	44,500[a]	1,200[b]	3.5[b]

[a] *Number of households are projections from SEWRPC's* VISION 2050 Plan.

[b] *Relative to 2010.*

Source: U. S. Bureau of the Census and SEWRPC

[10] *SEWRPC Planning Report No. 55*, Vision 2050 Volume III: Recommended Regional Land Use and Transportation Plan, *July 2017.*

[11] *U.S. Department of Agriculture National Agricultural Statistics Service,* 2012 Census of Agriculture: Wisconsin State and County Data, *May 2014.*

for about 4,851 acres, or about 7 percent of the County's agricultural land. The remaining agricultural land is categorized as orchards, nurseries, and farm buildings, which accounted for a combined total of 3,081 acres, or about 5 percent of the County's agricultural land.

Map 2.2 also shows the agricultural lands that were within the one-percent-annual-probability (100-year recurrence interval) floodplain in Ozaukee County in 2015. About 3,244 acres of agricultural land, or about 5 percent of the agricultural lands in the County, were in the mapped floodplain. Lands in agricultural uses that are within the one-percent-annual-probability floodplain in the County are inventoried by municipality and class of agricultural land use in Table 2.8. Information on the location of agricultural resources in relation to the one-percent-annual-probability floodplain may highlight areas where mitigation strategies could be implemented to ensure protection against flood damages to crops.

Mobile homes can be particularly vulnerable to some hazards such as high winds or tornadoes. In 2015, there were a total of 69 mobile homes within two mobile home parks in the County. In addition, there is a single mobile home located at a separate location within the Town of Port Washington. Map 2.3 shows the location of the mobile home parks within the County.

Planned Land Use

Planned land use must seek to accommodate the impending demand for land within the Region, which primarily depends on future population, household, and employment levels. SEWRPC recently completed projections of land use, population, households, and employment from the period of 2010 to 2050 to provide a basis for preparation of VISION 2050. As indicated on Map 2.4 and in Table 2.9, urban land uses in Ozaukee County are projected to increase by approximately 3,341 acres between 2015 and 2050, or about 9 percent increase in urban land. Table 2.10 shows the forecast growth of population, households, and employment levels for Ozaukee County between the same time periods. Anticipating the needs of future populations, rather than responding to problems as they occur, is a main goal of hazard mitigation planning. Therefore, sound land use planning is a necessary tool for reducing or eliminating the costs of future hazard events.

Table 2.4
Number of Jobs in Ozaukee County: 1950-2050

Year	Number of Jobs	Change from Previous Time Period	
		Number	Percent
1950	6,600	--	--
1960	10,200	3,600	54.5
1970	21,256	11,056	108.4
1980	28,250	6,994	32.9
1990	35,309	7,059	25.0
2000	50,773	15,464	43.8
2010	52,500	1,727	3.4
2050	69,300[a]	16,800[b]	32.0[b]

[a] *Estimated jobs for the year 2050 as projected reported in SEWRPC's* VISION 2050 Plan.

[b] *Relative to 2010.*

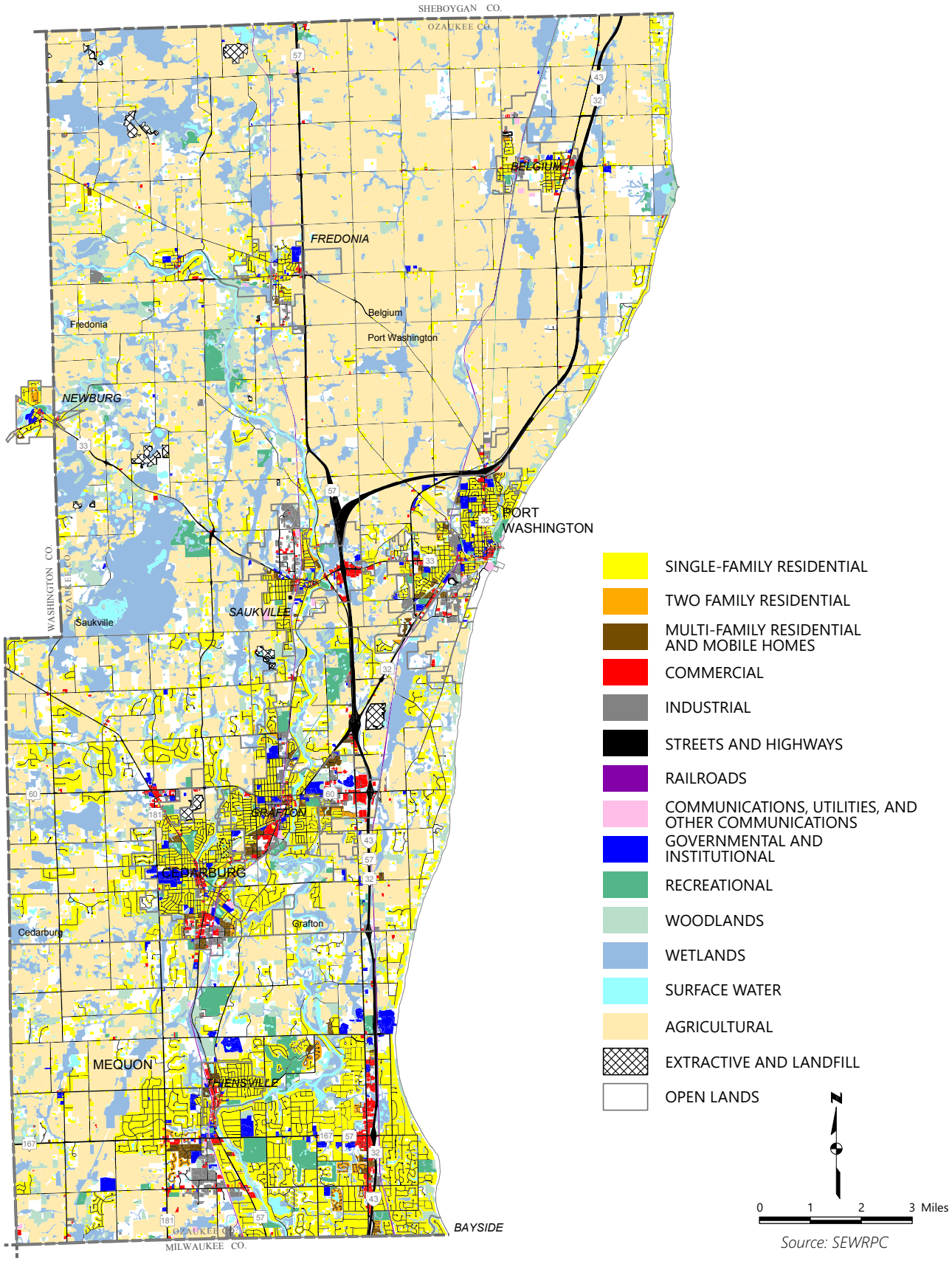
Source: U. S. Bureau of the Census and SEWRPC

Table 2.5
Equalized Value of Property in Ozaukee County by Community: 2013 and 2017

Community	2013 Equalized Value ($)	2017 Equalized Value ($)	Percent Change
Cities			
Cedarburg	1,156,752,200	1,309,147,300	13.2
Mequon	3,949,468,500	4,610,493,300	16.7
Port Washington	841,068,100	974,672,000	15.9
Subtotal	5,947,288,800	6,894,312,600	15.9
Villages			
Bayside	23,336,200	26,704,900	14.4
Belgium	168,731,100	180,705,200	7.1
Fredonia	146,669,300	164,544,100	12.2
Grafton	1,095,444,400	1,333,313,600	21.7
Newburg	5,338,200	5,937,300	11.2
Saukville	396,618,600	424,867,200	7.1
Thiensville	298,390,600	366,996,600	23.0
Subtotal	2,134,528,400	2,503,068,900	17.3
Towns			
Belgium	249,437,000	264,894,500	6.2
Cedarburg	773,226,400	874,306,600	13.1
Fredonia	206,625,400	215,528,700	4.3
Grafton	533,880,100	586,480,800	9.8
Port Washington	185,882,000	206,233,700	10.9
Saukville	195,588,000	221,155,600	13.1
Subtotal	2,144,638,900	2,162,572,434	0.8
Total	10,226,456,100	11,559,953,934	13.0

Source: Wisconsin Department of Revenue and SEWRPC

Map 2.1
Existing Land Use Within the Ozaukee County Planning Area: 2015



Source: SEWRPC

Table 2.6
Land Uses in Ozaukee County: 2015

Land Use Category[a]	Acres	Percent of Subtotal	Percent of County
Urban			
Single-Family Residential[b]	19,503	49.4	12.9
Multifamily Residential[c]	1,207	3.1	0.8
Commercial	1,268	3.2	0.8
Industrial	1,320	3.2	0.8
Transportation, Communications, and Utilities	10,122	25.8	6.8
Governmental and Institutional	1,401	3.5	1.0
Recreational	2,680	6.8	1.8
Unused Urban	1,974	5.0	1.3
Urban Subtotal	39,475	100.0	26.2
Nonurban			
Agricultural and Other Open Lands	80,755	72.6	53.6
Woodlands	8,141	7.3	5.4
Wetlands	19,657	17.7	13.0
Surface Water	2,628	2.4	1.7
Nonurban Subtotal	111,181	100.0	73.8
Total	150,656	--	100.0

Note: This table does *not* reflect the 521 acres of the Village of Newburg that lies within Washington County.

[a] *Parking lots are included with the associated use.*

[b] *Includes mobile homes (9 acres) and single-family rural residential (3,663 acres).*

[c] *Includes two-family residential.*

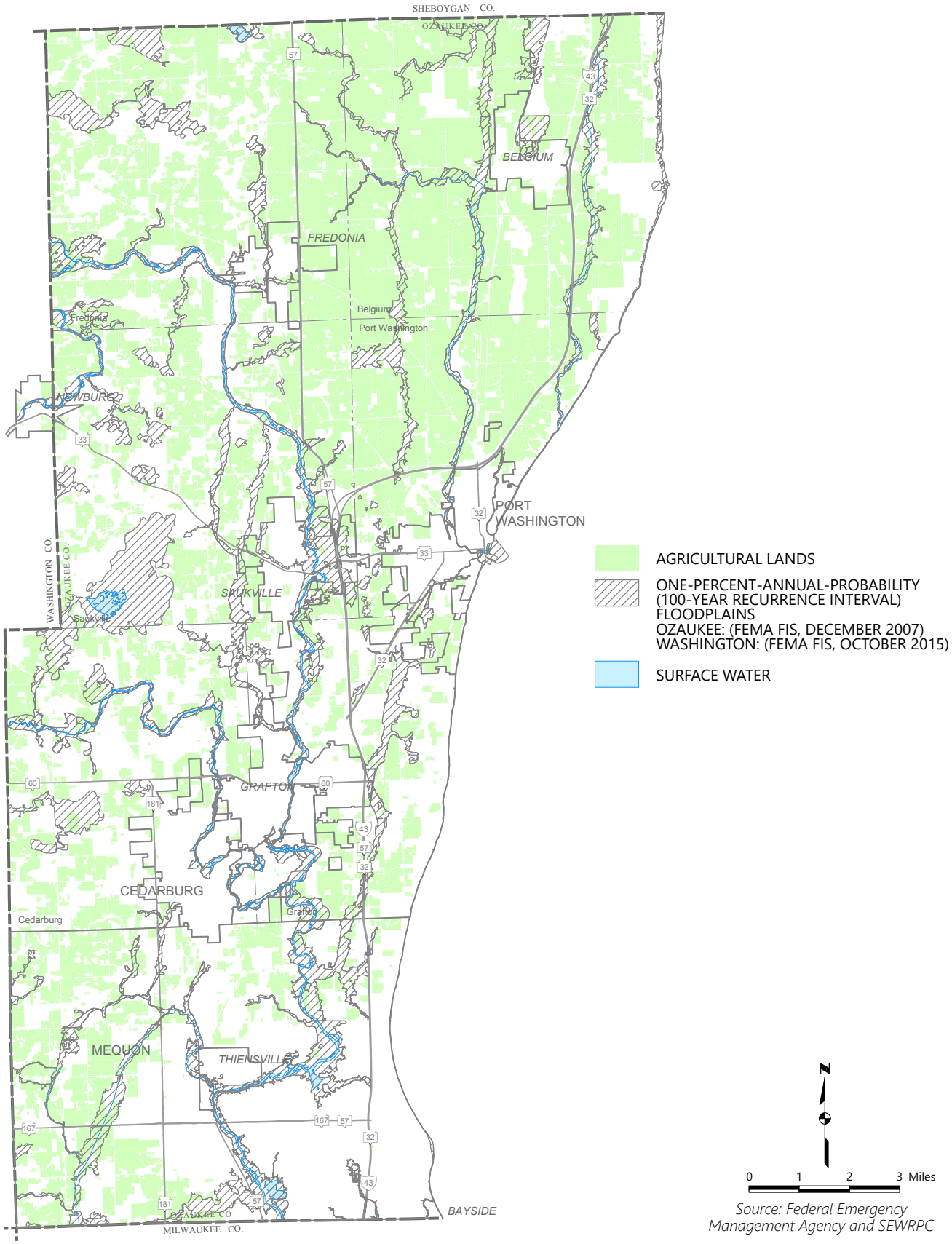
Source: SEWRPC

2.5 ENVIRONMENTAL CORRIDORS

SEWRPC has identified and delineated those areas of Ozaukee County having concentrations of natural, recreational, historic, aesthetic, and scenic resources that should be preserved and protected to maintain the overall quality of the environment. Such areas normally include one or more of the following seven integral elements of the natural resource base which are essential to the maintenance of both the ecological balance and the natural beauty of the Region: 1) lakes, rivers, and streams and the associated undeveloped shorelands and floodplains; 2) wetlands; 3) woodlands; 4) prairies; 5) wildlife habitat areas; 6) wet, poorly drained, and organic soils, and 7) rugged terrain and high-relief topography. There are five additional elements that are important considerations in identifying and delineating areas with scenic, recreational, and educational value. These additional elements are: 1) existing outdoor recreation sites; 2) potential outdoor recreation and related open space sites; 3) historic, archaeological, and other cultural sites; 4) significant scenic areas, and 5) natural and scientific areas.

In Southeastern Wisconsin, the delineation of these 12 natural resource and natural resource-related elements on maps result in an essentially linear pattern of relatively narrow, elongated areas which have been termed "environmental corridors" by SEWRPC. Ozaukee County planning area environmental corridors are shown on Map 2.5. Primary environmental corridors (PEC) include a wide variety of the aforementioned important resource and resource-related elements and are, by definition, at least 400 acres in size, two miles in length, and 200 feet in width. In Ozaukee County in 2010 there were about 21,617 acres of primary environmental corridors, or about 14 percent of the land area in the County. These generally lie along rivers and streams and adjacent to lakes, or are associated with woodlands, wetlands, or park and open space sites. Secondary environmental corridors generally connect with the primary environmental corridors and are at least 100 acres in size and one mile long. In Ozaukee County there are about 5,395 acres of secondary environmental corridors, or about 3.6 percent of the total land area in the County. These are located primarily along the smaller perennial and intermittent streams in the County, including wetlands or smaller ponds associated with these streams. In addition, smaller concentrations of natural resource features that have been separated physically from the environmental corridors by intensive urban or agricultural land uses have also been identified. These areas, which are at least five acres in size, are referred to as isolated

Map 2.2
Agricultural Lands Within the Ozaukee County Planning Area: 2015



Source: Federal Emergency Management Agency and SEWRPC

Table 2.7
Agricultural Lands in the Ozaukee County Planning Area: 2015

Municipality	Cropland (acres)	Pasture and Other Agricultural Lands (acres)	Orchards and Nurseries (acres)	Farm Buildings (acres)	Total Land Area (acres)
Cities					
Cedarburg	322	6	--	9	337
Mequon	5,851	1,088	801	207	7,948
Port Washington	725	--	--	1	726
Villages					
Bayside[a]	--	--	--	--	--
Belgium	500	5	--	7	512
Fredonia	382	26	--	1	409
Grafton	197	13	--	2	212
Newburg[b]	81	25	--	7	113
Saukville	273	23	--	4	300
Thiensville	--	--	--	--	--
Towns					
Belgium	15,184	876	134	307	16,501
Cedarburg	4,358	539	255	204	5,355
Fredonia	11,891	915	39	291	13,136
Grafton	2,509	463	40	127	3,139
Port Washington	7,381	179	88	165	7,812
Saukville	7,742	693	117	275	8,827
Total	57,396	4,851	1,474	1,607	65,328

[a] *Data shown in this table only represents the portion of the Village of Bayside that lies within Ozaukee County.*

[b] *Data shown in this table represents the entire Village of Newburg, which includes both Ozaukee and Washington Counties.*

Source: SEWRPC

natural resource areas. In Ozaukee County there are roughly 4,037 acres of isolated natural resource areas, or about 2.7 percent of the land area of the County. The portion of the Village of Newburg that lies within Washington County has approximately 71 acres of primary environmental corridors and roughly 2 acres of isolated natural resource areas.

2.6 SURFACE AND GROUND WATER RESOURCES AND FLOOD HAZARD AREAS

Groundwater resources constitute a valuable element of the natural resource base of Ozaukee County. This resource is present because of the state's geologic history and climate. The groundwater reservoir not only sustains lake levels and provides the base flow of streams in the County but also comprises a major source of water for domestic, municipal, and industrial water usage. Like surface water, groundwater is susceptible to depletion in quantity and to deterioration in quality, which is discussed in greater detail later in this Report.

Surface water resources, consisting of streams and lakes, also form a particularly important element of the natural resource base. Surface water resources provide recreational opportunities, influence the physical development of the County, and enhance its aesthetic quality. Lake Michigan is also major source of water for domestic, municipal, and industrial water use within Ozaukee County. Practices carried out on the land within the County can positively or negatively affect the water quality of the inland lakes and streams of the County and in turn affect the quality of water within Lake Michigan.

While some small lakes exist within the County, the most significant water features are the perennial rivers and streams and their related watersheds. Major streams are defined as those which maintain, at a minimum, a small continuous flow throughout the year except under unusual drought conditions. There are five major watersheds and an area that drains directly into Lake Michigan within Ozaukee County. All of the major watersheds are part of the Great Lakes-St. Lawrence River Drainage system. The major watersheds include the Milwaukee River watershed, Menomonee River watershed, Sheboygan River watershed, Sauk

Table 2.8
Agricultural Lands Within the One-Percent-Annual-Probability Floodplain in the Ozaukee County Planning Area: 2015

Municipality	Cropland (acres)	Pasture and Other Agricultural Lands (acres)	Orchards and Nurseries (acres)	Farm Buildings (acres)	Total Land Acreage in Floodplain
Cities					
Cedarburg	0.9	--	--	--	0.9
Mequon	459.1	93.0	7.8	0.9	560.8
Port Washington	9.8	--	--	--	9.8
Villages					
Bayside[a]	--	--	--	--	--
Belgium	34.5	--	--	--	34.5
Fredonia	11.3	4.7	--	--	16.0
Grafton	0.4	--	--	--	0.4
Newburg[b]	0.6	1.0	--	0.5	2.1
Saukville	59.4	1.1	--	--	60.5
Thiensville	--	--	--	--	--
Towns					
Belgium	1,137.1	56.9	4.8	3.7	1,202.5
Cedarburg	227.6	21.2	11.1	2.9	262.8
Fredonia	353.3	47.9	--	1.0	402.2
Grafton	130.7	25.7	1.6	4.2	162.2
Port Washington	207.9	1.6	5.7	1.5	216.7
Saukville	283.8	20.3	4.2	4.3	312.6
Total	2,916.4	273.4	35.2	19.0	3,244.0

[a] *Data shown in this table only represents the portion of the Village of Bayside that lies within Ozaukee County.*

[b] *Data shown in this table represents the entire Village of Newburg, which includes both Ozaukee and Washington Counties.*

Source: Federal Emergency Management Agency and SEWRPC

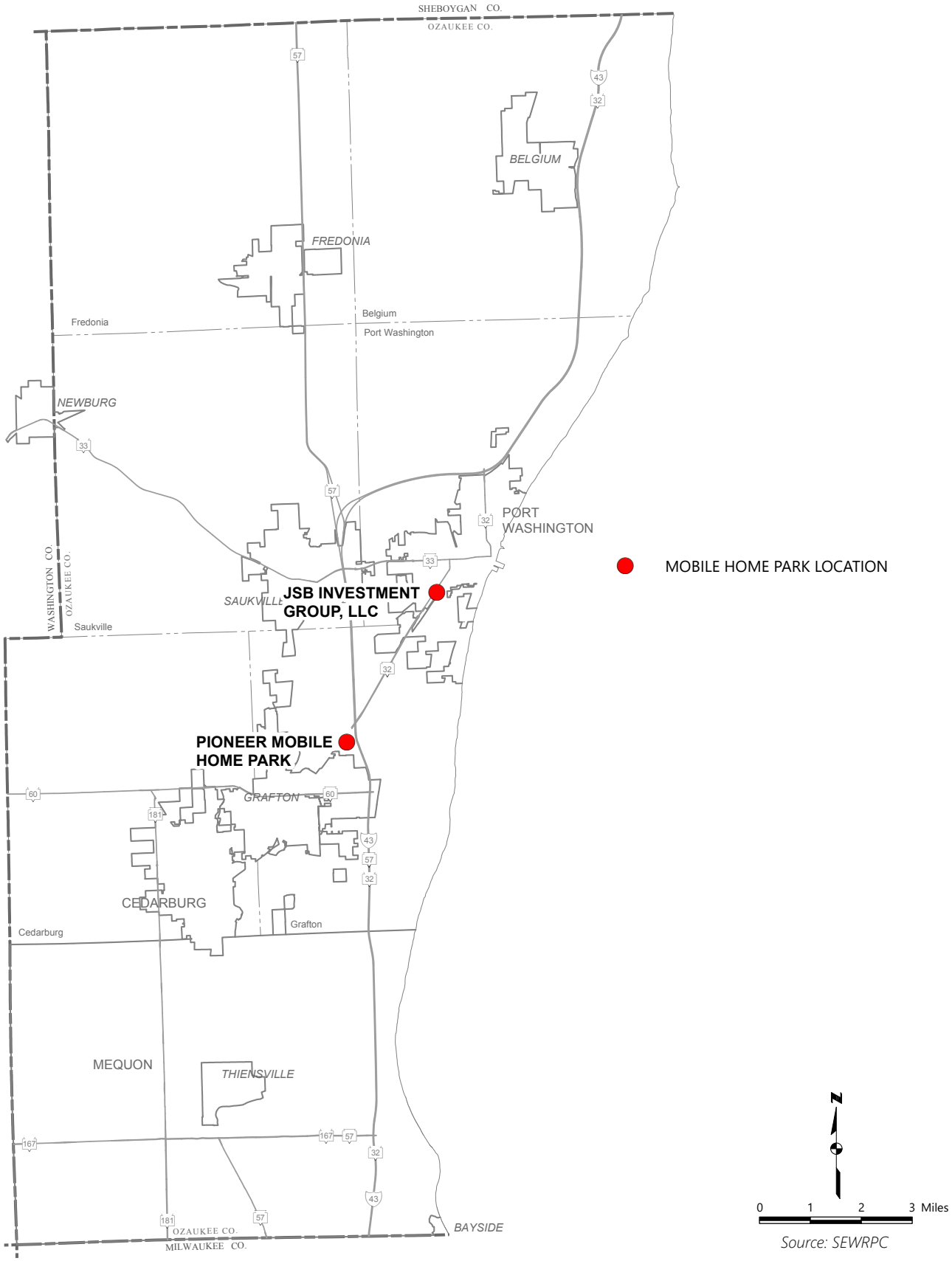
Creek watershed, and Sucker Creek watershed. The majority of Ozaukee County is located in the Milwaukee River watershed which covers 96,667 acres, or 64 percent of the County. All of the major watersheds are further subdivided into sub-watersheds. Map 2.6 illustrates the major watersheds and sub-watersheds within Ozaukee County.

SEWRPC classifies lakes as either being minor or major. Major lakes are 50 acres or more in lake surface area. There are three major lakes located entirely or partially within Ozaukee County, all within the Milwaukee River watershed. The major lakes include Lac du Cours (57 acres) in the City of Mequon, Mud Lake (148 acres) in the Town of Saukville, and Spring Lake (65 acres) in the Town of Fredonia and the Town of Sherman in Sheboygan County.

Floodplains are the wide, gently sloping areas contiguous to, and usually lying on both sides of a stream channel. For planning and regulatory purposes, floodplains are normally defined as the areas, excluding the stream channel, subject to inundation by the one-percent-annual-probability (100-year recurrence interval) flood event. There is a 1 percent chance of this flood event being reached or exceeded in any given year. Floodplain areas are generally not well suited to urban development, not only because of the flood hazard, but also because of the presence of high-water tables and, generally, of soils poorly suited to urban uses. Floodplain areas often contain important natural resources, such as high-value woodlands, wetlands, and wildlife habitat and, therefore, constitute prime locations for parks and open space areas.

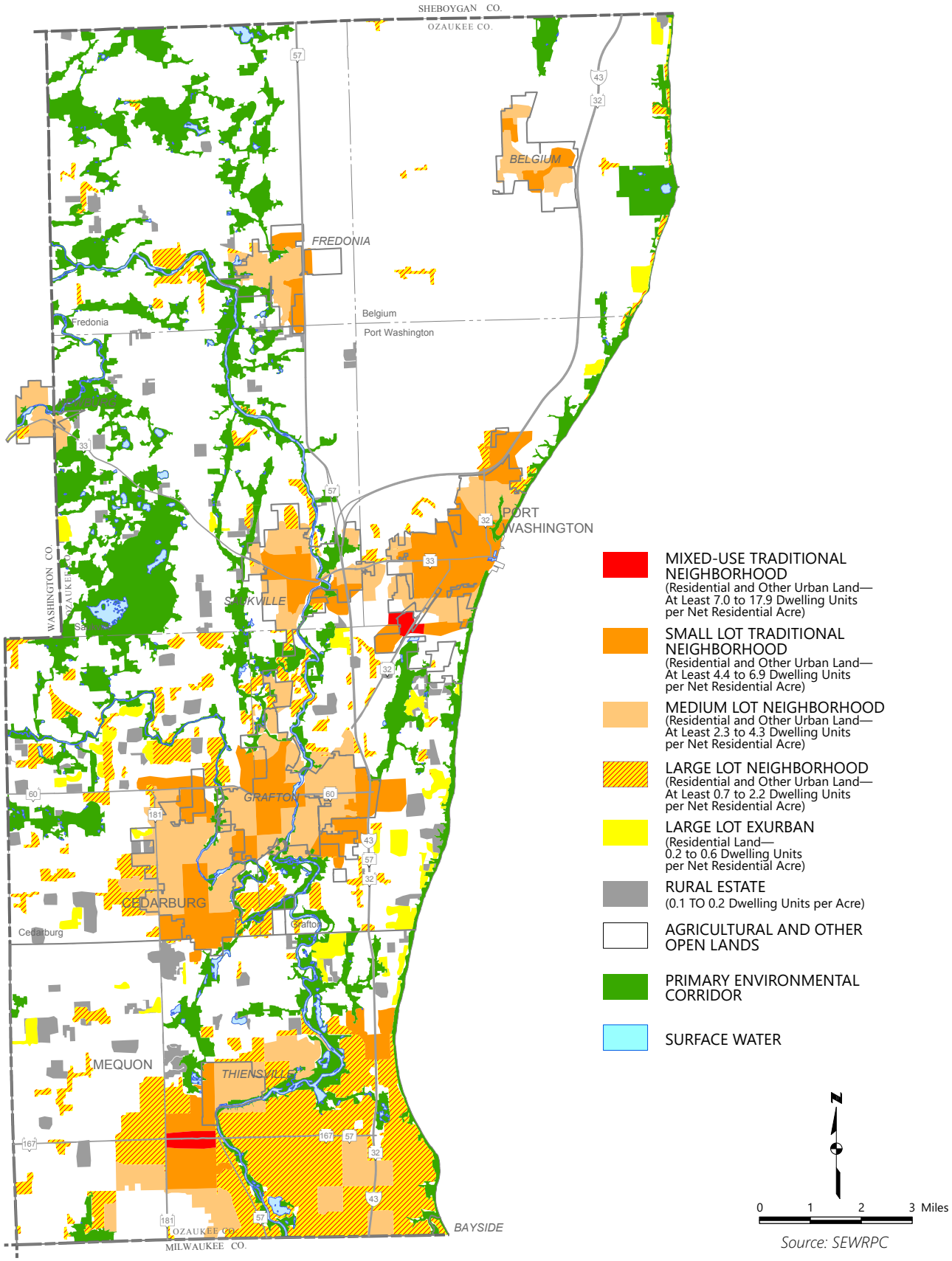
Floodplains identified by Ozaukee County, SEWRPC, the Wisconsin Department of Natural Resources (WDNR), and the Federal Emergency Management Agency (FEMA) are shown on Map 2.7. In 2007, under FEMA's direction, the WDNR performed hydrologic and hydraulic analyses for Ozaukee County's Flood Insurance

Map 2.3
Mobile Home Parks in Ozaukee County: 2015



Source: SEWRPC

Map 2.4
Regional Land Use Plan as it Pertains to the Ozaukee County Planning Area: 2050



Source: SEWRPC

Table 2.9
Projected Changes in Land Uses in Ozaukee County: 2015 and 2050

Land Use Category	Acres			Percent Change
	2015	2050	Change	
Developed Land				
Residential	20,710	23,040	2,330	11.3
Commercial	1,268	1,856	588	46.4
Industrial	1,320	1,984	664	50.3
Transportation, Communications, and Utilities	10,122	10,752	630	6.2
Governmental and Institutional	1,401	1,408	7	0.5
Recreational	2,680	2,880	200	7.5
Unused Urban	1,974	896	-1,078	-54.6
Developed Land Subtotal	39,475	42,816	3,341	8.5
Undeveloped Land				
Agricultural and Other Open Lands	80,755	78,208	-2,547	-3.2
Surface Water	2,628	2,624	-4	-0.2
Wetlands	19,657	19,712	55	0.3
Woodlands	8,141	7,296	-845	-10.4
Undeveloped Land Subtotal	111,181	107,840	-3,341	-3.0
Total	150,656	150,656	--	--

Source: SEWRPC

Study (FIS).[12] The FIS revised and updated information on the existence and severity of flood hazards within Ozaukee County, and it provides floodplain boundaries and delineations to assist communities in developing sound floodplain management measures.

Table 2.10
Forecast Growth in Ozaukee County: 2050

Type	Existing (2010)	Forecast (2050)	Percent Change: 2010-2050
Population	86,400	109,100	26.3
Households	34,200	44,500	30.1
Employment	52,500	69,300	32.0

Source: SEWRPC

Approximately, 19,267 acres, or about 13 percent of the total area of the County, are located within the one-percent-annual-probability flood hazard area. The land area within the one-percent-annual-probability floodplain in each community is given in Table 2.11. This total includes about 870 acres of detailed floodplains modeled by SEWRPC staff in 2017 within the City of Mequon and portions of the Village of Bayside (Ozaukee County). Of the 19,267 acres of delineated floodplains within the County, about 8,086 acres are approximately-delineated floodplains (otherwise known as "A" zones).[13] In addition, roughly 10,972 acres within those delineated floodplains are detailed zones with floodway (otherwise known as "AE" zones). There are about 209 acres within the County that are detailed floodplains without floodway.

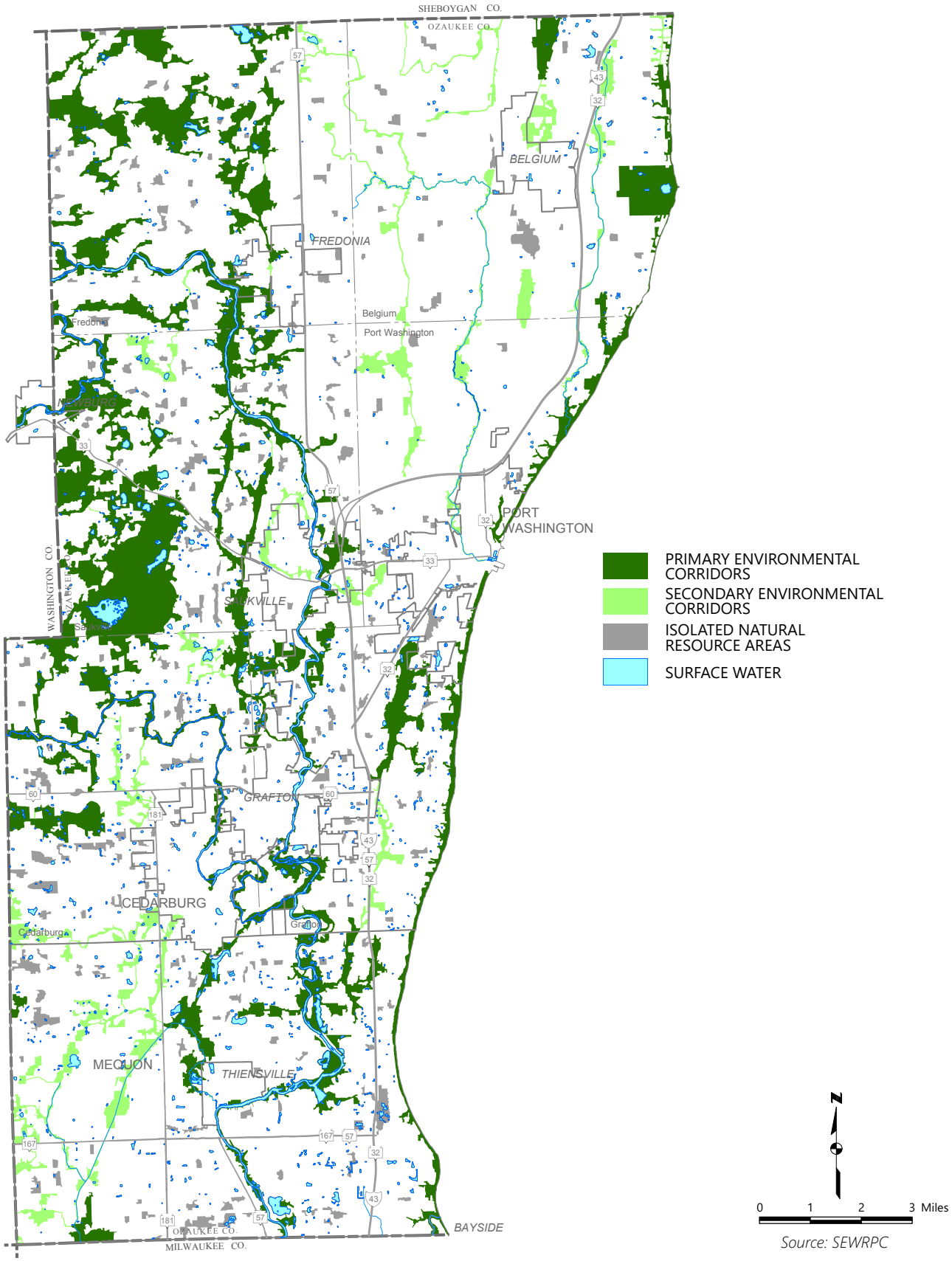
A consideration in flood hazard mitigation is the potential for a chance of flooding due to dam failures. Since there are several major and minor dams in Ozaukee County, future evaluation of floodplain areas related to dam failure should be considered. Dams are barriers built across a waterway to store, control, or divert water. Dams in the County that have been identified by the WDNR are inventoried in Table 2.12, and locations of each are shown on Map 2.8. There are 21 existing dams and eight dams that have been removed or abandoned. Of the 21 existing dams identified, one has been assigned a high hazard rating by the WDNR, indicating the potential for loss of human life as well as economic loss, environmental damage, or disruption of lifeline facilities during failure or mis-operation. Another two dams have been assigned significant hazard ratings, indicating the potential for economic loss, environmental damage, or disruption of lifeline facilities. Most of these dams are small, mill-type dams under the jurisdiction of the WDNR and most are owned by the WDNR or privately.[14] The remaining dams have been classified as low hazard, or a hazard rating has not been assigned.

[12] Flood Insurance Study, Ozaukee County, Wisconsin and Incorporated Areas, *Vol. 1 of 2. Federal Emergency Management Agency, Flood Insurance Study Number 55089CV001A, Revised December 4, 2007.*

[13] *Approximate floodplains do not include flood elevation information.*

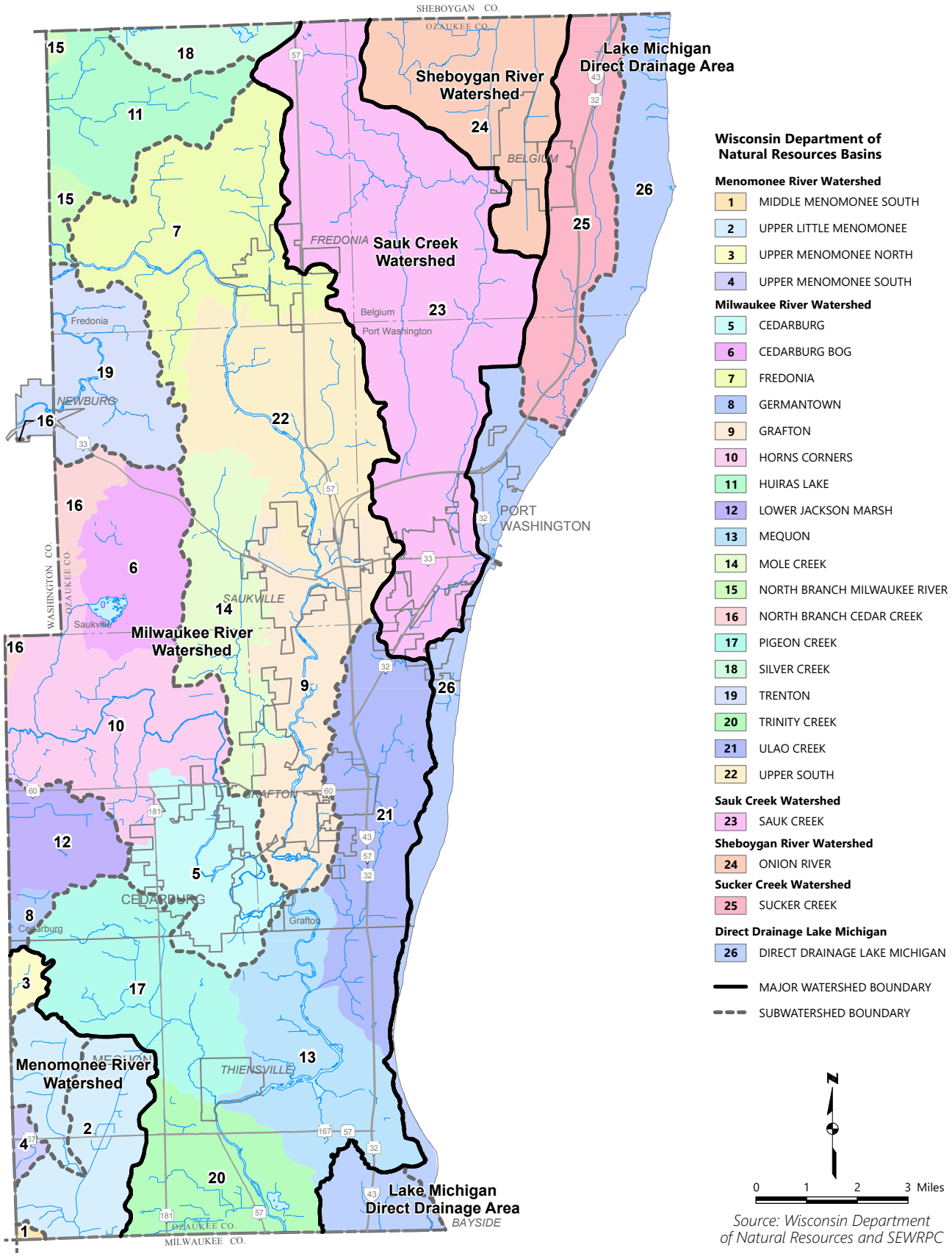
[14] *EPTEC;* Ozaukee County Hazard Mitigation Plan*, 2013.*

Map 2.5
Environmental Corridors and Isolated Natural Resource Areas Within the Ozaukee County Planning Area: 2015



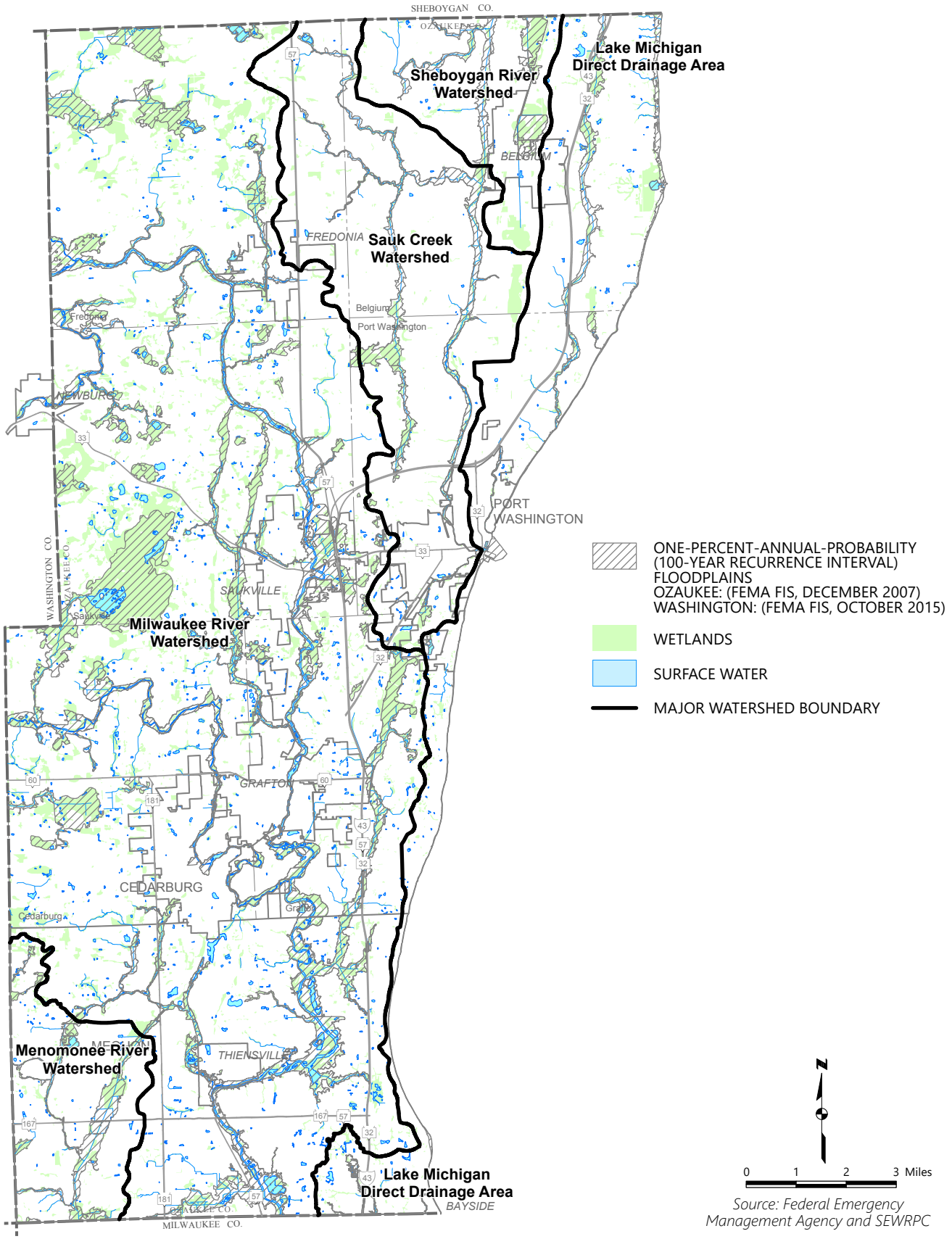
Source: SEWRPC

Map 2.6
Watershed Features Within the Ozaukee County Planning Area



Source: Wisconsin Department of Natural Resources and SEWRPC

Map 2.7
Surface Waters, Wetlands, and Floodplains Within the Ozaukee County Planning Area: 2015



Source: Federal Emergency Management Agency and SEWRPC

2.7 LAKE MICHIGAN COASTAL BLUFF EROSION

Shoreline Erosion and Bluff Stability Conditions

Wisconsin has several hundred miles of Great Lakes coastline. Slightly over a third of the people in Wisconsin (2 million people) live in the 15 coastal counties along Lake Michigan and Lake Superior. Property values along the coast are substantially greater than those of non-coastal properties. Development pressure on the Great Lakes coastline continues to increase with larger and larger homes being built in this dynamic environment. However, living on the coast poses some risks. People living on Wisconsin's Great Lakes coastline are vulnerable to coastal hazards including erosion, lake level changes, waves, storm surge, floods, ice shove, and landslides.[15] Identifying coastal reaches with unstable bluffs and determining recession rates provides coastal communities and landowners with the information needed to avoid constructing buildings at risk. Portions of the Lake Michigan shoreline in Ozaukee County are highly vulnerable to shore erosion largely because much of the coastal landforms are comprised of mixed, unconsolidated glacial materials such as gravels, lake-deposited clays, and tills. Map 2.9 illustrates the different land uses by parcel along the Lake Michigan coastline within Ozaukee County. As indicated on Map 2.9 most parcels along the coastline are in residential land uses. Ozaukee County's Department of Land and Water Management webpage provides information about shoreline stability, erosion in the Great Lakes Region, weekly Great Lakes water levels, and material about shoreline erosion and recession.[16]

Table 2.11
Areal Extent of One-Percent-Annual-Probability Floodplain by Civil Division in Ozaukee County: 2018

Civil Division	Area (acres)
Cities	
Cedarburg	174
Mequon	3,894
Port Washington	162
Villages	
Bayside[a]	5
Belgium	70
Fredonia	103
Grafton	157
Newburg[b]	63
Saukville	659
Thiensville	101
Towns	
Belgium	2,559
Cedarburg	2,194
Fredonia	2,413
Grafton	1,724
Port Washington	936
Saukville	4,053
Total	19,267

Note: Lake Michigan shoreline has approximately 102 acres of detailed floodplains that are not included in this table.

[a] *Data shown in this table only represents the portion of the Village of Bayside that lies within Ozaukee County.*

[b] *Data shown in this table represents the entire Village of Newburg which includes lands in both Ozaukee and Washington County.*

Source: Federal Emergency Management Agency and SEWRPC

An inventory of the shoreline conditions and bluff stability within the entire Southeastern Wisconsin Region was conducted in 1977[17] by a number of coastal technical consultants under the Wisconsin Coastal Management Program (WCMP), and again in 1997 by SEWRPC, in conjunction with WCMP.[18] Coastal conditions can change over time since they are related to changes in, among other related factors, climate, water levels (i.e., seasonal fluctuations), the geometry of the onshore beach and nearshore areas, the extent and condition of shore protection measures, the type and extent of vegetation, and the type of land uses in shoreland areas.

The 1997 Lake Michigan shoreline recession and bluff stability study, conducted by SEWRPC, included evaluations of lands along the Lake Michigan shoreline in Kenosha, Racine, Milwaukee, and Ozaukee Counties that directly affect, or are directly affected by, shoreline erosion, bluff recession, and storm damage processes. This relatively narrow strip of land along the Lake Michigan shoreline extends approximately 89 miles from the Wisconsin-Illinois state line to the Ozaukee-Sheboygan county line, including approximately 26 linear miles in Ozaukee County. The Ozaukee County shoreline contains areas of substantial bluffs

[15] *A.R. Lulloff and P. Keillor,* Managing Coastal Hazard Risks on Wisconsin's Dynamic Great Lakes Shoreline, *Wisconsin Coastal Management Program, 2011 with updates provided in 2015.*

[16] *www.co.ozaukee.wi.us.*

[17] *D.M. Mickelson, L. Acomb, N. Brouwer, T.B. Edil, C. Fricke, B. Haas, D. Hadley, C. Hess, R. Klauk, N. Lasca, and A.F. Schneider, Shore Erosion Study,* Technical Report, Shoreline Erosion and Bluff Stability Along Lake Michigan and Lake Superior Shorelines of Wisconsin*, Wisconsin Coastal Management Program, February 1977.*

[18] *SEWRPC Technical Report No. 36,* Lake Michigan Shoreline Recession and Bluff Stability in Southeastern Wisconsin: 1995, *December 1997.*

Table 2.12
Wisconsin Department of Natural Resources Dam Inventory Information

Map ID	Municipality	Water Feature	Name		Owner Type	Owner Organization	Size[a]	Structure Height (feet)	Impoundment Surface Area (acres)	Hazard Potential	Status
			Official	Local							
1	City of Cedarburg	Cedar Creek	Cedarburg Woolen Mill	--	Public	City of Cedarburg	Large	18.0	6.0	Significant	Existing
2	City of Cedarburg	Cedar Creek	Columbia Mills	--	--	City of Cedarburg	Large	15.0	15.0	Low	Existing
3	City of Cedarburg		Hamilton Mill Dam	Dave Uihlien Dam						--	Removed
4	City of Cedarburg	Cedar Creek	Ruck Pond Dam	--	Private	Cedarburg Supply Company	Small	17.0	4.0	Low	Existing
5	City of Cedarburg	Cedar Creek	K.M. Company	Wire and Nail Factory	--	Cedarburg Hydro Electric Corporation	Large	28.0	2.0	Low	Existing
6	City of Mequon	Fish Creek	Fish Creek Dam	Fish Creek	--	South Fairy Chasm Association	--	--	--	--	Removed
7	City of Mequon	Tributary to Milwaukee River	Albright, John	Drainage Swale	--	--	Small	12.0	1.0	Low	Existing
8	City of Mequon	Lac Du Cours Creek	Lac Du Cours	--	--	Lac Du Cours Homeowners Association	Small	1.8	57.0	Low	Modified
9	City of Mequon	--	Stonefield's Subdivision	--	--	Rudella Corporation	Small	9.0	3.5	Low	Existing
10	City of Mequon	Milwaukee River	Thiensville Dam	--	--	City of Mequon	Large	13.0	45.0	Low	Existing/ Fishway
11	City of Mequon	Trinity Creek	Trinity Creek Dam	Trinity Creek	--	City of Mequon	Small	3.5	35.0	Low	Existing
12	City of Mequon	--	Wisconsin Lutheran Seminary Dam	--	--	--	--	--	--	--	Removed
13	City of Port Washington	Mineral Springs Creek	Mineral Springs Creek Bypass	--	--	--	Small	5.0	--	Low	Existing
14	City of Port Washington	Mineral Springs Creek	Mineral Springs Creek	--	--	Jadair International, Incorporation	Small	10.0	--	Low	Removed
15	Village of Fredonia	Fredonia Creek	--	--	--	--	--	--	--	--	Removed
16	Village of Grafton	Milwaukee River	Grafton Dam	Bridge Street		Village of Grafton	Large	20.0	35.0	Significant	Existing
17	Village of Grafton	Milwaukee River	Chair Factory Dam	Norman Sorenson	--	Robert Reisinger	--	--	--	--	Removed
18	Village of Grafton	--	Meadowbrook Detention Pond	--	--	Village of Grafton	Small	6.7	31.0	Low	Existing
19	Town of Belgium	Unnamed Tributary to Lake Michigan	A. H. Lau Dam	--	--	James Ellioff	Small	12.0	0.3	--	Existing
20	Town of Belgium	--	Forest Beach Preserve Dike #3	Squires	--	Ozaukee Washington Land Trust	Small	8.0	1.0	Low	Existing
21	Town of Belgium	Puckett's Pond	Harrington Beach	WDNR	--	WDNR Ranger-	Small		2.0	Low	Existing
22	Town of Cedarburg	Unnamed Tributary to Mole Creek	G. E. Harris	--	--	--	Large	15.0	17.0	High	Existing
23	Town of Cedarburg	Tributary to Cedar Creek	H. Zindler Lake	--	--	H Zindler Lake Development	Small	15.0	6.7	Low	Existing
24	Town of Fredonia	Crystal Springs Creek	Ron Robbins	Crystal Springs Lake	--	Crystal Springs Park Association, Incorporation	Small	15.0	11.0	Low	Existing

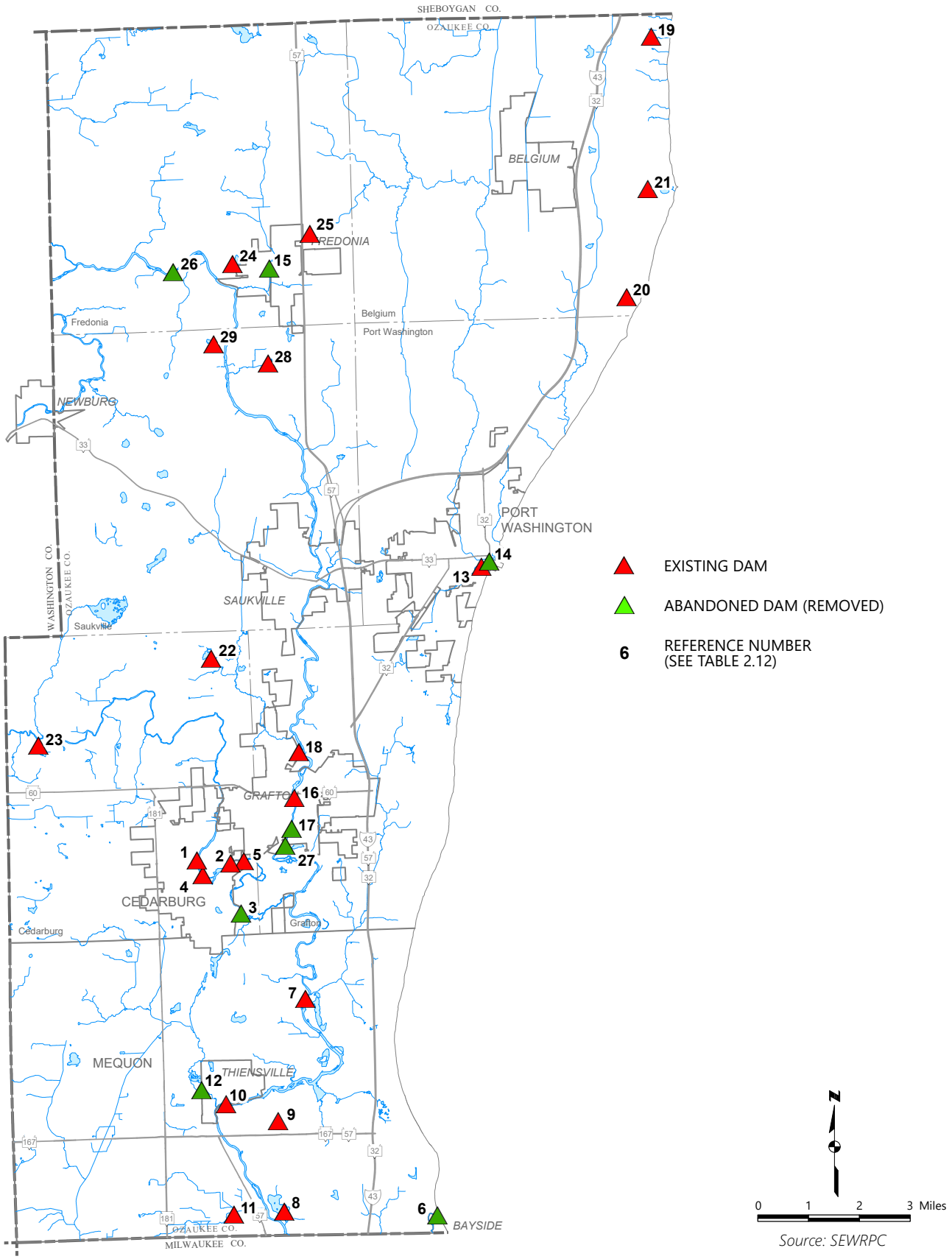
Table continued on next page.

Table 2.12 (Continued)

Map ID	Municipality	Water Feature	Name		Owner Type	Owner Organization	Size[a]	Structure Height (feet)	Impoundment Surface Area (acres)	Hazard Potential	Status
			Official	Local							
25	Town of Fredonia	Unnamed Tributary to Sauk Creek	John Depies	--	Private	--	Small	5.6	3.6	Low	Existing
26	Town of Fredonia	--	Waubeka Mill Incorporated	Waubeka Dam	--	--	--	--	--	--	Removed
27	Town of Grafton	--	Lime Kiln Park Dam	--	Village of Grafton	--	--	--	--	--	Removed
28	Town of Saukville	Tributary to Milwaukee River	Ozaukee County Park	Hawthorne Hills County Park	--	Ozaukee County	Small	22.0	15.0	Low	Existing
29	Town of Saukville	--	Hawthorne Drive Creek	--	Private	--	--	--	--	--	Existing

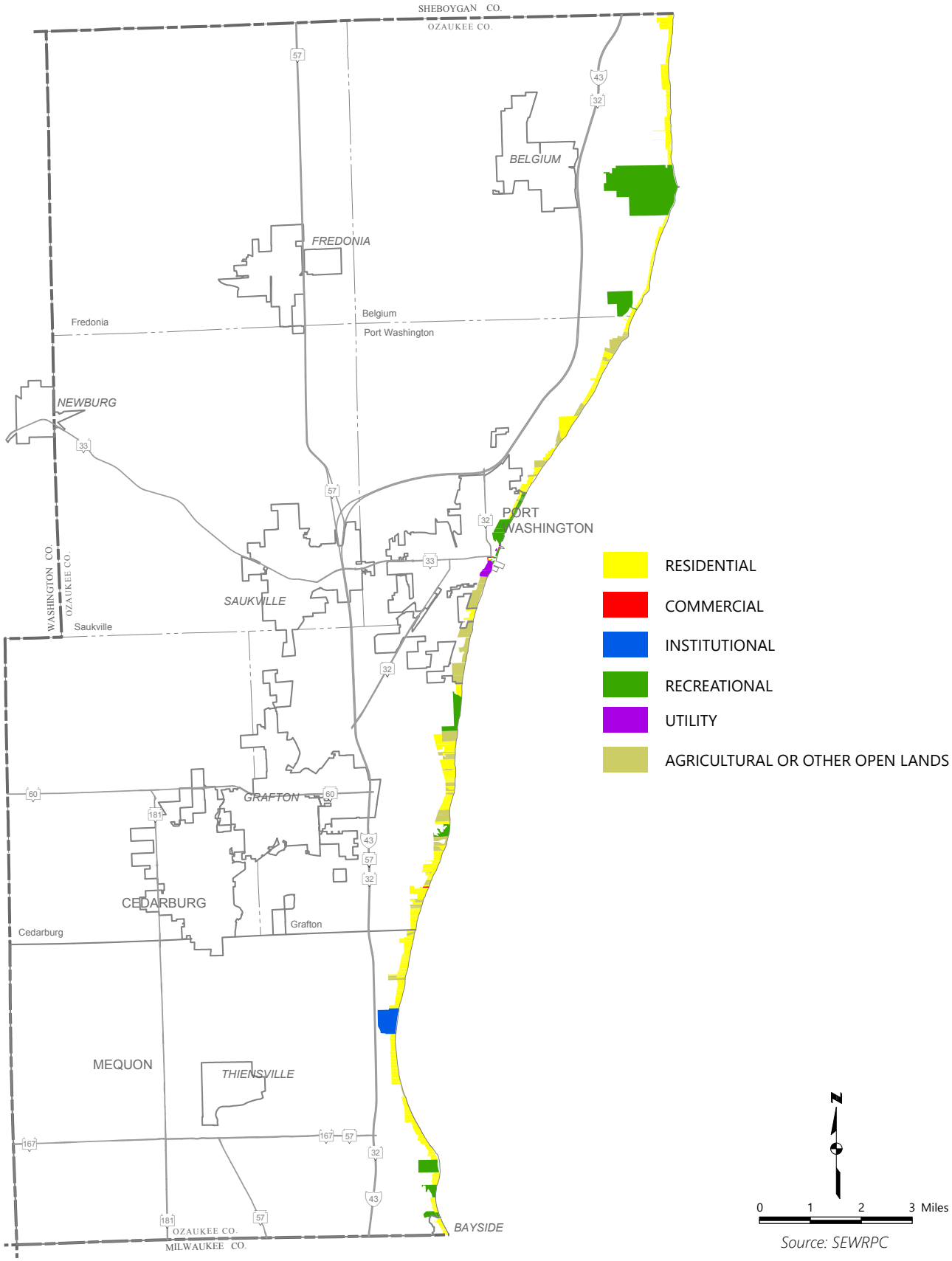
Source: Wisconsin Department of Natural Resources and SEWRPC

Map 2.8
Dam Locations in Ozaukee County: 2017



Source: SEWRPC

Map 2.9
Parcel Land Uses Located Along Lake Michigan Coastline: 2015



Source: SEWRPC

with heights of up to 140 feet, ravines, areas of gently rolling beaches with widths of up to 150 feet, and areas of low sand dune ridges. For analytical purposes, under the 1997 study, the Lake Michigan shoreline was divided into 17 reaches, including seven reaches (reaches 11-17) within, or partially within, Ozaukee County, as shown on Map 2.10. These reaches were selected to have relatively uniform beach and bluff characteristics. These reaches generally correspond to those utilized in the 1977 shoreline erosion study mentioned above, with some refinement to reflect 1995 conditions.

During the 1995-1997 field assessment, surveys were conducted to measure the geometry of the bluff slope at 192 sites, including 62 sites in Ozaukee County. These measurements provided a basis for site-specific assessments of the bluff conditions at the selected locations. In addition, beach and nearshore lakebed conditions were measured for selected sites.

Based upon the 1995-1997 data collected and the assessment and analysis of that data, the findings for Ozaukee County's bluff stability and shoreline erosion conditions were developed and are summarized in Table 2.13 and shown graphically on Map 2.10. Information summarized in Table 2.13 includes bluff height, bluff stability, shoreline recession data, and beach width for each associated reach area. A safety factor score was calculated for potential failure surfaces within the bluffs using shear strengths and stresses. A safety factor against sliding of less than 1.0 is considered unstable, a factor of 1.0 to 1.1 considered marginally stable, and a factor of greater than 1.1 is considered stable. According to Table 2.13, in 1995 bluff stability ranged from unstable to stable for those reaches within Ozaukee County that contained bluffs. The findings for bluff stability were similar to the results of the 1977 study, except for reach 13, which showed improvement in stability conditions in some areas from 1977 to 1995.

Great Lakes water levels vary seasonally, annually, and over multi-decade cycles. Water levels in Lake Michigan have been increasing since 2013. Water levels in Lake Michigan were below the long-term average from 1999 to 2014 and quickly jumped above that average in spring 2014.[19] The long-term average water level for Lake Michigan is 578.84 feet (International Great Lakes Datum 1985). As of December 2019, the water level in Lake Michigan was 581.53 feet (IGLD 1985), 2.7 feet above the long term average, about 5.5 feet above record low levels that occurred in January 2013, and less than one foot below the record high levels that occurred in October 1986, as shown in Figure 2.1. While higher water levels can benefit communities, businesses, and industries that depend on Great Lakes waters for commercial shipping, hydropower, recreational boating, and tourism, they can lead to negative impacts such as coastal erosion, beach loss, flooding, and property damage along the shoreline. Low water levels have the effect of reducing shoreline erosion caused by scour at the base of the bluff however, shoreline habitat and beaches can be negatively affected by low levels as can shipping, power generation, and tourism. Given the cyclic nature of water levels in the Great Lakes, a return to lower lake levels may occur in the future.

Bluff Stabilization Project: 2005

The Concordia University property in the City of Mequon contains 2,700 feet of shoreline and sits atop a nearly 130-foot-high bluff along the Lake Michigan coast. In the early 2000s, University officials began to observe the bluff edge eroding nearly a foot each year, or the equivalent of 20,000 tons of sediment per year. Campus officials determined that the bluff erosion was threatening the safety of campus, in 2005, and hired an engineering firm to formulate a plan and carry out a project to stabilize the eroding bluff. The stabilization project decreased the slope of the bluff to a stable incline, revegetated exposed soils on the bluff face, added coastal wetlands, and placed 100,000 tons of stone revetments along the shoreline to protect the bluff toe from persistent wave action.[20] The project took eight years to plan, fund, and execute.

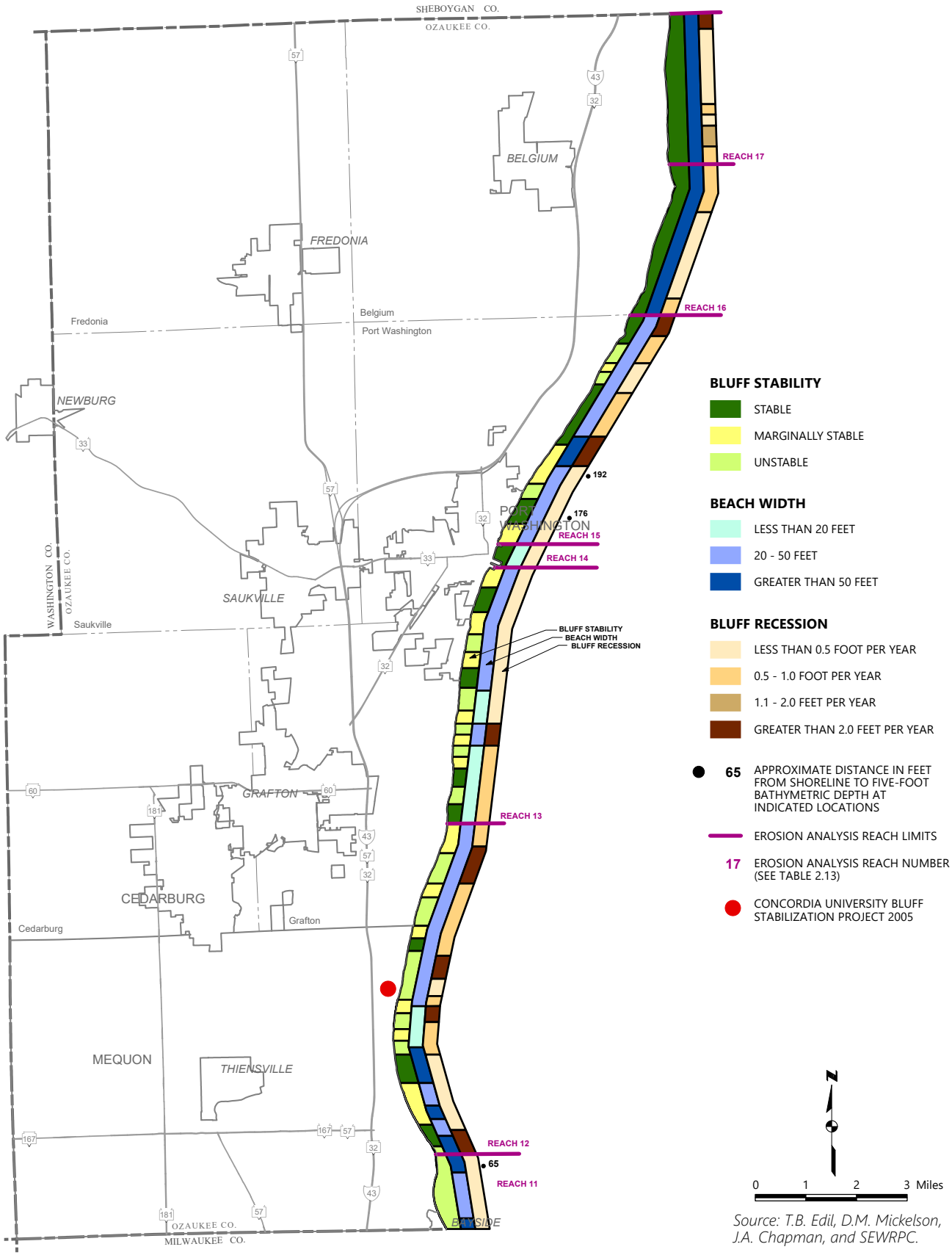
Although this project was successful in significantly reducing the rate of erosion on Concordia's bluff, it has caused some unintended consequences to neighboring properties to the south (down shore). With the new revetments in place, sediment could no longer wash into the Lake and be taken by the longshore currents[21]

[19] *University of Wisconsin Sea Grant Institute. seagrant.wisc.edu/Home/Topics/CoastalEngineering.*

[20] *Great Lakes Coastal Resilience Planning Guide,* Stabilizing Concordia University's Bluff, *www.greatlakesresilience.org, 2013.*

[21] *Longshore currents, otherwise known as the littoral drift is the natural process of the transportation of soil particles (i.e., sand, silt, and clay) along the coastline. Soil particles are carried by the longshore currents which are formed as waves strike the shoreline at an oblique angle, forcing some of the surf-zone water to move laterally. The movement is influenced by the circulation patterns of the Great Lakes.*

Map 2.10
Lake Michigan Shoreline Erosion and Bluff Stability Analysis for Ozaukee County: 1995



Source: T.B. Edil, D.M. Mickelson, J.A. Chapman, and SEWRPC.

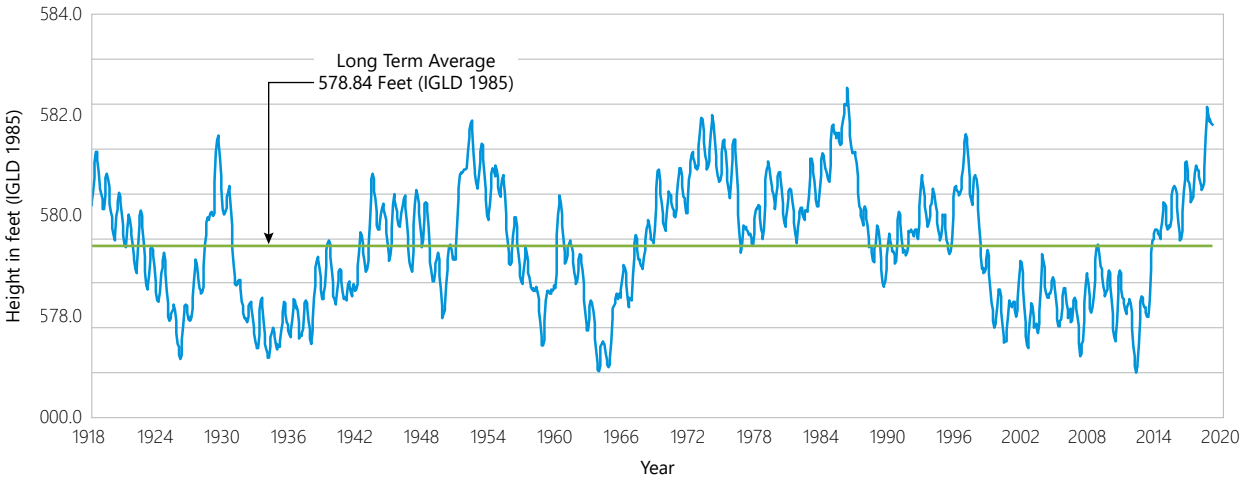
Table 2.13
Bluff Stability and Shoreline Recession Along Lake Michigan Shoreline of Ozaukee County: 1995

Shoreline Analysis (see Map 2.10)	Bluff Heights (feet)	Deterministic Bluff Stability Safety Factor		Shoreline Recession Data 1963-1995		Estimated Beach Width (feet)	
		1995 Conditions	1977 Conditions	Total (feet)	Annual Average (feet per year)	1995 Conditions	1977 Conditions
Reach 11[a]	80-140	0.69-1.12 (Unstable to Stable)	0.69-1.13 (Unstable to Stable)	20-100	0.3-2.5	0-100	10-25
Reach 12	80-140	0.57-1.88 (Unstable to Stable)	0.66-1.05 (Unstable to Marginally Stable)	0-70	0.0-2.2	0-100	0-25
Reach 13	100-130	0.59-1.81 (Unstable to Stable)	0.49-0.82 (Unstable)	0-60	0.0-1.9	0-50	10-30
Reach 14	No Significant Bluff	N/A	N/A	50	1.6	No Significant Beach	No Significant Beach
Reach 15	85-100	0.72-1.47 (Unstable to Stable)	0.61-1.21 (Unstable to Stable)	0-50	0.0-1.6	10-100	5-70
Reach 16	No Significant Bluff	N/A	N/A	0-80	0.0-2.5	0-150	5-20
Reach 17	No Significant Bluff	N/A	N/A	0-130	0.0-4.1	30-100	Less than 20

[a] *Includes a portion of Milwaukee County.*

Source: Wisconsin Coastal Management Program and SEWRPC

Figure 2.1
Lake Michigan Mean Monthly Water Levels 1918-2019



Source: National Oceanic and Atmospheric Administration Great Lakes Environmental Research Laboratory and SEWRPC

to properties south of the school. By armoring the shore, sediment transport budgets have been altered and have prevented areas down shore of the project from being nourished with new sediments, thus increasing erosion rates in those areas.[22]

These bluff stabilization challenges are not limited to this particular project. Bluff erosion and the impacts associated with shoreline structure management continue to be studied within the Great Lakes Region. As discussed below, research, education, and outreach are actively being pursued within Ozaukee County and other Great Lake coastal communities to better understand shoreline management practices along the Lake Michigan coast to minimize future coastal hazards.

Integrated Assessment on Water Levels and Coastal Shores in Northern Milwaukee County and Southern Ozaukee County, Wisconsin

Changes in the Lake Michigan shoreline caused by fluctuating water levels precipitated the need to bring together existing research on coastal bluffs and engage coastal communities, including those of Ozaukee County, to explore a broader range of policy options for increasing the integrity of coastal bluffs. In March 2015, two grants totaling $60,000 were awarded by the Graham Sustainability Institute at the University of Michigan to conduct an integrated assessment study of changing Lake Michigan water levels and their impact on coastal beaches between the Village of Shorewood in Milwaukee County, and the City of Port Washington in Ozaukee County. The University of Wisconsin Sea Grant Institute led the study with a team of coastal engineers; geologists; ecologists; urban and regional planners, including the SEWRPC staff; law and policy experts; landscape architects; and social scientists. The full project consisted of an initial planning phase and three phases of a full integrated assessment.

The planning grant phase included interviews with stakeholders, partners, and investigators; development of an online bibliography[23] of relevant research on variable water levels and coastal bluffs; formulation of a white paper on finding and organizing existing research,[24] data and decision tools; and a workshop to provide information about the integrated assessment to determine if there was support to continue participation in the project. The planning grant phase concluded that there was support for continued participation.[25]

[22] *Great Lakes Coastal Resilience Planning Guide*, greatlakesresilience.org, *2013*.

[23] *For online bibliography see www.zotero.org/groups/1569452/wisconsin_coastal_hazards_bibliography/items.*

[24] *Hart, David,* Finding and Organizing Existing Research, Data, and Decision Tools Related to Water Level Variability and Coastal Bluffs in Northern Milwaukee County and Southern Ozaukee County, Wisconsin, *University of Wisconsin Sea Grant Integrated Assessment Project White Paper, 2015*.

[25] *University of Wisconsin Sea Grant Institute,* Planning for an Integrated Assessment on Water Level Variability and Coastal Bluffs in Northern Milwaukee County and Southern Ozaukee County, Wisconsin*, September 2015*.

Phase one of the integrated assessment produced a synthesis of existing research and data to better understand the effects that increased variation in water levels in Lake Michigan has on coastal bluffs and beaches. A workshop was conducted with investigators and partners to prioritize the most relevant reports, studies, and data for the integrated assessment. A report was produced in this phase of the project that described the status and trends concerning changing water levels and coastal bluffs in the study area and corresponding consequences of those trends.[26]

Phase two of the project consisted of extensive community conversations to identify and prioritize policy options for local governments, adaptive actions for private property owners, and outreach decision tools for both groups. Three meetings were held in the summer of 2016 at which brainstorming exercises were conducted to understand the local hopes and concerns. A list of 29 response options from these meetings were analyzed and prioritized by the project team.[27]

The third, and final phase of the project put forth a preferred set of policy options, adaptive actions, and decision tools intended to lead to a measurable increase in the resilience of bluffs in the study area to coastal erosion. Deliverables from this phase included a resource guide for property owners living on the coast of Lake Michigan,[28] a resource guide for local officials in the southeastern Wisconsin coastal communities,[29] and a final integrated assessment report.[30]

Southeast Wisconsin Coastal Resilience Project

Planning and preparing for, and adapting to, coastal hazards can enhance community resilience and strengthen coastal economies. In 2017, a project team consisting of the Wisconsin Coastal Management Program, the University Of Wisconsin Sea Grant Institute, the University of Wisconsin-Madison Department of Civil and Environmental Engineering, and SEWRPC were awarded a three-year National Atmospheric and Oceanic Administration (NOAA) Coastal Resilience Grant to enhance community capacity in southeastern Wisconsin and to build resilience to these coastal hazards. This project will provide resources and assistance to communities in Ozaukee, Milwaukee, Racine, and Kenosha Counties to plan and prepare for coastal hazards.

A Community of Practice has been formed that includes municipalities, counties, State agencies, and Federal partners. This network of officials will meet semi-annually over the three-year project period to demonstrate resilience resources, discuss ongoing hazard issues, initiate collaboration, and develop consistent approaches to address coastal hazards in the Region.

The project team is expected to evaluate and map shoreline recession rates by analyzing historical aerial photographs and assess scenarios of potential shoreline recession under Lake level extremes and high-energy storm conditions. An interactive mapping tool will be developed to help visualize recession rates and scenarios.

The Coastal Resilience project will also develop educational and outreach materials for bluff best management practices, bluff slope vegetation practices that can improve bluff stability, nature-based shoreline protection specifically for Great Lakes shorelines, and resilient beach restoration practices that increase resistance to erosion. In addition, a small harbor and marina infrastructure and dredging cost evaluation matrix will be updated for use in maintenance and adaptation planning.

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[26] *University of Wisconsin Sea Grant Institute, Integrated Assessment on Water Level Variability and Coastal Bluffs and Shores in Northern Milwaukee County and Southern Ozaukee County, Wisconsin*, Interdisciplinary Synthesis of Existing Research, *November 2016*.

[27] *University of Wisconsin Sea Grant Institute, Integrated Assessment on Water Level Variability and Coastal Bluffs and Shores in Northern Milwaukee County and Southern Ozaukee County, Wisconsin*, Response Options, *November 2016*.

[28] *A. Mangham, D. Hart, A. Belche, G. Clark, D. Peroff, J. Noordyk, B. Stitt, and L. Stitt, University of Wisconsin Sea Grant Institute, Adapting to a Changing Coast,* Options and Resources for Lake Michigan Property Owners, *August 2017*.

[29] *A. Mangham, D. Hart, A. Belche, G. Clark, D. Peroff, J. Noordyk, B. Stitt, and L. Stitt, University of Wisconsin Sea Grant Institute, Adapting to a Changing Coast,* Options and Resources for Local Officials in Southeastern Wisconsin Coastal Communities, *June 2018*.

[30] *M. Allen, J. Callewaert, and K. Olsen, University of Michigan Graham Sustainability Institute,* Great Lakes Water Levels Integrated Assessment Report, *February 2018*.

The project team will also work with counties and municipalities to assess their vulnerabilities to coastal hazards through a self-assessment exercise. A guided resilience assessment will also be offered to communities to help identify and prioritize potential actions to address coastal hazards. The project has set aside funding to begin to implement some of these actions to proactively address the local vulnerabilities to coastal hazards.[31]

Great Lakes Coastal Flood Study: Ozaukee County

Along with coastal erosion hazards, it is also important to consider coastal flooding for hazard mitigation planning. The Great Lakes Coastal Flood Study (GLCFS) is an ongoing collaboration of FEMA, the U.S. Army Corps of Engineers Engineering Research and Data Center (USACE-ERDC), State partners, the Association of State Floodplain Managers (ASFPM), and FEMA contractors. The GLCFS is FEMA's comprehensive storm and wind study of the Great Lakes basin for updating coastal flood hazard information and Digital Flood Insurance Rate Maps (DFIRMs) for Great Lakes coastal communities, including Ozaukee County. The purpose of the DFIRMs is to identify the areas in a community that are subject to flooding. One such area is the Special Flood Hazard Area (SFHA), or the 1-percent-annual floodplain.

Included in the GLCFS was 50 years of historical wave and wind data, storm surge modelling, statistical wave and water level analyses, and response-based modelling to determine the coastal SFHA. The coastal SFHA was determined from water level and wave combinations that could potentially impact the coastline, including wave run-up.[32]

As a part of the GLCFS coastal hazard analysis and mapping, FEMA used cross-sectional transects to determine near shore flood hazards. A total of 16 transect locations were used for Ozaukee County. Transects represented coastal reaches with similar physical characteristics and are set perpendicular to the average shoreline. Because of the large proportion of bluffs in Ozaukee County the main concern is not coastal flooding, but rather the impact of wave run-up on the stability of the bluffs.

2.8 TRANSPORTATION SYSTEM

The transportation system of Ozaukee County provides the basis for movement of goods and people into, out of, through, and within the County. An efficient transportation system is essential to the sound social and economic development of the County, and of the Region. An understanding of the existing transportation system is also a factor to be considered in the preparation of a hazard mitigation plan for the County. Accordingly, this section presents a description of existing transportation facilities in Ozaukee County. Included are descriptions of the existing arterial street and highway system, public transit facilities, air service facilities, and railway facilities within Ozaukee County.

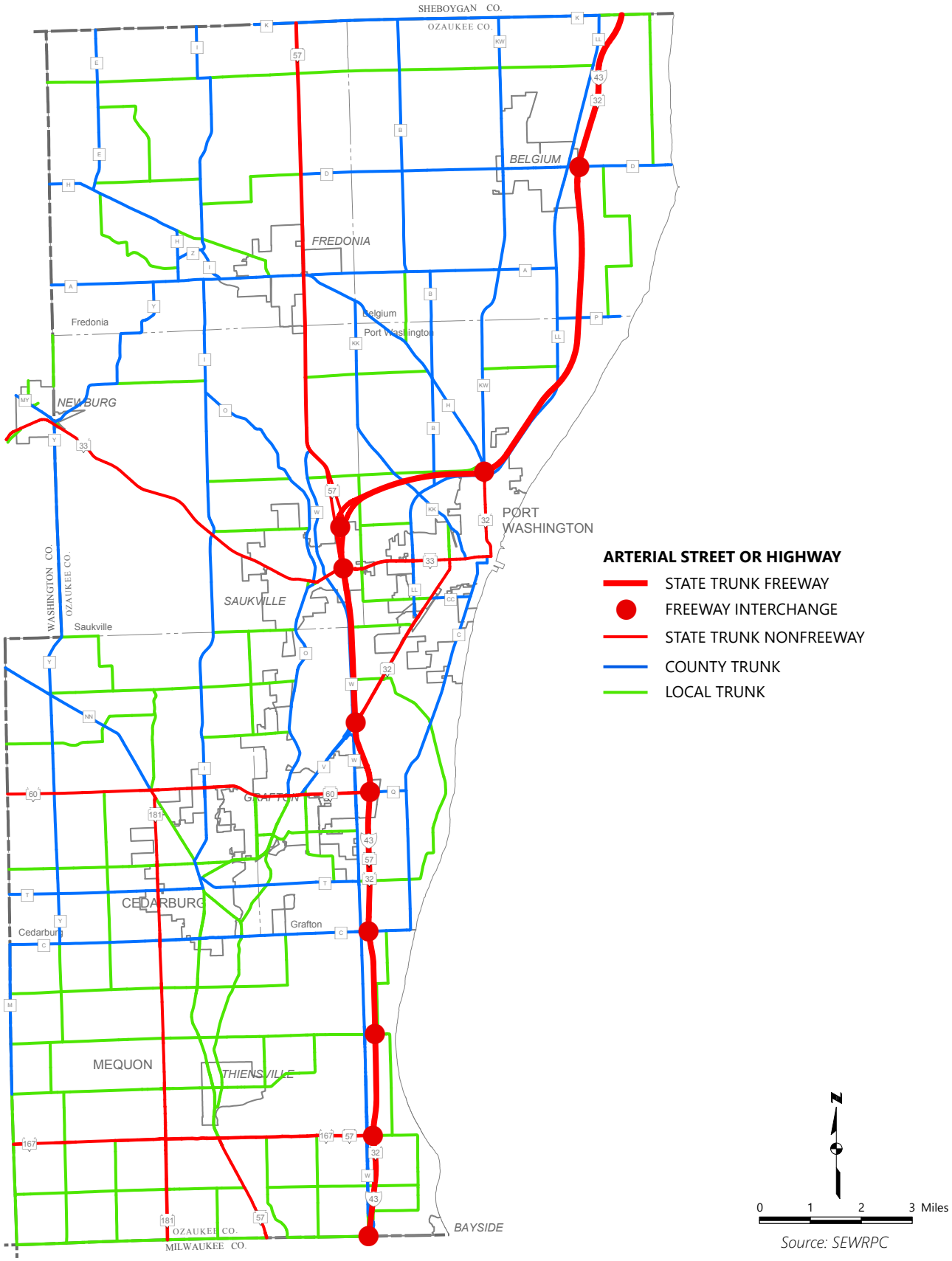
Arterial Streets and Highways

Arterial streets and highway systems are intended to provide a high degree of travel mobility, serving the through movement of traffic between and through urban areas. The arterial street and highway system serving Ozaukee County is shown on Map 2.11. As shown on Map 2.11, the existing arterial network in the eastern and southern portion of the County is relatively denser than the northwestern portion of the County. Arterial streets and highways accounted for 303 miles, or about 32 percent of the mileage of the road system in 2013. State trunk highways (STH) serve the longest trips, predominantly carrying traffic traveling through Ozaukee County and between Ozaukee County and adjacent counties. County trunk highways (CTH) form an integrated system together with the State highways and mainly serve traffic between communities within the County. Interstate Highway (IH) 43 runs along the eastern portion of the county, parallel to Lake Michigan. Bayside, Belgium, Grafton, Mequon, Port Washington, Saukville, and Thiensville, all have close access to IH 43.

[31] *www.sewicoastalresilience.org.*

[32] *Wave Run-up is the uprush of water from wave action on a beach, steep bluff, or coastal structure, typically caused by a storm surge.*

Map 2.11
Arterial Streets and Highways Within the Ozaukee County Planning Area: 2017



Source: SEWRPC

The traffic-carrying capacity of the arterial street and highway system, while dependent upon several factors, is primarily a function of the number of traffic lanes and the type of facility. As shown in Table 2.14, a two-lane arterial generally has a design capacity of about 14,000 vehicles per average weekday, a four-lane undivided arterial has a design capacity of about 18,000 vehicles per average weekday, a four-lane arterial with a two-way left turn lane has a design capacity of about 21,000 vehicles per average weekday, a four-lane divided arterial has a design capacity of about 27,000 vehicles per average weekday, a six-lane divided arterial has a capacity of about 38,000 vehicles per average weekday, and an eight-lane divided arterial has a capacity of about 50,000 vehicles per average weekday. The design capacities cited are for urban arterials typically having urban cross-sections with curb and gutter and auxiliary parking lanes, which can also serve as distress lanes and, importantly, serve as bypass lanes at intersections. The traffic capacities of urban arterials are established by the capacity of the intersections with other arterial streets, which are typically controlled by traffic signals. As also shown in Table 2.14, a four-lane freeway has a design capacity of about 60,000 vehicles per average weekday, a six-lane freeway has a design capacity of about 90,000 vehicles per average weekday, and an eight-lane freeway has a design capacity of about 120,000 vehicles per average workday.

Public Transit Facilities

Ozaukee County Express Service Route 143

The Ozaukee County Express Service is a two-way, traditional commuter bus service between Ozaukee County and the City of Milwaukee, running southbound in the morning and northbound in the evening, as shown on Map 2.12. The service is funded by Ozaukee County and operated through a contract with Milwaukee County Transit System (MCTS). Route 143 generally follows IH 43 between the Cities of Milwaukee and Port Washington. Ozaukee County has free parking at six park-and-ride parking lots located at CTH 32/H in Port Washington, the Saukville Wal-Mart, CTH V in Grafton, the Grafton Commons, the Target Store in Grafton, and CTH C (Pioneer Road) near Cedarburg. There are also five additional stops along N. Port Washington Road in the City of Mequon including one serving Columbia St. Mary's Hospital. Approximately 15 stops are located in downtown Milwaukee along Kilbourn Street and Wisconsin Avenue, seven stops between W. Capitol Drive and McKinley Boulevard, and two more between downtown and Mitchell Street.

There are five bus trips into Milwaukee each weekday from Port Washington and Saukville park-and-ride lots, and ten trips from the park-and-ride lot in Grafton and the other designated stops south of Grafton. Eight evening return trips leave downtown Milwaukee each weekday as well as several morning trips to get workers to Ozaukee County.

The Ozaukee County Shared-Ride Taxi System
(Rural and Small Urban Community Public Transportation)

The Ozaukee County Shared-Ride Taxi system is provided and operated by Ozaukee County. The system is designed to serve all areas within Ozaukee County during its operating hours (Monday through Friday from 5:00 a.m. to 10:00 p.m., Saturday from 8:30 a.m. to 10:00 p.m., and Sunday from 8:00 a.m. to 6:00 p.m.). The Ozaukee County Shared-Ride Taxi System provides curb-to-curb and door-to-door service for the general public, persons with disabilities, and the elderly. The Shared-Ride Taxi Service uses sedans and wheelchair-accessible vans if needed. Starting in 2017, the service now connects with three MCTS bus stops in Milwaukee County including Cherrywood Lane and Green Bay Road, Glencoe Place just northeast of IH 43 and Brown Deer Road, and the Brown Deer park-and-ride lot. Operations are provided on the day requested through an advance reservation system. The maximum response time is 45 minutes.

Cedarburg Senior Center Van Service

The Cedarburg Senior Center provides a shared ride transportation service to City of Cedarburg residents 55 years of age or older. The service is provided within the City of Cedarburg as well as extended service up to 15 miles beyond City limits. The service operates Monday through Friday from 8:00 a.m. to 4:00 p.m.

Ozaukee County Transit Development Plan: 2018

At the request of Ozaukee County, SEWRPC has completed a five-year plan for public transit services for the County, which proposes a set of recommended service changes for the transit system. The planning process included a performance review of the existing County transit system, an examination of the travel patterns and needs of system users, and an analysis of potential transit system alternatives. After careful

Table 2.14
Estimated Freeway and Surface Arterial Facility Design Capacity and Attendant Level of Congestion

Facility Type	Average Weekday Traffic Volumes (Vehicles per 24 Hours)			
	Design Capacity and Upper Limit of Level of Service C	Upper Limit of Moderate Congestion and Level of Service D	Upper Limit of Severe Congestion and Level of Service E	Extreme Congestion and Level of Service F
Freeway				
Four-Lane	60,000	80,000	90,000	>90,000
Six-Lane	90,000	121,000	135,000	>135,000
Eight-Lane	120,000	161,000	180,000	>180,000
Surface Arterial				
Two-Lane	14,000	18,000	19,000	>19,000
Four-Lane Undivided	18,000	23,000	24,000	>24,000
Four-Lane with Two-Way Left Turn Lane	21,000	29,000	31,000	>31,000
Four-Lane Divided	27,000	31,000	32,000	>32,000
Six-Lane Divided	38,000	45,000	48,000	>48,000
Eight-Lane Divided	50,000	60,000	63,000	>63,000

The level of congestion on arterial streets and highways may be summarized by the following operating conditions:

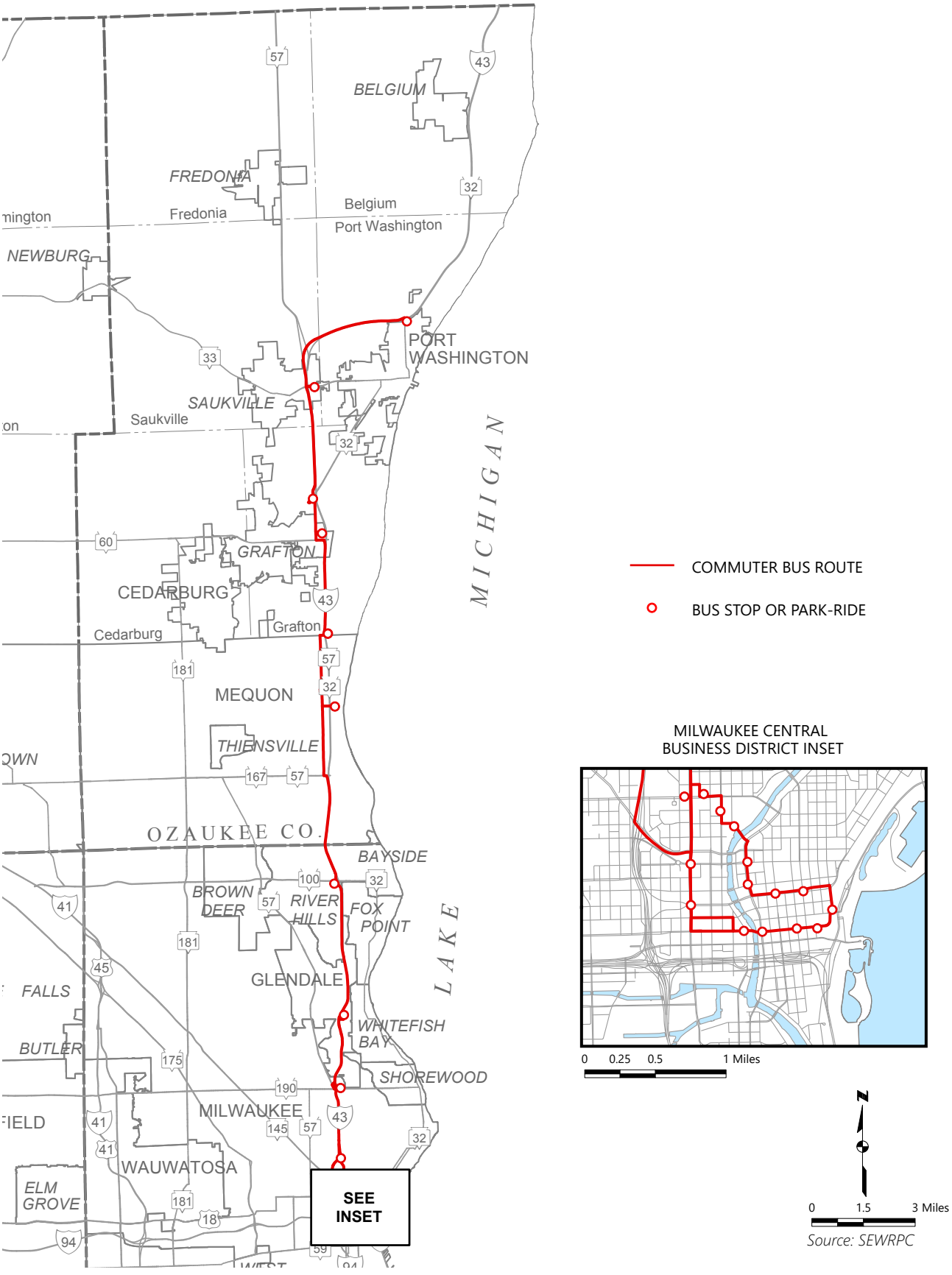
Freeway			
Level of Traffic Congestion	Level of Service	Average Speed	Operating Conditions
None	A and B	Freeway operates at free-flow speed	No restrictions on ability to maneuver and change lanes.
None	C	Freeway operates at free-flow speed	Ability to maneuver and change lanes noticeably restricted.
Moderate	D	Freeway operates at 1 to 2 mph below free-flow speed	Ability to maneuver and change lanes more noticeably limited. Reduced driver physical and psychological comfort levels.
Severe	E	Freeway operates at up to 10 mph below free-flow speed	Virtually no ability to maneuver and change lanes. Operation at maximum capacity. No usable gaps in the traffic stream to accommodate lane changing.
Extreme	F	Freeway average speeds are 20 to 30 mph or less	Breakdown in vehicular flow with stop-and-go, bumper-to-bumper traffic.

Surface Arterial			
Level of Traffic Congestion	Level of Service	Average Speed	Operating Conditions
None	A and B	70 to 100 percent of free-flow speed	Ability to maneuver within traffic stream is unimpeded. Control delay at signalized intersections is minimal.
None	C	50 to 100 percent of free-flow speed	Restricted ability to maneuver and change lanes at mid-block locations.
Moderate	D	40 to 50 percent of free-flow speed	Restricted ability to maneuver and change lanes. Small increases in flow lead to substantial increases in delay and decreases in travel speed.
Severe	E	33 to 40 percent of free-flow speed	Significant restrictions on lane changes. Traffic flow approaches instability.
Extreme	F	25 to 33 percent of free-flow speed	Flow at extremely low speeds. Intersection congestion with high delays, high volumes, and extensive queuing.

[a] *Design capacity is the maximum level of traffic volume a facility can carry before beginning to experience morning and afternoon peak traffic hour traffic congestion, and is expressed in terms of number of vehicles per average weekday.*

Source: SEWRPC

Map 2.12
Ozaukee County Commuter Bus Service: 2017



Source: SEWRPC

study and evaluation, on June 5, 2018, the Advisory Committee approved the Recommended Transit Service Plan, which includes a set of service recommendations for the Ozaukee County Transit System that should be implemented between 2019 and 2023, contingent on the amount of funding the County has available for transit services. The Plan also lists possible transit service alternatives that could be explored further and those that should not be considered for further implementation.

Railway Facilities

As shown on Map 2.13, there are three railway companies providing approximately 54 miles of active mainline railway freight services within Ozaukee County. The Union Pacific Railroad provides freight service over an approximate 25-mile segment of railway in the eastern portion of the County. This railway traverses the County from south to north serving the urban service areas of Mequon-Thiensville, City of Port Washington, and Village of Belgium. The Canadian National Railway provides freight service over an approximate 17-mile segment of railway from the southern boundary of the County to the northern limits of the Village of Saukville. The 11-mile segment of railway from north of the Village of Saukville to the northern boundary of the County is owned by the State of Wisconsin and operated by the Wisconsin and Southern Railroad Company. According to the Wisconsin Department of Transportation there are a total of 59 at-grade railway crossings within Ozaukee County.

Airports

There are no public use airports, either publicly or privately owned, within Ozaukee County; however, air services are available within a reasonable distance. The closest commercial airline service is provided by General Mitchell International Airport, located in Milwaukee County. Chartered air service and air freight services are also provided at General Mitchell International Airport.

There are five private-use airports and three private-use heliports within Ozaukee County, as shown on Map 2.14. These airports include Ashenfelter Aerodrome, Flying S Ranch, Ozaukee Airport, and Didier Field. Private heliports are located at Columbia-St. Mary's Hospital and Hoffman Properties, Inc. in the City of Mequon and Aurora Medical Center in the Village of Grafton. These airports and heliports are restricted use facilities and are not open for use by the general public. The airports include turf runways, lighting, and navigational aids.

2.9 UTILITY SYSTEMS

Utility systems are among the most important and permanent elements of urban growth and development, as urban development is highly dependent upon utility systems providing electricity, natural gas, communications, water, and sewerage. A public utility is a set of services provided by an organization that maintains the infrastructure for public service consumption. Because of this reliance, utility systems are an important consideration in hazard mitigation planning.

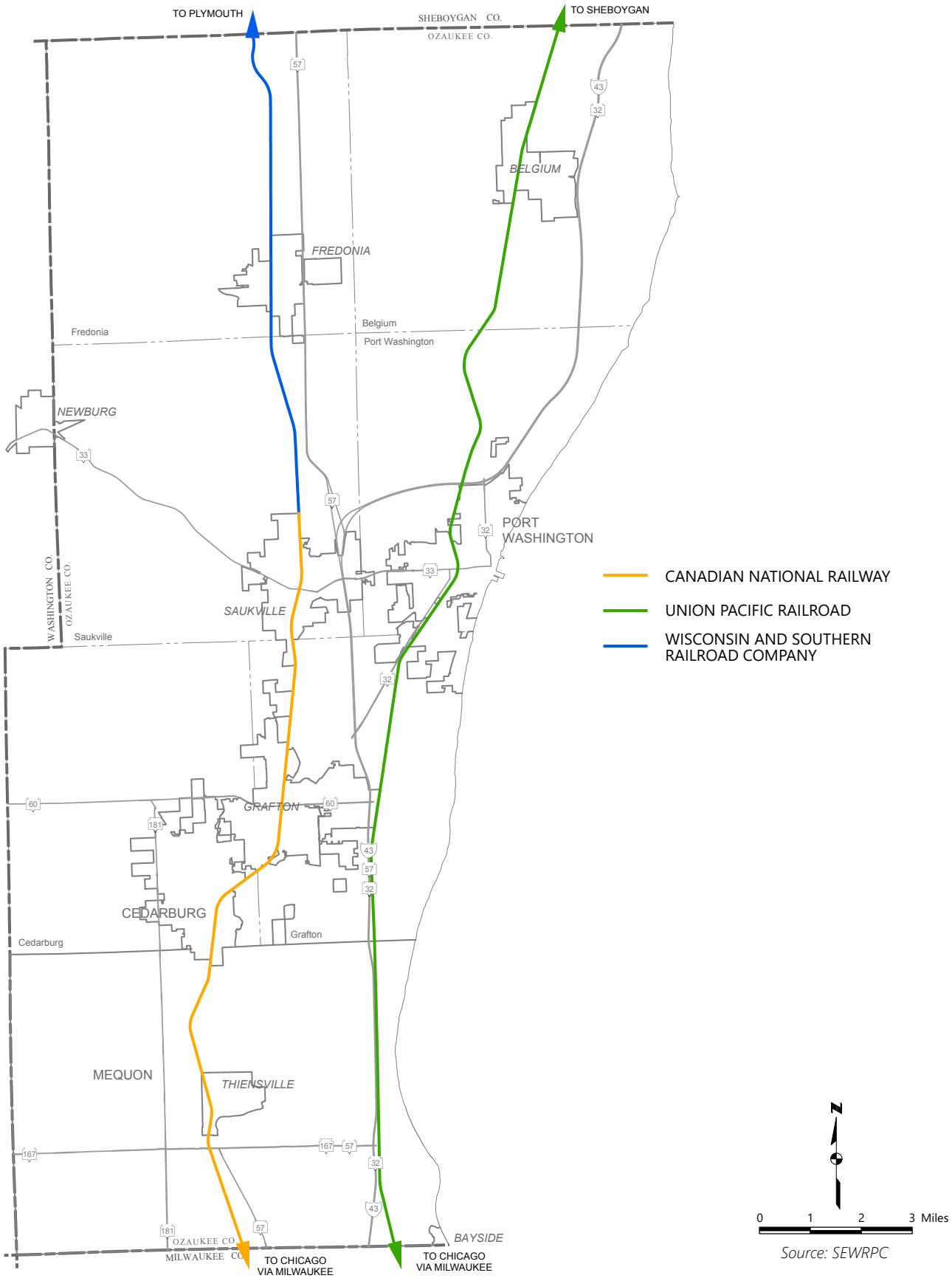
Public and Private Water Supply Systems

Map 2.15 shows the areas of Ozaukee County served by public water utilities and private water supply systems,[33] and those areas where the water supply is provided by development depends on the use of private wells. Portions of Ozaukee County that are served by public water utilities encompassed about 24 square miles, or about 10 percent of the County, in 2010. An estimated 54,882 County residents, or about 63 percent of the County population, were served by public water utilities in 2010 (see Table 2.15). There were seven public water utilities in the County. Five public water utilities supplied groundwater (encompassing a service area of about 13 square miles), and two (Mequon Water Utility and Port Washington) supplied Lake Michigan water (encompassing a service area of about 11 square miles). According to the City of Mequon, there are still quite a few properties in the Mequon-Thiensville area that use a private well or water trust.

Water supply service is also provided by private residential community systems utilizing groundwater as a source of supply. As of 2015, about 6,698 residents were served by such water systems. These systems are listed in Table 2.16 and their service areas are shown in red on Map 2.15.

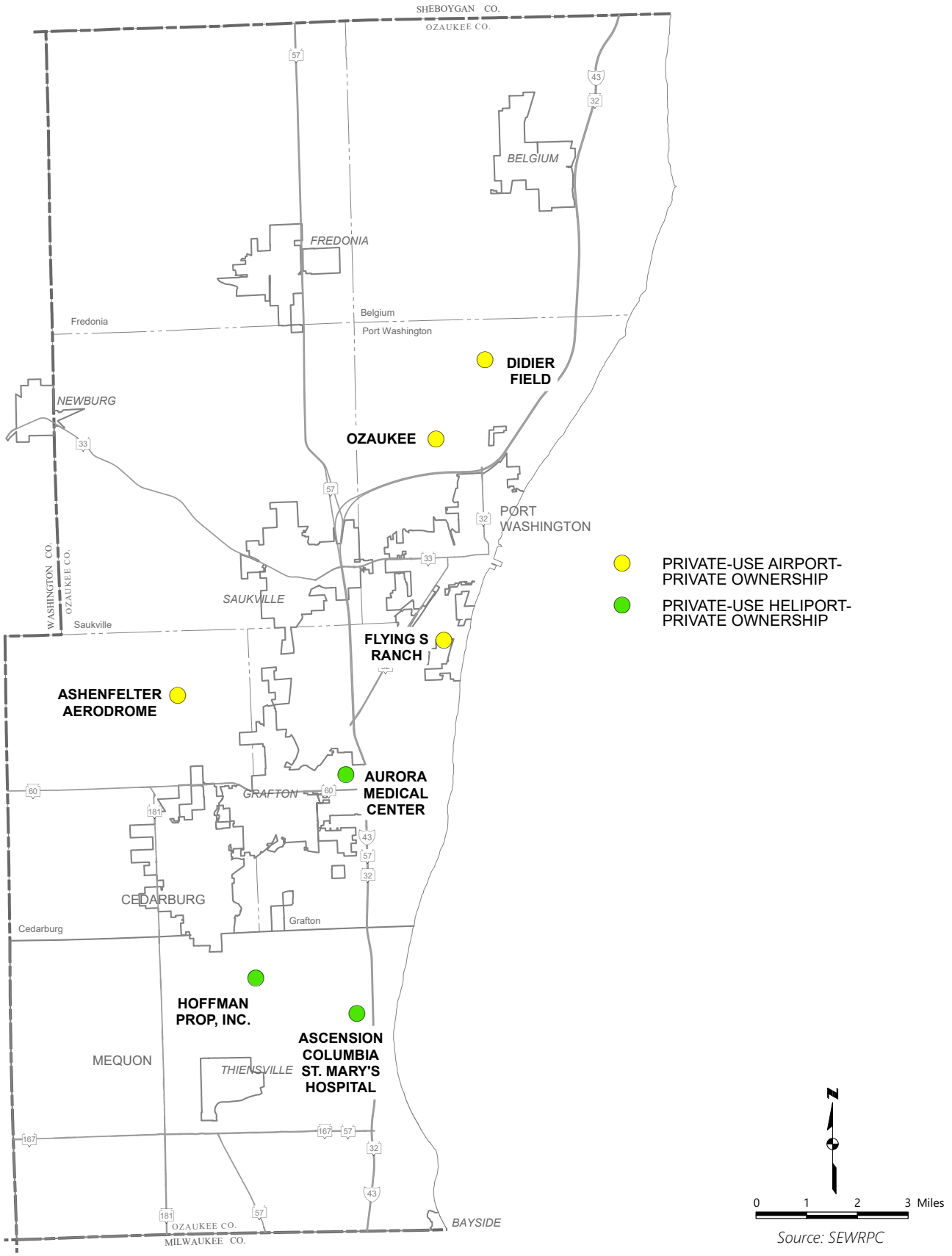
[33] *Private water supply systems typically provide infrastructure to serve multiple residences in a single family residential or multi-family residential development or a large institutional development. Water serving these developments does not come from a municipal source.*

Map 2.13
Common Carrier Rail Freight Lines in Ozaukee County: 2017



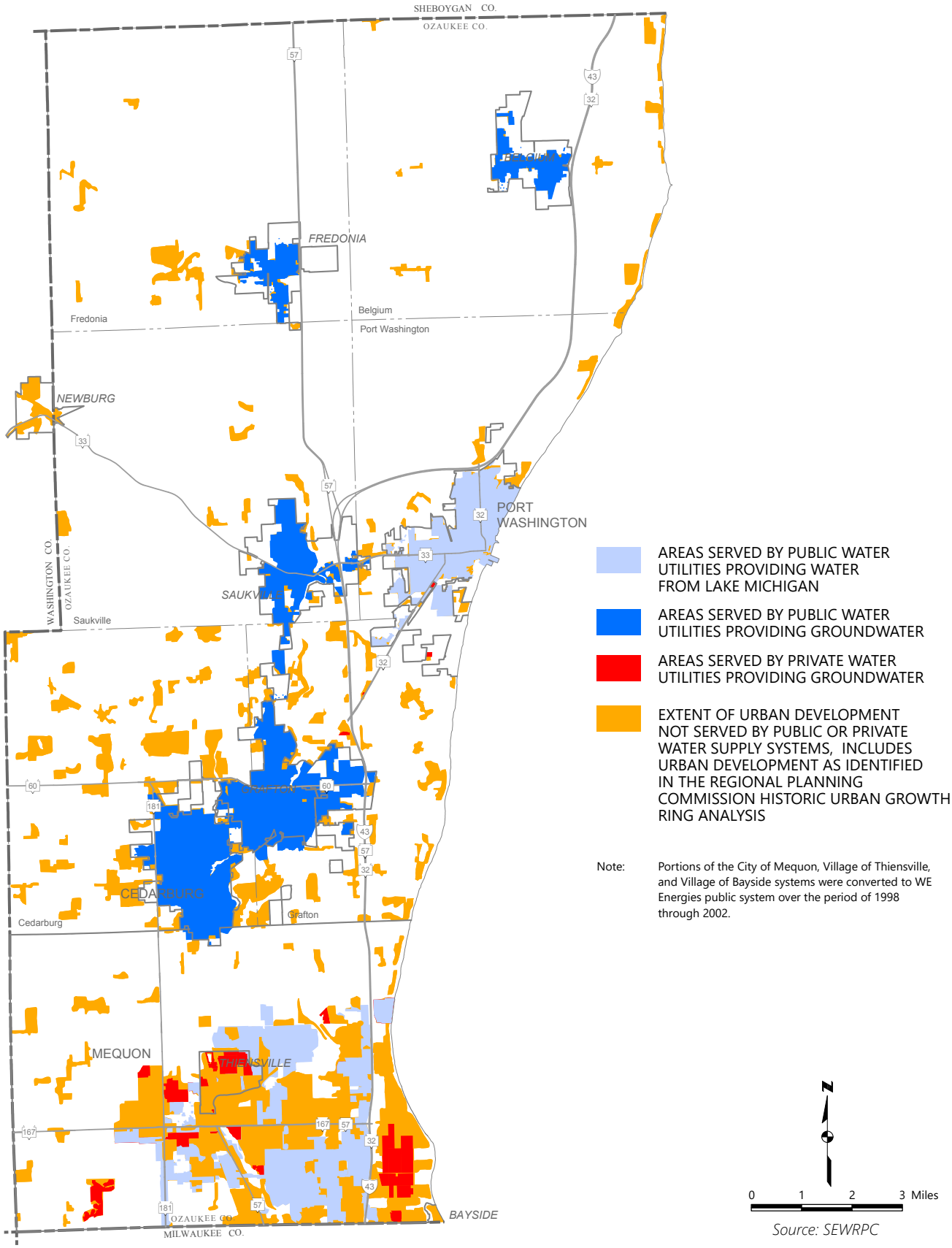
Source: SEWRPC

Map 2.14
Existing Airports in Ozaukee County: 2015



Source: SEWRPC

Map 2.15
Areas Served by Public and Private Water Utilities Within the Ozaukee County Planning Area: 2010



Source: SEWRPC

Table 2.15
Municipal Water Supply Systems in Ozaukee County

Utility Name	Civil Division	Population Served	Source
Belgium Waterworks	Village of Belgium	2,245	Groundwater
Cedarburg Light and Water Commission	City of Cedarburg	11,900	Groundwater
Fredonia Waterworks	Village of Fredonia	2,191	Groundwater
Grafton Waterworks	Village of Grafton	11,490	Groundwater
Mequon-Thiensville Water Utility	City of Mequon	11,152	Lake Michigan
Port Washington Waterworks	City of Port Washington	11,439	Lake Michigan
Saukville Waterworks	Village of Saukville	4,465	Groundwater

Source: Wisconsin Department of Natural Resources and SEWRPC

Table 2.16
Private Residential Community Water Supply Systems in Ozaukee County

Community Name	Civil Division	Population Served
Alberta Subdivision	Village of Thiensville	75
Beechwood Farms Estates	City of Mequon	300
Brighton Ridge Subdivision	City of Mequon	200
Century Estates 1	Village of Thiensville	130
Country Terrace Condo Homes	City of Mequon	160
Grand Ave Apartments	Village of Thiensville	80
Haddonstone Subdivision	City of Mequon	195
Heidel Rd. Apartments 139	Village of Thiensville	40
Heidel Rd. Apartments 152	Village of Thiensville	40
Highland Colony Estates Condominiums	City of Mequon	88
Huntington Park	City of Mequon	600
JBS Investment Group	City of Port Washington	30
Kenilworth Subdivision	City of Mequon	120
Laurel Lakes 508	Village of Thiensville	50
Laurel Lakes 608	Village of Thiensville	80
Linden Lane Apartments 117	Village of Thiensville	90
Linden Lane Apartments 141	Village of Thiensville	75
Mequon Colony Estates	City of Mequon	75
Mequon on the Square Condominium Owners Association, Inc.	City of Mequon	110
Mequon Park Apartments, LLC.	City of Mequon	60
Mequon Trail Town Homes	City of Mequon	615
Mequon Water Trust	City of Mequon	26
Park Place Subdivision	City of Mequon	260
Pines Subdivision	City of Mequon	200
Pioneer Mobile Home Park	Town of Grafton	150
Ravine Farms Home Owners Association	City of Mequon	100
River Garden Apartments	Village of Thiensville	25
River Lake Subdivision	City of Mequon	100
River Trails Estates Water Users	City of Mequon	84
Stonecroft Condominium Association	City of Mequon	50
Village Glen Apartments	Village of Thiensville	30
Village Heights	Village of Thiensville	130
Vintage Estates	City of Mequon	130
Water's Edge Condominium Association	Village of Thiensville	50
Westchester Lakes Subdivision	City of Mequon	300
206 Williamsburg Drive	Village of Thiensville	48
207, 209, 210, 213, 214 Williamsburg Drive	Village of Thiensville	70
220 Williamsburg Drive	Village of Thiensville	32
Woodridge Estates	City of Mequon	100
Wyngate Subdivision	City of Mequon	100

Source: Wisconsin Department of Natural Resources and SEWRPC

The estimated daily use of water in Ozaukee County is summarized in Table 2.17. As shown in Table 2.17, approximately 1.15 million gallons per day (mgd) of Lake Michigan-derived surface water and about 3.96 mgd of groundwater supply were used by public water utility systems in the County in 2015. Considering all water uses, including industrial, commercial, agricultural, and private water supply, approximately 1.27 mgd of surface water and 7.16 mgd of groundwater are used in Ozaukee County.

The protection of the public water supply facilities from potential contamination is a consideration for hazard mitigation planning. As such, wellhead protection planning and protection and monitoring of water supply intake, treatment, storage, and distribution systems is an important potential plan element.

Sanitary Sewer Service Systems

Virtually all sanitary sewerage service within incorporated areas is provided by municipalities. Map 2.16 shows sanitary sewer service areas, refined sanitary sewer service areas, unrefined sanitary sewer service areas, and locations of existing sewage treatment plants within Ozaukee County. These areas include the Cities (and surrounding areas) of Cedarburg and Port Washington; Villages (and surrounding areas) of Belgium, Fredonia, Grafton, Newburg, and Saukville; and the unincorporated community of Waubeka in the Town of Fredonia. The Villages of Bayside and Thiensville and portions of the City of Mequon are located within the Milwaukee Metropolitan Sewerage District's (MMSD) service boundaries and wastewater is treated at MMSD sewage treatment plants in Milwaukee County. Areas outside the sanitary sewer service area are served by individual, private on-site wastewater treatment systems (POWTS) consisting of conventional in-ground septic tanks, holding tanks, or mound systems. Septage from private systems is typically periodically transported to a nearby sewage treatment plant.

Solid Waste Disposal

Currently We Energies WEPCO Landfill, located on STH 32 in the Town of Grafton, is the only active, licensed, and operated landfill within Ozaukee County. The waste types handled at this landfill are noncombustible boiler ash and coal ash. According to Wisconsin Department of Natural Resources Solid and Hazardous Waste Information System (SHWIMS) database, there are a total of 29 inactive solid waste landfill, storage, treatment, and transfer, and recyclable transporter facilities located throughout the County. Most of these sites have gone through proper closure procedures specified by the WDNR.

Trash and recycling collection within Ozaukee County are provided by Advanced Disposal, Waste Management, or local municipalities. Advanced Disposal provides services for the majority of Ozaukee County including the Cities of Cedarburg, Mequon and Port Washington; the Villages of Belgium, Fredonia, Grafton, Newburg, and Saukville; and the Town of Grafton. Advance Disposal collection companies operating within Ozaukee County include Advanced Disposable-Horicon, Sheboygan, Hartland Trash Collection and Recycling Solutions, and Muskego Trash Collection and Recycling Solutions. Transfer stations used by Advanced Disposal for the Ozaukee County include the Sheboygan transfer station and West Bend transfer station. Waste Management provides garbage and recycling services for the residents of the Town of Port Washington and the Village of Thiensville. The Town of Cedarburg is serviced by municipal garbage pickup. Glacier Ridge Landfill, located in Horicon, Wisconsin is the primary solid waste landfill site provided for Ozaukee County.

Ozaukee County partners with Veolia Environmental Services to host an annual spring Clean Sweep event that provides household and agricultural hazardous waste collection for the residents within the County. Residents can drop off household waste that contains hazardous/infectious waste, flammable liquids and chemicals, and paint and oil products that cannot be discharged with household waste or recyclable items. These items can be dropped off at Veolia Environmental Services located in the City of Port Washington. Veolia Environmental Services is also an Electronic Recycling Group. Veolia North America-Port Washington can handle the following types of waste: mercury bearing lamps, mercury devices, mercury compounds, mercury debris, mercury soil, mercury contaminated phosphor, lamp ballasts, small PCB capacitors (<9 lbs.), all types of batteries, computers, and electronics.[34]

[34] *www.veolianorthamerica.com.*

Veolia Environmental Services also handles hazardous waste material for small businesses located within Ozaukee County. For small business, this is a convenient, safe, and low-cost opportunity for very small quantity waste generators (VSQG), to dispose of unwanted, unused, damaged, and/or banned hazardous chemicals, especially pesticides. A VSQG business generates less than 220 pounds of hazardous waste per month and stores less than 2,205 pounds per year. In addition Ozaukee County offers a used tire collection once a year at a drop-off located in the Town of Cedarburg.

Table 2.17
Estimated Use of Water in Ozaukee County: 2015

Usage Category	Water Source: Surface Water (Lake Michigan) (MGD)	Water Source: Groundwater (MGD)
Public[a]	1.15	3.96
Industrial	0.00	0.64
Commercial	--	--
Irrigation	0.08	0.46
Agricultural	0.04	0.39
Aquaculture	0.00	0.04
Mining	--	--
Domestic	0.00	1.68
Total	1.27	7.16

[a] *Includes water delivered to residents, industry, and commerce within the area served by a public water supply system.*

Source: U.S. Geological Survey and SEWRPC

Other Private Utility Systems

Electric Power Service

Most of Ozaukee County is provided with electric power service by We Energies. Electric power service is available on demand throughout Ozaukee County. Three electric power transmission lines[35] run through the County in a north-south direction and are transected by another transmission line that runs in a west-east direction in the central portion of the County as shown on Map 2.17. A We Energies electric power generation facility is located in the City of Port Washington along Lake Michigan. The City of Cedarburg Light and Water Utility provides electric power within the City of Cedarburg and a small portion of the Town of Cedarburg adjacent to the City. The Cedarburg Light and Water Utility is a member of WPPI Energy, a "regional power company serving 51 locally owned electric utilities."[36]

Natural Gas Service

Natural gas distribution service is provided for the entire County by We Energies. The main gas supply for the County is provided by West Shore Pipeline Company.[37] A major natural gas pipeline follows an east to west route entering the County in the northwest corner of the Town of Cedarburg and extending to the We Energies power plant in the City of Port Washington, as shown on Map 2.17. An additional gas pipeline runs in a direct north-south direction from Sheboygan County to the Village of Fredonia (see Map 2.17).

Telecommunications Service

Telecommunication services include the following categories: 1) Voice Transmission Services; 2) Data Transmission Services, including the Internet; 3) Multimedia Services, including video, imaging, streaming video, data, and voice; and 4) Broadcast Services, including: AM/FM radio, satellite radio and television, television, and cable television. In Ozaukee County, the majority of these services are provided by AT&T, Nextel, Sprint, T-Mobil, U.S. Cellular, Verizon, and Spectrum (formally Time Warner Cable). Map 2.18 shows the locations of wireless antennas in Ozaukee County provided by Cingular, Nextel, Sprint, T-Mobil, U.S. Cellular, and Verizon. Since 2005, nine new wireless antenna locations have been added.

2.10 PUBLIC SAFETY FACILITIES AND SERVICES

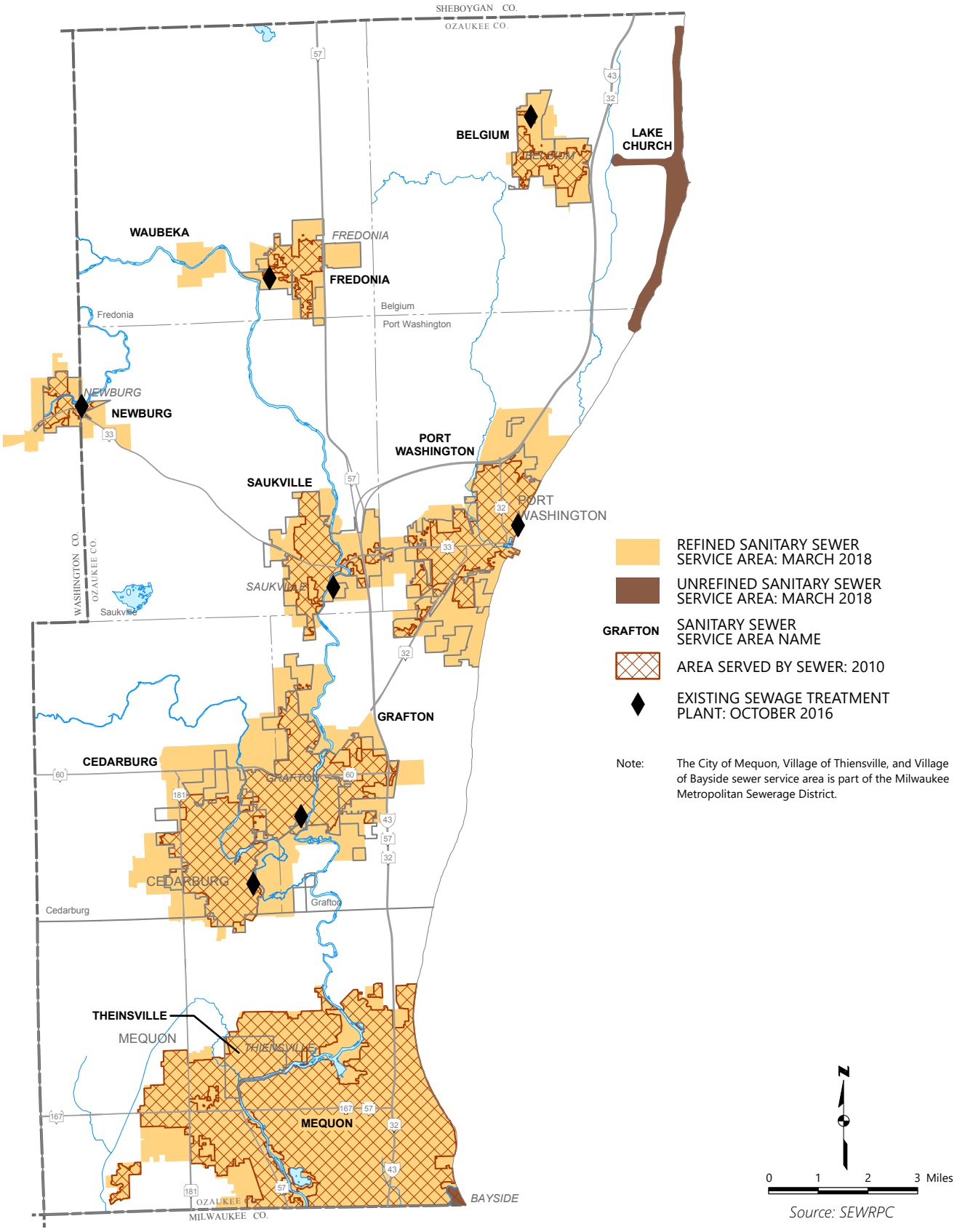
The type and location of public safety facilities are important considerations in hazard mitigation planning, because of the potential direct involvement of such facilities in certain hazard situations. The location of the fire stations, emergency medical rescue service areas, Mutual Aid Box Alarm System (MABAS) areas, police and sheriff's stations, and dispatch centers in Ozaukee County are shown on Maps 2.19 through 2.23. Listings of these facilities are included in Appendix C. The location of these public safety facilities in relation to the floodplain areas are further analyzed and described in Chapter 3.

[35] *American Transmission Company (ATC) is a multi-state transmission-only utility in the United States. ATC transports We Energies electricity in Ozaukee County.*

[36] *wppienergy.org.*

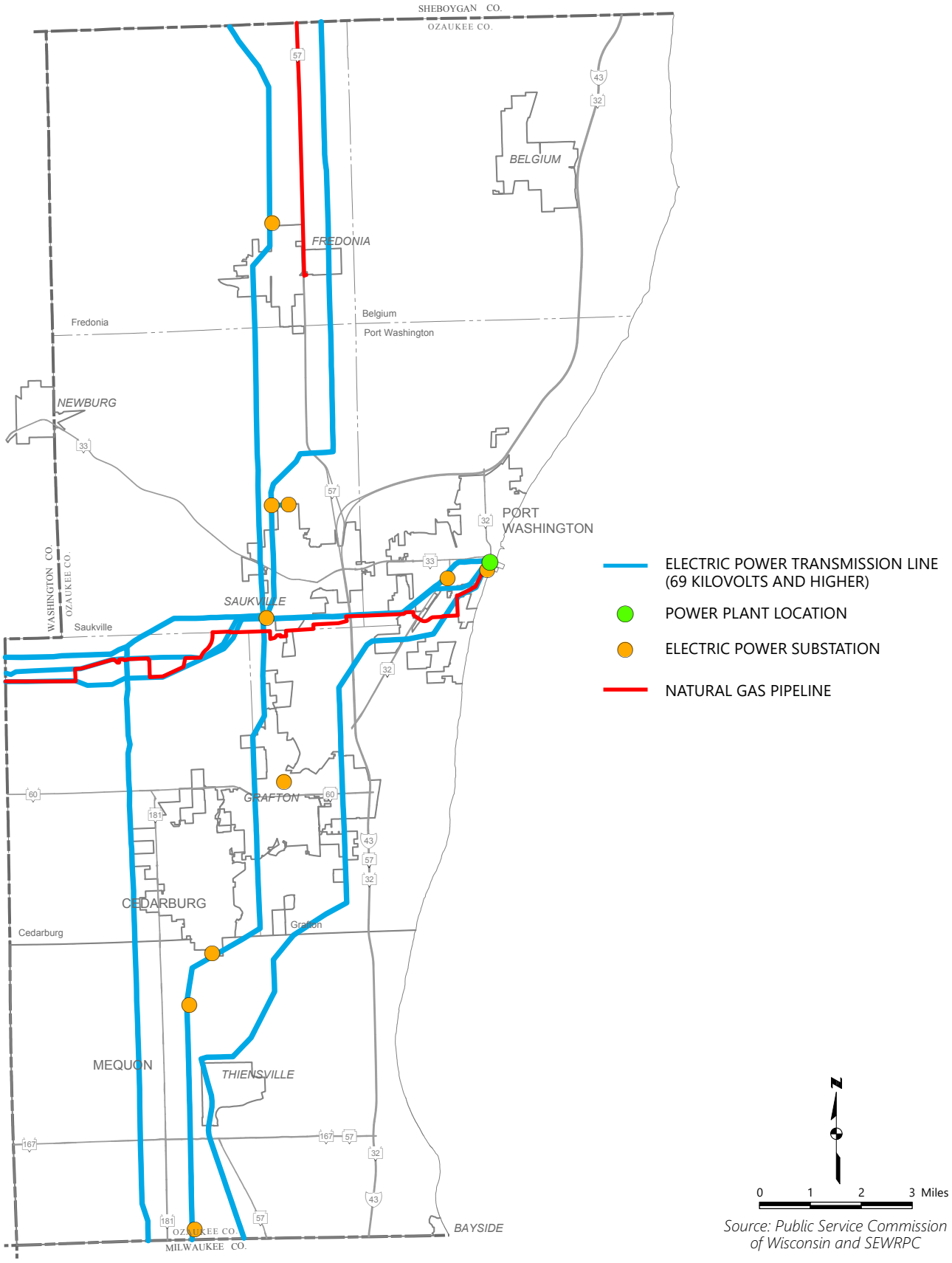
[37] *Ozaukee County Sheriff's Department,* 2018 Ozaukee County Strategic Plan*, March 2018.*

Map 2.16
Planned Sanitary Sewer Service Areas and Areas Served by Sewer Within the Ozaukee County Planning Area



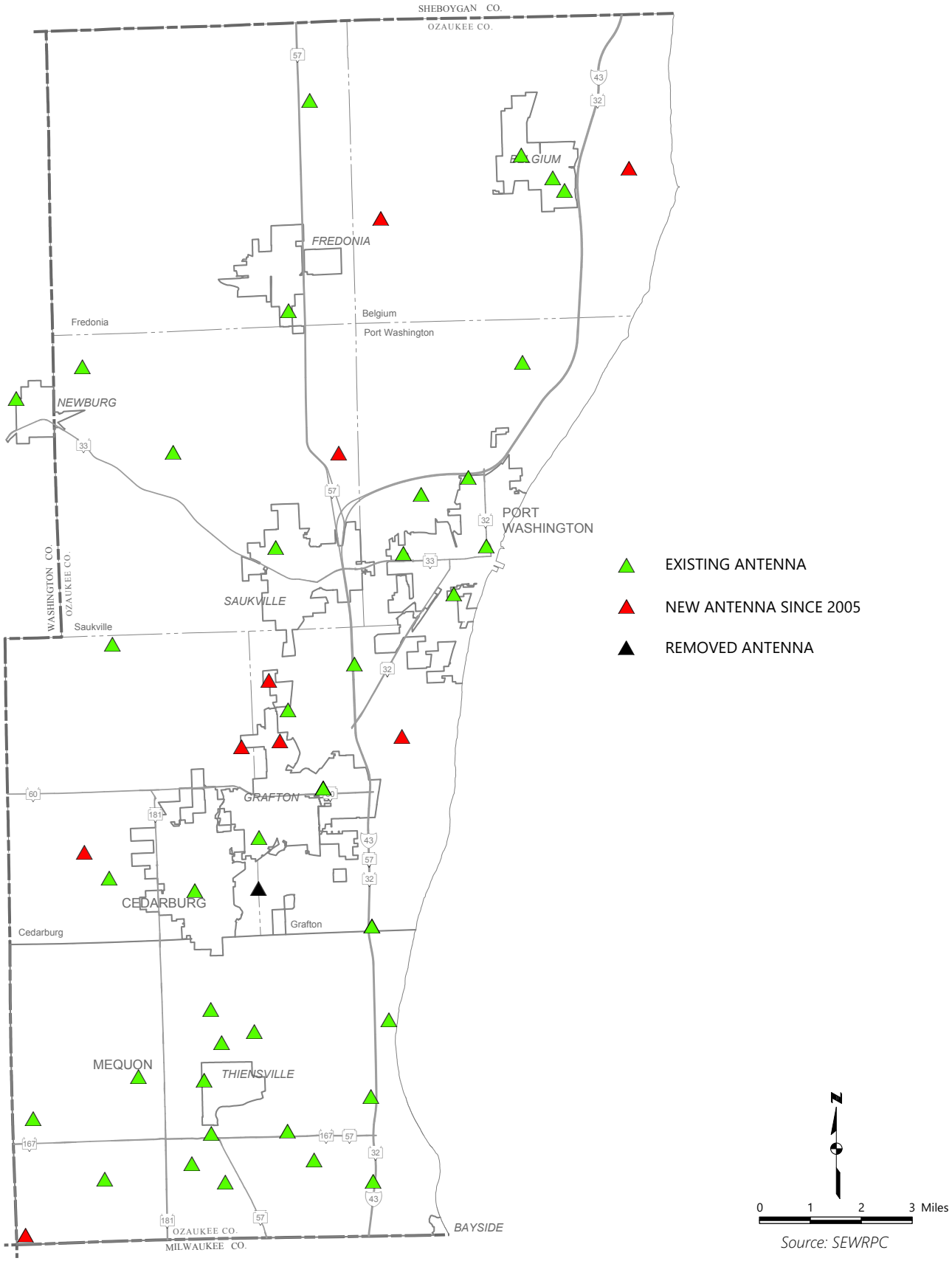
Source: SEWRPC

Map 2.17
Electric Power Transmission Lines, Power Plants, Substations, and Natural Gas Pipelines in Ozaukee County: 2015



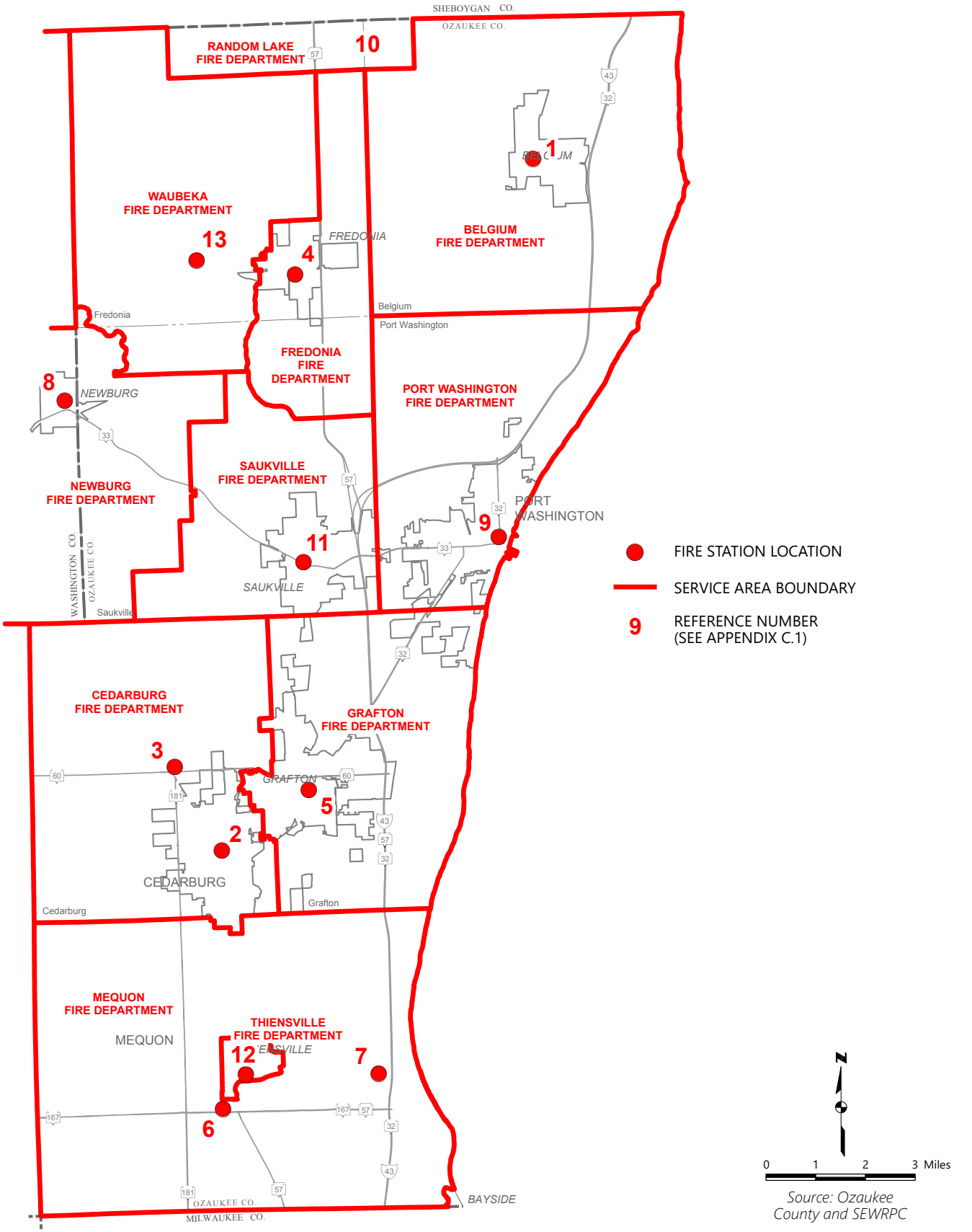
Source: Public Service Commission of Wisconsin and SEWRPC

Map 2.18
Wireless Antennas Within the Ozaukee County Planning Area: 2015



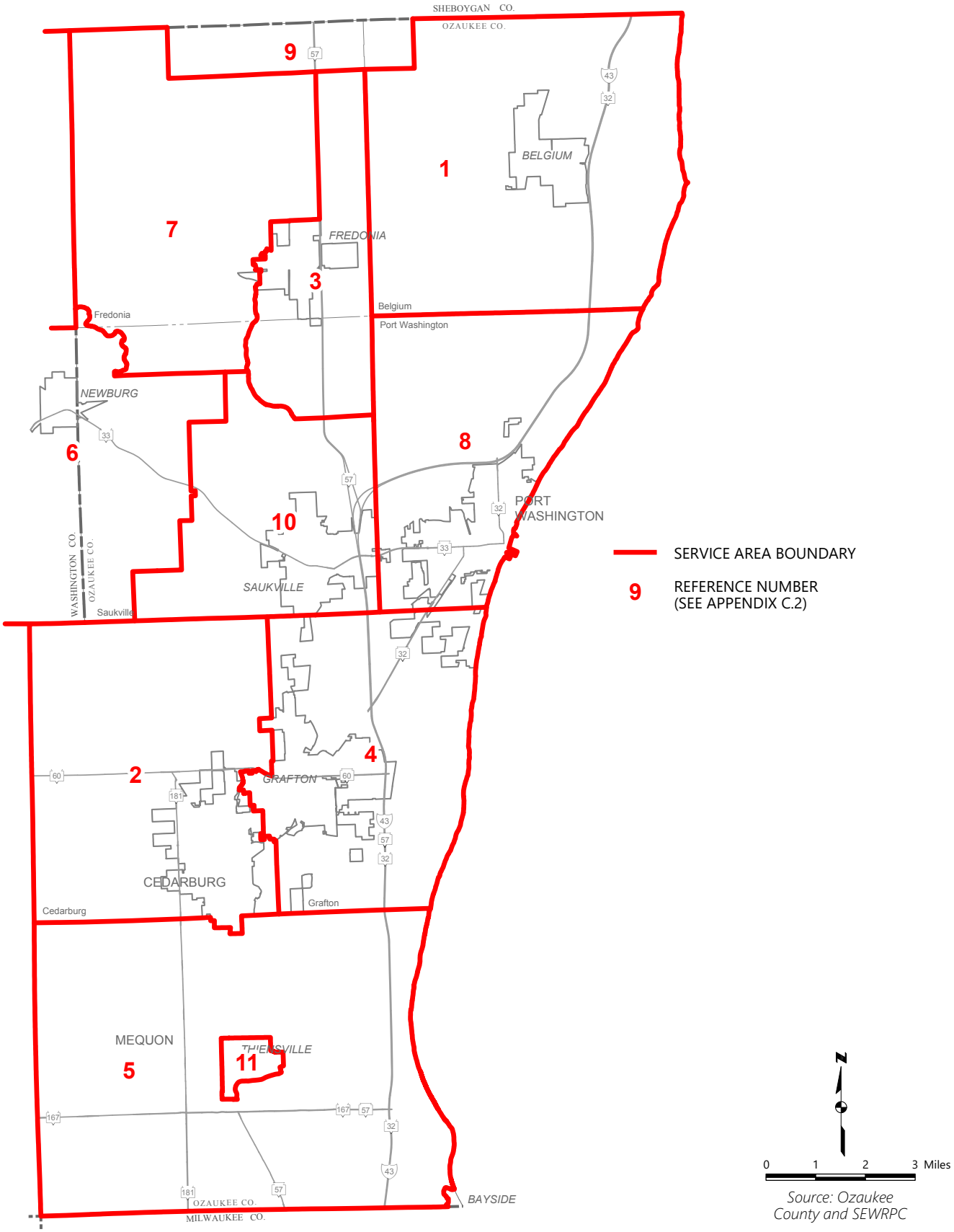
Source: SEWRPC

Map 2.19
Fire Stations and Fire Department Service Areas Within the Ozaukee County Planning Area: 2018



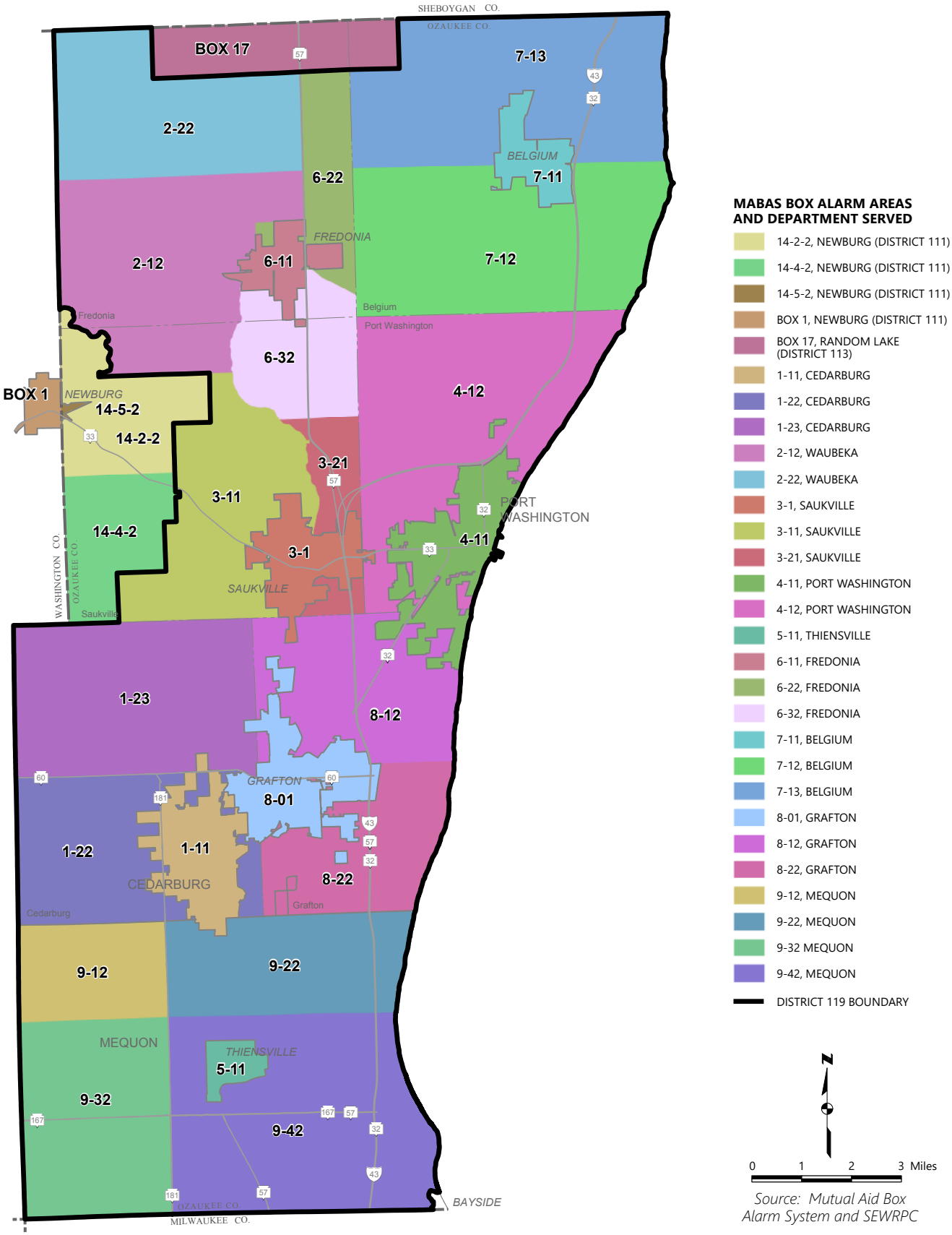
Source: Ozaukee County and SEWRPC

Map 2.20
Emergency Medical Service-Rescue Departments Within the Ozaukee County Planning Area: 2018



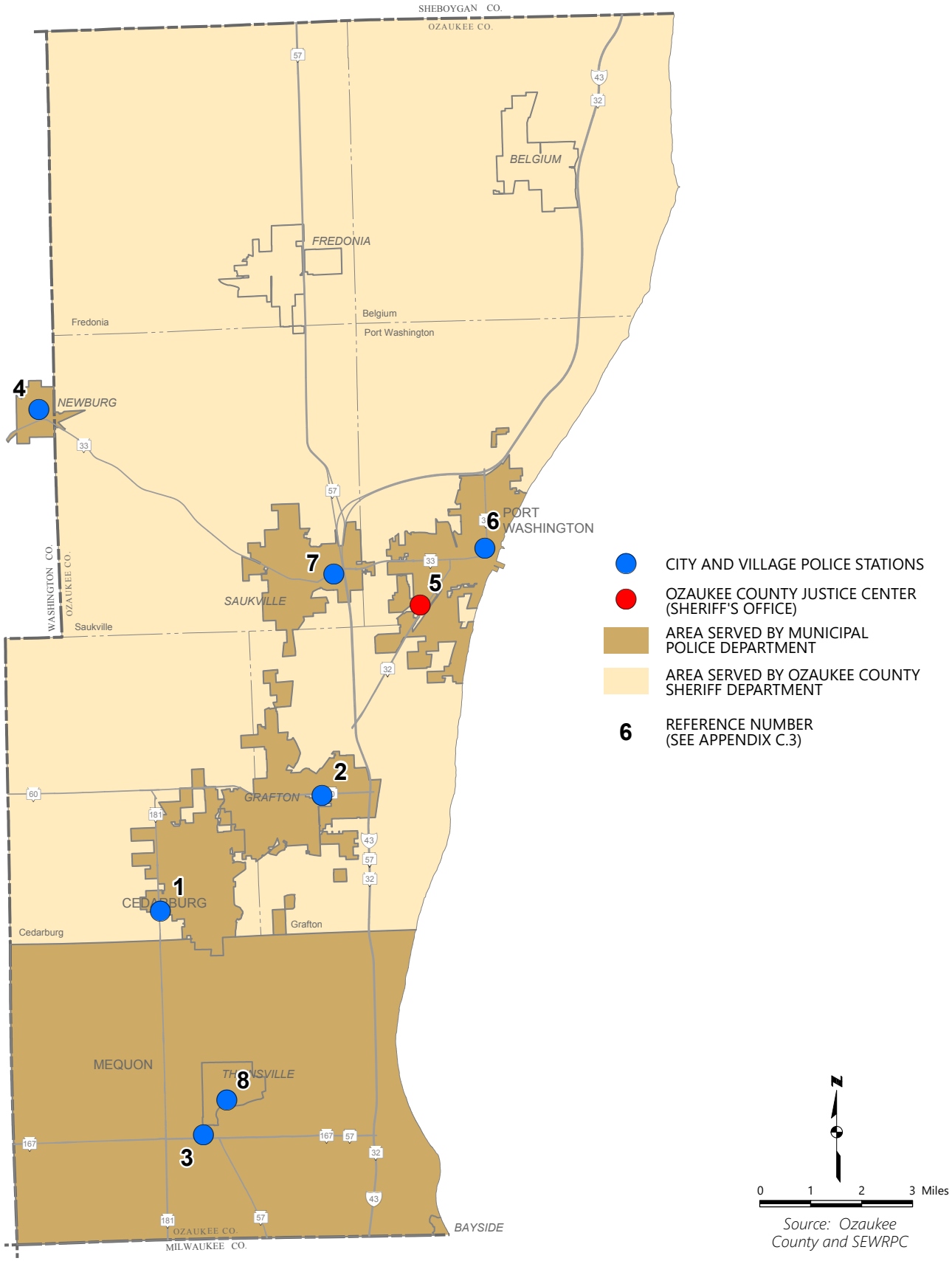
Source: Ozaukee County and SEWRPC

Map 2.21
Mutual Aid Box Alarm System (MABAS) Areas Within the Ozaukee County Planning Area



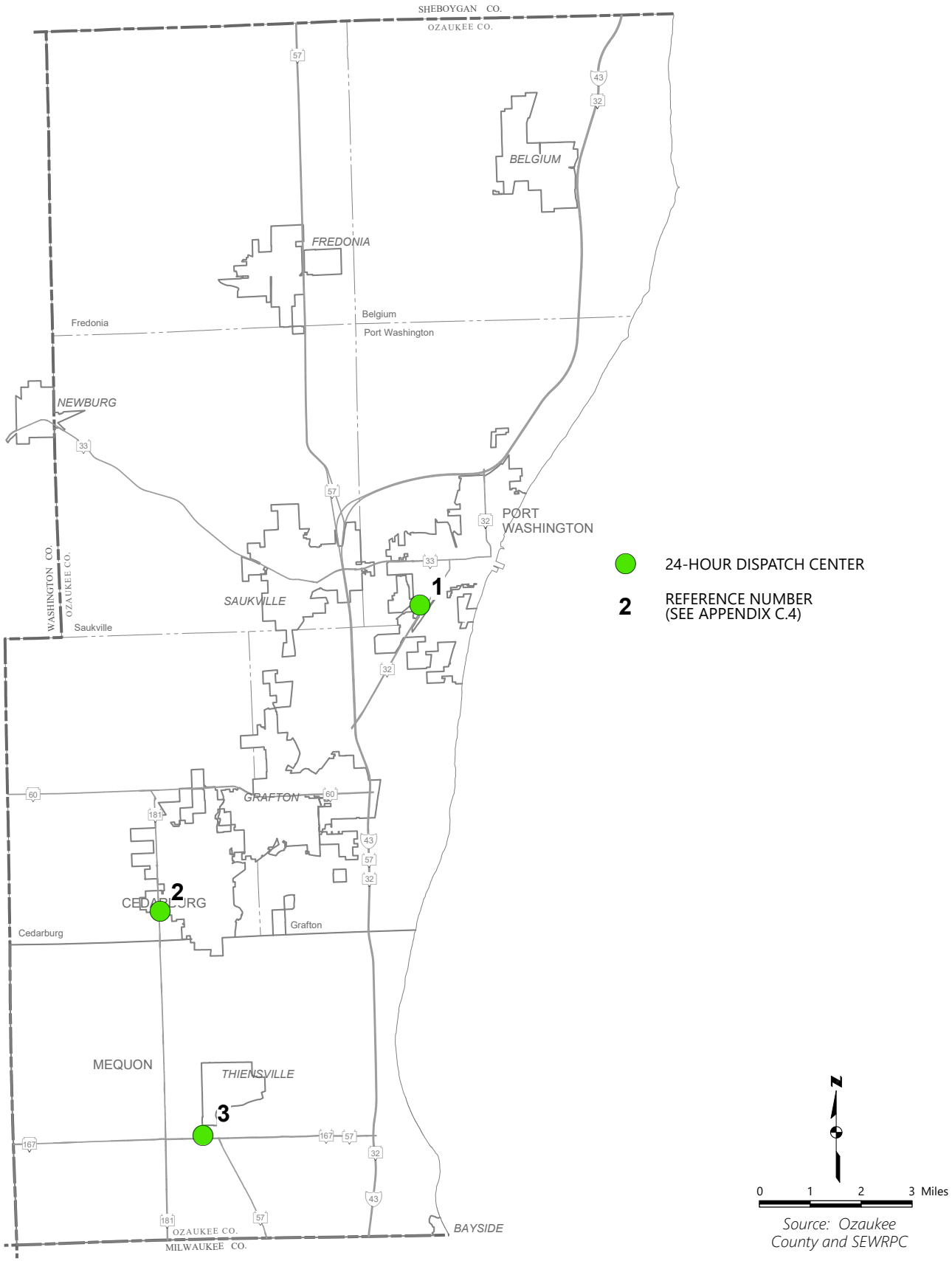
Source: Mutual Aid Box Alarm System and SEWRPC

Map 2.22
Police and Sheriff's Station Service Areas Within the Ozaukee County Planning Area: 2018



Source: Ozaukee County and SEWRPC

Map 2.23
Dispatch Centers in Ozaukee County: 2018



Source: Ozaukee County and SEWRPC

Fire Protection Services

Map 2.19 shows locations of local fire departments, all affiliated fire stations, and the fire protection service area of each department as of 2018. The Ozaukee County Planning Area is served by 12 fire departments which include Belgium, Cedarburg, Fredonia, Grafton, Mequon (2 stations), Newburg, the North Shore Fire/Rescue Commission (Village of Bayside-not mapped), Port Washington, Random Lake, Saukville, Thiensville and Waubeka fire departments. Table 2.18 provides information about the working status of fire fighters within each system—that is, whether they are full-time, volunteer, paid-on-call volunteer, or some combination thereof.

Emergency Medical Services and Fire Protection Combined

Ozaukee County relies on a mix of volunteer, paid-on-call, and paid staff to provide pre-hospital emergency medical services (EMS). As shown on Map 2.20, there are 11 emergency medical service (EMS) zones including four that provide paramedic services (Grafton, Mequon, Port Washington, and Thiensville). Table 2.18 provides further detail on Ozaukee County EMS services. Most departments that serve Ozaukee County have combined fire and emergency medical services, meaning some or the majority of the departments' personnel are trained for both fire and emergency medical service operations, including:

- Belgium Fire and EMS Department (EMS is First Responders only)
- Cedarburg Fire and EMS Department
- Fredonia Fire and EMS Department (Northern Ozaukee Ambulance)
- Grafton Fire and EMS Department
- Mequon Fire and EMS Department
- Newburg Fire and EMS Department
- Port Washington Fire and EMS Department
- Saukville Fire and EMS Department
- Thiensville Fire Department and Paramedics
- Waubeka Fire and EMS Department

All of the fire and rescue departments in Ozaukee County participate in the Mutual Aid Box Alarm System (MABAS) agreement, as shown on Map 2.21. This agreement enables each department to render assistance to, and receive assistance from, other departments in the County as needed to respond to fire and rescue emergencies. Under the agreement, departments render assistance without charge to the extent that available resources are not required for the protection of their own service areas. This agreement enables individual departments to significantly supplement their own personnel, apparatus, and equipment with that from other departments in responding to emergencies. Importantly, the agreement allows individual departments to access equipment, such as tankers, aerial trucks, and extrication equipment, which they themselves do not possess and which they may only need infrequently. In addition, MABAS allows communities and fire departments to request fire and rescue resources from outside of Ozaukee County using the standardized MABAS agreement. MABAS agreements are pre-approved by each municipality and emergency responses are pre-planned using a standardized Box Alarm Card form.

Law Enforcement

Six of the 16 municipalities in Ozaukee County provide for law enforcement through full-time police departments. The Cities of Cedarburg, Mequon, and Port Washington; and the Villages of Grafton, Saukville, and Thiensville have their own police officers. The Villages of Fredonia and Newburg Police Departments are entirely part-time. In the remaining communities law enforcement is provided through a contract with the Ozaukee County Sheriff's Department to provide primary law enforcement. Map 2.22 illustrates the location of police and Sheriff's departments within Ozaukee County and the areas they serve. Table 2.18 provides further information regarding the working status of law enforcement associated with each community.

Table 2.18
Working Status of Fire Departments, Emergency Medical Service Providers, and Law Enforcement Departments Serving Ozaukee County: 2018

Jurisdiction	Working Status of Fire/Rescue Departments	Emergency Medical Service Arrangement	Working Status of Law Enforcement
City and Town of Cedarburg	Cedarburg Fire Department operates out of two stations. Staffed with 50 Volunteers, one part-time Fire Chief, and one full-time Inspector/EMT.	Emergency Medical Technicians are trained to the Basic and Advanced EMT level.	Cedarburg Police Department has 19 sworn officers and ten civilian support & reserve officers employees. The Ozaukee County Sheriff's Department provides services to the Town of Cedarburg. The Town of Cedarburg maintains one part-time Constable position for Code enforcement
City and Town of Port Washington	Port Washington Fire and Rescue Department is made up of 65 paid-on-call personnel, one full-time Fire Chief, one full-time Fire/Paramedic, up to three part-time Fire/Paramedics or EMT per day Monday through Friday.	Emergency Medical Technicians and Paramedics provide three levels of pre-hospital emergency care: EMT-Basic level, EMT-Advanced Level, and EMT-Paramedic level.	Port Washington Police Department has an estimated 1.6 officers per 1,000 residents. Personnel consist of the Chief of Police, two Captains of Administration, three Lieutenants, and 13 patrol officers, and 12 civilian support and reserve officers. The Ozaukee County Sheriff's Department provides services to the Town of Port Washington.
City of Mequon	Mequon Fire Department provides fire prevention, fire suppression and rescue. Fire suppression in the City is provided by 60 paid-on-call Fire /EMS personnel, one full-time Fire Chief. One full-time assistant Fire Chief, nine part-time Fire/EMS positions per day during the week.	Emergency medical transport (ambulance) is provided by paid-on-call staff that are trained from EMT-Basic to Paramedic/Advanced Life Support (ALS) level.	The Mequon Police Department consists of 38 sworn officers and 13 civilian support & reserve officers.
Village of Bayside	The North Shore Fire and Rescue (NSFR) Commission provides service to the Village of Bayside, Brown Deer, Fox Point, River Hills, Shorewood, and Whitefish Bay. The Department consists of 112 full-time staff and funded primarily through contributions from each member community.	All NSFR personnel are certified Emergency Medical Technicians (50 percent are certified Paramedics).	Bayside Police Department has 12 sworn officers-one Chief of Police, one lieutenant, one sergeant, and nine patrol officers.
Village and Town of Belgium	Belgium Volunteer Fire Department provides fire and medical services for the Village and Town of Belgium. Village of Random Lake Volunteer Fire Department (Sheboygan County) consists of 45 members, 25 of which are certified as EMT's or Emergency Medical Responders (EMR). The Department provides services for the east half of the Town of Belgium.	Belgium Volunteer Fire Department provides EMS services as a Wisconsin First Responder Unit for the entire Village and most of the Town of Belgium. The Village of Random Lake certified EMT's provide services for the northwest portion of the Town of Belgium. Ambulance transport services are provided by the City of Port Washington East of Interstate- 43 and the Village of Fredonia West of Interstate-43.	Ozaukee County Sheriff's Department provides service to the Village and Town of Belgium. The Village maintains one part-time Village Marshal for code enforcement purposes.
Waubeka (Unincorporated in Town of Fredonia)	Waubeka Volunteer Fire Department is contracted through the Town of Fredonia. The Department consists of 42 active unpaid volunteers and a Fire Chief. Services are provided for most of the Town of Fredonia and portions of the Town of Saukville.	Waubeka EMS and ambulance provide services for most of the Town of Fredonia and portions of the Town of Saukville. EMT's are trained as EMT Basic level & EMT Advanced level.	Ozaukee County Sheriff's Department provides service to Waubeka

Table continued on next page.

Table 2.18 (Continued)

Jurisdiction	Working Status of Fire/Rescue Departments	Emergency Medical Service Arrangement	Working Status of Law Enforcement
Village and Town of Fredonia	Fredonia Volunteer Fire Department consists of 45 paid-on-call personnel and one full-time EMT during the week 8am to 5pm. The Department provides services for the entire Village of Fredonia and portions of the Towns of Fredonia and Saukville. Random Lake Volunteer Fire Department consists of 45 members, 25 of which are certified as EMT's. The Department provides services for the northwest portion of the Town of Fredonia.	EMS service is provided to the portions of the Town of Fredonia and Saukville. The Fredonia Fire and Rescue Department consists of 19 EMT's and six ambulance drivers. EMT's are certified to the EMT Basic and EMT Advanced levels. Village of Random Lake certified EMT's provide services for the northwest portion of the Town of Fredonia.	The Fredonia Marshal's office is entirely part-time. Consisting of one sworn Marshal and seven sworn Deputy Marshals. Additional services to the Village and Town of Fredonia. are provided by Ozaukee County Sheriff's Department.
Village and Town of Grafton	The Grafton Fire Department is made 50 paid-on-call Fire/EMS personnel, one full-time Fire Chief, one full-time Division Chief, one full-time Fire/Paramedic each 3 days a week for a 24-hour shift, and five part-time positions during the week.	The Grafton Fire Department and EMS personnel are trained to a mix of EMT Basic, EMT Advanced, and EMT Paramedic levels providing service to the Village and Town of Grafton.	The Grafton Police Department is a full-service law enforcement agency with 22 sworn officers with 10 civilian support & reserve officers. The Ozaukee County Sheriff's Department serves the Town of Grafton.
Village of Newburg	Newburg Volunteer Fire and EMS Department provides services to the Village of Newburg, Town of Trenton, and a portion of the Town of Saukville.	Village of Newburg EMS provides services the Village of Newburg, Town of Trenton, a portion of the Towns of Saukville and Farmington.	The Village of Newburg Police Department is a part-time department serving all of the Village of Newburg. The Department has a Chief, an Assistant Chief, and six officers.
Village and Town of Saukville	Saukville Fire Department is paid-on-call department of 40 paid-on-call Fire/EMS personnel one art-time Fire Chief. The Department provides service to the Village of Saukville and portions of the Town of Saukville.	Saukville EMS is paid-on-call. EMS personnel are trained to the Emergency Medical Responder (EMR), EMT Basic, and EMT Advanced levels.	The Saukville Police Department is a full-time agency comprised of eleven sworn police officers, one sergeant, one lieutenant, and a police chief. The Department also employs 10 civilian support and reserve officers. The Ozaukee County Sheriff's Department serves the Town of Saukville.
Village of Thiensville	Thiensville Fire Department is a paid-on-call department 30 paid-on-call Fire/EMS Paramedic Level, one part-time Fire Chief, and one full-time Deputy Chief.	The Fire Department provides paid-on-call Paramedic (EMT-P), EMT Advanced and Basic (EMT-B) EMS services to the Village of Thiensville.	The Thiensville Police Department is a full-time agency comprised of seven sworn officers, one civilian employee, and 14 special reserve officers.
Ozaukee County Sheriff's Office		The Ozaukee County Rescue Boat staff is currently working with local hospitals to develop the unit into a Wisconsin licensed Emergency Medical Responder Unit to provide EMS response in Ozaukee County Waters of Lake Michigan.	85 full-time sworn Officers, 19 sworn part-time Officers (including Court Officers and prisoner transport officers), two full-time Emergency Management, 16 paid-on-call Emergency Management, including hazmat team and rescue boat staff.
Ozaukee County Coroner			One full-time Coroner, three paid-on-call Deputy Coroners, one part-time office support staff, Four paid-on-call Livery Drivers, and Medical Examiner Services contracted with Milwaukee County.

Note: Port Washington provides paramedics to the City and Town of Port Washington, Village of Saukville and portions of the Town of Saukville, Waubeka Area, Village and Town of Fredonia, and Village and Town of Belgium.

Source: Ozaukee County Department of Land Information and SEWRPC

Dispatch Centers

Ozaukee County utilizes the Computer Assisted Dispatch (CAD) system for their dispatch services. The Ozaukee County dispatch CAD system has the ability for the entry of nearest cross roads to any validated address, which can assist the dispatcher in locating the caller. Wireless 911 calls, dependent on the cellular carrier, can automatically populate on the County's CAD system to show the approximate location of the caller to within 50-300 meters of the caller's actual location. There are currently four dispatch centers within Ozaukee County operating 24 hours per day. The dispatch centers are operated by the Ozaukee County Sherriff's Department and the Cedarburg and Mequon Police Departments, and are shown on Map 2.23. The Village of Bayside, which is partially located within Ozaukee County, also has a dispatch center and provides services for the City of Glendale and the Villages of Brown Deer, Fox Point, River Hills, the North Shore Fire Department, Shorewood, and Whitefish Bay.

Specialized Response Teams

The Ozaukee County Level B Hazardous Materials Emergency Response Team is part of the Division of Emergency Management. All members of the team have completed U.S. Environmental Protection Agency 165.15 training and maintained competency in required areas as set forth by SARA Title III, CFR 29, CFR 40, CFR 49, and NFPA 471. The team is on call 24 hours per day to respond to calls within Ozaukee County and from surrounding counties when requested.

The Ozaukee County Sheriff's Office Rescue Boat is the primary provider of emergency services for approximately 900 square miles of Lake Michigan's waters. Patrol members routinely train in conjunction with the watercraft and helicopter assets of the U.S. Coast Guard.

In addition, some fire departments and law enforcement agencies in the County participate in several specialized response teams. The City of Port Washington Fire/Rescue has both a Dive Team and a Rescue Task Force. The Dive Team was established in 1982 and is comprised of current and former firefighters as well as EMS personnel. There are two components to the dive team, surface support and divers. Surface support helps divers gear up, review checklists, communicate signals, and control the divers' search patterns from the surface. The divers execute the search and are certified as either advanced open water dive, ice diver, rescue dive, search or recovery diver, and/or diver rescue 1. The U.S. Coast Guard also provides surface ice rescue training to the entire Fire Department.

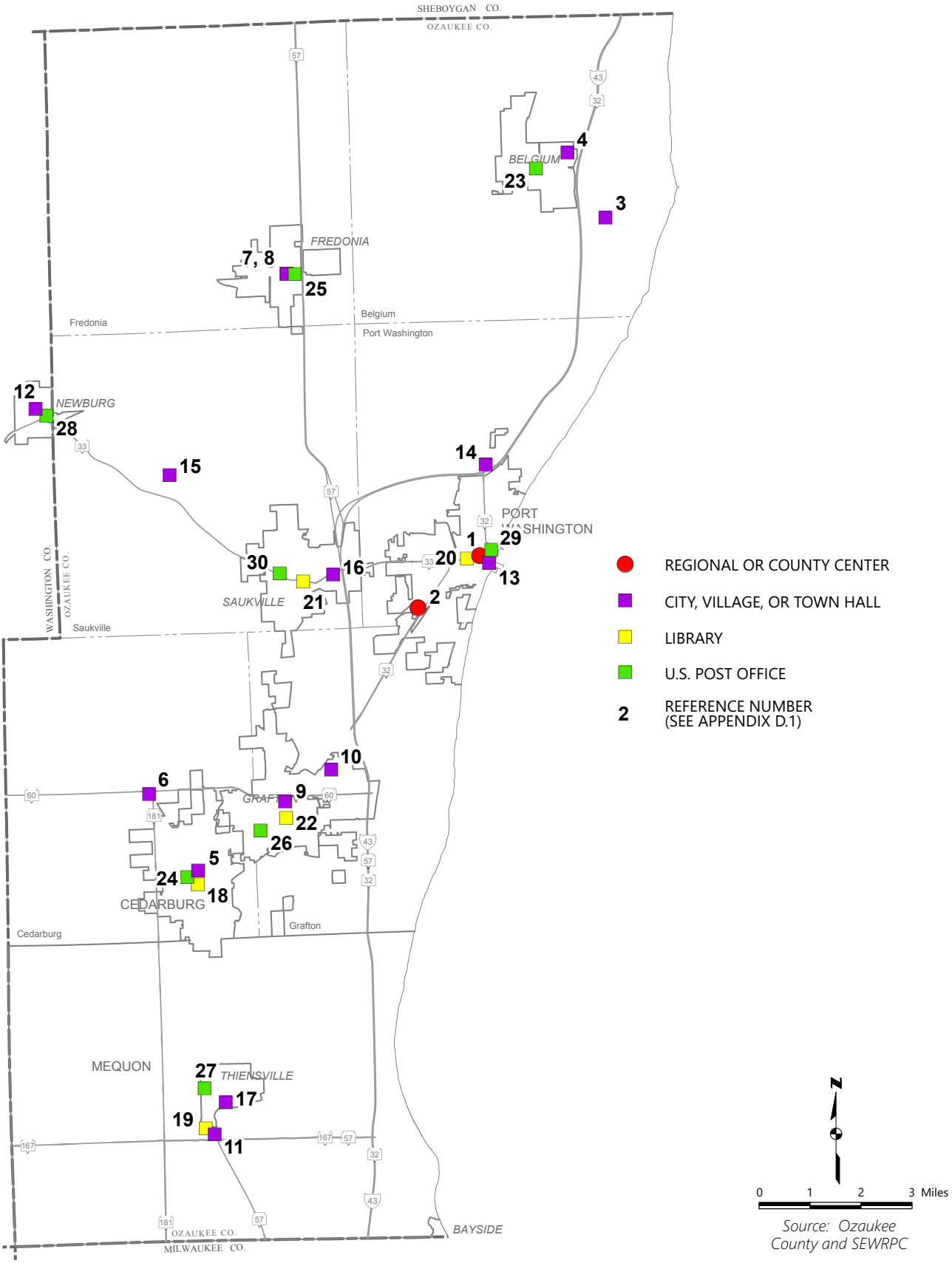
In 2016, in response to several major active shooter incidents that occurred throughout the country, the Port Washington Fire and Rescue Department established a Rescue Task Force (RTF). The RTF concept is a model that integrates trained medical responders with law enforcement to respond to potentially hostile situations and provide rapid medical treatment and triage at the scene. RTF members are outfitted with ballistic vests, helmets, and other protective gear, and are specially trained and equipped to deal with violence-induced trauma. Training includes Tactical Emergency Casualty Care (TECC), directed medical care and triage procedures, RTF Incident Command System structure, and advanced patient extrication techniques.

The City of Mequon's Fire Department provides confined space rescue, high angle rescue and water rescue. The City of Cedarburg has several firefighters certified in open water dive, advanced open water dive, confined space rescue, and ice rescue. The Thiensville Fire Department has a Dive-Rescue Team that is equipped to handle incidents involving swift water rescue, cold-water rescue, SCUBA diving, and ice rescue. The Village of Grafton Fire Department has members trained in swift water rescue. The North Shore Fire Rescue Department deploys a Special Operations Unit for rescues involving confined spaces and trenches, hazardous materials incidents, and a boat for water or ice rescue.

2.11 CRITICAL COMMUNITY FACILITIES

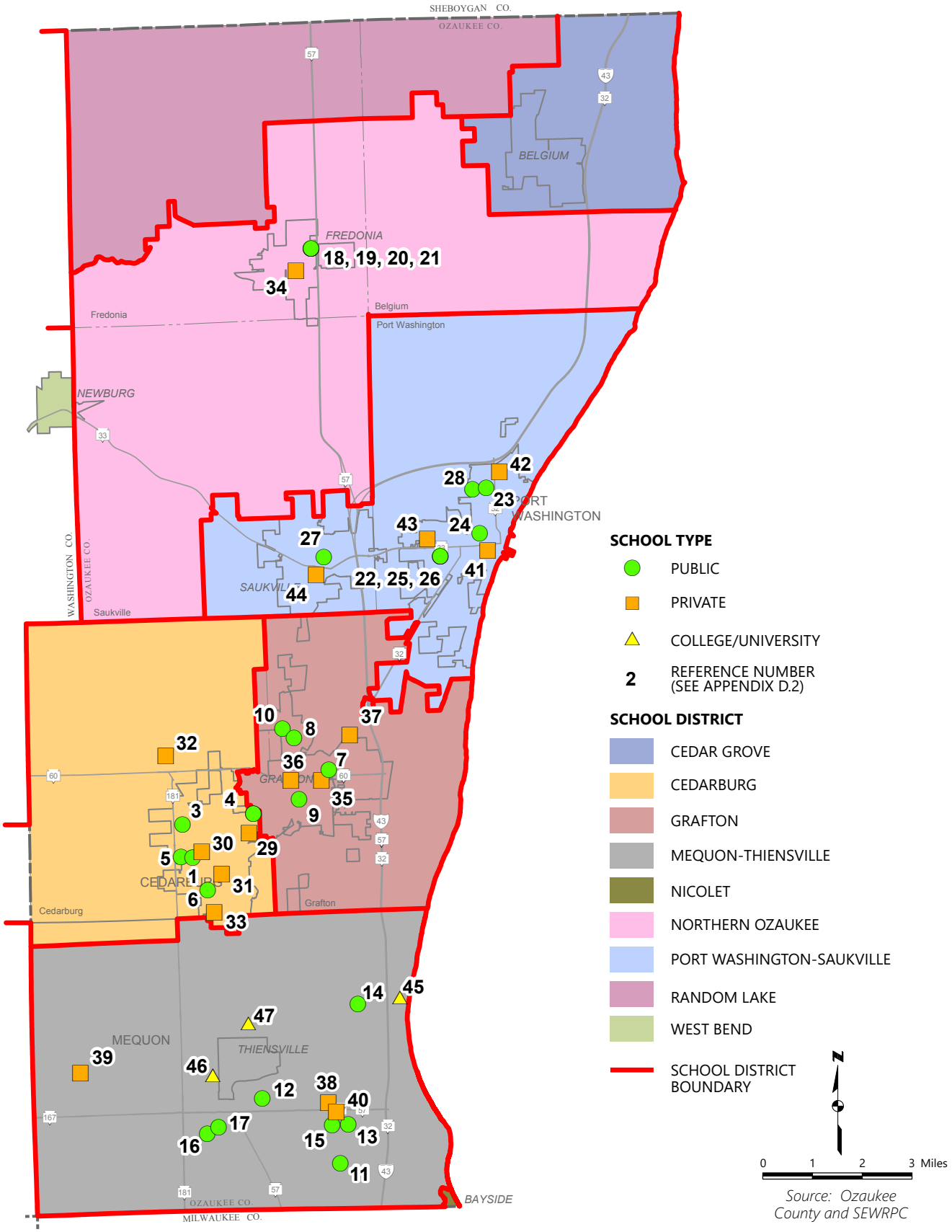
In addition to fire stations and law enforcement stations, as described above, other community facilities which are of importance in hazard mitigation planning include schools, hospitals and major clinics, nursing or adult care homes, day care centers (with a capacity of approximately 20 children or more), and government administration buildings. Maps 2.24 through 2.28 show the location of selected types of critical community facilities within Ozaukee County. Because of the need for access to and from these facilities, the hazard mitigation plan includes their locations. Their relationship to flood hazard areas is described in Chapter 3. A listing of the critical community facilities and their location is included in Appendix D.

Map 2.24
Selected Government Administration Buildings Within the Ozaukee County Planning Area: 2015



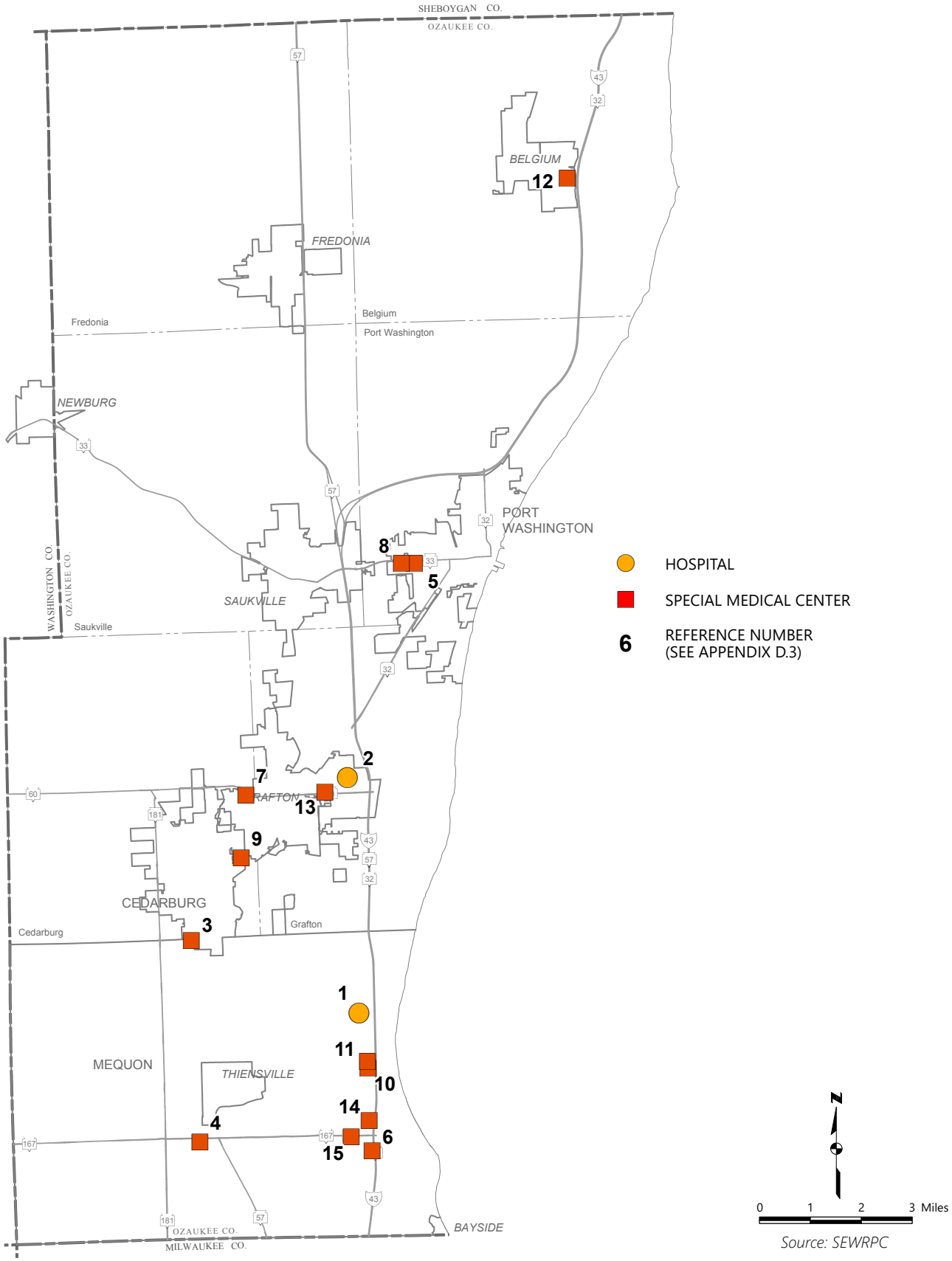
Source: Ozaukee County and SEWRPC

Map 2.25
Public, Private, and Higher Educational Schools Within the Ozaukee County Planning Area: 2018



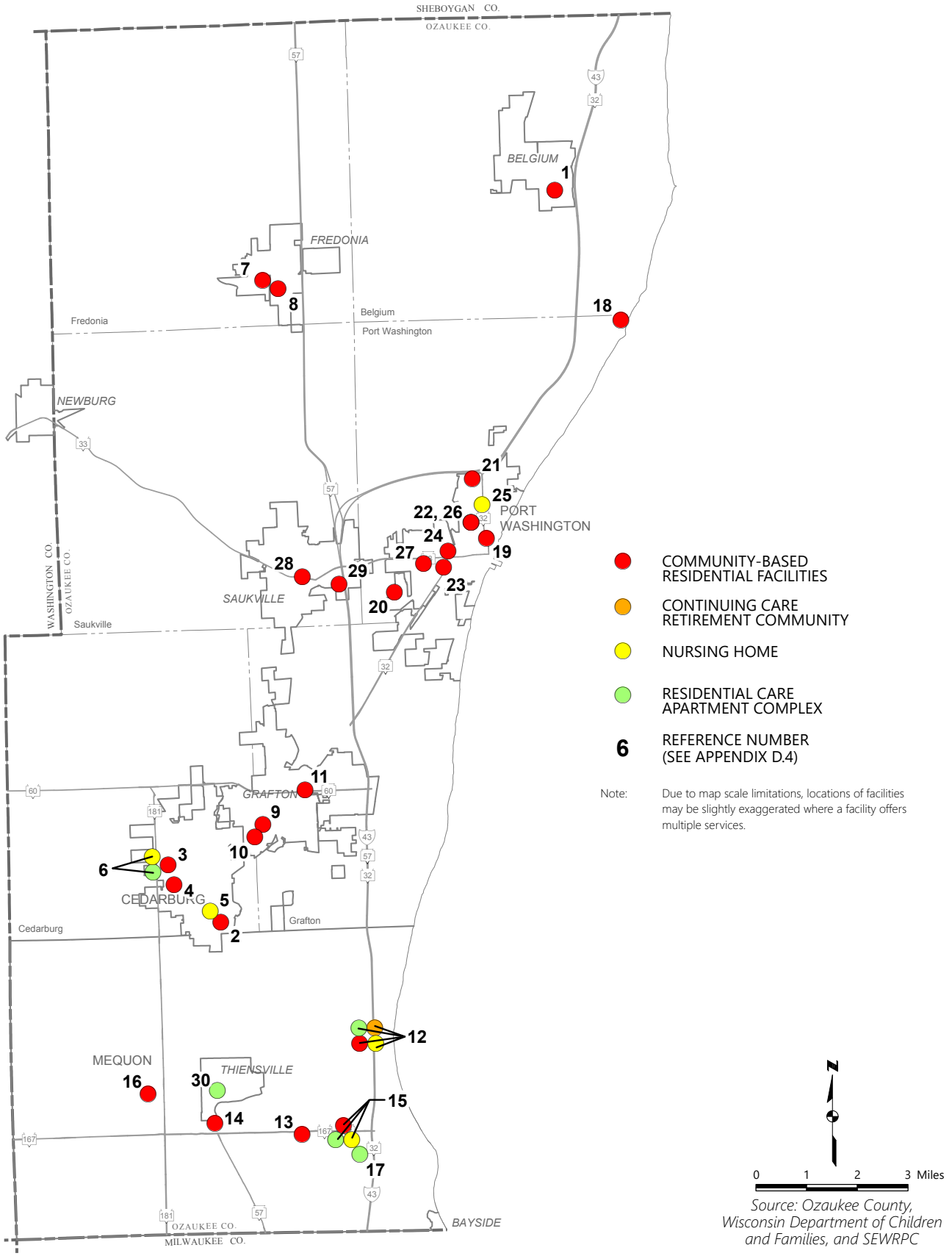
Source: Ozaukee County and SEWRPC

Map 2.26
Hospitals and Special Medical Centers in Ozaukee County: 2015



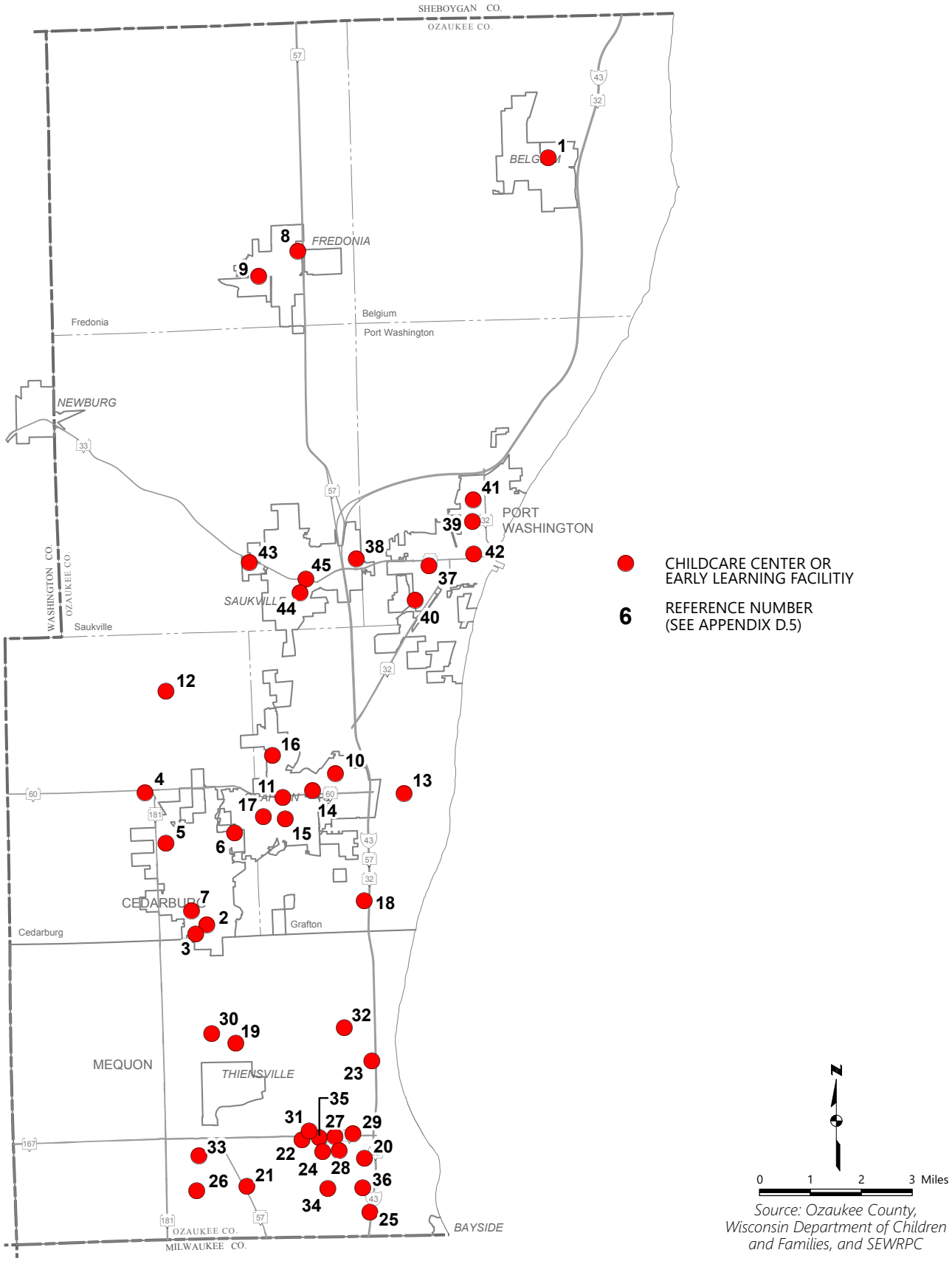
Source: SEWRPC

Map 2.27
Elderly Facility Centers in Ozaukee County: 2018



Source: Ozaukee County, Wisconsin Department of Children and Families, and SEWRPC

Map 2.28
Early Learning Facilities and Childcare Centers in Ozaukee County: 2018



Source: Ozaukee County, Wisconsin Department of Children and Families, and SEWRPC

2.12 HAZARDOUS MATERIAL STORAGE AND USE

Public Law 99-499, the Superfund Amendment and Reauthorization Act (SARA/Title III) of 1986 and Wisconsin Act 342 set forth requirements for hazardous material reporting and safety planning. The primary reporting and centralized record-keeping related to hazardous materials is carried out under a partnership program involving the industries and other users of hazardous materials, the Wisconsin Division of Emergency Management, county emergency management departments/local emergency planning committees, and local fire departments. In 2018, there were 33 identified users of extremely hazardous substances (EHS) classified as planning facilities and 92 users classified as reporting facilities in Ozaukee County. Reporting facilities are any facility that uses, stores, or produces chemicals at or above 10,000 pounds. Because there is no "hazardous chemical" list, the general assumption is that anything requiring the completion of a material safety data sheet (MSDS) is included as a reporting requirement. Reporting facilities include manufacturers, warehouses, and petroleum storage site operators. Planning facilities include a wide range of users of limited amounts of hazardous materials. In addition to industrial materials, the agricultural industry routinely uses materials considered extremely hazardous. These uses range from individual farm use materials to large chemical storage facilities. Detailed listings of these planning and reporting facilities, which are noted above as storing or producing hazardous materials throughout Ozaukee County are provided in Tables 2.19 and 2.20.[38]

2.13 HISTORIC SITES

Historic sites in Ozaukee County often have important recreational, educational, and cultural value. Certain sites of known historic significance are listed on the National Register of Historic Places. In 2018, there were 34 individual sites (including shipwrecks) and five historic districts[39] within the County that were listed on the National Register. The location of Historic Sites and Districts in Ozaukee County are described in Appendix E and shown on Map 2.29. Sites and Districts listed on the National and State Registers of Historic Places have an increased measure or protection against degradation and destruction. Listing on the National or State Register requires government agencies to consider the impact on the designated property of their activities, such as the construction or reconstruction of a highway or a permit which they issue. If the property would be adversely affected, the agency must work with the State Historic Preservation Officer to attempt to avoid or reduce adverse effects.

2.14 REGULATIONS AND PROGRAMS RELATED TO HAZARD MITIGATION

The current ordinances and programs which are most directly related to hazard mitigation and plan implementation include general zoning, floodplain zoning, shoreland or shoreland–wetland zoning regulations, and emergency operations programs. Those ordinances and operations programs administered by Ozaukee County and the local units of government in the County are summarized in Table 2.21, and in the following text.

General Zoning

Cities in Wisconsin are granted general, or comprehensive, zoning powers under Section 62.23 of the *Wisconsin Statutes*. The same powers are granted to villages under Section 61.35 of the *Wisconsin Statutes*. Counties are granted general zoning powers within their unincorporated areas under Section 59.69 of the *Wisconsin Statutes*. However, a county zoning ordinance becomes effective only in those towns that ratify the county ordinance. Towns that have not adopted a county zoning ordinance may adopt village powers and subsequently utilize the city and village zoning authority conferred in Section 62.23 of the *Wisconsin Statutes*. Town zoning, however, is subject to county board approval where a general county zoning ordinance exists. Alternatively, towns may adopt a zoning ordinance under Section 60.61 of the *Wisconsin Statutes* where a general county zoning ordinance has not been adopted, but only after the county board fails to adopt a county ordinance at the petition of the governing body of the town concerned. General zoning is in effect in all communities in Ozaukee County.

[38] *Ozaukee County Sheriff's Department,* 2018 Ozaukee County Strategic Plan, *March 2018.*

[39] *A historic district is a geographically definable area, urban or rural, that contains a concentration of significant historic sites or structures from the same period of time.*

Table 2.19
Off-Site Planning Facilities with Extremely Hazardous Substances Greater Than Threshold Planning Quantity Within Ozaukee County: 2018

Facility Name	Facility Address
Cedarburg	
AT&T-PG1107	W63 N548 Hanover
Kemps, LLC.	W55 N155 McKinley Boulevard
Cedar Crest Specialties	7359 Hwy 60
WI-999 Charter Communications Cedarburg Hub	W59 N196 Cardinal Road
Fredonia	
Cedar Valley Cheese	W3111 Jay Road
Grafton	
Aurora Medical Center-Grafton	975 Port Washington Road
Costco Wholesale #628	950 Port Washington Road
John Crane Orion	1111 Cedar Creek Road
Rexnord Flat Top Division	1272 Dakota Drive
North Mequon AT&T/Cingular	1060 Pioneer Road
Mequon	
AT&T-PG0106	7404 W. County Line Road
Columbia Street Mary's Hospital-Ozaukee County	13111 N. Port Washington Road
HB Performance Systems	5800 Donges Bay Road
Kleen Test Products	5600 W. County Line Road
Ozaukee Country Club	11175 N. River Road
Rockwell Automation	6400 W. Enterprise Drive
SPI Lighting, Inc.	10400 N. Enterprise Drive
Port Washington	
AT&T-PL6206	301 W. Grand Avenue
Kleen Test Products	603 Moore Road
Kleen Test Products	1671 Sunset Road
Port Washington Generating Station	146 S. Wisconsin Street
Port Washington Water Filtration Plant	408 N. Lake Street
Sigma-Aldrich Chemical, LLC.	690 Oakland Avenue
Saukville	
Wal-Mart #1650	825 E. Green Bay Avenue
Charter Steel	1658 Cold Springs Road
Jeneil Biotech	400 N. Dekora Woods Boulevard
Saukville Well #1	110 W. Dekora Street
Saukville Well #3	295 South Foster Street
Saukville Well #4	405 Progress Drive
Saukville Well #5	431 Northwoods Road
Saukville Well #6	1799 Cold Springs Road

Source: Ozaukee County Division of Emergency Management and SEWRPC

Floodplain Zoning

Section 87.30 of the *Wisconsin Statutes* requires that cities, villages, and counties, with respect to their unincorporated areas, adopt floodplain zoning to preserve floodplain areas and to prevent the location of new flood damage-prone development in flood hazard areas. The minimum standards that such ordinances must meet are set forth in Chapter NR 116, "Wisconsin's Floodplain Management Program," of the *Wisconsin Administrative Code*. The required regulations govern filling and development within a regulatory floodplain, which is defined as the area subject to inundation by the one-percent-annual-probability (100-year recurrence interval) flood event. Under Chapter NR 116, local floodplain zoning regulations must prohibit nearly all forms of development within the floodway, which is that portion of the floodplain required to convey the one-percent-annual-probability peak flood flow. Local regulations must also restrict filling and development within the flood fringe, which is that portion of the floodplain located outside of the floodway that would be covered by floodwater during the one-percent-annual-probability flood. Permitting the filling and development of the flood fringe area, however, reduces the floodwater storage capacity of the natural

Table 2.20
Hazardous Chemical Tier II Reporting Facilities Within Ozaukee County: 2018

Facility Name	Facility Address
Belgium	
Frontier Communications	361 Main Street
Peiffer Oil & Propane, INC.	480 S. Royal Avenue
Cedarburg	
Cedarburg Co. – PG1107	W63 N548 Hanover Avenue
Cedar Crest Specialties, INC.	7359 Highway 60
Ozaukee County Garage	1221 Hilltop Drive
Cedarburg Wastewater Plant	W54 N370 Park Lane
Cedarburg Public Works	W59 N306 Johnson Avenue
Kemps, LLC.	W55 N155 McKinley Boulevard
Lasata Care Center	W76 N677 Wauwatosa Road
Carlson Tool & Manufacturing Corp	W57 N14386 Doerr Way
Fast Track	W62 B271 Washington
WI.-999 Charter Communications Cedarburg Hub	W59 N196 Cardinal Road
Speedway 4203	W63 N121 Washington Ave
Louis C. Hoffmann & Son, INC. Yard & Office	9526 Western Avenue
Cedarburg Bulk Plant	1206 Hilltop Drive
Fredonia	
Village of Fredonia Water Utility	242 Fredonia Avenue
Hartmann Sand & Gravel Company, INC.	N6621 Pioneer Drive
Guy & O'Neill, INC.	200 Industrial Drive
Guy & O'Neill, INC.	617 Tower Drive
Village of Fredonia Wastewater Treatment Plant	210 Park Road
Cedar Valley Cheese	W3111 Jay Road
Grafton	
United Division	460 9th Avenue
Rexnord Flat Top Division	1272 Dakota Drive
Pace Industries-East Division	1600 7th Avenue
Grafton Water & Wastewater Utility	1900 9th Avenue
The Home Depot Store #4919	1350 Port Washington Road
Costco Wholesale #628	950 Port Washington Road
Aurora Medical Center - Grafton	975 Port Washington Road
Grafton Plant	989 Ulao Road
John Crane Orion	1111 Cedar Creek Road
Cedarburg Pharmaceuticals	900 Cheyenne Avenue
Kapco, INC.	1046 Hickory Street
Kapco, INC.	1000 Badger Circle
North Mequon - USID58170	1060 Pioneer Road
Mequon	
Copps industries, INC.	10600 N. Industrial Drive
Spi lighting, INC.	10400 N. Enterprise Drive
Milwaukee Chestnut Co. - PG0106	7404 W. County Line Road
Genmet Corporation	10245 N. Enterprise Drive
Mequon Maintenance Garage	6300 W. Mequon Road
Ajax metal Products, INC.	5300 W. County Line Road
Ozaukee Country Club	11175 N. River Road
Hayes Performance Systems	5800 W. Donges Bay Road
Ascension Columbia St. Mary's Hospital – Ozaukee	13111 N. Port Washington Road
Concordia university Wisconsin	12800 North Lake Shore Drive
Ozaukee Ice Center	5505 W. Pioneer Road
Telsmith INC.	10910 N. Industrial Drive
JBT Corporation	10605 N. Baehr Road
Oerlikon Metco	10607 N. Baehr Road
Kleen Test Products	5600 W. County line Road

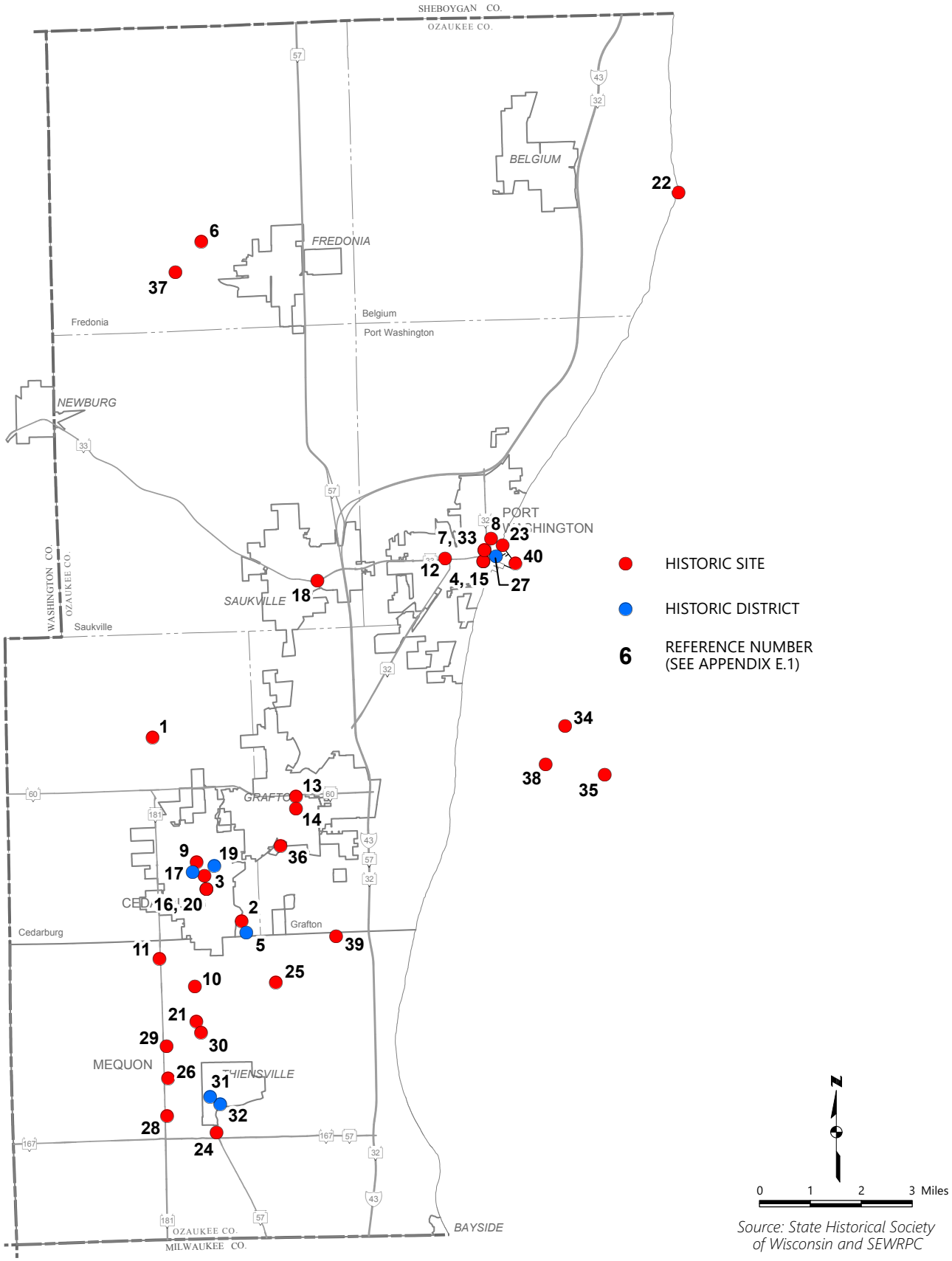
Table continued on next page.

Table 2.20 (Continued)

Facility Name	Facility Address
Rockwell Automation	6400 W. Enterprise Drive
Mequon Highway Garage	10800 N. Industrial Drive
Fox Welding Supply, INC.	6809 west Donges Bay Road
Mequon Terminal	6926 Donges Bay Road
Port Washington	
Port Washington Service Center	700 Sunset Road
Port Washington Co. - PL6206	301 Grand Avenue
Port Washington Water Filtration	408 N. Lake Street
Kleen Test Products	603 Moore Road
Schmitz Ready-Mix Port Washington	775 Schmitz Drive
Ozaukee County garage	410 South spring Street
Port Washington Wastewater Treatment Plant	450 N. Lake Street
Port Washington Generating Station	146 S. Wisconsin Street
Molded dimensions, INC.	701 Sunset Road
Port Washington Marina	106 N. Lake Street
Port Washington Garage	333 N. Moore Road
Veolia Technical Solutions, LLC.	1275 Mineral Springs Drive
Johnson School Bus Service, INC.	3900 Highway KW
Manitowoc Cranes Port Washington	1190 Mineral Springs Drive
Kleen Test Products	1671 Sunset Road
Harbor Campus	425 W. Walters Street
Aldrich Chemical Company, LLC.	690 Oakland Avenue
Veolia Technical Solutions, LLC.	215 S. Park Street
Kickhaefer Manufacturing Company, LLC.	1151 Mineral Springs Drive
Kickhaefer Manufacturing Company, LLC.	1221 S. Park Street
Saukville	
Johnson Brass & Machine Foundry, INC.	270 N. Mill Street
Saukville Well #3	295 South Foster Street
Ozaukee County Highway Department	3979 Lakeland Road,
Charter Steel	1658 Cold Springs Road
Saukville Department of Public Works	649 S. Main Street
Village of Saukville, Well #5	431 Northwoods Road
Jeneil biotech, INC.	400 N. Dekora Woods Boulevard
TMS international	1658 Cold Springs Road
Injectec. incorporated	451 N. Dekora woods Boulevard
Cedarsauk Substation	1890 Cedarsauk Road
The Bog	3121 County Highway 'I'
Saukville Well #1	110 W. Dekora Street
Sauk Technologies	300 North Dekora woods Boulevard
Saukville Well #4	405 progress Drive
Saukville Wastewater Treatment Plant	1600 Cottontail Lane
Air Liquide Industrial US LP	1600 Cold Springs Road
Thiensville	
Herbst Oil, INC.	230 S. Orchard Street
Waubeka	
Ozaukee County Garage	County Highway "Z" W4074

Source: Ozaukee County Division of Emergency Management and SEWRPC

Map 2.29
National and State Registers of Historic Sites and Districts in Ozaukee County: 2017



Source: State Historical Society of Wisconsin and SEWRPC

Table 2.21
Regulations and Programs Within Ozaukee County Related to Hazard Mitigation: 2018

Municipality	General Zoning	Floodplain Zoning	Stormwater Management Ordinance or Plan	Shoreland or Shoreland Wetland Zoning	Emergency Operations Ordinance or Plan
Ozaukee County	Adopted	Adopted	Yes	Adopted	Yes
City of Cedarburg	Adopted	Adopted	Yes	Adopted	Yes
City of Mequon	Adopted	Adopted	Yes	Adopted	Yes
City of Port Washington	Adopted	Adopted	Yes	Adopted	Yes
Village Bayside	Adopted	Adopted	Yes	--	Yes
Village of Belgium	Adopted	Adopted	Yes	Adopted	Yes
Village of Fredonia	Adopted	Adopted	Yes	Adopted	--
Village of Grafton	Adopted	Adopted	Yes	Adopted	--
Village of Newburg	Adopted	Adopted	Yes	Adopted	Yes
Village of Saukville	Adopted	Adopted	Yes	Adopted	Yes
Village of Thiensville	Adopted	Adopted	Yes	Adopted	Yes
Town of Belgium	Adopted	County Ordinance	County Ordinance	County Ordinance	--
Town of Cedarburg	Adopted	County Ordinance	Yes[a]	County Ordinance	Yes
Town of Fredonia	Adopted	County Ordinance	County Ordinance	County Ordinance	Yes
Town of Grafton	Adopted	County Ordinance	Yes[a]	County Ordinance	--
Town of Port Washington	Adopted	County Ordinance	Yes[a]	County Ordinance	Yes
Town of Saukville	Adopted	County Ordinance	County Ordinance	County Ordinance	Yes

[a] *The Towns have adopted erosion control and stormwater management ordinances or regulations. The Towns are also regulated under the Ozaukee County Construction Site Erosion Control and Post-Construction Storm Water Management Ordinance. In the event of conflicting regulations between the Town and County ordinances, the more restrictive regulation applies.*

Source: Ozaukee County Municipal Webpages and SEWRPC

floodplain, and may thereby increase flood flows and stages. The County Shoreland and Floodplain Zoning Ordinance applies in all of the unincorporated areas of the towns in Ozaukee County. All incorporated cities and villages where floodplains have been identified have adopted floodplain zoning ordinances.

Shoreland and Shoreland-Wetland Zoning

Under Section 59.692 of the *Wisconsin Statutes*, counties in Wisconsin are required to adopt zoning regulations within statutorily defined shoreland areas, or, those lands that are within 1,000 feet of the ordinary high water mark (OHWM) of a navigable lake, pond, or flowage, or 300 feet of the OHWM of a navigable stream, or, to the landward side of the floodplain, whichever distance is greater, within their unincorporated areas. Standards for county shoreland zoning ordinances are set forth in Chapter NR 115, "Wisconsin's Shoreland Protection Program," of the *Wisconsin Administrative Code*.[40] Chapter NR 115 sets forth requirements regarding lot sizes and building setbacks; restrictions on cutting of trees and shrubbery; and restrictions on filling, grading, lagooning, dredging, ditching, and excavating that must be incorporated into county shoreland zoning regulations. In addition, Chapter NR 115 requires that counties place all wetlands five acres or larger and located within the statutory shoreland zoning jurisdiction area into a wetland conservancy zoning district to ensure their preservation after completion of appropriate wetland inventories by the WDNR. Aside from wetlands within the shoreland zone, selected wetlands generally five acres and larger are also placed into conservancy zoning outside the shoreland zone in the unincorporated areas of the County.

[40] *The 2015-2017 State Budget (Act 55) changed State law relative to shoreland zoning. Under Act 55 a shoreland zoning ordinance may not regulate a matter more restrictively than it is regulated by a State shoreland-zoning standard unless the matter is not regulated by a standard in Chapter NR 115, "Wisconsin's Shoreland Protection Program," of the* Wisconsin Administrative Code. *(Examples of unregulated matters may involve wetland setbacks, bluff setbacks, development density, and stormwater standards.) In addition, under Act 55, a local shoreland zoning ordinance may not require establishment or expansion of a vegetative buffer on already developed land and may not establish standards for impervious surfaces unless those standards consider a surface to be pervious if its runoff is treated or is discharged to an internally drained pervious area.*

In 1982, the State Legislature extended shoreland-wetland zoning requirements to cities and villages in Wisconsin. Under Sections 62.231 and 61.351, respectively, of the *Wisconsin Statutes* cities and villages in Wisconsin are required to place wetlands five acres or larger and located in statutory shorelands into a shoreland-wetland conservancy zoning district to ensure their preservation. Minimum standards for city and village shoreland-wetland zoning ordinances are set forth in Chapter NR 117, "Wisconsin's City and Village Shoreland-Wetland Protection Program," of the *Wisconsin Administrative Code*.

An important element of Ozaukee County shoreland zoning ordinances relates to the regulation of land use activities and facilities along the Lake Michigan shoreline and bluffs. The Wisconsin Coastal Management Program (WCMP) developed a model coastal ordinance for construction setback distances above and beyond the setback required by the State's Shoreland Protection Program. Ozaukee County has adopted the WCMP model ordinance, which states all buildings must be set back a minimum of 75 feet from top of bluff edge or the calculated stable slope angle setback, whichever is greater. The stable slope angle must be determined by a professional engineer or surveyor and approved by the County Zoning Administrator.[41]

Emergency Operations Planning

Ozaukee County has developed a comprehensive emergency management plan (CEMP)[42] which sets forth an all-hazards action plan. The CEMP provides the framework for Ozaukee County government and partner entities to respond to public emergencies within the local jurisdiction and regionally. Ozaukee County's comprehensive emergency management plan notes that the County is exposed to many hazards that have the potential for disrupting the community, causing damage, and creating casualties. In addition to flooding, the plan recognizes that the County is vulnerable to other natural hazards, including tornadoes and severe weather; technological hazards; accidents involving hazardous materials; terrorism and civil disorder; and utility hazards, such as power failure and water shortages or contamination.

The County plan provides the framework for Ozaukee County government and partner entities to respond to public emergencies within the local jurisdiction and regionally. The CEMP establishes a unified command and control structure for emergency response operations to ensure a coordinated and effective response. The CEMP also incorporates the concepts and processes of the National Incident Management System (NIMS) as the standard for emergency response.

The CEMP design was based on the Comprehensive and Integrated Emergency Management Model which is the platform for modern emergency management. This comprehensive model entails four structural phases: mitigation, preparedness, response, and recovery. The CEMP framework allows for a continuous and sustained process of pre-incident, trans-incident, and post-incident activities. The CEMP remains dynamic and flexible as it matures in order to allow changes and updates to be effective.

In 2018, the Ozaukee County Sheriff's Department released its Strategic Plan. This plan defines the roles, responsibilities, and inter/intra-organizational relations of government and private organizations for a response to a hazardous materials incident, including discharges, releases, accidents, and/or spills within the County. Additionally, this plan forms a portion of the Ozaukee County Comprehensive Emergency Management Plan mentioned above.

[41] *For more detailed information about the stable slope angle setback ordinance refer to Ozaukee County Code of Ordinance, Chapter VII,* Shoreland and Floodplain Zoning Ordinance, Section 310.

[42] *Ozaukee County, Wisconsin,* Comprehensive Emergency Management Plan (CEMP)*, January 2013.*

ANALYSIS OF HAZARD CONDITIONS 3

To evaluate various potential hazard mitigation alternatives for Ozaukee County and select the most effective and feasible hazard mitigation strategies, the existing potential hazard problems in the County must first be analyzed and the vulnerability to such hazards documented. Accordingly, this chapter provides the following:

- Identification of the hazards likely to affect Ozaukee County
- Profiles of the extent and severity of hazard events that occurred in the County
- Assessment of the vulnerability and risk associated with each type of hazard
- Identification of the potential for changes in hazard severity and risk under future conditions, such as climate change.

The vulnerability assessment focuses on the County and community assets described in Chapter 2.

In preparing both the previous update and this update to the plan, the analysis of the existing potential hazard problems and the documentation of the vulnerability to such hazards were reviewed and updated as warranted. This review and updating included:

- Reevaluation of the identification of the hazards likely to affect Ozaukee County
- Updating the data that serves as the basis for the profiles of the extent and severity of hazard events in the County
- Reassessment of the vulnerability and risk associated with each type of hazard in light of the updated data
- Reevaluation of the potential for changes in hazard severity and risk under future conditions, such as climate change

3.1 HAZARD IDENTIFICATION

The process of identifying those hazards that should be specifically addressed in the Ozaukee County hazard mitigation plan was based upon consideration of a number of factors. The process included input from the Ozaukee County Hazard Mitigation Local Planning Team (LPT),[43] including a priority rank ordering of hazards; review of the hazard identification set forth in the State hazard mitigation plan; review of documentation of past hazard events; and review of related available mapping, plans, and assessments. As part of the updating process, the identification of hazards likely to affect Ozaukee County was reviewed and reevaluated. This reevaluation included additional input from the Ozaukee County Hazard Mitigation Local Planning Team.

Local Input

In December 1995, Ozaukee County completed a flood hazard mitigation plan. That plan was updated in 2001. The flood hazard mitigation plan was used as a reference for the first edition of Ozaukee County's Pre-Disaster Hazard Mitigation Plan, which was completed in 2008. The first edition of the County's all hazards

[43] *For the development of the initial plan and the 2013 update, this group was called the Ozaukee County Hazards Mitigation Plan Workgroup, which was overseen by the Hazard Mitigation Committee. For the current plan update, the name of this group has been changed to the Ozaukee County Hazard Mitigation Plan Local Planning Team to reflect the current terminology used by FEMA. The terms Workgroup and Committee will be used when referring to actions taken during the development of the initial plan and the first plan update.*

mitigation plan was prepared under the guidance of a Hazard Mitigation Committee and an Ozaukee County Hazard Mitigation Plan Workgroup. The Committee was comprised of Ozaukee County's Emergency Management staff, Land Information Office staff, the Planning, Resources and Land Management Director, as well as elected officials from the City of Port Washington, Village of Thiensville, and Towns of Fredonia and Saukville. The Committee met several times during the plan preparation period to incorporate input on the types of hazards to be considered, the appropriate mitigation strategies, and to review and provide input on the draft report chapters. The Ozaukee County Hazard Mitigation Workgroup reviewed past hazard event records to determine the probability of future events as either "high," "medium," or "low". The Workgroup also discussed potential mitigation projects suitable for hazard mitigation planning within Ozaukee County.[44]

The first update to the 2008 hazard mitigation plan was completed in 2013. This plan update was based on the requirements and procedures of the Disaster Mitigation Act of 2000. As part of the process for the first plan update, the Ozaukee County Division of Emergency Management completed and updated an Ozaukee County Hazard Vulnerability Analysis (HVA). The HVA identified all likely natural and technological hazards that might or have occurred within the County and is based on the State of Wisconsin's HVA. As with the initial Ozaukee County Hazard Mitigation Plan, a Hazard Mitigation Committee and a Hazard Mitigation Plan Workgroup were formed. Again, The Committee and Workgroup met several times during the plan preparation period to incorporate input on the types of hazards to be considered, the appropriate mitigation strategies, and to review the draft report chapters. The Workgroup reevaluated the hazards to be considered by reviewing past hazard event records and coming to a consensus on the probability of future events. This probability was designated as "very high," "high," "medium," "low," or "very low". The Workgroup also selected potential mitigation projects related to hazard mitigation planning within Ozaukee County. Each of those projects were assigned a "very high," "high," "medium," "low," or "very low" priority based on the Workgroup's internal assessment of risk, reward, cost benefit, and likelihood of local will and funding (local or grant) to complete the project (see Appendix B).[45]

For the third edition of the Ozaukee County hazard mitigation plan, Commission staff worked with the Ozaukee County Division of Emergency Management to form a Local Planning Team (LPT) to reevaluate the potential hazards to be included in the Plan. A list of hazards was presented at the first LPT meeting, which was used to complete the hazard and vulnerability assessment tool. A copy of this tool is included in Appendix A. Members of the LPT indicated the likelihood of each hazard occurring and evaluated the severity of each hazard on the basis of possible impacts to people, property, and business. Finally, the LPT evaluated the relative state of preparedness for each hazard. The ratings given by the LPT for each hazard were used to derive a perceived level of risk posed by each hazard. This perceived level of risk was utilized to rank the hazards.

Summary of Hazard and Vulnerability Assessment Tool Results

Methods

The assessment tools were completed at the February 2018 meeting of the LPT, with 19 surveys being returned and analyzed. For each of 23 hazards in the survey, a perceived risk was computed using the formula:

Perceived Risk (in %) = [(Probability/3) x (Human impact + Property impact + Business impact + Preparedness)/ (4*3)]* 100

Where Probability (likelihood that an event would occur), Human impact (possibility of death or injury), Property impact (physical losses and damages), and Business impact (interruption of services) were each assigned a number from 0 to 3, with 0 indicating "not applicable", 1 indicating low, 2 indicating moderate, and 3 indicating high. For Preparedness (preplanning), the scale is reversed. A number was assigned from 0 to 3, with 0 indicating "not applicable", 1 indicating high, 2 indicating moderate, and 3 indicating low or no preparedness.

The interpretation of the result returned by this formula is that the perceived threat increases with increasing percentage risk.

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[44] *Lenora Borchardt,* Ozaukee County Hazard Mitigation Plan*, EPTEC, Inc., 2008*.

[45] *Lenora Borchardt,* Ozaukee County Hazard Mitigation Plan*, EPTEC, Inc., 2013*.

For each hazard, an average risk was calculated using the results of all the returned surveys. The hazards were then ranked by **average risk**, with a rank of 1 indicating the highest perceived risk. For each hazard, minimum and maximum risks were calculated. The results from the assessment tool were analyzed for 23 hazards.

Results

The results from the assessment tool are summarized in Table 3.1. Hazard events are listed in order of average ranking from highest perceived risk to lowest perceived risk. The **average level** of risk for hazards ranged from 12.3 percent for the lowest ranked hazard (dust storms) to 51 percent for the highest ranked hazard (thunderstorm). Other hazards with high perceived risks included high straight-line winds, lightning, tornados, heavy snow storms, hail, and stormwater flooding (see Table 3.1).

The five hazards with the lowest average perceived risks according to the HVA analysis were dust storms, wildfires, earthquake, utility disruption or loss, and dam failure.

Past Hazard Experience

Past experiences with disasters can indicate the vulnerability of Ozaukee County to future disasters. Accordingly, past hazards that have faced Ozaukee County were reviewed and ranked by risk based upon disaster history and emergency management experience. As a part of this plan update, the review of hazards faced by the County was updated to include experiences that have occurred since the first plan update was completed, and the ranking by risk was reevaluated in light of this updated disaster history.

Major declarations are made by the President, when the President determines assistance is needed to supplement State and local efforts in providing services such as the protection of lives, property, public health and safety, and to lessen the threat of a disaster. Secretarial disaster declarations are by the Secretary of Agriculture is authorized to designate counties as disaster areas to make available emergency loans for agricultural producers that have suffered severe production losses due to a natural disaster.

Between 1965 and 2017, Ozaukee County had nine major disaster declarations and at least three secretarial disaster declarations by the USDA.[46] The total documented estimated damages of these 12 events exceeded $28 million as shown in Table 3.2. It should be noted that damage estimates generally underestimate the actual damages that occurred. In addition, an undetermined amount of damages may have been covered by insurance. Almost every year there are significant weather events causing millions of dollars of damage for which no Federal disaster assistance is requested. Thus, losses that were sustained in Ozaukee County over the period 1965 through 2017 are likely significantly greater than the $28 million estimate shown in Table 3.2.

Major indicators of hazard severity are the deaths, injuries, and economic losses resulting from natural hazards and disasters. Table 3.3 summarizes the documented damages associated with the 565 weather hazard events which have occurred in Ozaukee County since 1950. The data in Table 3.3 are primarily sourced from the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI), formally known as the National Climatic Data Center (NCDC), which publishes National Weather Service (NWS) data describing recorded weather events and resulting deaths, injuries, and damages in their Storm Events Database. For economic losses resulting from damages to crops, the data from the NCDC can be supplemented with records of crop insurance indemnities from the U.S. Department of Agriculture Risk Management Agency. It should be noted, the NCDC relies on damages reported by county, state, and federal emergency management officials, local law enforcement officials, volunteer weather spotters, NWS damage surveys, newspaper articles, the insurance industry, and the general public. Often property damage and crop damage due to weather events will go unreported. Thus, property damages and crop damages discussed below clearly represent an underestimate of actual damages that have occurred due to weather events.

These hazard events recorded since 1950 were estimated to have caused almost $89.7 million in total damages. Over $69 million of those damages, or about 77 percent, were property related damages, and about $20.7 million, or 23 percent, were crop related damages. It should be noted, in addition to the likely underreporting of property and crop damages, records going back to 1950 for some hazards were spotty.

[46] *Data for USDA Secretarial disaster declarations is only available going back to 2012.*

Table 3.1
Perceived Risks of Hazards as Determined by Hazard and Vulnerability Assessment Tool: 2018

Event	Rank	Average (percent)[a]	Minimum (percent)[a]	Maximum (percent)[a]
Thunderstorm	1	51.0	13.9	91.7
High Straight-Line Wind	2	47.4	16.7	91.7
Lightning	3	45.0	22.2	91.7
Tornado	4	44.0	11.1	91.7
Heavy Snow Storm	5 (tie)	41.1	16.7	83.3
Hail	5 (tie)	41.1	11.1	58.3
Stormwater Flooding	6	38.6	11.1	91.7
Coastal Erosion	7	37.2	8.3	66.7
Fog	8	36.4	8.3	75.0
Extreme Cold	9	36.0	11.1	75.0
Riverine Flooding	10	34.8	8.3	75.0
Blizzard	11	33.6	11.1	66.7
Extreme Heat	12	31.8	11.1	66.7
Ice Storm	13	29.9	2.0	61.1
Drought	14	25.5	8.3	66.7
Landslide	15	23.8	8.3	66.7
Lake Flooding	16	23.3	11.1	83.3
Land Subsidence	17	22.7	5.6	66.7
Dam Failure	18	21.7	11.1	50.0
Utility Disruption or Loss	19	18.9	8.3	33.3
Earthquake	20	17.0	8.3	27.8
Wildfire	21	15.6	8.3	25.0
Dust Storm	22	12.3	8.3	16.7

[a] *Perceived threat increases with percentage.*

Source: SEWRPC

The amount of estimated losses reported from major weather events has been increasing. Based upon the date of the event occurrences summarized in Table 3.3, there were nearly $44 million in hazard-related property damages and expenses and over $17.5 million in crop damages reported to be associated with weather related hazards that took place between 1996 and 2017. This proportion represents 68 percent of all reported damages over the period 1950 to 2017. Furthermore, three major events, a significant flash flood event on June 18, 1996, another flash flood event on June 21, 1997, and one severe thunderstorm event on May 31, 1998, contributed to almost 40 percent of the property damages reported in the 68 year period shown in Table 3.3. The 2000s was also an unusually active decade for natural disasters in the State of Wisconsin as a whole including large flood events in southeastern Wisconsin in 2008 and 2010. Another possible reason for the increase in reported damage estimates may be improvements in how local community and County officials report damages. However, it is apparent that Ozaukee County is experiencing significant rates of loss due to natural hazards.

The NWS and crop insurance data summarized in Table 3.3 shows that winter storms are the most frequent weather hazard affecting Ozaukee County, followed by fog, thunderstorm winds, hail storms, non-thunderstorm strong-to-high-winds, and temperature extremes. Flooding is the most damaging weather hazard, followed by tornadoes, hail, and thunderstorm winds. The 1964 tornado accounted for the most injuries caused by a weather hazard in Ozaukee County, with 30 injuries reported. Thunderstorm winds, lightning, and a flood event, each accounted for additional injuries reported. There are no known deaths caused directly by a natural hazard within Ozaukee County. It is important to note that these data only account for deaths directly related to the weather hazard. Numerous deaths caused indirectly by weather hazards also occur, but are not included in these totals. In addition, weather events are often complex and damages may occur from multiple hazards, such as when hail, rain, wind, and tornadoes strike during a single storm.

Table 3.2
Summary of Estimated Disaster Damages and Assistance in Ozaukee County for Selected Federally Declared and Non Declared Disaster Emergencies

Date of Disaster and Event(s)	Estimated Property and Crop Damages (2017 dollars)	Public Assistance[a]	Individual Assistance[b]
1965 – Tornadoes, Severe Storms & Flooding (DR-192)[c]	19,753,500	X	X
1973 – Severe Storms & Flooding (DR-376)[c]	--	X	X
1976 – Severe Storms, Icing, Wind & Flooding (DR-496)[c]	--	X	X
1986 – Severe Storms & Flooding (DR-775)[c]	--	--	X
1991 – Severe Storms & Hail (DR-912)[c]	--	X	--
1997 – Severe Storms & Flooding (DR-1180)[c]	5,525,932	X	X
2001 – Snow (EM-3136)[d]	--	X	--
2004 – Severe Storms & Flooding (DR-1526)[c]	1,156,256	X	X
2008 – Severe Storms, Tornadoes, & Flooding (DR-1768)[c]	1,146,141	X	X
2012 – Drought (S4189)[e]	959,580	N/A	N/A
2013 – Winter Storms, Ice Storms, Snow, Blizzard to Excessive Rain (S3551)[e]	58,367	N/A	N/A
2017 – Winter Freeze (S3305)[e]	4,000	N/A	N/A
Total	28,603,776	--	--

Note: During the production of this plan significant flood events occurred in 2018 and 2019 that are not included in this table. The flooding in 2018 resulted in a Presidential major disaster declaration for the State of Wisconsin, in which Ozaukee County was able to receive Public Assistance for emergency work and repair or replacement of facilities damaged by the severe weather.

[a] *Public assistance includes assistance to local units of government and nonprofit organizations.*

[b] *Individual assistance includes disaster assistance through FEMA programs and disaster loans from the U.S. Small Business Administration to Individuals, households, and businesses.*

[c] *Presidential major disaster declaration.*

[d] *Presidential emergency declaration.*

[e] *Secretarial disaster declarations issued by the U.S. Department of Agriculture. Note that data related to Secretarial disaster declarations was only available going back to 2012.*

Source: National Climatic Data Center, U.S. Department of Agriculture Risk Management Agency, Wisconsin Emergency Management, and SEWRPC

To illustrate the potential frequency of thunderstorms, tornadoes, and flooding events a review was made of the warnings historically issued by the National Weather Service (NWS), as shown in Table 3.4. Over the period 1986 through 2017, there have been 272 thunderstorm-related watches or warnings, 39 tornado-related watches or warnings, and 71 flood related warnings or advisories.

Improved weather forecasting and warning systems, as well as stronger building codes, help explain why tornado mortality has not been as prevalent in the recent past, although tornadoes remain a very serious threat to human life.

Summary and Ranking of Hazards

There are several ways the Ozaukee County hazards can be ranked and summarized to be specifically considered in the County hazard mitigation plan. Current guidance for all hazard mitigation plans promotes comprehensive consideration of all natural hazards. These hazards have been ranked by consideration of their frequency, amount of damage, and death and injuries incurred, as well as by concerns of, and degree of importance assigned by, the collective judgment of the Ozaukee County Hazard Mitigation LPT.

The hazards to be specifically considered in this plan are summarized in Table 3.5, along with qualitative information on the hazard severity. As part of the updating process, the hazards considered in the first plan

Table 3.3
Weather Hazard Events Recorded in Ozaukee County, Wisconsin from 1950 Through 2017 (Sorted by Number of Events)

Event	Number of Events[a]	Deaths[b]	Injuries	Property Damage[c] (2017 dollars)	Crop Damage[c] (2017 dollars)
Winter Storms (1959-2017)	169	0	0	3,515,535	360,371
Fog (1996-2017)	79	0	0	0	0
Thunderstorm Winds (1960-2017)	71	0	6	6,155,282	1,353,525
Hail (1961-2017)	58	0	0	7,898,813	778,452
Strong/High Winds (1964-2017)	56	0	0	2,128,957	52,430
Temperature Extremes (1995-2017)	52	0	0	2,227	74,818
Flood (1996-2017)	24	0	1	26,358,798	12,269,778
Lightning (1968-2017)	23	0	3	2,738,275	8,503
Drought (1976 -2017)	28	0	0	0	5,398,246
Tornado (1964-2017)	5	0	30	20,220,862	357,512
Wild and Forest Fire	0	0	0	0	0
Dust Storm	0	0	0	0	0
Total	565	0	40	69,018,749	20,653,635

[a] *Number of events include events reported to NCDC database as well as events described in NCDC Image and Publications System (IPS). Some events in the IPS are not reported specifically for the County in NOAA's NCDC severe weather database. Reporting of some events in some years was spotty.*

[b] *Deaths that are reported in this table refer only to deaths that are directly caused by the hazard event, indirectly related deaths are not reported in this table. For example, a death caused by a car accident where fog or snow covered roads were contributing factors are considered indirectly related deaths, and are not reported in this table.*

[c] *Dollar values were adjusted to year 2017 by using the average annual Consumer Price Index (CPI) values from the U.S. Department of Labor, Bureau of Labor Statistics.*

Source: National Climatic Data Center (NCDC), National Oceanic and Atmospheric Administration (NOAA), and National Environmental Satellite, Data and Information Service (NESDIS), and the U.S. Department of Agriculture Risk Management Agency

update were reevaluated, giving consideration to data related to the occurrence of hazards since the last plan update and to the perceived risk associated with each hazard as summarized in Table 3.5.[47]

Hazard severity can be assessed and ranked in a variety of ways. The purpose of ranking hazards is to help set priorities and direct more resources to address those hazards of the greatest severity. However, the kinds of mitigation actions that will be needed and warranted depend on the type of vulnerability to be addressed. Some hazards, such as excessive heat and lightning, are unlikely to cause a disaster, but they can be fatal and, therefore, are serious hazards. Vulnerability to such hazards can best be addressed by preventative measures, such as public information to encourage hazard awareness and personal protection. Other hazards, such as flooding, are pervasive and devastating, and may require a variety of tools—mapping, building codes, zoning laws, insurance, elevation or acquisition of floodprone structures, and public awareness—to effectively reduce the risk of disaster. However, flooding might not result in more fatalities than a heat wave. In general, ranking hazards by the number of deaths that they cause shifts the focus away from major disasters, such as floods. Weather hazards that have caused past Ozaukee County disasters are probably the hazards that will cause future disasters. However, the types of natural hazards that result in fatalities remain a public health and safety concern.

[47] *The rankings in Table 3.5 were assigned by combining rankings of the natural hazards listed based upon the number of occurrences, amount of damages, numbers of fatalities and injuries reported since 1950, and the perceived risk associated with each hazard as identified by the Local Planning Team and summarized in Table 3.1. It is important to note that some of the natural hazards listed in Table 3.5 represent combinations of hazards listed in Table 3.1. For example, while specific risks associated with thunderstorms, such as hail and lightning are listed separately in Table 3.1, they are combined into one category in Table 3.5. It should also be noted that prior to 1994, the reports of certain weather hazards in the NCDC database are somewhat incomplete.*

Table 3.4
Ozaukee County Severe Weather History: 1986-2017

Year	Flash Flood Warning	Flood Warning	Severe Thunderstorm		Tornado		Areal Flood Warning[a]	
			Watch	Warning	Watch	Warning	Advisory	Warning
1986	3	0	0	3	0	1	0	0
1987	0	0	0	4	0	1	0	0
1988	0	0	0	2	0	0	0	0
1989	0	0	0	5	0	0	0	0
1990	0	0	0	4	0	0	0	0
1991	0	0	0	3	0	1	0	0
1992	0	0	0	2	0	1	0	0
1993	0	0	0	3	0	0	0	0
1994	0	0	0	4	0	0	0	0
1995	0	0	0	6	0	0	0	0
1996	1	0	0	7	0	2	0	0
1997	1	0	0	7	0	0	0	0
1998	1	0	0	6	0	0	0	0
1999	2	0	0	5	0	1	0	0
2000	2	0	0	8	0	0	0	0
2001	0	0	0	6	0	1	0	0
2002	0	0	0	5	0	0	0	0
2003	0	0	0	1	0	1	0	0
2004	0	0	0	4	0	1	0	0
2005	0	0	0	8	0	0	0	0
2006	0	0	18	12	2	0	0	0
2007	0	0	6	4	3	1	0	0
2008	7	7	7	16	6	0	3	5
2009	0	3	5	0	1	0	2	0
2010	1	0	4	4	7	1	6	0
2011	0	1	11	8	2	0	3	0
2012	0	0	5	8	0	0	0	0
2013	0	5	5	11	2	0	3	0
2014	1	2	7	10	0	0	4	0
2015	0	1	6	6	1	0	2	0
2016	0	0	9	2	1	0	1	0
2017	0	1	6	9	2	0	3	0
Total	19	20	89	183	27	12	27	5

[a] *Area flood warnings are issued for flooding that develops more gradually, usually from prolonged and persistent moderate to heavy rainfall. Typically results in ponded water in low-lying, flood prone areas, as well as small creeks and streams.*

Source: Iowa State University College of Agriculture- Department of Agronomy, and SEWRPC

Additional Hazards Considered

The hazards listed below were discussed as possible hazard concerns for Ozaukee County but will receive less emphasis in the subsequent sections of the report or are incorporated as sub-elements among existing categories, as summarized in Table 3.5.

Mudslides/Landslides

A landslide is a relatively sudden movement of soil and bedrock downhill in response to gravity. The movement of soil can cause damage to structures by removing the support for the foundation of a building or by falling soil and debris colliding with or covering a structure. Landslides can be triggered by heavy rain, bank or bluff erosion, or other natural causes. In Wisconsin landslides generally are not dramatic. Many of Wisconsin's notable landslides have occurred during major flood events. In Ozaukee County on June 18, 1996, the City of Port Washington experienced a severe flash flood event as a result of 7 inches of rain within 2 hours. This event caused several mudslides within the City and on the bluffs of Lake Michigan. Additionally, there have been instances of bluff slumping and failure along the shore of Lake Michigan within Ozaukee County. Wisconsin Emergency Management has determined that landslide probability is highly site-specific, and cannot be

Table 3.5
Summary of Hazards to be Considered in the Ozaukee County Hazard Mitigation Plan

Hazard	Risk of Occurrence (high, medium, or low)	Damage to Property (high, medium, or low)	Threat to Life Safety (high, medium, or low)	Duration of Impact (long, moderate, or short)	Size of Area Affected (large, medium, or small)
Flooding	High	High	Medium	Moderate	Large
Thunderstorm, High Winds, Hail, Lightning	High	Medium	Medium	Long	Large
Coastal Erosion	Medium	High	Medium	Long	Medium
Winter Storms	Medium	Medium	Medium	Moderate	Large
Tornadoes	Low	High	High	Short	Small
Temperature Extremes	Medium	Low	High	Long	Large
Drought	Medium	Low	Low	Long	Large
Contamination or Loss of Utility Systems	Low	Low	Medium	Moderate	Medium
Fog	Medium	Low	Low	Short	Medium

Source: SEWRPC

accurately characterized on a statewide basis except in a general sense. The U.S. Geological Survey (USGS) and the Wisconsin Geological and Natural History Survey (WGNHS) performed a statewide analyses for landslide susceptibility. Ozaukee County is indicated as being a moderate incidence to landslide susceptibility. This analysis noted that the majority of Ozaukee County's susceptibility to landslides is along its Lake Michigan coast. Coastal erosion and effects of this hazard will be discussed in subsequent sections of this report.

Wildfires

A forest fire is an uncontrolled fire occurring on forest or woodlands outside the limits of incorporated villages or cities. A wildfire is any instance of uncontrolled burning in brush, marshes, grasslands or field lands. The most common of these in Ozaukee County is brush fires, which do occasionally occur. However, these are normally responded to by local fire suppression departments in accordance with established response procedures and no specific mitigation actions are deemed warranted. The causes of these fires include lightning, sparks from trains, human carelessness, or arson. Land use, vegetation, amount of combustible materials present, and weather conditions, such as wind, low humidity, and lack of precipitation, are the chief factors determining the number of fires and acreage burned.

Only about 7,296 acres, or 5 percent, of the land area in Ozaukee County is woodland, as summarized in Chapter 2 of this report. Historical agricultural land use and urbanization has reduced the threat of a large-scale forest or wildfire event. According to the Wisconsin Department of Natural Resources (WDNR), Bureau of Forestry, no forest fires or wildfires over 500 acres have occurred in Ozaukee County in the period from 1976 through 2017. Based on guidance from the National Association of State Foresters, the WDNR, in conjunction with its Federal and tribal partners, developed a Statewide assessment of communities at risk from wildfires. None of the communities in Ozaukee County were determined to be at high or very high risk. Considering the low risk and lack of historic incidents, forest and wildfire hazards will not be addressed in later chapters.

Dust Storms

There have been no dust storm events reported in Ozaukee County from January 1, 1950, through December 31, 2017. Natural hazard events that occurred in the past are likely to reoccur in the future, providing the opportunity to plan for them. A dust storm event in Ozaukee County would be atypical, therefore, mitigation strategies will not be recommended for this hazard in the current plan.

Earthquake

An earthquake is a shaking or sometimes violent trembling of the earth that results from the sudden shifting of rock beneath the earth's crust. This sudden shifting releases energy in the form of seismic waves or wave-like movement of the earth's surface. Earthquakes can strike without warning and may range in intensity from slight tremors to great shocks lasting a few seconds or over five minutes. The actual movement of the ground during earthquakes is seldom the direct cause of injury or death. Casualties may

result from falling objects and debris, and disruption of communications; electrical power supplies; and gas, sewer, and water lines should be expected from severe earthquakes. The severity of an earthquake can be measured by comparing the peak acceleration associated with the horizontal shaking it produces to the normal acceleration a falling object experiences due to the force of gravity. This is usually expressed as a percentage of *g*, the acceleration due to gravity. The level of risk due to earthquake can be expressed as the percentage of *g*, for which there is a 2 percent probability of being exceeded in a 50-year period. Depending on location, sites in Ozaukee County have a 2 percent probability of experiencing earthquakes in a 50-year period in which the peak acceleration associated with horizontal shaking exceeds between 4 percent and 8 percent of *g*.[48] These are low values. While these levels of shaking can be noticeable, they are rarely associated with damage to structures. The earthquake threat to the State and Ozaukee County is considered low, therefore earthquakes will not be considered further in subsequent sections of this Report.

Hazardous Materials Incidents

Hazardous materials are any solid, liquid, or gas that can pose a threat to human health and/or the environment due to being radioactive, flammable, explosive, toxic, corrosive, a biohazard, an oxidizer, an asphyxiant, or capable of causing severe allergic reactions. The health effects associated with exposure to a hazardous material contaminant depends on who is exposed, how long he/she is exposed, and how they became exposed. Individuals also react differently to chemical exposures depending upon their age and health, and on whether a chemical is ingested or inhaled. [49]

A hazardous materials incident is the uncontrolled release of hazardous materials capable of posing a risk to life, health, safety, property, or the environment. A hazardous materials incident is most often a result of accidents at fixed facilities or during transportation.

As stated in Chapter 2 of this report, Wisconsin Emergency Management (WEM) is responsible for implementing the federal Emergency Planning and Community Right-to-Know Act (EPCRA), also known as the Superfund Amendments and Reauthorization Act (SARA Title III) of 1986, at the State and local levels. SARA brings industry, government, and the general public together to address emergency preparedness for accidental chemical releases.

In 2018, there were 33 identified users of extremely hazardous substances (EHS) classified as planning facilities and 92 users classified as reporting facilities in Ozaukee County (shown in Tables 2.19 and 2.20). Reporting facilities include manufacturers, warehouse, and petroleum storage site operators. Planning facilities include a wide range of users of limited amounts of hazardous materials. These uses range from industrial materials to individual farm use materials to large chemical storage facilities.

Transportation of hazardous materials through Ozaukee County occurs every day by highway, rail, and/or cargo shipments. There is one major interstate highway, IH 43, that runs along the eastern portion of the County and transports significant quantities of hazardous materials every day. Rail transportation through Ozaukee County is comprised of the Union Pacific, Canadian National, and Wisconsin and Southern Railroad companies. All rail transportation companies have reported that they do not transport hazardous materials that need to be placarded or reported in and through the County. Hazardous material cargo transported by boat is includes gasoline, alcohol (Fuel), coal, and compressed flammable gasses, and small amounts of crude oil.[50]

Ozaukee County has a trained and certified Level B Hazardous Materials Emergency Response Team as part of the Division of Emergency Management. All members of the team have completed U.S. Environmental Protection Agency 165.15 training and maintain competency in required areas as set forth by SARA Title III, CFR 29, CFR 40, CFR 49, and NFPA 471. The team is on call 24 hours per day to respond to calls within Ozaukee County and from surrounding counties when requested.

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[48] *U.S. Geological Survey,* Preliminary 2018 Update of the U.S National Seismic Hazard Model: Overview of Model, Changes, and Implications*, 2018*.

[49] *Wisconsin Department of Emergency Management and Military Affairs,* State of Wisconsin Hazard Mitigation Plan, *December 2016*.

[50] *Ozaukee County Strategic Plan, 2018*.

In addition to having a certified hazardous response team and a Local Emergency Planning Committee (LEPC) the County also prepares a Strategic Plan. This plan defines the roles, responsibilities, and inter-organizational relationships of governmental and private organizations for a response to a hazardous materials incident, including discharges, releases, accidents, and/or spills. This plan is a part of the Ozaukee County Emergency Comprehensive Management Plan (CEMP).[51]

Because Ozaukee County has few reported hazardous material incident events and specifically focuses on this subject in additional County planning efforts, hazardous materials incidents are not considered further in subsequent sections of this Report.

Cyber Security

Local government uses information technology and computer networks in many of its operations and activities. While there are differences among units of local government in the functions they perform with these technologies, typical functions performed include accounting, distributing and receiving payments, budgeting, planning and engineering, correspondence, record keeping, materials management, mapping, communicating with residents, monitoring and controlling utility systems and other infrastructure, and training staff. Because of the pervasive use of these technologies, the operations of local governments depend upon having information technology systems that are reliable and secure.

The threat of cyberattack is an emerging threat to the security and reliability of local government information systems. A cyberattack on a local government is a disruption of its information system. In information technology systems, computers are connected to one another through networks, including the internet. This places them at risk of cyberattack and the nature of such an attack may vary. In some instances, an attack may be a deliberate effort to gain access to a local government's systems or processes. In other instances, an attack may be the result of a randomly initiated threat, such as a computer virus or an electronic mail phishing attempt. Unlike physical threats that are often readily apparent and prompt immediate action, cyberattacks can be difficult to identify and recover from.

Cyberattacks can take several forms, depending on the motives of the attacker, the technological means available to the attacker, and the weakness of the information system that is attacked. The forms that a cyberattack on a local government could take include:

- Disabling an information system—Disruption of information structures to crash or disable a system or otherwise make it unavailable. Examples of this include denial of service attacks, email bombing, and spamming;

- Information theft—Penetration of a system to steal information or sensitive data. Examples of this include password cracking and packet sniffing;[52]

- Modifying system output—Penetration of a system to embed code, such as Trojan horses[53] or logic bombs,[54] to perform unauthorized functions at a later time;

- Modifying system data—Penetration of a system to alter data stored within the system. Examples of this include defacing of websites and ransomware software, which encrypts files or data to make it inaccessible; and

[51] *Ibid.*

[52] *A packet sniffer is a computer program that can intercept and log traffic that passes over a computer network.*

[53] *A Trojan horse is a program designed to breach the security of a computer system while ostensibly preforming some innocuous function.*

[54] *A logic bomb is a set of instructions secretly incorporated into a program so that if a particular condition is satisfied, they will be carried out, usually with harmful effects.*

- Taking control of a system—Transfer of control of all or part of an information system from the intended operator or user either to an automated function, such as inclusion in a botnet,[55] or an unauthorized user.

There are at least four major means through which a cyberattack could be executed. It should be noted that these means are not mutually exclusive and some attacks could involve two or more of these techniques. The major means an attacker could use to execute a cyberattack include:

- Hacking—Examples of which include gaining unauthorized access to a computer system via the use of stolen user names and passwords, exploitation of backdoors in software, and brute force attacks to discover passwords;

- Malware—Programs such as viruses, worms, and Trojans are installed in a computer system via means such as email links or attachments, websites, software upgrades, or portable data storage media. These malware programs can perform a variety of actions, including inserting backdoors allowing access into the system, disabling security controls, or capturing data and/or sending it to an external site;

- Social engineering—Using email, telephone, internet, or in person presence to gain sensitive information through posing as a trusted individual, solicitation, bribery, or extortion; and

- Physical theft or loss of information technology assets such as computers, storage media and devices, and documents.

A recent analysis of cyberattack incidents involving data breaches found that about 95 percent of the incidents that were reported during the period 2011through 2013 fell into nine broad categories:[56]

1. Point of sale intrusions in which remote attacks are made against retail environments in which purchases are made with credit or debit cards

2. Web application attacks in which the application provides a path for the attack by either exploiting a weakness in the application or using stolen authentication credentials to impersonate a valid user

3. Unapproved use or misuse of organizational information technology resources by authorized users, usually for personal or financial gain

4. Loss or theft of an information asset either through misplacement or malice

5. Unintentional actions which directly compromise the security of an information asset

6. Payment card skimmers implanted on a card reader such as an automatic teller machine that reads data from the card

7. Cyber-espionage

8. Denial of service attacks intended to compromise the availability of a site, system, or network

9. Miscellaneous malware not fitting the previous patterns that is intended to gain control of a system for illicit uses

It is likely that local governments are more vulnerable to some of these types of attacks than others. The 2011 through 2013 national analysis indicated that public sector entities tend to be most affected by unapproved use or misuse of resources by authorized users, loss or theft of information assets, unintentional actions that

[55] *A botnet is a group of computers connected to the internet that have been set up to forward transmissions, such as spam or viruses, to other computers on the internet. Usually, the owners of the affected computers are unaware of the fact that their computers are doing this.*

[56] *Verizon,* 2014 Data Breach Investigations Report, *2015.*

compromise security, denial of service attacks, and miscellaneous malware. In addition, utilities operated by local governments may also be vulnerable to web application attacks. The analysis also noted that public agencies were highly affected by cyber-espionage; however, it did not indicate how much of this activity was directed at units of government other than the Federal government.

Ozaukee County has no reported incidents of major cyber-attacks in which the security and reliability of local government information or communication was affected. Additionally, Ozaukee County addresses cyber security in further detail and incident preparedness in the County's Continuity of Operations Plan. Because of this, cyber security is not considered further in subsequent sections of this Report.

Interruption of 9-1-1 Communication Systems

9-1-1 communication systems are a type of dispatch known as "public safety dispatcher." Public Safety dispatchers (also known as emergency dispatchers, Telecommunications Officers, or 9-1-1 dispatchers) receive calls from individuals who need assistance from firefighters, police officers, or Emergency Medical Services (EMS). Once information is obtained from the caller, the dispatcher will send services necessary to respond to the nature of the call. A dispatcher is also responsible for obtaining pertinent information to relay to field units to help ensure the safety of the first responders. Fast, effective, and efficient response to diverse public safety hazards and threats require coordinated efforts among first responders and real-time mobile communications that allow personnel to assess, track, notify, plan, command, execute, and respond to any man-made and natural incidences, emergencies, and life threatening situations. Recently, there have been several reported 9-1-1 dispatch communication system outages in Wisconsin, as well as 9-1-1 cyber-attacks within the United States.

On August 7, 2018, a damaged fiber-optic line from an excavator caused several south-central Wisconsin counties including, Columbia, Adams, Juneau, and Marquette to lose 9-1-1 phone and internet services for nearly six hours. Columbia County Sheriff's Office sent out a message through their Nixle text messaging application to advise residents that the 9-1-1 lines were not working. Columbia County and three other counties also used social media to alert residents of the incident.

In August 2018, a third party vendor performing a routine process on the 9-1-1 operating system network caused nearly an hour long service failure across Minnesota. The widespread outage lasted about 50 minutes and disrupted emergency lines to first responders in cities, county sheriff's offices, and the Minneapolis-St. Paul International Airport. It also affected services in North Dakota and North Carolina. In response to the system failure, dozens of local public safety agencies immediately posted alternative emergency numbers on social media.[57] On April 24, 2019, a 9-1-1 outage impacted about 100 people in Brown County, Wisconsin.

In June 2016, Henry County, Tennessee experienced one the country's first so-called ransomware attacks on one of its 9-1-1 call centers. The hackers shut down the center's computerized dispatch system and demanded more than $2,000 in bitcoin to turn it back on. The dispatch staff refused to pay the ransom, which meant that they had to track emergency calls by pencil and paper for three days as the system was rebuilt. Nearly two years later, on March 25, 2018, a ransomware attack was aimed at a dispatch center in Baltimore, Maryland.[58] In 2018, over 200 cyber-attacks were reported that impacted local governments and public safety. Locally, on January 15, 2018, the Kewaskum Police Department in Washington County, Wisconsin was hacked. The hackers were suspected of stealing much of the police department's data as well as information from the general public.[59]

Most 9-1-1 outages are caused by utility contractors or civilians unknowingly digging in locations of buried communication lines. To avoid this situation, a potential solution could involve installing separate and redundant buried communication lines. Ozaukee County has had no reported 9-1-1 communication incidences involving an outage or security threat. Due to that, 9-1-1 service outages are not considered further in subsequent sections of this Report.

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[57] *Minneapolis Star Tribune, August 2, 2018.*

[58] *Jon Schuppe, U.S. News,* Hackers have taken down dozens of 911 centers. Why is it so hard to stop them? *April 3, 2018*

[59] *www.seculore.com.*

3.2 VULNERABILITY ASSESSMENT ANALYSIS METHODS AND PROCEDURES

In the previous section of this Report the hazards considered applicable to Ozaukee County were identified and ranked. This section of the Report develops a vulnerability assessment for the identified hazards, including vulnerable asset description, hazard event profiling, and estimated loss information. This vulnerability assessment provides the basis for developing mitigation strategies that address the identified hazards.

The procedures utilized in the vulnerability analyses are based upon guidance provided by the Federal Emergency Management Agency (FEMA) and the Wisconsin Department of Military Affairs, Division of Emergency Management (WEM).[60] The analysis includes three components: 1) profile of hazard events, 2) inventory of assets, and 3) estimation of losses. In addition, where applicable, potential changes in vulnerability under future conditions and the variance of vulnerability among the 16 communities within Ozaukee County are analyzed.

In general, the procedures utilized in this analysis focused upon the methodology consistent with the Hazard U.S. (HAZUS) software as maintained by the Federal Emergency Management Agency. In many cases, the mapping of assets and problem areas was done utilizing the detailed mapping and orthophotography available for Ozaukee County in both hard copy and digital form, including general base maps and 2015 large-scale topographic and orthophotographic maps. All the mapping was done utilizing geographic information system (GIS) ArcGIS software.

With regard to the community assets, the basic Ozaukee County inventory data set forth in Chapter 2 includes data and mapping on existing and planned land use, demographics, and economic characteristics of the County; property value by community; flood hazard mapping; Lake Michigan coastal erosion hazard areas; transportation and utility systems; public safety facilities and services; critical community facilities; and historic sites. These data have been used and supplemented with information obtained from the National Oceanic and Atmospheric Administration National Climatic Data Center; the U.S. Department of Agriculture Agricultural Risk Management Agency; WEM; and more hazard-specific local data, such as building-specific structure values, as the basis for the community asset database. The profiling of hazard events was developed by utilizing the HAZUS methodology, data available on the FEMA and National Oceanic and Atmospheric Administration National Climatic web sites; data provided by WEM; data available from the Ozaukee County's Division of Emergency Management, and SEWRPC.

Data for estimated losses and vulnerability were developed utilizing the standard risk assessment methodology set forth in FEMA and WEM guidelines for hazard mitigation planning where hazards can be estimated spatially and by order of magnitude over a range of events. For hazards that cannot be quantified, alternative approaches relying on qualitative measures were used.

A vulnerability description for each of the applicable hazards is listed in Table 3.5.

Assessments of Potential Future Changes in Hazard Conditions Relative to Climate Change

The risk posed to Ozaukee County by many of the natural hazards profiled in this plan have been estimated based largely upon the history of occurrence of, and impacts attributed to, the hazard within the County. For example, the estimates given below for the number of thunderstorms and thunderstorm-related hazards that would be expected to impact the County and the amount of damages to property and crops in the County reflect the average number of occurrences of these storms and the associated damages that were reported over a recent 15-year period. Over the short term, such as the five-year period covered by this plan, estimates of risk and damages derived in this manner should serve as reasonably reliable indicators of the degree of risk associated with various hazards. Over longer periods of time, climate change may render estimates of risk based on historical occurrences and impacts unreliable. Recent assessments have

[60] *Federal Emergency Management Agency,* State and Local Mitigation Planning How-to Guide*, "Understanding Your Risks, Identifying Hazards and Estimating Losses," Publication No. FEMA 386-2, August 2001; Federal Emergency Management Agency,* Local Multi-Hazard Mitigation Planning Guidance*. July 1, 2008; Federal Emergency Management Agency,* Local Mitigation Planning Handbook. *March 1, 2013. See also Federal Emergency Management Agency,* State and Local Plan Interim Criteria under the Disaster Mitigation Act of 2000*, July 11, 2002*.

documented changes in Wisconsin's climate over the late 20th century.[61] Projections of Wisconsin's climate based on downscaled data from 14 global climate models indicate that additional changes will occur through the 21st century.[62] The following subsections describe the changes that have occurred in Wisconsin's climate since 1950 and the changes that are projected to occur by the middle of the 21st century. For those hazards whose frequency of occurrence or impacts are likely to be affected by the changes in climate, these descriptions will form the basis of evaluating potential long-term changes in hazard conditions.

Average annual temperatures in Wisconsin increased over the last half of the 20th century. Between 1950 and 2006, average annual temperature in the State increased by an average of 1.1°F.[63] In Ozaukee County the increase was between 1.0°F and 1.5°F. Much of this increase in average temperature occurred in the form of higher night-time low temperatures. For example, over the period 1950 through 2006, the average number of days in Ozaukee County in which the daily low temperature fell below 0°F decreased by about six days per year. The greatest increase in temperatures occurred during winter and spring months. Depending on location, average winter temperatures in Ozaukee County increased by 2.5-3.0°F over this period.

The consensus from downscaled results of climate models indicate that average annual temperatures will continue to increase through the 21st century.[64] Depending on location, it is projected that average temperatures in the State of Wisconsin will increase by between 4.0°F and 9.0°F over the period 1980 through 2055. This increase is projected to be on the order of 6.0°F to 6.5°F in Ozaukee County. The greatest changes are projected to occur during winter months, with average winter temperatures being estimated to increase by about 7.5°F in Ozaukee County. By contrast, average temperatures in Ozaukee County during the summer are projected to increase by about 5.5°F. Changes in extreme temperatures will accompany these changes in average temperature. The frequency of extreme daily high temperatures is projected to increase. The average number of days per year with daily high temperatures greater than 90°F is currently about 12 in southern Wisconsin. This is likely to double to about 25 days per year by 2055. By contrast, the frequency of extreme daily low temperatures is projected to decrease. The average number of days per year with daily low temperatures below 0°F is currently about 15 in southern Wisconsin. This is estimated to decrease to about nine days per year by 2055.

Average annual precipitation in Wisconsin increased over the last half of the 20th century. Between 1950 and 2006, average annual precipitation in the State increased by an average of about 3.1 inches.[65] It should be noted that there was substantial variability in the change in precipitation across the State, with some areas experiencing increases of up to 7.0 inches and some areas in northern Wisconsin experiencing decreases. In Ozaukee County annual precipitation increased over this period by between 4.0 inches and 7.0 inches, with smaller increases occurring in the northern portion of the County and the largest increases occurring in the southwestern portions of the County. The largest precipitation increases in Ozaukee County occurred during spring months. Depending on the location, these ranged between 1.5 and 3.0 inches. Much of the increase in average precipitation also occurred during autumn months. In Ozaukee County, average precipitation during the autumn increased by between 1.0 and 1.5 inches between 1950 and 2006. Increases in precipitation also occurred in the County during winter months. Throughout the State, the changes in average precipitation during summer months were highly variable. In Ozaukee County, average precipitation during summer months increased between 1950 and 2006. This increase was on the order of 1.0 inch to 2.0 inches. The frequency and magnitude of heavy precipitation events has also been increasing in Wisconsin. Extreme rainfall patterns in the City of Madison illustrate this trend. In the decade between 2001 and 2010, there were 24 days in which 2.0 inches or more of precipitation fell. This is twice the previous maximum of 12 days in the 1950s.

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[61] *For example, Christopher J. Kucharik, Shawn P. Serbin, Steve Vavrus, Edward J. Hopkins, and Melissa M. Motew, "Patterns of Climate Change across Wisconsin from 1950 to 2006,"* Physical Geography, *Volume 31, pages 1-28, 2010.*

[62] *Wisconsin Initiative on Climate Change Impacts,* Wisconsin's Changing Climate: Impacts and Adaptation, *Nelson Institute for Environmental Studies, University of Wisconsin-Madison and Wisconsin Department of Natural Resources, 2011.*

[63] *Kucharik and others, 2010,* op. cit.

[64] *Wisconsin Initiative on Climate Change Impacts, 2011,* op. cit. *Downscaling is an analysis approach that enables climatological data generated by Intergovernmental Panel on Climate Change general circulation models developed at a relatively coarse geographic scale (e.g., climate change data for several large regions in an entire state) to be modified to represent a finer geographic scale (e.g., at the scale of a county or smaller).*

[65] *Kucharik and others, 2010,* op. cit.

The consensus from downscaled results of climate models project several changes in precipitation through the 21st century.[66] Most of the models project an increase in average annual precipitation in southeastern Wisconsin of about 1.5 inches to 2.0 inches. The projections indicate that the amount of precipitation falling during winter is likely to increase by about 25 percent. Due to the projected increase in temperatures, it is estimated that a greater amount of precipitation occurring during the winter will fall as rain rather than snow.[67] This will be accompanied by both an increase in the likelihood of freezing rain events and decreases in snow depth and snow cover. Model projections also show that Wisconsin will receive more precipitation and more frequent intense precipitation events during the spring, especially during early spring. As in winter, it will become more likely for early spring precipitation to fall as rain rather than snow. The total amount of precipitation occurring during the summer is not projected to change much, however the frequency of intense rainfall events will increase. In southern Wisconsin, the frequency of precipitation events in which two or more inches fall in a 24-hour period is expected to increase from about 12 events per decade to 15 events per decade by the middle of the 21st century. These changes will be concentrated in the spring and fall. The projections indicate that the magnitude of the heaviest precipitation events will also increase. The shift to more heavy rainfall events but little change in total summertime precipitation implies that more dry days will occur in Wisconsin during the summer. More dry days, coupled with higher summer temperatures and the increases in evapotranspiration that are likely to result from higher temperatures, will lead to an increase in the likelihood of summer droughts.

3.3 VULNERABILITY ASSESSMENT FOR FLOODING AND ASSOCIATED STORMWATER DRAINAGE PROBLEMS

Floods are natural events that provide many environmental benefits, such as enriching soils and recharging aquifers. Floods are only considered hazards when development occurs in the floodplain, exposing people and/or property to the risk of flood damages. Nationwide, hundreds of flood hazard events occur each year, making it one of the most common hazards in all 50 states and U.S. territories.[68]

Flooding is a significant hazard in Ozaukee County. As described in Chapter 2, there are approximately 155 miles of major streams in Ozaukee County, located within five major watersheds (see Map 2.6): the Milwaukee River watershed, Menomonee River watershed, Sheboygan River watershed, Sauk Creek watershed, and the Lake Michigan Direct Drainage area. Below is a brief description of the major watersheds that make up the County.

Lake Michigan Direct Drainage

The Lake Michigan Direct Drainage watershed in Ozaukee County is located in the far eastern edge of the County immediately adjacent to Lake Michigan. This watershed encompasses about 17,650 acres, or about 11.7 percent of the total land of the County. The main streams within this watershed are Sucker Creek, which originates in Sheboygan County and flows south into Ozaukee County until it enters Lake Michigan north of Port Washington, and Fish Creek in the extreme southeastern corner of the County. The other streams within this watershed are mainly small and intermittent. There is some residential development scattered directly adjacent to the Lake Michigan coast. This watershed is also subject to wave run-up flooding from Lake Michigan. This watershed will also be addressed in the coastal hazards section later in this Chapter.

Menomonee River Watershed

A very small portion of the Menomonee River watershed is located in the southwestern corner of Ozaukee County, totaling 7,442 acres, or 4.9 percent of the County. The headwater streams to the Menomonee River form near Mequon before flowing south into Milwaukee County. Most of the land within the Ozaukee County portion of this watershed is agricultural, however there is scattered urban development as well.

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[66] *Wisconsin Initiative on Climate Change Impacts, 2011,* op. cit.

[67] *Michael Notaro, David J. Lorenz, Daniel Vimont, Stephen Vavrus, Christopher Kucharik, and Kristie Franz, "21st Century Wisconsin Snow Projections Based on an Operational Snow Model Driven by Statistically Downscaled Climate Data,"* International Journal of Climatology, *Volume 31, pages 1615-1633, 2011.*

[68] *Wisconsin Department of Emergency Management and Military Affairs,* State of Wisconsin Hazard Mitigation Plan, *December 2016.*

Milwaukee River Watershed

Covering 96,667 acres, and encompassing 64 percent of Ozaukee County, the Milwaukee River Watershed is the largest watershed within the County. The Milwaukee River Watershed as a whole is made up of several sub-watersheds within Ozaukee County including: the Silver Creek, Cedar Creek, Lower Cedar Creek, Lower Milwaukee River, Middle Milwaukee River, North Branch Milwaukee River, and Upper Milwaukee River sub-watershed. The major streams within the watershed are the Milwaukee River and Cedar Creek. Tributaries to the Milwaukee River extend into Dodge, Fond du Lac, Milwaukee, Ozaukee, Sheboygan, and Washington Counties. Cedar Creek extends into Washington County. This watershed covers much of the developed portions of the County including all, or portions of, Fredonia, Newburg, Saukville, Grafton, Cedarburg, Thiensville, and Mequon. Because of the presence of this urban development, this watershed experiences the greatest impacts from flooding of any of the watersheds in the County. There is also significant agricultural land within the Milwaukee River watershed.

Sheboygan River Watershed

The Sheboygan River watershed covers about 7,322 acres, or about 4.9 percent of Ozaukee County. The watershed is located in the far northcentral and northeastern portion of the County. The portion of the watershed in Ozaukee County contains small headwater streams flowing to the Onion River in Sheboygan County. Land use in this watershed is primarily agricultural. Portions of the Village of Belgium make up the primary urban area of the Ozaukee County portion of this watershed.

Sauk Creek Watershed

The Sauk Creek watershed covers about 12,572 acres, or about 14.3 percent of the County. The watershed is located in the north-northcentral part of the County. The main stream in the watershed is Sauk Creek, which flows south from its headwaters in the western portions of the Town of Fredonia until it enters Lake Michigan in the City of Port Washington. The land use within the watershed is predominantly agricultural, however the downstream portion of Sauk Creek flows through the central urban areas of the City of Port Washington.

Floodplains

Floodplains are the wide, gently sloping areas contiguous to, and usually lying on both sides of a stream, channel or lake. For planning and regulatory purposes, floodplains are normally defined as the areas subject to inundation by the one-percent-annual-probability (100-year recurrence interval) flood event. The "100-year flood," has a one-percent chance of occurring in any given year. The area that is inundated during the 100-year flood is also called the Special Flood Hazard Area (SFHA). The 100-year recurrence interval floodplains shown on Map 2.7 in Chapter 2 of this report have been identified by Ozaukee County, SEWRPC, WDNR, and FEMA. Approximately 19,267 acres, or about 13 percent of the total area of the County, are located within the one-percent-annual-probability flood hazard area. Floodplain mapping, resources about property protection from flood events, an overview of the major watersheds within Ozaukee County, and information about flood insurance and risks are provided through the County's Land and Water Management division website.[69] A GIS-based interactive map is also maintained for the County and allows users to view a variety of spatial based information, including floodplain areas.[70]

Flood Hazards Related to Dam Failure

A consideration in flood hazard mitigation is the potential for increased flooding due to dam failures. As such, an evaluation of floodplain areas related to dam failure should be considered. As indicated in Table 2.12 in Chapter 2 of this report, there are 21 existing dams identified by the WDNR in Ozaukee County. Both dams built according to accepted engineering principles at the time of construction and dams built without application of engineering principles can fail. Although sunny day failures do happen, many of Wisconsin's dam failure incidents have occurred during flood events. When a dam fails, or is subject to overtopping, large quantities of water can rush downstream with great destructive force. In the State of Wisconsin, WDNR inspects and assigns hazard ratings to dams. Hazard ratings are set for all large dams in the state.[71] The hazard rating is not based on the physical attributes, quality or strength of the dam itself, but rather

[69] *www.co.ozaukee.wi.us/386/Flood-Protection.*

[70] *ozaukeeco.ags.ruekert-mielke.com.*

[71] *A dam is classified as a large dam if it has a structural height of over 6 feet and impounds 50 acre-feet or more or has a structural height of 25 feet or more and impounds more than 15 acre-feet.*

the potential for loss of life or property damage should the dam fail. Table 2.12 in Chapter 2 of this report indicates that the 19 of the 21 existing dams in Ozaukee County have been assigned hazard ratings by the WDNR. Two of those dams, the Cedarburg Woolen Mill Dam on Cedar Creek and the Grafton Dam on the Milwaukee River, are currently assigned a significant hazard rating. One dam in the County, the G.E. Harris dam on an unnamed tributary to Mole Creek, is assigned a high hazard rating. The remaining 17 dams have been assigned low hazard ratings.[72] The Hawthorne Drive Creek Dam, a private dam in the Town of Saukville and the A.H. Lau Dam in the Town of Belgium have not been assigned a hazard rating. It should be noted that research has not indicated any loss of life associated with dam failures in Ozaukee County.

Recent Dam Removal Projects in Ozaukee County

Beginning in 2006, the Ozaukee County Planning and Parks Department was awarded Federal, State, local, and private funds to develop, refine, and implement the Ozaukee County Fish Passage Program. The program restores natural stream functions and enhances habitat quality through stream and habitat restoration activities. A major aspect of this program has been the removal of dams that impose barriers to fish migration. Dam removals associated with this program include the Lime Kiln Dam in 2010, the Newburg Dam in 2012, and the Mineral Springs Dam in 2016.[73] Although the removal of these dams was primarily related to stream and habitat restoration, any risk of a flooding event due to dam failure associated with the dams is no longer a threat for the County.

In addition to the dams removed through the fish passage program, four other dams have recently been removed in Ozaukee County. The dam name, the water body that the dam was on, and the year the dam was removed are listed below:

- Wisconsin Lutheran Seminary Dam, Pigeon Creek (removed in 2007)
- The Chair Factory Dam, Milwaukee River (removed in 2001)
- Waubeka Dam, Milwaukee River (removed in 2001)
- Hamilton Mill Dam, Cedar Creek (removed in 1996)

Flood Hazards Related to Ice Jams

Flows that would normally be conveyed within stream and river channels with little problem can become to flood hazards when an ice jam forms downstream. Likewise, ice jams can intensify flooding from streams that are already swollen from large storm events or spring melt. Ice jams occur when chunks of ice clump together to block the flow of a waterway, creating a temporary dam made of ice. The waterway backs up and floods adjacent land—often with swiftly moving water. Ice jams can develop near bends in a river, places where topography flattens, or around bridges. Jams usually occur when there are large temperature swings that cause snow melt to swell a river before the ice has a chance to thaw. The volume and speed of water released from an ice jam can be a highly destructive combination.

On March 20, 2019, the Milwaukee River in Ozaukee County, blocked by ice, crested to record-high levels and caused historic flooding that overwhelmed houses and businesses, swept away trees and damaged parks in northern Ozaukee County's river communities (see Figure 3.1). In Waubeka, 20 homes, businesses, and a fire station were flooded. Flood waters crested at 13.7 feet in the Town of Fredonia, 15.6 feet in Saukville, and 15.3 feet in the Town of Grafton for this event. County Highway W was closed after the river poured over its banks and the occupants in two cars had to be rescued. Fisherman's Park in Newburg sustained an estimated $50,000 (2019 dollars) in damage after ice ripped out the left and right field fences of the baseball diamond, damaged the concession stand, undermined parts of the asphalt driveway, and washed away

[72] *Chapter NR 333, "Dam Design and Construction," of the* Wisconsin Administrative Code *states that 1) a high hazard "rating must be assigned if loss of human life during failure or mis-operation of the dam is probable," 2) a significant hazard rating would be assigned if "failure or mis-operation of the dam would result in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities," and 3) a low hazard rating would be assigned if "failure or mis-operation of the dam would result in no probable loss of life, low economic losses (losses are principally limited to the owner's property), low environmental damages, (and) no significant disruption of lifeline facilities."*

[73] *www.co.ozaukee.wi.us.*

picnic tables and other equipment. In total, due to this ice jam event Ozaukee County sustained damage to an estimated 20 homes and two businesses and $165,000 in damages to public facilities.

Figure 3.1
March 20, 2019, Ice Jam Flooding: Milwaukee River Near Waubeka

Source: Ozaukee County Press (Photos by Sam Arendt)

Flood Hazards Related to Stormwater Drainage Problems

In addition to flooding related to riverine and lake flooding, dam failure, and ice jams—stormwater drainage problems exist on a scattered basis throughout Ozaukee County. The distinction between stormwater drainage, stormwater management, and flood control is not always clear. For the purpose of this report, flood control is defined as the prevention of damage from the overflow of natural streams and watercourses (also known as riverine flooding). Drainage is defined as the control of excess stormwater on the land surface before such water has entered stream channels. The term "stormwater management" encompasses both stormwater drainage and nonpoint source pollution control measures. While the focus of this section of the plan is on the flooding hazard, the related stormwater drainage hazards are also considered because of the interrelationship between these two hazard conditions. Note, coastal flooding hazards are discussed in the "Vulnerability Assessment for Lake Michigan Coastal Hazards" section of this Report.

In order to evaluate various potential flood mitigation alternatives for Ozaukee County and select the most effective and feasible flood mitigation strategies, past and existing flooding problems in the County must first be analyzed. Accordingly, the following section summarizes the extent and severity of the flooding problems within the County and the potential for these problems to increase in the future, and sets forth analyses of such problems. As shown in Table 3.6, from 1996 through 2017, the NCDC database has documented 24 reported flood and flood-related events that have affected Ozaukee County.

Historical Flooding Problems

Humans have settled on the edges of lakes, rivers, and other waterbodies since the earliest civilizations. Native Americans and early European settlers were the first populations to settle and inhabit areas along the major creeks and streams in Ozaukee County, creating the first villages and permanent settlements. As the area's population grew, these permanent settlements along the Milwaukee River (Thiensville, Fredonia, Saukville, and Grafton); Cedar Creek (Cedarburg); and Sauk Creek (Port Washington) began to experience natural periodic riverine overflowing and flooding.

As noted earlier in this chapter, a number of major flooding events, including several that caused significant damage, have been recorded in Ozaukee County. Most of the County's past and present flood problems have been concentrated within the Milwaukee River watershed (primarily flooding near the Milwaukee River and Cedar Creek) and the Sauk Creek watershed.

Table 3.6
Flood Events Within the Ozaukee County Area: 1996-2017

Date	Type	Property Damages (2017 dollars)	Crop Damages (2017 dollars)
February 27, 1996	Flood	--	--
June 17, 1996	Flash Flood	310,880	27,980
June 18, 1996	Flash Flood	1,554,400	27,980
June 18, 1996	Flash Flood	310,880	27,980
June 18, 1996	Flash Flood	8,238,320	27,980
June 18, 1996	Flood	--	27,980
June 18, 1996	Flood	6,062,160	4,663,200
June 21, 1997	Flash Flood	5,502,240	13,459
May 16, 1999	Flood	--	--
May 17, 2000	Flash Flood	106,260	59,171
February 9, 2001	Flood	27,904	--
August 13, 2002	Flood	--	--
August 21, 2002	Flood	--	6,357
November 1, 2003	Heavy Rain	--	--
May 23, 2004	Flood	174,879	151,179
May 23, 2004	Heavy Rain		151,179
June 1, 2004	Flood	3,380,994	6,477,000
April 2, 2007	Heavy Rain	--	--
July 26, 2007	Flash Flood	111,370	3,239
June 12, 2008	Flash Flood	514,245	572,412
July 22, 2010	Flash Flood	22,496	23,917
April 10, 2013	Flood	5,289	8,136
April 14, 2014	Flood	--	303
April 9, 2015	Heavy Rain	36,481	327
	Total	26,358,798	12,269,778

Note: Dollar Values were adjusted to year 2017 by the average annual Consumer Price Index (CPI) values from the U.S. Department of Labor, Bureau of Labor Statistics.

In many instances damages from hazard events go unreported. This table represents estimated losses and should not be considered as an exact documentation of damages and losses incurred from a particular event or time period.

Source: National Climatic Data Center, U.S. Department of Agriculture Risk Management Agency, and SEWRPC

Milwaukee River Watershed

Historical flooding has occurred along both the Milwaukee River (1918, 1924, 1929, 1959, 1960, 1973, 1975, and 1986) and Cedar Creek (1952, 1959, 1960, and 1975) since early European settlement.[74] Floods on both the Milwaukee River and Cedar Creek usually occur during the spring due to snow melt and periods of heavy rain, however floods have also resulted from strong summer thunderstorms or a string of consecutive intense rain events. Listed below are descriptions of several historical Milwaukee River watershed flooding events within Ozaukee County.

- August 6, 1924 – The 1924 flood was one of the largest flooding events for the Milwaukee River. It equaled the peak discharge of 15,100 cubic feet per second (cfs) that occurred in the March 1918 flood event. The 1924 flood was a result of a high-intensity thunderstorm centered approximately over the City of West Bend and was a flood having an approximately 77-year recurrence interval. It was particularly devastating because it washed out dams in the villages of Newburg and Saukville.[75]

- 1973 – The Milwaukee River between Waubedonia Park and Saukville spilled over its banks, rendering several hundred acres of farmland useless for the year. Severe basement damage occurred to many houses along the river. A Presidential Disaster Declaration was granted.

[74] *Federal Emergency Management Agency,* Flood Insurance Study-Ozaukee County, Wisconsin. *Vol. 1 of 2, December 2007.*

[75] *Ibid.*

- March 21, 1975 – This flood was a result of a snowmelt event that was enhanced by a large amount of rainfall. The high-water peak was also influenced heavily by large amounts of ice on the river. Flooding was confined mainly along river banks and basins. The Milwaukee River from Glendale in northern Milwaukee County to Saukville in Ozaukee County experienced flooding with 50 residential homes needing to be evacuated.

- September 10, 1986 – A series of intense rain showers and thunderstorms saturated the ground of Ozaukee County and the surrounding region, causing widespread flooding. The National Weather Service issued a flood warning for the County. The University of Wisconsin-Milwaukee field station recorded a total of 7.13 inches of rain in the Village of Saukville, while the City of Port Washington received 6.86 inches. A peak discharge of 10,180 cfs, which corresponds to a 20-year flood discharge, was reported at a Milwaukee River gage located in the City of Milwaukee. The damage in downtown Saukville was caused by water backing up in public sewers and stormwater drainage systems. Two miles north of the Village of Saukville, railroad tracks were washed out on the bridge over the Milwaukee River causing five cars to derail on the Soo Line. Several thousand dollars of damages were reported, and a Presidential Disaster was declared for the affected area.

- April 20, 1993 – Flash flooding, road closures, and flooded basements occurred. Twenty-five structures in the Village of Thiensville were affected and total damage estimates were approximately $422,700. A home in the Town of Cedarburg sustained $18,599 in damages, and another in the City of Port Washington sustained $1,691 in damages (2017 dollars).

- June 17-20, 1996 – Due to heavy rains, water levels for the Milwaukee River and Cedar Creek exceeded flood stage in the Town of Grafton, Village of Thiensville, and City of Mequon. The National Weather Service issued a river flood warning for Ozaukee County. Total rainfalls for the 3-day period ranged from five inches to over 15 inches. There were many reports of flooded basements, businesses, farmland, and low lands along the rivers, streams, and creeks. Several roads were blocked for extended periods of time in Mequon, Cedarburg, Saukville, and Thiensville. The Milwaukee River on the east side of Cedarburg crested at 12.6 feet, or 1.6 feet above flood stage. A request for Presidential Disaster aid was denied by FEMA.

- June 21, 1997 – Flash flooding occurred in southern Ozaukee County as a result of heavy rainfall in excess of eight inches over a 30-hour period. This flash flooding event was greater than a 100-year-recurrence interval flood. The flooding caused widespread private home and business damages as well as damage to public facilities. The hardest hit areas were the City of Mequon, Village of Thiensville, a small area about two miles southwest of Fredonia, and a location east of Cedarburg. Areas along and near the Milwaukee River experienced moderate to major damage to homes and businesses. Hundreds of residents experienced basement and personal property damage. Many customers lost electrical power, natural gas, and telephone service. The loss of electrical service prevented the use of sump pumps in many homes, which compounded the flooding problems. Many roads and underpasses across southern Ozaukee County were flooded with several feet of water, resulting in road closures. Some drivers had to be rescued after their vehicles were swept away by deep, fast water flows over roads. Rainfall totals for the 30-hour period ranged from 8.50 inches in extreme southern Ozaukee County, 6.25 inches near the Mequon City Hall, 3.09 inches in Cedarburg, 3.08 inches in Waubeka, and 2.26 inches in Port Washington. On July 7, 1997 a Presidential Disaster Declaration was made for Ozaukee County. Federal disaster aid was granted.

Sauk Creek Watershed

- June 17-20, 1996 – Fifteen inches of rain fell in 24 hours causing extensive flash flooding and damage in the City and Town of Port Washington and the Village and Town of Belgium. Water reached three to four feet deep on some roads, while most manhole covers were swept away. Portions of two roads and two bridges in Belgium were washed out. One of the roads was Forest Beach Lane near the Lake Michigan shoreline. Whole sections of some city streets in Port Washington were washed away. A rampaging Sauk Creek severely damaged the Wisconsin Street Bridge. A railroad embankment and a section of the railroad tracks near Grand Avenue was also washed away. Lake Michigan bluffs also sustained severe damage in the form of mudslides that extended down to the water's edge. City officials declared a State of Emergency, however a Presidential Disaster Declaration request was denied by FEMA.

Recent Flood Events: 2002-2017

Between 2002 and 2017, as shown in Table 3.6, there have been 13 flood events reported by the National Climatic Data Center (NCDC) affecting Ozaukee County. Those flood events were reported to have caused property and crop damages totaling, in 2017 dollars, about $11.1 million, of which $6.8 million was related to crop damages. The most severe recent flood events happened in May 2004, June 2004, July 2007, June 2008, July 2010 and April 2015. These flood events, which are significant with regard to the current hazard mitigation planning effort for the County, are described below. It should be noted that on August 27, 2018, there was a significant flood event that occurred in Ozaukee County. However, due to data availability through the NCDC storm events database, this plan has analyzed weather data through December 2017. Because of that, estimated damages for the August 2018 flood were not included in final estimated damages for this report, although a description of the event is provided below.

- The May-June 2004 flood events were caused by a series of weather systems that moved east across the central and southern parts of Wisconsin that generated thunderstorms and heavy rains. This resulted in widespread river, urban, and agricultural flood damage totaling over $347.7 million in Southeastern Wisconsin and over $10 million for Ozaukee County (2017 dollars). Rainfall amounts ranged from seven inches to a maximum of 14.7 inches in Crawford County. In May alone, the water level of Lake Michigan rose 11 inches due to rain and runoff. In June, rainfall totals ranged from five to 12.7 inches in the southern Wisconsin area. Some of the larger rivers rose two to four feet above flood stage.[76] On May 23, the Milwaukee River at Cedarburg rose above its flood stage of 10 feet and crested at 13.19 feet. Damage to roads, public buildings, public utilities, and basements were reported. Plantings of corn, soy bean, and alfalfa crops were either delayed or badly damaged by the two consecutive months of flooding events. The June 2004 flooding was particularly bad, drawing comparisons to the epic floods of 1993 in Wisconsin. A total of 109 houses in Ozaukee County reported basement flooding from the June 2004 event.

- June 2008 – This widespread severe flood and flash flooding event was caused by two rounds of heavy rains. The first round of heavy rains occurred June 5-8, followed by a second round on June 12-13. Collectively, amounts ranged from 6 to over 15 inches of rain for the southeastern Wisconsin area. The Village of Fredonia measured 4.5 to 5 inches of rain within a couple of hours, resulting in flash flooding. On June 13, the Milwaukee River near Cedarburg reached 13.9 feet, setting a new record. There was flash flooding from Belgium to northeast Mequon. Water depths on road surfaces reached 3 feet or more with gravel washouts throughout the County. Several roads and bridges sustained damage. Additionally, 127 homes reported minor damage, while 191 homes had major damage. A total of $4.2 million for all home property losses was reported. Business losses were about $900,000. Crop losses were estimated at $556,000 and public sector damage was about $1.2 million. A Presidential Disaster was declared for Ozaukee County, making property owners and government bodies eligible for both Public and Individual Assistance.

- July 22, 2010 – Parts of south-central and southeast Wisconsin experienced several rounds of record-setting heavy rains that led to flash flooding and numerous reports of damages. The greatest rain amounts fell in Milwaukee County, with Milwaukee Mitchell International Airport recording 5.6 inches. About 32,000 We Energies utility customers lost electrical power throughout southeast Wisconsin due to the flooding and lightning. Extensive property damage was reported for Ozaukee County for this event. Runoff from heavy rains caused a few sewer backups in Mequon and manhole covers in Cedarburg were reported to be blown off due to the overwhelmed storm sewers. Interstate 43 at both Mequon Road and County Line Road was closed due to ponded water on the roads. Mequon and Thiensville officials reported 2.8 inches of rain in less than two hours.

- April 9, 2015 – This event was produced from a warm front that brought numerous thunderstorms and heavy rain to southern Wisconsin. A 100-yard stretch of southbound IH 43 near Port Washington became flooded resulting in two vehicles mostly submerged in standing water (see Figure 3.2). The flooding was under the overpass and a clogged drain significantly contributed to the flooding. Approximately two to three inches of rain had fallen during the overnight period.

[76] *Wisconsin Department of Emergency Management and Military Affairs,* State of Wisconsin Hazard Mitigation Plan, *December 2016*.

- August 27, 2018 – This flood and flash flooding event was a result of multiple rounds of strong to severe thunderstorms that moved across southern Wisconsin. Flash flooding occurred in Washington, Ozaukee, and northern Milwaukee County and was followed by prolonged river flooding (see Figure 3.3). Four to eight inches of rain had fallen over this area over one night. The thunderstorms produced sporadic tree and power line damage across southern Wisconsin. In Ozaukee County, many municipalities experienced severe street flooding and closures, including Port Washington, Cedarburg, Grafton, and Saukville. Several miles of IH 43 from Belgium to Lake Church were also shut down due to flooding. Several piers washed away on the Milwaukee River and dozens of vehicles across the County were stranded in flood waters. The Milwaukee River reached minor flood stage throughout Ozaukee County. Overall, 76 homes sustained flood damage, 11 homes of which experienced major damage. In addition, 25 businesses sustained minor flood damage and five businesses sustained major flood damage. As a result, approximately $866,000 in property damage and about $5,000 in crop damage was reported (2018 dollars). A request for a Federal Disaster Declaration for the affected counties, including Ozaukee, was denied by FEMA. However, funds for low income homeowners and landlords that rent to low income families became available for Ozaukee County residents in January 2019 through the Southern Housing Region Emergency Assistance Program.

Figure 3.2
Interstate Highway 43 Flooding on April 9, 2015: Near Port Washington

Source: Ozaukee County Sheriff's Department

Vulnerability and Community Impacts Assessment

To assess the vulnerability of the Ozaukee County area to flooding hazards and related stormwater drainage problems, the applicable basic inventory asset data described in Chapter 2 were refined and analyzed. For this purpose, consideration was specifically given to potential structure flooding, including critical facilities, and cropland flood damages.

One-percent-annual-probability floodplain areas for Ozaukee County, as well as the sources of hydrologic and hydraulic data for each floodplain area is shown on Map 3.1. These areas are generally located along major stream systems throughout the County. The majority of the floodplains shown on Map 3.1 were developed for FEMA using detailed modeling and GIS techniques to produce the Flood Insurance Rate Maps (FIRMs) (shown in red on Map 3.1). The remaining floodplains shown on Map 3.1 were delineated from more recent flood studies conducted by SEWRPC. These areas, shown in green on Map 3.1, include the Little Menomonee River and Little Menomonee Creek, in the southwestern portion of the County, and Fish Creek in the southeastern portion of the County.

The analyses estimating the damages that would result from a one-percent-annual-probability flood were based on the floodplains that were available at the time the analyses were conducted. It should be noted that several floodplain mapping projects are currently being conducted in Ozaukee County that would refine these floodplains and associated data and could potentially change the damage estimates. These projects are described in further detail in Chapter 5 of this report.

Damage Estimation Method: Parcel-Based Loss Analysis

SEWRPC staff conducted a parcel-based analysis to estimate the damages that would be sustained by buildings as the result of a one-percent-annual-probability flood event. GIS was used to identify those parcels that are wholly or partially located in the one-percent-annual-probability floodplain. The parcels were then examined using both 2015 orthophotography and topography to determine whether a principal building, such as a house, a commercial building, or an industrial building was located within the floodplain. For those parcels in which a principal building was located wholly or partially in the floodplain, the 2018 assessed value of improvements was obtained from the Ozaukee County Assessor's Office through the County's GIS portal. The information in the assessment was used to classify each principal building as residential (including

mobile homes), commercial, agricultural, governmental, parks and recreational, industrial, utility, or other. For each principal building, the elevation of the ground at the building was determined from the 2015 one-foot contour topographic maps.

Standard assumptions were made as to the elevation of the first floors of the principal buildings. For a residential building, it was assumed that the first floor was 1.0 feet above the ground elevation. It was also assumed that a residential building had a basement. For mobile homes it was assumed that the first floor was 2.0 feet above ground elevation. For all other building types, it was assumed that the first floor is 0.5 feet above ground elevation.

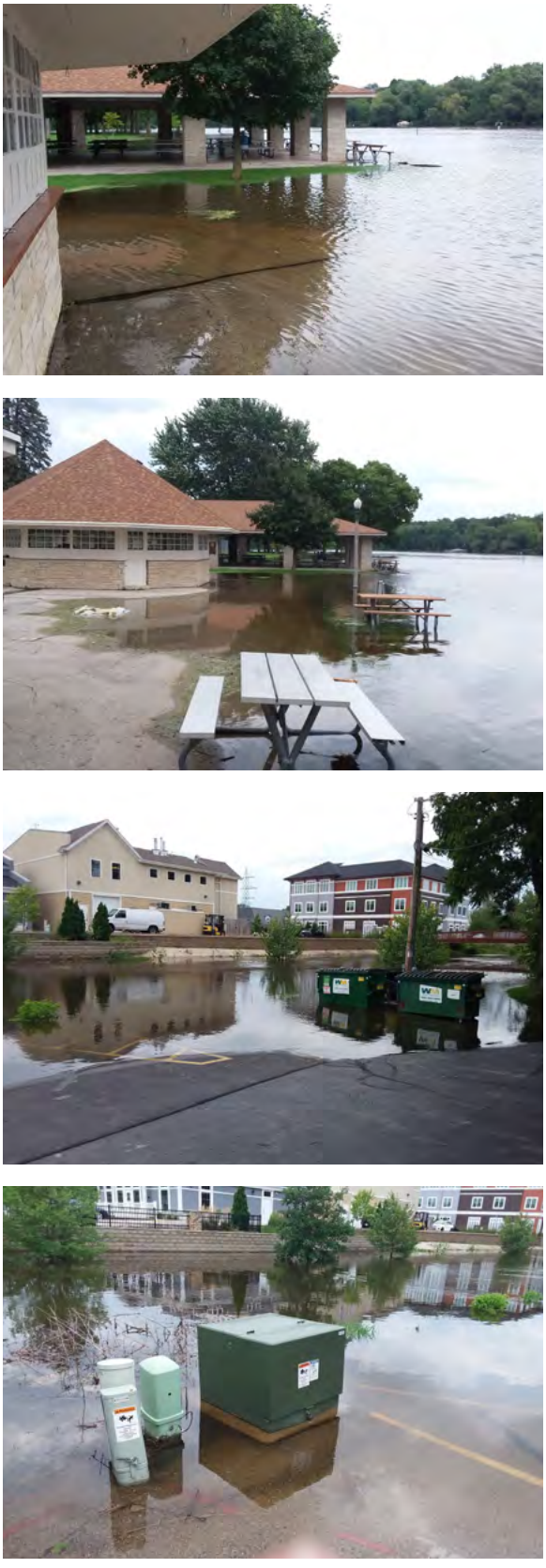
Flood elevations for the one-percent-annual-probability flood event were derived from information in the Flood Insurance Study for the County. For those buildings located in floodplains that were developed using detailed methods (Zone AE on the digital flood insurance rate map (DFIRM)), the flood elevation at the closest upstream cross section on the DFIRM was used as the elevation. Slightly different methodology was used for those buildings located in floodplains that were developed using approximate methods (Zone A on the DFIRM). A transect was drawn at the building through the floodplain perpendicular to the stream. In most cases, the higher contour elevation at the floodplain margin was used to estimate the flood elevation. In cases where the difference between the elevations at the two margins of the floodplain was greater than 10 feet, the average of the contour elevations at the floodplain margins was used to estimate the flood elevation.

For each building, the first-floor elevation and flood elevation were compared. The extent of direct damage—such as the costs associated with cleaning, repairing, or replacing the structure, its contents, the land—for each principal building was estimated as a percent of the value of improvements based on standardized flood loss depth-damage curves prepared by FEMA, U.S. Army Corps of Engineers, and SEWRPC (Table 3.7). Indirect damages—such as the costs associated with temporary evacuations, relocations, lost wages, lost production and sales, and the incremental costs of traffic detours—were estimated to be a percentage of direct damages for residential, commercial and industrial buildings.

Impacts of a One-Percent-Annual-Probability Flood

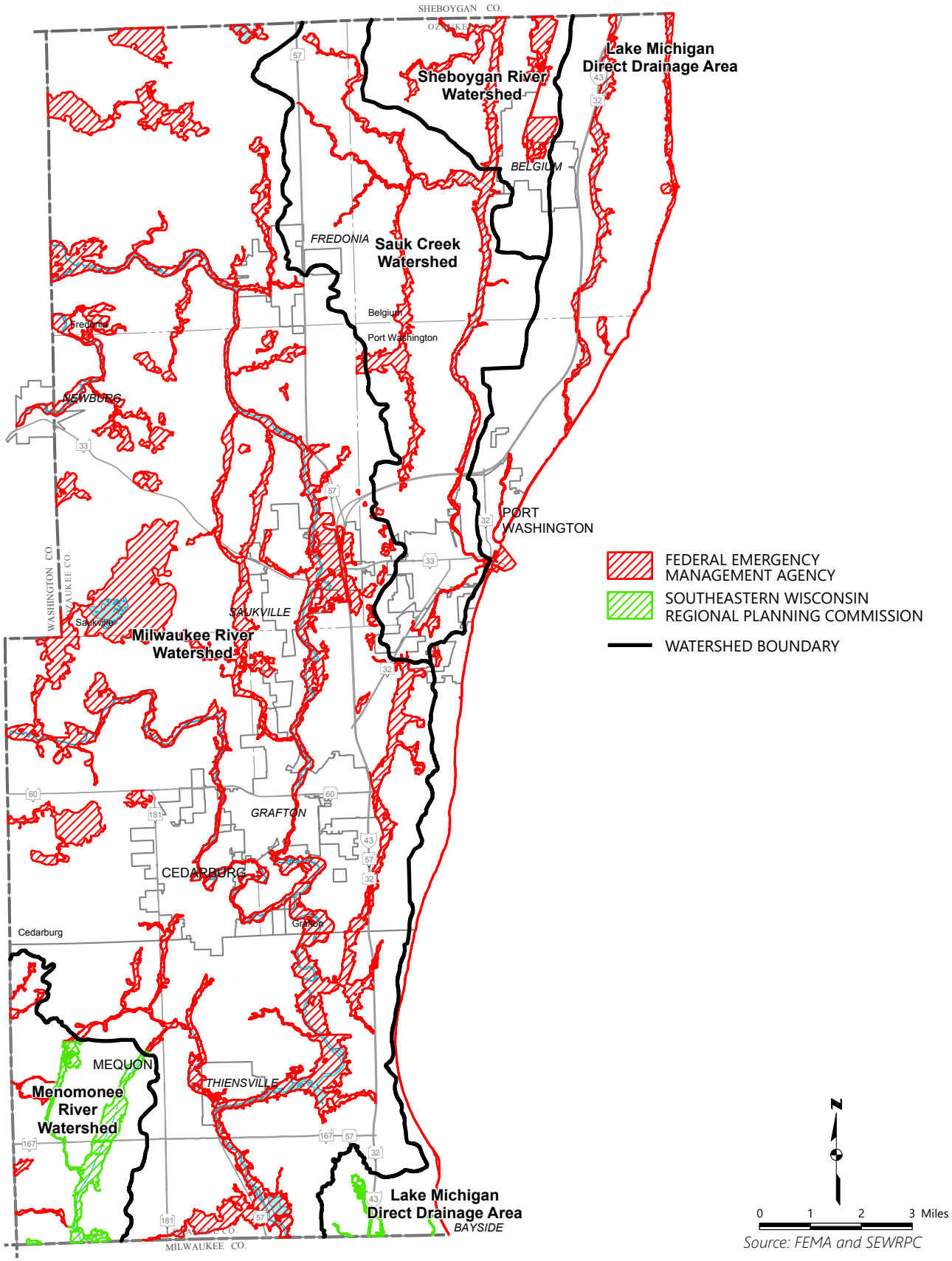
A review of the community assets described in Chapter 2 indicate the potential for flooding impacts to: 1) a variety of floodprone residential, commercial, and other developed land uses; 2) agricultural lands; 3) roadway transportation facilities; 4) seven hazardous material storage sites; and 5) five critical community facilities. No significant impacts are expected to other infrastructure or utility systems.

Figure 3.3
August 28, 2018, Flooding: Milwaukee River in the Village of Thiensville



Source: SEWRPC Staff

Map 3.1
Sources of Flood Hazard Data for the Stream Reaches in Ozaukee County: 2018



Source: FEMA and SEWRPC

Table 3.7
Percentage of Building Damaged Based on First Floor Flood Depth

Depth of Inundation Relative to the First Floor (feet)	Residential Buildings				Commercial Buildings	
	One Story		Two Story			
	Basement	No Basement	Basement	No Basement	Basement	No Basement
-8.0	0.000	--	0.000	--	0.000	--
-7.0	0.050	--	1.425	--	2.000	--
-6.0	1.000	--	2.850	--	4.000	--
-5.0	1.500	--	4.275	--	6.000	--
-4.0	2.040	--	5.700	--	8.500	--
-3.0	3.000	--	7.000	--	10.500	--
-2.0	4.080	--	8.500	--	12.500	--
-1.9	4.440	--	8.600	--	12.700	--
-1.8	4.900	--	8.800	--	12.900	--
-1.7	5.300	--	8.900	--	13.100	--
-1.6	5.600	--	9.000	--	13.300	--
-1.5	6.100	--	9.200	--	13.500	--
-1.4	6.500	--	9.300	--	13.700	--
-1.3	6.900	--	9.500	--	13.900	--
-1.2	7.300	--	9.600	--	14.100	--
-1.1	7.700	--	9.800	--	14.300	--
-1.0	8.110	0.000	9.900	0.000	14.500	0.000
-0.9	8.400	0.800	10.000	0.700	14.700	0.700
-0.8	8.800	1.600	10.200	1.300	14.900	1.400
-0.7	9.300	2.500	10.400	2.000	15.000	2.100
-0.6	9.600	3.300	10.500	2.700	15.300	2.800
-0.5	10.000	4.200	10.700	3.400	15.500	3.500
-0.4	10.400	5.000	10.800	4.000	15.600	4.200
-0.3	10.700	5.900	11.000	4.700	15.800	4.900
-0.2	11.200	6.700	11.100	5.500	16.000	5.600
-0.1	11.500	7.500	11.300	6.100	16.200	6.300
0.0	11.930	8.370	11.400	6.820	16.400	7.000
0.1	12.200	9.100	11.700	7.000	16.700	7.500
0.2	12.500	9.800	12.100	7.300	17.000	8.000
0.3	12.800	10.500	12.400	7.600	17.400	8.600
0.4	13.100	11.200	12.700	7.900	17.700	9.100
0.5	13.400	12.000	13.100	8.100	18.000	9.700
0.6	13.700	12.700	13.400	8.400	18.300	10.200
0.7	14.000	13.500	13.700	8.700	18.600	10.700
0.8	14.300	14.100	14.000	8.900	19.000	11.200
0.9	14.700	14.900	14.400	9.200	19.300	11.800
1.0	14.960	15.650	14.700	9.460	19.600	12.300
1.1	15.500	16.500	15.200	9.800	20.100	12.800
1.2	16.000	17.300	15.600	10.200	20.600	13.400
1.3	16.600	18.200	16.100	10.600	21.100	13.900
1.4	17.100	19.000	16.500	10.900	21.600	14.400
1.5	17.700	19.900	17.000	11.300	22.100	15.000
1.6	18.100	20.700	17.500	11.700	22.600	15.500
1.7	18.700	21.500	17.900	12.000	23.100	16.000
1.8	19.200	22.400	18.400	12.500	23.600	16.500
1.9	19.800	23.200	18.800	12.800	24.100	17.100
2.0	20.350	24.140	19.300	13.220	24.600	17.600
2.1	20.600	24.500	19.800	13.700	25.100	18.100
2.2	20.900	24.800	20.200	14.200	25.600	18.600
2.3	21.100	25.100	20.700	14.600	26.100	19.200
2.4	21.400	25.400	21.100	15.100	26.600	19.700
2.5	21.800	25.700	21.600	15.600	27.200	20.200

Table continued on next page.

Table 3.7 (Continued)

Depth of Inundation Relative to the First Floor (feet)	Residential Buildings				Commercial Buildings	
	One Story		Two Story			
	Basement	No Basement	Basement	No Basement	Basement	No Basement
2.6	22.000	26.100	22.100	16.000	27.700	20.700
2.7	22.300	26.400	22.500	16.500	28.200	21.200
2.8	22.600	26.700	23.000	17.000	28.700	21.800
2.9	22.900	27.000	23.400	17.500	29.200	22.300
3.0	23.160	27.420	23.900	17.920	29.700	22.800
3.1	23.600	27.600	24.400	18.100	30.200	23.300
3.2	24.000	27.800	24.800	18.300	30.700	23.900
3.3	24.500	28.000	25.300	18.500	31.200	24.400
3.4	24.900	28.200	25.700	18.700	31.700	24.900
3.5	25.400	28.400	26.200	18.900	32.200	25.500
3.6	25.800	28.700	26.700	19.100	32.700	26.000
3.7	26.300	28.900	27.100	19.300	33.200	26.500
3.8	26.700	29.000	27.600	19.500	33.700	27.000
3.9	27.200	29.200	28.000	19.800	34.200	27.600
4.0	27.610	29.500	28.500	19.960	34.700	28.100
8.0	48.470	44.680	47.000	30.000	48.000	44.000

Source: Federal Emergency Management Agency, U.S. Army Corps of Engineers, and SEWRPC

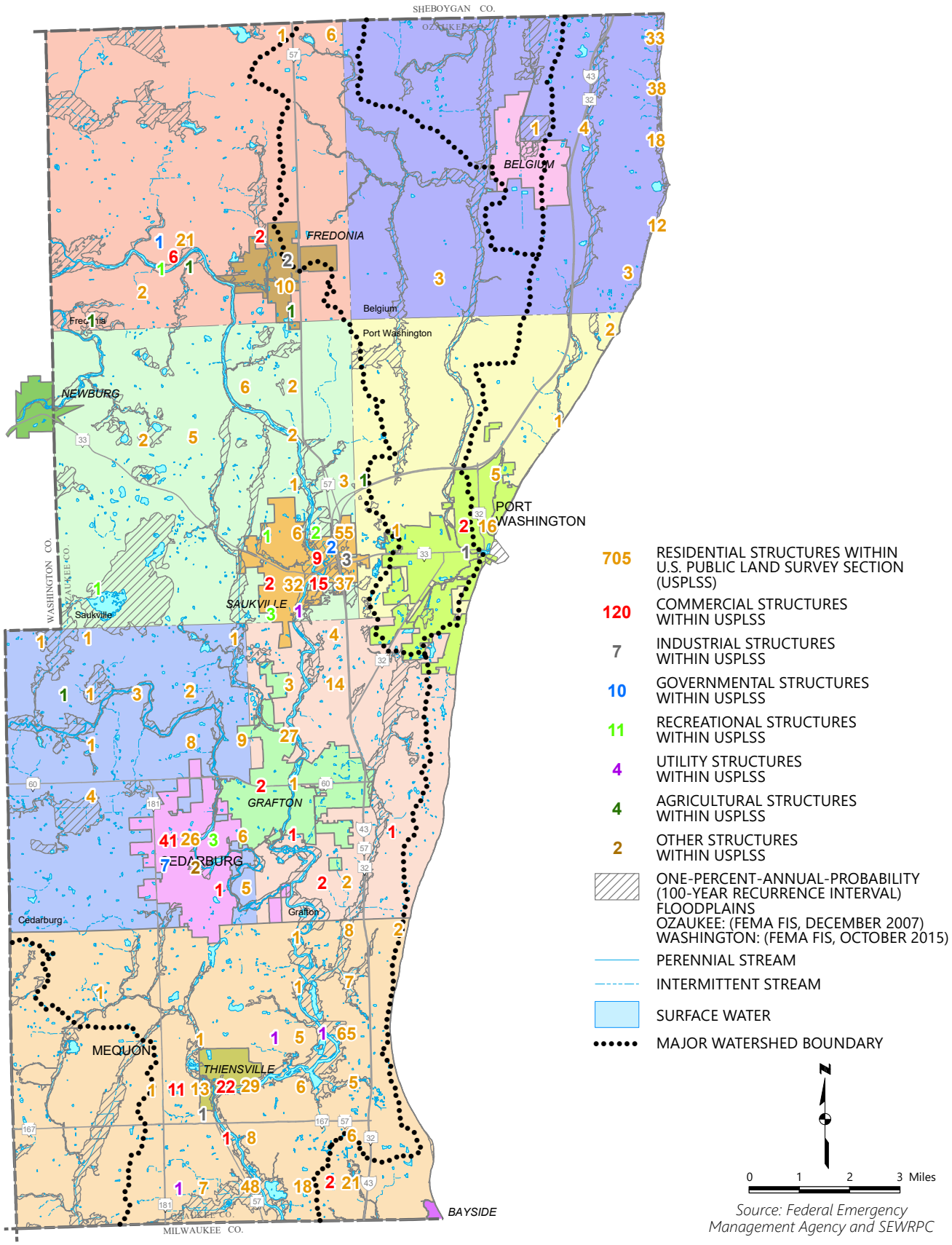
The parcel-based loss analysis refined the property value data available by community in Chapter 2 to reflect specific floodprone structure information. Initial visual review estimated that 1,109 structures were located within the one-percent-annual-probability (100-year recurrence interval) flood hazard areas of Ozaukee County. Of these 1,109 total structures, 246 were either determined to be outside the flood hazard area after the review of the Letter of Map Amendments (LOMA) and Letter of Map Revisions (LOMR) within the County, or determined not to sustain damages during a 100-year recurrence interval flood.[77]. As a result, 863 structures are currently estimated to be located within the 100-year recurrence interval floodplain in Ozaukee County and are expected to sustain damages during such a flood event. The locations of these structures are shown on Maps 3.2 and 3.3. There are 705 residential structures (including six residential recreational vehicle (RV) homes), seven industrial facilities, 120 business and commercial structures, four agricultural buildings, ten government buildings, four community utility buildings, 11 park and recreation buildings, and two churches.

As of February 28, 2019, there were 27 structures that are considered by FEMA to be repetitive- or severe repetitive-loss properties in Ozaukee County. Repetitive-loss structures are those that have two or more flood insurance claims of at least $1,000 each. Severe repetitive-loss properties are those that either have four or more flood insurance claims for damages to building or contents of at least $5,000 each or two or more flood insurance claims for building damages that total more than the existing value of the building. The Wisconsin Division Emergency Management (WEM) has made the acquisition and demolition of repetitive-loss and severe repetitive-loss properties a priority. Acquisition and demolition of such properties are eligible for funding through FEMA's Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation Program (PDM). One repetitive-loss structure was acquired and demolished as part of a PDM project in the Village of Grafton. Listed below are the locations of the 27 repetitive-loss properties within the County along with the numbers of each building type.

- City of Mequon: 14 single-family residential buildings
- Village of Thiensville: 11 buildings (one single-family residential building, 8 "other" residential buildings, one 2-4 family residential building, and one non-residential building)

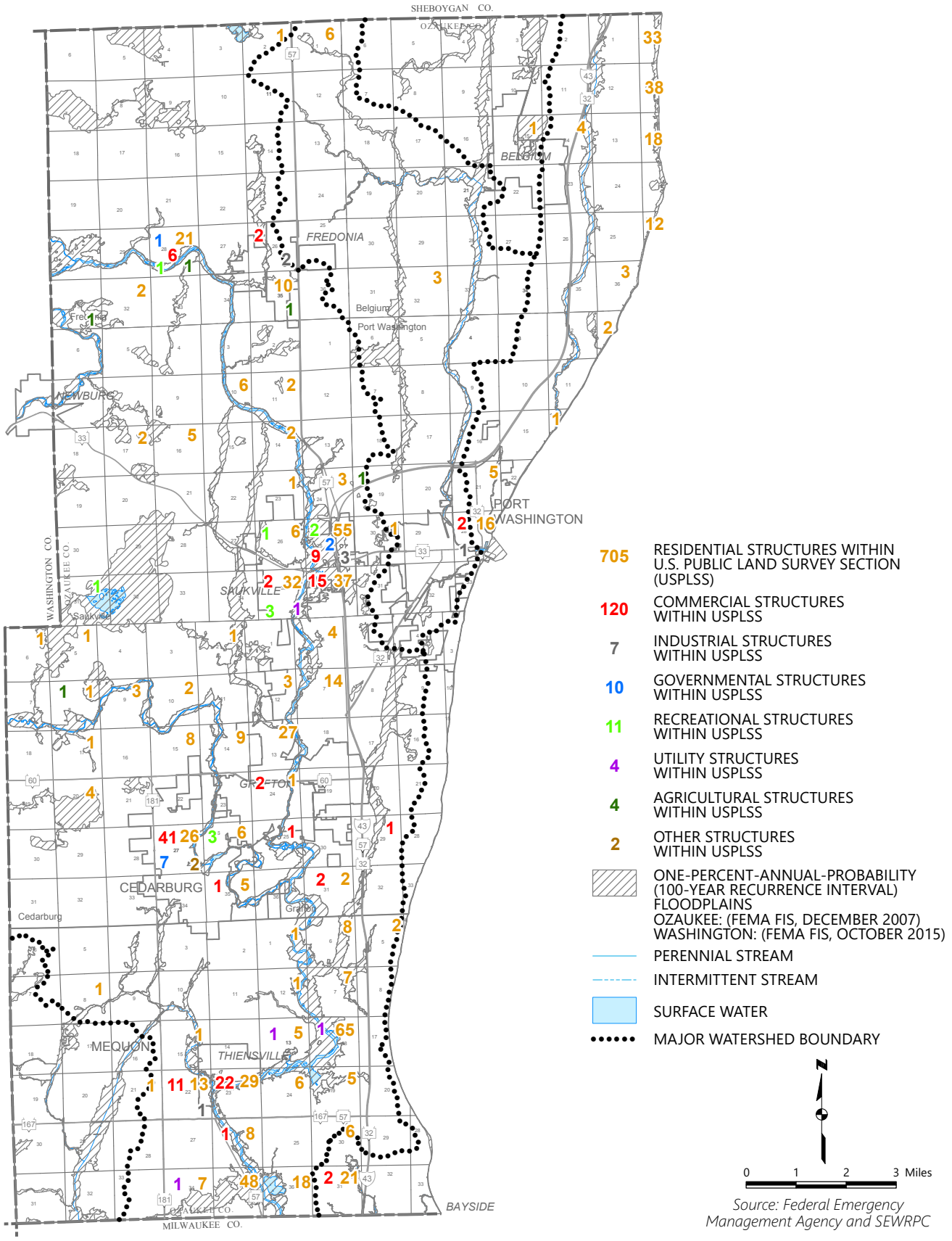
[77] *LOMA (Letter of Map Amendment) is a letter from FEMA that a given structure or parcel of property is not within the Special Flood Hazard Area (SFHA) as shown on the effective Flood Insurance Rate Map (FIRM). Typically a LOMA will remove the Federal requirement for the homeowner to obtain flood insurance coverage for a property located in the SFHA. LOMR (Letter of Map Revision) is a letter from FEMA officially revising the current FIRM to show changes to floodplains, floodways, or flood elevations. Typically these letters are associated with large scale map changes.*

Map 3.2
Number of Structures Within Flood Hazard Areas by Civil Division in Ozaukee County: 2015



Source: Federal Emergency Management Agency and SEWRPC

Map 3.3
Number of Structures Within the Flood Hazard Areas by U.S. Public Land Survey Section in Ozaukee County: 2015



Source: Federal Emergency Management Agency and SEWRPC

- City of Port Washington: One single-family residential building

- Village of Saukville: One single-family residential building

Estimated damages from the parcel-based analysis are shown in Table 3.8 for the one-percent-annual-probability (100-year recurrence interval) flood event. In 2018, the total value of the 863 structures (not including land value) which are identified as being subject to flooding was more than $197 million. The total market value of structures plus contents within these structures are estimated about $249 million. Damages expected during a one-percent-annual-probability flood event affecting the entire County are estimated to be more than $27 million, including direct and indirect damages.

It should be noted that, with few exceptions, all of these structures were identified as being in the floodplain based upon the best available topographic mapping. Field surveys would be required to determine the precise structure relationship to the floodplain. Some buildings may be found to be outside the flood hazard area based upon detailed field survey data.

Maps 3.4 and 3.5 show the location of selected types of critical community facilities in Ozaukee County, including hospitals, nursing homes, clinics, schools, and local government facilities (see Map 3.4), and fire stations, police stations, and Ozaukee County's Sherriff's Department (see Map 3.5) relative to the one-percent-annual-probability floodplain. There are 169 buildings identified as public safety or critical community facilities that are distributed geographically throughout the County. A listing of those facilities can be found in Appendices C and D. Eight of these facilities appear to be located within the flood hazard area and are shown on Map 3.6. These structures include the Cedarburg Public Library and Post Office; the Thiensville Village Hall, Police Department, and Fire Department; the Village of Fredonia Public Works building; a Saukville Elementary School; the Fredonia Town Hall; and the Waubeka Fire Department. It should be noted that other critical community facilities are located in the immediate vicinity of the flood hazard area. Because of the need for access to and from these facilities, this report includes their location and shows the relationship to the flood hazard areas. Considerations should be made regarding access to these facilities during a major flood event.

A review of the location of historic sites and districts in Ozaukee County, as documented in Chapter 2 of this report, indicates that seven of these sites are located within the flood hazard areas. These locations are shown on Map 3.7.

As can be seen by review of Maps 3.4 and 3.5, the floodplain overtops a number of arterial and collector streets in Ozaukee County. This can be problematic by disrupting portions of the transportation system, as occurred during the April 9, 2015 and August 27, 2018 flood events that closed IH 43 in the County. Note, during these situations, emergency and police vehicles need to consider the utilization of alternative transportation routes to provide services. Listed below are additional known locations within the County that regularly experience water that overtops roads during a heavy rain or flood event:

- City of Port Washington:
  - Sunset Road underpass at the Union Pacific rail line

- Village of Fredonia:
  - South Milwaukee Street at Meadowbrook Drive
  - Wisconsin Street at Wenzel Avenue

- Village of Grafton:
  - South Green Bay Road between Vienna Court and Falls Road

- Village of Saukville:
  - County Highway W approximately a quarter mile north of STH 33

An assessment of the extent and severity of flooding conditions within Ozaukee County indicates that there is a significant community impact, in part, as a result of the damages caused by flooding of buildings and due to disruption of the transportation system during extreme flooding events.

Table 3.8
Estimated Flood Damages for a One-Percent Annual Probability Flood in Ozaukee County

Municipality	Number of Structures in Floodplain	Flood Damages[a]		
		Direct ($)	Indirect ($)	Total ($)
Cities				
Cedarburg	84	5,671,300	2,068,570	7,739,870
Mequon	228	5,349,600	858,470	6,208,070
Port Washington	25	640,370	143,150	783,520
Villages				
Bayside[a]	0	0	0	0
Belgium	1	4,610	690	5,300
Fredonia	15	73,890	17,670	91,560
Grafton	25	184,910	46,150	231,060
Newburg[a]	0	0	0	0
Saukville	164	4,450,360	1,160,550	5,610,910
Thiensville	65	1,953,330	549,540	2,502,870
Towns				
Belgium	116	1,477,650	221,660	1,699,310
Cedarburg	39	720,210	114,120	834,330
Fredonia	39	376,640	74,540	451,180
Grafton	32	450,980	78,310	529,290
Port Washington	4	42,260	6,580	48,840
Saukville	26	326,520	49,050	375,570
Total	863	21,722,630	5,389,050	27,111,680

Note: Estimated damages are based on assessed improvement values in 2018.

[a] *Only the portion of the community within Ozaukee County was analyzed for this assessment.*

Source: Wisconsin Department of Natural Resources and SEWRPC

Agricultural Flood Damages

As noted earlier in this chapter, flood damages to agricultural land in Ozaukee County have been significant, with crop damages totaling an estimated $12.2 million over the period of 1996 through 2017. Thus, the average annual reported damages in the County have been approximately $557,700 per year. Because these approximations are only based on reported damages, they are assumed to represent an underestimation of actual flood related agricultural damages. As discussed in Chapter 2 of this report, there were about 3,244 acres of agricultural land located within the identified flood hazard areas in 2015, equaling about 5 percent of the agricultural lands in the County. Thus, during a 100-year flood event, it can be expected that crops in these areas would sustain some level of damage. It should be noted that localized crop damage can also be expected during smaller storm events.

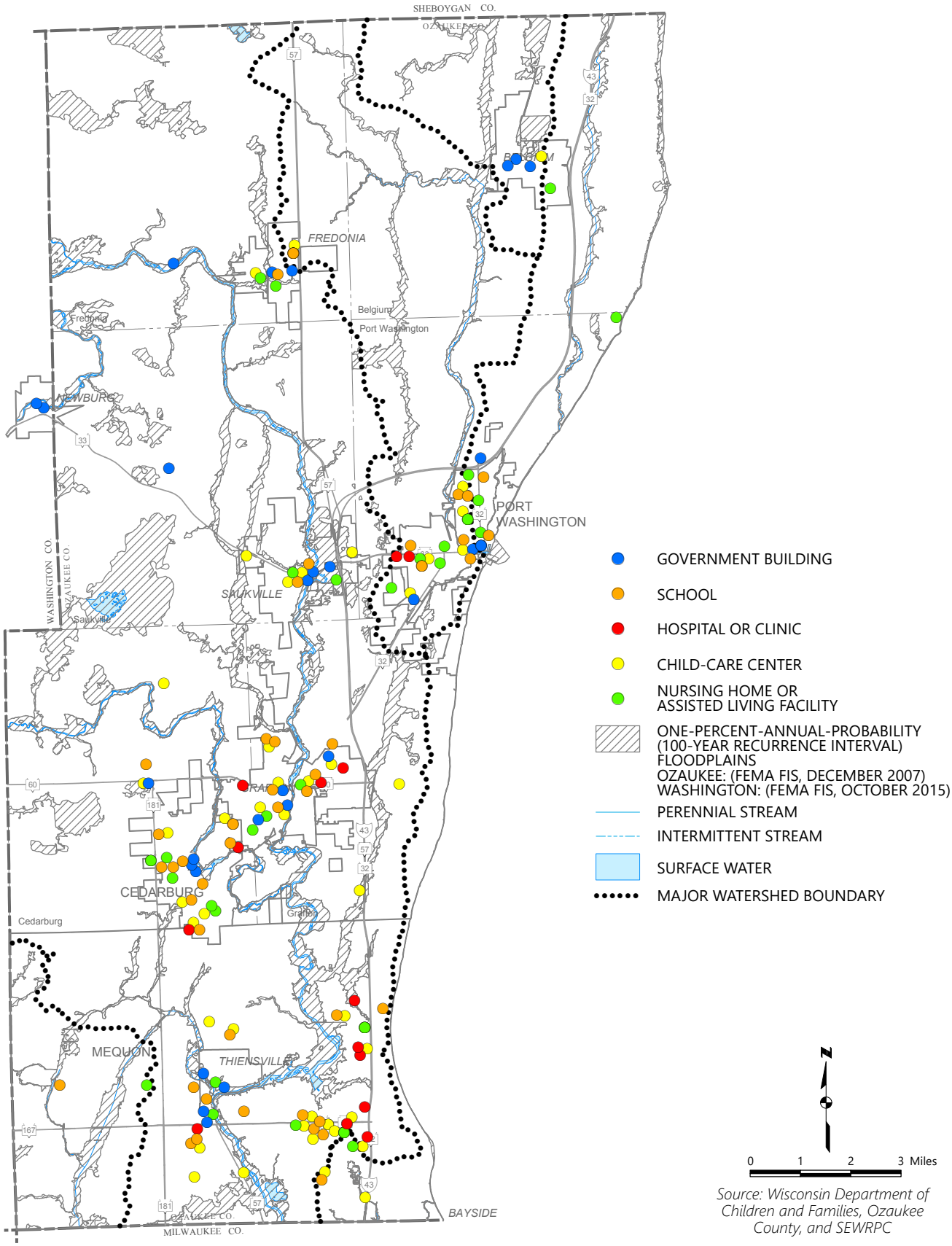
Stormwater Drainage Problems

Because of the interrelationship between stormwater management and floodland management, stormwater management actions are an important consideration of the flood vulnerability assessment. Small area stormwater drainage problems are known to exist throughout the urbanized portions of the County. Most of the communities have undertaken stormwater management planning programs or ordinances. Stormwater management plans are typically required by Ozaukee County and the local municipalities for new developments. This practice should minimize the creation of new stormwater related problems. Stormwater management planning in Ozaukee County is described further in the following chapters, and that planning serves as the basis of the assessment of stormwater drainage problem vulnerability. Such problems largely impact community facilities by causing nuisance conditions and are not generally of concern for community health and welfare.

Probability of Flood Occurrence in Ozaukee County

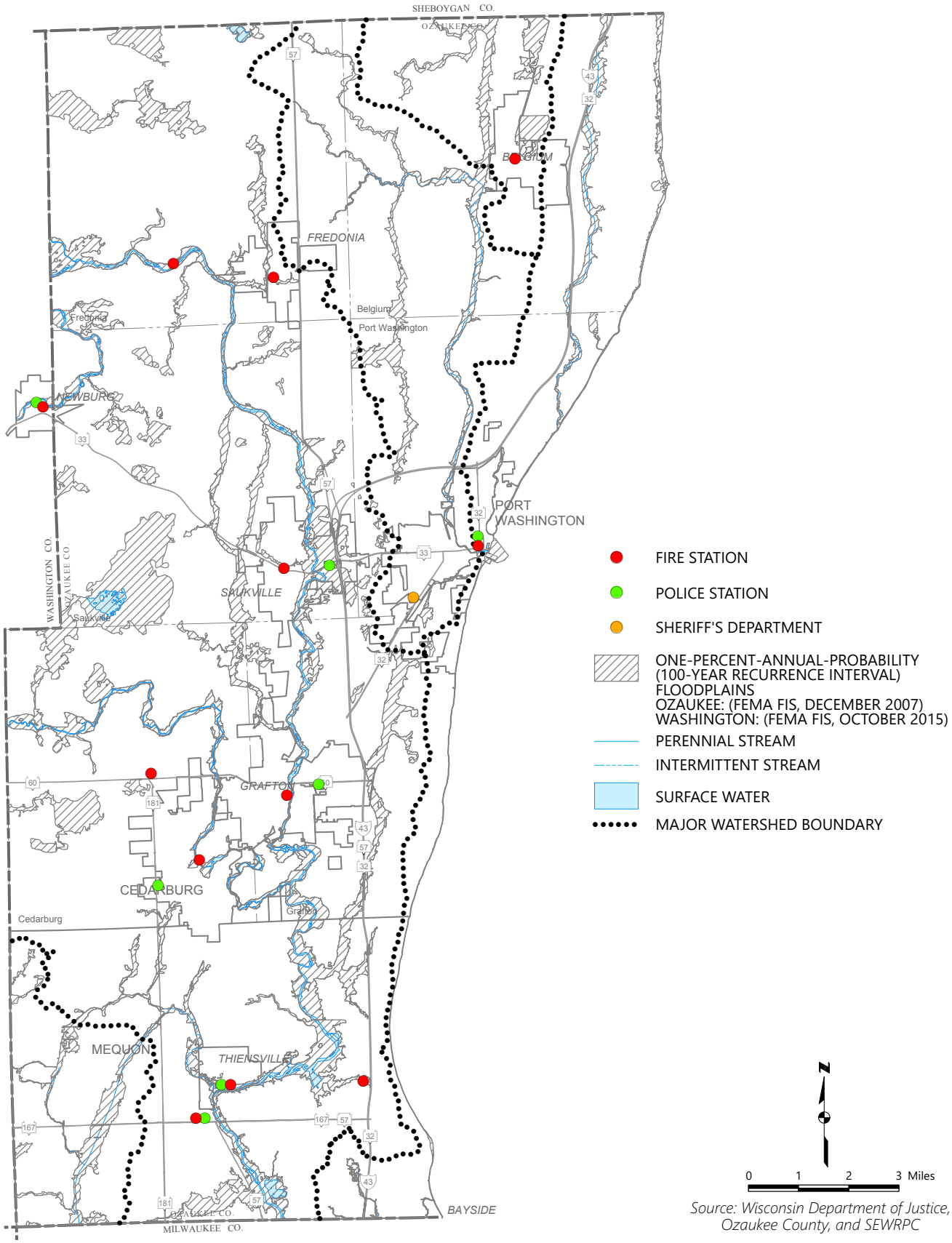
According to the NCDC storm events database there have been 22 flood or flashflood events reported in Ozaukee County over the most recent 22-year period from 1996 through 2017. Based on this record, Ozaukee County can expect to experience an average of just over one flood event per year somewhere in

Map 3.4
Locations of Critical Community Facilities in Relation to Floodplains in Ozaukee County: 2015



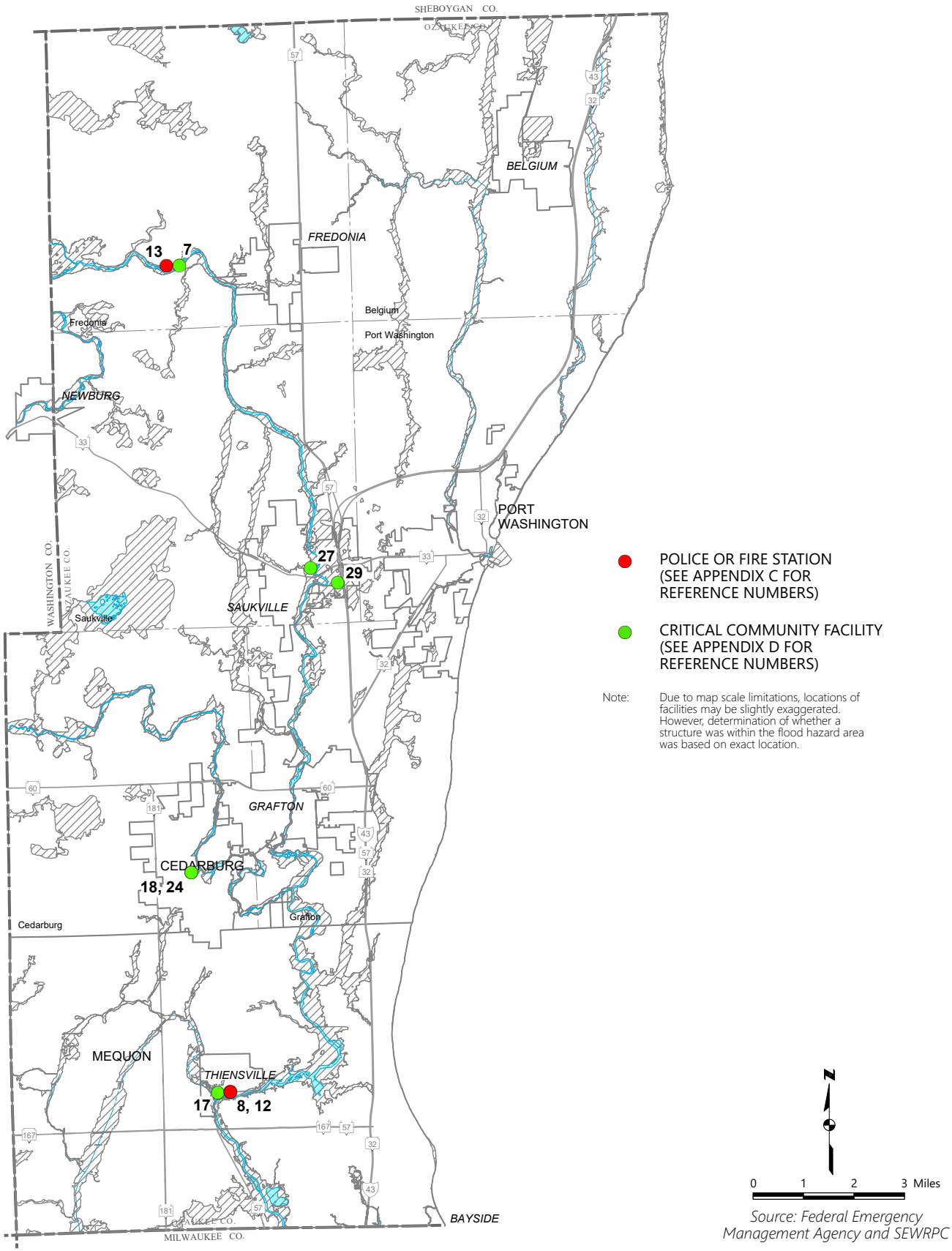
Source: Wisconsin Department of Children and Families, Ozaukee County, and SEWRPC

Map 3.5
Law Enforcement and Fire Station Facilities in Relation to Floodplains in Ozaukee County: 2015



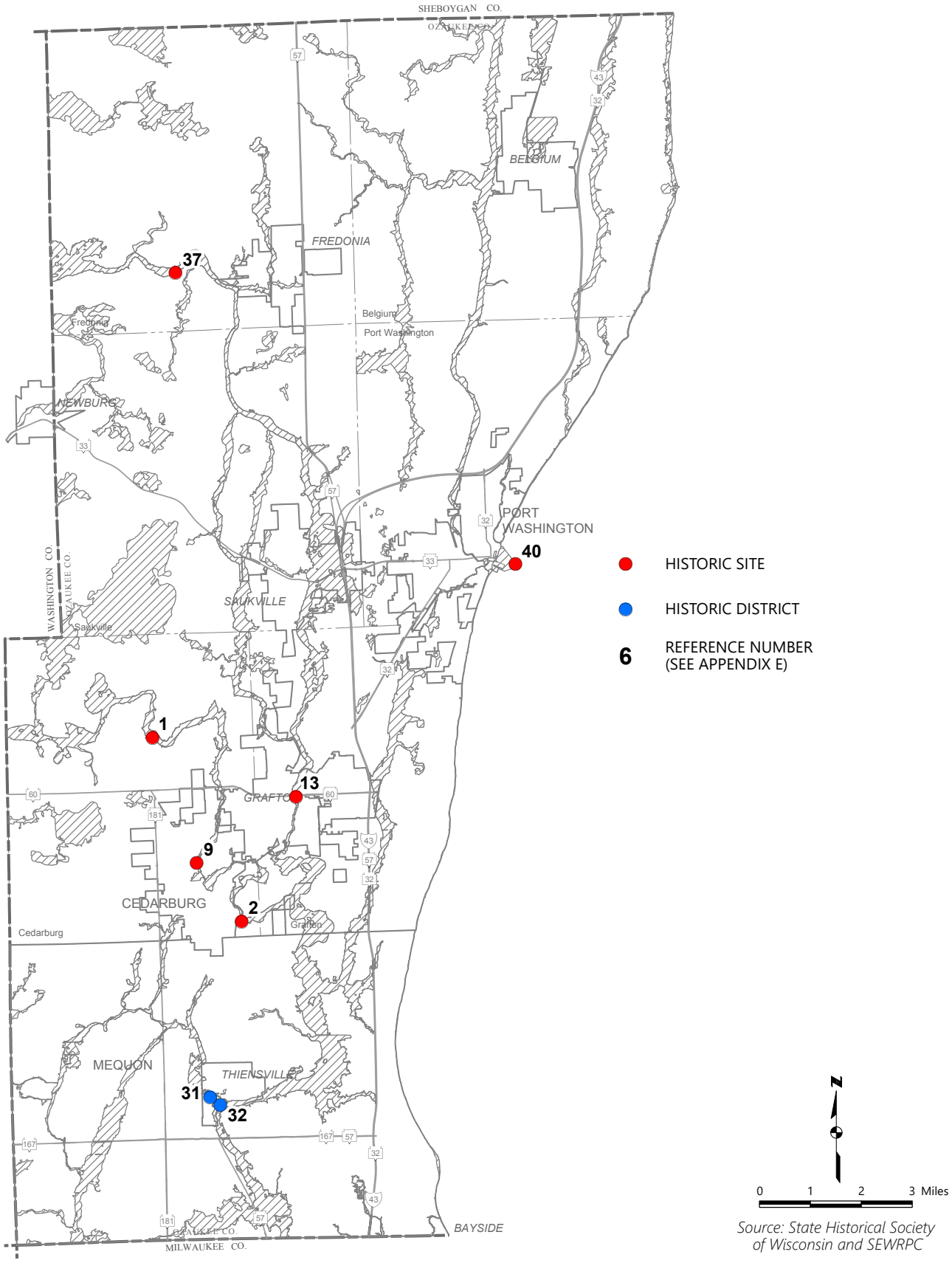
Source: Wisconsin Department of Justice, Ozaukee County, and SEWRPC

Map 3.6
Critical Facility Structures, Police Stations, and Fire Stations Estimated to be Within the 100-Year Floodplain



Source: Federal Emergency Management Agency and SEWRPC

Map 3.7
National and State Registers of Historic Sites and Districts Within the 100-Year Floodplain in Ozaukee County: 2017



Source: State Historical Society of Wisconsin and SEWRPC

the County. While it would be expected that some years the County will experience either fewer or more events than the average number, the average annual number of events is not expected to change over the five-year planning period of this Plan.

Potential Future Changes in Flooding Problems and Floodplain Boundaries

Changes in land use can have a direct impact on flood flows and stages and, accordingly, can impact flooding problems. Projected changes in urban land use during the period of 2010 to 2050 is summarized in Table 2.9 in Chapter 2 of this Report. As indicated in the table, land in urban uses in Ozaukee County is projected to increase by approximately 4,224 acres between 2010 and 2050, a 10.9 percent increase in urban land. It is expected that these changes will result in an increase in the amounts of impervious surface in the County's watersheds. In the absence of mitigative measures, this could lead to increases in future flood flows and stages, especially in downstream areas. As is discussed later in this report, there are a number of programs in place that will tend to mitigate the potential for such increases in flood flows. Nevertheless, it is important that future condition flood flows and stages be considered as mitigative actions are being developed.

Based upon the increase in urban land use, it can be concluded that the extent and severity of flooding problems within the County has the potential to become more severe to a limited extent. This conclusion highlights the importance of implementing current floodplain and related ordinances and existing and ongoing stormwater management plans and regulations, as is discussed in Chapters 4 and 5 of this report.

Changes in climate are likely to affect the potential for flooding in Ozaukee County during the 21st century. As previously described, model projections show Wisconsin receiving more precipitation and more frequent intense precipitation events. By the mid-21st century, Ozaukee County may receive three more precipitation events of two or more inches in 24 hours per decade, roughly a 25 percent increase in the frequency of heavy precipitation events. This is likely to increase the frequency of high flows and high water levels and potentially increase the frequency and severity of flooding. In particular, the expected increases in the magnitude and frequency of large rainfall events will likely increase flood magnitudes in streams and rivers in Wisconsin, although the amount of increase will vary across the County. The amount of precipitation that falls as rain during winter and early spring months is expected to significantly increase with climate change. Winter rain can create stormwater management problems due to icing and runoff over frozen ground which may also lead to increased risk of flooding.

These climate changes may lead to several flood and stormwater related impacts. Increased rainfall and shifting precipitation patterns that favor more rain during periods of low infiltration and evapotranspiration may lead to more frequent and severe stream and river flooding. Increased precipitation during winter and spring may result in increased occurrence of inland lake flooding. Increased cold-weather precipitation and increased variability in frost conditions may cause a rise in water tables in some areas leading to an increase in surface flooding caused by groundwater.

The projected increase in the magnitude and frequency of heavy storms could also affect the performance of existing and planned stormwater management and flood mitigation systems. This increase could also expand flood hazard areas, such as the one-percent-annual-probability flood hazard area, beyond their existing boundaries, potentially encompassing more existing development. Larger floodplains could lead to an increase in the risk of flood damages and a need for larger stormwater management facilities and programs.

The magnitudes of potential increases in flooding are unknown, and there is a complex interrelationship between the climatological factors that will be affected by climate change and the features of watersheds that produce runoff. In some cases, climate change-induced modifications to certain climatological factors may offset the changes in other factors relative to their effects on flood flows. In other cases, the effects will reinforce one another. Thus, it is very important to continue to improve methods for downscaling the global circulation model data, to expand the climatological parameters for which downscaled data can be developed, and to apply hydrologic and hydraulic simulation models to quantify the potential effects on flooding resulting from climate change.

Multi-Jurisdictional Flooding and Stormwater Management Risk Assessment

Flooding and associated stormwater drainage problems have been identified as a significant risk in Ozaukee County. As noted earlier and shown on Map 3.1, flood hazard areas (or floodplains) have been identified within all of the 16 general-purpose local units of government in the County, including the Village of Newburg. In addition, there are related stormwater drainage problems in selected areas of many communities. Based upon the number of structures potentially impacted (see Maps 3. 4 and 3.5), the extent of the agricultural flood damage potential, and the extent of roadway flooding, 14 of the 16 communities within the planning area will require special consideration with regard to the selection of mitigation measures for flooding and related stormwater problems. Those communities are noted in Table 3.9, along with the basis of special consideration over and above the countywide consideration. It is important to note Ozaukee County is part of FEMA's National Flood Insurance Program (NFIP) and Community Rating System (CRS) program, which makes buying flood insurance more affordable for Ozaukee County residents. The CRS program is discussed in more detail later in this report.

3.4 VULNERABILITY ASSESSMENT FOR THUNDERSTORM WIND, NON-THUNDERSTORM HIGH WIND, HAIL, AND LIGHTNING

Thunderstorms

Compared to other natural hazards within the State of Wisconsin, thunderstorms are the most common type of severe weather event and can occur throughout the State during any month of the year. The highest frequency of thunderstorms in southeastern Wisconsin occurs from May through September. A thunderstorm is defined as a severe and violent form of convection produced when warm, moist air is overrun by dry, cool air. As the warm air rises, thunderheads (cumulonimbus clouds) form. These thunderheads produce the strong winds, lightning, thunder, hail, and heavy rain that are associated with these storm events. The thunderheads formed may be a towering mass averaging 15 miles in diameter and reach up to 40,000 to 50,000 feet in height. These storm systems may contain as much as 1.5 million tons of water and enormous amounts of energy. Thunderstorms and their related high winds, lightning, hail hazards, and non-thunderstorm high winds are covered within this section. However, excessive rains that cause flash flooding and tornadoes are covered separately from this hazard analysis (see Vulnerability Assessment for Flooding and Associated Stormwater Drainage Problems and Vulnerability Assessment for Tornadoes).

A thunderstorm often lasts approximately 30 minutes in a given location, because an individual thunderstorm cell frequently moves at an average velocity that ranges between 30 to 50 miles per hour. However, strong frontal systems may produce more than one squall line composed of many individual thunderstorm cells. In Wisconsin, these fronts can often be tracked across the entire State from west to east.[78] Thunderstorms may occur individually, form clusters, or as a portion of a large line of storms. Therefore, it is possible that several thunderstorms may affect one particular area in the course of a few hours, as well as larger areas of the State or County, within a relatively short period of time.

All thunderstorms are potentially dangerous. However, only about 10 percent of the thunderstorms that occur each year nationwide are classified as severe. According to the National Weather Service, a thunderstorm is considered severe if it produces hail sizes at least one-inch in diameter, wind speeds equal to or greater than 58 miles per hour (measured or implied by tree and/or structural damage), or a tornado.[79] A thunderstorm with wind speeds equal to or greater than 40 miles per hour or hail at least 0.5 inch in diameter is defined as approaching severe. Wisconsin averages between 30 and 50 thunderstorm days and between 10 and 30 severe thunderstorm days per year, with more of each occurring toward the southern portion of the State. This number will fluctuate from year to year. Between 1982 and 2010, when thunderstorms in Wisconsin became more severe, weather materialized in the form of damaging high winds 61 percent of the time, large hail 32 percent of the time, and tornadoes seven percent of the time. Severe thunderstorms can cause injury or death and can also result in substantial property and crop damage. They may also lead to power outages, disrupt telephone service, severely affect radio communications, and impact surface and air transportation, all of which could seriously impair the emergency management capabilities of the impacted areas.

[78] *National Weather Service Forecast Office.*

[79] *Prior to 2010, the National Weather Service criteria for a severe thunderstorm was production of hail at least 0.75 inch in diameter, wind speeds equal to or greater than 58 miles per hour, or a tornado.*

Table 3.9
Communities in Ozaukee County with Special Flood and Related Stormwater Drainage Considerations: 2018

Civil Division	Reason for Consideration
Cities	
Cedarburg	84 structures estimated to be in flood hazard area, including the Public Library and Post Office
Mequon	228 structures estimated to be in flood hazard area, including 14 repetitive loss structures
Port Washington	25 structures estimated to be in flood hazard area, including one repetitive loss structure; known roadway flooding problems
Villages	
Belgium	1 structure estimated to be in flood hazard area
Fredonia	15 structures estimated to be in flood hazard area including the Fire Department; known roadway flooding problems
Grafton	25 structures estimated to be in flood hazard area; known roadway flooding problems
Saukville	164 structures estimated to be in flood hazard area, including the Saukville Elementary School and one repetitive loss structure; known roadway flooding problems
Thiensville	65 structures estimated to be in flood hazard area, including the Police Department, the Fire Department, the Village Hall, and 11 repetitive loss structures
Towns	
Belgium	116 structures estimated to be in flood hazard area
Cedarburg	39 structures estimated to be in flood hazard area
Fredonia	39 structures estimated to be in flood hazard area, including the Town Hall and the Waubeka Fire Department
Grafton	32 structures estimated to be in flood hazard area
Port Washington	4 structures estimated to be in flood hazard area
Saukville	26 structures estimated to be in flood hazard area

Source: Ozaukee County and SEWRPC

The National Weather Service monitors severe weather for 20 southern Wisconsin counties, including Ozaukee County, from its Milwaukee/Sullivan office.[80] A thunderstorm watch indicates that conditions are favorable for severe weather, and that persons within the area for which the watches are issued should remain alert for approaching storms. A severe thunderstorm warning indicates that severe weather has been sighted in an area or indicated by weather radar and persons should seek shelter immediately. These severe thunderstorm watch and warning advisories are disseminated over a number of telecommunication channels, including the NOAA Weather Radio, the NOAA Weather Wire, and the State Law Enforcement TIME System. NOAA Weather Radio is available to any individual with a weather alert radio. This system and the other sources are routinely monitored by local media which rebroadcast the weather bulletins over public and private television stations, radio stations, and mobile alert applications on cell phones. In addition, the National Weather Service operates two 24-hour weather radio transmitters that serve all of Ozaukee County. KEC60, operating at a frequency of 162.400 megahertz (MHz), transmits near Delafield in Waukesha County. WWG91, operating at a frequency of 162.525 MHz, transmits from Sheboygan County.

Thunderstorm Winds

High-velocity, straight-line winds that are produced by thunderstorms and widespread non-thunderstorm high winds are the third most destructive natural hazard in Wisconsin and are responsible for most wind-related damages to property.[81] Thunderstorm winds can also be fatal. During the period from 1982 to 2015 in the State of Wisconsin, 17 fatalities and dozens of injuries were attributed to wind from severe thunderstorms.[82] Although distinctly different from tornadoes, straight-line winds produced by thunderstorms can be very powerful, are common, and can cause damage similar to that of a tornado event. During the period of 1982 to 2015, Ozaukee County has experienced seven events with hurricane force winds (74 mph or higher), one event of wind greater than 100 mph, and 58 thunderstorm wind events (winds greater than 58 mph).[83]

[80] *National Weather Service, Milwaukee/Sullivan Weather Forecast Office.*

[81] *Wisconsin Emergency Management Department of Military Affairs,* State of Wisconsin Hazard Mitigation Plan*, July 2001.*

[82] *Ibid.*

[83] *Ibid.*

Depending upon their intensity, thunderstorm winds can uproot trees and crops, down power lines, and damage or destroy buildings and infrastructure. Flying debris can cause serious injury and death to humans, livestock, and wildlife in their path. Boats, mobile homes, and airplanes are also extremely vulnerable to damage from thunderstorm winds.

Non-Thunderstorm High Winds

High winds are also produced in the absence of thunderstorms. Non-thunderstorm high winds tend to be less forceful than thunderstorm winds but are typically more sustained and widespread. These high winds can affect a region for hours, or even several days. Longer lasting windstorms have two main causes: large differences in atmospheric pressure across a region, and strong jet-stream winds overhead. Horizontal pressure differences can accelerate the surface winds substantially as air travels from a region of higher atmospheric pressure to one of lower pressure. Intense winter storms can also cause long-lasting and damaging high winds. Cold fronts associated with intense low-pressure systems can produce high winds both as they pass and for a period afterward as colder air flows overhead. High winds in the winter can produce dangerous wind chills when air temperatures are cold. Severe wind chills are discussed further in the extreme temperature section to follow.

Like thunderstorm winds, non-thunderstorm high winds can uproot trees and crops, cause widespread power outages, damage buildings, and make travel treacherous. Because non-thunderstorm high winds tend to be more sustained and widespread, they tend to lead to more damage over a whole region, as compared to thunderstorm winds.

Hail

Hailstorms are relatively frequent across the United States. From 1986 to 2015, nearly 3,000 individual hail events have been reported annually across the county. Although they can occur in any state in the U.S, the Great Plains (Kansas, Oklahoma, Nebraska, South Dakota, and Texas) experience the highest average number of annual hail days, according to the 2016 Wisconsin Hazard Mitigation Plan. A hailstorm is a product of strong thunderstorms and unique weather conditions where atmospheric water particles form into rounded or irregular masses of ice that fall to earth. Hail normally falls near the center of the moving storm along with the heaviest rain. In some instances, strong winds at high altitudes can blow the hailstones away from the storm center, causing unexpected hazards at places that otherwise might not appear threatened. Hailstones normally range from the size of a pea to the size of a golf ball, but hailstones 1.5 inches or larger in diameter are not uncommon in the State of Wisconsin. Hailstones form when subfreezing temperatures cause water in thunderstorm clouds to accumulate in layers around an icy core. When strong underlying, updraft winds no longer can support their weight, the hailstones fall earthward. Hail tends to fall in swaths that may be 20 to 115 miles long and five to 30 miles wide and can fall continuously or sporadically in a series of hail strikes. Hail strikes are typically about one-half mile wide and five miles long. They may partially overlap, but often leave completely undamaged gaps between them.

Hailstorms are considered formidable among the weather and climatic hazards to property and farm crops, because they dent vehicles and structures, break windows, damage roofs, and batter crops to the point that significant agricultural losses result. Falling hailstones can also cause serious injury and potentially loss of human life and livestock, however these occurrences are rare. In addition to impact damage, thick hail combined with heavy rain can clog storm sewers and contribute to stormwater flooding. Hail sufficiently thick to cover a road will pose a traffic hazard. Hail storms materialize more often during the warmer months, with 85 percent occurring between May and September, although hail has been reported with thunderstorms in every month of the year. During 2003 to 2012, most of Wisconsin's counties experienced an average of two to five severe hail events annually, with a higher average concentration of up to eight events in southeastern Wisconsin.[84]

[84] *Wisconsin Emergency Management Department of Military Affairs,* State of Wisconsin Hazard Mitigation Plan*, July 2001.*

Lightning

Every thunderstorm produces lightning, and lightning has been shown to kill more people within the United States each year than tornadoes.[85] Lightning is defined as a sudden and violent discharge of electricity from within a thunderstorm due to a difference in electrical charges and represents a flow of electrical current from cloud to cloud or cloud to ground. Water and ice particles also affect the distribution of electrical charge. Lightning bolts can travel 20 miles before striking the ground. The air near a lightning bolt can be heated to 50,000 degrees Fahrenheit (°F), which is five times hotter than the surface of the sun. The rapid heating and cooling of the air near the lightning channel causes a shock wave that results in thunder.

Lightning is a significant hazard associated with any thunderstorm and can cause extensive damage to buildings and structures, kill or injure people and livestock, start forest fires and wildfires, and damage electrical and electronic equipment. Lightning is a major cause of damage to farm buildings and equipment, responsible for more than 80 percent of all livestock losses, and is the number one cause of farm fires. In Wisconsin, there were 872 reported damage-causing lightning events between 1982 and 2015. During this period, 26 deaths and 210 injuries from lightning were reported in the State. According to the NCDC storm events database, Ozaukee County reported 21 lightning events during that same time period.[86] These numbers are likely underestimated because few people report suspected lightning deaths, injuries, and damages. From 2000 to 2015, Wisconsin had nearly $55 million in property and crop damages from lightning. Also, from 2007 to 2015, Wisconsin reported six fatalities and 11 injuries caused by lightning.[87] Counties in southern Wisconsin experience a higher number of lightning events than other parts of the State due to higher thunderstorm frequency and more thorough documentation by the local media. Statistics have also shown that 92 percent of lightning-related fatalities occur during May through September, and 73 percent of these events occur during the afternoon and early evening. Approximately 30 percent of persons struck by lightning die and 74 percent of lightning strike survivors have permanent disabilities.

Historical Thunderstorm Wind, Non-Thunderstorm High Wind, Hail, and Lightning Problems

Historically, Ozaukee County averages only about 4 days per year in which thunderstorms inflict wind, hail, or lightning damage. These thunderstorms and related high winds, hail, and lightning hazards can occur throughout Ozaukee County during any month of the year with little warning. However, their highest frequency has been shown to occur during the period of May through September and between the hours of noon and 10:00 p.m.

The gravity of any particular thunderstorm wind, non-thunderstorm high wind, hail, and lightning hazard event is measured in terms of resulting deaths, injuries, and economic losses. Despite their relatively small size when compared with winter storms, thunderstorms and their related hazard events occur frequently and are dangerous. Excluding the 1964 tornado event, thunderstorm related hazard events and high wind events have caused more injuries than any other natural hazards examined in Ozaukee County, as shown in Table 3.3. In addition, these hazard events are the second most costly natural hazards to impact Ozaukee County, following damage associated with floods.

Thunderstorm Wind Events

A total of 71 thunderstorm wind events have been recorded in Ozaukee County during the 58-year period from 1960 through December 2017. These events are shown on Map 3.8, and documented in terms of their magnitude and impact in Table 3.10, based upon data published by the National Climatic Data Center. As shown in Table 3.10, these damaging storms can range from one to six events per year, which demonstrates the high unpredictability of these events. In total, these thunderstorm wind events have resulted in six injuries, over $6.1 million in property damages, and nearly $1.4 million in crop damages within Ozaukee County. Several examples of recent events are described below (all damage amounts are adjusted to 2017 dollars using the consumer price index from the U.S. Bureau of Labor Statistics, unless otherwise noted).

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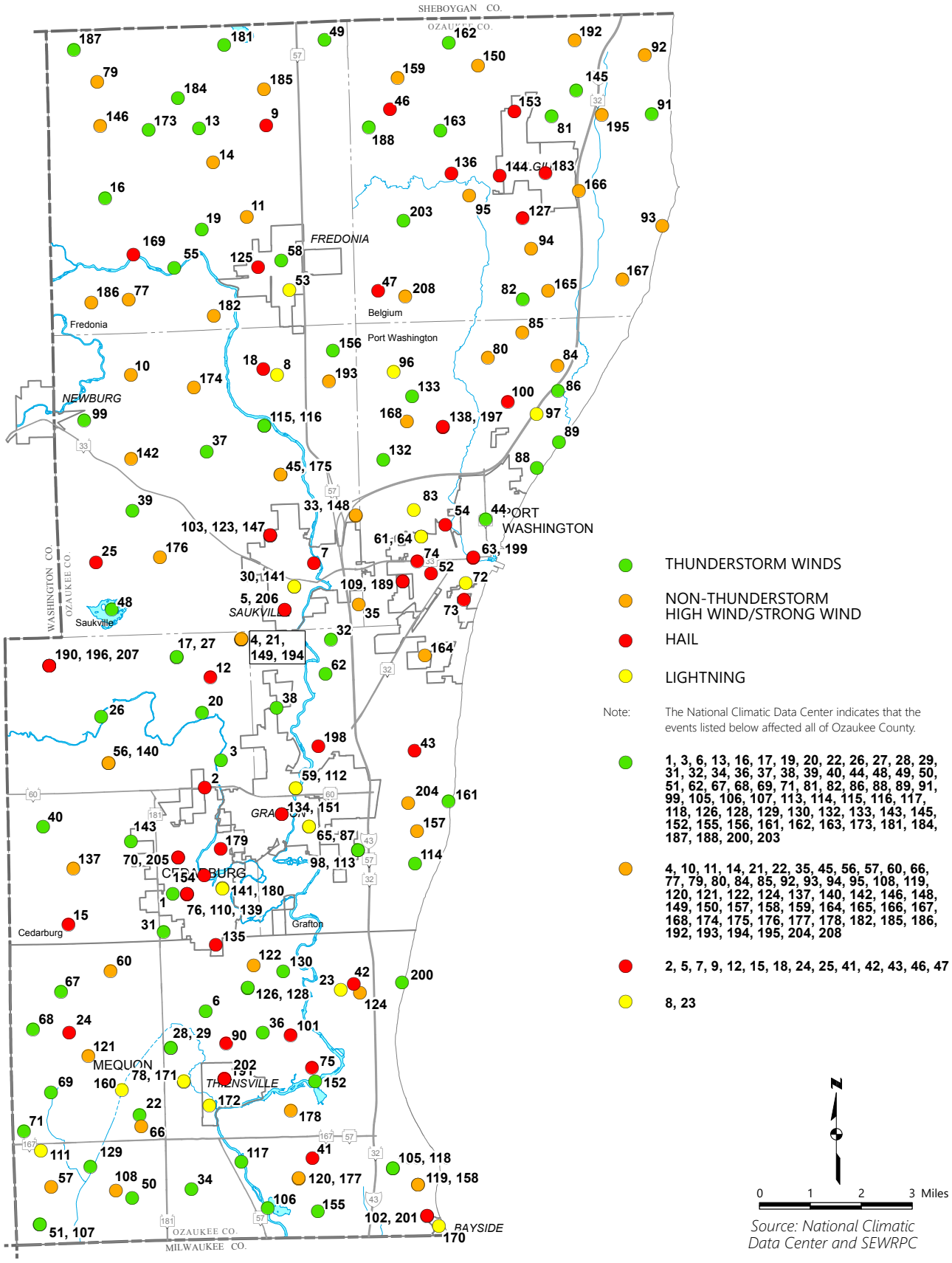
[85] *National Oceanic and Atmospheric Administration.*

[86] *Wisconsin Department of Emergency Management and Military Affairs,* State of Wisconsin Hazard Mitigation Plan, *December 2016.*

[87] *Ibid.*

Map 3.8
Thunderstorm Wind, Non-Thunderstorm High-Wind, Hail, and Lightning Events Reported Within Ozaukee County, July 1960-December 2017



Source: National Climatic Data Center and SEWRPC

Table 3.10
Thunderstorm Wind, Non-Thunderstorm High Winds, Hail and Lightning Events Reported in Ozaukee County From July 1960 Through December 2017

Map Number	Date	Location of Event	Event Type	Magnitude[a]	Reported Damages			
					Deaths	Injuries	Property Damage (2017 dollars)	Crop Damage (2017 dollars)
1	July 22, 1960	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
2	June 22, 1961	Ozaukee County	Hail	0.75 in.	--	--	--	--
3	June 22, 1961	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
4	April 13, 1964	Statewide	Strong Wind	--	--	--	54,871	
5	August 8, 1966	Ozaukee County	Hail	--	--	--	74,931	7,493
6	January 24, 1967	Southern and Eastern Counties	Thunderstorm Wind	--	--	--	363,605	--
7	July 11, 1967	Ozaukee County	Hail	1.0 in.	--	--	--	--
8	August 19, 1968	Ozaukee County	Lightning	--	--	--	34,722	--
9	August 26, 1970	Ozaukee County	Hail	1.75 in.	--	--		--
10	April 9, 1973	Southern Counties	High Wind	--	--	--	1,404	--
11	June 16, 1973	Southern Counties	High Wind	--	--	--	--	--
12	May 16, 1974	Ozaukee County	Hail	0.75 in.	--	--	--	--
13	July 3, 1974	Southern and Eastern Counties	Thunderstorm Wind	60 mph	--	--	--	--
14	January 11, 1975	Statewide	Strong Wind	66 mph	--	--	3,085	--
15	July 19, 1975	Ozaukee County	Hail	1.0 in.	--	--	--	--
16	July 19, 1975	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
17	June 13, 1976	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
18	July 30, 1976	Ozaukee County	Hail	1.0 in.	--	--	--	--
19	July 30, 1976	Southern and Eastern Counties	Thunderstorm Wind	65 mph	--	--	8,472	--
20	July 6, 1977	Ozaukee County	Thunderstorm Wind	--	--	--		--
21	October 7, 1977	Eastern Wisconsin	Strong Wind	--	--	--	595,470	--
22	July 31, 1978	Ozaukee County	Thunderstorm Wind	--	--	--		--
23	September 20, 1978	Ozaukee County	Lightning	--	--	--	291,312	--
24	May 18, 1979	Ozaukee County	Hail	0.75 in.	--	--	--	--
25	May 30, 1980	Ozaukee County	Hail	0.75 in.	--	--	--	--
26	May 30, 1980	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
27	August 4, 1980	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
28	July 12, 1981	Ozaukee County	Thunderstorm Wind	60 mph	--	--	--	10,357
29	August 3, 1982	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
30	July 1, 1983	Saukville	Lightning	--	--	--	48,678	--
31	July 19, 1983	Ozaukee County	Thunderstorm Wind	60 mph	--	--	--	--
32	July 19, 1983	Ozaukee County	Thunderstorm Wind	71 mph	--	--	--	--
33	November 27, 1983	Ozaukee County	High Wind	--	--	--	--	--

Table continued on next page.

Table 3.10 (Continued)

Map Number	Date	Location of Event	Event Type	Magnitude[a]	Reported Damages			
					Deaths	Injuries	Property Damage (2017 dollars)	Crop Damage (2017 dollars)
34	June 6, 1984	Ozaukee County	Thunderstorm Wind	60 mph	--	--	--	4,490
35	March 4, 1985	Ozaukee County	High Wind	--	--	--	451,100	--
36	September 26, 1986	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
37	June 29, 1987	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
38	July 29, 1987	Ozaukee County	Thunderstorm Wind	60 mph	--	--	--	--
39	August 16, 1987	Ozaukee County	Thunderstorm Wind	60 mph	--	--	--	--
40	June 22, 1988	Ozaukee County	Thunderstorm Wind	60 mph	--	--	--	--
41	May 30, 1989	Ozaukee County	Hail	0.75 in.	--	--	--	7,232
42	July 27, 1989	Ozaukee County	Hail	2.0 in.	--	--	--	455
43	July 27, 1989	Ozaukee County	Hail	2.5 in.	--	--	--	455
44	August 4, 1989	Ozaukee County	Thunderstorm Wind	--	--	--	--	8,782
45	March 15, 1990	Statewide	High Wind	65 mph	--	--	12,795	--
46	June 14, 1991	Ozaukee County	Hail	2.0 in.	--	--	--	--
47	July 1, 1991	Ozaukee County	Hail	1.75 in.	--	--	--	--
48	July 1, 1991	Ozaukee County	Thunderstorm Wind	71 mph	--	--	--	--
49	July 7, 1991	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
50	June 17, 1992	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
51	June 17, 1992	Ozaukee County	Thunderstorm Wind	--	--	--	--	--
52	April 18, 1995	Port Washington	Hail	0.88 in.	--	--	--	--
53	October 19, 1995	Fredonia	Lightning	--	--	--	85,118	8,030
54	July 18, 1996	Port Washington	Hail	1.75 in.	--	--	--	--
55	July 18, 1996	Waubeka	Thunderstorm Wind	--	--	--	31,088	--
56	April 6, 1997	Ozaukee County	High Wind	60-70 mph	--	--	382,100	--
57	May 5, 1997	Ozaukee County	High Wind	60-70 mph	--	--	1,528	--
58	June 24, 1997	Fredonia	Thunderstorm Wind	--	--	--	1,528	8,704
59	July 13, 1997	Grafton	Lightning	--	--	--	306	--
60	March 8, 1998	Ozaukee County	High Wind	64 mph	--	--	7,521	--
61	May 13, 1998	Port Washington	Lightning	--	--	--	22,562	--
62	May 31, 1998	Countywide	Thunderstorm Wind	90-100 mph	--	4	5,204,186	451,230
63	July 20, 1998	Port Washington	Hail	0.75 in.	--	--	--	--
64	July 20, 1998	Port Washington	Lightning	--	--	--	12,033	--
65	July 20, 1998	Grafton	Lightning	--	--	--	15,041	--
66	November 10, 1998[b]	Ozaukee County	High Wind	65 mph	4	14	376,025	37,603
67	June 6, 1999	Mequon	Thunderstorm Wind	--	--	--	4,394	27,925
68	June 6, 1999	Belgium	Thunderstorm Wind	--	--	--	1,465	27,925
69	June 10, 1999	Fredonia	Thunderstorm Wind	--	--	--	1,465	27,925
70	June 11, 1999	Cedarburg	Hail	0.75 in.	--	--	--	27,925
71	July 23, 1999	Grafton	Thunderstorm Wind	66 mph	--	--	7,324	39,178

Table continued on next page.

Table 3.10 (Continued)

Map Number	Date	Location of Event	Event Type	Magnitude[a]	Reported Damages			
					Deaths	Injuries	Property Damage (2017 dollars)	Crop Damage (2017 dollars)
72	August 10, 1999	Port Washington	Lightning	--	--	--	14,648	--
73	March 8, 2000	Port Washington	Hail	0.75 in.	--	--	--	--
74	March 8, 2000	Port Washington	Hail	1.5 in.	--	--	--	--
75	March 8, 2000	Mequon	Hail	0.75 in.	--	--	--	--
76	May 18, 2000	Cedarburg	Hail	1.5 in.	--	--	14,168	--
77	May 24, 2000	Ozaukee County	Strong Wind	40-55 mph	--	--		--
78	April 5, 2001	Mequon	Lightning	--	--	3	27,904	--
79	April 7, 2001	Ozaukee County	High Wind	58 mph E	--	--	--	--
80	April 11, 2001	Ozaukee County	High Wind	58 mph M	--	--	--	--
81	June 11, 2001	Ozaukee County	Thunderstorm Wind	63 mph E	--	--	104,640	141,045
82	July 22, 2001	Cedarburg	Thunderstorm Wind	60 mph E	--	--	41,856	--
83	August 22, 2001	Port Washington	Lightning	--	--	--	20,928	--
84	September 19, 2001	Ozaukee County	Strong Wind	36-46 mph	--	--	--	--
85	December 5, 2001	Ozaukee County	Strong Wind	45-50 mph	--	--	6,976	--
86	July 8, 2002	Thiensville	Thunderstorm Wind	60 mph E	--	--	--	--
87	August 12, 2002	Grafton	Lightning	--	--	--	20,442	--
88	August 21, 2002	Fredonia	Thunderstorm Wind	60 mph E	--	--	--	6,357
89	September 2, 2002	Grafton	Thunderstorm Wind	60 mph E	--	--	--	--
90	August 1, 2003	Mequon	Hail	1.0 in.	--	--	--	20,064
91	August 1, 2003	Newburg	Thunderstorm Wind	64 mph EG	--	--	--	--
92	November 12, 2003	Ozaukee County	Strong Wind	47 mph MG	--	--	4,013	--
93	March 7, 2004	Ozaukee County	Strong Wind	46 mph EG	--	--	3,886	--
94	March 14, 2004	Ozaukee County	Strong Wind	46 mph EG	--	--	2,591	--
95	April 18, 2004	Ozaukee County	Strong Wind	52 mph MG	--	--	12,954	--
96	May 21, 2004	Port Washington	Lightning	--	--	--	32,385	--
97	May 21, 2004	Port Washington	Lightning	--	--	--	129,540	--
98	May 21, 2004	Cedarburg	Thunderstorm Wind	60 mph MG	--	--	64,770	12,216
99	May 21, 2004	Port Washington	Thunderstorm Wind	75 mph EG	--	--	194,310	12,216
100	May 23, 2004	Port Washington	Hail	1.5 in.	--	--	--	151,179
101	May 23, 2004	Mequon	Hail	1.5 in.	--	--	--	151,179
102	May 23, 2004	Mequon	Hail	0.75 in.	--	--	--	151,179
103	June 23, 2004	Saukville	Hail	0.75 in.	--	--	--	130,646
104	June 23, 2004	Thiensville	Hail	3.0 in.	--	--	64,770	130,646
105	June 23, 2004	Waubeka	Thunderstorm Wind	64 mph EG	--	--	--	130,646
106	June 23, 2004	Thiensville	Thunderstorm Wind	60 mph EG	--	--	--	130,646
107	July 16, 2004	Belgium	Thunderstorm Wind	64 mph EG	--	--	6,477	1,696
108	December 12, 2004	Ozaukee County	Strong Wind	46 mph MG	--	--	1,295	--
109	June 30, 2005	Port Washington	Hail	0.75 in.	--	--	--	--

Table continued on next page.

Table 3.10 (Continued)

Map Number	Date	Location of Event	Event Type	Magnitude[a]	Reported Damages			
					Deaths	Injuries	Property Damage (2017 dollars)	Crop Damage (2017 dollars)
110	July 4, 2005	Cedarburg	Hail	0.75 in.	--	--	--	--
111	July 4, 2005	Mequon	Lightning	--	--	--	626,350	--
112	July 21, 2005	Grafton	Lightning	--	--	--	25,054	--
113	July 21, 2005	Saukville	Thunderstorm Wind	64 mph EG	--	--	--	--
114	September 13, 2005	Mequon	Thunderstorm Wind	64 mph EG	--	--	--	--
115	September 13, 2005	Thiensville	Thunderstorm Wind	64 mph EG	--	--	--	--
116	September 13, 2005	Cedarburg	Thunderstorm Wind	64 mph EG	--	--	--	--
117	September 13, 2005	Port Washington	Thunderstorm Wind	64 mph EG	--	--	--	--
118	September 13, 2005	Waubeka	Thunderstorm Wind	60 mph EG	--	--	--	--
119	November 13, 2005	Ozaukee County	High Wind	60 mph EG	--	--	12,527	--
120	January 24, 2006	Ozaukee County	Strong Wind	45 mph EG	--	--	6,108	--
121	March 13, 2006	Ozaukee County	Strong Wind	48 mph MG	--	--	6,108	--
122	March 31, 2006	Ozaukee County	Strong Wind	45 mph EG	--	--	2,443	--
123	April 13, 2006	Saukville	Hail	1.75 in.	--	--	7,744,944	--
124	May 11, 2006	Ozaukee County	Strong Wind	36 kts. EG	--	--	1,222	--
125	May 17, 2006	Fredonia	Hail	0.75 in.	--	--	--	--
126	June 21, 2006	Mequon	Thunderstorm Wind	60 mph EG	--	--	12,216	4,858
127	July 17, 2006	Belgium	Hail	0.75 in.	--	--	--	--
128	July 30, 2006	Cedarburg	Thunderstorm Wind	64 mph EG	--	--	6,108	5,612
129	August 1, 2006	Saukville	Thunderstorm Wind	58 mph EG	--	--	--	473
130	August 1, 2006	Cedarburg	Thunderstorm Wind	60 mph EG	--	--	--	473
131	August 2, 2006	Cedarburg	Lightning	--	--	--	91,620	473
132	August 2, 2006	Saukville	Thunderstorm Wind	58 mph EG	--	--	18,324	473
133	August 2, 2006	Thiensville	Thunderstorm Wind	58 mph EG	--	--	--	473
134	September 8, 2006	Grafton	Hail	0.75 in.	--	--	--	--
135	September 8, 2006	Cedarburg	Hail	1.0 in.	--	--	--	--
136	October 2, 2006	Belgium	Hail	0.75 in.	--	--	--	--
137	February 22, 2007	Ozaukee County	Strong Wind	52 mph MG	--	--	2,227	--
138	March 21, 2007	Port Washington	Hail	0.75 in.	--	--	--	--
139	March 21, 2007	Cedarburg	Hail	0.75 in.	--	--	--	--
140	April 4, 2007	Ozaukee County	Strong Wind	45 mph EG	--	--	5,569	--
141	May 1, 2007	Saukville	Lightning	--	--	--	83,528	--
142	May 24, 2007	Ozaukee County	Strong Wind	45 mph EG	--	--	2,227	--
143	June 18, 2007	Grafton	Thunderstorm Wind	60 mph EG	--	--	2,227	379
144	July 5, 2007	Belgium	Hail	0.75 in.	--	--	--	--
145	August 22, 2007	Grafton	Thunderstorm Wind	60 mph EG	--	--	33,411	14,235
146	August 27, 2007	Ozaukee County	Strong Wind	45 mph EG	--	--	11,137	2,265
147	September 27, 2007	Saukville	Hail	0.88 in.	--	--	--	--

Table continued on next page.

Table 3.10 (Continued)

Map Number	Date	Location of Event	Event Type	Magnitude[a]	Reported Damages			
					Deaths	Injuries	Property Damage (2017 dollars)	Crop Damage (2017 dollars)
148	November 5, 2007	Ozaukee County	Strong Wind	45 mph EG	--	--	5,569	--
149	December 23, 2007	Ozaukee County	Strong Wind	48 mph MG	--	--	5,569	--
150	April 26, 2008	Ozaukee County	Strong Wind	48 mph MG	--	--	5,564	--
151	May 2, 2008	Grafton	Hail	0.75 in.	--	--	--	--
152	June 28, 2008	Cedarburg	Thunderstorm Wind	66 mph MG	--	--	556	--
153	July 2, 2008	Belgium	Hail	0.75 in.	--	--	--	--
154	July 10, 2008	Cedarburg	Hail	0.75 in.	--	--	--	--
155	July 10, 2008	Saukville	Thunderstorm Wind	58 mph. EG	--	--	--	2,499
156	July 16, 2008	Saukville	Thunderstorm Wind	60 mph EG	--	--	--	--
157	September 27, 2009	Ozaukee County	Strong Wind	49 mph MG	--	--	5,708	--
158	October 6, 2009	Ozaukee County	Strong Wind	56 mph MG	--	--	5,708	--
159	May 5, 2010	Ozaukee County	Strong Wind	45 mph EG	--	--	11,248	--
160	June 23, 2010	Mequon	Lightning	--	--	--	1,124,800	--
161	July 15, 2010	Saukville	Thunderstorm Wind	60 mph EG	--	--	--	23,917
162	August 20, 2010	Port Washington	Thunderstorm Wind	64 mph EG	--	--	--	20,365
163	September 2, 2010	Saukville	Thunderstorm Wind	75 mph EG	--	--	--	78
164	September 24, 2010	Ozaukee County	Strong Wind	45 mph EG	--	--	1,125	--
165	October 26, 2010	Ozaukee County	High Wind	57 mph EG	--	--	22,496	--
166	February 18, 2011	Ozaukee County	Strong Wind	30 mph ES	--	--	2,185	--
167	April 15, 2011	Ozaukee County	Strong Wind	45 mph EG	--	--	3,277	--
168	May 15, 2011	Ozaukee County	Strong Wind	45 mph EG	--	--	5,462	--
169	May 22, 2011	Waubeka	Hail	1.0 in.	--	--		--
170	July 27, 2011	Bayside	Lightning	--	--	--	2,185	--
171	July 27, 2011	Freistadt	Lightning	--	--	--	2,185	--
172	July 27, 2011	Thiensville	Lightning	--	--	--	5,462	--
173	September 3, 2011	Mequon	Thunderstorm Wind	64 mph EG	--	--	--	10,808
174	September 29, 2011	Ozaukee County	Strong Wind	45 mph EG	--	--	2,185	4,823
175	October 19, 2011	Ozaukee County	Strong Wind	45 mph EG	--	--	2,185	7,739
176	November 29, 2011	Ozaukee County	Strong Wind	30 mph MS	--	--	1,092	--
177	January 1, 2012	Ozaukee County	Strong Wind	45 mph EG	--	--	1,074	--
178	March 10, 2012	Ozaukee County	Strong Wind	34 mph ES	--	--	2,147	--
179	May 28, 2012	Cedarburg	Hail	1.25 in.	--	--	--	--
180	May 28, 2012	Cedarburg	Lightning	--	--	--	21,474	--
181	May 28, 2012	Cedarburg	Thunderstorm Wind	64 mph EG	--	--	5,369	--
182	June 18, 2012	Ozaukee County	Strong Wind	45 mph EG	--	--	10,737	--
183	June 22, 2012	Belgium	Hail	1.0 in.	--	--	--	--
184	September 4, 2012	Fredonia	Thunderstorm Wind	57 mph EG	--	--	3,221	--
185	January 19, 2013	Ozaukee County	Strong Wind	46 mph EG	--	--	5,289	--

Table continued on next page.

Table 3.10 (Continued)

Map Number	Date	Location of Event	Event Type	Magnitude[a]	Reported Damages			
					Deaths	Injuries	Property Damage (2017 dollars)	Crop Damage (2017 dollars)
186	April 11, 2013	Ozaukee County	Strong Wind	45 mph EG	--	--	5,289	--
187	June 30, 2014	Grafton	Thunderstorm Wind	63 mph EG	--	--	7,349	113,772
188	June 30, 2014	Thiensville	Thunderstorm Wind	72 mph EG	--	--	10,499	113,772
189	August 2, 2015	Port Washington	Hail	0.75 in.	--	--	--	--
190	August 2, 2015	Five Corners	Hail	1.0 in.	--	--	--	--
191	August 2, 2015	Thiensville	Hail	1.0 in.	--	--	--	--
192	November 12, 2015	Ozaukee County	Strong Wind	49 mph EG	--	--	2,085	--
193	December 23, 2015	Ozaukee County	Strong Wind	49 mph EG	--	--	1,042	--
194	February 19, 2016	Ozaukee County	High Wind	57 mph EG	--	--	30,633	--
195	March 16, 2016	Ozaukee County	High Wind	57 mph EG	--	--	5,106	--
196	April 25, 2016	Five corners	Hail	1.5 in.	--	--	--	--
197	April 25, 2016	Port Washington	Hail	1.75 in.	--	--	--	--
198	April 25, 2016	Bartel	Hail	1.0 in.	--	--	--	--
199	April 25, 2016	Port Washington	Hail	1.0 in.	--	--	--	--
200	May 28, 2016	Freistadt	Thunderstorm Wind	81 mph EG	--	--	20,422	--
201	June 15, 2016	Bayside	Hail	1.5 in.	--	--	--	--
202	June 15, 2016	Mequon	Hail	1.0 in.	--	--	--	--
203	March 7, 2017	Thiensville	Thunderstorm Wind	60 mph MG	--	--	--	--
204	March 8, 2017	Ozaukee County	High Wind	60 mph MG	--	--	15,000	--
205	May 15, 2017	Cedarburg	Hail	1.75 in.	--	--	--	--
206	May 15, 2017	Saukville	Hail	1.75 in.	--	--	--	--
207	August 10, 2017	Five Corners	Hail	0.75 in.	--	--	--	--
208	December 4, 2017	Ozaukee County	Strong Wind	52 mph MG	--	--	4,000	--
				Total	4	21	18,921,329	2,192,910

Note: Dollar Values were adjusted to year 2017 by the average annual Consumer Price Index (CPI) values from the U.S. Department of Labor, Bureau of Labor Statistics.

In some instances prior to 1995 the NCDC assigned one estimated total damage amount to a region or all counties in the State that were affected by a particular hazard event. Those total damages were divided by the number of counties that were listed in the NCDC publication as being affected by that hazard event, and reported in this table as damages incurred by Ozaukee County.

In many instances damages from hazard events go unreported. This table represents estimated losses and should not be considered as an exact documentation of damages and losses incurred from a particular event or time period.

[a] *Wind magnitude can be measured as- Measured Gust: 'MG', Estimated Gust: 'EG', Measured Sustained: 'MS', or Estimated Sustained: 'ES'. Hail magnitude is measured in diameter of hail stone.*

[b] *The four deaths and 14 injuries associated to this event were indirect, hence their exclusion from Table 3.3 data.*

Source: The National Climatic Data Center (NCDC) a part of the Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), and the National Environmental Satellite, Data and Information Services (NESDIS), and the U.S. Department of Agriculture Risk Management Agency

- "The Southern Great Lakes Derecho of 1998". On the early evening hours of Saturday, May 30, tornado-producing supercells developed over eastern South Dakota. These supercells merged and became a squall line that moved east into southern Minnesota. As the squall line moved east toward southcentral and southeast Wisconsin it gathered strength and developed many microbursts and macrobursts events creating a "derecho." All south-central and southeast Wisconsin counties experienced winds above the severe limits of 58 mph. Extremely strong measured wind gusts of 100 to 128 mph were recorded in a band from northeast of Madison to the northern part of the Milwaukee metropolitan area. The strong winds knocked down hundreds of power poles and thousands of trees. About 250,000 customers lost electrical power. Affected utilities companies and some emergency managers stated that this was the most damaging and widespread straight-line thunderstorm wind event to affect southern Wisconsin in 100 years. Over 5,000 homes, businesses, and farm buildings were damaged and about two dozen homes and businesses were destroyed. Total damage estimates for Wisconsin exceeded $90 million (2017 dollars). All parts of Ozaukee County suffered some kind of tree or structural damage. There were three swaths of concentrated damage within the County: Saukville through Port Washington, Little Kohler to Belgium, and Cedarburg to Grafton. Peak measured wind gusts were recorded at 90 to 110 mph. A total of 600 Ozaukee County residences had minor damage, two had major damage, and one was destroyed. Similarly, 134 businesses reported minor damage, and nine reported major damage; 55 farm buildings had minor damage and five reported major damage. In addition, several sailboats were damaged, and a dozen milking cows were killed.

- On May 21, 2004, severe thunderstorms with damaging winds affected portions of south-central and most of southeastern Wisconsin. Some of the stronger wind reports occurred in Washington and Ozaukee County where widespread tree and structural damage resulted. Hundreds of trees fell, with some falling onto the roofs of homes and vehicles from Hartford to Newburg in Washington County. Winds through Washington County were estimated at 90 mph. In Ozaukee County, winds blew over trees, which crushed four vehicles and six homes causing about $194,310 dollars in damage. Trees were also uprooted and deposited on IH 43 near Port Washington. Winds in Ozaukee County were estimated at 75 mph, which is hurricane strength. Other reports of damaging winds were noted across Dane, Rock, Walworth, Racine, and Kenosha counties with mainly scattered areas of tree damage.

- September 13, 2005, a strong cold front pushed into an unusually hot and humid airmass over south-central and southeastern Wisconsin, resulting in severe thunderstorms with damaging straight-line winds. A broken line of severe storms from Marquette County to Dane County tracked east-northeast into Dodge, Fond du Lac, Washington, and Sheboygan counties. This line produced damaging wind gusts from between 58 mph to 71 mph. Tree and power line damage was reported across many areas affected by this line of storms. Another area affected by severe storms stretched from Rock County through Walworth, Waukesha, Milwaukee, and Ozaukee counties as one large supercell developed and tracked northeast along IH 43. Several reports of damaging winds estimated speeds of more than 80 mph. Widespread tree and power line damage was noted from Mukwonago through Brookfield. More sporadic tree and power line damage was reported across northern Milwaukee and southern Ozaukee counties.

- On June 18, 2007, small clusters of storms moved northeast through southeastern Wisconsin ahead of a cold front. Microbursts generated powerful wind gusts of 75 to 100 mph that toppled large trees, damaged power-lines and power-poles, and pushed over vehicles. Localized flash flooding was reported. About 19,400 customers lost electrical service.

Hail Events

From 1961 through 2017, 58 major hailstorms were reported in Ozaukee County that resulted in significant damage (see Map 3.8). In all, the National Climatic Data Center has recorded nearly $7.9 million in property damage and $27,557 in crop damage from these hailstorm events. In addition, nearly $750,895 in crop insurance indemnities have been paid in Ozaukee County between 1961 and 2017 for hail damage, as shown in Table 3.10.

It should be noted that over 97 percent of the property damages discussed above occurred from one extremely damaging hail storm on April 13, 2006 ($7.7 million in 2017 dollars). This event, Wisconsin's most-costly hailstorm, pummeled a large area from Mineral Point (Iowa County) to north of the City of Milwaukee. Three main hailstorms affected southern Wisconsin that day. The first hailstorm contained hail four inches in diameter and caused damage from southern Iowa County to northern Milwaukee County. A second hailstorm developed south of the first storm and left hail damage from northern Lafayette County through central Milwaukee County. This storm produced hailstones up to 1.5 inches in diameter. The third hailstorm developed in southern Dodge County and pushed through southern Washington County into central Ozaukee County. This storm produced one to two-inch diameter hail. Thousands of motor vehicles, residential homes, businesses, and farms sustained hail damage. There were no reports of injuries or deaths. Vehicle damage consisted of dents and broken windows. Roofs, windows, and siding of buildings were also damaged. Many birds were killed on several inland lakes. No crop losses were reported, given that the growing season had not started.

Lightning Events

From 1968 through 2017, 23 lightning events were reported in Ozaukee County that resulted in reported property damage (see Map 3.8). In all, the National Climatic Data Center has reported more than $2.7 million in property damage and three injuries from these lightning events, as shown in Table 3.10. Described below are examples of lightning events that have caused significant property damage within Ozaukee County.

- On May 21, 2004, most of southeast Wisconsin experienced severe thunderstorms, damaging winds, and lightning. Lightning was reported to have lit two buildings on fire in and near Port Washington. Total lightning and fire damage were estimated at $129,540 in Port Washington.

- On July 4, 2005, a severe thunderstorm moved across Ozaukee County and produced lightning and penny-sized hail in Cedarburg. A lightning bolt struck a condominium complex in Mequon resulting in a fire with 20-foot flames causing $626,350 in property damages.

- On June 23, 2010, a lightning strike in the City of Mequon resulted in a fire at a strip mall on North Port Washington Road that destroyed nine businesses causing $1.12 million in property damage. This single event accounts for over 41 percent of all the reported damages caused from lightning between 1968 and 2017.

Non-Thunderstorm High Wind Events

A total of 56 non-thunderstorm high wind events have impacted Ozaukee County from 1960 through 2017, as shown in Table 3.10. The National Climatic Data Center has documented more than $2.1 million in property damages and $52,430 in crop damages from these events. Crop insurance indemnities paid from non-thunderstorm high wind events for the Ozaukee County area during that period is reported at $14,872.

A significant amount of the above-mentioned property damages can be attributed to a few non-thunderstorm high wind events that impacted southeastern Wisconsin. These events are described below.

- On April 6, 1997, strong gradient winds, enhanced by higher wind gusts associated with scattered rain and snow showers, resulted in wind damage across Ozaukee County. The peak wind gusts were estimated to be about 60 to 70 mph. Across the County the high winds toppled hundreds of large trees, blew over many power lines, ripped off roof shingles, twisted road signs, damaged street lights, bent basketball poles, damaged roof canopies, and blew in garage doors. The hardest hit areas were in Thiensville, Grafton, Cedarburg, Port Washington, and Mequon. This wind storm resulted in about $382,100 in reported property damage.

- On November 10, 1998, high winds were reported in south-central and southeastern Wisconsin counties, resulting in widespread damage to thousands of trees, homes, businesses, power lines, street lights, structures, crops, and vehicles. This event resulted in four deaths, and 14 injuries throughout the south-central and southeastern Wisconsin region. Estimated damages were $15.5 million to property and $2.4 million to crops (2017 dollars). The sustained southwesterly winds of 30 to 40 mph gusted to 60 to 70 mph, with isolated locations having gusts to around 80 mph. These winds eventually caused about 125,000 customers to lose electrical power. In Ozaukee

County, siding was ripped off several homes and telephone poles were snapped in the City of Port Washington. In Belgium, a portion of a roof was torn off of a building under construction. Several schools closed early in City of Mequon and Village of Thiensville. As a result of these high winds, $376,025 in property damages and $37,602 in crop damages were reported in Ozaukee County.

- On October 26, 2010, widespread high winds hit south-central and southeast Wisconsin. These high winds lasted about 36 hours, resulting in numerous reports of fallen trees, broken tree branches, downed power-lines, and damage to structures and vehicles. This event was a result of a record-breaking low pressure system from the Central Plains. This unusually strong system broke the record for the lowest sea level pressures measured in the states of Wisconsin and Minnesota. Based on severity of resulting damage, isolated maximum wind gusts were estimated to be as high as 70-75 mph. Rural Mutual Insurance reported claims from agricultural producers of one million dollars in damage to buildings and equipment from across all of Wisconsin. We Energies reported 20,000 customers in southeast Wisconsin were without power. In Ozaukee County, wind gusts of about 58 mph blew down trees and power lines across the County. A large maple tree fell on a portion of a home in Grafton, destroying an awning over the front door and damaging roof shingles on the home. As a result of this high wind event, $22,496 in property damages were reported in Ozaukee County.

Vulnerability and Community Impact Assessment

The National Weather Service can forecast and track a line of thunderstorms that may be likely to produce severe high winds, hail, lightning, and tornadoes, but where these related hazards form or touch down, and how powerful they might be, remains unpredictable. As can be seen from the distribution of reported thunderstorm related hazard events and high wind events that have impacted Ozaukee County during the past 57 years, shown on Map 3.8, the locations of storm impact points are widely scattered throughout the County.

In order to assess the vulnerability of the Ozaukee County area to thunderstorm related hazards and non-thunderstorm high winds, a review of the community assets described in Chapter 2 indicate the potential for significant thunderstorm and related hazard impacts to: 1) a variety of residential, commercial, and other developed land uses; 2) agricultural lands; 3) roadway transportation system; 4) utilities; 5) critical community facilities; and 6) historic sites. Significant impacts may also be possible to other infrastructure or utility systems, or hazardous material storage sites. According to the NCDC storm events database over the period of record 1960 through 2017 (58 years), the 208 thunderstorm related hazards and non-thunderstorm high winds events have resulted in an average of $101,510 of reported damages per event in the County, consisting of about $90,968 of damages to property and $10,543 in damages to crops. It should be noted that some events had no damages reported to the NCDC database, and several large events have been responsible for a large percentage of the total damages. Thus, the average damage cost is only a very approximate measure of potential damages. According to the NCDC database, on average, there are about 2.6 strong thunderstorm related events reported per year and about one non-thunderstorm high wind event per year in Ozaukee County.

When analyzing the most recent 15-year period from 2003 through 2017, thunderstorm related hazards and non-thunderstorm high wind events have averaged about $705,042 in property damages per year and about $89,987 in crop damages per year, or for an average annual total of about $795,029. In 2017, total equalized assessed property value in Ozaukee County was estimated at $13 billion. Based on the current average estimate of $705,402 in reported property damages per year it can be expected that approximately 0.005 percent of the value of all property, including buildings and infrastructure, in Ozaukee County will be damaged from these events each year. Due to the unpredictability of thunderstorm wind, hail, lightning, and non-thunderstorm high wind events, all buildings, infrastructure, and critical facilities within the County are considered at risk.

Potential Future Changes in Thunderstorm Wind, Non-Thunderstorm High Wind, Hail, and Lightning Conditions

Based upon recent historical data from the period 2003-2017, Ozaukee County can expect to experience averages of 2.2 thunderstorm wind events per year, 1 lightning event per year, 2.4 hail events per year, and 2.6 non-thunderstorm high wind events per year somewhere in the County. It should be noted that

these numbers are based only on events that are reported to and by the NCDC and likely represent an underestimation of total events that occur. Furthermore, the historical record shows considerable variation among years in the numbers of these events that have occurred. While it would be expected that in some years the County will experience either fewer events or more events than the average number, the average annual number of events is not expected to change.

The likely effect of climate change on thunderstorm and high wind events is not clear. While projections based upon downscaled climate model results indicate that the magnitude and frequency of heavy precipitation events are likely to increase by the middle of the 21st century, they do not address potential trends in wind, hail, or lightning conditions. Modeling studies utilizing the output of multiple climate models suggest that the number of days per year in which atmospheric conditions that are known to support the formation of severe thunderstorms under current climatic conditions will increase between now and the end of the 21st century.[88] It should also be noted that wind strengths over the Great Lakes have increased and are expected to continue increasing in the future. Surface wind speeds above the Lakes are increasing by about 5 percent per decade, exceeding trends in wind speed over land.[89]

Changes in land use can have an impact on the potential for damage to occur from thunderstorm related events and non-thunderstorm high winds. Such changes relate to the potential future increase in development within the County. Changing land use patterns within Ozaukee County, as documented in Ozaukee County's Multi-Jurisdictional Comprehensive Plan and VISION 2050, and summarized in Chapter 2 of this Report, indicate a potential increased risk of thunderstorm-related damage and related losses in the expanding urbanized areas within the County. Because of the actions that have been taken by the County and local units of government and individuals, as well as improvements in the ability to forecast these events, the current vulnerability to thunderstorms and related hazards has decreased in recent years. The ongoing mitigation measures of the County and local municipalities are described further in Chapter 5.

Multi-Jurisdictional Thunderstorm Wind, Strong-to-High Wind, Hail, and Lightning Risk Management

Based upon a review of the historic patterns of thunderstorm wind, non-thunderstorm high wind, hail, and lightning events in Ozaukee County, there are no specific municipalities that have unusual risks. Rather, the events are relatively uniform and of countywide concern.

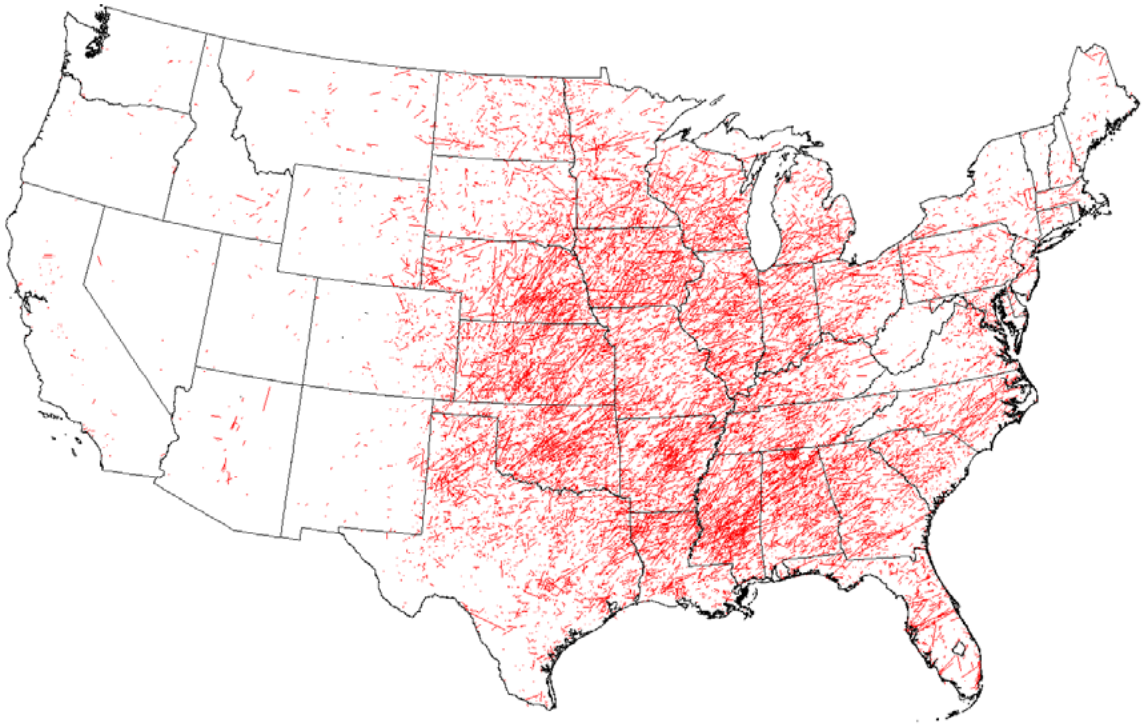
3.5 VULNERABILITY ASSESSMENT FOR TORNADOES

Wisconsin lies along the northern edge of an area of the United States commonly known as "tornado alley." This area extends northeasterly along an axis extending from Oklahoma and Iowa in the west, to Michigan and Ohio in the east. This corridor is the one of the most tornado-prone areas of the United States. Figure 3.4 depicts tracks of tornadoes that occurred nationwide between 1950 and 2015. A tornado is defined as a violently rotating column of air extending from the ground up to the thunderstorm base. It generally lasts for only a short period. The tornado appears as a funnel-shaped column with its lower, narrower end touching the ground and upper, broader end extending into the thunderstorm cloud system. In some cases, the visible condensation cloud may not appear to reach the ground, but meanwhile tornado-force winds may be causing severe destruction (rotating winds can be nearly invisible, except for dust and debris). Similar events, not reaching the land surface, are known as funnel clouds. Funnel clouds may be a precursor to a tornado event. In Wisconsin, tornadoes usually occur in company with thunderstorms formed by eastward-moving cold fronts striking warm moist air streaming up from the south. However, it is not possible to predict tornado activity based upon the occurrence of thunderstorms, and, occasionally, multiple outbreaks of tornadoes occur along the frontal boundaries, affecting large areas of the State at one time. Tornadoes generally occur near the trailing edge of a thunderstorm. It is not uncommon to see clear, sunlit skies behind a tornado.

[88] *Noah S. Diffenbaugh, Martin Scherer, and Robert J. Trapp, "Robust Increases in Severe Thunderstorm Environments in Response to Greenhouse Forcing,"* Proceedings of the National Academy of Sciences, *Volume 110, pages 16,361-16,366, 2013.*

[89] *Ankur R. Desai, Jay A. Austin, Val Bennington, and Galen A. McKinley, "Stronger Winds Over a Large Lake in Response to Weakening Air-to-Lake Temperature Gradient,"* Nature Geoscience, *Volume 2, pages 855-858, 2009.*

Figure 3.4
Recorded Tracks of Tornados Occurring in the United States: 1950-2015



Source: National Oceanic and Atmospheric Administration

Historically, tornadoes have been categorized based upon the most intense damage along their paths using the Fujita Scale. This scale is shown in Table 3.11. Tornado intensities under this scale range from F0 events, representing the tornadoes doing the smallest amount of damage, to F5 events, representing the tornadoes doing the greatest amount of damage. Wind velocities necessary to produce the particular damage were associated with ratings along the Fujita Scale, but that practice was often misleading. The wind estimates associated with the Fujita Scale are intended to be based upon the expected damage to a well-built residential structure. Poorly built structures can suffer significant structural damage under lesser winds than the Fujita Scale might suggest. Other types of structures may or may not experience the same failures under high wind speeds that a house might. Thus, the Fujita Scale is largely a residential scale, with much more care required in assessment after wind damage to other types of structures. Starting in February 2007, the Fujita Scale was replaced by the Enhanced Fujita Scale which retains the same basic design of its predecessor with six strength categories. This scale is shown in Table 3.12. The newer scale reflects more refined assessments of tornado damage surveys, more standardization, and consideration of damage over a wider range of structures. Because the National Weather Service has decided not to reclassify tornadoes that occurred prior to the implementation of the Enhanced Fujita Scale, the Fujita Scale classifications have been retained for those storms which occurred prior to February 2007.

The destructive power of the tornado results primarily from its high-wind velocities, wind-driven debris, and uplifting force. These tornado characteristics likely account for about 90 percent of tornado-caused damage. Since tornadoes are generally associated with severe storm systems; hail, torrential rain, and intense lightning usually accompany tornado events. In addition, tornadoes may be accompanied by downbursts, events which are characterized by strong downdrafts initiated by a thunderstorm that manifest as straight-line winds on or near the ground. These winds can be powerful, with speeds up to 70 to 100 mph. These winds interact with tornadoes and can affect the path of the tornado event in such manner as to make tornadoes somewhat unpredictable. Depending on their intensity, tornadoes can uproot trees and crops, down power lines, and damage or destroy buildings and infrastructure. Flying debris can cause serious injury and death to humans, livestock, and wildlife in their path. An approaching cloud of debris can mark the location of a tornado, even if the classic funnel cloud is not visible. Before a tornado hits, the wind may die down and the air may become very still.

The National Weather Service (NWS) monitors severe weather nationwide from its Norman, Oklahoma office. This office is the only entity that can issue severe weather watches and warnings, including for tornados. If a law enforcement or fire service spotter reports a tornado to their dispatch, the information is given to the NWS to issue the tornado warnings and activate all of the integrated warning systems at the same time so the public receives the outdoor warning sirens, available cell phone and email alerts (i.e., AlertSense, Notify-Me, and Hyper-Reach), NOAA Weather Radio All Hazards alerts[90], and Emergency Alert System (EAS) notifications on radio and television. Once a warning is issued from the NWS, Ozaukee County Sheriff's officials will engage the outdoor warning sirens that they control, which include sirens in Belgium, Fredonia, Grafton, Port Washington, and Waubeka. County officials also confirm that sirens in Saukville have sounded, as the system there is automated to sound when the tornado warning tone is sounded on NOAA Weather Radios. In addition to engaging warning sirens in their control, Ozaukee County will broadcast the weather alert to the other dispatch centers in Cedarburg and Mequon (these communities also have NOAA Weather Radios in dispatch, so the County's notice is for redundancy). Finally, Ozaukee County Sheriff's officials will also broadcast a County-wide broadcast to all law enforcement and fire departments as well as County division personnel. The City of Mequon has physical control of engaging warning sirens in Mequon and Thiensville. Cedarburg dispatch has the physical control for outdoor warning sirens in the City of Cedarburg, and can also can engage, and acts as a backup for, the sirens that the County and the City of Mequon normally engage. Ozaukee County Sheriff's dispatch is considered the primary warning point by the NWS, while the Cedarburg Police Department is considered the secondary warning point. The number of sirens within the communities of Ozaukee County, and the agencies that control each are shown in Table 3.13.

Table 3.11
Fujita Scale Characteristics

F-Scale	Wind Speed (miles per hour)[a]	Character of Damage	Relative Frequency (percent)
FO (weak)	40-72	Light	29
F1 (weak)	73-112	Moderate	40
F2 (strong)	113-157	Considerable	24
F3 (strong)	158-206	Severe	6
F4 (violent)	207-260	Devastating	2
F5 (violent)	261-318	Incredible (rare)	<1

[a] *Equivalent wind speeds associated with the Fujita Scale represent the fastest one-quarter mile wind.*

Source: National Oceanic and Atmospheric Administration (NOAA)

Table 3.12
Enhanced Fujita Scale Characteristics

EF-Scale	Wind Speed (miles per hour)[a]	Character of Damage	Relative Frequency (percent)
EFO (weak)	65-85	Light	53
EF1 (weak)	86-110	Moderate	32
EF2 (strong)	111-135	Considerable	11
EF3 (strong)	136-165	Severe	3
EF4 (violent)	166-200	Devastating	1
EF5 (violent)	>200	Incredible (rare)	<1

[a] *Equivalent wind speeds associated with the Enhanced Fujita Scale represent a three-second gust of wind.*

Source: National Oceanic and Atmospheric Administration (NOAA)

OZARES (Ozaukee Amateur Radio Emergency Services) is the County's volunteer/nonprofit amateur radio system. OZARES is used to provide auxiliary communications during a hazard event as well as backup in the event that the County loses some or all of its radio system functionality.[91]

A tornado watch means that tornadoes are possible, and that persons within the area for which the watches are issued should remain alert for approaching storms. A tornado warning means that a tornado has been sighted in an area or indicated as likely to have occurred by weather radar. When tornado warnings are issued for an area, persons near and within that designated area are advised to move to a pre-designated place of safety. According to the Iowa State University College of Agriculture, over the period 1986 through 2017, there were 27 tornado watches and 12 tornado warnings in Ozaukee County (Table 3.4). National Weather Service data indicates about 11 tornado watches are issued per year that cover at least a part of Wisconsin. Tornado shelters are identified by appropriate signage in public buildings.

[90] *NOAA Weather Radio All Hazards is a nationwide network of radio stations broadcasting continuous weather information directly from the nearest National Weather Service office. This service broadcasts official National Weather Service warnings, watches, forecasts and other hazard information 24 hours a day, 7 days a week.*

[91] *Ozaukee County Division of Emergency Management.*

Table 3.13
Tornado Warning Sirens Within Ozaukee County

Community	Number of Tornado Sirens	Agency Responsible for Engaging Sirens
City of Cedarburg	6	City of Cedarburg Police Department
City of Mequon	7	City of Mequon Police Department
City of Port Washington	4	Ozaukee County Sheriff's Department
Village of Fredonia	2	Ozaukee County Sheriff's Department
Village of Grafton	5	Ozaukee County Sheriff's Department
Village of Saukville	4[a]	Automatically engaged by NOAA Weather Radio tornado warning tone
Village of Thiensville	1	City of Mequon Police Department
Town of Fredonia (Waubeka)	1	Ozaukee County Sheriff's Department

Note: The City of Cedarburg Police Department is the backup agency responsible for engaging warning sirens that are normally the responsibility of the Ozaukee County Sheriff's Department and the City of Mequon Police Department.

The Ozaukee County Sheriff's Department is the primary warning point for the National Weather Service. The City of Cedarburg Police Department is the secondary warning point.

[a] *One additional backup siren.*

Source: Ozaukee Division of Emergency Management

In addition to tornado watches and warnings, severe thunderstorm watches and warnings indicate severe weather conditions that may generate conditions in which tornadoes may occur. Such watches and warnings may be followed by tornado watches and warnings as weather conditions develop.

Description of Tornado Events

The average Wisconsin tornado between 1982 and 2007 had a lifespan of 7.1 minutes, a path length of 3.7 miles, a path width of 118 yards, and an EF rating of 0.7 (between EFO and EF1),[92] although tornadoes of a mile or more in width and 300 miles in length have been known to occur elsewhere in the United States. On average, tornadoes in Southeastern Wisconsin move across the land surface at speeds of between 25 and 45 miles per hour, although overland speeds of up to 70 mph have been reported. Tornadoes rarely last more than a few minutes over a single spot, or more than 15 to 20 minutes in a 10-mile area, but in those few minutes significant devastation may occur.

According to the National Weather Service, from 1844 to 2014 there have been 1,537 documented tornadoes in the State of Wisconsin, causing 511 directly related deaths and at least 3,056 directly related injuries.[93] A total of five tornadoes have been recorded in Ozaukee County during the 54-year period from January 1964 through December 2017. The locations and paths of these tornadoes are shown in Map 3.9, and documented in terms of their magnitude and impact in Table 3.14. There have been three F0 or EF0 tornadoes, one F1 tornado, and one F4 tornado. In total, these five tornadoes resulted in 30 injuries and almost $20.6 million in reported property and crop damages adjusted to reflect 2017 costs.

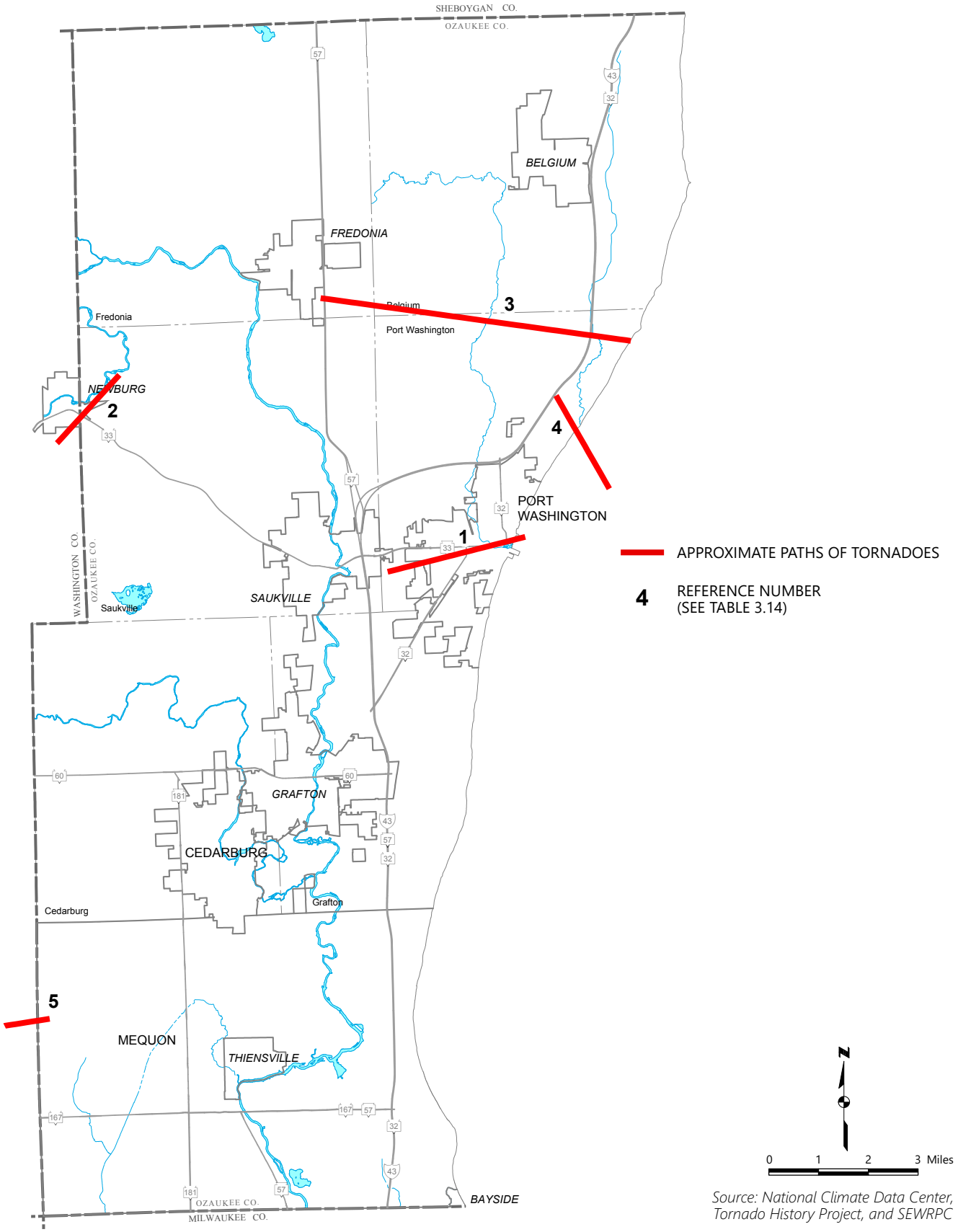
On August 22, 1964, a powerful tornado struck the City of Port Washington. This tornado was classified as an F4 event on the Fujita Scale that tracked 2 miles in length and was 50 yards wide. The tornado first touched down near State Trunk Highway (STH) 32 and traveled from southwest to northeast. Although there were no fatalities, 30 people were reported injured and nearly $19.8 million (adjusted for 2017 dollars) was reported in property damages, making it the worst tornado event in the City's 130 years.[94] Though such strong tornadoes are relatively rare events in Ozaukee County, they have the potential to cause substantial injuries, loss of life, and damage to property and crops.

[92] *Wisconsin Department of Emergency Management and Military Affairs,* State of Wisconsin Hazard Mitigation Plan, *December 2016.*

[93] *The National Weather Service. www.weather.gov. Data prior to 1950 is incomplete because in many cases, only large tornadoes were reported and many rural tornadoes went unreported.*

[94] *www.newspapers.com,* The Sheboygan Press*, August 24, 1964.*

Map 3.9
Paths of Tornados in Ozaukee County



Source: National Climate Data Center, Tornado History Project, and SEWRPC

Table 3.14
Tornado Events Reported in Ozaukee County: 1964-2017

Map Number[a]	Date	Location	Magnitude (Fujita)	Deaths	Injuries	Property Damages (2017 dollars)	Crop Damages (2017 dollars)
1	8/22/1964	Port Washington	F4	0	30	19,753,500	0
2	7/27/1970	Newburg	F0	0	0	0	0
3	7/18/1996	Fredonia	F1	0	0	466,320	357,512
4	7/18/1996	Port Washington	F0	0	0	0	0
5	8/10/2015	Mequon	EF0	0	0	1,042	0
			Total	0	30	20,220,862	357,512

Note: Dollar Values were adjusted to year 2017 by the average annual Consumer Price Index (CPI) values from the U.S. Department of Labor, Bureau of Labor Statistics.

In many instances damages from hazard events go unreported. This table represents estimated losses and should not be considered as an exact documentation of damages and losses incurred from a particular event or time period.

[a] *See Map 3.9 for location and estimated paths of tornados.*

Source: National Climatic Data Center (NCDC), Tornado History Project: Ozaukee County, SEWRPC

The following are descriptions of other, less destructive tornados that have impacted Ozaukee County:

- On July 18, 1996, a weak tornado touched down one mile north-northwest of Fredonia and then skipped 0.6 miles southeast near Holy Cross (unincorporated community in the Town of Belgium) where it intensified from F0 to F1. This tornado continued on the ground in an east-southeast direction south of Dixie Road to the Lake Michigan shoreline 3.4 miles northeast of Knellsville. This tornado then became a waterspout as it continued east-southeast over Lake Michigan. It destroyed six homes, four barns, three machine sheds, and one garage. There was crop damage to about 500 acres along its path through rural areas. Several vehicles were also destroyed or damaged. There were no injuries or deaths. Total damage amounts were $466,320 in private/public property and $357,512 for crops.

- Also, on July 18, 1996, a weak (F0) tornado touched down 1.6 miles east of IH 43, and proceeded to head southeast to the Lake Michigan shoreline 1.8 miles northeast of the City of Port Washington. It then moved out over Lake Michigan as a waterspout. No significant damage was noted.

- On August 10, 2015, the passage of a weak cold front within an unstable airmass resulted in a few severe thunderstorms with damaging winds, large hail, and one brief and weak tornado along western edge Mequon.

Vulnerability and Community Impact Assessment

In order to assess the vulnerability of the Ozaukee County area to tornado and related storm hazards, a review of the community assets described in Chapter 2 was made which indicates the potential for significant tornado impacts to: 1) a variety of residential, commercial, and other developed land uses; 2) agricultural lands; 3) roadway transportation system; 4) utilities; 5) critical community facilities; and 6) historic sites. Significant impacts may also be possible to other infrastructure or utility systems, solid waste disposal sites, or hazardous material storage sites.

Tornado prediction is not an exact science. The National Weather Service can forecast that a line of thunderstorms may be likely to produce tornadoes, but where they form or touch down, and how powerful they might be, remains unpredictable. In addition, tornadoes can form quickly without ample warning. Because Doppler radar does not see below the cloud base, these tornadoes can be difficult to detect. As can be seen from the distribution of the five historic tornado events during the past 53 years in Map 3.9, the locations of tornado impact paths are widely scattered throughout the County, although the northern portion of the County has experienced more tornado events when compared to the rest of County.

Tornado events have resulted in almost $20.6 million of reported damages in Ozaukee County (see Table 3.14). On average, the reported damages due to tornadoes have resulted in about $4.1 million in

damages per event. It should be noted that one event was responsible for about 96 percent of the total damages. Thus, the average damages may not be representative of the damages that could be expected from a tornado affecting the County.

During a tornado, homes, businesses, public buildings, and infrastructure may be damaged or destroyed by high winds, rain, and hail. Airborne debris, carried by the tornado and associated high winds, can break windows and doors, allowing winds and rain access to interior spaces. Fixed infrastructure, such as roads and bridges, also can be damaged by exposure to high winds, although more damage appears to result from washout associated with flash flooding and debris jams as opposed to direct damage due to contact with funnel clouds. In an extreme tornado event, such as an EF4 event, the force of the wind alone can cause tremendous devastation, uprooting trees, toppling power lines, and inducing the failure of weak structural elements in homes and buildings.

Based on limited frequency of tornadoes in Ozaukee County, it can be expected that there will no to very little damages per year from these events. Due to the unpredictability of tornado events, all buildings, infrastructure, and critical facilities within the County are considered at risk.

Potential Future Changes in Tornado Conditions

Changes in land use can have an impact on the potential for damage due to tornadoes and related hazards to occur. Such changes relate to the potential future increase in development within the County. As noted above, changing land use patterns within Ozaukee County, as documented in the SEWRPC's VISION 2050 plan, Ozaukee County's Multi-Jurisdictional Comprehensive Plan, and summarized in Chapter 2, indicate a continuing level of moderate risk of tornado damage and related losses in the County. Because of the actions that have been taken by the County and local units of government and individuals, the current vulnerability to tornadoes and related hazards has generally decreased in recent years. These ongoing mitigation measures are described further in Chapter 5.

The likely effects of climate change on tornado frequency and severity are not clear. The projections based upon downscaled climate model results do not address potential trends in tornado conditions. A recent study that examined trends in tornados rated F1 or EF1 and higher over the period 1954 through 2013 found that the frequency of outbreaks of multiple tornadoes may be changing.[95] While the study found no change in the frequency at which tornadoes occur, it found a decrease in the number of days per year on which at least one tornado occurs. At the same time, it found an increase in the number of days per year on which multiple tornadoes occur. Increasing trends were found at several different thresholds for defining outbreaks of multiple tornadoes. Thus, the study found that the proportion of tornadoes that occur on "big tornado days" has increased. In addition, the study found that the spatial and temporal density of the tornadoes occurring has increased. The study concluded that the risk of "big tornado days" featuring clusters of densely packed tornadoes is increasing. This trend could potentially increase tornado-related damages in the future.

Multi-Jurisdictional Tornado Risk Management

Based upon a review of the historic patterns of tornado events in Ozaukee County, there are no specific municipalities that have unusual risks. Rather, the risks are relatively uniform and of a countywide concern.

3.6 VULNERABILITY ASSESSMENT FOR EXTREME TEMPERATURES

Average temperatures in the United States have increased by 1.3 to 1.9°F since record keeping began in 1895. Heat waves have become more frequent and intense, and cold waves have become less frequent across the nation.[96] Heat and cold are two of the most underrated, least understood, and deadly of all the natural hazard events that impact Ozaukee County. In contrast to the visible, destructive, and violent characteristics associated with floods and tornadoes, extreme high or low temperatures are "silent killers."

[95] *James B. Elsner, Svetoslava C. Elsner, and Thomas H. Jagger, "The Increasing Efficiency of Tornado Days in the United States,"* Climate Dynamics, *Volume 45, pages 651-659, 2015.*

[96] *Sarofim, M.C., S. Saha, M.D. Hawkins, D.M. Mills, J. Hess, R. Horton, P. Kinney, J. Schwartz, and A. St. Juliana,* The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment, Ch. 2: Temperature-Related Death and Illness, *U.S. Global Change Research Program, pages, 43–68, 2016.*

Days that are hotter than the average seasonal temperature in the summer or colder than the average seasonal temperature in the winter cause increased levels of illness and death by compromising the body's ability to regulate its temperature or by inducing direct or indirect health complications. Deaths from extreme heat and cold occur quietly, without headline-making destruction.

There is no standard method for defining a heat wave or cold wave. There are also dramatic differences in the observed relationships between temperature, death, and illness across different regions and seasons. These relationships vary based on average temperatures in those locations and the timing of the heat or cold event.[97]

The Centers for Disease Control and Prevention (CDC) reports that nationwide between 2006 and 2010, excessive heat was the underlying cause of death for an average of 407 persons and a contributing cause of death for an average of 326 persons each year.[98] Over the same time period, the CDC reports that excessive cold was the underlying cause of death for an average of 638 persons and a contributing cause of death for an average of 693 persons each year.[99] In Wisconsin, there were 137 direct heat-related deaths between 1998 and 2015 and an additional 102 indirect heat-related deaths. This averages to 4.2 direct and 3.1 indirect heat-related deaths per year.[100] A death is considered direct if the medical examiner ruled that heat was the primary cause of death. If heat was only a contributing factor, the medical examiner will rule that death indirectly caused by heat.

Temperature data for two selected observation stations within Ozaukee County are shown in Table 3.15. The table shows extreme high and low temperatures and the departure from average temperatures recorded in the period from 1990 through 2017. The Port Washington station stopped collecting data in 2011, and the Saukville station started collecting data in 2010. The average annual high and low extreme temperatures for these two stations are 95.0°F and 8.5°F for the City of Port Washington and 91.8°F and 11.0°F for the Village of Saukville during this period. Prolonged exposure to either of these temperatures could present a significant danger. It should be noted that Lake Michigan may be exerting some effect on the average and the extreme cold temperature but is not appreciably reducing the average extreme high temperature.

As previously stated, average temperatures in the United States have increased by 1.3 to 1.9°F since record keeping began in 1895. Heat waves have become more frequent and intense while cold waves have become less frequent across the nation.[101] Extreme summer heat is intensified with the combination of very high temperatures and exceptionally humid conditions. Heat and humidity together can create the most severe problems to human health. High humidity makes heat more dangerous because it slows the evaporation of perspiration, which is the body's natural cooling process. The Heat Index (HI) is a measure of discomfort and the level of risk posed to people in high-risk groups by heat and humidity. The HI is expressed in degrees Fahrenheit (°F) and incorporates an adjustment to the air temperature for relative humidity (RH). For example, if the air temperature is 94°F and the RH is 55 percent, the HI would equal about 106°F (see Table 3.16). Since HI values were devised for shady, light wind conditions, exposure to full sunshine can increase HI values by up to 15°F. The level of risk to people in high-risk groups associated with different levels of the HI is shown in Table 3.17.[102] The National Weather Service (NWS) will initiate alert procedures (advisories or warnings) when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat wave determines whether advisories or warnings are issued. High temperature periods are often also accompanied by the related air quality problems such as stagnant air masses and changes in the atmospheric chemistry that affect the concentrations of pollutants related to ground-level ozone. Ground-level ozone can be harmful, especially to sensitive groups, such as active children, the

[97] *Ibid.*

[98] *Jeffrey Berko, Deborah D. Ingram, Shubhayu Saha, and Jennifer D. Parker, "Deaths Attributed to Heat, Cold, and Other Weather Events in the United States, 2006-2010,"* National Health Statistics Reports*, No. 76, July 30, 2014.*

[99] Ibid.

[100] *State of Wisconsin Hazard Mitigation Plan, December 2016, op.cit.*

[101] *Sarofim, M.C., S. Saha, M.D. Hawkins, D.M. Mills, J. Hess, R. Horton, P. Kinney, J. Schwartz, and A. St. Juliana,* The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment, Ch. 2: Temperature-Related Death and Illness, *U.S. Global Change Research Program, pages, 43–68, 2016.*

[102] *High-risk groups include the very young, the old, and persons with chronic health conditions.*

Table 3.15
Extreme Temperatures and Departure from Average Temperature Within Ozaukee County: 1990-2017

	Port Washington				Saukville WWTP			
Year	Extreme High Temperature (°F)	Extreme Low Temperature (°F)	Average Annual Temperature (°F)	Departure From Average Temperature (°F)	Extreme High Temperature (°F)	Extreme Low Temperature (°F)	Average Annual Temperature (°F)	Departure From Average Temperature (°F)
1990	97	-9	46.9	0.6	N/A	N/A	N/A	N/A
1991	95	-8	46.8	0.5	N/A	N/A	N/A	N/A
1992	90	-7	44.7	-1.6	N/A	N/A	N/A	N/A
1993	92	-6	44.8	-1.5	N/A	N/A	N/A	N/A
1994	92	-25	45.4[a]	-0.9	N/A	N/A	N/A	N/A
1995	106	-10	44.7	-1.6	N/A	N/A	N/A	N/A
1996	97	-29	42.9	-3.4	N/A	N/A	N/A	N/A
1997	95	-10	44.7	-1.6	N/A	N/A	N/A	N/A
1998	93	-6	49.9[a]	3.6	N/A	N/A	N/A	N/A
1999	98	-10	48.0	1.7	N/A	N/A	N/A	N/A
2000	92	-6	46.3[a]	0.0	N/A	N/A	N/A	N/A
2001	97	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2002	99	-3	47.5	1.2	N/A	N/A	N/A	N/A
2003	95	-8	45.2[a]	-1.1	N/A	N/A	N/A	N/A
2004	90	-10	46.4	0.1	N/A	N/A	N/A	N/A
2005	96	-2	47.3	1.0	N/A	N/A	N/A	N/A
2006	99	14	48.4	2.1	N/A	N/A	N/A	N/A
2007	97	-13	47.3	1.0	N/A	N/A	N/A	N/A
2008	90	-10	45.2	-1.1	N/A	N/A	N/A	N/A
2009	90	-13	45.4	-0.9	N/A	N/A	N/A	N/A
2010	92	1	48.0	1.7	87	-4	46.4	1.0
2011	98	-8	46.4[a]	0.1	95	-14	44.9[a]	-0.5
2012	N/A	N/A	N/A	N/A	100	-4	48.1	2.7
2013	N/A	N/A	N/A	N/A	93	-9	43.1	-2.3
2014	N/A	N/A	N/A	N/A	89	-18	41.6	-3.8
2015	N/A	N/A	N/A	N/A	90	-14	45.4	0.0
2016	N/A	N/A	N/A	N/A	91	-17	47.0	1.6
2017	N/A	N/A	N/A	N/A	89	-8	46.3	0.9
Average	95	-8.5	46.3	--	91.8	-11	45.4	--

Note: N/A indicates data not available.

[a] *Average and/or total values computed with one to nine daily values missing.*

Source: National Oceanic and Atmospheric Administration, National Climatic Data Center, and SEWRPC

Table 3.16
Heat Index Chart

	Relative Humidity (percent)												
	100	95	90	85	80	75	70	65	60	55	50	45	40
Temperature (°F)	Heat Index (°F)												
80	87.2	86.4	85.6	84.9	84.2	83.6	83.0	82.4	81.8	81.3	80.8	80.3	79.9
82	94.5	93.0	91.5	90.1	88.8	87.6	86.4	85.4	84.4	83.6	82.8	82.5	81.5
84	102.7	100.3	98.0	95.9	94.0	92.2	90.5	88.9	87.5	86.3	85.1	84.1	83.3
86	111.5	108.3	105.3	102.5	99.8	97.3	95.1	93.0	91.1	89.4	87.9	86.6	85.4
88	121.2	117.1	113.2	109.6	106.3	103.1	100.2	97.6	95.1	93.0	91.0	89.4	87.4
90	131.6	126.6	121.9	117.5	113.3	109.5	105.9	102.7	99.7	97.0	94.6	92.5	90.7
92	142.8	136.9	131.3	126.0	121.0	116.4	112.2	108.3	104.7	101.4	98.5	96.0	93.8
94	154.8	147.9	141.3	135.2	129.4	124.0	119.0	114.4	110.2	106.3	102.9	99.8	97.2
96	167.5	159.6	152.1	145.0	138.3	132.1	126.4	121.0	116.1	111.7	107.6	104.0	100.9
98	181.0	172.0	163.5	155.5	147.9	140.9	134.3	128.2	122.6	117.4	112.8	108.6	104.9
100	195.3	185.2	175.7	166.7	158.2	150.2	142.8	135.9	129.5	123.6	118.3	113.5	109.3
102	210.4	199.2	188.5	178.5	169.0	160.1	151.8	144.1	136.9	130.3	124.3	118.8	113.9
104	226.2	213.8	202.1	191.0	180.5	170.7	161.4	152.8	144.8	137.4	130.6	124.4	118.9
106	242.7	229.2	216.4	204.2	192.6	181.8	171.6	162.0	153.1	144.9	137.3	130.4	124.2
108	260.1	245.4	231.3	218.0	205.4	193.5	182.3	171.1	161.9	152.8	144.4	136.7	129.8
110	278.2	262.2	247.0	232.5	218.8	205.8	193.5	182.0	171.2	161.2	152.0	143.4	135.7

Source: National Weather Service

elderly, and adults with respiratory problems. For example, during 2016 and 2017, there were 5 days each year when weather conditions were forecast in Southeastern Wisconsin that could result in unhealthy levels of ozone (the main component of smog).

The following definitions/criteria are used for the 20 counties in south-central and southeastern Wisconsin served by the Milwaukee/Sullivan Weather Forecast Office:

- **Outlook Statement**—Issued two to seven days prior to time that minimal Heat Advisory or Excessive Heat Warning conditions are expected. Serves as a long-term "heads-up" message;

Table 3.17
Level of Risk for Persons in High Risk Groups Associated with the Heat Index

Heat Index (°F)	Category	Possible Heat Disorders for Persons in High-Risk Groups
80-90	Caution	Fatigue possible with prolonged exposure and/or physical activity
90-105	Extreme Caution	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity
105-129	Danger	Sunstroke, muscle cramps and/or heat exhaustion likely. Heatstroke possible with prolonged exposure and/or physical activity
130 or above	Extreme Danger	Heat stroke or sunstroke likely

Source: National Weather Service

- **Excessive Heat Watch**—Issued 24 to 48 hours in advance when Excessive Heat Warning conditions are expected;

- **Heat Advisory**—Issued six to 24 hours in advance of any 24-hour period in which daytime heat indices are expected to be 100° to 104°, or 95° to 99° for four or more consecutive days, and nighttime heat indices are greater than or equal to 75°. Advisories are issued for less serious conditions that cause significant inconvenience and, if caution is not exercised, could lead to situations that may threaten life; and

- **Excessive Heat Warning**—Issued six to 24 hours in advance of any 48-hour period in which daytime heat indices are expected to exceed 105° for three or more hours, and nighttime heat indices are greater than or equal to 75°. In addition, if Heat Advisory conditions are expected to persist for four or more days, then an Excessive Heat Warning will be issued. Warnings are issued for weather conditions posing a threat to life.

During extended periods of very high temperature, coupled with high humidity levels, individuals can suffer a variety of ailments, including heat cramps (muscular pains and spasms due to heavy exertion). Although heat cramps are the least severe heat-related ailment, they are an early signal that the body is having trouble with the heat. Heat exhaustion typically occurs when people exercise heavily or work in a hot, humid place where body fluids are lost through heavy sweating. Blood flow to the skin increases, causing blood flow to decrease to vital organs. This results in a form of mild shock. If not treated, the victim may suffer heat stroke. Heat stroke is life threatening and requires immediate medical attention. The victim's temperature control system, which produces sweat to cool the body, stops working. The body temperature can rise so high that brain damage and death may result if the body is not cooled quickly. Sunstroke is another term for heat stroke. In addition to posing a public health hazard, periods of excessive heat usually result in high electrical consumption for air conditioning, which can cause power outages and brown outs.

Most heat-related deaths occur in large urban areas that can exhibit "heat islands effects." Brick buildings, asphalt streets, and tar roofs store and radiate heat like a slow burning furnace. Heat builds up in a city during the day and cities are slower than rural areas to cool down at night. The amount of sunshine is an important contributing factor in urban heat waves. In addition, the stagnant atmospheric conditions associated with a heat wave trap ozone and other pollutants in urban areas. The worst heat disasters, in terms of loss of life, happen in large cities when a combination of high daytime temperatures, high humidity, warm nighttime temperatures, and an abundance of sunshine occurs for a period of several days. There are also socioeconomic problems that make some urban populations at greater risk. The elderly, disabled, and debilitated are especially susceptible to heat-related illness and death.

Extreme cold is also a deadly hazard. Exposure to extreme cold temperatures can cause several health conditions and can lead to loss of fingers and toes; or cause permanent kidney, pancreas, and liver injury,

and even death. These health impacts often result from a combination of cold temperatures, winds, and precipitation. As a result, winter storms can pose substantial risks because they can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. In addition, when deaths and injuries due to cold-related vehicle accidents and fatalities, fires due to dangerous use of heaters, carbon monoxide poisoning due to use of nontraditional sources of heat such as cooking ovens, and other winter weather fatalities are considered, the impact of severe cold periods becomes even greater.

Frostbite and hypothermia are two major health risks associated with severe cold. Frostbite is an injury caused by freezing of the skin and underlying tissues. Frostbite causes a loss of feeling and a white or pale appearance in extremities. Mild frostbite, known as frostnip, does not cause permanent skin damage and can be treated with first aid measures. More severe frostbite can damage skin and underlying tissues and requires medical attention. Potential complications of severe frostbite include infection and nerve damage. Frostbite is most common on fingers, toes, nose, ears, face, and chin. While exposed skin in cold, windy weather is most vulnerable to frostbite, this injury can occur on skin covered by gloves or other clothing.

Hypothermia is a condition brought on when the core body temperature drops to less than 95°F. It occurs when the body loses heat more quickly than it can produce it. Relative to temperature extremes, this occurs due to exposure to cold or frigid environments. As with frostbite, wind or wetness can contribute to producing hypothermia. Symptoms of mild hypothermia can include shivering, dizziness, hunger, nausea, fatigue, increased heart and respiration rates, lack of coordination, and difficulty speaking. As hypothermia worsens, shivering may end. Symptoms of moderate to severe hypothermia include lack of coordination, slurred speech, confusion, drowsiness, progressive loss of consciousness, weak pulse, and shallow breathing. Hypothermia may cause lasting kidney, liver, and pancreas problems or death. Members of certain populations are particularly vulnerable to hypothermia. These include older adults, infants and very young children, the homeless, persons consuming alcohol or other drugs, and persons taking certain medications.

Wind chill is an index used to evaluate the risk posed by the combination of cold temperatures and wind. It is based on temperature and wind speed. Table 3.18 shows the wind chill table used by the National Weather Service. Wind chill is not the actual temperature, but rather a measure of how the combination of wind and cold feel on exposed skin. As the wind increases, heat is carried away from the body at an accelerated rate, driving down the body temperature. This combination can strongly affect the risks associated with exposure to temperature. For example, a wind chill of 20°F will cause frostbite on exposed skin in just 30 minutes. Based on data from 1971 through 2000, Ozaukee County experiences an average of 10 to 20 days of zero degrees or lower per year, as shown in Figure 3.5.

The National Weather Service issues wind chill advisories when wind chill temperatures are potentially hazardous and wind chill warnings when wind chill temperatures are life threatening. The exact criteria of a wind chill advisory and warning varies from state to state. A wind chill advisory in Wisconsin is issued when wind chill values reach 20°F to 34°F, with wind speeds of four mph or more. A wind chill warning in Wisconsin is issued when wind chill values will reach 35°F or colder, with wind speeds of at least four mph for three hours or more. In addition, a wind chill watch is issued 12 to 48 hours before these conditions are expected to occur.

What constitutes extreme cold varies in different parts of the country. In the south, near freezing temperatures are considered extreme cold. Freezing temperatures can cause severe damage to citrus fruit crops and other vegetation. Pipes may freeze and burst in homes that are poorly insulated or without heat. In the north, extreme cold means temperatures well below zero. Winter residents in Ozaukee County may see heavy snow, strong winds/blizzards, extreme wind chill, lake-effect snow, and ice storms. The public can stay informed by listening to NOAA Weather Radio, commercial radio or television for the latest winter storm warnings and watches.

Description of Past Extreme Temperature Events

Extreme temperatures that affect Ozaukee County are not localized events, as they usually encompass the entire south-central to southeastern portion of the State and may continue for several days or weeks. Table 3.19 lists the extreme high and low temperature events in Ozaukee County from June 1995 through December 2017, as well as associated property and crop damages.

Table 3.18
Wind Chill Temperatures[a]

Wind (mph)	Temperature (°F)																	
	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	**-22**	**-28**	**-34**	**-40**	**-46**	**-52**	**-57**	**-63**
10	34	27	21	15	9	3	-4	-10	-16	**-22**	**-28**	**-35**	**-41**	**-47**	**-53**	**-59**	**-66**	**-72**
15	32	25	19	13	6	0	-7	-13	**-19**	**-26**	**-32**	**-39**	**-45**	**-51**	**-58**	**-64**	**-71**	**-77**
20	30	24	17	11	4	-2	-9	-15	**-22**	**-29**	**-35**	**-42**	**-48**	**-55**	**-61**	**-68**	**-74**	**-81**
25	29	23	16	9	3	-4	-11	-17	**-24**	**-31**	**-37**	**-44**	**-51**	**-58**	**-64**	**-71**	**-78**	**-84**
30	28	22	15	8	1	-5	-12	**-19**	**-26**	**-33**	**-39**	**-46**	**-53**	**-60**	**-67**	**-73**	**-80**	**-87**
35	28	21	14	7	0	-7	-14	**-21**	**-27**	**-34**	**-41**	**-48**	**-55**	**-62**	**-69**	**-76**	**-82**	**-89**
40	27	20	13	6	-1	-8	-15	**-22**	**-29**	**-36**	**-43**	**-50**	**-57**	**-64**	**-71**	**-78**	**-84**	**-91**
45	26	19	12	5	-2	-9	-16	**-23**	**-30**	**-37**	**-44**	**-51**	**-58**	**-65**	**-72**	**-79**	**-86**	**-93**
50	26	19	12	4	-3	-10	-17	**-24**	**-31**	**-38**	**-45**	**-52**	**-60**	**-67**	**-74**	**-81**	**-88**	**-95**
55	25	18	11	4	-3	-11	**-18**	**-25**	**-32**	**-39**	**-46**	**-54**	**-61**	**-68**	**-75**	**-82**	**-89**	**-97**
60	25	17	10	3	-4	-11	**-19**	**-26**	**-33**	**-40**	**-48**	**-55**	**-62**	**-69**	**-76**	**-84**	**-91**	**-98**

[a] *Wind Chill (°F) = 35.74 + 0.6215T - 35.75($V^{0.16}$) + 0.4275T($V^{0.16}$), where T = air temperature (°F) and V = wind speed (mph). The wind chill temperature is only defined for temperatures at or below 50°F and wind speeds above 3 mph. Bright sunshine may increase wind chill temperature by 10°F to 18°F.*

Frostbite times associated with wind chills:

- 30 minutes
- 10 minutes
- 5 minutes

Source: National Weather Service

Extreme Heat

Historically, most of the all-time maximum daily temperatures in Wisconsin were recorded during the Dust Bowl years between 1934 and 1936. In 1936 alone, there were over 5,000 deaths. The highest temperature ever recorded in Wisconsin was 114°F, which occurred on July 13, 1936, at the Wisconsin Dells.

Two major heat waves occurred in Wisconsin in the summer of 1995, one in June and one in July. Both heat waves affected most of Wisconsin and resulted in a combined 154 fatalities, 82 direct deaths and 72 indirect deaths across the State, and hold the record as the number one weather-related killer in Wisconsin since it became a state in 1848. The second heat wave which occurred from July 12 through July 15, 1995 was especially rare and, in some respects, unprecedented in terms of both unusually high maximum and minimum temperatures and the accompanying high relative humidity. High temperatures ranged from 100°F to 108°F with heat index values between 120°F and 130°F. In Ozaukee County, on July 13, 1995, the maximum temperatures reached 106°F and the heat index peaked at 125°F. This was the first time that the National Weather Service in Sullivan, Wisconsin, had issued a heat advisory and an excessive heat warning. In addition to the impacts on humans, a large impact on livestock was felt with an estimated 100,000 animals dying due to the extreme heat. An all-time electricity demand necessitated volunteer usage reductions in order to prevent brownouts.

An extreme heat wave struck central and southeast Wisconsin at the end of July 1999. This heat wave was responsible for directly killing eight people, and indirectly killing an additional six people in this part of the State. Most of these deaths occurred in or near the City of Milwaukee where they saw a minimum air temperature of 70°F degrees or higher for the last 11 days of July. In addition, at least 150 people were treated at local hospitals for heat-related exhaustion or dehydration. During the heat wave high humidity and temperatures in the 90s and 100s produced heat index values from 110°F to as high as 125°F. During this time, there was record peak daily electric power demand in the Milwaukee area, and for that summer there was a record set for the Midwest region for electrical demand.

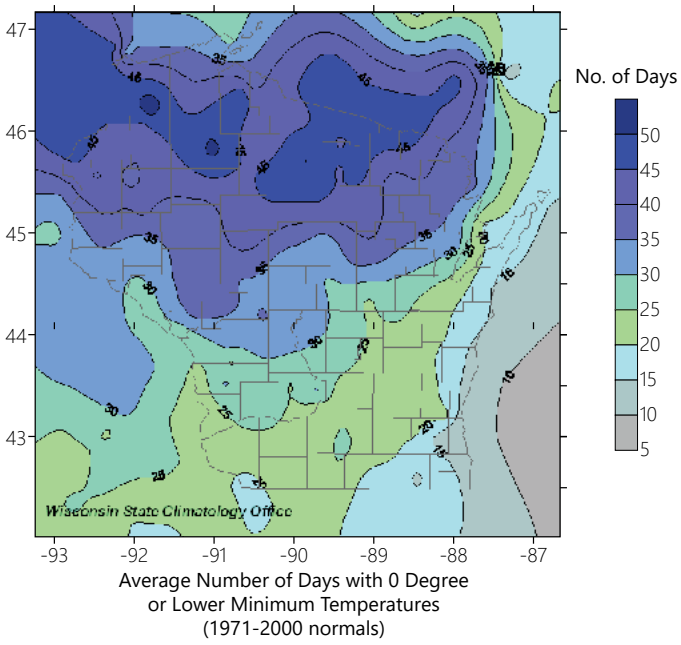
Another heat wave occurred in August of 2001. This excessive heat episode was the third, and longest, of the 2001 summer in south-central and southeast Wisconsin. Daytime heat indices reached 105°F to 110°F

and stayed above 80°F at night. Maximum air temperatures were in the lower to mid-90s, while dewpoints were in the mid-70s. Newspaper accounts indicated that dozens of people were treated at hospitals across south-central and southeast Wisconsin for heat-related illnesses and eight people died in the southeastern Wisconsin area.

July 2012 was the second warmest July on record with an average temperature of 79.4°F. There were four periods of heat waves during this month: July 3 through 6, July 16 through 17, July 23, and July 25 (see Table 3.19). High temperatures topped out between 98°F and 101°F, with dew points near 70 combining with the hot temperatures to produce heat index values between 100°F and 108°F across southeast Wisconsin. Temperatures in the Region reached 100°F or more six times during the month.

Between June 1995 and December 2017, about $38,863 in crop damages, in 2017 dollars, have been attributed to extreme heat.

Figure 3.5
Average Annual Number of Days in Wisconsin with Below Zero Degree Lows: 1971-2000



Source: State of Wisconsin Climatology Office and SEWRPC

Extreme Cold

An extended episode of bitter cold arctic air struck Southeastern Wisconsin on January 30, 1996, and continued through February 3, 1996. By the end of the cold-snap, the City of Milwaukee had a string of 73 hours of below zero temperatures, and Madison was below the zero-degree mark for 177 hours. In Ozaukee County, temperatures got down to -25°F with wind chills in the -35°F to -60°F range at times. There were four cold-weather related hypothermia deaths, and 18 reported frostbite injuries just to the south of Ozaukee County, in Milwaukee County. Numerous water main pipes burst and fiber optic cables froze, disrupting telephone service. Most schools were closed during this extreme cold snap.

Very cold wind chill values affected all of south-central and southeast Wisconsin during the evening hours of February 17, 2006, through the morning hours of February 18, 2006, in the wake of the winter storm on the previous two days. After daytime maximum readings mostly in the mid-20s over the southeast corner of the State on the afternoon of February 17, temperatures dropped overnight. The lowest temperature readings during the early morning hours of February 18 were 10°F in Racine County. Brisk west to northwest winds gusted to 17 to 23 mph and wind chills dropped to 20°F to -34°F.

Extreme cold temperatures and wind chills occurred over the four-day period of February 3-6, 2007, as a massive arctic high-pressure system pushed southeast through the western Great Lakes region, resulting in the coldest temperatures and lowest wind chills of the 2006-2007 winter season. The lowest minimum temperatures of the four-day period occurred on February 5, ranging from -1°F in Milwaukee to -26°F at the Lone Rock Airport in Sauk County. Maximum afternoon temperatures on February 5 topped out at -4°F in Port Washington. Wind chill values were as low as -34°F during the early morning hours on February 5th.

An arctic cold wave affected southern Wisconsin during the period of January 27 through 29, 2014. West to northwest winds of 10 to 20 mph combined with an arctic cold front brought wind chill temperatures of 20°F to 38°F, lasting through both days. Widespread school and business closings occurred during this time and the Governor declared a State of Emergency due to a propane shortage across the State. Numerous water main breaks and frozen laterals continued to occur throughout the entire month of January and two cold weather deaths occurred in the southeastern Wisconsin area.

Table 3.19
Extreme Temperature Events in Ozaukee County: July 1995 Through December 2017

Date	Type	Deaths	Injuries	Property Damages (2017 dollars)	Crop Damages (2017 dollars)
July 13, 1995	Extreme Heat	--	--	--	3,896
January 30, 1996	Cold/Wind Chill	--	--	--	1,934
January 31, 1996	Cold/Wind Chill	--	--	--	1,934
February 1, 1996	Cold/Wind Chill	--	--	--	1,934
June 29, 1996	Heat Wave	--	--	--	651
January 17, 1997	Cold/Wind Chill	--	--	--	4,098
November 28, 1998	Heat	--	--	--	--
December 1, 1998	Heat	--	--	--	--
January 5, 1999	Cold/Wind Chill	--	--	--	--
July 4, 1999	Heat	--	--	--	--
July 23, 1999	Heat	--	--	--	--
July 29, 1999	Heat	--	--	--	--
November 8, 1999	Heat	--	--	--	--
November 13, 1999	Heat	--	--	--	--
August 6, 2001	Heat	--	--	--	--
April 15, 2002	Heat	--	--	--	--
June 22, 2002	Heat	--	--	--	5,648
June 30, 2002	Heat	--	--	--	5,648
July 1, 2002	Heat	--	--	--	--
July 8, 2002	Heat	--	--	--	--
December 18, 2005	Cold/Wind Chill	--	--	--	--
February 17, 2006	Cold/Wind Chill	--	--	--	--
February 18, 2006	Cold/Wind Chill	--	--	--	--
July 30, 2006	Heat	--	--	--	--
August 1, 2006	Heat	--	--	--	23,009
February 3, 2007	Cold/Wind Chill	--	--	2,227	--
January 19, 2008	Cold/Wind Chill	--	--	--	9,094
January 30, 2008	Extreme Cold/Wind Chill	--	--	--	8,151
February 10, 2008	Extreme Cold/Wind Chill	--	--	--	--
December 15, 2008	Cold/Wind Chill	--	--	--	--
December 21, 2008	Cold/Wind Chill	--	--	--	--
January 14, 2009	Cold/Wind Chill	--	--	--	5,909
January 21, 2011	Cold/Wind Chill	--	--	--	--
July 17, 2011	Heat	--	--	--	11
July 20, 2011	Heat	--	--	--	--
June 28, 2012	Heat	--	--	--	--
July 3, 2012	Excessive Heat	--	--	--	--
July 16, 2012	Heat	--	--	--	--
July 23, 2012	Heat	--	--	--	--
July 25, 2012	Heat	--	--	--	--
January 21, 2013	Cold/Wind Chill	--	--	--	2,901
July 16, 2013	Heat	--	--	--	--
August 30, 2013	Heat	--	--	--	--
January 6, 2014	Extreme Cold/Wind Chill	--	--	--	--
January 27, 2014	Cold/Wind Chill	--	--	--	--
January 7, 2015	Cold/Wind Chill	--	--	--	--
January 9, 2015	Cold/Wind Chill	--	--	--	--
July 21, 2016	Heat	--	--	--	--
December 14, 2016	Cold/Wind Chill	--	--	--	--
December 18, 2016	Cold/Wind Chill	--	--	--	--
December 25, 2017	Cold/Wind Chill	--	--	--	--
Total	--	--	--	2,227	74,818

Table continued on next page.

Table 3.19 (Continued)

Note: Dollar Values were adjusted to year 2017 by the average annual Consumer Price Index (CPI) values from the U.S. Department of Labor, Bureau of Labor Statistics.

In some instances prior to 1995 the NCDC assigned one estimated total damage amount to all counties in the State that were affected by a particular hazard event. Those total damages were divided by the number of counties that were listed in the NCDC publication as being affected by that hazard event, and reported in this table as damages incurred by Ozaukee County.

In many instances damages from hazard events go unreported. This table represents estimated losses and should not be considered as an exact documentation of damages and losses incurred from a particular event or time period.

Source: National Climatic Data Center and U.S. Department of Agriculture Risk Management Agency

On January 31, 2019, an extreme cold event known as a "Polar Vortex" struck the Midwest, including Wisconsin. Numerous daily records and a few all-time records were broken throughout the Midwest. Schools, businesses, and government offices were closed throughout the Region for several days. The arctic air mass that settled over Wisconsin sent temperatures to as low as -20°F and wind chills to as low as -45°F. The U.S. Postal Service suspended mail delivery in Port Washington. For some locations in the upper Midwest, it was the coldest outbreak since the 1990s. Because this event occurred after the draft phase of this report, it is not included in Table 3.19.

Between June 1995 and December 2017, about $2,227 in property damages and $35,955 in crop damages, in 2017 dollars, have been reported in Ozaukee County because of extreme cold temperatures. These numbers, especially the property damage, are assumed to be largely underestimated. For example, damages and costs for municipalities to repair damaged infrastructure are likely not included in these estimates.

Vulnerability and Community Impact Assessment

Temperature extremes are primarily a public health concern. The poor and seniors are much more susceptible to temperature-related deaths and injury. Education, improved social awareness, and community outreach programs have likely helped to reduce the number of individuals killed or injured by extreme temperature events. Those at greatest risk are the very young, the very old, and the sick. Most deaths during a heat wave are the result of heat stroke. Large and highly urbanized cities can create an island of heat that can raise the area temperature by 3°F to 5°F. Therefore, urban communities with substantial populations of seniors. People with disabilities, and debilitated people could face a significant medical emergency during an extended period of excessive heat. Some residents in high crime areas, especially seniors, are afraid to open windows or go out to cooling shelters. As neighborhoods change, some older residents become isolated because of cultural, ethnic, and language differences.

The Building Resilience Against Climate Effects (BRACE) program in the Wisconsin Department of Health Services has compiled heat vulnerability index maps for the State and each county. The results of the Ozaukee County heat vulnerability index is shown in Figure 3.6. The heat vulnerability index is based on multiple indicators associated with risk for heat-related illnesses and mortality including health factors, demographic and household characteristics, natural and built environment factors, and population density. As indicated in Figure 3.6, areas within Ozaukee County that have the highest vulnerability to an extreme heat event include portions of the City of Mequon, the City and Town of Port Washington, the City and Town of Cedarburg, and the Villages of Grafton and Thiensville.

High demands for electricity can result in black outs and brown outs. Loss of water pressure can result from opening of fire hydrants in urban areas. Stagnant atmospheric conditions that occur with heat waves are also favorable for trapping ozone and other pollutants in urban areas and can cause respiratory problems for susceptible individuals. Pets and livestock can suffer from prolonged exposure to excessive heat or excessive cold.

Severe cold temperatures can cause breaks in water mains that can interrupt water supply. The impacts of a water main break depend on the size and location of the main. In some instances, a break may only affect a small local area. Other breaks may affect large portions of the distribution system. Water main breaks can also be costly to municipalities. Frozen service laterals can also interrupt water supply to individual buildings.

Figure 3.6
Ozaukee County Heat Vulnerability Index

Ozaukee County Heat Vulnerability Index

The Ozaukee County Heat Vulnerability* analysis was created by the Building Resilience Against Climate Effects program within the Wisconsin Department of Health Services. The data displayed in the map is meant to serve as an informational tool to better understand the spatial distribution of human populations most vulnerable to extreme heat related events.

Ozaukee County Vulnerability (county based quantiles)

by Census Block Group

Heat Vulnerability

- High (top 20%)
- Moderate High
- Moderate
- Moderate Low
- Low (bottom 20%)

* The Ozaukee County Heat Vulnerability Index is based on the Wisconsin Heat Vulnerability Index** but has a reduced number of health-related indicators. It is representative of the heat vulnerability in Ozaukee County, and is not representative of the vulnerability compared to the other counties in Wisconsin.

** The Wisconsin Heat Vulnerability Index is based on multiple indicators associated with risk for heat-related illness and mortality. The index analysis was created as a measure of vulnerability by U.S. Census block groups during an extreme heat event. The measure includes: health factors, demographic and household characteristics, natural and built environment factors (e.g., air quality, temperature, land cover) and population density.

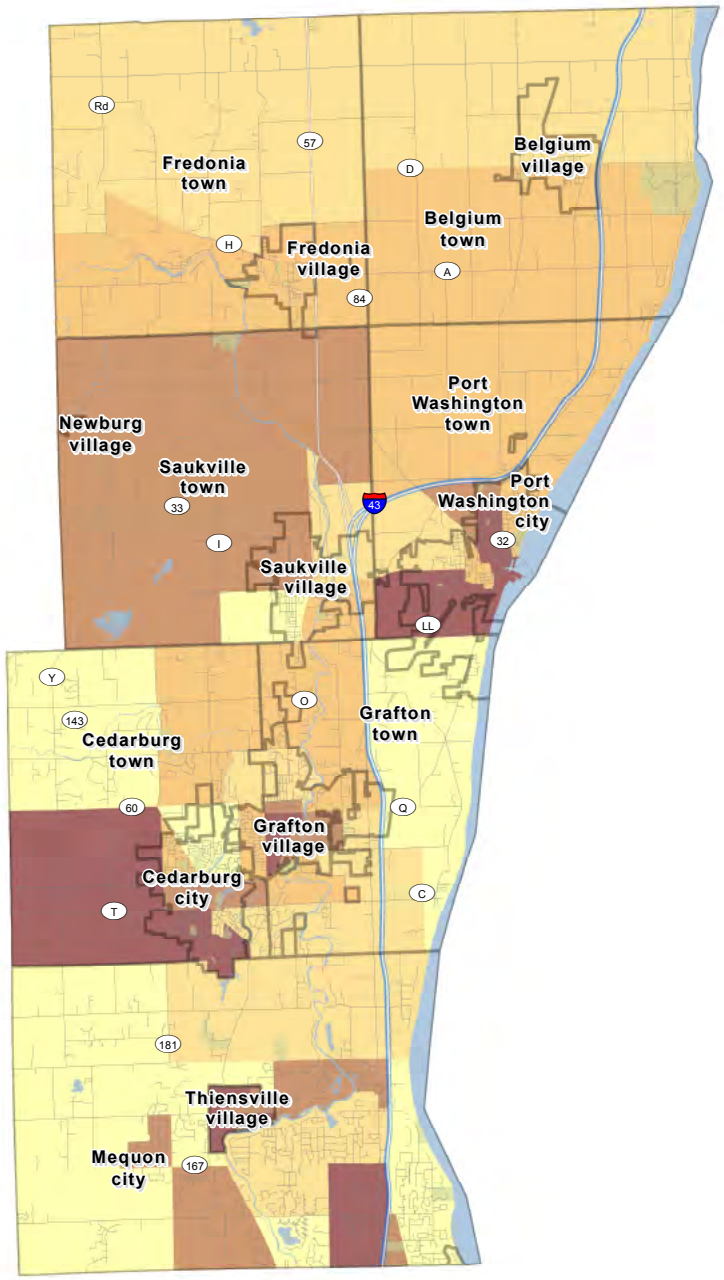
Reference Data

- Park / Forest
- Water
- Municipal Boundary

N

0 2

Miles



Map created by the Bureau of Information Technology Services in cooperation with the BRACE Program, Bureau of Environmental & Occupational Health, Division of Public Health, Department of Health Services, State of Wisconsin - P-01084 (8/2015)

Maps and related information are provided as a public service for informational purposes only. We make no warranties on the accuracy of content. Use of information from this document is at your own risk.

Property and crop damages have occasionally been reported as resulting from extreme temperature events. Table 3.19 shows that between 1995 and 2017, extreme temperature events have been reported as causing about $2,227 in property damages and $74,818 in crop damages (2017 dollars) in Ozaukee County. All of the property damages reported were from a single event. It is also important to note that the property damages reported do not include municipal damage costs and are assumed to be underestimates of actual damage caused by extreme temperatures as many damages often go unreported. On average, there are about 2.2 extreme temperature events per year in Ozaukee County. According to the NCDC storm events database over this period of record, extreme temperature hazards have resulted in about $3,253 in crop damages per year. It should be noted that before 1995 the NCDC recorded extreme temperature event data statewide, which was not included in this analysis because the focus was primarily Ozaukee County and its surrounding area (southeast Wisconsin).

A review of the community assets described in Chapter 2 indicate the potential for extreme temperature hazard events to impact: 1) residents at a countywide level, especially the poor, seniors, and sick, 2) agricultural croplands; 3) pets and livestock; 4) municipal water and electric utilities; and 5) natural surface and groundwater reserves. No specific cost data are estimated for temperature extreme events, because the nature of such events does not readily permit direct cost analysis.

The Ozaukee County Division of Emergency Management participates in the statewide public information campaigns for winter and heat "Awareness Weeks" each year and provides links to personal preparedness information in the County and public health websites.

Potential Future Changes in Extreme Temperature Conditions

Based upon recent historical data, Ozaukee County can expect to experience an average of 2.4 extreme temperature events per year. On average, these occur as 1.2 extreme heat events and one extreme cold event per year. While it would be expected that in some years the County will experience either fewer events or more events than the average number, the average annual number of events is not expected to change over the five-year term of this plan update.

According to research conducted by the Wisconsin Initiative on Climate Change Impacts (WICCI), 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°F. One 2003 report predicted that Wisconsin summers may become more like Illinois summers by the year 2030; by 2100, summer in Wisconsin could feel more like summer in present-day Arkansas.[103]

The projections based on downscaled results from climate models indicate that there will likely be substantial changes in the frequencies of extreme cold and extreme heat events over the 21st century.

As previously described, average summertime temperatures in Ozaukee County are projected to increase by 5.5°F by year 2055. The number of days per year in which temperatures in southern Wisconsin exceed 90°F is expected to double from about 12 to about 25 by 2055.[104] Peak temperatures in the area are likely to reach 110-112°F. The hottest day during the period from 2046 to 2065 is likely to be hotter than the historic hottest day on record from 1960 to 1999.[105] Public health officials and concerned citizens will be charged with the task of protecting the most vulnerable populations in the face of these changes.

Given that much of the documented increases in average temperature since 1950 have occurred through increases in night-time low temperatures, it is likely that there will be fewer night-time breaks in the heat during extreme heat events in the future. This could result in some extreme heat events persisting longer. Heat waves have direct impacts on human health, especially among sensitive populations such as young children, people with certain diseases, such as cardiovascular and respiratory illnesses, economically

[103] *Union of Concerned Scientists and the Ecological Society of America, Confronting Climate Change in the Great Lakes Region, 2003.*

[104] *Wisconsin Initiative on Climate Change Impacts,* Wisconsin's Changing Climate: Impacts and Adaptation, *Nelson Institute for Environmental Studies, University of Wisconsin-Madison and Wisconsin Department of Natural Resources, 2011.*

[105] State of Wisconsin Hazard Mitigation Plan, *December 2016*, op.cit.

disadvantaged individuals, and seniors. In the absence of mitigative measures, the projected increase in the frequency, duration, and severity of heat waves will be likely to cause increases in fatalities and illnesses related to extreme heat.

By contrast, the frequency of extreme cold events may decrease by the middle of the century. The projected warming trends are expected to be greatest during the winter. Average winter temperatures in Ozaukee County are projected to increase by about 7.5°F. This may result in a reduction of some risks associated with extreme cold.[106]

Multi-Jurisdictional Extreme Temperature Risk Management

Based upon a review of the historic patterns of extreme temperature events in Ozaukee County, there are no specific municipalities that have unusual risks. Rather, the events are of a uniform countywide concern.

3.7 VULNERABILITY ASSESSMENT FOR LAKE MICHIGAN COASTAL HAZARDS

The Lake Michigan coast in Ozaukee County consists of about 27 miles of shoreline, encompassing portions of six local units of government, including the Cities of Mequon and Port Washington, the Village of Bayside, and the Towns of Belgium, Grafton, and Port Washington. The portion of the Lake Michigan shoreline lying within the jurisdiction of each of these general-purpose local units of government is shown in Table 3.20. The land uses along the shoreline are shown on Map 2.9 in Chapter 2 of this Report.

There are three types of Lake Michigan coastal hazards of concern that pose risk to Ozaukee County:

- **Erosion of Coastal bluffs, beaches, and near shore lake beds**
- **Coastal Flooding** from high Lake Michigan levels and/or storm surge and storm-induced waves (i.e., wave run-up) causing damage to structures such as residences, businesses, and public facilities
- **Damage and failure of shoreline protection structures** (revetments[107], seawalls, and groins[108]) from wave action, storm surge, and varying lake levels

The main focus of this vulnerability assessment will be on the first two types of coastal hazards noted above; erosion of coastal bluffs and beaches and coastal flooding from high Lake levels and/or storm surge. With regard to the third hazard listed above—damage and failure of shoreline protection structures—there is little available information about the amount, location, and condition of shoreline protection structures in the County, particularly on privately owned coastal parcels. For this reason, this hazard will not be addressed at length in this assessment. It should be noted that there are structures and facilities, mainly in the City of Port Washington, that are protected by riprap revetments, bulkheads, sheet piling, and a breakwater system. The designs of these shore protection structures, most notably those protecting the sewage treatment plant, the marina, City water department, and the We Energies power plant, have applied standards suitable for major public and private facilities. In addition, these structures have been maintained as needed.

It is important to note that shoreline protection structures have been known to contribute to coastal problems by decreasing, or preventing, natural erosion of littoral material (lake bottom near shore) such as sand and gravel from existing shorelines. Additionally, these structures can disrupt the natural flow and deposition of those sediments along the lake shore, affecting beach ecosystems. Some shoreline protection structures may redirect wave energy to adjacent shorelines, which can increase the potential for erosion at neighboring sites.[109]

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[106] *Ibid.*

[107] *Revetments are sloping structures placed on banks or cliffs in such a way as to absorb the energy of incoming water (i.e., wave impact). Many materials may be used such as wooden piles, loose-piled boulders (i.e., riprap), concrete shapes, or geotextile fabric sand bags.*

[108] *A groin is a narrow structure (i.e., breakwater and/or jetty) built out into the water from a beach in order to prevent beach erosion or to trap and accumulate sediments that would otherwise drift along the beach face. A groin can be successful in stabilizing a beach on the up-drift side, but erosion tends to be aggravated on the down-drift side.*

[109] *University of Wisconsin Sea Grant,* Great Lakes Coastal Shore Protection Structures and Their Effects on Coastal Processes, *2013.*

Nearly 80 percent of Wisconsin's Lake Michigan shoreline is affected by coastal erosion and bluff recession to some degree, and recurring erosion presents a significant risk in almost every coastal county. The terms recession and erosion are often used interchangeably. Recession is the landward movement of a land feature, such as a bluff crest, while erosion is the wearing away of land. Recession is expressed as distance or a change in distance, while erosion is expressed as a volume or change in volume. Recession can be thought of as a consequence of erosion.[110] Shoreline recession rates are usually determined by comparing aerial photographs taken on different dates.

Table 3.20
Lake Michigan Shoreline Length of Civil Divisions in Ozaukee County

Civil Division	Lake Michigan Shoreline Length	Percent of County Total
Village of Bayside	0.39	1.4
City of Mequon	6.03	22.5
City of Port Washington	4.52	16.8
Town of Belgium	6.35	23.6
Town of Grafton	5.09	19.0
Town of Port Washington	4.48	16.7
Total	26.85	100.0

Source: SEWRPC

The rate at which coastal erosion occurs is dependent on a variety of factors including Lake Michigan level fluctuations, disruption of the transport of beach-building sediments, elevated groundwater levels, storms, and surface stormwater runoff. Additional contributing factors to coastal erosion can include soil composition, vertical cracks in the upper slope of the soil, shoreline ice cover, freezing and thawing cycles, shoreline orientation, beach composition, beach width and slope, the presence or absence of shore protection, and the type of shore protection.[111] Shores that have cohesive materials, such as clay, till, and bedrock have strong binding forces. Shores that have noncohesive materials, such as sand and/or gravel have weak or no binding forces. Like most of the Great Lakes Region, the soils in Ozaukee County are composed of sand, gravel, clay, and clay-like material known as glacial till. Much of the bluffs along the Ozaukee County coast are relatively high (50-200 feet) and are prone to landslides, slumping, surface rill erosion, and soil creep[112].

Lake Level Fluctuations

Lake level can be a significant factor in determining the rate of erosion along Wisconsin's coasts. As mentioned above, high Lake levels and increased wave action can worsen both coastal erosion and coastal flooding issues. As lake levels rise, bluff recession rates can also increase. Major storm events can also lead to high erosion rates because of increased wave action on the shoreline. The effects of wave-induced erosion are usually greater during periods of high Lake levels. Conversely, low Lake levels pose problems for facilities that are dependent on constant access to water, such as ports, marinas, and nearshore water utility intakes. Low water levels can also cause problems with shore protection structures, such as normally submerged timber pilings being exposed to air.

Water levels in the Great Lakes fluctuate seasonally, annually, and over multi-decade cycles. Seasonally, the lakes are at their lowest levels during the winter, when much of the precipitation is held on land in the form of snow and ice, and evaporation occurs over open water. The highest seasonal levels are during the summer when snowmelt from the spring thaw and summer rains contribute to the Lake water supply. For Lake Michigan in the 30-year-period between 1988 and 2017, the average difference between summer high water levels and winter low water levels has been about one foot.[113] Long-term variations in Lake levels (over multi decades) depend on climatic factors such as precipitation, the presence or absence of ice cover on the Lake during the winter, and evaporation of water from the Lake.

[110] *www.co.ozaukee.wi.us.*

[111] *U.S. Army Corps of Engineers-Detroit District, University of Wisconsin Sea Grant,* Living on the Coast: Protecting Investments in Shore Property on the Great Lakes, *2003.*

[112] *Soil creep (also known as downhill creep, or creep) is the slow and subtle downward progression of rock and soil down a low grade slope.*

[113] *This is a calculated average from monthly water levels obtained from the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory.*

Coastal hazard problems have been most evident in southeastern Wisconsin and Ozaukee County during high water periods. These have occurred in recent history on Lake Michigan in the early 1950s, the early 1970s, and the mid-1980s, with water levels in 2019 approaching the record set in 1986. As of December 2019, the water level in Lake Michigan was 2.7 feet above the long-term average, about 5.5 feet above record low levels that occurred in January 2013, and just under one foot below the record high levels that occurred in October 1986. Water levels in Lake Michigan from 1918 through 2019 can be seen in Figure 2.1 in Chapter 2 of this Report.

Description of Coastal Hazard Conditions and Assessments in Southeastern Wisconsin and Ozaukee County

Lake Michigan Shoreline Recession and Bluff Stability in Southeastern Wisconsin: 1995

As described in Chapter 2, an inventory of the shoreline conditions and bluff stability within the entire Southeastern Wisconsin Region was conducted in 1977[114] by a number of coastal technical consultants under the Wisconsin Coastal Management Program (WCMP) and again in 1995 for a study published in 1997 by SEWRPC in conjunction with the WCMP.[115] Information from the later study is summarized in Table 2.13 and includes bluff heights, bluff stability, shoreline recession, and beach width for each associated reach area. Bluff stability, bluff recession rates, and beach width are also shown on Map 2.10. The study found recession rates of up to 4.1 feet per year over the period 1963 to 1995 in the northern part of the County where low-lying beaches are common. Recession rates of up to 2.5 feet per year were found in southern portions of the County where tall bluffs line the lakeshore. In general, the study found Ozaukee County's bluff conditions to range from unstable to stable in 1995. However, of the 62 bluff stability profiles conducted in 1995, 42 percent were reported as unstable. Locations of unstable bluff conditions from the 1995-1997 study are shown on Map 3.10. These unstable areas are all south of the Belgium and Port Washington town line, and are scattered intermittently along the coast to the Ozaukee/Milwaukee County line. Communities that exhibited unstable bluffs during the 1995 surveys included—from south to north—the Village of Bayside, City of Mequon, Town of Grafton, and the City and Town of Port Washington.

Wisconsin Shoreline and Oblique Photo Viewer

WCMP, the Association of State Floodplain Managers (ASFPM), and Geo-Professional Consultants, LLC have developed a web mapping tool to view shoreline conditions along most of Wisconsin's Great Lakes coast. The Wisconsin Shoreline Inventory and Oblique Photo Viewer (shoreline viewer tool)[116] can be used to view and compare assessments on shoreline protection and shore and bluff conditions. Shoreline characteristics and conditions were derived from interpretation of oblique aerial photography of the Lake Michigan coastline taken in 1976 and 2007, performed by David M. Mickelson.[117] It should be noted that these interpretations represent conditions on the date that these photographs were taken and are limited by what can be seen in the photos.

In addition, geotagged oblique images can be viewed and compared on the shoreline viewer tool from 1976, 2007, 2010, 2016, and 2018. These images can be used with the interactive mapping tool to understand and evaluate how bluffs along the Ozaukee County coast have changed over a 42-year period.

Map 3.11 summarizes an assessment of the types of shore protection in the County in 2007, as provided on the shoreline viewer tool. Nearly 70 percent of the shoreline in Ozaukee County was unprotected in 2007. The most common type of shore protection in the County was poorly organized riprap or rubble (11.4 percent); followed by revetment (10.1 percent); seawall or bulkhead (6.7 percent); unknown armor types (1.9 percent); and offshore breakwater, groins, or jetties (0.1 percent).

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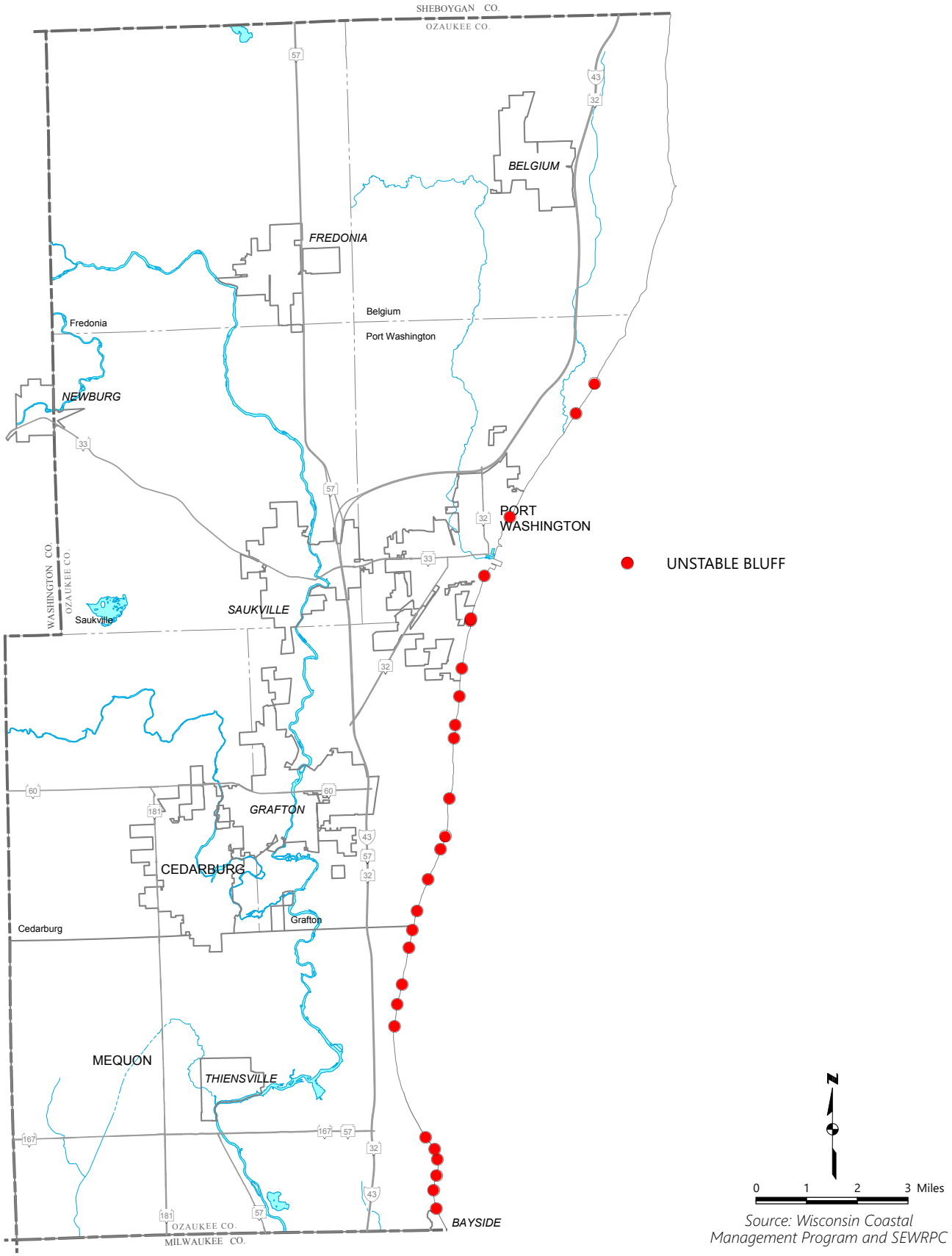
[114] *D.M. Mickelson, L. Acomb, N. Brouwer, T.B. Edil, C. Fricke, B. Haas, D. Hadley, C. Hess, R. Klauk, N. Lasca, and A.F. Schneider,* Technical Report, Shoreline Erosion and Bluff Stability Along Lake Michigan and Lake Superior Shorelines of Wisconsin, *Wisconsin Coastal Management Program, February 1977*.

[115] *SEWRPC Technical Report No. 36,* Lake Michigan Shoreline Recession and Bluff Stability in Southeastern Wisconsin: 1995, *December 1997*.

[116] *Floodatlas.org/asfpm/oblique viewer.*

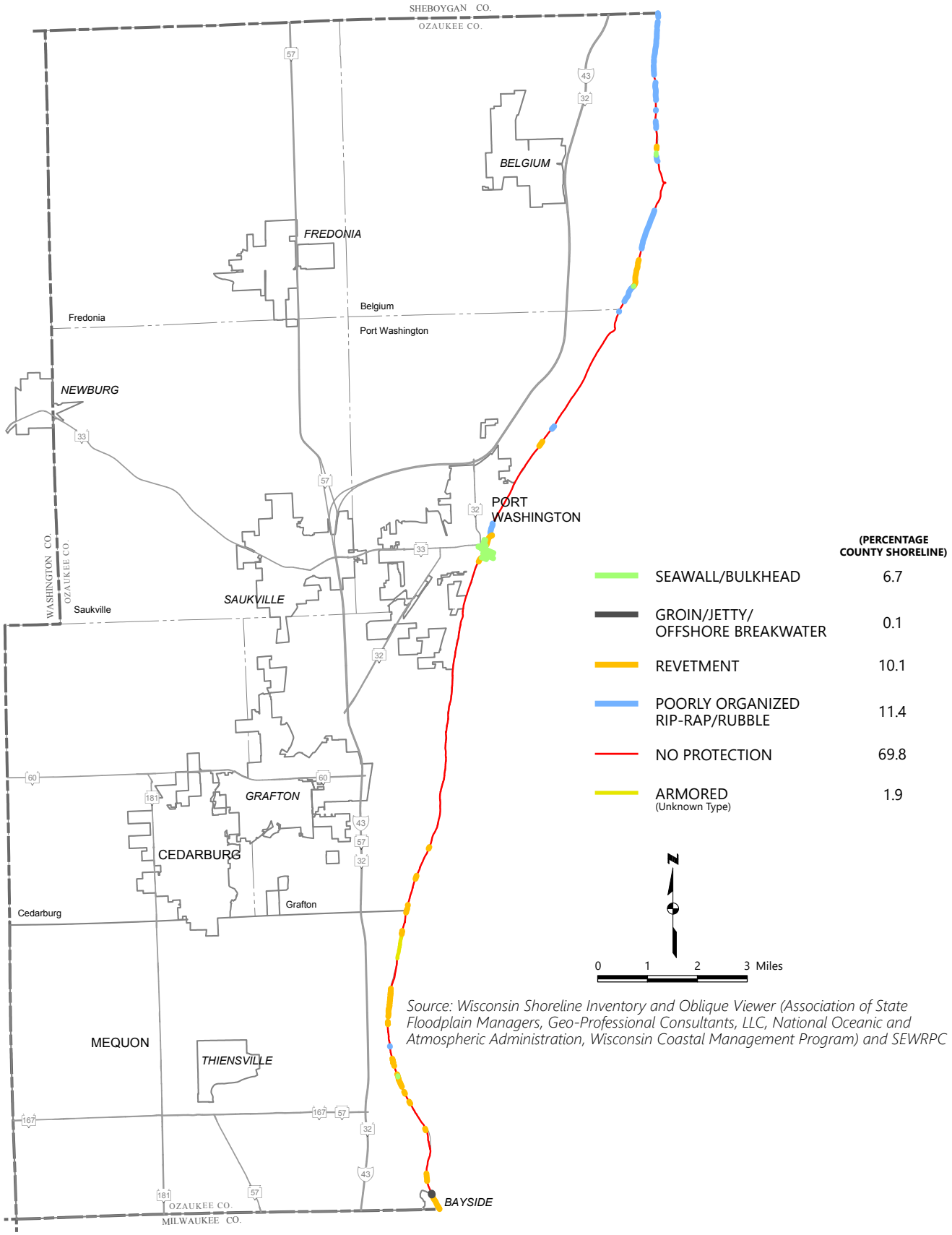
[117] *Mickleson, D and Stone J,* Wisconsin's Lake Superior and Lake Michigan Shoreline Oblique Photography: Analysis of Changes 1976 (78) to 2007 (08), A Report to the Wisconsin Coastal Management Program, *2012*.

Map 3.10
Locations of Unstable Bluff Conditions Within Ozaukee County: 1995-1997



Source: Wisconsin Coastal Management Program and SEWRPC

Map 3.11
Types of Shore Protection in Ozaukee County: 2007



Source: Wisconsin Shoreline Inventory and Oblique Viewer (Association of State Floodplain Managers, Geo-Professional Consultants, LLC, National Oceanic and Atmospheric Administration, Wisconsin Coastal Management Program) and SEWRPC

The shoreline viewer tool also provides insight into general conditions of Lake Michigan bluffs in 2007, as shown in Map 3.12. In 2007, 58.6 percent of Ozaukee County's shoreline was considered to have moderately unstable to unstable/failing bluffs (as shown in black and red on Map 3.12). According to the assessment, bluffs considered to be unstable or failing were located in the same municipalities—the Village of Bayside, City of Mequon, Town of Grafton, and the City and Town of Port Washington—as the 1995-1997 assessment. Map 3.13 specifies the types of bluff failure that was occurring at the time of the 2007 assessment. Shallow slides were the most common observed type of bluff failure, occurring at 34.7 percent of the assessed County shoreline, followed by deep seated slumps (25 percent), and creep failure (1.2 percent).

Long-Term (1956-2015) and Short-Term (1995-2015) Bluff Toe and Bluff Crest Recession

A recent analysis by the University of Wisconsin-Madison Coastal Sustainability and Environmental Fluid Mechanics Laboratory is also available to view on the shoreline viewer tool. The study measured long-term (1956-2015) and short term (1995-2015) bluff toe recession, bluff crest recession, and general shoreline recession along the shores of Kenosha, Milwaukee, Ozaukee, and Racine Counties.[118] Bluff recession distances were measured from historical aerial photos in Geographic Information Systems (GIS) software. The bluff crest, bluff toe, and shoreline were carefully traced on each aerial photo. The bluff crest is identified as the break in slope between the upland and the bluff slope; the bluff toe is identified as the break in slope between the bluff slope and the beach; and the shoreline is defined as the location that appears as the interface between the water and land at the time the photo was taken (see Figure 3.7). Once each feature was digitized, the Digital Shoreline Analysis System (DSAS) software was used to measure the location of each digitized feature along transect lines spaced at 10-meter intervals along the shoreline. Data in Maps 3.14 through 3.18 show recession distances that have been spatially averaged along 300-foot sections of coast. The data therefore represent average recession over a distance wider than a typical parcel or shoreline frontage and should not be interpreted as recession at a specific property.

This recession analysis can provide useful insights into the historic migration of the Lake Michigan coast in Ozaukee County. It should be noted that bluff recession can be sporadic. A bluff crest that remained unchanged for decades can recede many feet almost instantly due to a bluff collapse. This analysis represents how the bluffs have responded to historical environmental conditions and human actions over a specific time period. There will always be uncertainty in how bluff and shoreline recession will respond to future conditions.

Long-Term Bluff Toe and Crest Recession

As shown in Map 3.14, about 67.5 percent of the bluff toe in Ozaukee County has experienced at least some recession in the 59-year long term period from 1956 to 2015. Furthermore, about 32.5 percent of the County's bluff toe was estimated to have experienced significant recession of at least 20 feet to more than 60 feet, mostly observed in the southern half of the County. The most severe long term bluff toe recession has occurred in the City of Mequon and Town of Grafton (see Map 3.14). It is estimated that about 32.5 percent of the bluff toe in the County has either experienced no recession or has moved towards the Lake. It should be noted that accretion or small bluff toe recession distances may represent areas where the bluff crest has slumped towards the shoreline or where the construction of shore protection structures has advanced the bluff toe lakeward.

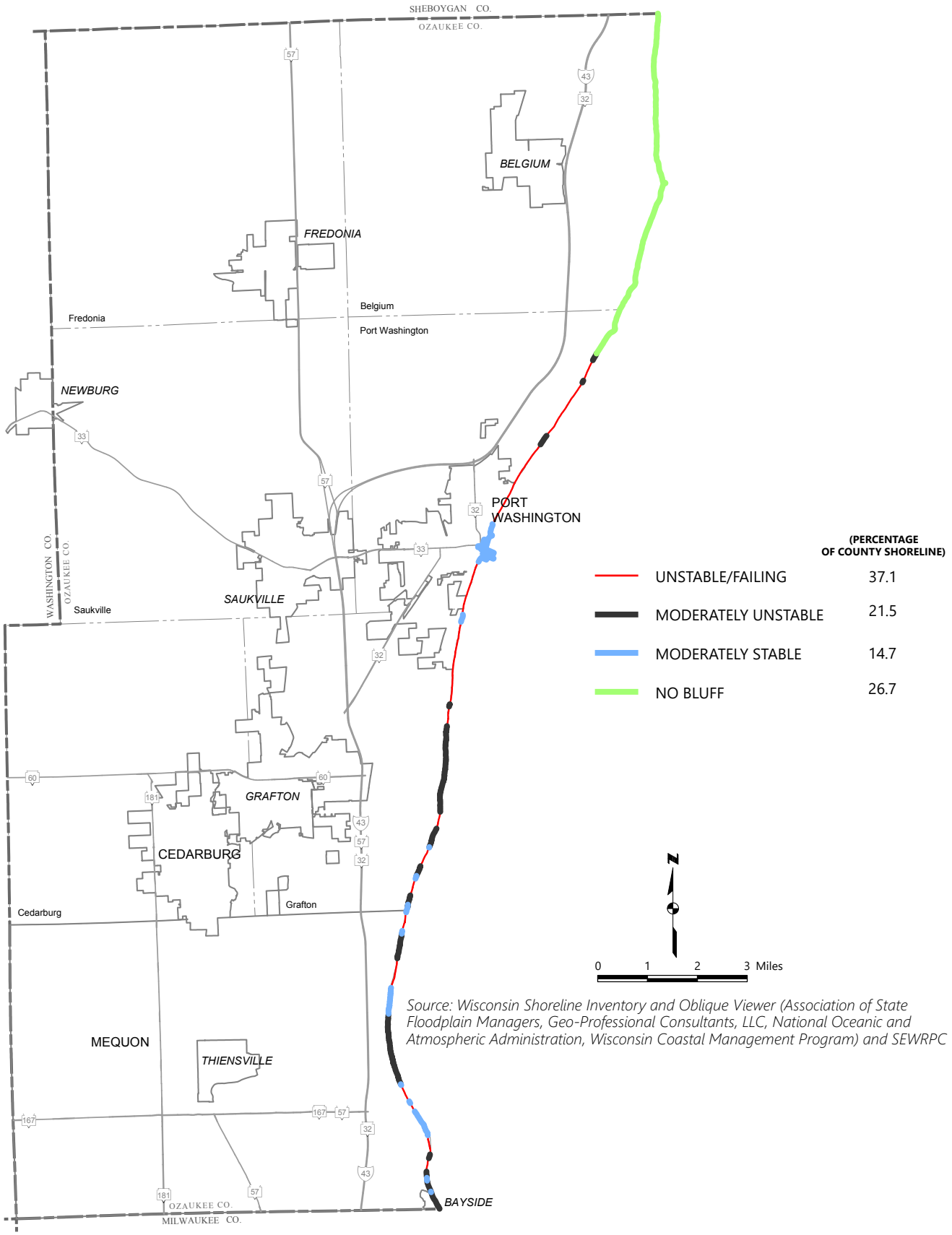
Map 3.15 shows long term bluff crest recession distances in the County. About 79.6 percent of the bluff crest in Ozaukee County has experienced at least some recession, with 58.9 percent experiencing at least 20 feet of retreat, and 16.4 percent experiencing more than 60 feet of recession. The largest bluff crest recession distances have occurred in the Village of Bayside, City of Mequon, Town of Grafton, and the City and Town of Port Washington. About 20.4 percent of the bluff crest in the County has had no recession or has experienced accretion, possibly due to fill added to the bluff in a slope stabilization project.

Short-Term Bluff Toe and Crest Recession

As shown in Map 3.16, about 42.6 percent of the bluff toe in Ozaukee County has experienced at least some recession in the 20-year short term period from 1995 to 2015, with most of that percentage experiencing 0 to 10 feet of bluff toe retreat. A few reaches in the City of Mequon and the City and Town of Port Washington

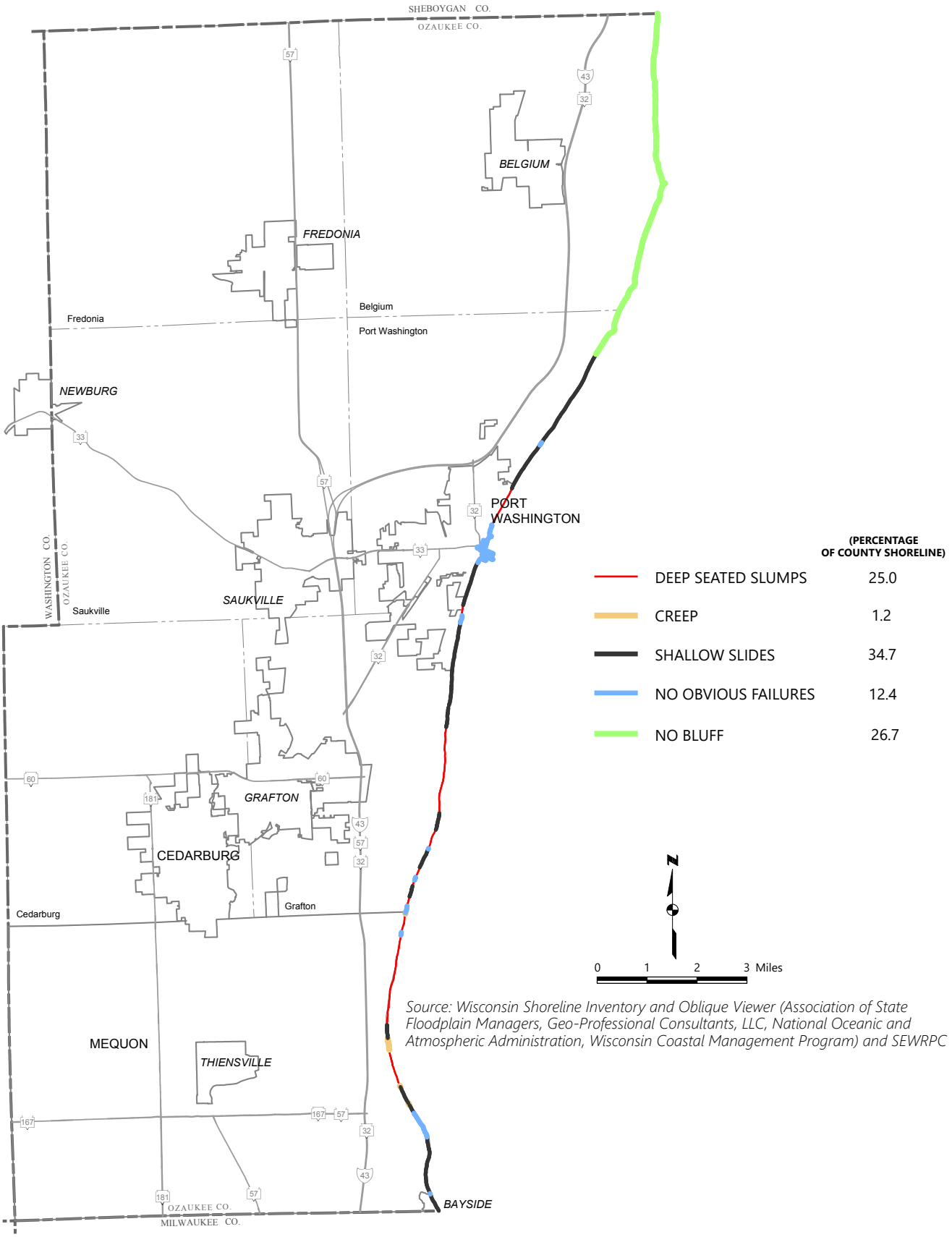
[118] *This study was funded by the Wisconsin Coastal Management Program and the National Oceanic and Atmospheric Administration, Office for Coastal Management.*

Map 3.12
General Bluff Conditions in Ozaukee County: 2007



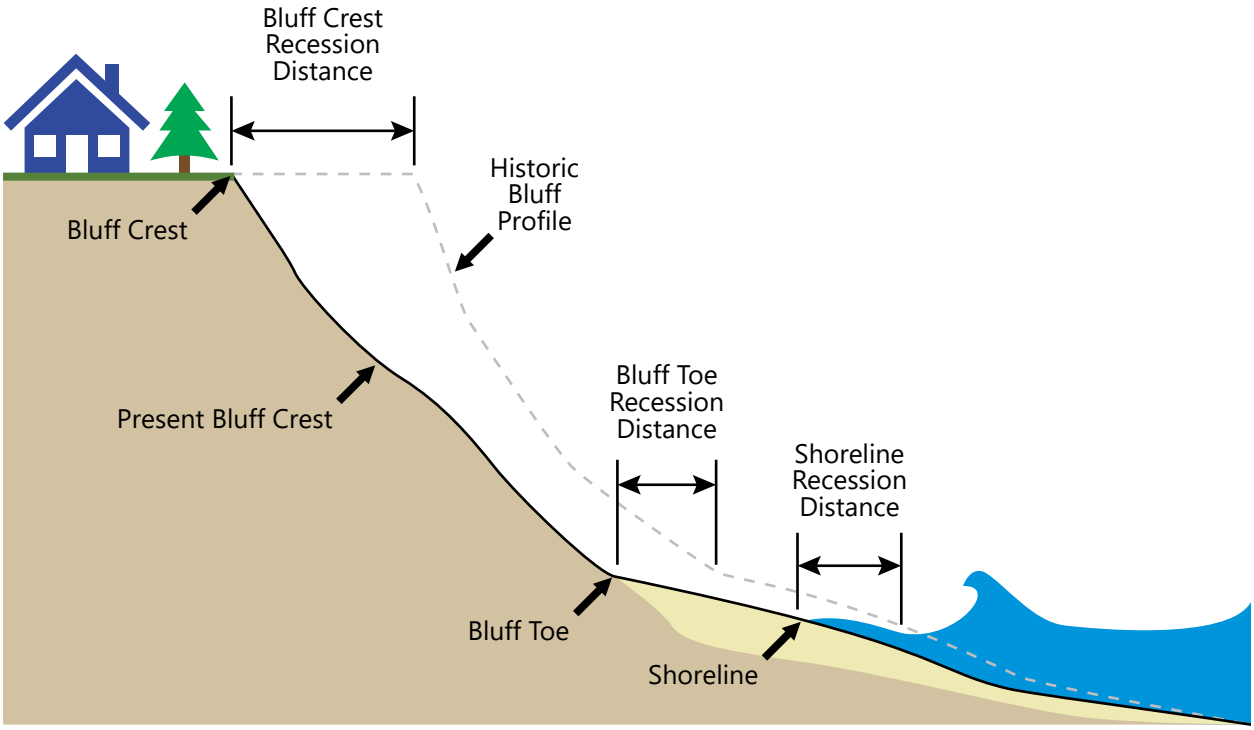
Source: Wisconsin Shoreline Inventory and Oblique Viewer (Association of State Floodplain Managers, Geo-Professional Consultants, LLC, National Oceanic and Atmospheric Administration, Wisconsin Coastal Management Program) and SEWRPC

Map 3.13
Types of Bluff Failure in Ozaukee County: 2007



Source: Wisconsin Shoreline Inventory and Oblique Viewer (Association of State Floodplain Managers, Geo-Professional Consultants, LLC, National Oceanic and Atmospheric Administration, Wisconsin Coastal Management Program) and SEWRPC

Figure 3.7
Bluff Recession Schematic



Source: Wisconsin Coastal Management Program and SEWRPC

have experienced bluff toe recession distances greater than 20 feet. It is estimated that 1.4 percent of bluff toe in the County has not seen any recession and 56 percent has experienced accretion. Again, it should be noted that bluff toe accretion may represent areas where material has slumped from the bluff crest above.

Map 3.17 shows short term bluff crest recession distances in Ozaukee County. About 81.4 percent of bluff crest data collected in the County has shown at least some recession in the 20-year short term period, 43.9 percent has experienced at least 10 feet of recession, and 11.8 percent has seen retreat of the bluff crest of more than 20 feet. Bluff crest recession distances greater than 20 feet have occurred in the City of Mequon, Town of Grafton, and the City and Town of Port Washington. Conversely, 18.6 percent of the bluff crest in Ozaukee County has either experienced no recession or accretion during this short term period.

Short-Term Beach Recession—Non-Bluff Coastal Areas

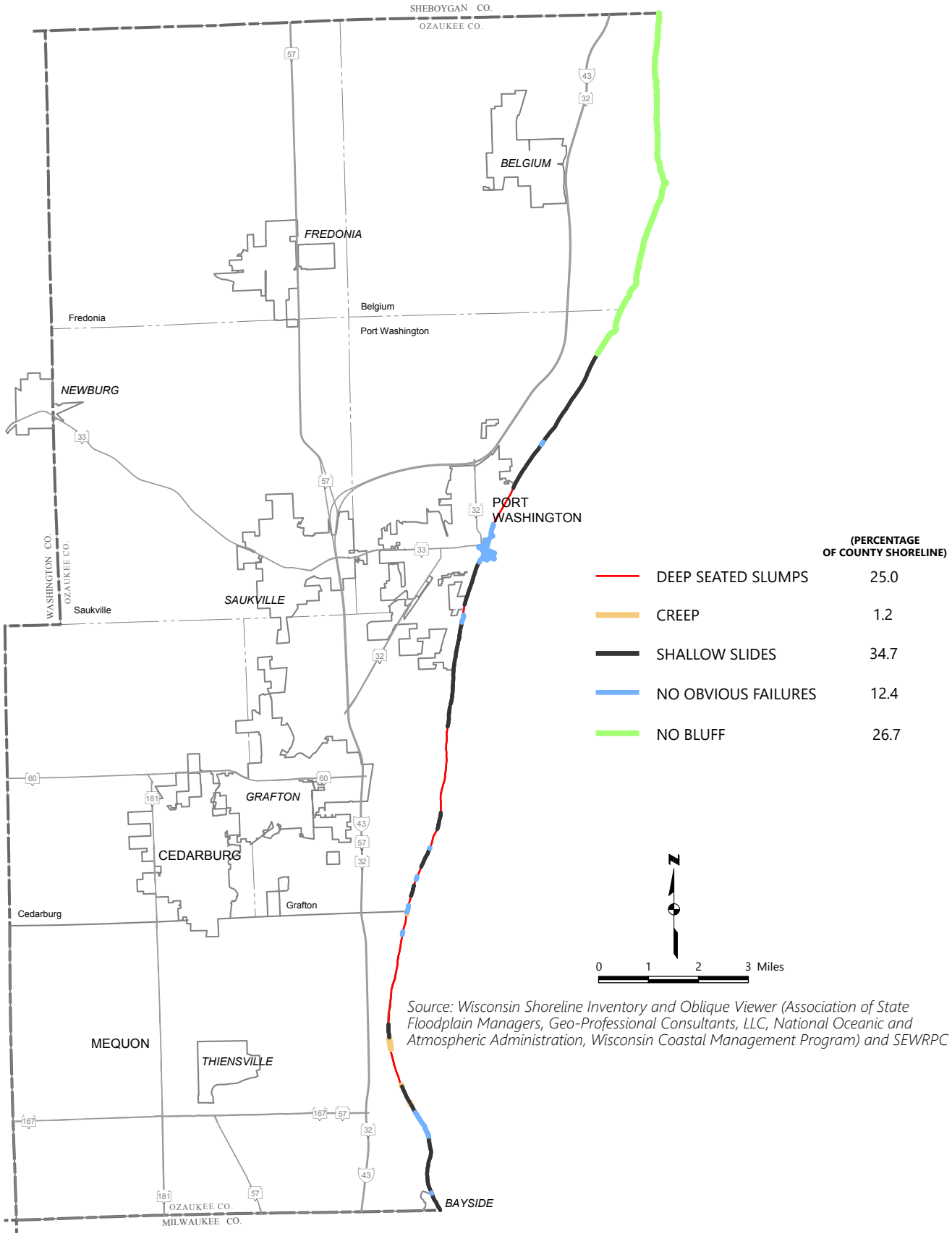
Map 3.18 shows short term (1995-2015) shoreline recession distances in the northern portion of the County where no bluffs are present (Town of Belgium and extreme northern portion of the Town of Port Washington). This analysis represents estimates of beach loss in these areas. Over this time period, about 23.3 percent of the assessed area experienced at least some beach recession. However, of those areas, about 16.4 experienced relatively small distances of recession of up to 10 feet. About 6.9 percent of the area assessed experienced more than 10 feet of shore recession, with less than one percent of the area experiencing greater than 20 feet of recession. A large portion of the shoreline studied during this time period experienced beach accretion. It should be noted that the short term period that was analyzed for this assessment ended in 2015 and Lake Michigan water levels have continued to increase. Anecdotal evidence also suggests that shoreline recession in the region shown in Map 3.18 has increased since 2015.

Potential Flood Damage for Coastal Areas

Coastal flooding tends to be most serious in the low-lying areas.[119] The risk of coastal flooding is reduced when lake levels are low, however other factors such as storm-induced winds and wave run-up can cause or exacerbate coastal flooding. Likewise, when lake levels are high, storm surge, wave height, and wave run-up

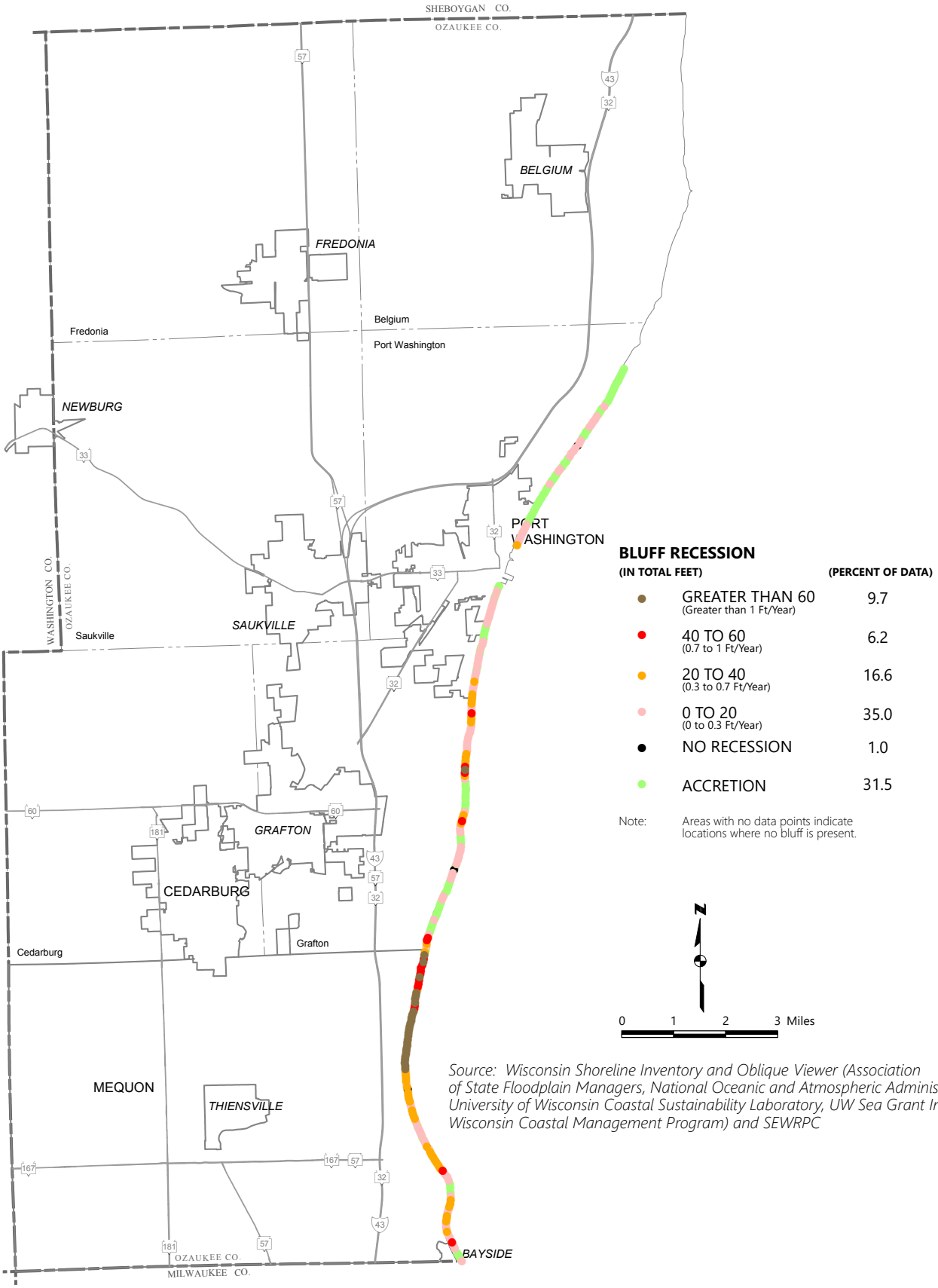
[119] *State of Wisconsin Hazard Mitigation Plan, December 2016, op.cit.*

Map 3.13
Types of Bluff Failure in Ozaukee County: 2007



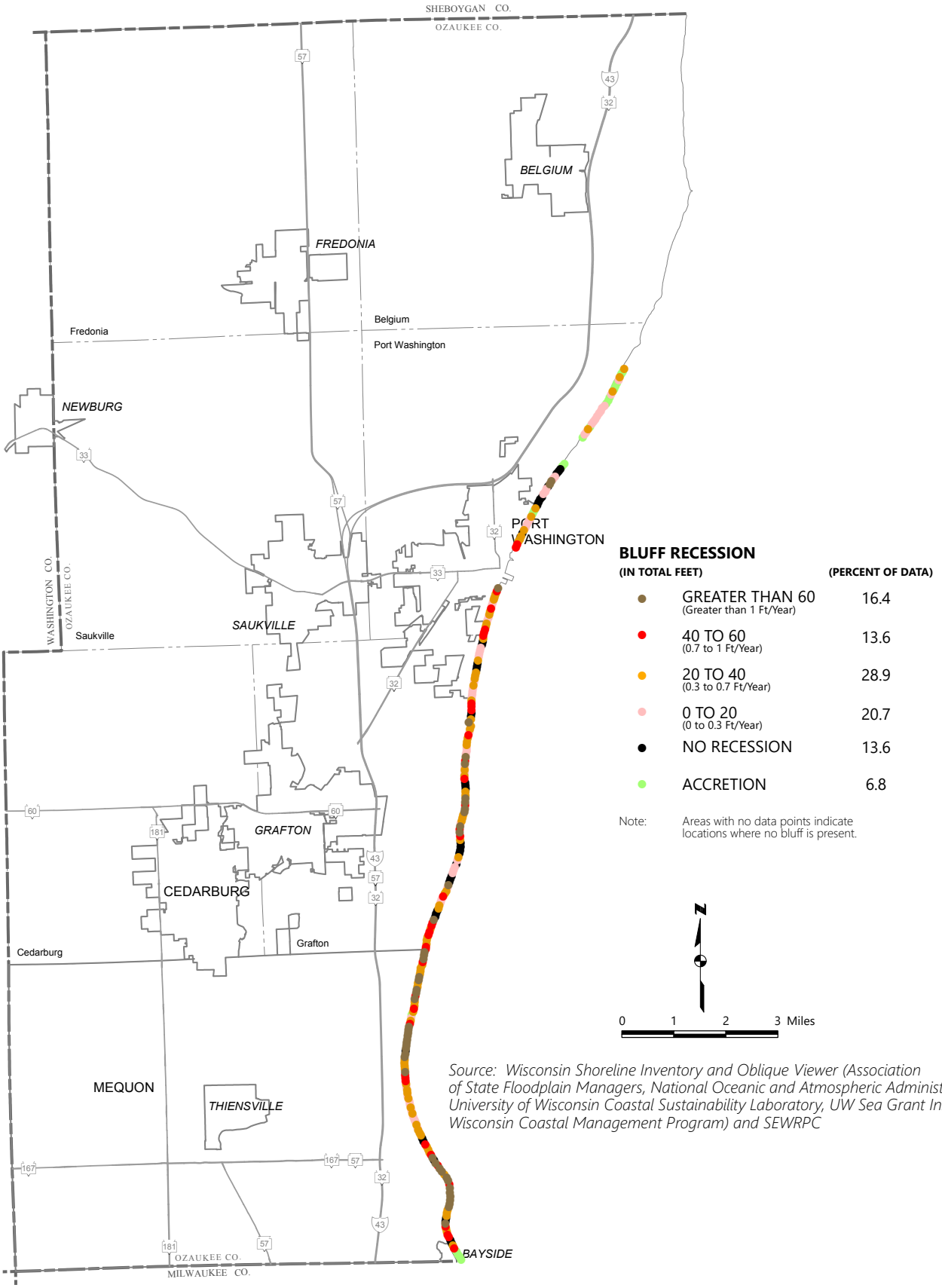
Source: Wisconsin Shoreline Inventory and Oblique Viewer (Association of State Floodplain Managers, Geo-Professional Consultants, LLC, National Oceanic and Atmospheric Administration, Wisconsin Coastal Management Program) and SEWRPC

Map 3.14
Long Term Bluff Toe Recession in Ozaukee County: 1956-2015



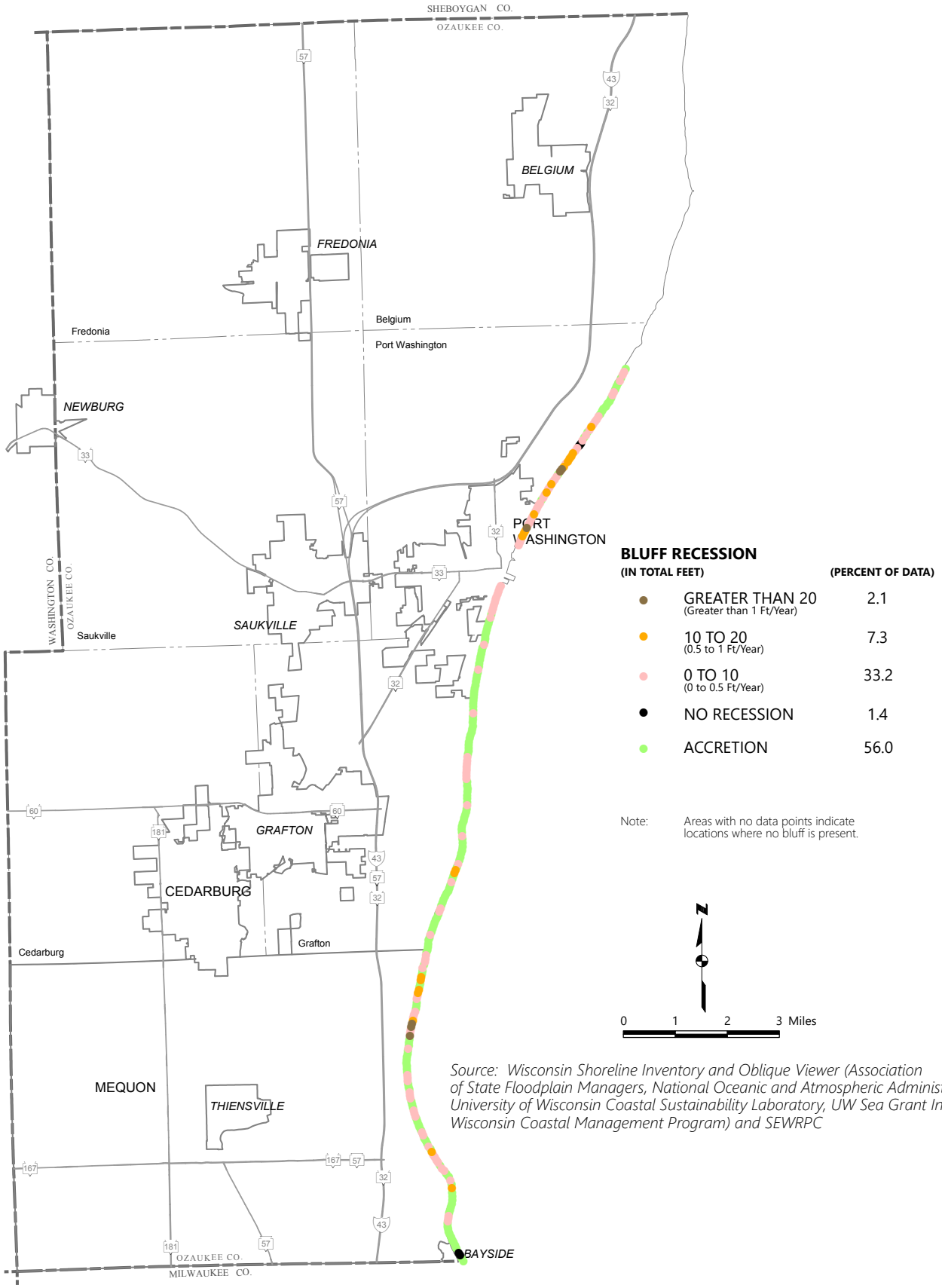
Source: Wisconsin Shoreline Inventory and Oblique Viewer (Association of State Floodplain Managers, National Oceanic and Atmospheric Administration, University of Wisconsin Coastal Sustainability Laboratory, UW Sea Grant Institute, Wisconsin Coastal Management Program) and SEWRPC

Map 3.15
Long Term Bluff Crest Recession in Ozaukee County: 1956-2015



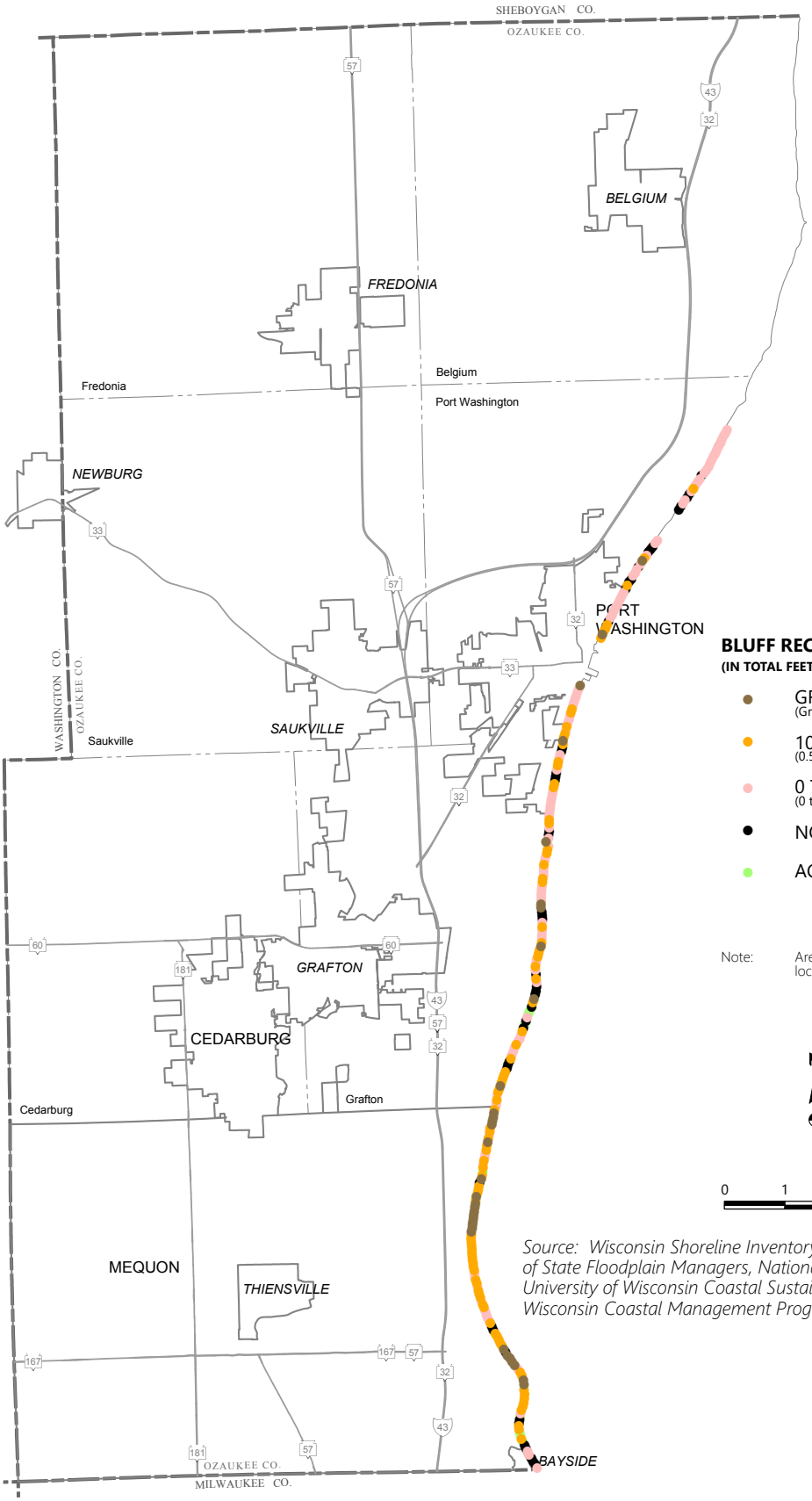
Source: Wisconsin Shoreline Inventory and Oblique Viewer (Association of State Floodplain Managers, National Oceanic and Atmospheric Administration, University of Wisconsin Coastal Sustainability Laboratory, UW Sea Grant Institute, Wisconsin Coastal Management Program) and SEWRPC

Map 3.16
Short Term Bluff Toe Recession in Ozaukee County: 1995-2015



Source: Wisconsin Shoreline Inventory and Oblique Viewer (Association of State Floodplain Managers, National Oceanic and Atmospheric Administration, University of Wisconsin Coastal Sustainability Laboratory, UW Sea Grant Institute, Wisconsin Coastal Management Program) and SEWRPC

Map 3.17
Short Term Bluff Crest Recession in Ozaukee County: 1995-2015



BLUFF RECESSION

(IN TOTAL FEET)	(PERCENT OF DATA)
GREATER THAN 20 (Greater than 1 Ft/Year)	11.8
10 TO 20 (0.5 to 1 Ft/Year)	32.1
0 TO 10 (0 to 0.5 Ft/Year)	37.5
NO RECESSION	15.7
ACCRETION	2.9

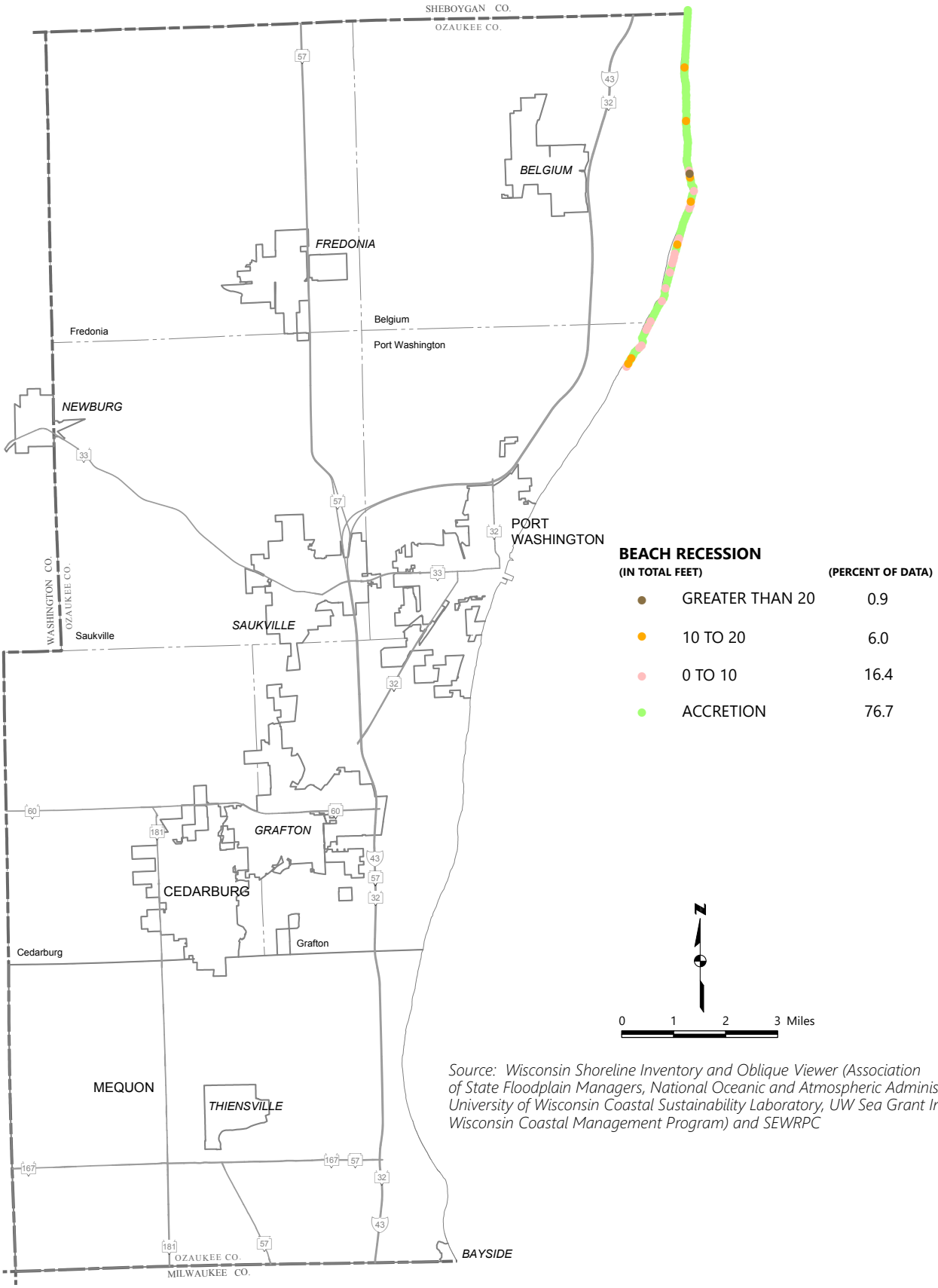
Note: Areas with no data points indicate locations where no bluff is present.

N

0 1 2 3 Miles

Source: Wisconsin Shoreline Inventory and Oblique Viewer (Association of State Floodplain Managers, National Oceanic and Atmospheric Administration, University of Wisconsin Coastal Sustainability Laboratory, UW Sea Grant Institute, Wisconsin Coastal Management Program) and SEWRPC

Map 3.18
Short Term Beach Recession in Ozaukee County: 1995-2015



Source: Wisconsin Shoreline Inventory and Oblique Viewer (Association of State Floodplain Managers, National Oceanic and Atmospheric Administration, University of Wisconsin Coastal Sustainability Laboratory, UW Sea Grant Institute, Wisconsin Coastal Management Program) and SEWRPC

also influence the severity of coastal flooding. Communities positioned on low terraces are at a medium-risk of flooding, whereas communities in the County located on high bluff areas are not vulnerable to coastal flooding.[120]

Ozaukee County's northern shoreline is low-lying with beach and sand dune ridges. Based on SEWRPC's parcel-based analysis, as described earlier in this Chapter, an estimated 92 parcels (mostly residential) and 116 structures were identified within Lake Michigan's 100-year recurrence interval floodplain (special flood hazard area). Assessed value of these structures in 2018 was estimated at about $16.3 million and more than $20.2 million when the value of contents is considered. The location of the parcels with structures within the flood hazard areas are shown on Map 3.19. Because of their proximity to the Lake and low lying position, these identified structures are vulnerable to coastal flooding and its associated hazards such as storm-induced winds or wave run-up. It is estimated that in the event of 100-year recurrence interval coastal flood, these structures would sustain about $2.21 million in damages ($1.89 million in direct damages, and $322,000 in indirect damages).

As mentioned in Chapter 2, the Great Lakes Coastal Flood Study (GLCFS)—an on-going collaboration between FEMA and the U.S. Army Corps of Engineers (USACE)—will soon complete mapping for coastal flood velocity zones (V Zones) for the Great Lakes. At this time, the Lake Michigan coast has flood Zones A or AE along much of its coast, including Ozaukee County.[121] Zones A and AE are typically inland (i.e., lakes and rivers) flood zones that do not account for wave action greater than 3 feet or storm surge. Zones V and VE represent the area along the coast that is subject to inundation by the one-percent-annual-probability flood with additional hazards associated to wave run-up greater than 3 feet above the base flood elevation (BFE). Note, Zones AE and VE have detailed hydraulic studies to determine the BFE (i.e., elevation data), while Zones A and V do not and are approximate flood Zones. Digital Flood Insurance Rate Maps (DFIRMs) showing the new coastal V and VE Zones for the Great Lakes should be available for Southeast Wisconsin within the life span of this plan.[122]

Description of Recent Coastal Erosion Hazard Events in Southeastern Wisconsin

- In the early 2000's, the Concordia University property located in the City of Mequon along 2,700 feet of Lake Michigan bluff, began to observe bluff erosion of nearly one foot per year, or the equivalent of 20,000 tons of sediment per year. Campus officials determined that the bluff erosion was threatening the safety of the campus, and in 2005 hired an engineering firm to formulate a plan and carry out a project to stabilize the bluff. The project included decreasing the slope of the bluff to a stable incline, installation of a drain tile system to "de-water" the bluff and ultimately reduce the pressure placed on the eroding soils, revegetating the bluff face, and installing stone revetments along the shore to protect the bluff toe from persistent wave action. Although the project was successful in reducing much of the erosion that was occurring on Concordia's bluff, it has caused some unintended consequences to neighboring properties to the south of the project site. With the new revetment armoring in place, sediment could no longer wash into the Lake and be transported to nourish down shore southern properties as it normally did prior to the project. Thus, properties down shore began to experience increased bluff erosion rates. Many of the neighboring properties immediately south of the Concordia property have since installed riprap revetment to slow erosion rates.

- In February 2011, a homeowner along the Lake Michigan coast in neighboring Sheboygan County began to notice that their bluff was starting to fail. By May 2011, the bluff crest had receded several feet. To prevent damage to the home, the owners relocated the house from its original location (about 165 feet from the bluff) to land across the highway from the Lake bluff. The relocation was completed in September 2011 for a total cost of $90,000 ($10,000 to move the structure and $80,000 to excavate and pour the foundation, purchase required permits, move utilities, and install a new septic system). Bluff instability on this property was likely caused by high groundwater conditions and poor stormwater management in the area.

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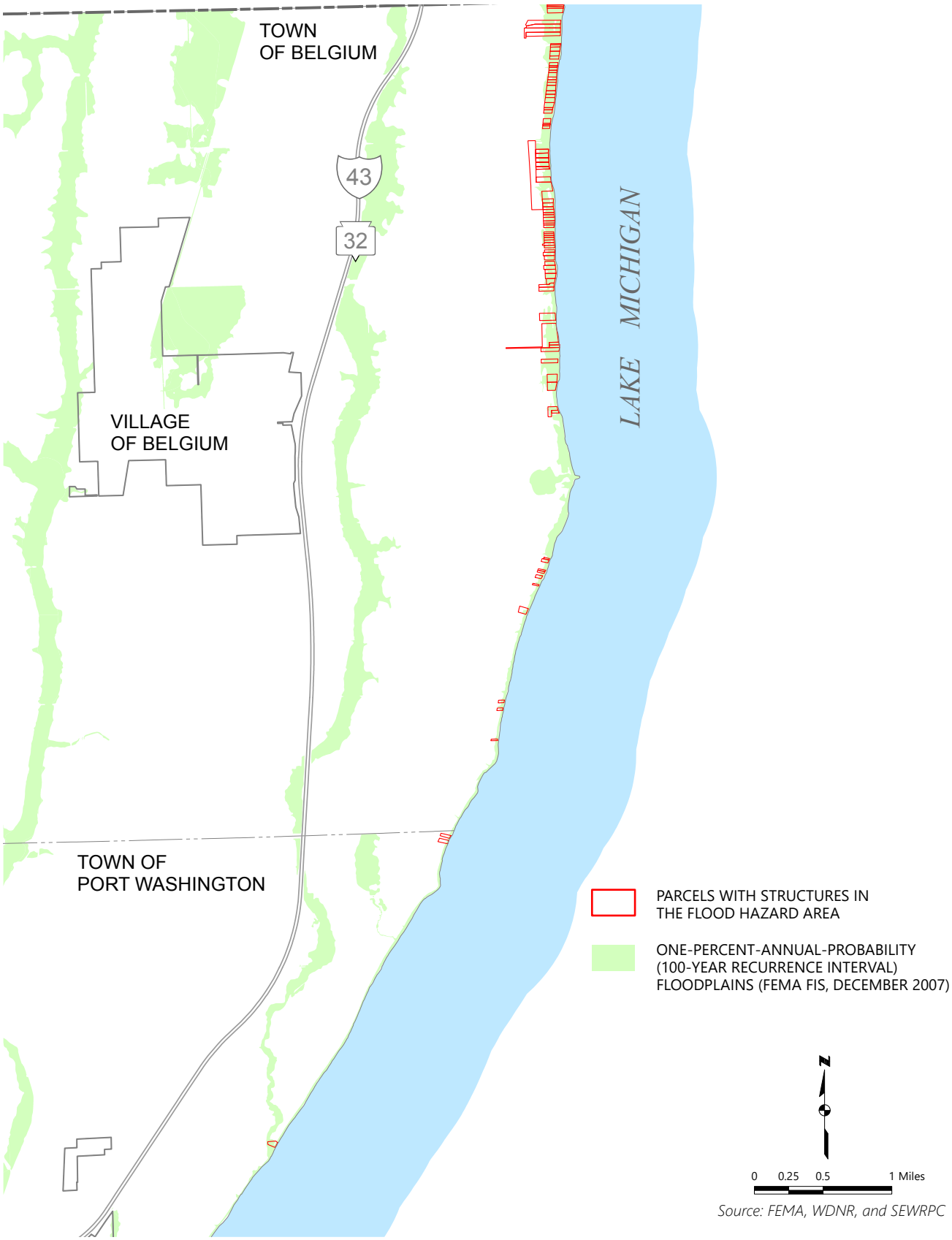
[120] *Ibid.*

[121] *Note that the Ozaukee County FIS indicates that the Lake Michigan coastal AE Zone floodplain elevations were based on wave run-up calculations.*

[122] *State of Wisconsin Hazard Mitigation Plan, December 2016, op.cit.*

Map 3.19
Location of Structures Along the Lake Michigan Coast that are Within the One-Percent-Annual-Probability Flood Hazard Area: 2015



Source: FEMA, WDNR, and SEWRPC

- Beginning in 2015, residents in the Lake Park neighborhood in the Village of Mount Pleasant (Racine County), whose homes reside on a bluff overlooking Lake Michigan, experienced significant erosion and bluff recession issues. The erosion has been caused by a combination of wave action reaching up the bottom of the bluff and groundwater seepage from the top of the bluff. Some property owners reported losing 40 feet or more of land due to the erosion. One home needed to be moved in April 2016, while another 10 to 12 homes were threatened by the receding bluff. In addition, public utilities and roads were at risk. Several homes in the Village of Caledonia were also at risk. In May 2016, the Racine County Executive issued a declaration of emergency to better position the County to receive State and Federal assistance as well as to make personnel and resources available to assist affected residents. In late 2018, a project was completed to stabilize and reinforce 750 feet of shoreline along the Mount Pleasant coastline.[123]

- On April 14, 2018, a prolonged period of strong northeast winds resulted in high waves crashing to the western shore of Lake Michigan. The winds were persistently strong from 25 to 35 mph for about 24 hours. Waves on Lake Michigan reached 15 feet as they crashed into the shore. These waves and high lake levels resulted in areas of lakeshore erosion in Ozaukee County. Damage was reported in Port Washington at the entrance to the breakwater structure which leads to the historic harbor lighthouse.

Vulnerability and Community Impacts Assessment

In 2016, Wisconsin Emergency Management (WEM) conducted a county-level coastal erosion risk and vulnerability assessment for the State. WEM used the newly-developed statewide parcel inventory (Wisconsin Statewide Parcel Database) as the basis for estimating the existing potential losses from Lake Michigan coastal erosion. Each parcel contained information such as total parcel value, improvement value, and property class. A GIS buffer analysis was conducted to identify parcels within one-quarter and one-half mile of the Lake Michigan coastline. Parcels within one-quarter of a mile from the coast were considered to be at high-risk, while parcels within one-half mile at low-risk. As a result, a total of 4,094 parcels were determined to be within the coastal risk erosion zones of Ozaukee County (see Table 3.21). Of those 4,094 identified parcels, 3,832 were classified as residential, 246 as commercial, and 16 as manufacturing. The low-risk zone has an estimated value of improvements of almost $659 million while the high-risk zone has a value of improvements of more than $360 million, for a combined total value of improvements around $1.02 billion. It should be noted that the high and low risk coastal zones are solely based on distance from the Lake Michigan shoreline. Steps already taken, such as shoreline protection structures, likely have reduced the coastal hazard risk to many of these structures.

In addition, the analysis described above has highlighted particular areas along the Ozaukee County coast that are of particular concern due to bluff toe and crest recession over time. These communities include (from south to north) the Village of Bayside, the City of Mequon, the Town of Grafton, and the City and Town of Port Washington.

Some low lying areas in the northern portion of the County where bluffs are not present have been susceptible to recent beach erosion and also contain structures vulnerable to a one-percent annual flood hazard event. These communities include the City and Town of Port Washington, and the Town of Belgium. As discussed above, the 116 structures identified as a possible risk to coastal flooding along the low-lying coastline in northern Ozaukee County had an estimated $1.89 million of potential direct damages and $322,000 potential indirect damages, for an estimated total of $2.21 million in total damages for a 100-year recurrence interval storm event.

A review of the community assets described in Chapter 2 indicate the potential for coastal hazard impacts to: 1) floodprone residential, commercial, and other developed land uses; 2) agricultural lands; 3) a limited extent of the roadway transportation system; 4) utilities associated with the potentially impacted roadways and structures; and 5) some utilities located immediately along the lakeshore. Utility facilities that are located directly adjacent to the Lake Michigan coast include the WE Energies Port Washington Power Plant, the Port Washington Water Department, and the Port Washington Sewage Treatment Plant. All of these facilities are currently protected by adequate shoreline protection structures, however, inspection, reevaluation, and

[123] *www.mtpleasantwi.gov/2439/Lake-Bluff-Stabilization-Project.*

Table 3.21
Parcels Within the Low and High Risk Coastal Erosion Zones in Ozaukee County: 2016

	Improved Parcels in Erosion Risk Zone				Value of Improvements (2016 dollars)			
Ozaukee County	Residential	Commercial	Manufacturing	Total	Residential	Commercial	Manufacturing	Total
Low-Risk Zone (within 0.5 miles)	2,556	154	13	2,723	561,999,600	85,203,700	11,789,700	658,993,000
High-Risk Zone (within 0.25 miles)	1,276	92	3	1,371	331,067,500	28,625,300	980,200	360,673,000
Total	3,832	246	16	4,094	893,067,100	113,829,000	12,769,900	1,019,666,000

Source: Wisconsin Emergency Management

maintenance of these protections on a routine basis should continue to be a priority. No significant impacts are expected to other infrastructure or utility systems, solid waste disposal sites, or hazardous material storage sites. A review of the mapping of critical community facilities, public safety facilities, and historic sites in the County indicate that there are two child care centers, three nursing home or assisted living facilities, four government buildings, three schools, a City of Port Washington Police and Fire Department building, and 11 historic sites (four being shipwrecks in Lake Michigan) within the 1/2 mile low risk coastal hazard zone. Critical facilities within the 1/4 mile high risk coastal hazard zone include two nursing home or assisted living facilities, three government buildings, one school and one university, and ten historic sites (including four shipwrecks in Lake Michigan). The names of these critical facilities within the high risk coastal zones are included in Table 3.22. As noted above, the high and low risk coastal zones are solely based on distance from the Lake Michigan shoreline. Steps already taken, such as shoreline protection structures, likely have reduced the coastal hazard risk to many of these structures.

A review of the Lake Michigan coastal erosion conditions within Ozaukee County indicates that there is a significant potential community impact as a result of the potential loss of land improvements and infrastructure in selected areas due to lakeshore erosion. A review of coastal flooding conditions within Ozaukee County indicates that there is a moderate potential community impact as indicated from the potential damages to structures within the one-percent-annual-probability flood hazard area along the northern coast of the County.

Potential Future Changes in Coastal Hazard Conditions

Changes in land use can have an impact on the potential for coastal erosion hazards to occur. Such changes relate to the potential future increase in coastal development within the erosion hazard areas, particularly when not accompanied by proper shore protection measures. Ozaukee County has adopted a structural setback ordinance, which states any applicants for new development on the coast must hire a certified engineer or surveyor to determine height of bluff and stable slope angle setback. All buildings must be set back a minimum of 75 feet from the top of bluff or the calculated stable slope angle setback, whichever is greater. The City of Mequon has an ordinance that calls for all permanent structures along Lake Michigan to be set back from the top of bluff at a distance based on a slope ratio of two feet horizontal to every one foot vertical from the toe of bluff, with all buildings set back a minimum of 75 feet from the top of bluff.

Lake Michigan water levels have risen more than four feet since January 2013, causing some residents in the County to witness significant erosion and bluff recession issues. In addition, climate change may lead to more drastic fluctuations in Lake Michigan water levels. Over the five-year period covered by this plan update, Lake Michigan water levels are expected to fluctuate but are currently higher than the long-term average. Potential future fluctuations in Lake Michigan water levels could lead to continued bluff failures, particularly in areas that have no shoreline protection, where shoreline protection structures are not maintained adequately, or where shoreline protection structures are not built to sufficient specifications to protect against fluctuating water levels. Mitigation measures to protect areas along the Lake Michigan coast are described further in Chapter 5.

Changes over the 20th century and projections based on downscaled results from climate models indicate that there will likely be changes affecting coastal conditions over the 21st century. Coastal areas have experienced, and are projected to experience, increases in air temperatures; increases in precipitation, especially during fall, winter, and spring months; and increases in the frequency of heavy precipitation events. Wind strengths have increased over the Great Lakes and are expected to continue increasing into

Table 3.22
Communities in Ozaukee County with Special Coastal Hazard Concerns

Community	Reason for Special Consideration
City of Port Washington	Unstable or failing bluffs; Short-term bluff toe and crest recession rates of more than one foot per year; Utility facilities located along the coast include a WE Energies Power Plant, the City Water Department, and the City Sewage Treatment Plant; Critical community facilities within the high risk coastal hazard zone include the Abundance of Life and Anita's Gardens nursing home/assisted living facilities, the Neiderkorn Public Library, the Ozaukee County Administration Center, the Port Washington City Hall and Post Office, and St. John XXIII Elementary School;[a] Historic sites within the high risk coastal hazard zone include the Edward Dodge House, Old Ozaukee County Courthouse, St. Mary's Roman Catholic Church, the Port Washington Light Station, the Port Washington Fire Engine House, the Port Washington Downtown Historic District, and four shipwrecks within Lake Michigan
City of Mequon	Unstable or failing bluffs; Numerous locations have observed recent bluff crest and toe recession rates more than one foot per year; Critical community facilities within the high risk coastal zone include Concordia University
Village of Bayside[b]	Moderately unstable bluffs; Short-term bluff crest recession rates of up to 0.5 feet per year
Town of Belgium	Low-lying coastal areas contain residential structures within the one-percent annual flood hazard area; Significant recent beach erosion has occurred
Town of Grafton	Unstable or failing bluffs; Short-term bluff toe recession rates up to one foot per year and crest recession rates of more than one foot per year
Town of Port Washington	Unstable or failing bluffs; Short-term bluff toe and crest recession rates of more than one foot per year; Areas with no bluffs have experienced significant recent beach erosion

[a] *Saint John XXIII Elementary School (Lower Campus) is approved and planned to be converted to at least 25 and up to 32 apartment units.*

[b] *Only the portion of the Village of Bayside within Ozaukee County was included in this analysis.*

Source: University of Wisconsin Coastal Sustainability Lab, Wisconsin Coastal Management, and SEWRPC

the future.[124] In addition, wind patterns over Lake Michigan have altered. Prevailing winds during summer months shifted from coming from the southwest during the 1980s to coming from the east after 1990.[125] These climatic changes are expected to influence Lake Michigan levels, coastal erosion, flooding, and shoreline stability, sometimes in complex ways. According to the NOAA Office for Coastal Management in 2015, "recent climate studies, along with the large spread in existing modeling results, indicate that projections of Great Lakes water levels represent evolving research and are still subject to considerable uncertainty."

For example, Lake Michigan is likely to be impacted by trends that act both to increase and to decrease water levels. Increased precipitation[126] will increase water contributions to the Lake. At the same time, increases in temperatures will lead to increases in evaporation of water from the Lake. The temperature increase will also result in reduced ice cover over the winter. This affects evaporation because ice cover on the Lake acts as a cap, reducing evaporation by preventing water vapor from escaping into the air. As a result of both of these processes, evaporation from the Lake is projected to increase. Methods of projecting lake levels in the mid to late 21st century have undergone a revolution in recent years. Older models had shown evapotranspiration from land as extremely sensitive to climate change. Scientist now know that those earlier analyses tended to overestimate the evapotranspiration effects. Recently, the general consensus, based on newer model projections for Great Lake levels anticipate a small drop or even a small rise in lake levels around the historic mean, in contrast to the large drops projected using the older models.[127] It should be noted that water levels in the Lake Michigan vary widely around their average, with high-water and low-water decades occurring. This variability is expected to continue.

[124] *Desai, Austin, Bennington, and McKinnley, 2009,* op.cit.

[125] *James T. Waples and J. Val Klump, "Biophysical Effects of a Decadal Shift in Summer Wind Direction over the Laurentian Great Lakes,"* Geophysical Research Letters*, Volume 29, pages 43-1 through 43-4, 2009.*

[126] *Wisconsin Initiative on Climate Change Impacts, 2011,* op. cit. *The WICCI report indicates there is a 75 percent probability that average annual precipitation will increase under mid-century climate change conditions.*

[127] *Environmental Law & Policy Center,* An Assessment of the Impacts of Climate Change on the Great Lakes*, Scientists and Experts from Universities and Institutions in the Great Lakes Region, page 21.*

While the hazard impacts associated with water level variations should be similar in type to those impacts currently resulting from water level variations, there may be some increase in the magnitude of these impacts. While low water levels may allow beaches and beach ridges to build and beach-anchoring vegetation to move toward the Lake, they may also adversely impact shipping, power generation, and tourism. It should be noted that long periods of low water levels may lead to erosion of the lakebed, which may allow storm-generated waves to reach farther inland when water levels rise. While high water levels may benefit communities, businesses, and industries that depend upon Great Lake waters for commercial shipping, hydro power, recreational boating, and tourism, higher water levels with increased storm frequency and intensity could increase shoreline and bluff erosion. This could increase damages to lakefront property and reduce the area extent of beaches.

Several other elements of climate change may also act to intensify shoreline erosional processes. Increases in wind strength over the Lake and changes in prevailing wind direction would be likely to lead to greater offshore wave development. This would produce higher waves along the coast. In addition, ice cover has declined across the Great Lakes region. Days where ice was present on the Great Lakes has declined by five days per decade over the period 1974 through 2004. Storms need open water in order for strong winds to produce large waves, this length of open water in which wind can travel is known as fetch. Ice cover reduces the fetch that a storm needs to produce waves, and can protect the shore from wave activity.[128] The strongest storms in the Great Lakes occur in the fall and winter, and reduced ice cover during these seasons could lead to increased fetch and the wave action along the coastline may increase.

Changes in several elements of climate may affect the stability of bluffs along the lakeshore. The amount of water contained in bluff soils is an important factor determining their stability. Friction between soil particles hold them in place. As water fills the spaces between these particles the friction between soil particles decreases, causing the soil to become more fluid and less stable. Higher lake levels and increases in 1) precipitation, 2) the frequency of heavy storms, and 3) the number of freeze-thaw cycles will all contribute to shoreline bluffs becoming less stable and more susceptible to slumping. Prolonged dry periods and droughts may also contribute to reduced stability of coastal bluffs. As bluff soils dry out, cracks in the soil can form, weakening the surface soil. During long-term droughts, these cracks can develop into deep fractures. Such fractures can allow surface water to penetrate deep into bluff soils. If heavy rainfall events occur following a drought, they may cause rapid saturation of dry, fractured bluff soils. This could cause a major slope failure.

Multi-Jurisdictional Coastal Hazard Conditions Risk Assessment

Shoreline erosion, bluff failure, and coastal flooding, when combined, present a high risk in Ozaukee County. As discussed above, coastal hazard risks are present in all seven local units of government in Ozaukee County along Lake Michigan. Areas of recent active erosion and bluff instability have been identified within the Cities of Mequon and Port Washington, the Village of Bayside, and the Towns of Grafton and Port Washington. Areas of the County where bluffs are not present have not been spared from coastal hazard conditions as beach recession has been observed in the Towns of Port Washington and Belgium. In addition, residential structures along the Lake in low-lying areas in the Town of Belgium may be susceptible to coastal flooding during a one-percent-annual-probability flood event. Communities at risk for coastal hazards, along with the basis for special consideration are listed in Table 3.22.

3.8 VULNERABILITY ASSESSMENT FOR WINTER STORMS

Winter storms can vary in size and strength and include heavy snow storms, blizzards, freezing rain, sleet, ice storms, and blowing and drifting snow conditions. Extremely cold temperatures accompanied by strong winds can result in wind chills that cause bodily injury, such as frostbite and death. A variety of weather phenomena and conditions can occur during winter storms. For clarification, the following are National Weather Service approved descriptions of winter storm elements:

- **Heavy Snowfall**—The accumulation of six or more inches of snow in a 12-hour period or eight or more inches in a 24-hour period.

[128] *Environmental Law & Policy Center,* An Assessment of the Impacts of Climate Change on the Great Lakes*, Scientists and Experts from Universities and Institutions in the Great Lakes Region, page 37.*

- **Blizzard**—An occurrence of sustained wind or frequent gusts 35 mph or higher accompanied by falling or blowing snow, and visibilities of one-quarter mile or less, for three or more hours.

- **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 surfaces, resulting in ice accumulations of one-quarter inch or more within 12 hours or less.

- **Freezing Drizzle/Freezing Rain**—The effect of drizzle or rain freezing upon impact on objects that have a temperature of 32°F 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 describes the combined effect of wind and low air temperatures on exposed skin.

Much of the snowfall in Wisconsin occurs in small amounts of between one and three inches per occurrence. Heavy snowfalls that produce at least eight to 10 inches of widespread accumulation happen on the average only once per winter season across southern Wisconsin. In addition, a snowfall event of six to eight inches usually occurs once per winter. The northwestern portion of Wisconsin receives most of its snow during early and late season storms, while the southwestern and southeastern counties receive heavy snows more often in midwinter. According to the National Weather Service, the 30 year average snowfall from 1981 through 2010 ranges from about 38 inches near Lake Michigan in Port Washington to about 46 inches in the extreme southwestern part of Ozaukee County. Lake Michigan can have both an enhancement effect and a dampening effect on snowfall totals in the County. Warmer water temperatures in the Lake can keep winter air temperatures on land near the lakeshore warm enough for precipitation to fall as rain where it may fall as snow only a mile further inland. On the other hand, lake effect snow bands can drop significant amounts of snow on nearshore communities, while areas slightly further inland may see none. Lake effect snow occurs when cold air moves across the relatively warm open waters of Lake Michigan, causing warm air and moisture to transfer into the lowest portion of the atmosphere, forming snow producing clouds.

Blizzard-like conditions often can occur during heavy snowstorms when gusty winds cause severe blowing and drifting of snow, even if the conditions did not last long enough to be considered a true blizzard. True blizzards are not common in Wisconsin. However, when they do occur, they tend to affect the eastern counties near Lake Michigan. Due to less frictional drag over Lake Michigan, northwest wind storms can reach higher speeds. According to the NCDC and shown in Table 3.23, Ozaukee County has experienced ten blizzard events during the period from 1959 to 2017.

Freezing rain, ice, and sleet storms can occur at any time from October into April. The majority of these storms occur in westcentral to northeast Wisconsin, based on data from 1982-2019 (see Figure 3.8). In a typical winter season there are three to five light freezing rain events in the southeastern Wisconsin region. On average, a major ice storm occurs about once every other year somewhere in the State, once every seven years over southeastern Wisconsin, and about once in every four years in west-central Wisconsin. If one-half inch of rain freezes on trees and utility wires, extensive damage can occur, especially if accompanied by high winds that compound the effects of the added weight of the ice. There are also between three and five instances of glazing (less than one-quarter of an inch of ice) throughout the State during a normal winter. According to NCDC data, Ozaukee County has experienced four ice storm events during the period from 1982 through 2016.

Historical Winter Storm Problems

Heavy snow and ice storms have been a part of nearly every winter in Ozaukee County history. Based on data reported in the NCDC severe weather database, it is estimated that there have been 169 major winter weather events reported during the 59-year period from 1959 through 2017 that have affected Ozaukee County (see Table 3.23).[129] As shown in Table 3.23, the number of these winter storm events can

[129] *It was not until 1996 that the NCDC database began to collect detailed information and data for individual counties that experienced a major winter events (i.e., blizzard, heavy snow, sleet, freezing rain, winter weather, winter storm). Information prior to 1996 is therefore spotty and often referenced from the NWS publication inventory.*

Table 3.23
Winter Events Recorded Within the Ozaukee County Area: 1950-2017

Date	Type	Property Damages (2017 dollars)	Crop Damages (2017 dollars)
December 23, 1959	Heavy Snow	5,823	--
March 4, 1964	Heavy Snow	49,384	--
December 25, 1965	Blizzard	48,452	--
January 26, 1971	Blizzard	4,165	--
February 5, 1974	Heavy Snow	2,969	--
February 21, 1974	Blizzard	296,875	--
April 2, 1975	Heavy Snow	--	--
January 25, 1976	Heavy Snow	--	--
March 2, 1976	Ice Storm	84,716	--
March 4, 1976	Ice Storm	2,941,528	--
March 3, 1977	Winter Storm	--	--
November 24, 1977	Heavy Snow	--	--
December 8, 1977	Heavy Snow	--	--
January 26, 1978	Heavy Snow	--	--
February 6, 1978	Heavy Snow	--	--
December 31, 1978	Heavy Snow	--	--
January 12, 1979	Heavy Snow	--	--
February 1, 1979	Heavy Snow	--	--
January 22, 1982	Winter Weather	--	--
March 20, 1982	Heavy Snow	--	--
December 31, 1984	Heavy Snow	--	--
February 3, 1986	Ice Storm	58,711	58,711
January 29, 1987	Winter Weather	--	--
December 14, 1987	Heavy Snow	--	--
January 25, 1988	Heavy Snow	--	--
March 17, 1989	Heavy Snow	--	--
February 15, 1990	Heavy Snow	--	141
December 2, 1990	Blizzard	--	--
January 10, 1991	Heavy Snow	--	--
December 2, 1991	Heavy Snow	--	--
January 13, 1993	Heavy Snow	--	--
February 20, 1993	Heavy Snow	--	--
February 12, 1994	Heavy Snow	--	--
April 30, 1994	Heavy Snow	--	--
December 5, 1994	Heavy Snow	--	--
January 20, 1995	Heavy Snow	--	1,741
February 26, 1995	Ice Storm	--	--
November 26, 1995	Heavy Snow	--	--
December 14, 1995	Ice Storm	--	--
January 5, 1996	Heavy Snow	--	--
January 16, 1996	Winter Weather	--	--
January 23, 1996	Heavy Snow	--	--
January 26, 1996	Heavy Snow	--	3,766
January 29, 1996	Blizzard	--	--
January 9, 1997	Heavy Snow	--	--
January 16, 1997	Blizzard	--	--
March 12, 1997	Heavy Snow	--	--
January 8, 1998	Winter Storm	--	--
January 2, 1999	Blizzard	7,324	--
March 9, 1999	Winter Storm	--	--
April 7, 2000	Winter Storm	--	--
December 11, 2000	Heavy Snow	--	7,993
December 18, 2000	Heavy Snow	--	7,993

Table continued on next page.

Table 3.23 (Continued)

Date	Type	Property Damages (2017 dollars)	Crop Damages (2017 dollars)
March 2, 2002	Heavy Snow	--	--
February 3, 2003	Winter Weather	--	--
April 4, 2003	Winter Storm	--	--
January 4, 2004	Winter Weather	--	--
January 16, 2004	Winter Weather	--	--
February 8, 2004	Winter Weather	--	--
December 18, 2004	Winter Weather	--	--
January 6, 2005	Winter Storm	--	441
January 22, 2005	Winter Storm	--	3,105
February 20, 2005	Winter Storm	--	--
February 16, 2006	Winter Storm	--	--
November 10, 2006	Winter Weather	--	--
December 1, 2006	Winter Storm	--	--
January 12, 2007	Winter Weather	--	--
January 14, 2007	Winter Weather	--	--
January 21, 2007	Winter Weather	--	--
February 13, 2007	Winter Weather	--	--
February 23, 2007	Winter Storm	--	900
February 24, 2007	Blizzard	--	900
February 25, 2007	Winter Storm	--	900
March 1, 2007	Winter Weather	--	--
March 2, 2007	Winter Weather	--	--
April 11, 2007	Winter Storm	11,137	--
November 21, 2007	Winter Weather	--	--
December 1, 2007	Winter Storm	--	--
December 4, 2007	Winter Weather	--	--
December 11, 2007	Winter Storm	--	--
December 15, 2007	Winter Weather	--	--
January 21, 2008	Heavy Snow	--	--
January 29, 2008	Winter Storm	--	8,152
February 5, 2008	Winter Storm	--	13,810
February 9, 2008	Winter Weather	--	--
February 11, 2008	Winter Weather	--	--
February 17, 2008	Ice Storm	4,451	--
March 21, 2008	Winter Storm	--	--
November 24, 2008	Winter Weather	--	--
November 30, 2008	Winter Storm	--	773
December 1, 2008	Winter Storm	--	773
December 3, 2008	Winter Weather	--	--
December 8, 2008	Winter Storm	--	86
December 16, 2008	Winter Weather	--	--
December 18, 2008	Winter Storm	--	6,421
December 21, 2008	Winter Storm	--	6,421
December 23, 2008	Winter Weather	--	--
December 24, 2008	Winter Weather	--	--
December 25, 2008	Winter Weather	--	--
December 27, 2008	Winter Weather	--	--
January 3, 2009	Winter Weather	--	--
January 12, 2009	Winter Weather	--	5,909
January 13, 2009	Winter Weather	--	5,909
February 21, 2009	Winter Storm	--	--
February 26, 2009	Winter Weather	--	--
March 28, 2009	Winter Storm	--	6,537
December 8, 2009	Winter Storm	--	--

Table continued on next page.

Table 3.23 (Continued)

Date	Type	Property Damages (2017 dollars)	Crop Damages (2017 dollars)
December 23, 2009	Winter Storm	--	--
January 7, 2010	Winter Storm	--	--
February 9, 2010	Winter Storm	--	--
December 9, 2010	Winter Weather	--	--
December 11, 2010	Blizzard	--	--
December 20, 2010	Winter Weather	--	--
January 17, 2011	Winter Weather	--	--
February 1, 2011	Blizzard	--	--
February 20, 2011	Winter Storm	--	--
February 21, 2011	Winter Weather	--	--
March 9, 2011	Winter Weather	--	--
December 29, 2011	Winter Weather	--	--
January 12, 2012	Winter Weather	--	1,870
January 17, 2012	Winter Weather	--	1,870
January 20, 2012	Winter Weather	--	5,392
January 22, 2012	Winter Weather	--	5,392
February 23, 2012	Winter Weather	--	--
March 2, 2012	Winter Storm	--	1,777
December 20, 2012	Winter Storm	--	--
January 27, 2013	Winter Weather	--	19,827
January 30, 2013	Winter Weather	--	19,827
February 7, 2013	Winter Storm	--	--
February 22, 2013	Winter Weather	--	--
February 26, 2013	Winter Storm	--	11,861
March 5, 2013	Winter Weather	--	--
March 15, 2013	Winter Weather	--	20,996
March 18, 2013	Winter Weather	--	20,996
November 25, 2013	Winter Weather	--	--
December 8, 2013	Winter Weather	--	--
December 19, 2013	Winter Weather	--	--
December 22, 2013	Winter Storm	--	--
January 2, 2014	Winter Weather	--	--
January 10, 2014	Winter Weather	--	--
January 14, 2014	Winter Storm	--	--
January 24, 2014	Winter Weather	--	--
January 26, 2014	Winter Weather	--	2,628
January 26, 2014	Winter Weather	--	2,628
February 13, 2014	Winter Weather	--	1,186
February 17, 2014	Winter Storm	--	5,789
November 22, 2014	Winter Weather	--	2,579
November 28, 2014	Winter Weather	--	11,158
December 18, 2014	Winter Weather	--	70,500
January 3, 2015	Winter Weather	--	--
January 8, 2015	Winter Weather	--	--
February 1, 2015	Winter Storm	--	--
November 20, 2015	Winter Weather	--	--
December 28, 2015	Winter Storm	--	--
March 1, 2016	Winter Weather	--	--
March 24, 2016	Winter Weather	--	--
April 2, 2016	Winter Weather	--	7,291
April 8, 2016	Winter Weather	--	7,291
December 4, 2016	Winter Weather	--	--
December 10, 2016	Winter Storm	--	--
December 16, 2016	Winter Storm	--	--

Table continued on next page.

Table 3.23 (Continued)

Date	Type	Property Damages (2017 dollars)	Crop Damages (2017 dollars)
January 10, 2017	Winter Weather	--	--
January 11, 2017	Winter Weather	--	--
January 16, 2017	Winter Weather	--	--
January 24, 2017	Winter Weather	--	--
February 24, 2017	Winter Weather	--	--
March 1, 2017	Winter Weather	--	--
March 12, 2017	Lake-Effect Snow	--	--
December 13, 2017	Winter Weather	--	--
	Total	3,515,535	360,371

Note: Dollar Values were adjusted to year 2017 by the average annual Consumer Price Index (CPI) values from the U.S. Department of Labor, Bureau of Labor Statistics.

In some instances prior to 1995 the NCDC assigned one estimated total damage amount to a region or all counties in the State that were affected by a particular hazard event. Those total damages were divided by the number of counties that were listed in the NCDC publication as being affected by that hazard event, and reported in this table as damages incurred by Ozaukee County.

In many instances damages from hazard events go unreported. This table represents estimated losses and should not be considered as an exact documentation of damages and losses incurred from a particular event or time period.

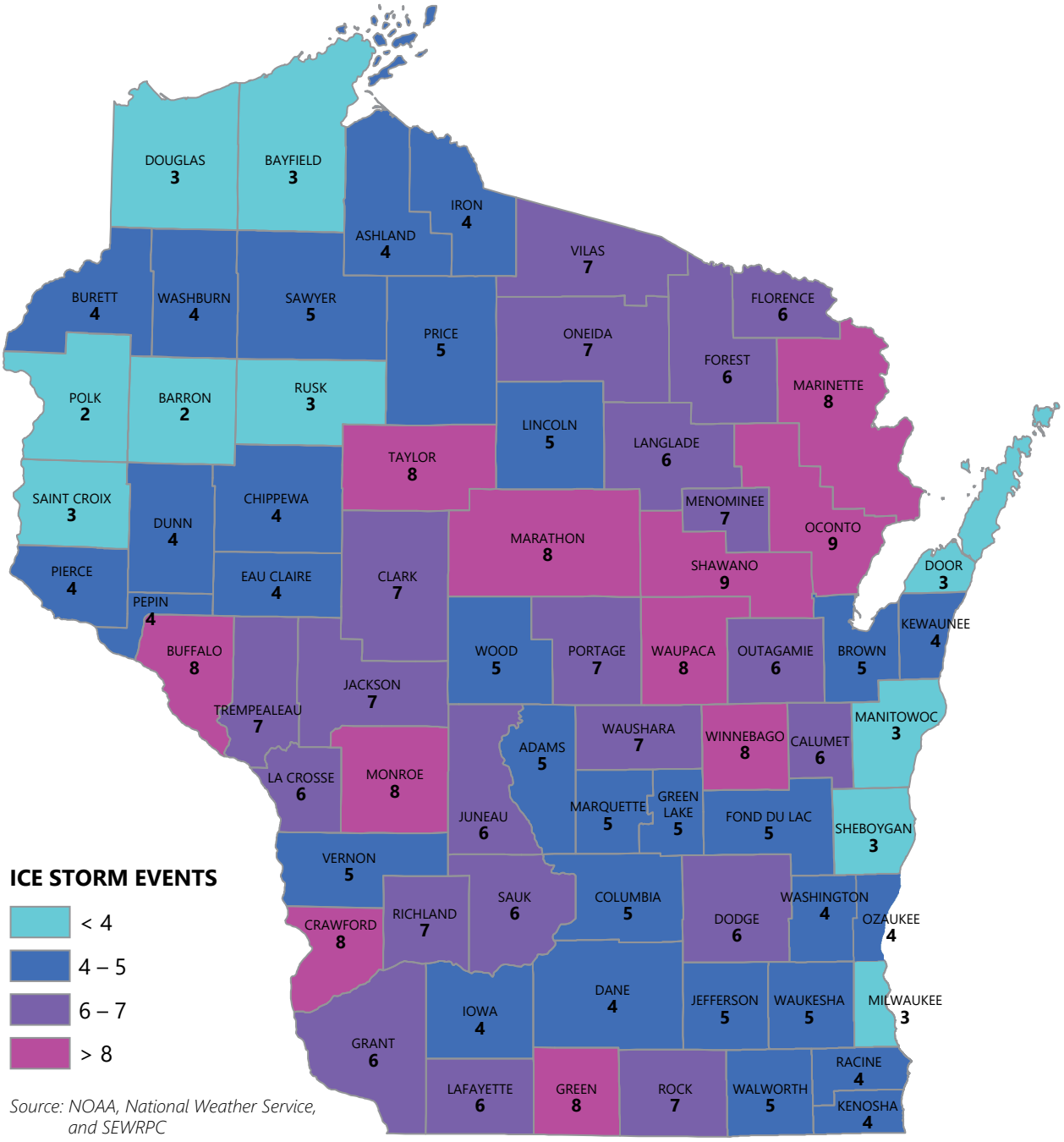
Source: National Climatic Data Center

range from one event per year up to 19 events per year, which demonstrates the high unpredictability of these events. This also highlights the inconsistency in reporting of the occurrence of winter storm events in the NCDC database. All of these reported storms contained some form of snow, sleet, freezing rain, ice, or slippery road conditions. There have been no deaths or injuries directly attributed to winter storm events in Ozaukee County, but it can be assumed that winter storm conditions have indirectly resulted in many injuries and deaths over time. A heavy snowstorm may cause schools and businesses to close, delay or cancel airline flights, and create treacherous roadway travel conditions. The NCDC reported almost $3.9 million in estimated property and crop damages have occurred within the County due to winter storm events. Because of this, it is important to review past events to help prepare for future major winter events in Ozaukee County.

A severe ice storm on March 4, 1976, affected most the southern and eastern portions of eastern Wisconsin, while heavy snow and sleet hit central regions and blizzard conditions hit the northwest region. Some of the areas, previously hard hit by the freezing rain on March 1 and 2, were hit again by this severe ice storm. This event caused heavy damage, which included hundreds of completely snapped utility poles, thousands of downed power and telephone lines, and many trees totally destroyed by massive ice accumulations. Some ice accumulations ranged up to five inches in diameter on wires and limbs of trees. On March 5, the already critical ice storm situation was complicated by strong winds, gusting above 50 mph. Up to 600,000 residents in the State were directly affected by the ice storm and up to 100,000 people were without power. The Governor declared the ice storm as one of the worst natural disasters to hit Wisconsin in history. According to Sheriff Departments, local Emergency personnel, state surveys, and newspapers, damage estimates from this ice storm were more than $50.4 million statewide (1976 dollars). This figure includes: $17.2 million in agricultural losses, $13.7 million in private utility damage, $8.4 million in damage to local government property and related expenses, and $10.9 million in private losses (1976 dollars). Several counties, including Ozaukee, were declared Federal Disaster Areas. Property damages of approximately $3 million were estimated in Ozaukee County from these ice storms (2017 dollars).

A storm system created a broad band of light freezing rain and freezing drizzle over much of southern Wisconsin from the night of February 3, 1986, into the morning hours of February 5, 1986. Ice accumulated on and damaged many trees. Birches, soft maples, weeping willows, and elms were especially impacted. Slinger and West Bend in Washington County and Port Washington in Ozaukee County appeared to be the hardest hit communities. About 50 to 75 percent of the trees in those areas sustained ice damage. Falling limbs also caused widespread damage to vehicles and roofs of houses. Numerous power lines snapped in many areas. Over 30,000 customers were without power at one time or another during the event. Power was not restored to some areas in neighboring Washington County for five days. Several television cable

Figure 3.8
Number of Ice Storm Events in Wisconsin by County: 1982-2019



Source: NOAA, National Weather Service, and SEWRPC

systems failed, schools were closed, and some mail deliveries were cancelled. This freezing rain event caused an estimated $58,711 in property damages (2017 dollars) in Ozaukee County.

Description of Recent Winter Storm Events: 1999-2017

Generally, the winter storm season in Wisconsin runs from October through March. Severe winter weather has occurred, however, as early as September and as late as the latter half of April and into May in some locations in the State. The average annual duration of snow cover in Ozaukee County is approximately 85 days.

- On January 2, 1999, a blizzard affected southcentral and southeast Wisconsin, depositing 10 to 20.5 inches of snow and generating wind gusts of 45 to 63 mph. Snow drifts of 4 to 8 feet in height were reported, causing numerous vehicle collisions. Peak wind gusts in Port Washington were measured at 63 mph. This winter storm was unusual in that the duration of the blizzard-like conditions lasted for 12 to 15 hours, while snowfall rates peaked at 1 to 1.5 inches per hour. Structural damage to buildings was reported in the City of Port Washington. Two businesses noted damage to signs and roofs, and a church had a stained glass window blown in. Areas in Ozaukee County reported 15 inches of snow accumulation and $7,324 in property damage (2017 dollars).

- December 2000 was one of the ten coldest Decembers on record throughout most of the state. In addition to low temperatures, record or near-record snow depths of 15 to 34 inches occurred in much of the southern part of Wisconsin during December. Fourteen counties, including Ozaukee, received a Presidential Emergency Declaration as a result of the snowfalls. In total, these counties received over $5.4 million in federal funds to cover costs associated with snow removal and emergency response efforts.

- A strong late winter storm affected much of south-central and southeast Wisconsin on April 11, 2007. Wet snow accumulation and winds gusting to 48 mph created near-blizzard conditions. Some rain, freezing rain, and sleet were mixed in with the snow. Temperatures were around the freezing mark causing some snowmelt to occur while it snowed. Power outages were the result of ice accumulation on power lines, snow accumulation on tree branches and strong winds. About 100,000 customers lost electrical power in southcentral Wisconsin and about 44,000 lost power in southeastern counties. According to the NCDC storm events database, $11,137 in property damages were reported in Ozaukee County from this storm.

- The 2007-2008 winter season in Wisconsin was "one-for-the-ages." Numerous winter storms, including a couple of blizzards and four ice storms, heavily affected the southern half of the State. Winter snowfall totals of 70 to 122 inches across the southern counties established new all-time winter snowfall records at many locations. The NCDC storm events database reported 12 winter weather events affected Ozaukee County throughout that winter season. Some of the more notable storms from the winter of 2007-2008 are described below:

- The first major winter storm of the 2007-2008 winter season occurred on December 1-2. This storm affected all of south-central and southeast Wisconsin with a mix of snow, sleet, and freezing rain. Precipitation started as snow, changed to sleet, then to freezing rain overnight. Ice accumulation ranged from a quarter- to half-inch. Hundreds of vehicle accidents occurred across south-central and southeast Wisconsin. Ice-covered branches broke and fell on power-lines due to the 35-45 mph wind gusts. As a result, scattered power outages occurred, and 12,000 customers in the area were without power. Ozaukee County reported 5 inches of snow accumulation.

- February 5-6, 2008 – A long-duration, massive winter storm with near blizzard conditions occurred in southern Wisconsin with snow accumulations of 10 to 21 inches, wind gusts up to 35 mph, and blowing and drifting snow that reduced visibility to a quarter of a mile. This was reported as one of the worst winter storms on such a widespread basis since the late 1970s. Two-day snowfall totals include: 16.4 inches at Cedarburg, 16.0 inches in Saukville, and 15.0 inches in Thiensville.

- On February 17, 2008, an ice storm affected an area stretching from Janesville in Rock County to Port Washington in Ozaukee County. Ice accumulations due to freezing rain ranged from a quarter-inch to a half-inch thick. Some light snow was mixed in with the freezing rain. Many civic

functions and businesses had closed ahead of the storm. Scattered power outages occurred as falling branches snapped power lines. Many vehicle accidents were reported. An estimated $4,451 in property damages were reported in Ozaukee County.

- During the overnight hours of February 1 to February 2, 2011, a powerful low-pressure center passing south of Wisconsin produced blizzard conditions across much of southern Wisconsin (the Groundhog Day Blizzard of 2011). Snow associated with the system began in the mid-afternoon hours in far southern Wisconsin and pushed northward into the State through the evening. Twenty-four-hour snowfall totals were between 20 and 26 inches around southeastern Wisconsin. This was in addition to several inches of snow that had fallen on January 31. Very strong winds were associated with this storm for an extended period of time. Sustained northeast winds of 30 to 40 mph were common through the event, with peak wind gusts between 45 and 65 mph. The lakeshore observation site at Sheboygan reported a 55 mph wind gust. The combination of high winds and heavy snow created widespread sustained visibilities of less than one-quarter mile, with frequent whiteout conditions and near zero visibilities. Many locations saw blizzard conditions beginning during the evening of February 1 and continuing through the early morning hours of February 2. Snow drifts of four to 12 feet were common, with reports of some drifts reaching up to 15 feet in open rural areas. Drifting snow closed county highways and roads with many stranded motorists having to be rescued from vehicles buried in the drifting snow. About 100 National Guardsman were mobilized statewide in response to the Governor's emergency declaration for 29 counties. At the height of the storm, We Energies reported 5,200 customers were without power across southeastern Wisconsin. A Presidential disaster declaration was issued for 11 Wisconsin Counties, not including Ozaukee County, as a result of the Groundhog Day Blizzard of 2011.

Vulnerability and Community Impact Assessment

Prior to 1996, the reports of winter storms in the NCDC database for Ozaukee County are irregular. Between 1996 and 2017, 130 reported winter weather events have affected Ozaukee County. Based on this, it is estimated that Ozaukee County experiences an average of 6.5 major winter weather events per year. It should be noted that during this time period there has been considerable variation around this average, with the County experiencing as few as zero reported major winter storm events (i.e., in 2001) and as many as 19 reported winter storm events (i.e., in 2008) as shown in Table 3.23.

From the period of 1959 through 2017, over $3.5 million (2017 dollars) in property damages have been reported as having been caused by winter weather events in Ozaukee County. Records of crop insurance indemnities from the U.S. Department of Agriculture Risk Management Agency show about $303,529 (2017 dollars) have been paid out due to damage caused by winter storms in Ozaukee County.[130] On average, the reported winter storms have resulted in about $20,802 of reported property damages and $2,143 of reported crop damages per event. It should be noted that often times it is only a handful of events responsible for most of the reported damages. Because of this the average damages per event may not be representative of the damages that could be expected from a winter storm event affecting the County. Over the period of 1959 through 2017, winter storm hazards have resulted in about $59,585 in property damages and about $6,140 in crop damages per year for an average annual total of about $65,725.

Winter storms can lead to treacherous conditions that can present a serious threat to the health and safety of affected citizens and can result in significant damage to property. Snow and ice are the major hazards associated with winter storms and are the eighth most destructive natural hazard in Wisconsin. Snow and ice can cause traffic accidents, bring down telephone and power lines, damage trees, impede transportation, burst water pipes, and can challenge the public's capabilities for snow removal during heavy storms. A major winter storm can have a serious impact on a community. Loss of heat and mobility are key complications that contribute to winter storm fatalities.

[130] *February 3, 1986, was the only NCDC winter-related event with crop damages to have possibly affected Ozaukee County at an estimated $58,711 (2017 dollars). All other crop reported damages came from the USDA Risk Management Agency with $303,529 (2017 dollars). In total, and shown in Table 3.23, $360,371 in crop damages was estimated for Ozaukee County.*

Ice storms and freezing rain are less common than snow, but produce road conditions that can make travel hazardous. Even fog or mist on cold roads can produce a glaze of ice that makes travel dangerous. Accumulated ice can cause the structural collapse of buildings or bring down trees and power lines, causing property damage or loss of power, and isolating people from assistance or services.

A review of the community assets described in Chapter 2 indicates there is a potential for winter storm hazard events to impact: 1) residents at a countywide level, 2) roadway transportation systems, 3) utilities, and 4) the operation of critical community facilities.

In 2017, the total equalized assessed property value in Ozaukee County was estimated at almost $11.4 billion. Based on the current estimate of $3,515,535 in reported total damages, it can be expected that approximately 0.03 percent of the value of all property, including buildings and infrastructure, in Ozaukee County will be damaged from these events each year. Due to the unpredictability of winter storms, all buildings, infrastructure, and critical facilities within the County are considered at risk.

Potential Future Changes in Winter Storm Conditions

Based upon recent historical data from the period 1990-2017, Ozaukee County can expect to experience an average of 5.1 major winter storm events per year. It should be noted that the historical record shows considerable variation among years in the numbers of these events that occurred. While it would be expected that in some years the County will experience either fewer events or more events than the average number, over the five-year term of this plan update the average annual number of events is not expected to change.

Changes in the 20th century and projections based on downscaled results from climate models indicate that there will likely be changes in winter storm conditions affecting Ozaukee County over the 21st century. The observed warming since 1950 has been greatest in winter, with an average increase of 2.5°F across Wisconsin. It is projected that by 2055, the average winter temperature in Ozaukee County will increase by about 7.5°F.[131] In addition, the average amount of precipitation that Ozaukee County receives during the winter will increase by about 0.5 to 1.0 inch (measured as water), an increase of about 25 percent. Due to increasing winter temperatures, the amount of precipitation that falls as rain during the winter rather than as snow is projected to increase significantly. It is also projected that freezing rain will be more likely to occur.

It should also be noted that the likelihood of lake effect snow occurring could be affected by climate change. A lack of ice cover over Lake Michigan during the winter promotes the development of lake effect snow. Rising temperatures during the winter will reduce the frequency and extent of ice cover over the Lake. Because the increase in temperature may also result in some of this precipitation falling as rain, it is not clear whether this will lead to an increase in the frequency of lake effect snow events.

Multi-Jurisdictional Winter Storm Risk Management

Based upon a review of the historical patterns of winter storm events in Ozaukee County, there are no specific municipalities that have unusual risks. Rather, the events are of a uniform countywide concern.

3.9 VULNERABILITY ASSESSMENT FOR DROUGHT

Drought is the result of a natural decline in the expected precipitation over an extended period of time, and occurs in virtually every climate on the planet, including areas of high and low precipitation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds, high temperatures, and low relative humidity. Drought is a complex natural hazard which is reflected in the following four definitions commonly used to describe it:

1. Meteorological drought: The degree of dryness, expressed as a departure of actual precipitation from expected average or normal amount, based on monthly, seasonal, or annual time scales

2. Hydrological drought: The effects of precipitation shortfalls on streamflows, reservoir, lake, and groundwater levels

[131] *Wisconsin Initiative on Climate Change Impacts 2011, op. cit.*

3. Agricultural drought: Soil moisture deficiencies relative to water demands of crop life

4. Socioeconomic drought (or water management drought): Occurs when the demand for water exceeds the water supply, resulting in a water shortage

A drought's severity depends on several factors, including its duration, its intensity, its geographic extent, and the demands for water for use by both humans and vegetation.

Drought can be difficult to define in exact terms. This is partly due to its multi-dimensional nature and partly due to the ways it differs from other natural hazards. There is no exact and universally accepted definition of what constitutes a drought. The onset and end of a drought are difficult to determine due to the slow accumulation of its impacts and the lingering of its effects after its apparent end. The impacts of drought are less obvious than those of some other hazards and may be spread over a larger geographic area. These characteristics have hindered the preparation of drought contingency or mitigation plans by many governments and can make it difficult to perform an accurate risk assessment analysis.

Droughts can have several impacts. They can reduce water levels and flows in surface waterbodies and groundwater. This can cause shortages of water for human and industrial consumption, hydroelectric power, recreation, and navigation. Water quality may also decline and the number and severity of wildfires may increase during a drought. Severe droughts may result in reduced yields or the loss of agricultural crops and forest products, undernourished wildlife and livestock, and lower land values.

One method to measure the magnitude of a drought is by using the Palmer Drought Severity Index. This method takes into account factors like temperature, soil moisture, and precipitation, which are entered into an algorithm that returns results between -4 (extreme drought) and 4 (extremely moist) with zero being normal conditions. The U.S. Drought Monitor uses the Palmer Index, along with other indicators, to rate drought conditions into the following categories:

- D0: Abnormally Dry
  - Short-term dryness slowing planting and growth of crops or pastures
  - Some lingering water deficits (coming out of drought conditions)
  - Pastures or crops not fully recovered (coming out of drought conditions)

- D1: Moderate Drought
  - Some damage to crops and pastures
  - Streams, reservoirs, or wells low, some water shortages developing or imminent
  - Voluntary water-use restrictions requested

- D2: Severe Drought
  - Crop or pasture losses likely
  - Water shortages common
  - Water restrictions imposed

- D3: Extreme Drought
  - Major crop and pasture losses
  - Widespread water shortages or restrictions

- D4: Exceptional Drought
  - Exceptional and widespread crop and pasture losses
  - Shortages of water in reservoirs, streams, and wells creating water emergencies

Wisconsin is most vulnerable to agricultural drought. The State has approximately 14.3 million acres of farmland on 68,500 farms.[132] Even small droughts of limited duration can significantly reduce crop growth and yields, adversely affecting farm incomes and local economies. Droughts significantly increase the risk of forest fires and wildfires. Additionally, the loss of vegetation in the absence of sufficient water to maintain it can result in flooding, even from an average rainfall.

[132] *State of Wisconsin Department of Agriculture, Trade and Consumer Protection,* 2019 Wisconsin Agricultural Statistics.

Estimates of agricultural losses experienced in Ozaukee County due to drought over the period 1976 through 2017 are shown in Table 3.24. These estimates come from two sources: event descriptions in the NCDC storm events database and records of indemnities paid to agricultural operators by Federal crop insurance programs.[133] For those years in which loss estimates were available from both the NCDC and crop insurance indemnities, the larger value was used to estimate losses due to drought for that year. The loss estimates reflect several factors. First, crop losses often go unreported. Second, Federal crop insurance policies offer coverage to only certain types of crops in any particular year. Third, agricultural operators generally insure only a portion of their crops when purchasing Federal crop insurance. Thus, loss estimates derived from these two sources are likely to be underestimates of actual losses. It should be noted that indemnities for drought related losses were paid out in most years. This probably reflects variability in rainfall (or lack thereof) causing localized crop losses. Based on these sources, it is estimated that Ozaukee County experienced crop damages of nearly $5.4 million (2017 dollars) between 1976 and 2017. Average annual crop losses due to drought in Ozaukee County are estimated to be about $128,530.

Historical Drought Problems

Small droughts of shortened duration have occurred in Wisconsin at an interval of about every 10 years since the 1930s. Extended, widespread droughts have been infrequent in Wisconsin. The five most significant droughts, in terms of severity and duration, are 1929-1934, 1948-1950, 1955-1959, 1976-1977, and 1987-1988.

The 1929-1934 drought probably was the most significant in Wisconsin history considering its duration, as well as its severity. This drought affected a large majority of the United States and contributed to the Dust Bowl period that greatly damaged agriculture throughout the County (see Figure 3.9) Wisconsin experienced at least a 75-year recurrence drought interval in most of the State and over 100-year recurrence drought interval in certain areas. The severe economic impact of the Depression compounded its effects. The drought continued with somewhat decreased effect until the early 1940s in some parts of the State.

The drought that occurred during 1948-1950 was most significant in the northern part of the State. In the most severely affected areas, the drought had a recurrence interval of greater than 70 years. The drought of 1955-1959 had a recurrence interval of between 30 and 70 years in all but the northwestern corner of Wisconsin.

The drought of 1976-1977 was most severe in a wide band stretching from north to south across the State. Stream flow measuring stations recorded low flow recurrence intervals from 10 to 30 years. Agricultural losses during this drought were set at $624 million in Wisconsin. Sixty-five counties were declared Federal disaster areas and deemed eligible for assistance under the Disaster Relief Act. Additionally, numerous private and municipal wells went dry due to lowered groundwater tables. Federal assistance was also obtained to assist communities in drilling new wells and obtaining new water supplies. Although Ozaukee County was not declared a Federal disaster area, it was estimated to sustain more than $2.9 million in drought related crop damages during the 1976-1977 drought.

In 1987 and 1988 Wisconsin experienced one of the most severe droughts in recent history. It was characterized not only by below normal precipitation, but also by persistent dry air and above normal temperatures throughout the Midwest. Streamflow measuring stations indicated low flow recurrence intervals of between 75 and 100 years. The drought's effects were most severe in northcentral and northeastern Wisconsin. The drought occurred early in the growing season and resulted in a 30 to 60 percent crop loss, with agricultural losses set at $1.3 billion in Wisconsin. Fifty-two percent of the State's farms were estimated to have crop losses of 50 percent or more, with 14 percent estimated having losses of 70 percent or more. In addition to crop losses, fish, birds, and wildlife were adversely affected. The amount of electric power generated by hydroelectric plants was reduced by as much as 80 percent as a result of the low water levels associated with this drought. A combination of State and Federal drought assistance programs helped the State's farmers recover a portion of their losses. All Wisconsin counties were designated eligible for this drought assistance. The effect of this drought on municipal and private water supplies was not as severe, with only a few reports of individual wells drying up. A number of municipal water utilities experienced maximum use of their water delivery systems and imposed some type of water-use reduction rules or restrictions, usually involving the limitation of lawn sprinkling and yard watering.

[133] *Payments of crop insurance indemnities are reported by the U.S. Department of Agriculture Risk Management Agency.*

Table 3.24
Estimates of Crop Losses Due to Drought in Ozaukee County: 1976-2017

Year	NCDC Loss Estimate (2017 dollars)	Crop Insurance Indemnity Paid (2017 dollars)	Loss Estimate Used in Risk Assessment (2017 dollars)[a]
1976	2,941,528	--	2,941,528
1977	--	--	--
1978	--	--	--
1979	--	--	--
1980	--	--	--
1981	--	--	--
1982	--	--	--
1983	--	3,992	3,992
1984	--	--	--
1985	--	1,660	1,660
1986	--	--	--
1987	--	647	647
1988	--	6,111	6,111
1989	--	2,498	2,498
1990	--	--	--
1991	--	--	--
1992	--	4,526	4,526
1993	--	--	--
1994	--	889	889
1995	--	26,070	26,070
1996	--	11,229	11,229
1997	--	--	--
1998	--	13,917	13,917
1999	--	2,725	2,725
2000	--	917	917
2001	--	43,385	43,385
2002	136,280	21,400	136,280
2003	--	310,358	310,358
2004	--	125,028	125,028
2005	--	38,037	38,037
2006	--	15,359	15,359
2007	55,685	24,446	55,685
2008	--	250,195	250,195
2009	--	117,004	117,004
2010	--	--	--
2011	--	13,358	13,358
2012	--	959,580	959,580
2013	--	60,290	60,290
2014	--	235,683	235,683
2015	--	5,487	5,487
2016	--	15,808	15,808
2017	--	--	--
Total	3,133,493	2,310,599	5,398,246

Note: Dollar Values were adjusted to year 2017 by the average annual Consumer Price Index (CPI) values from the U.S. Department of Labor, Bureau of Labor Statistics.

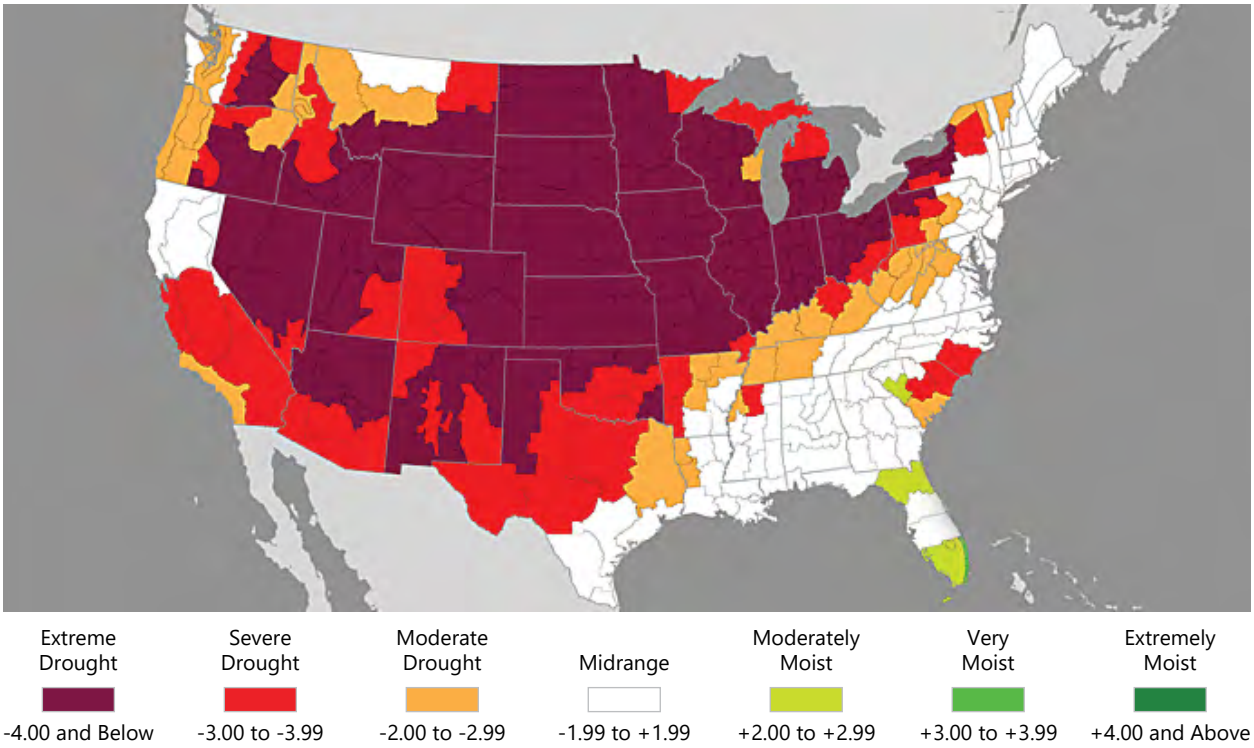
In some instances prior to 1995 the NCDC assigned one estimated total damage amount to all counties in the State that were affected by a particular hazard event. Those total damages were divided by the number of counties that were listed in the NCDC publication as being affected by that hazard event, and reported in this table as damages incurred by Ozaukee County.

In many instances damages from hazard events go unreported. This table represents estimated losses and should not be considered as an exact documentation of damages and losses incurred from a particular event or time period.

[a] *For those years in which loss estimates were available from both the NCDC and crop insurance indemnities, the larger value was used.*

Source: National Climatic Data Center (NCDC), the U.S. Department of Agriculture Risk Management Agency, and SEWRPC

Figure 3.9
Palmer Drought Severity Index for July 1934



Source: National Climatic Data Center and SEWRPC

Description of Recent Drought Events

The summer of 2002 was a drought period in south-central and southeastern Wisconsin. Mild drought began in early July, and intensified in early August. Most locations received less than one inch of rain for the first 11 days of August, with Milwaukee Mitchell International Airport reporting only 0.24 inch during this period. This drought affected much of the country, with about 45 percent of the territory in the contiguous United States experiencing a severe or extreme drought. Crop yields were reduced due to this drought. Many farmers reported that their corn crops had withered and that soybeans had stopped growing. The NCDC crop loss estimate database and USDA Risk Management Agency reported a total of about $157,680 (2017 dollars) in drought related crop losses for Ozaukee County (see Table 3.24).

Drought conditions returned to south-central and southeast Wisconsin in August 2003. For much of the year, the jet stream and associated low pressure systems stayed north of Wisconsin resulting in few cold front passages. As a result, precipitation was far below normal for the year. For example, at Milwaukee Mitchell International Airport 22.3 inches of precipitation were recorded for the year—about 12.5 inches less than normal—making 2003 the driest year since 1963. This drought continued into September 2003, and was determined to be "severe" by the U.S. Drought Monitor. By October, soils in southeastern Wisconsin were reported to be dry to depths of 18 to 30 inches. The drought resulted in estimated losses of 25 to 50 percent of the corn crop and about 50 percent of the soybean crop. On July 28, 2003, the Governor declared a statewide drought emergency. This emergency declaration included provisions permitting the WDNR to grant farmers' requests for permits to irrigate dry crops by diverting water from streams or lakes. Subsequently, the U.S. Department of Agriculture designated 59 counties in the State of Wisconsin as primary agricultural disaster areas due to damages and losses caused by drought conditions over the period May 1, 2003, through October 31, 2003, and the Federal Small Business Administration (SBA) declared 70 Wisconsin counties as disaster areas due to drought conditions over the same period. About $310,358 (2017 dollars) in indemnities were paid to farmers in the County from Federal crop insurance programs in 2003 for damages related to drought.

Drought conditions developed in Southeastern Wisconsin during the summer and fall of 2005 following a persistent dry spell which began in March and lasted most of the year coupled with warm dry air. The drought classification for south-central and southeast Wisconsin worsened from D0 to severe drought (D2) by mid-July. By mid-July, only 12.5 inches of precipitation had been recorded for the year at Milwaukee Mitchell International Airport—about 9.5 inches less than normal. August remained warm and dry for the area. Rainfall deficits ranged from 2.5 to 3.5 inches for the month. September began with warm and dry conditions strengthening the ongoing drought classifications. Some relief was provided by heavy rains in mid- September. Tremendous drought improvements were noted, however the drought persisted through October. By the end of November drought conditions improved due to above normal precipitation. On July 15, 2005, former Governor Doyle declared a statewide drought emergency that included provisions permitting the WDNR to grant farmers' requests for permits to irrigate dry crops by diverting water from streams or lakes. The U.S. Department of Agriculture issued a Secretarial Disaster Declaration for drought for portions of Wisconsin for the period March 1, 2005, through September 30, 2005, however this declaration did not include Ozaukee County. In addition, the SBA made Federal disaster loans available to nonfarm agriculture-dependent business for drought-related losses from the period March 1, 2005, through September 30, 2005. The drought resulted in estimated losses of 35 to 40 percent of the corn crop and 50 percent of the soybean crop in the State. In Ozaukee County, over $38,037 (2017 dollars) in indemnities were paid to farmers in the County from Federal crop insurance programs in 2005 for damages related to drought.

A short-lived drought affected Ozaukee County during summer 2007. Abnormally dry conditions began in late June as the jet stream steered storm systems away from Southeastern Wisconsin. By late July, these dry conditions had intensified to moderate drought. Drought conditions persisted until late August when thunderstorms provided some relief. About $55,685 was reported in crop losses in the County. Crop insurance indemnities of about $24,446 were paid out to farmers in the County from Federal crop insurance programs in 2007.

A lack of rain over south-central and southeastern Wisconsin during June 2012 allowed a drought to slowly develop. The intensity of this drought increased rapidly and by June 26 the drought intensity was rated abnormally dry by the U.S. Drought Monitor. The drought continued through the month of July and by August the conditions were extremely dry across the Southeastern Wisconsin. Several rainfall and thunderstorm events occurred in August but precipitation amounts were still below normal. The end of August ended with above normal temperatures, increasing the effects on the already stressed crops and water supply. Drought conditions improved by October with above normal precipitation. For many farmers across the region the drought conditions over the summer reduced crop yields. Agricultural operators in Ozaukee County received over $959,580 in crop insurance indemnities in 2012 due to drought (Table 3.24). The drought also forced sell offs of some dairy and beef cattle herds. Farmers also reported that heat impacts to cows reduced milk production, in some instances by as much as 20 percent. In response to this drought, the Governor declared a drought emergency and authorized the WDNR to expedite permit applications for water withdrawals from lakes and streams for the purpose of watering crops.

Vulnerability and Community Impact Assessment

Ozaukee County is vulnerable to agricultural drought. There are about 65,000 acres of farmland comprising about 43 percent of the land in the County. Even small droughts of limited duration can significantly reduce crop growth and yields, adversely affecting farm income. More substantial events can decimate croplands and result in total loss, hurting the local economy. Due to the importance of agriculture to the Ozaukee County economy and the potential for large crop losses, drought is a major natural hazard threat. There are also 94 miles of perennial streams, three major and numerous smaller lakes, and approximately 18,560 acres of wetlands which can also be negatively impacted by drought conditions. In addition, groundwater levels can be affected by drought conditions. This is most important in areas of the County where groundwater constitutes the main source of water supply. In Ozaukee County, the population that lives outside of the Mequon-Thiensville and City of Port Washington areas depend on groundwater as their main water supply. The most severe droughts may only happen on average every 25 or 50 years, but the 1976 drought proves that, while severe droughts are rare, they can be devastating to agriculture, damaging to the local economy, and negatively impact the natural surface water system and groundwater supply system.

Drought generally impacts agricultural output by reducing crop yields and the health and product output of livestock (i.e., milk). As a result, a drought will seriously impact the economy of the entire County. The concern for agricultural losses due to drought is difficult to estimate because each incident will impact the County differently based on the length of the drought, when it occurs in the planting, season and which crops were planted in various locations in that particular season.

In 2012, the most recent year for which agriculture census data is available, the market value of agricultural products sold by farms in Ozaukee County was about $64.7 million. This was comprised of about $24.2 million in crops and $40.5 million in livestock, poultry, and their products.[134] Based on the current average estimate of $128,530 in crop losses per year, it can be expected that approximately 0.53 percent of the market value of all crops, or about 0.20 percent of the market value of all agricultural products sold by farms in the County, will be lost to drought each year. It is also expected that there will be considerable variation among years in the amount of losses experienced. Again, it is important to note that agricultural losses due to drought can be assumed to be underreported, thus the numbers cited above are likely to be substantially underestimated.

During a severe drought some wells, mainly private wells, may go dry. Agriculture is vulnerable to drought, as many farms in Ozaukee County do not irrigate. A review of the community assets described in Chapter 2 indicate the potential for drought hazard events to impact: 1) residents at a countywide level, 2) agricultural croplands, 3) livestock, 4) municipal water utilities, and 5) natural surface and groundwater reserves.

Potential Future Changes in Drought Conditions

Based upon NCDC data, from 2002 through 2017, Ozaukee County had about a 31 percent probability of drought conditions occurring during a portion of any given year. Some of these episodes are likely to be of short duration. The statewide historical record indicates that severe droughts can be expected to occur at roughly 10-year intervals. As can be seen in Figure 3.10, southeastern Wisconsin regularly experienced drought to at least a moderate level two to three times every ten years from 1895 through 2018.[135] It is not expected that the probability of drought will change during the five-year term of this plan update.

Changes over the 20th century and projections based on downscaled results from climate models indicate that there will likely be changes in drought conditions affecting Ozaukee County over the 21st century. By mid-century, average temperatures are projected to rise, leading to longer summers and shorter winters. The temperature increase will also lead to a longer growing season and increased rates of evapotranspiration during summer and early fall months. While the amount of rain during the summer is not projected to change, a greater proportion of precipitation is projected to fall in heavy rainfall events. This will result in a greater number of dry days during the summer. More dry days, coupled with higher summer temperatures and increases in evapotranspiration rates, will increase the likelihood of summer droughts occurring.

Multi-Jurisdictional Drought Risk Management

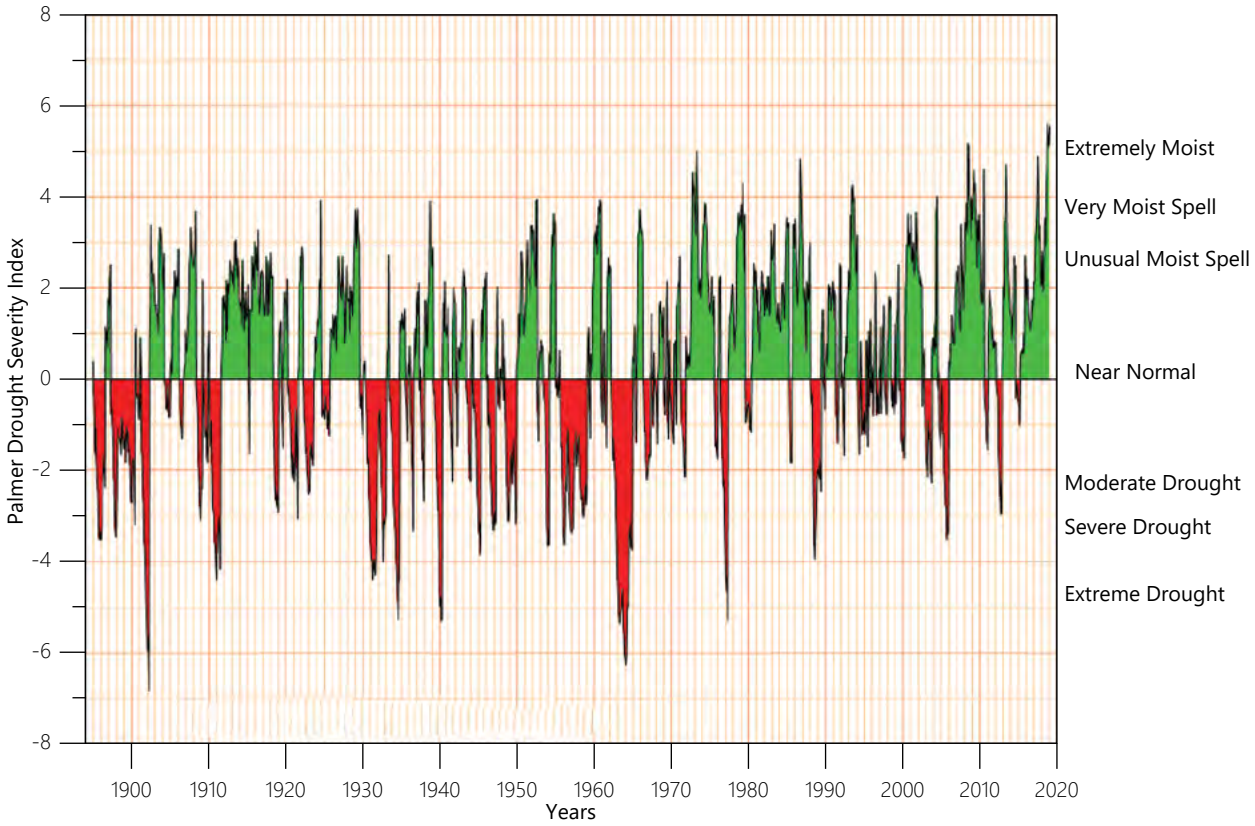
Based upon a review of the potential impacts of droughts in Ozaukee County, the areas most susceptible to hazard conditions are the agricultural communities, the municipalities served by public water supply that use groundwater as a source of supply, and those communities that have the largest numbers of private wells. This includes all of the communities in the County, except the City of Port Washington and portions of the City of Mequon and the Village of Thiensville.[136] The events are of a uniform countywide concern, with those communities with largely agricultural land uses being the most vulnerable to risk.

[134] *U.S. Department of Agriculture National Agricultural Statistics Service,* 2012 Census of Agriculture: Wisconsin State and County Data, *Volume 1, Geographic Area Series, May 2014.*

[135] *University of Wisconsin-Madison, Atmospheric and Oceanic Sciences, www.aos.wisc.edu.*

[136] *The City of Mequon and Village of Thiensville are wholesale customers to Milwaukee Water Works, which supplies Lake Michigan water.*

Figure 3.10
Palmer Drought Severity Index for Southeastern Wisconsin: 1895-2018



Source: University of Wisconsin Atmospheric and Oceanic Sciences and SEWRPC

3.10 VULNERABILITY ASSESSMENT FOR UTILITY FAILURE

The vast majority of the public is dependent on public and private utility infrastructure to provide life-supporting services such as electricity, fuel (i.e., natural gas), water, and sanitary sewer. The disruption or loss of one or more of these utility systems could have consequences on the public ranging from inconvenience to life threatening.

Most utility failures are relatively local in scope and short in duration. If not immediately addressed however, the disruption or failure of any of these utility systems can create a threat to public health and safety. If the disruption were to involve more than one utility system or is large enough in scope and magnitude, whole communities or regions could be severely impacted. A failure or disruption to any utility system will often impact the most vulnerable members of society, including the very young, the elderly, those in poor health, and the impoverished.[137]

Electrical power or natural gas outages can be caused by a fuel shortage, power failure, or natural disaster. Disruptions to the water and sewage systems are often the direct result of a natural disaster (i.e., flooding) or are indirect losses due to another failure (i.e., a power outage disturbing the pumping of waste and/or sewage).[138] Examples of utility failure that can lead to dangerous situations and a potential concern for Ozaukee County residents include, but are not limited to, electricity outage rendering fans and air conditioning useless during extreme heat, shortage of fuel during extreme cold, and a damaged or malfunctioning water or wastewater treatment system exposing the public to a sanitation concern.

[137] *State of Wisconsin Hazard Mitigation Plan, December 2016, op.cit.*

[138] *Lenora Borchardt,* Ozaukee County Hazard Mitigation Plan*, EPTEC, Inc., 2013.*

Contamination or Loss of Water Supply

Water supply systems are among the most important infrastructure facilities affecting the economic development and environmental quality of Ozaukee County. Such systems directly affect the health and welfare of the resident and transient populations of an area, and the viability of commercial and industrial activities in an area. Without a reliable water supply, urban areas become unhealthy. Accordingly, the availability of an ample supply of high-quality water for domestic, commercial, and industrial use and the protection and wise use of the available sources of supply is an important consideration.

Without a reliable water supply, urban areas can be subject to epidemics of such waterborne diseases as cholera, dysentery, typhoid fever, and parasitic infections, such as *Cryptosporidium*. In addition to providing safe drinking water, a reliable water supply system is also essential in other ways to good sanitation in urban areas. An adequate and reliable water supply system is essential for bathing, laundering, and other forms of cleaning and washing, and provides the basis for the system of sanitary sewage conveyance essential to a high quality of life in urban areas. An adequate and reliable water supply system is also essential to good fire protection, and to all types of commercial and industrial development. Table 2.15, in Chapter 2, lists the municipal water supply systems in Ozaukee County, the population served, and source of water supply. Table 2.16 lists private residential community water supply systems and populations served in Ozaukee County. All of the private residential community water supply systems listed in Table 2.16 are served by groundwater sources.

Ozaukee County has seen an increase in overall water consumption and groundwater consumption in recent decades. From 1979 to 2005, total water use has increased from 7.5 million gallons per day (mgd) to about 10.7 mgd.[139] As noted in Chapter 2, portions of Ozaukee County that are served by public water utilities encompassed about 24 square miles, or about 10 percent of the County, in 2010. An estimated 54,882 County residents, or about 63 percent of the population, were served by public water utilities.

Water Supply Issues Related to Groundwater

Almost 85 percent of the water served by public water utilities in the County is sourced from groundwater. Five municipal water utilities in Ozaukee County use groundwater to serve their customers—the City of Cedarburg Light and Water Commission, which serves nearly 12,000 customers; Belgium Waterworks, which serves about 2,245 customers; Fredonia Waterworks, which serves about 2,191 customers; Grafton Waterworks, which serves about 11,490 customers; and, Saukville Waterworks, which serves about 4,465 customers (see Table 2.15).

Groundwater Quantity and Quality

An adequate supply of high quality groundwater is essential as long as it continues to be used for domestic consumption in Ozaukee County. Like surface water, groundwater is susceptible to depletion and deterioration. The regional groundwater resources report prepared by SEWRPC[140] indicates that there is an adequate supply of groundwater in the shallow aquifer for Ozaukee County and the Region as a whole. The quantity of groundwater can be reduced by the loss of recharge areas, excessive or overly concentrated pumping, and change in ground cover. In addition, groundwater quality is subject to degradation from onsite wastewater treatment systems, surface water pollution, improper agricultural practices, and other soil and water pollutants. Identifying sources of groundwater and areas susceptible to groundwater contamination is important in proper water supply and quality planning to prevent adversely affecting the availability and quality of groundwater.

Approximately 40 percent of the Region's residents use groundwater as a source of drinking water, so the knowledge of the chemical character of groundwater and its variations is crucial for effective planning, management, and protection of groundwater resources. Systematic gathering of information on groundwater chemistry provides the base for determining future changes in groundwater quality. Some data are available from sampling of wells in Ozaukee County, which are summarized on a county basis in the Wisconsin Department of Natural Resources (WDNR) Groundwater Retrieval Network (GRN) database. It is important to note that the data summarized in this database represent the number of wells that have

[139] *U.S. Geological Survey,* Protecting Wisconsin's Groundwater Through Comprehensive Planning: Ozaukee County, *2007*

[140] *Documented in SEWRPC Technical Report No. 37,* Groundwater Resources of Southeastern Wisconsin*, June 2002.*

been sampled, the number of wells in which a substance was detected, and the number of wells in which the concentrations detected exceeded groundwater quality criteria established by the State of Wisconsin. In addition, the summaries do not indicate whether an individual well was sampled more than once, and, if a well was sampled more than once, whether the pattern of detections and exceedance of standards for the compound of interest was the same in all samplings. Beyond being located in Ozaukee County, the summaries do not indicate the locations of the wells sampled. Because of this, the summaries do not indicate whether exceedances of groundwater quality criteria represent conditions in a limited local area, conditions in a larger portion of the County, or conditions over the entire County. Similarly, the summaries do not indicate from which aquifers the wells sampled draw water. Finally, for most substances of concern, the number of wells sampled is small. Additional groundwater quality data should be collected and assessed in the future in order to fully address groundwater quality issues within the County.

The chemical composition of groundwater largely depends on the composition and physical properties of the soil and rocks it is in contact with, the length of the groundwater flow path, the residence time of the water, and the antecedent water quality. The composition of groundwater in the County is primarily a result of its movement through and interaction with Pleistocene unconsolidated materials (glacial drift) and Paleozoic rocks containing large amounts of dolomite, ($CaMg(CO_3)_2$), which is dissolved by water passing through it. In general, groundwater quality tends to be relatively uniform within a given aquifer basin, both spatially and temporally, but in different locations major contrasts in natural quality of groundwater can be observed. The current quality of groundwater in both the shallow and deep aquifers throughout the County is generally good and suitable for most uses; however, some water has chemical characteristics that make it objectionable or unsuitable for some uses. As noted above, most of the water contains calcium magnesium bicarbonate, but some has large proportions of sulfate, chloride, or sodium.

Groundwater Quality Concerns

Generally, groundwater quality in Ozaukee County is good. However, some water quality problems are caused by natural factors that cannot be controlled. For example, the abundant dolomite material in the County releases calcium and magnesium, which form about one-half of all ions in groundwater and are the principal components of hardness. Therefore, hardness is objectionably high in groundwater in most of the County and softening is required for many water uses. Additionally, radioactivity from radium is also a potential concern in Ozaukee County for groundwater supplies taken from the deep aquifer. Arsenic has also been identified in some private wells within Ozaukee County.

Potential sources of groundwater contamination are many and varied. In addition to some natural processes, human-installed facilities or structures and many human activities have the potential to eventually contribute to groundwater quality problems as well. Some of the human activities that may contribute to groundwater quality problems are summarized according to their place of origin in Table 3.25. Typical human influenced groundwater contamination instances involve bacteria, nitrates, pesticides, herbicides, and volatile organic chemicals (VOCs). The first four can affect quality of water in private wells, but generally they do not cause major problems in the County. Volatile organic chemicals are also a water quality concern that stems from landfills, leaking underground storage tanks (LUST), and spills from hazardous substances. Thousands of wells have been sampled for VOCs and about 60 different VOCs have been found in Wisconsin groundwater. Trichloroethylene is the VOC found most often in Wisconsin's groundwater.[141] There are not widespread problems with VOCs, bacteria, or agri-chemical contamination in groundwater supplies in Ozaukee County.

Rising nitrate concentrations in some areas of the State of Wisconsin have become a significant problem. High nitrate concentrations in groundwater are typically a result of land use activities and weather patterns. In 2006, the WDNR and the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) reported that nitrate-nitrogen (NO3-N) is the most widespread groundwater contaminant in Wisconsin and that the nitrate problem is increasing both in extent and severity. In Wisconsin's groundwater 80% of nitrate inputs originate from manure spreading, agricultural fertilizer, and legume cropping systems. On-site wastewater systems can also be a significant source in densely populated areas. From 1990 to 2006, 110 private well samples were collected in Ozaukee County and 99 percent met the health-based drinking water limit for nitrate-nitrogen. Of the 110 samples collected, 11 contained between 2 to 10 mg/L

[141] *Wisconsin Groundwater Coordinating Council Fiscal Year 2018 Report to the Legislature,* Executive Summary: Fiscal Year 2018*, 2018*.

Table 3.25
Human Activities That May Create Groundwater Quality Problems in Ozaukee County

Originating on the Land	Originating Below Land Surface
Above-Ground Storage Tanks	Above Water Table:
Accidental Spills	Animal waste storage facilities
Agricultural Activities:	Landfills
Animal Feedlots	Leakage:
Fertilizer and Pesticide Storage, Mixing, and Loading	Underground storage tanks
Irrigation Return Flow	Underground pipelines
Silage and Crop Residue Piles	Sewers
Highway Deicing	Septic Tanks and Fields
Liquid waste Spreading or Spraying	Surface wastewater impoundments
(sewage, sludge, septage, whey)	Sumps, dry wells
Stockpiles (chemicals, salt), Dumps	Below Water Table:
Infiltration of Contaminated Surface Water or Precipitation	Ground water development:
	Abandoned wells and holes
	Improper well construction
	Over pumping
	Illegal drainage or disposal wells
	Waste disposal in wet excavations

Source: Wisconsin Geological and Natural History Survey and SEWRPC

nitrate-nitrogen, and serve as indicators that land use likely affected groundwater quality. One additional sample exceeded the health-based drinking water limit of 10 mg/L.[142] Municipal water systems must take immediate action if a nitrate maximum contamination level (MCL) of 10 mg/L is observed.

Arsenic is an element that occurs naturally in soil and bedrock formations. Arsenic in groundwater is an emerging public health issue in southern Wisconsin. The U.S EPA and World Health Organization (WHO) standard for arsenic in drinking water is 10 parts per billion (ppb). Traces of arsenic are found in groundwater, aquifers, lakes, rivers, ocean water, fruits, vegetables, and seafood. Arsenic has been detected in every county in the State of Wisconsin. WDNR historical data show that 4,000 public wells and over 3,000 private wells have detectable levels of arsenic in the State. About 10 percent of these wells exceed the federal drinking water standard of 10 ppb.[143] In 2008, the Ozaukee County Public Health Department was awarded a grant by the Wisconsin Division of Health Services (DHS) to monitor private well water in Ozaukee County for arsenic. In the Mequon area, significant amounts of arsenic had been found in well water.[144] Because of this, the study also looked into the testing of well water in the Towns of Belgium, Cedarburg, Fredonia, Grafton, Port Washington, and Saukville. Well water testing lasted from October 2008 to February 2009. As a result, arsenic detects were found in water from wells in all six towns. Wells in the Town of Belgium had the highest percentage of arsenic detects (31.3 percent) versus wells in the Town of Fredonia, which had the lowest percentage of 11.8. The highest arsenic detect was from a well in the Town of Cedarburg (average of 28.5 ppb). Seven of the 98 wells (7.1 percent) tested had arsenic levels above EPA's health standard of 10 ppb.[145]

In areas where well histories show contamination of groundwater, such as VOCs or arsenic, Section NR 812.12(3) of the *Wisconsin Administrative Code* requires that the WDNR designate special well casing pipe depth areas. When wells are drilled in these areas, it also requires that they be provided with well casings that extend to sufficient depth to reduce the possibility that new wells will produce water containing significant concentrations of contaminants. As of 2018, according to WDNR, seven of these special well casing depth areas haven been designated in Ozaukee County. Table 3.26 lists the special well casing depth areas in the County and describes the contaminants found and the special casing requirments for each.

[142] USGS Groundwater Study for Ozaukee County, *May, 2007.*

[143] *Ibid.*

[144] *The Ozaukee County Public Health Department,* 2008 Arsenic in Well Water Report, *2008.*

[145] *Ibid.*

Table 3.26
Special Well Casing Pipe Depth Areas in Ozaukee County: 2018

Area ID	Location	Contaminant	Casing Requirements	Date Determined
Area 29a	Village of Thiensville (Personal Auto LUST Site) T9, R21E, Sections 22 and 23	VOCs	140-foot casing required	1/16/1991
Area 29b	Village of Thiensville (Personal Auto LUST Site) T9, R21E, Sections 14,15,22, and 23	VOCs	160-foot casing required	1/16/1991
Area 27	City and Town of Cedarburg (Prochnow Landfill) T10, R21E, Section 22 (southern ½) T10, R21E, Section 23 (southern ½) T10, R21R, Section 26	VOCs	Any new water supply well constructed or an existing water supply well reconstruction shall be sampled upon completion and tested for volatile organic compounds (VOCs) using EPA Method 502.2 or 524.2 and the results sent to the WDNR Southeast Region Office. Recommend to connect to municipal water supply, if possible.	1/22/1997
Area 28	Town and Village of Grafton (Lime Kiln Landfill and Quarry) T10, R21E, Section 25	VOCs	Any new water supply well constructed or an existing water supply well reconstruction shall be sampled upon completion and tested for volatile organic compounds (VOCs) using EPA Method 502.2 or 524.2 and the results sent to the WDNR Southeast Region Office. Recommend to connect to municipal water supply, if possible.	1/22/1997
Area 70	City and Town of Cedarburg (Kohlwey LUST Site) T10N, R21E, Section 14 (southern ½ of the southwest ¼ of the southeast ¼)	VOCs, Gasoline	130-foot cement-grouted casing required	9/1/2000
Area 101	Town of Grafton (Denow Landfill) T10N, R21E, Section 1 (southern ½ of the north ½) T10N, R21E, Section 1 (southeast ¼) T10N, R21E, Section 1 (eastern ½ of the southwest ¼) T10N, R22E, Section 6 (west ½ of the southwest ¼)	VOCs	150-foot of casing required Any new water supply well constructed or an existing water supply well reconstruction shall be sampled upon completion and tested for volatile organic compounds (VOCs) and the results sent to the WDNR Central Office.	11/18/2013

Source: Wisconsin Department of Natural Resources

Recent Instances of Groundwater Contamination near Ozaukee County

On July 17, 2012, an underground pipeline belonging to the West Shore Pipeline Company ruptured along a welded seam in the Town of Jackson, in neighboring Washington County. As a result of the rupture, the pipeline released about 55,000 gallons of gasoline into the environment. This contaminated the aquifer used as a source of water by private wells near the site of the spill, causing the aquifer to become unusable as a source of water for many years to come. Petroleum compounds were detected in water samples collected from 44 private wells located on 42 properties near the spill site. The concentrations of petroleum compounds detected in the samples from 39 of these wells exceeded health standards. In response to the release, the WDNR, DHS, and the Washington County Health Department issued a drinking water advisory, recommending persons in the area concerned to use bottled water or water from another clean source for cooking or drinking. In addition, the advisory area contained a smaller "flush only" area in which residents were advised to use their well water only for flushing toilets and to refrain from using it for drinking, bathing, washing dishes or clothing, and other uses of potable water. The "flush only" advisory was lifted on August 30, 2012. The West Shore Pipeline Company implemented a number of remedial actions to minimize the effects of the spill to the environment and water supplies in the area. The company provided bottled water to affected residents, removed about 7,270 tons of contaminated soil, installed groundwater recovery wells and soil vapor extraction wells to remove contaminants, sampled private water supply wells in the affected area, and installed point of entry treatment systems at many water supply wells. Property damages related to this hazardous material incident were estimated at about $24 million. As a result of this incident, the WDNR required 37 property owners to permanently abandon their contaminated wells. In addition, West Shore Pipeline Company was required to offer a new water supply to 153 town properties. As of March 2015, 139 property owners had accepted water service from the public water utility provided by the Village of Jackson.

Water Supply Issues Related to Surface Water

Lake Michigan surface water serves as the source of supply for residents served by the City of Port Washington Waterworks Department. The Mequon-Thiensville Water Utility Department, which serves portions of the City of Mequon, the Village of Bayside, and a small portion of the Village of Thiensville also utilize Lake water. The City of Port Washington Waterworks Department, which owns and operates a surface water treatment plant with two intake pipes, is the only direct supplier of treated surface water in Ozaukee County. The Mequon-Thiensville Water Utility Department purchases treated Lake Michigan water from the North Shore Water Commission and Milwaukee Water Works and distributes the water throughout portions of City of Mequon and Villages of Bayside and Thiensville.

Supplies of surface water can potentially be interrupted by anything that would partially or fully obstruct flow of water into the utility's surface water intake. Because of this, surface water intakes are designed and sited in ways intended to minimize obstruction problems. Despite this, obstructions can sometimes occur. An example of this is formation of frazil ice in water intakes. This happens during cold weather when the water temperature is near 32°F. This ice formation can cause the level of water in the utility's raw water pump station to drop and can make it difficult to maintain the flow rates necessary to operate the treatment plant. When these events happen, the Utility decreases its pumping rates, thus lowering velocities, which most often decreases or eliminates the formation of frazil ice. When the intake system recovers, normal pumping rates resume. For the most part, these icing events are considered minor in their effect on the operations of the Utility.

Other Water Supply Issues

Water Main Breaks

Temporary loss of water supply can also be caused by other factors. Breaks in water mains can interrupt water supply. The impacts of a water main break depend on the size and location of the main. The effects of a break can either be local or can have a large effect on a portion of the distribution system. Frozen service laterals can also interrupt water supply to individual buildings.

Lead Service Lines and Plumbing Fixtures

Lead is a toxic metal that is commonly found throughout the environment in lead-based paint, air, soil, food, and water. Lead in drinking water at high enough levels can pose a significant health risk, especially in young children and pregnant women. Children that are exposed to high levels of lead may experience

stunted mental and physical development. Lead exposure has also been linked to deficits in attention span and learning abilities. Excessive levels of lead in adults can damage the nervous system, brain, kidneys, red blood cells, and reproductive system. Most drinking water sources in the State of Wisconsin, both groundwater and surface water, have little or no measurable lead levels. However, prior to passage of a State law in 1984, lead solder was used extensively in the construction of many household plumbing systems in the State. Some drinking water fixtures were manufactured with lead until 1996. Plumbing materials such as lead pipes, lead based solder used to join copper pipes, faucets, and lead service lines connecting the home to the water main are common in older homes. Water within plumbing systems will continuously dissolve the contacted lead. The rate at which lead dissolves can vary greatly depending on the age of the plumbing system and corrosive characteristics of the water. When water stands in pipes for an extended period of time, lead concentrations in the water can increase substantially.

The dangers of lead in drinking water have been shown in Flint, Michigan, where corrosive characteristics from a new water supply caused lead levels in the drinking water to increase substantially. The increase in lead levels caused the rate of lead poisoning among children in Flint to double, going from 2.4 percent to 4.9 percent in 2015. Research conducted on lead service lines in Flint confirmed that lead leached into the water system because the water was not treated to prevent the corrosion of the toxic metal. State and Federal officials declared a state of emergency in the Flint region due to the alarming rise of lead levels in drinking water and children's blood.

Municipal water utilities are required by the WDNR to regularly test their water supply for lead. Under Section NR 809.54(3) of the *Wisconsin Administrative Code*, the lead action level is exceeded if the concentration of lead in more than ten percent of tap water samples collected during any monitoring period is greater than 15 micrograms per liter (µg/l), that is, if the 90th percentile lead concentration is greater than 15 µg/l, the utility is out of compliance with the WDNR lead standards.

Cross Connections

Cross-connections are actual or potential connections between potable water supplies and a source of contamination. The most common form of cross-connection is a garden hose, which is easily connected to the public water supply system and can be used to apply a variety of potentially dangerous substances, including chemicals and fertilizer. Other common cross-connections include dishwashers, toilets, pressure washers, boilers, pools, and lawn sprinkler systems. Water normally flows in only one direction in a plumbing system; however, under certain conditions, such as backsiphonage or backpressure, water can flow backwards, contaminating potable water supplies within a building or within a water distribution system. Backsiphonage may occur due to a loss of pressure in a water distribution system. Such a pressure loss can occur due to a water main break, a repair to the distribution system, or a firefighting emergency. This can create a siphon in a plumbing system which can draw water out of a sink or tank back into a building's water system and into the municipal system. Back pressure may be created when a source of pressure such as a boiler or a pump creates pressure greater than pressure supplied through the public water system. This may cause contaminated water to be pushed into a building's water system and into the municipal system. As mandated by the WDNR regulations NR 810.15, in order to protect the public water supply system, the water supplier for every municipal water system must develop and implement a comprehensive cross connection control program. In addition, State plumbing codes require that approved backflow prevention methods be installed at every point of potable water connection and use.

Vulnerability and Community Impact Assessment

Safe water supplies could be interrupted due to the following factors:

- Contamination of a groundwater source
- Contamination of the Lake Michigan surface water source in the vicinity of the water supply intakes
- Major facility malfunction or shutdown
- Obstruction of surface water supply intake
- Large numbers of water main breaks or breaks of particularly important water mains

- Contamination of a water supply source due to lead in plumbing systems
- Cross-connections between potable water supplies and a source of contamination.

Groundwater monitoring by State agencies to determine the extent of groundwater contamination in Wisconsin and identify the sources of contamination has found that the primary contaminants of concern are volatile organic compounds (VOCs), pesticides, and nitrates.

There are several factors that affect the contamination potential of groundwater resources. Many of those factors are related to soil physical properties and to the proximity of groundwater to the soils surface. Some of the soil properties that can affect groundwater quality include permeability of the subsoil, depth of the soil above the water table, clay and silt content in the soil profile, and the drainage conditions of the soil. Soils that have a high infiltration rate and high permeability with a low percentage of silt and clay increase the contamination potential of the groundwater. The potential of contamination is further enhanced when these soil conditions are coupled with a naturally occurring high water table or shallow underlying bedrock conditions.

SEWRPC has evaluated the contamination potential of shallow groundwater in Ozaukee County, which is shown on Map 3.20. An evaluation of the contamination potential of deep aquifers is not yet available due to data limitations. Table 3.27 sets forth the combination of parameters for contamination potential and the number of acres encompassed by each final contamination potential ranking within the County. The areas in Ozaukee County that are naturally the most vulnerable to groundwater contamination primarily occur along the western and central portions of the County, including the Cities of Cedarburg and Mequon; Villages of Grafton and Saukville; and Towns of Cedarburg, Fredonia, and Saukville. These areas have soils that consist of glacial sand and gravel outwash material that is highly to moderately permeable, of limited thickness, and have a shallow water table, shallow to bedrock conditions, or a combination of these conditions. There are approximately 55,579 acres of land, or about 35 percent of the County, that have a high potential for groundwater contamination (areas shown in red on Map 3.20). In addition, about 41,305 acres, or about 26 percent of the County, have a moderate potential for groundwater contamination, and approximately 61,673 acres, or 39 percent of the County, have a low potential for groundwater contamination.[146]

Lake Michigan has historically been a source of safe drinking water. However, no one can guarantee that an accident will not happen, and a mishap can have serious consequences. In 1993, the City of Milwaukee's public water supply became contaminated with *Cryptosporidium*, a parasite found in animal wastes. Nearly half of the 850,000 consumers were infected, 4,400 people were hospitalized, and at least 69 people died, making this the largest documented waterborne outbreak in U.S. history.[147] The exact source of the *Cryptosporidium* that caused this outbreak is still uncertain. The total cost of the outbreak associated with illness was estimated at about $37 million in medical costs and $77 million in productivity losses.[148]

Typically, water supply facilities have a history of safe operation with very minimal malfunctions or shutdowns. The industry has been known for providing continuous service due to the use of high-quality and redundant equipment. However, the facilities are always subject to the potential for an unanticipated event that could interrupt services. Since 2002, water utilities and related organizations, such as the American Water Works Association, have increased efforts to evaluate the vulnerability of water supply facilities to a wide range of hazards, including acts of terrorism. The focus of these efforts has been directed toward preparation of vulnerability assessments and emergency response and mitigation plans for each facility.

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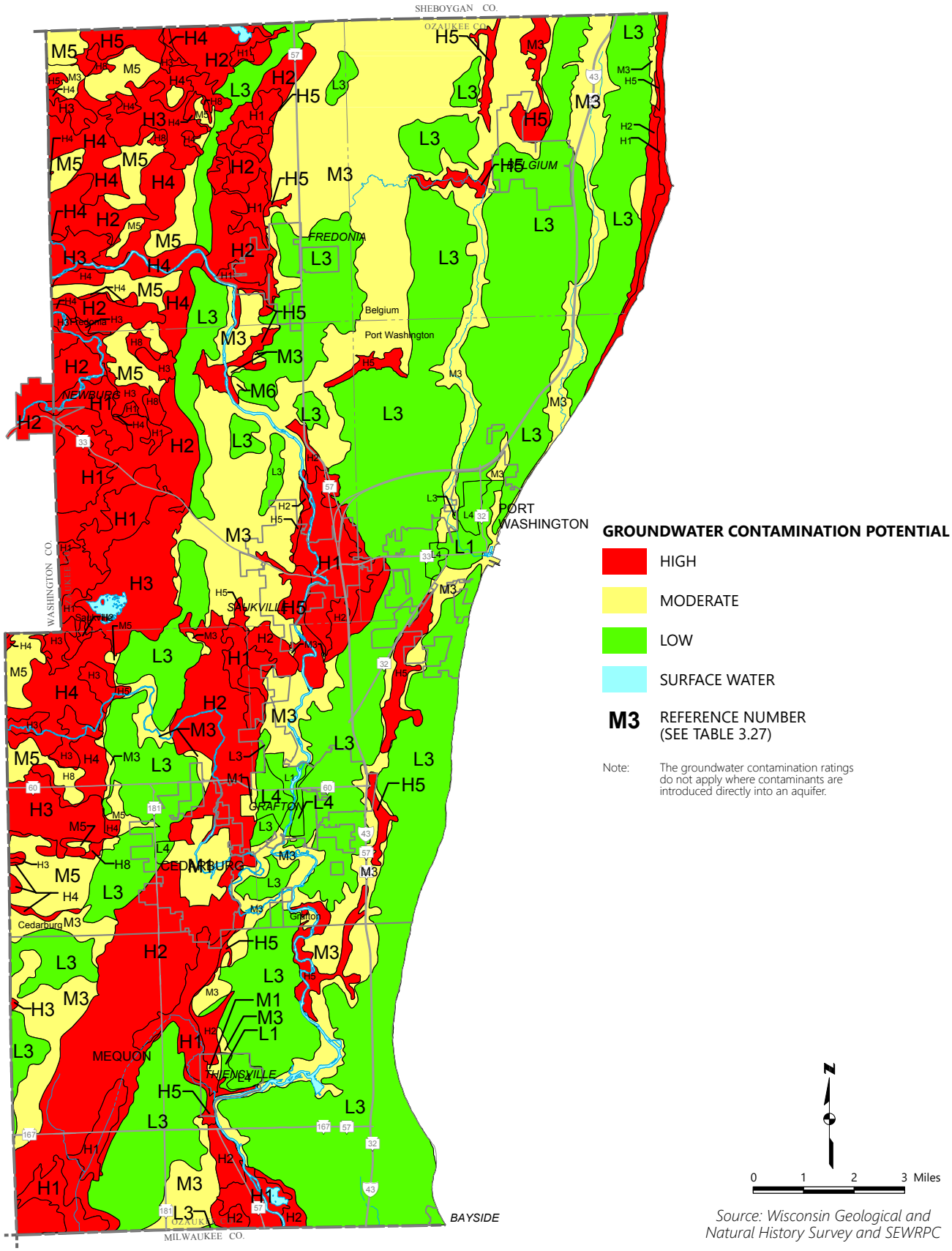
[146] *Schmidt, R.R.,* Groundwater contamination Susceptibility Map and Evaluation: Wisconsin Department of Natural Resources, Wisconsin's Groundwater Management Plan Report 5*, 1987.*

[147] *Peter L. Havens and Jeffrey P. Davis,* Cryptosporidium and Cryptosporidiosis, *Seminars in Pediatric Infectious Diseases, October 1996.*

[148] *Phaedra S. Corso, Michael H. Kramer, Kathleen A. Blair, David G. Addiss, Jeffrey P. Davis, and Anne C. Haddix, Cost of Illness in the 1992 Waterborne Cryptosporidium Outbreak, Milwaukee, Wisconsin, Emerging Infectious Diseases, Volume 9, No. 4, April 2003. Costs and losses adjusted to 2010 dollars.*

Map 3.20
Potential for Shallow Groundwater Contamination in Ozaukee County



Source: Wisconsin Geological and Natural History Survey and SEWRPC

Table 3.27
Potential Contamination of the Shallow Groundwater in Ozaukee County

Contamination Potential Rating and Reference Number (see Map 3.20)	Depth to Aquifer (Feet)	Estimated Permeability	Estimated Soil Percolation	Acres	Percent
Low					
L9	Greater than 50	Low	Low	0	0.0
L8	Greater than 50	Low	Moderate	0	0.0
L7	Greater than 50	Moderate	Low	0	0.0
L6	Greater than 50	Moderate	Moderate	0	0.0
L5	Greater than 50	High	Low	0	0.0
L4	25 to 50	Low	Low	1,196	0.8
L3	25 to 50	Low	Moderate	59,516	37.5
L2	25 to 50	Moderate	Low	0	0.0
L1	Less than 25	Low	Low	961	0.6
Subtotal				61,673	38.9
Moderate					
M9	Greater than 50	Low	High	0	0.0
M8	Greater than 50	Moderate	High	0	0.0
M7	Greater than 50	High	Moderate	0	0.0
M6	25 to 50	Low	High	109	0.1
M5	25 to 50	Moderate	Moderate	6,289	4.0
M4	25 to 50	High	Low	0	0.0
M3	Less than 25	Low	Moderate	33,812	21.3
M2	Less than 25	Moderate	Low	0	0.0
M1	Less than 25	High	Low	1,095	0.7
Subtotal				41,305	26.1
High					
H9	Greater than 50	High	High	0	0.0
H8	25 to 50	Moderate	High	552	0.3
H7	25 to 50	High	Moderate	0	0.0
H6	25 to 50	High	High	0	0.0
H5	Less than 25	Low	High	5,387	3.4
H4	Less than 25	Moderate	Moderate	6,466	4.1
H3	Less than 25	Moderate	High	7,569	4.8
H2	Less than 25	High	Moderate	24,101	15.2
H1	Less than 25	High	High	11,504	7.2
Subtotal	--	--	--	55,579	35.0

Source: SEWRPC

Multi-Jurisdictional Water Supply Risk Management

Those water supply systems serving the largest urban areas and populations would be of the most concern with regard to hazard risk. However, each municipality will have to evaluate the presence of any special water supply needs that would cause a interruption in supply to be a more serious problem.

Electrical Disruption or Outages

Investor owned utilities supply the vast majority of power to Wisconsin electricity customers. Other suppliers include municipal utilities and power cooperatives. The demand for electricity changes daily and seasonally. We Energies and Cedarburg Light and Water Utility are the main electrical utility providers for Ozaukee County residents. A We Energies Generating Station (i.e., power plant) is located in the City of Port Washington on Lake Michigan. The Port Washington generating station—part of Wisconsin Electric Company (WEC) Energy Group—is fueled by natural gas and produces about 1,150 megawatts of electricity, enough to power 400,000 houses. The electricity is placed on a grid and distributed throughout southeastern Wisconsin via transmission lines.[149] High-voltage transmission lines, such as those that are suspended between tall metal

[149] *Ozaukee County Press,* A four-person powerhouse, *July 18, 2018.*

towers, carry electricity over long distances to consumers. Higher voltage electricity is more efficient and less expensive for long-distance electricity transmission. Lower voltage electricity is safer for use in homes and businesses. Transformers at substations increase ("step up") or reduce ("step down") voltages to adjust to the different stages of the electrical journey from the power plant on long-distance transmission lines to distribution lines that carry electricity to homes and businesses.[150]

Cedarburg Light and Water Utility is a non-profit public power utility that maintains an electric distribution system that serves over 6,000 customers in the City of Cedarburg and portions of the Town of Cedarburg. The distribution system "steps down", or reduces, the 138,000 voltage delivered to its substation through transmission lines provided by Wisconsin Public Power Incorporation (WPPI Energy). Cedarburg Light and Water Utility is responsible for maintaining three substations with current capacity of over 100 megawatts and more than 256 miles of overhead and underground lines. [151]

Electrical transmission systems are designed with significant redundancy to withstand the unexpected loss of system elements without loss of the electrical load. While transmission system-related outages do occur, the design of the system most often keeps them localized in nature. When power outages occur, they are most often related to the electrical distribution system.[152]

According to We Energies, a majority of electrical system outages are caused by either equipment wear and tear (29 percent of outages) or weather-related hazards such as lightning, high winds, rain, snow, heat, cold, and ice (27 percent). Power outages are also caused by fallen trees and tree growth (20 percent), animal contact (11 percent), human accidents or vandalism (7 percent), and miscellaneous events such as mechanical damage, construction error, or fire (6 percent).[153] Loss of electrical power service was also considered to be a significant potential hazardous risk and therefore incorporated as part of the appropriate natural and human-induced hazards to be analyzed in this Chapter. In addition, because of the importance of this type of incident to the Ozaukee County Hazard Mitigation Task Force during development of the original plan, and during the development of the updates of the plan, this section of the report specifically analyzes vulnerability to power outages. Power outages in this context are those that last for an extended period of time. Momentary outages generally are a sign that the power supply monitoring system is working. Brief outages occur when the system detects a problem which affects the flow of electricity on a power line. The brief automatic interruption is designed to prevent hazards and equipment damage. In most cases, power is restored within a few seconds.

Description of Power Outage Events

Recent power outages (2008 to 2017), or incidents that have caused a power outage (i.e., fallen power lines, snapped power lines, fallen trees onto power lines, or flood event), were reviewed while assessing NCDC's severe weather database for Ozaukee County. That database reported 35 weather related events that caused power outages within and near the Ozaukee County area during that ten year span. Of those 35 power outages, 19 were related to non-thunderstorm high wind events, five were related to thunderstorm wind events, five related to a flood event, four were related to winter storms, one was related to an ice storm event, and one was related to a blizzard event. It should be noted that it is likely the NCDC database does not account for all weather related power outages that occurred during that time period. In general, Ozaukee 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. However, the possibility always exists that a man-made or natural disaster could affect the power system for an extended period of time.[154] Examples of weather related power outages in Ozaukee County and the surrounding areas are described in the following text.

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[150] *www.eia.gov.*

[151] *Cedarburg Light and Water Utility: www.cedarburglightandwater.org*

[152] *J. Lepinski, Public Service Commission, Division of Energy Regulation, personal communication, April 14, 2016.*

[153] *We Energies, Outage Causes and Restoration, we-energies.com/outages_safety/reporting/outages.htm, accessed April 14, 2016.*

[154] *EPTEC,* Ozaukee County Hazard Mitigation Plan, *2013.*

- March 3-4, 1976 – Southern and eastern Wisconsin (including Ozaukee County) was impacted by a severe ice-storm. Ice accumulations ranged up to five inches on wires and tree limbs. High winds gusting to 60 mph worsened the situation. The storm brought down hundreds of utility poles, thousands of power and telephone lines and a large number of trees. Up to 600,000 residences were directly affected and up to 100,000 were without power during the height of the storm. Some rural areas, including areas in Ozaukee County, were without power for over 10 days. Twenty-one counties were included in a federal disaster declaration.

- June 18, 1997 – Small clusters of storms moved northeast through Southeastern Wisconsin ahead of a cold front. Microbursts and macrobursts generated powerful wind gusts of 75 to 100 mph that toppled large trees, damaged power-lines and power-poles, and pushed over vehicles. About 19,400 customers lost electrical service due to this storm.

- June 21, 1997 – Flash flooding occurred in southern Ozaukee County as a result of heavy rainfall in excess of eight inches over a 30-hour period. This flash flooding event was greater than a 100-year recurrence interval flood. Besides public facilities damage, there were widespread private home and business damages. The hardest hit areas were the City of Mequon, Village of Thiensville, a small area about two miles southwest of Fredonia, and a location east of Cedarburg. Many customers lost electrical power, natural gas, or telephone service. The loss of electrical service prevented the use of sump pumps in many homes, which compounded the flooding problems.

- May 16, 1999 – Thunderstorms across southern Wisconsin caused damage to trees and power lines. Several counties had urban and small stream flooding due to the 2-to 3-inch rainfall within several hours. At one point, about 13,000 electrical customers in southcentral and southeast Wisconsin were without power due to lightning striking lines or transformers.

- July 22, 2001 – A severe thunderstorm passed through southeastern Wisconsin and caused a significant power outage. This storm toppled trees and power lines. About 11,200 customers in southern Washington and Ozaukee Counties lost power due to this storm.

- August 22, 2001 – Several lightning strikes around West Bend in Washington County, and in Port Washington in Ozaukee County, knocked out power lines and transformers, resulting in 2,000 customers losing electrical power.

- August 21, 2002 – A severe weather and flooding event affected much of southcentral and southeast Wisconsin. The event was probably the most widespread and significant outbreak of the 2002 warm season. Numerous weather phenomena were observed during this event, including a tornado; a funnel cloud; powerful, hurricane-force winds; down-burst winds; torrential rainfalls; urban and small stream flooding; and numerous lightning strikes. At least 56,000 customers in Southeastern Wisconsin lost electrical power due to lightning strikes and tree damage to power lines.

- December 1, 2007 – The first major winter storm event in the 2007-2008 winter season affected all of south-central and southeast Wisconsin with a mix of snow, sleet, and freezing rain. The precipitation started off as snow then changed to sleet and then freezing rain during the afternoon hours, then freezing drizzle or light rain during the overnight hours. Ice-covered tree branches broke and fell on power-lines due to 35 to 45 mph winds. As a result, scattered power outages occurred, and 12,000 customers in south-central and southeast Wisconsin were without power for at least several hours.

- January 8, 1998 – A major winter storm brought heavy snow and winds up to 40 mph. A major multi-vehicle accident on IH 43 in Ozaukee County closed for the interstate for about 10 hours. Many airline flights were delayed at Milwaukee Mitchell International Airport. Many trees were toppled by the heavy snow, and several power lines were downed resulting in about 4,000 customers losing electrical power in Sheboygan, Ozaukee, and Milwaukee Counties.

- October 26, 2010 – Long-duration, widespread, southwesterly high winds affected south-central and southeast Wisconsin for about 36 hours, resulting in numerous reports of felled trees, broken

tree branches, downed power-lines, and damage to structures and vehicles. We Energies reported 20,000 customers in Southeastern Wisconsin were without power at the peak of the power outages. In Ozaukee County, wind gusts blew down trees and power lines across the County.

- July 14, 2014 – A tree fell on electrical lines on the north side of the City of Port Washington. As a result, about 1,700 customers lost power for several hours.

- June 30, 2014 – A major thunderstorm raced across southern Wisconsin causing straight line wind damage in many areas. Numerous trees were uprooted and tree debris knocked down several power lines. The power lines were also impacted by lightning. We Energies reported a total power outage to about 110,000 homes in southern Wisconsin.

As stated earlier, most recent power outage events affecting Ozaukee County have been short-term, last from a few hours to, at the most, a few days. However, long-term power outage events can happen. Several examples from outside Wisconsin illustrate this. The Northeast blackout of 2003 was a widespread power outage in the northeastern and midwestern United States and Ontario, Canada. The primary cause was a software bug in the alarm system at a control room of the FirstEnergy Corporation, located in Ohio. Due to the lack of an alarm, operators were unaware of the need to re-distribute power after overloaded transmission lines hit unpruned tree foliage. This local failure lead to a widespread failure of the grid. According to the official analysis by the U.S. and Canadian governments more than 508 generating units at 265 power plants shut down during the outage. Some power was restored by 11 p.m. on the day of the outage. Power was not restored for many others until 2 days later.

In January 1998, the Montreal, Canada area experienced a major ice storm. The power outages resulting from this storm impacted over four million residents. Portions of the Montreal area were without power for over three weeks. Similarly, an ice storm hit the State of Kentucky in January 2009. At the peak of storm, about 700,000 customers were without power. Two weeks after the storm, 50,000 customers were still without power. It took 38 days to restore power to all of the affected customers.

Vulnerability and Community Impact Assessment

While likely to be rare, the impacts of a long-term outage event affecting Ozaukee County could be large. Such an event would likely involve many downed trees and power lines. Downed power lines can present safety hazards for residents, travelers, and emergency responders. The response to such an event could be hampered by roads blocked by power lines and debris.

Given experiences like the Montreal and Kentucky events, it is possible that a significant portion of Ozaukee County's population and facilities could be without power for one to three weeks, should a particularly severe event occur. Following the 2009 Kentucky ice storm, about 37 percent of affected customers were without power one week after the storm. About 7 percent were still without power after two weeks. The Kentucky event resulted in 36 fatalities. The largest cause of death related to this event was carbon monoxide poisoning resulting from improper generator use. Given that the average high and low temperatures in Ozaukee County during the winter are considerably colder than those in Kentucky,[155] the impacts on human life of an ice storm causing a power outage of similar severity in Ozaukee County may be even greater.

A review of the community assets described in Chapter 2 indicates the potential for significant, yet short-term, power outage impacts to a variety of residential, commercial, and other developed land uses; including critical community facilities. Significant impacts may also be possible to other infrastructure or utility systems, such as the We Energies generating system in Port Washington. During a power outage, the normal operation of homes, businesses, public buildings, and other critical community facilities may be interrupted.

Multi-Jurisdictional Power Outage Risk Management

Based upon a review of the historic patterns of power outage events in Ozaukee County, there are no specific municipalities that have unusual risks. Rather, the events are considered to be relatively uniform and of a countywide concern.

[155] *For example, average high temperatures during January are 43°F and 30°F, respectively, in Louisville and Port Washington. Average low temperatures during January are 27°F and 13°F, respectively, in Louisville and Port Washington.*

Sewerage System Disruption, Failure, or Loss

Properly designed, operated, and maintained sanitary sewer systems are meant to collect and transport all of the sewage that flows into them to a publicly-owned wastewater treatment plant (WWTP). At the WWTP, the wastewater is treated prior to being discharged into a waterbody or into groundwater. Although the specific treatment stages and processes differ among WWTPs, several treatment stages are often utilized. Initially, the influent wastewater may go through a pretreatment phase to remove large items such as garbage, rags, diapers, and cans. Following pretreatment, it passes into a primary treatment phase in which solids and floatables are removed. This is followed by a secondary treatment phase which uses aeration and biological processes to degrade organic wastes. This may be followed by additional treatment to reduce concentrations before discharge to surface water or groundwater.

Sewage conveyance and treatment systems provide important public health and environmental benefits. Sanitary wastewater containing feces and urine from humans and animals can carry a variety of disease-causing organisms. These pathogens include bacteria, such as those that cause typhoid fever, paratyphoid fever, bacillary dysentery, gastroenteritis, and cholera; viruses, such as those that cause Hepatitis A, polio, and viral gastroenteritis; parasitic protozoa, such as those that cause amoebic dysentery, giardiasis, and cryptosporidiosis; parasitic worms, such as hookworms, tapeworms, and roundworms; and fungi, such as those that cause ringworm and other dermatitis. Exposure to untreated sanitary wastewater, either through physical contact or contamination of drinking water, can transmit these diseases to members of the public. Conveyance of this wastewater to a WWTP and subsequent treatment substantially reduces the public's exposure to the pathogens carried in wastewater and consequently reduces the risks posed to the public by sanitary wastes.

Treatment of sanitary sewage also provides environmental benefits. The treatment processes remove solid material suspended in the wastewater. This reduces the amount of suspended solids discharged to receiving waters and results in less siltation in these waterbodies. In addition, treatment reduces concentrations of oxygen-demanding organic materials and nutrients in the wastewater, reducing or preventing degradation of water quality in receiving waters.

The State of Wisconsin required that all owners of sewage collection systems, including satellite sewage systems, develop and implement a Capacity, Management, Operation and Maintenance Program (CMOM) by August 1, 2016. A CMOM Program is meant to assure that a sewage system is properly managed, operated, and maintained at all times; has adequate capacity to convey peak flows; and all feasible steps are taken to eliminate excessive infiltration and inflow into the system. A CMOM Program must mitigate the impact of sewage overflows on waters of the state, the environment, and public health.

Recent Sanitary Sewer System Issues

- On April 17 through April 18, 2013, twelve Southeastern Wisconsin communities reported a total of nearly 53 million gallons in sanitary sewer overflows. The primary cause of this event was due to three to six inches of rainfall within two days atop already saturated soils from storms that had occurred in the previous week. Excess water got into sewers from leaking sanitary sewer laterals, foundation drains in older homes connected to laterals, and leaking municipal sewers. The communities affected included, Mequon, Bayside, Wauwatosa, Milwaukee, Greendale, South Milwaukee, Caledonia, Racine, Kenosha, Elkhorn, Somers, and Pleasant Prairie.[156]

- On August 27, 2018, a sanitary sewer overflow occurred at the City of Port Washington's Wastewater Treatment Plant. The incident lasted several hours. The overflow was located at the manholes at the entrance of Port Washington's Wastewater Treatment Plant. In addition, there were sewer overflow at various manholes on Jackson Street, between Wisconsin Street and Lake Street. The incident was due to the large amount of rain that fell on August 27, 2018, causing a high amount of inflow into the City's sewer network.

- On September 5, 2018, a sanitary sewer overflow occurred at the City of Port Washington's Wastewater Treatment Plant. The overflow lasted about 45 minutes and again occurred at the manholes at the entrance to the Plant. The incident was caused by a tree that fell on power lines

[156] *Don Behm, Milwaukee Journal Sentinel,* Twelve Wisconsin communities had sewer overflows in April*, April 28, 2013.*

along a bike path that took out both primary and secondary power to the wastewater treatment plant. Employees at the facility responded to the incident and were able to contain the overflow, limiting harm to the public and the environment.

Because of these incidents, the City of Port Washington is considering making improvements to its collection system to limit these types of incidents in the future.

Vulnerability and Community Impacts Assessment

The loss of a sewerage system creates a stressful and emotional situation for its users. This sort of loss can be caused by incidents affecting the conveyance system that collects and transports the sewage, the WWTP, or both. A number of factors can lead to failure of the conveyance system, including:

- Power failures or interruptions
- Failure of equipment such as pumps, valves, monitoring equipment, and control equipment
- Blockages of sewers
- Physical or chemical deterioration of sewers
- Vandalism

Failures in the conveyance system can disrupt gravity flow and pumping of sewage and can lead to overflows of wastewater, escape of wastewater into groundwater, and backups of wastewater into buildings.
Several factors can also lead to failure of the WWTP, including:

- Natural disasters such as floods and storms
- Power failures or interruptions
- Failure of equipment such as pumps, pipes, fittings, valves, monitoring equipment, and control equipment
- Discharges of hazardous materials into the waste stream
- Vandalism

Depending in part upon the cause, WWTP failures can have a variety of consequences. Such a failure can lead to overflows of wastewater or escape of wastewater to surface waters or groundwater. Plant failures could also reduce the effectiveness of sewage treatment through a variety of mechanisms. For example, a power or equipment failure that reduced or shut down aeration in secondary treatment units could lead to anaerobic conditions in these units, reducing treatment effectiveness. Similarly, discharges of hazardous substances into the waste stream could poison the organisms responsible for biological treatment processes, inhibiting these processes and reducing treatment effectiveness. Other types of failures could lead to damage to plant equipment or to the plant itself. In a severe instance, this could lead to plant shutdown.

Occasional unintentional discharges of raw sewage from municipal sanitary sewers occur in almost every system. These types of discharges are called sanitary sewer overflows (SSOs). SSOs have a variety of causes, including but not limited to severe weather, improper system operation and maintenance, and vandalism. The U.S. Environmental Protection Agency (USEPA) estimates that there are between 23,000 and 75,000 SSOs each year throughout the United States. The untreated sewage from these overflows can contaminate surface and groundwater, causing serious water quality problems. In some cases, an overflow may cause health and safety concerns as well as significant property loss. Loss of a sewerage system can lead to a sewer backup, which can lead to disease, destruction of valuables, damage to property, and electrical malfunctions. A proper response to a sewer backup can greatly minimize property damage and diminish the threat of illness.

In 2010, about 21,606 acres, or about 14.3 percent of Ozaukee County, including Village of Newburg, were provided with public sanitary sewer service. An additional 23,195 acres in the County were not sewered but were located within an adopted public sanitary sewer service area, meaning sanitary sewers could be extended to these areas if the municipality so chooses. Both the areas served as of 2010 and the areas that could be served are shown on Map 2.16 in Chapter 2 of this Report. Outside of these areas, the Ozaukee County population is served by private onsite wastewater treatment systems (POWTS). Historically, the onsite disposal systems have included conventional gravity-flow septic systems, mound systems, holding tanks, and a few specialized systems.

Typically, municipal sanitary sewerage systems have a history of safe operation with rare failures. While these failures are typically of short duration, there is the potential for longer-duration failures to occur, mostly as the result of natural disasters. The municipal wastewater treatment sector has been known for providing continuous service due to the use of high-quality equipment and redundancy. However, the facilities are always subject to the potential for an unanticipated event that could interrupt services.

Multi-Jurisdictional Risk Management

With regard to risk of loss of sewerage systems, the greatest concerns are related to those communities in the County that operate sanitary sewage collection and treatment systems. These communities include the Cities of Cedarburg, Mequon, and Port Washington; the Villages of Belgium, Fredonia, Grafton, Newburg, Saukville, and Thiensville; and portions of the Towns of Belgium, Cedarburg, Fredonia, Grafton, Port Washington, and Saukville, as indicated on Map 2.16 in Chapter 2 of this Report.

Natural Gas Utility Disruption or Loss

Natural gas is a form of nonrenewable energy. It is the earth's cleanest fossil fuel and is colorless and odorless in its natural state. The largest component of natural gas is methane, a compound with one carbon atom and four hydrogen atoms (CH_4). Today, natural gas is used extensively in residential, commercial, and industrial applications. The largest user of natural gas in Wisconsin is industry, accounting for 31 percent of the users, followed by residential (28.1 percent), electric utility (21.7 percent), and commercial (18.8 percent).[157] Natural gas is a main energy source in Ozaukee County to heat homes and to power appliances such as ovens, stoves, water heaters, and clothes dryers. In addition, natural gas is the main fuel used at the Port Washington WE Energies plant to produce electricity that serves much of the County and beyond. Compressed natural gas (CNG) is stored in tanks and often used in rural homes that are not connected to a public utility service. Because natural gas is used to heat many homes and fuel home appliances, the loss or disruption of this utility service can be detrimental for many Ozaukee County residences and the County's economy.

The U.S natural gas pipeline network is highly integrated and moves natural gas throughout the United States. The pipeline network has about 3 million miles of mainline and other pipelines that link natural gas production areas and storage facilities with customers. In 2017, the natural gas transportation network delivered about 25 trillion cubic feet (Tcf) of natural gas to 75 million customers.[158] As of 2018, We Energies, the main gas and electricity supplier to Ozaukee County, maintained about 20,000 miles of natural gas distribution mains, 530 miles of natural gas transmission pipelines, and provided natural gas to 1,127,000 customers in the State of Wisconsin.[159]

As stated in Chapter 2 of this report, Ozaukee County's natural gas distribution service is provided for the entire County by We Energies. The main gas supply for the County is provided by West Shore Pipeline Company. A major natural gas pipeline follows an east to west route entering the County in the northwest corner of the Town of Cedarburg and extending to the We Energies power plant in the City of Port Washington, as shown on Map 2.17. An additional gas pipeline runs in a direct north-south direction from Sheboygan County to the Village of Fredonia.

[157] *State of Wisconsin Hazard Mitigation Plan, December 2016, op.cit.*

[158] *U.S Energy Information Administration: www.eia.gov.*

[159] *www.we-energies.com.*

Description of Natural Gas Disruptions or Loss

- On June 21, 1997, flash flooding occurred in southern Ozaukee County as a result of heavy rainfall in excess of eight inches over a 30-hour period. This flash flooding event was greater than a 100-year recurrence interval flood. Besides public facilities damage, there were widespread private home and business damages. The hardest hit areas were the City of Mequon, Village of Thiensville, a small area about two miles southwest of Fredonia, and a location east of Cedarburg. Many customers lost electrical power, natural gas, or telephone service.

- On January 25, 2014, the Governor signed an Executive Order declaring a State of Emergency in response to severe winter weather and a propane shortage. The shortage is believed to be the result of several factors including, high demand for propane in November to dry a large, late harvest of corn; disruption of delivery of propane to the Midwest; and record cold and snow storms in the upper Midwest increasing use of propane and interfering with truck and rail delivery. DHS reports three probable cold weather related deaths occurred in Ashland, Marquette, and Milwaukee Counties.

Vulnerability and Community Impact Assessment

Most hazardous incidents involving natural gas pipelines involve a contractor or a homeowner severing a buried distribution line, weather, or outdated pipes. Natural gas is highly flammable and has the potential to cause an extensive amount of damage, by fire or explosion, which could also lead to a fuel shortage or disruption. Natural gas disruptions may also be caused by power failure, imbalance in supply, or a natural disaster. Ozaukee County has had no reported long duration or large impact natural gas pipeline disasters in the recent past.

Multi-Jurisdictional Fuel Loss Risk Management

Based upon a review of natural gas disruptions or loss events in Ozaukee County, there are no specific municipalities that have unusual risks. Rather, the events are considered to be relatively uniform and of a countywide concern.

Potential Future Changes in Utility Failure Conditions

Changes in Ozaukee County's future land use development and demand on public utility infrastructure can have an impact on the potential for utility supply disruption or loss, and related hazards that may occur. Section 66.1001 (2) (d) of the *Wisconsin State Statutes* requires a projection of the demand for future utilities and community facilities in the County and an approximate timetable of the expansion, rehabilitation, and replacement of existing facilities and the construction of new facilities to meet the projected land use development and demand. The projected demand and approximate timeline for various utilities and community facilities in the County are based on recommendations set forth by regional plans and the anticipated land use development pattern in the County comprehensive plan and the regional land use plan, as summarized in Chapter 2 of this report.

As stated in Chapter 2, Ozaukee County currently benefits from plentiful surface and ground water resources. However, these water resources are not always available in the quantity or quality that is needed for human uses. Some communities could encounter water supply challenges based on increased demand, reduction of the availability of quality and quantity of groundwater in aquifers, loss of groundwater recharge areas, and aging infrastructure. The number of communities facing water challenges is expected to grow in the future. The Public Service Commission (PSC) of Wisconsin works with Wisconsin water utilities to incorporate water conservation and efficiency measures into water supply planning.[160]

Additionally, deteriorating infrastructure is a current nationwide problem that is likely to be worsened by changing future conditions and demands. Sewers deteriorate over time and develop cracks, breaks, and blockages if not properly maintained on a regular basis. Ozaukee County communities will need to prepare for future demand on public sanitary sewer service utility infrastructure systems by continuing to maintain and update such structures and planning requirements to meet these demands.[161]

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[160] *Wisconsin Emergency Management, State Hazard Mitigation Plan of Wisconsin, December 2016, amended January 2017.*

[161] *Ibid.*

Proper and adequate planning and maintenance for future use and demand of electrical and fuel utility supply and infrastructure are important considerations for Ozaukee County hazard mitigation planning. Wisconsin's electrical and natural gas utilities, or local distribution companies are regulated by the Wisconsin PSC. The rates and services of interstate pipeline companies, as well as the construction of new pipelines, is regulated by the Federal Energy Regulatory Commission (FERC). As stated earlier, We Energies and Cedarburg Light and Water Utility are the main electrical and fuel utility providers for Ozaukee County residents. In addition, the American Transmission Company (ATC) is responsible for the transmission of the overhead electrical supply initiated by generation systems and then carried out to residential, industrial, commercial structures within the County. ATC continually plans and maintains for future supply and conditions, including safety, demand, and efficient use.

The likely effect of climate change on utility failure is not clear. Projections based upon downscaled climate model results indicated that the magnitude and frequency of heavy precipitation events are likely to increase by the middle of the 21st century. Modeling also indicates that the number of days per year in which atmospheric environments that are known to support the formation of severe thunderstorms under current climatic conditions will increase between now and the end of the 21st century.[162] In addition, wind strengths over the Great Lakes have increased and are expected to continue increasing in the future.[163] Severe winds, lightning, and flooding can all have an impact on utility infrastructure the ability of utility systems to function properly. Finally, the changes in temperature and precipitation that are projected to occur between now and the middle of the century are likely to cause a greater proportion of precipitation during winter to fall as rain rather than snow. Precipitation falling in the form of rain in winter can often freeze on impact, depending on the temperatures of the ground or infrastructure. Ice storms have the potential to cause long-term and widespread power outages. An increase in ice storm events would almost certainly lead to more widespread and longer term power outages in Ozaukee County.

Vulnerability and Community Impact Assessment for Utility Loss

The failure of any of the above utilities to function can have a wide-ranging impact in Ozaukee County. Residents, especially special needs populations, may not be able to safely live in their homes if utility failure were to disrupt the provision of drinking water, electricity, and natural gas. The disruption or failure of electricity to provide air conditioning and natural gas to provide adequate heat during an extreme temperature event can have a major impact on vulnerable community members throughout the County. Businesses and the utilities themselves would face severe economic impacts due to the inability to produce goods and services for which they bill. While there are generally back-up generators on sewage lift stations in Ozaukee 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 reduced capacity due to the loss of utility services. In addition, agricultural assets may be impacted by the loss of utilities. Transportation systems and roadways may also become unsafe due to the loss of directional and street signals.[164]

3.11 VULNERABILITY ASSESSMENT FOR FOG

Fog is a cloudlike mass or layer of tiny water droplets or ice crystals near the surface of the earth, appreciably reducing visibility. Fog appears when the air becomes saturated and cannot hold any additional moisture. As a result, the water vapor in the air condenses to liquid droplets, crystals, or ice, resulting in fog. Very light winds are usually a prerequisite for fog. This is one of the reasons that a slow-moving pressure system over the Midwest can be a fog producer. When the winds become stronger the atmosphere usually mixes drier air with the moist air and the chances of fog occurring decrease. When warmer, moist air flows above snow, the cold snow reduces the temperature near the ground to near the dew point resulting in saturation. This often produces wide areas of advection fog. The snow itself can add moisture to the air increasing the chances for fog. This is a process called sublimation that results in ice changing over to vapor without first changing to liquid.

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[162] *Noah S. Diffenbaugh, Martin Scherer, and Robert J. Trapp, "Robust Increases in Severe Thunderstorm Environments in Response to Greenhouse Forcing,"* Proceedings of the National Academy of Sciences, *Volume 110, pages 16, 361-16,366, 2013.*

[163] *Ankur R. Desai, Jay A. Austin, Val Bennington, and Galen A. McKinley, "Stronger Winds Over a Large Lake in Response to Weakening Air-to-Lake Temperature Gradient,"* Nature Geoscience, *Volume e, pages 855-858, 2009.*

[164] *EPTEC, Inc. Lenora Borchardt,* Ozaukee County Hazard Mitigation Plan*, 2013.*

There are four basic types of fog: radiation, advection, evaporation, and upslope. Each of these types of fog, except for upslope fog, has the potential to occur in Ozaukee County. Radiation fog is caused by cooling close to the earth's surface. The earth gives off long wave radiation that 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. Advection fog results from the movement of warm, moist air over a colder land mass. During the winter, this type of fog is common when snow covers much of the Midwest. Evaporation fog is caused by cold air crossing over warmer bodies of water. On cold days, this fog looks like steam over Lake Michigan, inland lakes, and rivers. Ozaukee County's proximity to Lake Michigan makes it geographically susceptible to widespread evaporation fog. Upslope fog is common near the Rocky Mountains. If the winds are out of the east, the air flows up in elevation approaching the mountains, and this can cool the air to its dew point and result in widespread fog.

Dense fog occurs during every month of the year in Wisconsin. It is more common during the cooler months of September through April. During the fall and spring months, dense fog favors the early morning hours, while during the winter months dense fog can occur nearly any time if certain weather conditions exist. Dense fog can be hazardous because it can restrict surface visibility. According to the NWS, fog becomes hazardous when it is obscures visibility to one-quarter mile or less. This results in decreased response time for operators of motor vehicles. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, complicate shipping operations, and impair the effectiveness of emergency response. Dense fog may persist for several hours or days, reducing visibility and leading to vehicle accidents, and flight delays or cancellations at airports.

Historical Fog Problems

According to the NCDC storm events database, there have been 79 fog events reported in and around Ozaukee County in the period from May 17, 1996, through December 31, 2017. Although no direct deaths or injuries are attributed to fog itself, fog can affect visibility and thus can make transportation very dangerous. Deaths and injuries due to traffic accidents that are likely caused by fog are numerous.

A serious fog related incident occurred in January 1996, when a 26-car pileup on southbound IH 43 near Ozaukee County injured 14 people. The first driver struck said he had missed his exit because of heavy fog and had slowed down to look for the next exit when he was hit from behind, initiating the pileup.[165]

Fog was the largest contributing factor leading to one of the worst traffic accidents in Wisconsin history, which occurred on October 11, 2002. On that morning, about 50 vehicles were involved in a pileup on IH 43 in Sheboygan County, near Cedar Grove, Wisconsin, just north of Ozaukee County. This accident was one of the deadliest car accidents in Wisconsin history with 10 people killed and at least 38 injured. The accident occurred when near zero visibility forced cars heading southbound to rapidly slow down. When vehicles travelling in clear conditions at freeway speeds approached the wall of fog, they were unable to see the stopped cars and collided into them. This led to a chain reaction as numerous cars were unaware of the scene hidden behind the blanket of fog.

In 2013 fog, smog, or smoke played a role in 732 traffic accidents in the State of Wisconsin, with 12 fatalities and 327 injuries. Most of these accidents occurred during wet road conditions.

Vulnerability, Community Impacts, and Multi-Jurisdictional Assessment

Fog events affect the transportation systems within Ozaukee County, primarily the road and highway systems. Fog is also a concern for boaters on Lake Michigan, both commercial and recreational. While the U.S. Coast Guard does not publish statistics for fatalities, injuries, and property damage due to boating accidents involving fog, one can make a reasonable assumption that fog has played a role in some of these accidents. Boaters caught in heavy fog may strike another vessel, dock, or natural feature such as a rock or bluff. As Lake Michigan fog often occurs when the temperatures are colder, victims are sometimes forced to evacuate their vessel and may suffer from hypothermia. Fog can also make it much more difficult for Lake Michigan rescuers to find the victims to provide aid.

[165] *EPTEC, Inc. Lenora Borchardt,* Ozaukee County Hazard Mitigation Plan*, 2013.*

Fog can occur anywhere in the County and can cause death, injury, and property loss. Certain types of fog, however, are more likely to form near rivers and lakes. Ozaukee County's coastal communities are more likely to experience impacts from dense fog from Lake Michigan. Responding governmental agencies also may suffer losses due to responders working in a reduced-visibility zone.[166]

Potential Future Changes in Fog Conditions

The climate projections based on downscaled results from global climate models did not address the frequency of dense fog events. Because of this, an assessment of long-term changes in fog-related hazard conditions cannot be made.

[166] *Governmental agencies may be impacted by a fog event due to the cost of response, damage done to the roadway and/or structures, and for potential injuries.*

HAZARD MITIGATION GOALS 4

Planning may be defined as a rational process for formulating and meeting goals and objectives. Consequently, the formulation of goals and objectives is an essential task that must be undertaken before plans can be prepared. This chapter sets forth hazard mitigation goals and objectives for use in the consideration of alternative hazard mitigation strategies for Ozaukee County and in the selection of recommended strategies from among those alternatives.

In formulating and setting forth goals and objectives, their differing natures and purposes must be kept in mind. In this regard, the definition of goals and objectives used herein is as promoted by the Federal Emergency Management Agency (FEMA). Goals are general guidelines that explain what a community desires to achieve. Based upon the selected goals, a community can then develop the specific objectives or standards needed to attain the goals. Objectives and standards more narrowly define strategies for meeting the selected goals and are more specific.

4.1 RELATIONSHIP OF HAZARD MITIGATION GOALS AND OBJECTIVES TO OTHER RELEVANT PLANNING EFFORTS

Ozaukee County and 14 of its local units of government, including the Village of Newburg, have prepared a comprehensive plan that will provide a basis for broad-based decision-making on land use related matters by County and local government officials, and will increase the awareness and understanding of County, city, village, and town planning goals and objectives by landowners, developers, and other private interests.[167] That plan incorporates and updates elements from other County and Regional plans as appropriate. Local comprehensive plans prepared as part of the multi-jurisdictional planning process were adopted by the Cities of Mequon and Port Washington; the Villages of Belgium, Fredonia, Grafton, Newburg, Saukville, and Thiensville; and the Towns of Belgium, Cedarburg, Fredonia, Grafton, Saukville, and Port Washington.[168] It should be noted that the City of Cedarburg also participated in intergovernmental meetings during the

[167] *SEWRPC Community Assistance Planning Report No. 285,* A Multi-Jurisdictional Comprehensive Plan for Ozaukee County: 2035, *April 2008, amended May 2009, July 2013. The plan was amended on May 6, 2009, to incorporate city, town, and village comprehensive plans adopted between April 2008 and May 2009. The plan was also amended on May 1, 2013, to update planned land use categories for l ands owned by Ozaukee County to reflect the County's planned uses of each parcel and to ensure consistency between the comprehensive plan and the Ozaukee County Zoning Ordinance for County-owned lands, and to incorporate the Park and Open Space Plan for Ozaukee County: 2035 as a component of the County comprehensive plan.*

The Purpose of Amendment 2013-02 was to incorporate the Ozaukee County Farmland Preservation Plan as a component of the comprehensive plan. The Farmland Preservation Plan was adopted by the County Board on July 3, 2013. This amendment also updates the comprehensive plan to reflect the recommendations of the farmland preservation plan, thereby ensuring consistency between the comprehensive plan and the farmland preservation plan as required by Section 91.10(2) of the Wisconsin Statues.

[168] Village of Belgium Comprehensive Plan for 2035, *January 5, 2009*; Town of Belgium Comprehensive Plan for 2035, *January 5, 2009, amended July 15, 2015;* Town of Cedarburg Comprehensive Plan: 2035, *April 2, 2008, amended in 2009 and 2012; Ruekert and Mielke,* Village of Fredonia Comprehensive Plan for 2035, *February 19, 2009;* Town of Fredonia Comprehensive Plan for 2035, *March 18, 2009; Vanderwalle and Associates,* Village of Grafton Comprehensive Plan: 2035, *February 2, 2009, amended October 17, 2016; Planning and Design Institute, Inc.,* Town of Grafton Comprehensive Plan*: 2035, April 9, 2008, amended May 10, 2017;* Comprehensive Plan for the City of Mequon: 2035, *April 14, 2009;* A Comprehensive Plan for the Village of Newburg, *November 13, 2008, updated May 8, 2014;* City of Port Washington Comprehensive Plan for 2035, *January 6, 2009; Ruekert and Mielke,* A Comprehensive Plan for the Town of Port Washington, *February 2009; Vanderwalle and Associates,* The Village of Saukville 2035 Comprehensive Plan, *January 20, 2009, updated August 24, 2016*; Town of Saukville Comprehensive Plan for 2035, *December 16, 2008, amended December 20, 2011; and,* A Multi-Jurisdictional Comprehensive Plan for the Village of Thiensville: 2035, *April 29, 2009.*

Multi-Jurisdictional planning process for the general purpose of accomplishing coordinated, adjusted, and harmonious development with Ozaukee County.[169]

Additional planning efforts that incorporate and update elements from pertinent County and Regional plans and were considered when forming goals and objectives for the County's hazard mitigation program include:

County Plans

- Jeff Bell, Andy Holschbach, and Geoff Schramm, Ozaukee County's Land and Water Management Department, *Ozaukee County Land and Water Management Plan: 2011-2015*, February 10, 2011

- SEWRPC Community Assistance Planning Report No. 133, *A Park and Open Space Plan for Ozaukee County (3rd Edition)*, June 2011

- SEWRPC Community Assistance Planning Report No. 87, *A Farmland Preservation Plan for Ozaukee County (2nd Edition)*, December 2013

Watershed Plans

- SEWRPC Planning Report No. 13, *A Comprehensive Plan for the Milwaukee River Watershed*, Volume One, *Inventory Finding and Forecasts*, December 1970, and Volume Two, *Alternative Plans and Recommended Plan*, October 1971

- SEWRPC Planning Report No. 26, *A Comprehensive Plan for the Menomonee River Watershed*, Volume One, *Inventory Finding and Forecasts*, December 1976, and Volume Two, *Alternative Plans and Recommended Plan*, October 1976

Regional Plans

- SEWRPC Planning Report No. 42, *Regional Natural Areas Plan*, September 1997, amended 2010

- SEWRPC Planning Report No. 50, *A Regional Water Quality Plan Update for the Greater Milwaukee Watersheds*, Part One, Chapters 1-12, December 2007 and Part Two, Appendices, December 2007 amended May 2013

- SEWRPC Planning Report No. 52, *A Regional Water Supply Plan*, Volume One, Chapters 1-12, December 2010 and Volume Two, Appendices, December 2010

- SEWRPC Planning Report No. 55, *VISION 2050: A Regional Land Use and Transportation Plan*, July 28, 2016, amended December 2018.

4.2 HAZARD MITIGATION GOALS AND OBJECTIVES

Figure 4.1 presents the six goals for the Ozaukee County hazard mitigation planning program. The goals have been established based, in part, upon goals established in the previous edition of the Ozaukee County hazard mitigation plan, as well as related County planning programs. Complementing each of these goals is a set of objectives which can be used to define more specific actions or strategies to achieve the goals.

[169] Smart Growth Comprehensive Land Use Plan: 2025-The City of Cedarburg*, February 25, 2008, amended March 14, 2016. The Village of Bayside, which is located partially in Ozaukee County and partially in Milwaukee County, was asked to participate in the multi-jurisdictional planning process but declined.*

Figure 4.1
Goals and Objectives for the Ozaukee County Hazard Mitigation Plan

➤ **Goal 1: Preserve life and minimize the potential for injuries.**

- **Objective 1.1:** Identify natural hazards that threaten life in Ozaukee County.
- **Objective 1.2:** Identify populations within Ozaukee County that are particularly vulnerable to each identified hazard.
- **Objective 1.3:** Implement programs and projects that assist in protecting lives of populations vulnerable to each identified hazard.

➤ **Goal 2: Preserve and enhance the quality of life throughout Ozaukee County by identifying potential property and crop damage risks and recommending appropriate mitigation strategies to minimize potential damages.**

- **Objective 2.1:** Identify locations where property or crop damages are vulnerable to each identified hazard.
- **Objective 2.2:** Improve and update hazard assessment information to make informed recommendations that encourage adaptive and preventative measures for existing development in areas vulnerable to identified hazards, and to discourage new development in such areas.
- **Objective 2.3:** Protect life and property by implementing and enforcing state-of-the-art standards, codes, ordinances, and construction procedures.
- **Objective 2.4:** Develop and maintain stormwater and floodplain management systems and dam safety planning that reduce the exposure of people to drainage- and flooding-related inconvenience and health and safety hazards, and that reduce the exposure of real and personal property to damage through inundation resulting from flooding and inadequate stormwater drainage as well as vulnerabilities from high hazard potential dams.
- **Objective 2.5:** Continue to participate in the National Flood Insurance Program (NFIP) and Community Rating System (CRS) program for all communities within the County.

➤ **Goal 3: Promote Countywide coordination, planning, and training that avoids transferring the risk of hazards from one community to an adjacent community, where appropriate.**

- **Objective 3.1:** Identify and encourage uniformity across municipal boundaries in implementing state-of-the-art standards, codes, ordinances, and construction procedures to mitigate hazard impacts, where appropriate, to strengthen desired outcomes (i.e.: stormwater management ordinances and Lake Michigan coastal development standards and bluff setbacks).
- **Objective 3.2:** Identify and encourage cross-jurisdictional and/or multiple property owner programs and projects where such cooperation would strengthen desired outcomes (i.e.: stormwater and Lake Michigan coastal shore protection projects).
- **Objective 3.3:** Provide and maintain facilities necessary to maintain high quality fire and police protection and emergency medical services throughout the County. Continue developing and strengthening inter-jurisdictional coordination and cooperation in the area of emergency services.
- **Objective 3.4:** Continue to develop, maintain, and support comprehensive mutual aid agreements.
- **Objective 3.5:** Continue providing Ozaukee County and municipal emergency services with training and equipment to address all identified hazards.

Figure 4.1 (Continued)

- **Objective 3.6:** Identify and develop programs that complement County and local emergency operations plans to mitigate the potential exposure to health and safety risks and the exposure of property to damage from a broad range of hazards that are unpredictable and not geographically specific in nature.

- **Objective 3.7:** Develop and maintain backup plans and communications interoperability and redundancy for emergency response throughout the County. Communications interoperability for other crucial public health, public works, dispatch, emergency management, and hospitals should also assure the adequate operations of prevention and response.

➤ **Goal 4: Maintain a spatial distribution of the various land uses that preserves and protects the natural resources of the County, including its soils, inland lakes and streams, groundwater, wetlands, woodlands, wildlife, floodplains, and natural areas and critical species habitats.**

- **Objective 4.1:** Floodplains should not be allocated to any urban development that would cause or be subject to flood damage or cause flood damage in upstream or downstream areas.

- **Objective 4.2:** No unauthorized structure or fill should be allowed to encroach upon and obstruct the floodway portion of stream channels.

- **Objective 4.3:** The types and distribution of land uses should be developed considering the potential impacts on flood flows, on surface water quality, and on groundwater quality and quantity. Considerations should be made to limit the amount of impervious surface in new development or redevelopment.

- **Objective 4.4:** All remaining undeveloped lands within the designated primary environmental corridors in the County should be preserved in essentially natural, open uses.

- **Objective 4.5:** All remaining undeveloped lands within the designated secondary environmental corridors and isolated natural resource areas in the County should be considered for preservation as urban development proceeds.

- **Objective 4.6:** All wetlands adjacent to streams or lakes, all wetlands within areas having special wildlife or other natural values, and all wetlands having an area of five acres or greater should not be allocated to any urban development, except limited recreational use, and should not be drained or filled. In addition, County and local units of government may choose to preserve all wetlands.

➤ **Goal 5: Increase public awareness to hazards that threaten life and property.**

- **Objective 5.1:** 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.

- **Objective 5.2:** Increase public awareness of populations that are particularly vulnerable to certain hazard threats, and inform them of actions they can take, as well as programs available to them, to reduce the risk of injury, death, and property damage.

- **Objective 5.3:** Provide informational items, partnership opportunities, and funding resource information to assist in implementing mitigation activities.

➤ **Goal 6: Identify potential funding sources that can assist in the implementation of mitigation projects and programs.**

- **Objective 6.1:** Because funding programs and opportunities are constantly changing, the involved County and local units of government staffs should monitor and maintain the potential funding sources and programs.

Figure 4.1 (Continued)

- **Objective 6.2:** Whenever possible seek funding programs that meet multiple objectives and recommendations made for this hazard mitigation plan as well as those of other County and local community planning efforts.

HAZARD MITIGATION STRATEGIES 5

5.1 PLANNING FOR HAZARD MITIGATION MEASURES

Hazard mitigation planning systematically evaluates the nature and vulnerability of existing hazards, along with developing continued actions to reduce or eliminate long-term risks from hazards and their effects. Specific purposes of hazard mitigation include eliminating loss of life, lessening danger to human health and safety, minimizing monetary damage to private and public property, reducing the cost of utilities and services, and minimizing disruption in community affairs. Hazard mitigation also involves avoiding the intensification of existing hazards and the creation of new hazards.

The preparation of a hazard mitigation plan for Ozaukee County involves developing and evaluation alternative mitigation measures, or actions to reduce risk, and selecting the most effective elements of the alternatives to formulate an integrated plan. For planning purposes, the alternative mitigation measures are separated into one of three categories: 1) Nonstructural, 2) Structural, and 3) Public Informational and Educational Programming.

The mitigation measures identified in each hazard category were evaluated based upon relative cost and likely benefits (both direct and indirect) as indicated in the cost-benefit analysis summary tables located at the end of each profiled hazard. Consideration was given to the likelihood of occurrence of each type of hazard as set forth in the hazard prioritization analysis in the preceding section. Greatest priority is recommended to be given to those mitigation measures that directly or indirectly resulted in minimized loss of life or injury.

Estimated Cost of Implementation

Where possible, the cost-benefit analysis table for each profiled hazard includes a summary of the estimated capital cost and average annual operation and maintenance cost for each mitigation measure. There are many mitigation measures, especially for hazards other than flooding and related stormwater drainage problems, where a meaningful direct monetary cost analysis was not possible. Therefore, mitigation measures were also assigned a classification of low-, moderate-, and high-cost to categorize the relative expense of implementing the measure. The three categories are generally defined as including:

Low-Cost (less than $100,000)
- Educational and informational programming
- Ongoing enforcement of ordinances
- Plan development
- Continued coordination/mutual aid/interagency agreements

Moderate-Cost (greater than $100,000 and less than $1,000,000)
- Addition of new staff
- Additional staff hours budgeted
- Additional equipment
- New ordinance development
- New programs/task force

High-Cost (greater than $1,000,000)
- Major construction
- New buildings (infrastructure)
- Capital programs

This cost assessment allows the mitigation measures to be prioritized with particular regard to cost effectiveness by comparing the estimated low-, moderate-, and high-cost to the number of both direct and indirect benefits identified.

Benefits (Direct and Indirect)

The benefits of implementing a mitigation measure can be classified as direct, or measurable, and as indirect, or intangible. Direct benefits were defined in terms of enhanced preparedness/protection of individuals or communities, reduced property damage, reduced injuries and reduced mortalities. Although the exact numbers or amounts of such direct benefits are often not known, these would be a direct result implementing a particular mitigation measure. In contrast, indirect benefits represent a range of potential benefits that may occur as a result of implementing specific management actions, such as increased environmental and recreational benefits/ecosystems services and reduced loss of life and injury with associated benefits for economic productivity. For this hazard mitigation plan, both direct and indirect benefits are combined into one category within each cost-benefit analysis table of the profiled hazard event.

Communities/Jurisdictions Affected

The cost-benefit analysis tables for each profiled hazard also indicate a list of the communities affected for each hazard and corresponding priority mitigation measure.

Some of the mitigative actions described are ongoing or committed actions, which do not require the evaluation of alternative measures, but are proposed to be integrated into the mitigation plan as such. In other instances, where there are viable alternatives, such alternatives are described and evaluated. This Chapter describes the hazard mitigation actions considered to resolve the identified hazard problems within Ozaukee County that were described in Chapter 3.

In preparing updates to the plan, SEWRPC staff, the Ozaukee County Division of Emergency Management (DEM), and the Ozaukee County Hazard Mitigation Plan Local Planning Team reviewed and reevaluated the hazard mitigation goals for the County (see Chapter 4 of this Report). This review included consideration of whether the goals of the initial plan were still applicable and whether additional goals should be added. In addition, hazard conditions within the County were reviewed and reevaluated (see Chapter 3 of this Report). This review included reevaluation of the identification of hazards likely to affect the County, updating the data upon which the profiles of the extent and severity of hazard events that occurred in the County were based, reassessment in light of the updated data of the vulnerability and risk associated with each type of hazard, and reevaluation as warranted by the updated assessments of potential for changes in hazard severity and risk under future conditions. This review and reevaluation of hazard mitigation goals and hazard conditions, along with consideration of changes in conditions within Ozaukee County since the drafting of the initial plan (see Chapter 2 of this Report), and progress in implementing the initial hazard plan, served as the basis for the review and reevaluation of viable measures to reduce vulnerability to hazards identified in the updated risk assessment and the selection of priority mitigation actions to address those hazards.

5.2 HAZARD MITIGATION PLAN COMPONENT FOR MULTIPLE HAZARD TYPES

One of the bedrock principles of emergency management is to approach issues from a multi-hazards perspective. This is generally very cost-effective because it accomplishes mitigation goals and preparedness for several types of hazards with *one* resource or strategy. This initial plan component includes mitigation strategies, actions, projects, or programs that benefit multiple types of identified hazard events. This means reducing similar mitigation strategies that would otherwise be repeated for several or all of the identified hazards in this Plan update. The planned mitigation measures that apply to multiple hazards are presented in the following text.

Nonstructural

- Continue to enforce State building code regulations that aim to improve the ability of structures to withstand hazardous weather conditions[170]

[170] *The State Uniform Dwelling Code (UDC) is a statewide regulation that sets standards for fire safety; structural strength; energy conservation; erosion control; heating, plumbing, and electrical systems; and general health and safety in dwellings constructed or altered after 1980. The UDC applies uniformly throughout the State, and local governments may not adopt a more or less stringent code. Consequently, should review of local ordinances reveal that a change in building code would be a viable mitigation measure, the County and the municipalities within the County would need to pursue a change in the UDC at the State level.*

- Encourage the periodic review of and/or explore the need for new municipal and County development regulations, especially in known hazard areas

- Continue to encourage local municipalities to participate in the National Weather Service's (NWS) StormReady program.[171] Requirements for this program include:

    - Establishing a 24-hour warning point and emergency operations center

    - Having multiple ways to receive severe weather warnings and forecasts to alert the public

    - Promoting the importance of public readiness through community seminars

    - Developing a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises

- Continue to promote and encourage participation in Ozaukee County Emergency Management's Weather Safety and Spotter training led by NWS

- Continue the integration of hazard mitigation planning into other local planning efforts (i.e. comprehensive and land use planning)

- Create local funding opportunities and mechanisms for hazard mitigation

- Continue to update a list of potential funding sources associated with hazard mitigation planning

- Continue to work with public health and human services departments, volunteer groups, NGOs, and the American Red Cross on reviewing plans and coordination efforts in regard to emergency circumstances and mass care, especially for at-risk populations

- Continue coordination of emergency response and operation plans among governmental units and first responders

Structural

- Maintain, update, and upgrade public early warning systems and mass communication networks, such as IPAWS, EAS, WEA, NOAA Weather Radios, Reverse 9-1-1, and TYL;

- Continue the use, maintenance, and updating of the County's interoperability communication network systems;

- Bury and protect power and utility lines, where feasible, to prevent damage from hazardous weather conditions;

- Promote emergency on-site back-up power generation at critical facilities, including water treatment and wastewater treatment facilities;

- Establish safe and appropriate locations for temporary debris disposal sites;

- Trim and maintain the health of trees near vulnerable infrastructure, such as utility lines, essential facilities and roads, as well as near homes and businesses. Communities should continue the monitoring of emerald ash borer (EAB) infestation and develop a funding strategy for removal of dead or infested ash trees. Communities should also encourage private landowners to remove dead or infested ash trees near vulnerable infrastructure on their properties.

[171] *City of Cedarburg and Village of Bayside participate in the NWS StormReady program. More information on the NWS StormReady program can be found at www.stormready.noaa.gov.*

Public Informational and Educational Programming

- Continue to promote, update, and add to Ozaukee County Division of Emergency Management's online resources related to hazardous weather events, preparedness, and post-event care
- Continue to participate in public outreach events that educate County residents on planning and preparing for severe weather events
- Continue to promote and update the Washington-Ozaukee Public Health Department's website on emergency preparedness
- Encourage residents to develop a Family Emergency Preparedness Plan and Kit (see Appendix F)
- Promote inclusion of safety strategies for severe weather events into driver educational classes and materials
- Encourage and educate the public on the use of severe weather warning applications (apps.) on electronic mobile devices (i.e., FEMA's *ready.gov* severe weather warning mobile app.)
- Continue to distribute and promote information and educational resources and programs on available home insurance, flood insurance (i.e., NFIP), and crop insurance for damages sustained during severe weather
- Promote and distribute information related to maintaining healthy trees on private lands.

Current Programs

Federal and State Programs

FEMA funds several programs that assist State and local governments with hazard mitigation efforts and are administered through WEM in the State of Wisconsin. Two of these programs fit best in this "multiple hazards" section because they address a broad array of hazard events. These programs include the Hazard Mitigation Grant Program and the Pre-Disaster Mitigation Program. These programs provide funding for both pre-disaster planning and on-the-ground projects and will be discussed in further detail in the hazard mitigation funding sources later in this Chapter. Federal and State agencies also have programs that offer awareness and educational resources and tools to enhance State, local, and Tribal hazard mitigation efforts. FEMA and WEM provide many online resources and social media tool kits to assist the public on hazardous weather preparedness, safety, and recovery. FEMA offers a free mobile application through the Department of Homeland Security's Ready Campaign program that features safety tips on what to do before, during, and after disasters as well as weather alerts and personal reminders.[172]

NOAA's NWS also has extensive public information and programs to educate people about the dangers of severe weather and preventing associated deaths and injuries. The NWS issues warnings, watches, and advisories when there is a threat of severe weather conditions. Wisconsin Department of Health Services, in conjunction with the NWS and other State and local government agencies, provides both preparedness information and severe weather information to the public.

Ozaukee County is an active participant in the NOAA Weather-Ready Nation (WRN) Ambassador Initiative and is actively pursuing the NWS StormReady Program designation. The WRN Ambassador initiative helps unify the efforts across government, non-profits, academia, and private industry toward making the nation more ready, responsive, and resilient against extreme weather hazards. As a WRN Ambassador, Ozaukee County commits to working with NOAA and other Ambassadors to strengthen resilience against extreme weather. The NWS StormReady Program encourages communities to take a proactive approach to improving

[172] *Department of Homeland Security's Ready Campaign was launched in February 2003 as a National public service campaign designed to educate and empower citizens to prepare for, respond to, and mitigate emergencies, including natural and man-made disasters. Go to Ready.gov to download the mobile app.*

local hazardous weather operations by providing emergency managers with guidelines on how to improve their hazardous weather operations.[173]

Local Programs

Ozaukee County DEM is responsible for developing, implementing, and managing the County's disaster prevention, preparedness, and response, recovery, and mitigation efforts. The DEM website has several online resources and links related to severe weather safety and other general emergency management-related topics and planning efforts. County and local jurisdictions provide online resources, pamphlets, brochures, and social media content on severe weather preparedness, safety, recovery, and emergency management. Similarly, the Washington-Ozaukee Public Health Department provides the public with a number of informational and educational resources on emergency and disaster preparedness. Ozaukee County DEM and municipalities in the County participate in a number of public outreach events including the Ozaukee County Fair, the YMCA Healthy Kids Day, Thiensville Safety Day, and State sponsored severe weather awareness campaigns.

There are many modes of communication in which the residents of Ozaukee County are able to receive severe weather warnings including outdoor warning sirens, NOAA Weather Radios, local television and radio broadcasts, digital mobile alert systems, social media platforms, and even door-to-door notifications in certain situations. Ozaukee County also has the capability to issue emergency alerts through its Integrated Public Alert and Warning System (IPAWS). IPAWS provides the County with an effective way to alert and warn the public about emergencies using the Emergency Alert System (EAS), Wireless Emergency Alerts (WEA), NOAA Weather Radios, and other public alerting systems from a single interface. In addition to IPAWS, Ozaukee County has the ability to alert the public through reverse-9-1-1, Teletypewriter (TTY), and several subscription-based mobile alert text and email messaging application systems (i.e., "Notify-Me," "E-Notify," and "Hyper-Reach"). The City of Mequon also maintains a mass notification system capable of reverse-9-1-1, subscription-based mobile alert text and email messaging applications, and TTY.

A detailed description of public early warning and notification systems used by Ozaukee County and communities within the County are provided below:

- **The Emergency Alert System (EAS)** allows officials to send emergency information targeted to specific geographical areas. The EAS sends alerts out to broadcast media, cable television providers, satellites, pagers, direct broadcast satellites, high-definition television, and video dial tone. This system uses the same digital protocols as NOAA Weather Radio. The NWS generates about 80 percent of EAS activations, primarily for short-duration weather warnings and watches. Federal, State, and local emergency personnel can also access this system to disseminate non-weather emergency messages through the NWS's HAZCollect system.

- **Wireless Emergency Alerts (WEA)** is a partnership including local and State public safety agencies, FEMA, the Federal Communications Commission (FCC), the Department of Homeland Security (DHS), and the NWS. With WEA, authorized County officials can send emergency messages to mobile devices of those that may be in harm's way without the need to download an app or subscribe to a service. WEAs are broadcast from area cell towers to mobile devices only in the specific area where there is a danger. These short messages are designed to get the recipient's attention in a critical situation and will look like a text message that will show the type and time of the alert, any action that recipients should take, and the agency issuing the alert. The WEA message will include a special tone and vibration that will be repeated twice. This system can send alerts for extreme weather warnings, local emergencies requiring evacuation or immediate action, AMBER Alerts, and Presidential alerts during a national emergency.

- **NOAA All Hazard Weather Radio** (**NWR**) is a nationwide network of radio stations broadcasting continuous weather information directly from the nearest NWS office, which is the Milwaukee/Sullivan office for Ozaukee County. Warnings transmitted through NWR are relayed to other media through the FCC's EAS systems.

[173] *More information on the Weather-Ready Ambassador Initiative and the StormReady Program can be found at www.weather.gov.*

- **Reverse-9-1-1** is a public safety communications technology used by public safety officials to communicate with groups of people in defined geographic areas. The system uses a databse of telephone numbers and associated addressed and GIS software to deliver recorded emergency notifications to a selected set of telephone service subscribers within a specified area.

- **Text Telephone / Teletype Terminal / Teletypewriter/ Telecommunication Device for the Deaf (TTY/TTD)** is a special device that lets people who are deaf, hard of hearing, or speech-impaired use the telephone to communicate, by allowing an individual to type text messages. A TTY is required at both ends of the conversation in order to communicate. It can be used with both land lines and cell phones. Unlike text messaging, it is designed for synchronous conversation, like a text version of a phone call. A modern digital cell phone must support a special digital TTY mode in order to be compatible with a TTY device.

Ozaukee County Amateur Radio Emergency Service (OZARES) provides backup auxiliary communications for the County during a planned or emergency event if the County loses some, or all, of its radio communication systems. Volunteers are also trained to spot and report a severe weather event. OZARES does not broadcast severe weather warnings to the public, rather providing ground truthing of reported severe weather events to either Ozaukee County Emergency Management or to the NWS. OZARES and the Ozaukee County DEM maintain a Memoranda of Understanding for services such as emergency communication and severe weather spotting.

As described in Chapter 2, Ozaukee County has developed a comprehensive emergency management plan (CEMP)[174] which sets forth an all-hazards action plan. Similarly, many of the local units of government have developed emergency operations plans and/or programs that complement the County's plan and also set forth procedures and actions to deal with a range of situations and events. Also, Ozaukee County maintains plans for mass care and sheltering with the Washington-Ozaukee Public Health Department, Ozaukee County's Department of Human Services, the American Red Cross, and the Wisconsin Humane Society.

Multi-Jurisdictional Considerations

The hazards addressed by mitigation measures in this multi-hazard plan component include multiple weather events as well as non-weather-related hazards. These events have the potential to impact all municipalities within Ozaukee County and may cause damage or loss to a variety of infrastructure (i.e., transmission lines, communication lines, and transportation routes), buildings (i.e., homes, businesses, critical facilities), and property. Hence, Ozaukee County, municipalities, and relevant businesses and organizations should continue to coordinate hazard mitigation activities through a cooperative County and local government partnership in countywide hazard mitigation planning and response mechanisms.

Evaluation of Alternatives and Identification of Priority Mitigation Measures

Based on the risk analysis given in Chapter 3 indicating the vulnerability of human life, property, and economic production related to various hazard events, it is indisputable that measures focusing on educating the public and providing advanced warning of impending hazard events should continue to represent a major component of planned mitigation actions. The existing warning systems should continue to rely upon the use of multiple means of communication to alert people to the threat of various hazard events. Warning systems will need to be maintained routinely and improved as technology advances. In addition, informing the public of the significance of various hazard events and the dangers they present is an important and ongoing component for minimizing the risks associated with these events. Community based informational programs should continue to be conducted by the County in partnership with Federal, State, and local officials.

Ozaukee County's participation and coordination in disaster and emergency preparedness with other local, State, and Federal organizations is a principle mitigative action to protect the citizens of the County and to preserve private property and public infrastructure.

[174] Ozaukee County, Wisconsin, Comprehensive Emergency Management Plan (CEMP), *January 2013*.

The best way to mitigate vulnerability to many hazards is to avoid them all together, when possible. Life and property are vulnerable to hazard events when they are in or near known hazard areas. For this reason, an important aspect to any hazard mitigation plan is continuing to enforce, review, and when necessary, enact new regulations and ordinances. The County and its municipalities should continue to review building code regulations and ordinances specifically related to new development and redevelopment. New development should not be permitted in or near known hazard areas.

Based upon the foregoing evaluation and consideration of risk, and review by the Ozaukee County Hazard Mitigation Plan LPT, there are 16 actions that apply to multiple types of hazards and were determined to be priority mitigation measures as part of this hazard mitigation plan update. These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.1.

5.3 HAZARD MITIGATION PLAN COMPONENT FOR FLOODING AND ASSOCIATED STORMWATER DRAINAGE PROBLEMS

As described in Chapter 3, flooding and related stormwater drainage problems represent one of the most common and damaging types of hazards affecting Ozaukee County. Generally, the amount of damage from flooding is a direct consequence of the contributing drainage area land use. Ozaukee County does have a history of flooding problems, especially along the Milwaukee River. This section describes alternative and selected priority strategies to mitigate these types of hazards. As part of the updating process, these strategies were reviewed and reevaluated by the Ozaukee County Hazard Mitigation LPT considering the updated hazard conditions and hazard mitigation goals documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

A variety of nonstructural, structural, and educational or informational measures are available for mitigating the impacts of flood and related stormwater drainage problem events for Ozaukee County. Structural measures typically are most effective where impacted buildings are concentrated, such as urban areas, while nonstructural measures are most effective where the flooded structures are scattered throughout the watershed. Educational and informational flood mitigation-related material is effective for communities, homeowners, landowners, businesses, farmers, and local officials who continually experience riverine and stormwater flooding events.

For purposes of organizing this extensive plan component, mitigation strategies are grouped into four plan elements:

- Preservation of Floodplains, Open Space, and Environmentally Sensitive Lands
- Floodplain Management
- Stormwater Management
- Public Information and Education Outreach

Preservation of Floodplain, Open Space, and Environmentally Sensitive Lands Plan Element

Floodplain management regulations and open space and environmentally sensitive land policies perform critical roles toward assuring that flood mitigation efforts are properly implemented. As detailed in Chapter 2, Ozaukee County and the municipalities within the County have several pertinent floodplain management regulations and programs in place, most notably in the form of zoning regulations and ordinances. In addition, a significant portion of environmentally sensitive lands within the County, including wetlands, woodlands, and floodplains are under protective ownership and/or zoning ordinance(s).

Table 5.1
Cost-Benefit Analysis for Priority Measures Included in the Ozaukee County Hazard Mitigation Plan: Multi-Hazards

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Continue to enforce State building code regulations that aim to improve the ability of structures to withstand hazardous weather conditions;	--[c]	--[c]	X			X	X	X	X			Ozaukee County and all local jurisdictions[d]
Continue the County's participation in the National Weather Service's (NWS) StormReady program	--[c]	--[c]	X			X						Ozaukee County and all local jurisdictions[d]
Continue to promote and encourage participation in Ozaukee County Emergency Management's Weather Safety and Spotter training program	--[c]	--[c]	X			X						Ozaukee County
Continue the integration of hazard mitigation planning into other local planning efforts (i.e., comprehensive and land use planning	--[c]	--[c]	X			X						Ozaukee County and all local jurisdictions[d]
Continue to work with public health and human services departments, volunteer groups, NGOs, and American Red Cross	--[c]	--[c]	X			X						Ozaukee County
Continue coordination of emergency response and operation plans among governmental units and first responders	--[c]	--[c]	X			X						Ozaukee County and all local jurisdictions,[d] and NGOs
Maintain, update, and upgrade public early warning systems and networks	--[e]	10,000 per year for County Dispatch		X		X						Ozaukee County and all local jurisdictions[d]
Continue the use, maintenance, and updating of the County's interoperability communication network systems	6.5 million for 2018-2021 replacement	125,000 per year in system maintenance		X		X	X					Ozaukee County[f]

Table continued on next page.

Table 5.1 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Bury and protect power and utility lines, where feasible and appropriate, to prevent damage from hazardous weather conditions	--[c]	--[c]			X	X						Ozaukee County and all local jurisdictions[d]
Promote emergency on-site back-up power generation at critical facilities, including water treatment and wastewater treatment facilities	--[c]	--[c]		X		X	X					Ozaukee County and all local jurisdictions[d]
Trim and maintain the health of trees near vulnerable infrastructure. Communities should continue the monitoring of emerald ash borer (EAB) and develop a funding strategy for removal. Communities should also encourage private landowners to remove dead or infested ash trees near vulnerable infrastructure.	--[g]	50,000 per year for county-owned lands		X		X	X					Ozaukee County and all local jurisdictions[d]
Continue to promote, update, and add to Ozaukee County Division of Emergency Management's online resources related to hazardous weather events, preparedness, and post-event management	--[c]	--[c]	X			X						Ozaukee County
Encourage residents to develop a Family Emergency Preparedness Plan and Disaster Supply Kit	--[c]	--[c]	X			X						Ozaukee County and all local jurisdictions[d]
Promote inclusion of safety strategies for severe weather events into driver educational classes and materials	--[c]	--[c]	X			X						Ozaukee County and all local jurisdictions[d]

Table continued on next page.

Table 5.1 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Encourage and educate the public on the use of severe weather warning applications (apps) on electronic mobile devices (i.e., FEMA's *ready.gov* severe weather warning cellular phone app)	--[c]	--[c]	X			X						Ozaukee County
Continue to distribute and promote informational and educational resources and programs on available home insurance, flood insurance (i.e., NFIP), and crop insurance for damages sustained during severe weather	--[f]	--[f]	X			X						Ozaukee County and all local jurisdictions[d]

[a] *All cost expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low	*Moderate*	*High*
Educational and informational programming	*Addition of new staff*	*Major construction*
Ongoing enforcement of ordinances	*Additional staff hours budgeted*	*New buildings (infrastructure)*
Plan Development	*Additional equipment*	*Capital programs*
Continued coordination/mutual aid/interagency agreements	*New ordinance development*	
	New programs/task force	

[c] *Costs covered under ongoing activity.*

[d] *Jurisdictions include general purpose units of government—Cities, Towns, and Villages—and special purpose units of government such as School Districts, Sanitary and Utility Districts, and Agricultural Drainage Districts.*

[e] *Costs are site-specific.*

[f] *Costs are only for Ozaukee County. It does not reflect maintenance for local jurisdictions end user equipment.*

[g] *Costs to be determined. Partially covered under ongoing programs.*

Source: Ozaukee County Division of Emergency Management and SEWRPC

Floodplain and Wetland Preservation Regulations

As indicated in Table 2.21 in Chapter 2 of this Report, floodplain management regulations include floodplain zoning ordinances and wetland-shoreland zoning ordinances.[175] The floodplain zoning ordinances are intended to preserve the floodwater conveyance and storage capacity of floodplain areas and to prevent the location of new flood-damage-prone development in flood hazard areas. The wetland, or wetland-shoreland zoning ordinance seeks to maintain the stormwater and floodwater storage capacity of wetlands

in the County and prohibits certain land uses detrimental to wetland areas.[176] More information regarding each of these ordinances is set forth in Chapter 2 of this Report. Implementing these ordinances on an ongoing basis is an integral part of the County flood mitigation strategy.

Environmentally Sensitive Lands and Open Space Preservation

Protecting environmentally sensitive lands, such as environmental corridors and important natural features on the landscape can assist in preventing increased flood flows and associated problems. These areas frequently include significant lowland areas of floodplains and wetlands. Preserving wetlands is of particular importance because wetlands often provide storage for floodwater, as well as enhance water quality and wildlife habitat. Furthermore, the intrusion of intensive urban development into environmentally sensitive areas that tend to have high water tables may result in serious and costly problems, such as failing foundations for pavements and structures, wet basements, excessive operation of sump pumps, excessive clear-water infiltration into sanitary sewerage systems, and poor drainage. Similarly, the destruction of vegetative ground cover may result in soil erosion, stream siltation, more rapid stormwater runoff, and increased flooding.

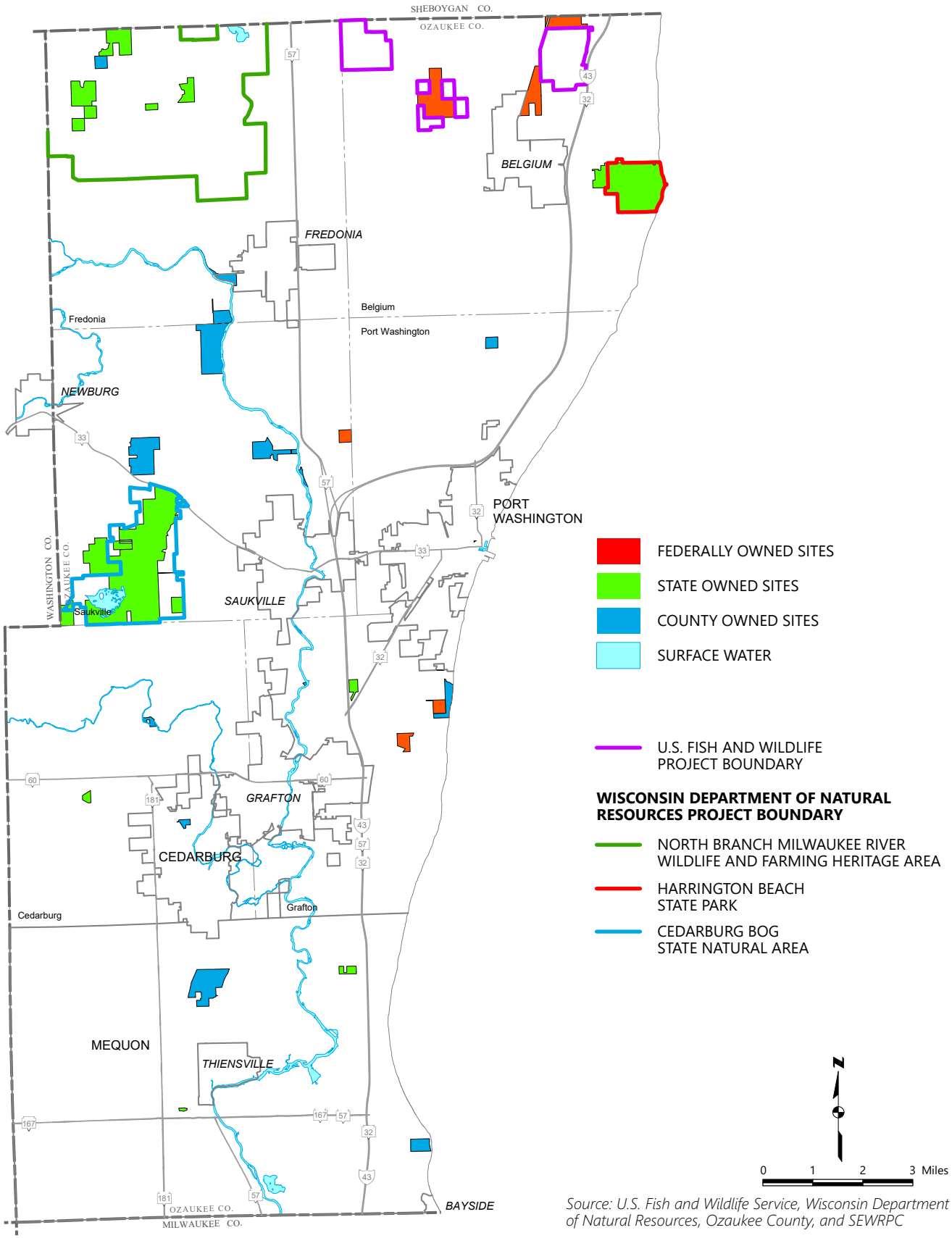
The regional land use plan[177] and park and open space plan described in Chapter 2 of this Report carry forward fundamental land use recommendations, including reducing and containing urban sprawl and protecting and preserving environmentally sensitive lands, such as environmental corridors, open space lands, and isolated natural resource areas. This regional land use plan forms the framework for local land use planning that is ongoing or has been carried out by the local units of government, including Ozaukee County. In 2018, Ozaukee County had 33 park and open space sites, encompassing 5,305 acres.[178] Of these park and open space sites, 10 sites were owned and maintained by the County, totaling 868 acres, and an additional 403 acres within five sites were owned by the County but not part of the County park system. In addition, there were 12 State-owned recreation and open space sites within the County, totaling 3,339 acres. Finally, six sites were owned by the Federal U.S. Fish and Wildlife Service, totaling 695 acres. The current status of County-, State-, and Federal-owned sites are shown on Map 5.1.

In addition to the 2018 County-, State-, and Federally-owned park and open space sites in Ozaukee County, there were 180 sites owned and maintained by local units of government, including cities, villages, towns, school districts, or other public districts, as shown on Map 5.2. Of those 180 sites, 18 were owned by the Milwaukee Metropolitan Sewerage District (MMSD) under its "Greenseams" program. This program was initiated in 2000 under MMSD's Conservation Plan. The Greenseams program is intended to permanently protect significant lands containing water-absorbing soils within watersheds contributing to the MMSD planning area for long-term benefits of floodplain management.[179] MMSD "Greenseams" areas are shown on Map 5.3. As of 2018, there was 611 acres of land within the County in the MMSD Greenseams program.

Other open space and environmentally sensitive sites in Ozaukee County are protected by private organizations or conservation easements. Conservation easements are typically voluntary contracts between a private landowner and a land trust or government body that limit, or prohibit, future development of the parcel. In 2018, conservation easements, as shown on Map 5.4, encompassed 2,319 acres in Ozaukee County. All of the conservation easements identified on the map provide for the permanent protection of resources on private land. These easements are typically voluntary contracts between a private landowner and a land trust or governmental body that limit, or in some cases prohibit, future development of the parcel.

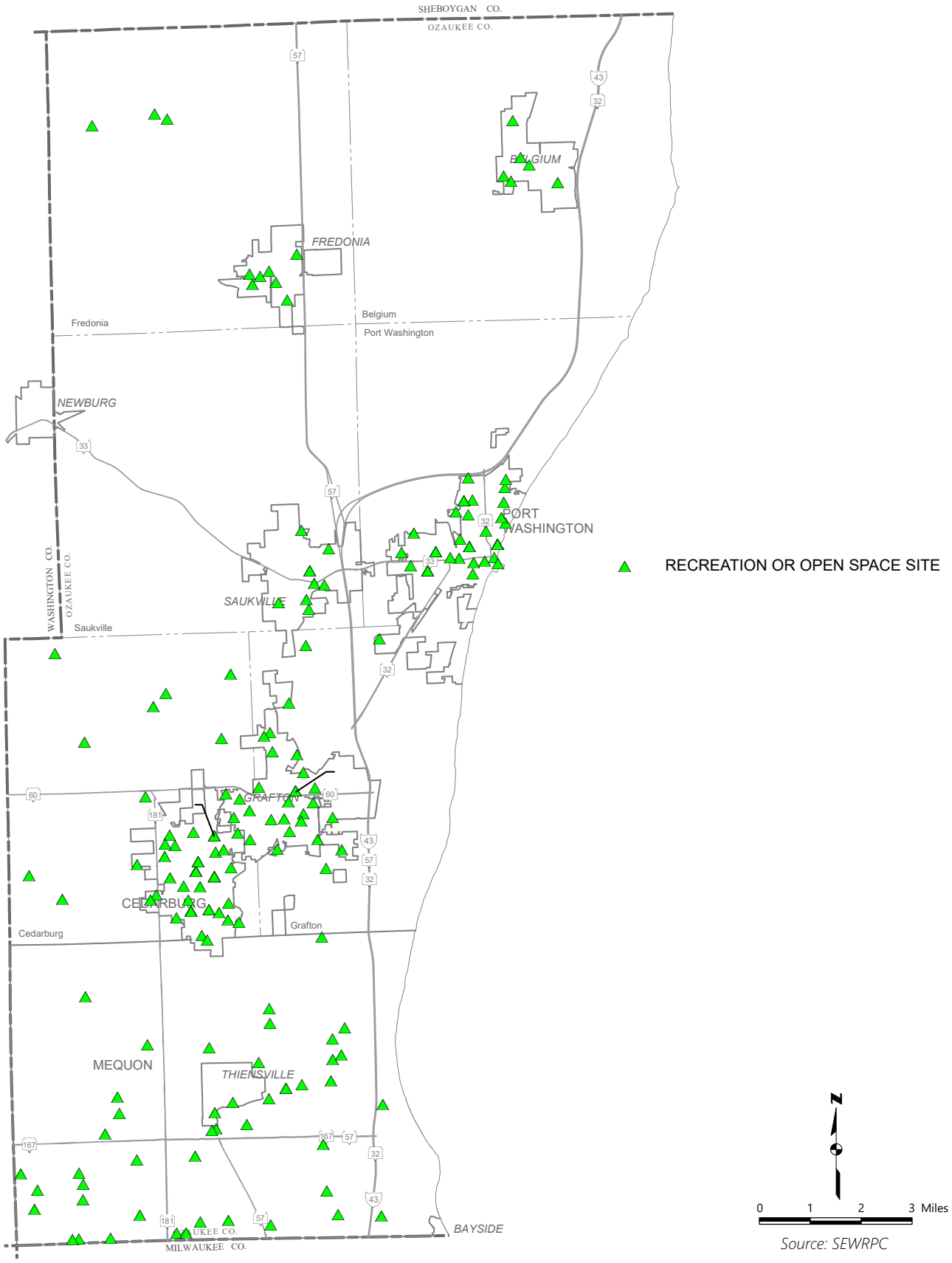
[179] *www.mmsd.com/what-we-do/flood-management/greenseams.*

Map 5.1
Ozaukee County, State of Wisconsin, and Federal Park and Open Space Sites: 2018



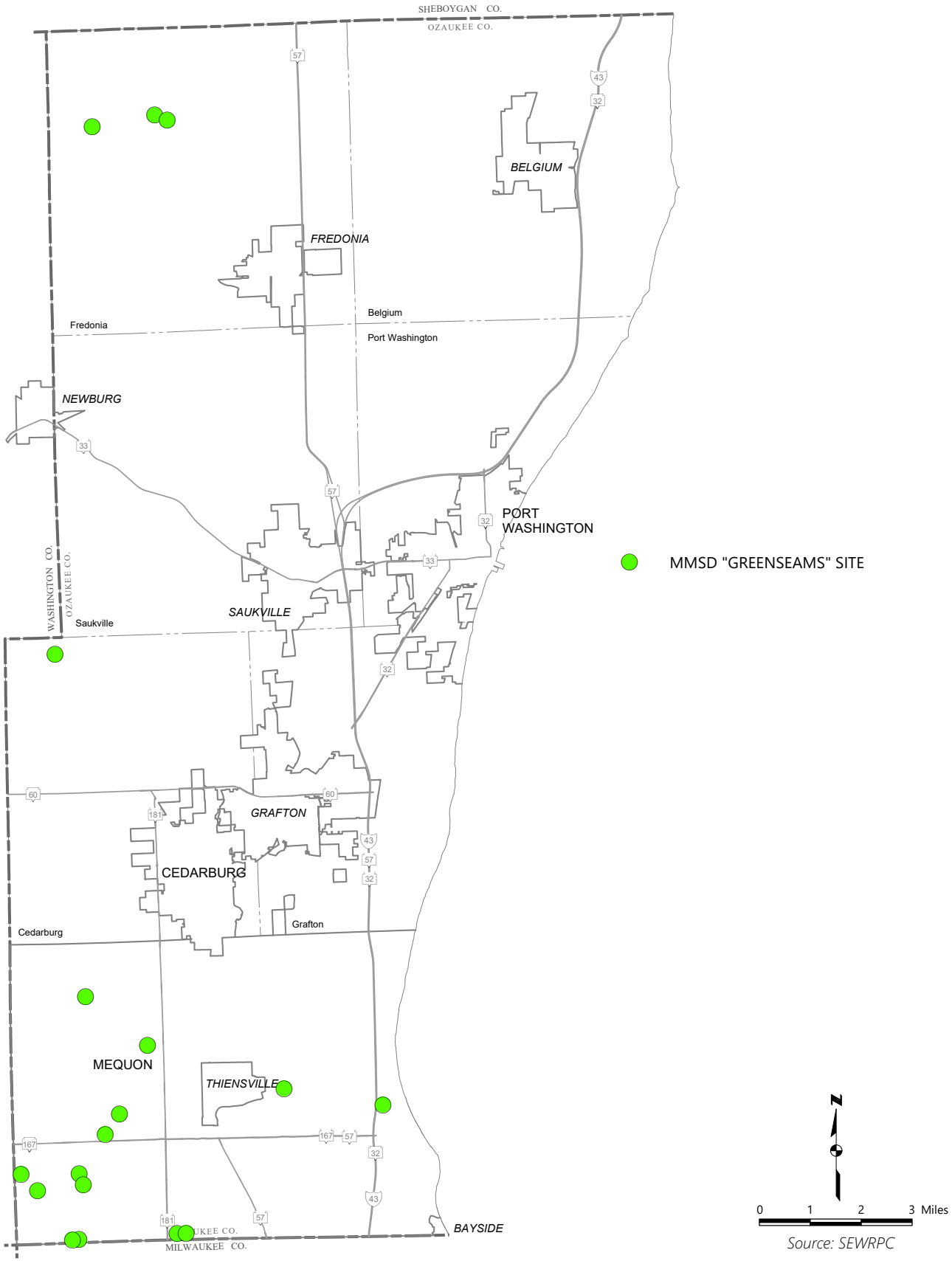
Source: U.S. Fish and Wildlife Service, Wisconsin Department of Natural Resources, Ozaukee County, and SEWRPC

Map 5.2
Park and Open Space Sites Owned by Cities, Villages, Towns, School Districts, or Other Public Districts in Ozaukee County: 2018



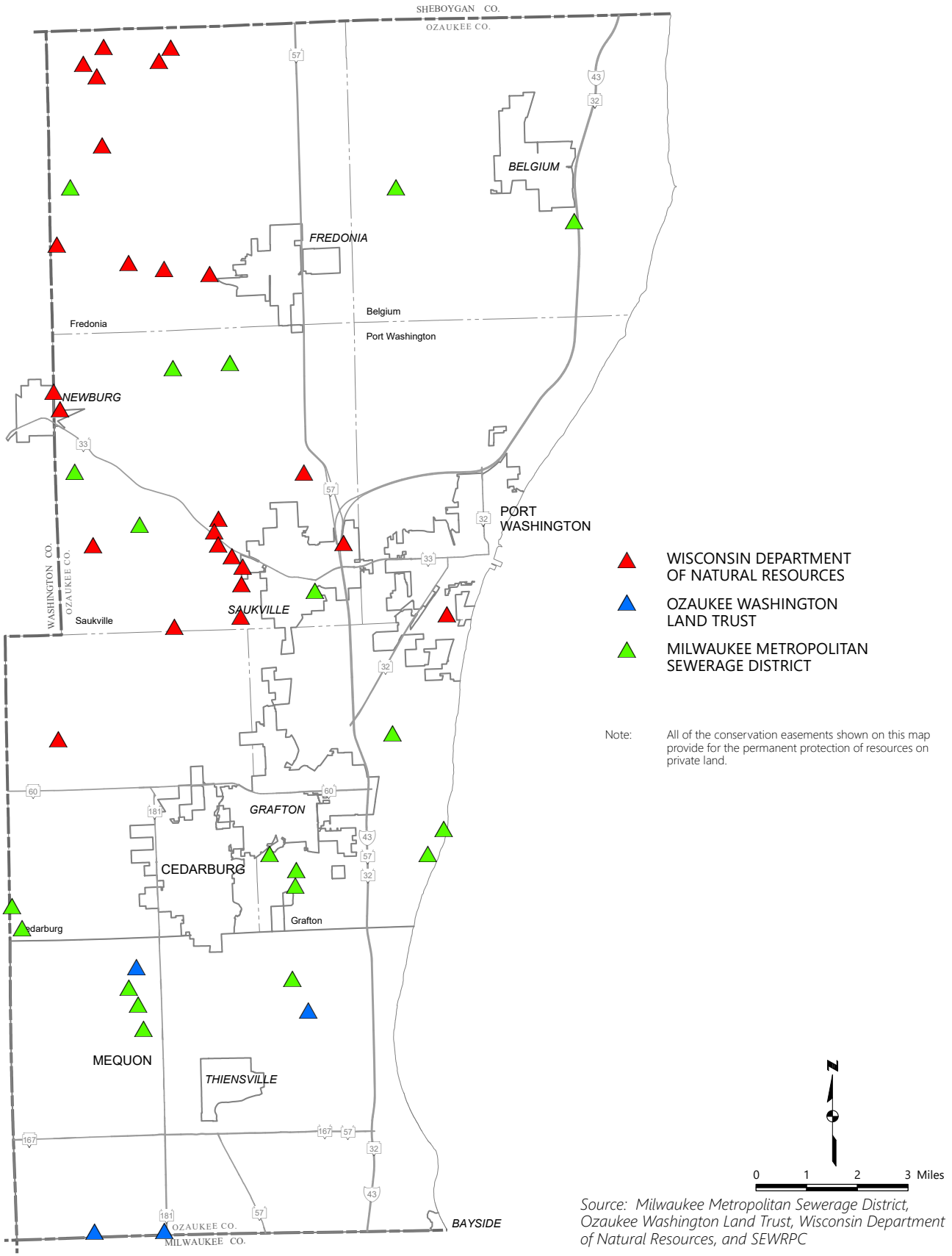
Source: SEWRPC

Map 5.3
Open Spaces Sites Owned by the Milwaukee Metropolitan Sewerage District: 2018



Source: SEWRPC

Map 5.4
Lands Under Conservation Easements in Ozaukee County: 2018



Source: Milwaukee Metropolitan Sewerage District, Ozaukee Washington Land Trust, Wisconsin Department of Natural Resources, and SEWRPC

The Ozaukee County park and open space plan[180] provides for the preservation of environmental corridors and isolated natural resource areas. The open space preservation and outdoor recreation elements of that plan are summarized on Maps 5.5 and 5.6, respectively. Ozaukee County and its municipalities have been active in promoting and preparing land use and park and open space plans consistent with Regional and County objectives for preserving environmentally sensitive lands. This Ozaukee County hazard mitigation plan update incorporates the open space and environmentally sensitive land preservation recommendations of the Ozaukee County Park and open space plan. The County park and open space plan recommends protecting total of 33,262 acres of open space lands, or about 22 percent of Ozaukee County, through a combination of public or nonprofit conservation organization ownership,[181] through conservation easements, or through protective zoning. These 33,262 acres include planned primary and secondary environmental corridors, planned isolated natural resource areas, and areas outside corridors but within U.S. Fish and Wildlife Service (USFWS), WDNR, and Ozaukee County project boundaries. All-natural areas and critical species habitat sites recommended to be preserved are contained within the planned primary or secondary environmental corridors or the planned isolated natural resource areas. The cost, in 2017 dollars, of full implementation of this recommendation is estimated to be about $42 million.

Wetland Restoration to Reduce Flood-Related Crop and Property Damages

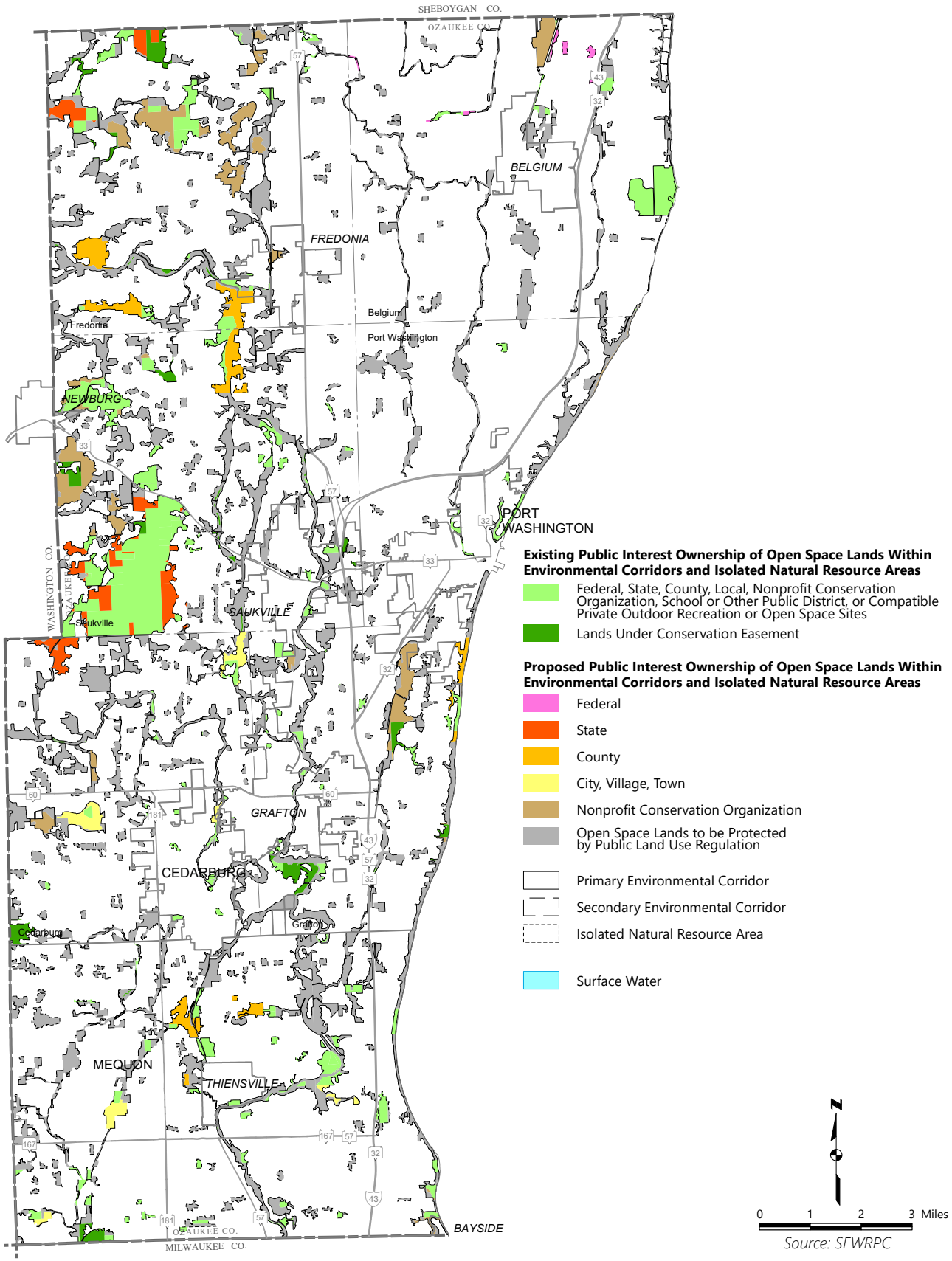
Wetlands and floodplains can provide natural storage areas for floodwaters during heavy rain or snow melt events. Restoring the natural function of former wetland areas can be an effective strategy to reduce potential flood damages in downstream areas. According to the U.S. Environmental Protection Agency (USEPA), a one-acre wetland can typically store about three acre-feet or about one million gallons of water at any given time. Wetland vegetation can slow the movement of floodwater and can transfer some of this water into the atmosphere through evapotranspiration. Increasing flood storage capacity in Ozaukee County by expanding wetland acreage may also help communities adapt to and reduce the potential impacts of climate change.[182]

As indicated in Table 2.6, Ozaukee County had about 19,657 acres of wetland in 2015. This is a fraction of the wetland area that existed in the County in pre-settlement years. Overall, nearly half of Wisconsin's original 10 million acres of wetlands have been drained or developed.[183] It is important to note, however, that in recent decades progress has been made in wetland protection and restoration within Ozaukee County. The County continually pursues wetland restoration efforts and initiatives. Nevertheless, urbanization and agricultural development have altered the landscape and surface water drainage characteristics in the Southeastern Wisconsin Region, including Ozaukee County. To facilitate drainage of wetlands and other low-lying areas for cultivation, networks of drainage tile were installed, agricultural drainage ditches were constructed, and some existing streams were channelized. Consequently, channelization has reduced, or eliminated, the connection between the stream channel and overbank areas during floods. This disconnection of streams from their floodplains has the effect of reducing floodwater storage in the overbank areas, potentially resulting in larger flood flows downstream.

In addition to providing storage for floodwaters and potentially reducing downstream property damages due to flooding, taking some marginally-productive agricultural lands out of production and returning them to their original wetland condition would reduce annual flood damages to crops. In 2015 there were approximately 3,224 acres of agricultural land located within the one-percent-annual-probability (100-year recurrence interval) flood hazard area in Ozaukee County, making them susceptible to riverine flooding during large storm events (see Table 2.8). As noted earlier in Chapter 3, an estimated $12.2 million in crop damages were reported due to flooding and poor drainage between 1996 through 2017.[184] The average annual reported crop damages due to flooding during this period were approximately $550,000 per year (2017 dollars). It should be noted that economic losses resulting from damage to crops often go unreported and records of losses prior to 1989 are spotty. Therefore, these estimated economic losses clearly represent an underestimate of the actual damages that have occurred in the County.

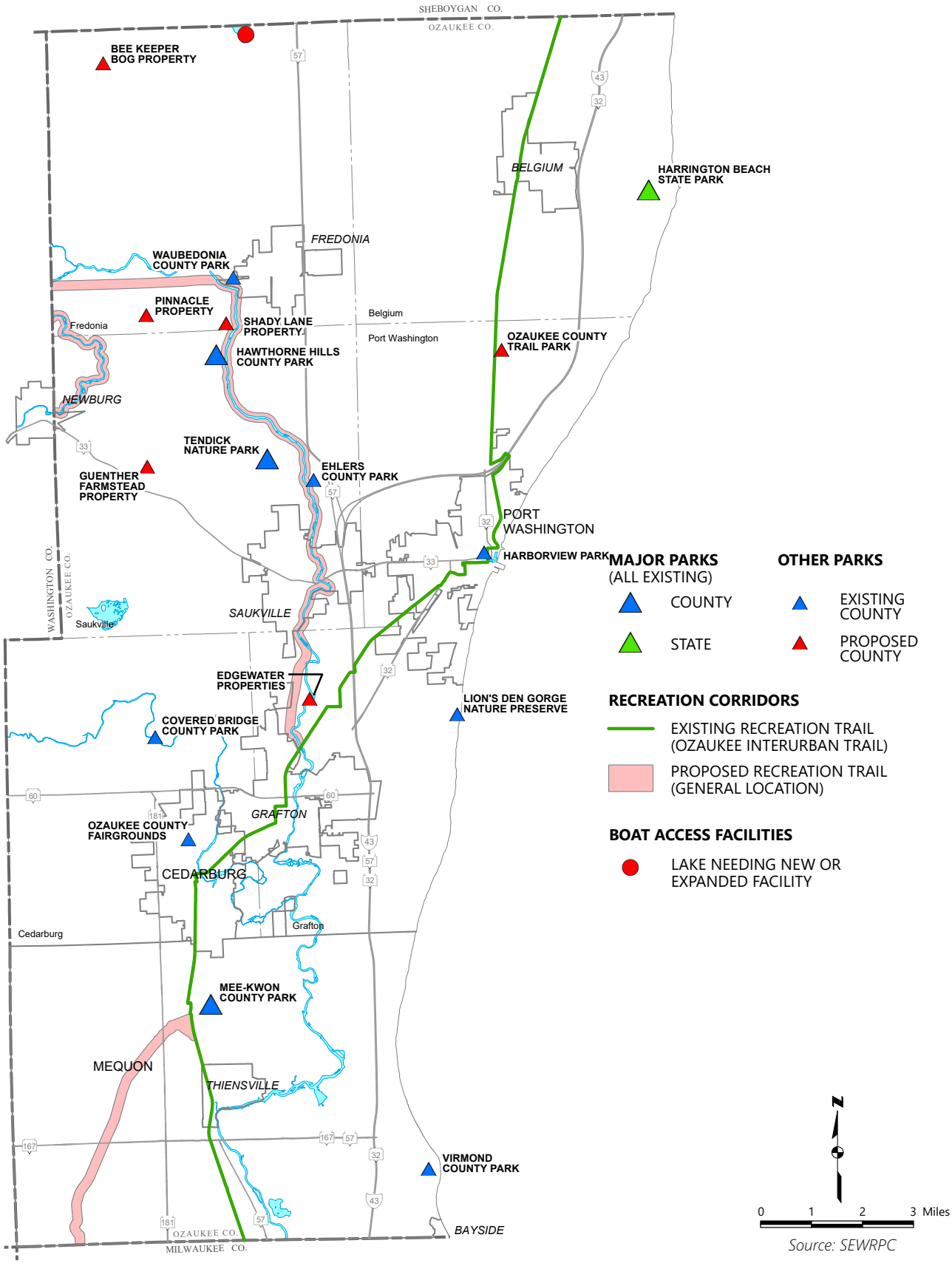
[180] *SEWRPC Community Assistance Planning Report No. 133, 3rd Edition,* A Park and Open Space Plan for Ozaukee County*, Wisconsin, June 2011.*

Map 5.5
Protection of Environmental Corridors and Isolated Natural Resource Areas in Ozaukee County: 2035



Source: SEWRPC

Map 5.6
Outdoor Recreation Element of the Ozaukee County Park and Open Space Plan: 2035



Source: SEWRPC

The WDNR has developed a digital dataset to identify areas of former wetland that were drained and converted to agricultural uses.[185] The WDNR refers to these areas as potentially restorable wetlands. Areas identified as potentially restorable wetlands must have hydric soils, a current land use that is compatible with wetland restoration techniques and must not be currently mapped as a wetland. There are about 6,053 acres of potentially restorable wetlands in Ozaukee County; however, not all of these are good candidates for restoration. About 1,321 acres of potentially restorable wetland are located within the one-percent-annual-probability flood hazard area and are currently in agricultural use per the SEWRPC 2015 land use inventory. These areas are shown on Map 5.7. An additional resource regarding Ozaukee County's wetlands and wetland restoration projects is located on the Great Lakes Coastal Resilience (GLCR) website, which provides informational and educational resources related to wetland restoration including a link to an interactive map on Ozaukee County wetlands and wetland restoration projects.[186]

Agricultural lands are prime candidates for wetland restoration because they are in undeveloped, open space uses, and because there are Federal and State programs available to support conversion of certain agricultural lands to wetlands. Conversion of agricultural lands could be done through land purchases, donation, or easements. Some programs provide a percentage of the restoration costs as well as an annual rental rate. In some instances, farmers may be able to plant a harvestable grass crop for hay. In other instances land may be purchased or permanently placed into conservation easement by willing land owners, restricting development and eliminating the chance that these open areas may be placed into more impervious urban land uses in the future.

Restoring selected potentially restorable wetlands currently in agricultural uses in Ozaukee County is one alternative flood mitigation measure to consider. In addition, some of the areas identified on Map 5.7 may also be recommended to be acquired by a governmental entity or nonprofit conservation organization as part of the environmentally sensitive areas and open space preservation element discussed in the section above.

It can be assumed that the majority of flood-related crop damages reported in the County occur within the 100-year flood hazard area. If all of the areas shown on Map 5.7 were taken out of agricultural production, crop losses due to flooding could potentially be reduced by up to 41 percent, or about $225,500 per year based on reported losses. Additional mitigation of potential downstream property damage is also possible.[187] Wetland restoration projects would potentially have the additional benefits of fish and wildlife habitat improvements, erosion control, water quality improvements, and recreational opportunities.

When opportunities present themselves on a particular tract of agricultural land, wetland restoration should be considered. This alternative would be implemented as a voluntary program, considered at the discretion of each individual property owner.

It should be noted that estimates of cost for wetland restoration vary greatly depending upon the type of wetland, the specific restoration techniques employed, local construction costs, and whether restoration costs include the cost of land acquisition. For the purpose of this recommendation, the estimated wetland restoration per acre cost developed for the Des Plaines River Watershed Plan of $5,300 (2017 dollars) was used.[188] Thus the estimated cost of restoring all 1,321 acres of potentially restorable wetland that are located within the one-percent-annual-probability flood hazard area and are currently in agricultural land uses would be about $7.0 million.

Floodplain Management Plan Element

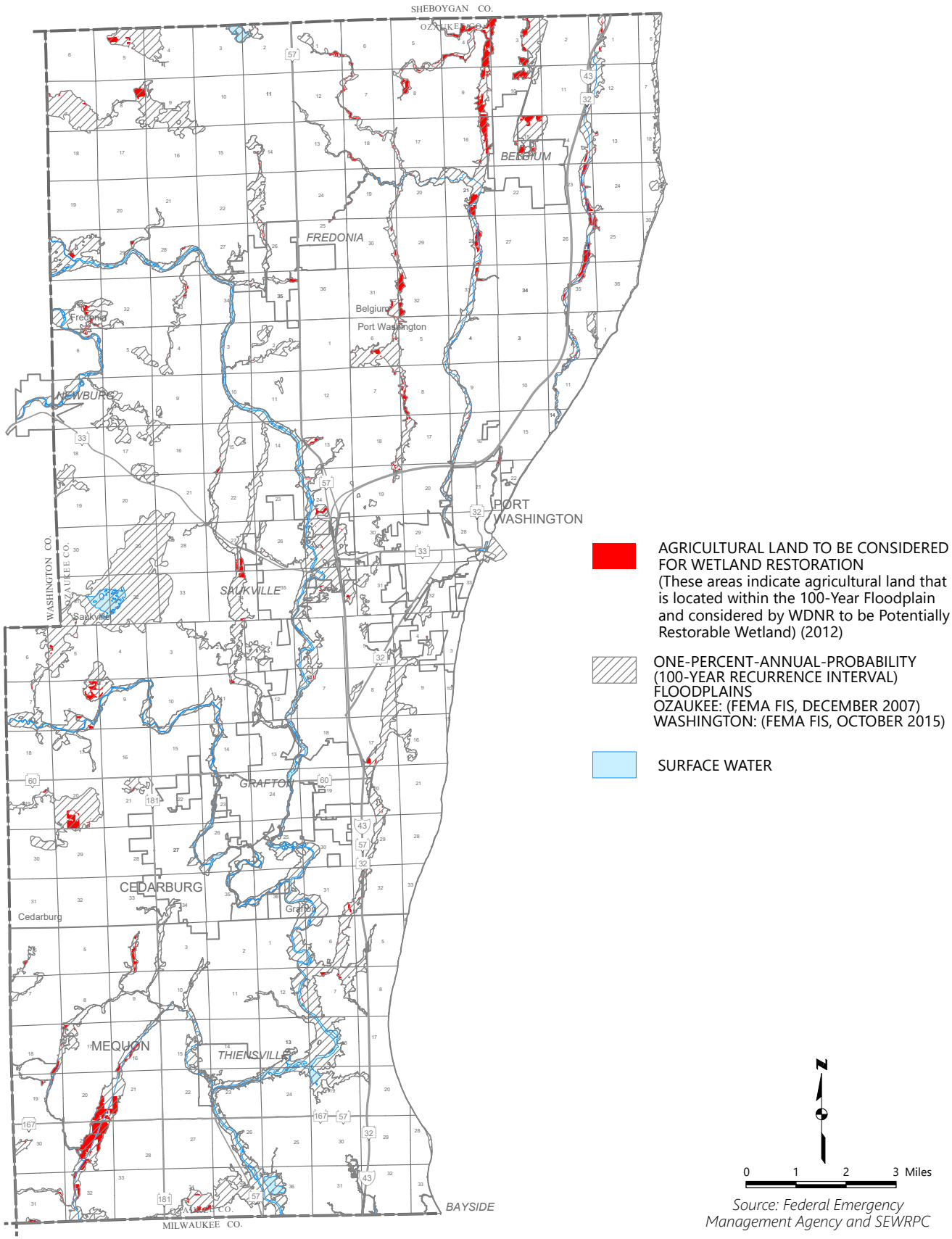
Actions to Address Structures Located in High-Risk Areas

The main emphasis of the floodplain management element of the Ozaukee County hazard mitigation plan is to address the structures identified in the parcel-based analysis as potentially being in the one-percent-annual-probability floodplains and structures that experience repetitive flooding issues. The principal features of this element and associated costs by community are given in Table 5.2.

[187] *Detailed modeling would need to be conducted to determine the amount of flood flow reduction associated with wetland restoration of agricultural land.*

[188] *SEWRPC Planning Report No. 44,* A Comprehensive Plan for the Des Plaines River Watershed, *June 2003.*

Map 5.7
Agricultural Land to be Considered for Wetland Restoration



Source: Federal Emergency Management Agency and SEWRPC

Table 5.2
Principal Features and Cost of the Recommended Floodplain Management Plan Element

Community	Surveys of Structures Identified as Being Potentially Located in Flood Hazard Area[a]		Repetitive Loss Structures Acquisition and Removal[a]		Single Family Homes in 100-Year Flood Hazard Area Acquisition and Removal[a]		Floodproof[a]	
	Number of Structures[b]	Capital Cost (2018 dollars)	Number of Structures	Capital Cost (2018 dollars)	Number of Structures	Capital Cost (2018 dollars)	Number of Structures	Capital Cost (2018 dollars)
Cities								
Cedarburg	84	100,800	--	--	31	8,814,940	53	7,336,038
Mequon	230	276,000	14	5,051,755	192	61,449,065	26	2,032,016
Port Washington	25	30,000	--	--	22	5,885,655	3	179,096
Villages								
Bayside[c]	--	--	--	--	--	--	--	--
Belgium	1	1,200	--	--	1	282,435	--	--
Fredonia	15	18,000	--	--	10	1,412,380	5	99,360
Grafton	25	30,000	--	--	8	2,588,610	17	957,955
Newburg[c]	--	--	--	--	--	--	--	--
Saukville	165	198,000	1	175,140	118	22,987,105	46	7,370,485
Thiensville	65	78,000	11	7,363,050	17	3,832,750	39	3,329,046
Towns								
Belgium	116	139,200	1	211,135	116	70,368,610	--	--
Cedarburg	39	46,800	--	--	36	11,871,270	3	176,457
Fredonia	39	46,800	--	--	20	2,818,854	19	142,618
Grafton	29	34,800	--	--	25	6,752,589	4	95,918
Port Washington	4	4,800	--	--	3	936,085	1	5,589
Saukville	26	31,200	--	--	25	4,027,520	1	518
Total	863	1,035,600	27	12,781,081	624	204,027,868	217	21,725,136

[a] *To be carried out at discretion of property owners.*

[b] *This number represents structures estimated to be in the one-percent-annual-probability floodplain. Five repetitive loss structures were estimated to be outside of the one-percent-annual-probability floodplain flood hazard area, thus they were not included in this total.*

[c] *Village of Bayside lies within both Milwaukee and Ozaukee Counties. Village of Newburg lies within both Washington and Ozaukee Counties. Data in this table represents information for Ozaukee County lands and hazard mitigation plan only. The Village of Bayside is covered under the Milwaukee County hazard mitigation plan and the Village of Newburg had no data represented for its Ozaukee County portion.*

Source: SEWRPC

As noted in Chapter 3 of this Report, based on information from large-scale topographic maps, the parcel-based analysis identified 863 structures as potentially being in the one-percent-annual-probability floodplains in Ozaukee County (see Maps 3.2 and 3.3). Based upon the County's 2018 assessment, the assessed value of these structures (not including land value) was estimated to be about $197 million. It was also estimated that the damages resulting from a one-percent-annual-probability-flood that affected the entire County would be more than $27 million (2018 dollars).

There are 27 buildings in Ozaukee County that are considered repetitive loss structures, with a combined estimated fair market value of $12.5 million in 2018. Of these structures, 22 of them were estimated to be located within the one-percent-annual-probability-floodplain and were included in SEWRPC's parcel-based analysis. The estimated fair market value of these 22 structures in 2018 was about $9.1 million. The damages to these 22 properties that would result from a one-percent-annual-probability flood are estimated to be about $910,000. The other five structures, while meeting the criteria for flood damages set by FEMA to be considered repetitive loss structures, were located in flood hazard areas outside of the one-percent-annual-probability-floodplain that was used in SEWRPC's parcel-based analysis. Thus these five repetitive loss structures were not included in the damage estimates made through this analysis. These five structures have a combined estimated fair market value of $3.4 million.

The following priority mitigation measures are recommended for addressing the 863 structures identified as potentially being located in the one-percent-annual-probability floodplain:

- Acquisition and demolition of the 27 repetitive loss properties that have been identified by FEMA in the County. Following demolition of the structures, the land should be kept in open space uses. This plan element is presented as an option, subject to the preference of each individual property owner. Based on the land and improvement values from the County's 2018 assessment and estimated demolition costs, it is estimated that the cost of this measure would be about $12.8 million.

- When implementation of floodproofing, relocation, or removal measures is being considered (as described below), field surveys should be made of those structures identified as being potentially located within one-percent-annual-probability floodplains in order to obtain a more definitive assessment of their flood hazard status. It should be noted that where LiDAR[189] topographic data are available, applicants for Letters of Map Amendment (LOMA) may submit LiDAR data to FEMA in lieu of a certified elevation survey by a professional engineer or land surveyor provided that certain standards are met.[190] This may allow a more definitive assessment of a structure's flood hazard status to be obtained at a lower cost. This plan element is presented as a voluntary option, subject to the preference of the individual property owner. The estimated cost of implementing this element of field surveys for all structures that have been identified as potentially being located within the one-percent-annual-probability floodplains is $1.0 million.

    - In portions of the County where floodplain maps are being refined and updated, field surveys as called for in the preceding recommendation should be pursued only for those structures that have been determined to be potentially located within the updated flood hazard area following the map updating.

    - Because many of the other structures identified as potentially being located within the one-percent-annual-probability floodplain are dispersed throughout the County, the decision to conduct the proposed surveys should generally be made on a case-by-case basis. Despite this, there are some areas within the County that have large enough numbers of flooded structures (i.e., clusters) including areas within the Cities of Cedarburg and Mequon and Villages of Fredonia, Saukville, and Thiensville, and in the unincorporated Waubeka area, that it may be worthwhile for the County or the affected communities to consider conducting such surveys as part of a larger program. These concentrated areas of structures in the 100-year flood hazard area can be seen on Maps 3.2 and 3.3.

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[189] *LiDAR stands for Light Imaging, Detection, and Ranging.*

[190] *The standards are summarized in Wisconsin Department of Natural Resources, "FEMA Announces New Letter of Map Amendment Guidance,"* Floodplain and Shoreland Management Notes*, Volume 11, Number 3, page 3, Fall 2012.*

- Floodproofing[191] of up to 217 structures identified in the parcel-based analysis (using geographic information system techniques and color orthophotography) as potentially being in the one-percent-annual-probability floodplains. These structures consist of all other building types besides single-family residential. These building types include multi-unit residential buildings such as condominiums and apartment buildings, commercial structures, agricultural structures, government and other structures. For any nonresidential structure, this recommendation should be implemented following confirmation of the structure's flood hazard status through the floodplain map updating and field surveys previously described.[192] This plan element is presented as a voluntary option, subject to the preference of the individual property owner. The damages that these properties would experience from a one-percent-annual-probability flood are estimated to be about $13.1 million (2018 dollars). The estimated cost of floodproofing all 217 structures is about $21.7 million.

    - Priority mitigation measures to protect and floodproof critical community facilities, infrastructure, and utilities from flood hazard events is recommended for Ozaukee County. As discussed in Chapter 3, and shown on Map 3.6, critical community structures located in the one-percent-annual-probability floodplain include the Cedarburg Public Library and Post Office; the Thiensville Village Hall, Police Department, and Fire Department; the Village of Public Work's Department building; a Saukville Elementary School; and the Waubeka Fire Department.

- Acquisition and removal of up to 624 residential structures identified in the parcel-based analysis (using geographic information system techniques and color orthophotography) as potentially being in the one-percent-annual-probability floodplains.[193] Following demolition of the structures, the land should be kept in open space uses. These structures consist of single-family residential buildings and some associated structures. For any structure, this recommendation should be implemented following confirmation of the structure's flood hazard status through the floodplain map updating and field surveys previously described. This plan element is presented as a voluntary option, subject to the preference of the individual property owner. The damages that these properties would experience from a one-percent-annual-probability flood are estimated to be about $13 million (2018 dollars). The estimated cost of acquiring and removing all 624 structures is about $204 million.

    - Included in this recommendation is the continued acquisition and removal of structures located on Edgewater Drive in the Town of Grafton. In 2015, 2017, and 2018 with State and Federal assistance, the Town of Grafton and Ozaukee County have acquired four properties along Edgewater Drive (see Table 1.3 for costs of these projects). This hazard mitigation plan update recommends the continued collaboration between the Town of Grafton, Ozaukee County, WEM, and FEMA to explore options to relocate vulnerable residents to safer locations while returning the properties back to a natural landscape. All properties purchased by Ozaukee County have been restored as open space sites and added to River Oaks County Park. In addition, the County plans to take steps to ensure that the road is of adequate height to escape flood damage.

- In addition to structural flooding, infrastructure such as major roadways and bridges within the County have been reported to experience frequent flooding problems. As shown on Map 2.7, the 100-year recurrence floodplain overtops a number of major roadways in Ozaukee County. Communities with known roadway flooding issues include the City of Port Washington; Villages of Fredonia, Grafton, and Saukville; and Town of Belgium. Chapter 3 details the roadway locations of

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[191] *Floodproofing is a combination of structural and non-structural changes, or adjustments made in the building that reduces or prevents flood damage to the structure and/or its contents. There are two main types of floodproofing: dry floodproofing and wet floodproofing. Dry flood proofing is the practice of making a building watertight or substantially impermeable to floodwaters up to the expected flood water height. (FEMA, 2008). Wet flood proofing reduces damage from flooding in three ways: allowing flood water to easily enter and exit a structure in order to minimize structural damage; Use of flood damage resistant materials; and elevating important utilities. (FEMA, 2008).*

[192] *It is anticipated that the results of the floodplain map updating efforts and the field surveys may reduce the number of structures that are confirmed to be in the flood hazard area and that may require floodproofing.*

[193] *Note that this total and the associated costs do not include the 27 repetitive loss properties previously described.*

these known flooding problems. Potentially raising these roadways and ongoing maintenance to reduce flood damage and flooding concerns related to infrastructure is an important consideration for Ozaukee County flood hazard mitigation planning.

- Because of its alignment and proximity to the Milwaukee River, County Trunk Highway W (CTH W), north of East Green Bay Road (State Highway 33) in the Village of Saukville has experienced a number of severe roadway overtopping flood events. The impacts from an event such as this can affect both people and property by obstructing access to the roadway and severing access to first responders such as police, medical and fire. Alternatives to improved roadway access during Milwaukee River flooding events at this location is recommended for this hazard mitigation plan update.

Once updated floodplain mapping is complete, for those areas of the County with large number of flooded structures in close proximity (clustered), in lieu of a large number of voluntary acquisitions it may also make sense to investigate a large flood control project. Project types could include levees, diversions, or impoundments, perhaps in combination with acquisitions and floodproofing. These types of projects are not recommended for this plan, but if a municipality would like to pursue further, the first step would be to perform an engineering evaluation to develop feasible alternatives.

Participation in the National Flood Insurance Program (NFIP) and Floodplain Map Updating Efforts

Based on a detailed Flood Insurance Study (FIS), FEMA produces Flood Insurance Rate Maps (FIRMs) to identify areas in the community that are subject to flooding. A FIS has been completed for Ozaukee County and all municipalities identified by FEMA as having flood hazard areas. This plan calls for the continued participation of Ozaukee County and its municipalities in the NFIP. The plan also calls for the appropriate County or incorporated municipality to request FEMA to revise, as necessary, the FIS to reflect new flood hazard data when such data becomes available. In addition, this plan recommends homeowners in and near floodprone areas purchase flood insurance to provide some financial relief for flood losses. Finally, as recommended flood control measures are implemented, the plan calls for FEMA to make the necessary revisions to the FIS. Participation in the NFIP by the communities in Ozaukee County is summarized in Table 5.3.

In 2007, under FEMAs guidance, the WDNR completed an update of the Ozaukee County FIS as part of the Map Modernization program.[194] The Map Modernization products include a countywide FIS and digital flood insurance rate maps (DFIRMs). The Map Modernization Program included floodplain delineations in both unincorporated areas and in all of the cities and villages in Ozaukee County. The floodplain delineations were mapped on orthophotos at a scale of one-inch equals 400 feet as part of the update to the Ozaukee County shoreland and floodplain zoning maps for all cities, towns, and villages in Ozaukee County except the City of Mequon. Where flood elevations were not available, approximate floodplain delineations from FEMA's Flood Insurance Rate Maps (FIRMS) were mapped on the orthophotos as part of the update to the shoreland and floodplain zoning maps.[195] The floodplain mapping for Ozaukee County is available as a digital file for the Ozaukee County cadastral mapping system and can be viewed on the County website.

FEMA has begun additional examinations of floodplains in several portions of Ozaukee County through its RiskMAP Program. This program provides communities with more precise flood mapping products, risk assessment tools, and planning and outreach support in order to reduce the risks due to flooding.[196]

As part of this RiskMAP program, additional detailed hydraulic and hydrologic floodplain modeling and mapping efforts were conducted for sections of the mainstem of the Milwaukee River, Cedar Creek and other major tributaries within Ozaukee County. The remaining portions of the Milwaukee River, Cedar Creek,

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[194] *In 2003, FEMA implemented the Map Modernization program. This program was intended to upgrade and distribute FIRMs into a digital format, rather than on paper (i.e., Digital Flood Insurance Rate Maps or "DFIRMs"). This program used state-of-the-art technology and advanced engineering to increase the quality, reliability, and availability of flood hazard maps and data and employed a collaborative process to involve state, regional and local partners in mapping tasks.*

[195] *Ozaukee County,* Land and Water Resource Management Plan*, 2011-2015.*

[196] *Risk Mapping, Assessment, and Planning (Risk MAP) is a FEMA program implemented in 2010 that provides communities with both flood information and tools and some updated DFIRMs that communities can use to make better informed decisions and to take action to reduce risk to life and property. Discovery meetings for the Milwaukee River watershed were held in 2013 and 2014.*

Table 5.3
Participation in the National Flood Insurance Program by Ozaukee County Jurisdictions

Civil Division	Participating in Ozaukee County Hazard Mitigation Plan	Participating in National Flood Insurance Program	Date Initial Flood Hazard Boundary Map Identified	Date of Initial Flood Insurance Rate Map (FIRM)	Current Effective Map Date	Entry Date into National Flood Insurance Program
Cities						
Cedarburg	Yes	Yes	12/28/1973	05/15/1980	12/04/2007	05/15/1980
Mequon	Yes	Yes	--	11/07/1972	12/04/2007	11/03/1972
Port Washington	Yes	Yes	05/31/1974	10/15/1981	12/04/2007	10/15/1981
Villages						
Bayside[a]	No	Yes	02/22/1974	06/15/1977	09/26/2008	06/15/1977
Belgium	Yes	Yes	06/07/1974	12/06/1999	(NSFHA) [b]	06/30/1999
Fredonia	Yes	Yes	01/09/1974	01/02/1981	12/04/2007	01/02/1981
Grafton	Yes	Yes	05/31/1974	05/15/1980	12/04/2007	05/15/1980
Newburg	Yes	Yes	--	12/04/2007	11/20/2013	11/13/2008
Saukville	Yes	Yes	01/16/1974	12/16/1980	12/04/2007	12/16/1980
Thiensville	Yes	Yes	05/24/1974	08/01/1978	12/04/07	08/01/1978
Towns						
Belgium	Yes	Yes	--	05/16/1977	12/04/2007	05/16/1977
Cedarburg	Yes	Yes	--	05/16/1977	12/04/2007	05/16/1977
Fredonia	Yes	Yes	--	05/16/1977	12/04/2007	05/16/1977
Grafton	Yes	Yes	--	05/16/1977	12/04/2007	05/16/1977
Port Washington	Yes	Yes	--	05/16/1977	12/04/2007	05/16/1977
Saukville	Yes	Yes	--	05/16/1977	12/04/2007	05/16/1977
County	Yes	Yes	--	05/16/1977	12/04/2007	05/16/1977

Note: In Wisconsin, towns are covered under county eligibility in the National Flood Insurance Program

[a] *The Village of Bayside is in both Milwaukee and Ozaukee Counties, because of this the Village has decided to participate in Milwaukee County's All Hazard Mitigation Plan.*

[b] *NSFHA stands for Non-Special Flood Hazard Area.*

Source: Federal Emergency Management Agency

and other major streams and tributaries in the County were remapped by overlaying existing hydrologic and hydraulic models and floodplain data onto new orthophotographs. The RiskMAP updated floodplain mapping for Ozaukee County was nearing completion during the updating of this Report and is expected to be available within the life cycle of this edition of the Ozaukee Country hazard mitigation plan.

Participation in the Community Rating System

The Community Rating System (CRS) is an additional program offered by FEMA as part of the NFIP. The CRS recognizes and encourages community floodplain management activities that go beyond the minimum NFIP standards. The program assigns a ranking to communities that participate based on voluntary floodplain management activities and outreach services that the community provides to its residents. A high CRS ranking will offer citizens of that municipality discounts on flood insurance premiums of up to 45 percent. In addition to the benefit of reduced insurance rates, floodplain management and outreach activities associated with CRS aim to further enhance public safety, reduce damages to property and public infrastructure, avoid economic disruption and losses, reduce human suffering, and protect the environment. Participation in the CRS program can provide extra incentive for communities to maintain and improve their floodplain management program. Technical assistance related to design and implementation of some activities associated with the CRS program are available at no charge.

Ozaukee County participates in the CRS program. As result, all unincorporated communities are eligible for premium discounts under the County's participation, while incorporated villages and cities are required to participate individually. Currently, no incorporated municipalities in Ozaukee County participate in the CRS program. It is recommended that the cities and villages in Ozaukee County investigate whether participating in the CRS would be appropriate for their residents based on the number of NFIP policies currently in effect in their community.

Lending Institution and Real-Estate-Agent Policies

This plan calls for lending institutions to continue their practice of determining the floodprone status of properties before mortgage transactions are completed. To that end, these institutions should consult with the appropriate local zoning department to inquire about any additional flood hazard studies for areas not identified in the FIS. The plan also calls for real-estate brokers and salespersons to continue to inform potential purchasers of property of any flood hazard that may exist at the site in accordance with rules of the Wisconsin Department of Safety and Professional Services.

Documentation of the Extent of Future Floods

It is recommended that when flooding occurs in Ozaukee County, the County and affected municipalities document the extent of the floods as well as damages incurred by the flood. A number of methods could be used to accomplish this, including aerial, satellite, or ground-based photography showing locations of flooded areas; surveying and mapping of the elevation of debris lines resulting from floods; or other documentation techniques.

While FIRMs and the associated FIS are based upon the best data available at the time of their development, the inundation patterns depicted on and described in them are not those of actual historical flood events. Instead they represent estimates of the extent of a hypothetical one-percent-annual-probability event based on historic events. These estimates are developed using models that are based upon the best available topography; land use; the geometry of, and conditions within, stream channels and adjacent overbank areas; and the presence, configuration, and condition of structures within and adjacent to the stream channel. Actual inundation patterns for actual floods will vary and the flooded areas are affected by a number of factors such as local intensity and duration of rainfall, which affects the magnitude of flood flows; blockages of drains and structures; the state of vegetation coverage; and changes that have occurred within the watershed since the development of the FIRM and FIS. It should also be noted that FIRMs only depict flooding related to waterbodies overflowing their banks and do not depict areas inundated by stormwater runoff as it travels to a receiving stream.

Data developed by documenting the extent of future floods can be used to periodically refine the hydrologic and hydraulic simulation models used to develop the FIRMs and FIS. In addition, such data may also be useful in bridge and culvert design and in water quality management planning.

Ice Jams and Mitigation Measures

Ice jams occur when floating river ice accumulates at a natural or man-made structure that impedes the progress of the ice downstream with the river current. Ice jams can significantly block the flow of a river causing upstream flooding. Ice jam flooding events are not uncommon on the Milwaukee River and have been known to affect several Ozaukee County communities, including road crossing locations near Cities of Cedarburg and Mequon; Villages of Fredonia, Saukville, Newburg; and unincorporated area of Waubeka. It is recommended that those communities implement mitigation measures to prevent future ice jam flood losses. Ice jam mitigation measures include:

- Development and maintenance of an ice jam event database to include:
    - Historical and recent records of ice jam events
    - Site-specific ice event data, including duration of freeze-up and ice cover breakup
- Implement the use of the U.S. Army Corps of Engineers (USACE) Cold Regions Research and Engineering Laboratory (CRREL) database.[197]

Stream Channel Maintenance

This plan calls for Ozaukee County, local municipalities, and drainage districts to continue to work together to develop and expand existing programs for regular stream channel maintenance. These programs would include the periodic removal of sediment deposits, selected heavy vegetation, and debris for all

[197] *Department of the Army, U.S. Army Corps of Engineers,* Engineering and Design ICE ENGINEERING*, October 30, 2002.*

watercourses in the County, including bridge openings and culverts, subject to obtaining any necessary local and State permits.

As mentioned in Chapter 3, beginning in 2006, the Ozaukee County Planning and Parks Department was awarded Federal, State, local, and private funds to develop, refine, and implement the Ozaukee County Fish Passage Program. To date, this program has completed successful projects for stream channel maintenance, restoration, and education. Some achievements of the program include reconstructing over 30 major road and stream crossings, removal of over 138 small stream impediments, reconnecting over 75 stream miles for fish and aquatic life passage, implementing a comprehensive environmental monitoring program (including fisheries, water quality, and sediment contamination surveys), and providing educational and outreach opportunities to many local residents and volunteers.[198]

Continued Maintenance of Existing U.S. Geological Survey (USGS) Stream Gages on Streams and Rivers in Ozaukee County and Installation of Additional Stream Gage Locations

Ozaukee County has three active USGS stream flow gages, all of which are located in the southern half of the County (see Map 5.8). These gages are located on the Milwaukee River near Cedarburg, Cedar Creek near Cedarburg, and the Little Menomonee River near Freistadt.[199] Continued maintenance, updating, and monitoring of this equipment is important for stream flow data and flood preparedness. As indicated on Map 5.8, the upper Milwaukee River in Ozaukee County does not have any continuous streamflow monitoring locations. This plan recommends establishing at least one additional USGS stream gage location on the upper portion of the Milwaukee River within the County. Continuous flow data collected at an additional location would provide information necessary to develop more precise floodplain modeling and more accurate flood event forecasting in the northern portion of the County. Costs to install one USGS stream gage with all new equipment is about $12,500 (2019 dollars). After installation, operation and maintenance costs are about $12,000 per year.

Actions to Manage the Potential Flood-Related Impacts of Dam Failure

Flooding can also occur as a result of a dam failure. Dam failure flooding may occur when flood flows exceed the hydraulic capacity of the dam spillways, resulting in water overtopping the dam or abutments or when structural failure of the dam occurs. The potential impacts of such failure are related both to the size and configuration of the dam and to the amount, types, and locations of development downstream of the dam.

As discussed in Chapter 2 of this report, the WDNR lists 21 existing dams located in Ozaukee County (see Table 2.12 and Map 2.8) One of these dam has been assigned a high hazard rating by the WDNR, indicating the potential for loss of human life as well as economic loss, environmental damage, or disruption of lifelines during failure or misoperation of the dam. In addition, two dams have been assigned significant hazard ratings. Most of the County dams are small, mill-type dams under the jurisdiction of the WDNR and most are owned by the WDNR or privately. The remaining dams have been classified as low hazard, or a hazard rating has not been assigned.

The following mitigation measures are recommended to address the risk of flooding due to dam failure in Ozaukee County:

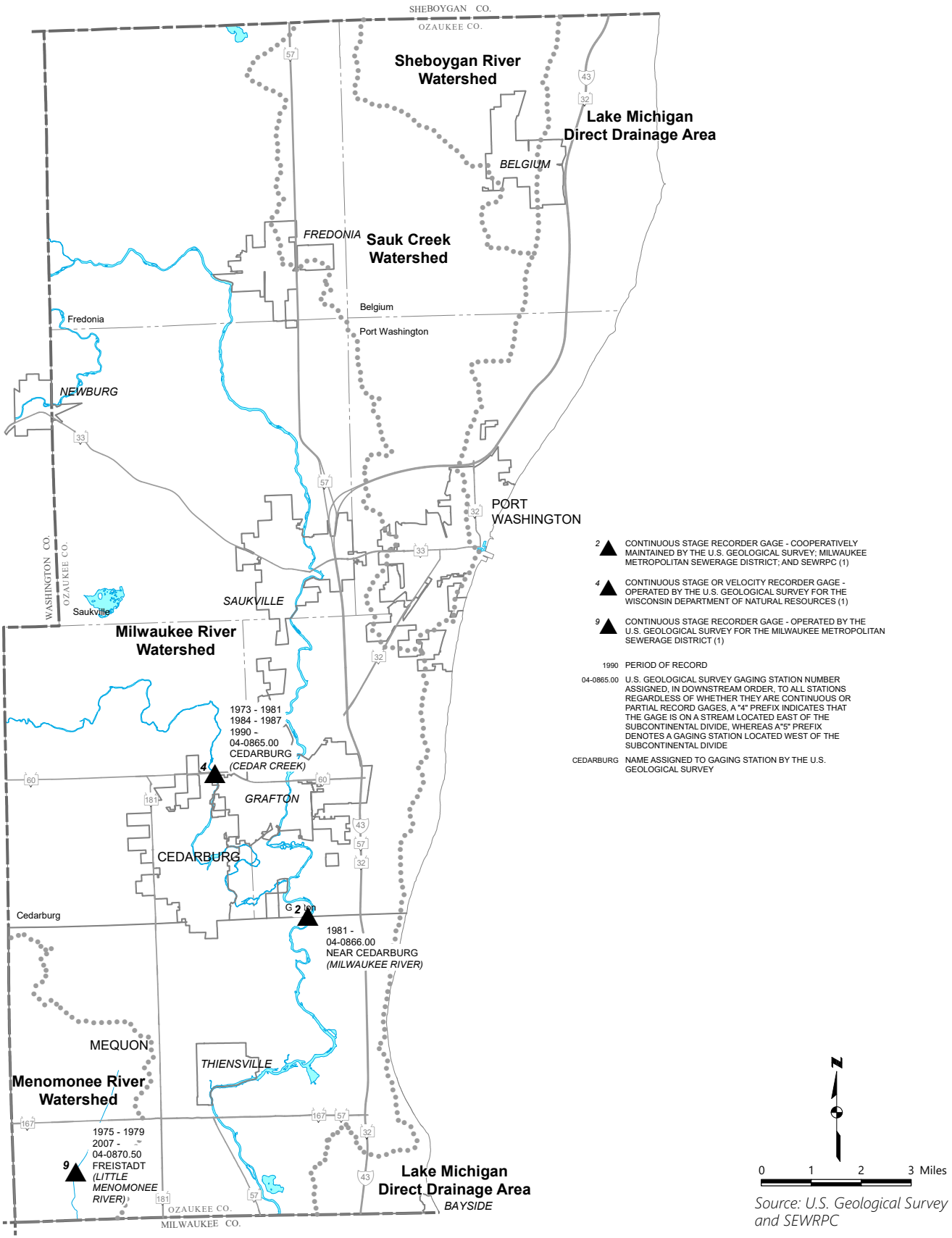
- All dams in Ozaukee County should be regularly inspected and maintained. Chapter 31, "Regulation of Dams and Bridges Affecting Navigable Waters," of the *Wisconsin Statutes,* requires inspection of dams by a professional engineer with experience in dams at a frequency based upon the dam's hazard rating. High hazard dams are required to be inspected every two years, significant hazard dams are required to be inspected every three to four years, and low hazard dams are required to be inspected every 10 years. In addition, it is recommended that owners and operators of dams inspect their dams both on a regular basis and following any high-water event.

- Owners or operators of dams should continue to monitor their dams during high water events.

[198] *linkedin.com/in/Ozaukee-fish-passage-program.*

[199] *Freistadt is a small unincorporated community in the southeastern corner of the County.*

Map 5.8
Locations of U.S. Geological Survey Stream-Gaging Stations in Ozaukee County: 2018



Source: U.S. Geological Survey and SEWRPC

- Investigate the willingness of the high hazard potential dam owner to work with the County to abandon and/or remove the high hazard potential dam.

- Owners and operators of high hazard and significant hazard dams should develop, maintain, and periodically update emergency action plans for their dams.

- Owners and operators of dams of any hazard rating should consider developing, maintaining, and periodically updating emergency action plans for their dams. Requirements for emergency action plans and guidance and templates for developing such plans are available from the WDNR. Such a plan should include:

    - Procedures to be followed to warn the public in the event that a dam failure is likely to occur

    - Procedures for evacuating areas likely to flood as a result of failure of the dam

    - An identification of road closings and rerouting needed to keep traffic and people out of danger areas in the event of flooding due to failure of the dam

- Dam failure analyses should be completed for those dams for which they are required and have not been done.

Hydraulic shadows from available dam failure analyses should be added to County and local government geographic information system (GIS) map layers. Local units of government within the County should regulate and zone the hydraulic shadow areas as floodway, unless the shadow area is specifically mapped as floodway and flood fringe for the dam hazard designation.

Stormwater Management Plan Element

As described in Chapter 2, floodplains provide a number of beneficial and natural functions, including flood control, erosion control, stormwater management, and water quality enhancement. With increases in urbanization and alterations to the natural landscape, many of the natural functions of floodplains are greatly reduced or even lost causing large amounts and high velocities of stormwater runoff.[200] Because of this, the relationship between stormwater management and floodplain management is an important consideration within the flood mitigation plan element of this Report.

Today most communities, including those in Ozaukee County, have stormwater management plans and/or regulations (i.e., ordinances) designed to minimize the adverse impacts caused by urban development. This element of the plan includes the status of stormwater management planning and related regulations in Ozaukee County.

Stormwater Management Plans and Programs

In *Wisconsin Administrative Code* Chapter NR 216, the State requires certain industrial facilities, construction sites, and municipal separate storm sewer systems (MS4s)[201] to obtain Wisconsin Pollutant Discharge Elimination System (WPDES) stormwater discharge permits[202] to manage the quantity and quality of stormwater runoff before it enters streams and waterbodies.

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[200] *Chagrin River Watershed Partners, Inc. and Biohabitats,* Floodplain Restoration and Storm Water Management: Guidance and Case Study, *March, 2009.*

[201] *What classifies as a Municipal Separate Stormwater Sewer System (MS4) is defined under Wisconsin Administrative Code Chapter NR 216.02. Generally, a MS4 is a conveyance or system of conveyances, including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm sewers designed or used for collecting or conveying untreated stormwater, and is owned or operated by a state, city, town, county, district, association, or other public entity.*

[202] *Individual (i.e., site-specific) WPDES permits are issued to municipal and industrial facilities discharging to surface water and/or groundwater. WPDES general permits are issued by the DNR for specific categories of industrial, municipal and other wastewater discharges. Under the authority in section 283.35, Wis. Stats., the department may issue WPDES general permits applicable to categories or classes of point source discharges.*

Designated WPDES entities (i.e., a MS4) are required to address the following application elements in order to obtain a State stormwater discharge permit: public education and outreach; public involvement and participation; an illicit discharge detection and elimination program; a construction site pollutant control plan; a post-construction stormwater management plan; a pollution prevention plan for the municipal facilities; and an annual report of their stormwater management including a map of their storm sewer system(s) and installed stormwater best management practices.

Communities that have received a WPDES Stormwater Discharge Permit under MS4 Phase I stormwater regulations include the Village and Town of Grafton (joint application); the City of Mequon and Village of Thiensville (joint application); the Village of Bayside (joint application with other Milwaukee County communities); the City of Cedarburg; the Village of Saukville; the Town of Cedarburg; and Ozaukee County. The Town of Saukville is covered under a general municipal stormwater permit.

In towns that are anticipated to remain mostly rural under the adopted land use plan, stormwater management planning is necessary only for certain site-specific areas where urbanization is expected or where isolated urban areas already exist, or where stormwater-related problems have developed.

Stormwater-Related Regulations

In 2002, the WDNR issued Chapter NR 151 of the *Wisconsin Administrative Code*, outlining the performance standards governing stormwater runoff from both agricultural and nonagricultural lands. Those standards include controls for both the quantity and quality of runoff from newly developed and redeveloped lands. These rules are administered by the WDNR through the Chapter NR 216 stormwater discharge permit system, although local municipalities have the option of adopting their own ordinances consistent with the *Administrative Code*. Chapter NR 152 of the *Administrative Code* contains model ordinances covering both agricultural and nonagricultural operations. Those communities that are required to obtain a WPDES stormwater discharge permit are required to have a stormwater management program that most often results in adoption of a stormwater management ordinance.

Ozaukee County Construction Site Erosion Control and Post-Construction Stormwater Management Ordinance

In accordance with Chapter NR 151, this ordinance applies to unincorporated areas of Ozaukee County that are located in an "urbanized area" as identified by the U. S. Bureau of the Census, areas adjacent to developing areas, and areas whose runoff will connect to a municipal separate storm sewer system that is regulated under Chapter NR 216, and where a town board has not adopted a similar ordinance. The ordinance regulates illicit discharges, requires construction site erosion control plans and post-construction stormwater management plans, and lays out the enforcement and inspection authorities of these requirements.[203]

Table 2.21 in Chapter 2 of this report indicates the communities in Ozaukee County that have adopted a stormwater management related ordinance or plan. Additional stormwater management plans that have been prepared by Ozaukee County communities are listed in Table 5.4.

Stormwater Management Facilities Maintenance

The effectiveness of stormwater management conveyance and detention facilities and other management measures can be sustained only if proper operation, repair, and maintenance procedures are carefully followed. Important maintenance efforts for stormwater conveyance features include the periodic repair of storm sewers, curbs and gutters, clearing of sewer obstructions, maintenance of open channel vegetation linings, and clearing of debris and sediment from open channels. Important maintenance efforts for stormwater treatment features include protection of the infiltration capacity of stormwater infiltration facilities, maintenance of detention facility inlets and outlets, maintenance of detention basin vegetative cover, and periodic removal of sediment accumulated in detention basins. This plan calls for these maintenance activities to be carried out on a continuing basis to maximize the effectiveness of the stormwater management facilities and to protect the capital investment in these facilities.

[203] *Ozaukee County,* Land and Water Resource Management Plan*, 2011-2015*.

Table 5.4
Stormwater Management Plans Prepared for Communities in Ozaukee County: 2007

Community	Plan	Prepared By	Year Prepared
Cities			
Cedarburg	Stormwater Management Plan – City of Cedarburg Districts 2, 4, and 7	Woodward Clyde Consultants	--[a]
	Final Report – Stormwater Management Plan, Phase 2	Rust Environment & Infrastructure	1997
Mequon	Stormwater Management Plan for the City of Mequon and Village of Thiensville	Camp, Dresser, and McKee Inc.	1999
Port Washington	City of Port Washington Stormwater Management Plan	Bonestroo	2006
Villages			
Belgium	Stormwater Management Study	McMahon Associates, Inc.	2004
Fredonia	Fredonia Creek Subwatershed Stormwater Management Plan	R. A. Smith & Associates Inc.	1994
Newburg	Stormwater Management Plan, Village of Newburg, Wisconsin, South of Milwaukee River	Bonestroo	1995
	Stormwater Management Plan, Village of Newburg, Wisconsin, North of Milwaukee River	Bonestroo	1996
Thiensville	Stormwater Management Plan for the City of Mequon and Village of Thiensville	Camp, Dresser, and McKee Inc.	1999
Towns			
Grafton	Ulao Creek Stormwater Management Plan	Bonestroo	1998
	Town of Grafton Stormwater Management Plan	Bonestroo	2007

[a] *No record of preparation date provided to SEWRPC.*

Source: SEWRPC

Green Infrastructure and Low Impact Design Integration

With continuing development and increased volumes of precipitation, stormwater management continues to evolve and change. Newer stormwater management techniques focus more on imitating natural systems by capturing rainwater where it falls. These types of practices are known as green infrastructure. Green infrastructure systems that enhance infiltration include rain gardens, bio-swales, retention ponds, vegetated rooftops, and permeable pavements. Similarly, low impact design (LID) practices can greatly reduce runoff volumes by preserving natural areas and vegetation, reducing the extent of impervious surfaces, and integrating stormwater management into the landscape. By reducing stormwater runoff and protecting floodplains, both green infrastructure and LID management techniques are recommended to be investigated for new development and redevelopment as mitigation measures to reduce stormwater flooding as well as enhance water quality and wildlife habitat in Ozaukee County. Furthermore, implementing green infrastructure and LID management techniques, such as detention, retention, or bioretention ponds into the County's stormwater management regulations can provide the County with CRS credit.

Public Education and Information Element

Public information, education, and participation constitute an integral aspect of Ozaukee County's flood and stormwater mitigation and related efforts. This element includes two subelement activities to be carried out, namely public education activities and public information programing and coordination associated with detailed stormwater and floodplain management plans.

Current Federal, State, and Local Educational and Outreach Activities

As discussed in the multiple hazards plan element, FEMA, the National Weather Service (NWS), and WEM provide many online resources and social media toolkits to assist the public with hazardous weather preparedness, safety, and recovery. FEMAs website provides a number of resources related to flooding hazards, flood insurance, and flood mitigation assistance programs. Currently, FEMA administers the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), and Repetitive Flood Claims (RFC). As previously described, Ozaukee County is currently participating in FEMA's PDM, RiskMAP, National Flood Insurance Program (NFIP), and Community Rating System (CRS) programming efforts. Continued outreach and educational efforts promoting the importance of obtaining flood insurance through the NFIP and CRS programming to Ozaukee County residents remains an important part of flood hazard mitigation.

FEMA's website also provides flood risk mapping services. The FEMA Flood Map Service Center (MSC) is the official online source for flood hazard information produced under the NFIP. All flood mapping products, such as Flood Insurance Rate Maps (FIRMs), Flood Insurance Studies (FIS), and National Flood Hazard Layer (NFHL) geodatabases, are available to view and download.[204] FEMA has also produced a Flood Risk Report that provides stakeholders with a comprehensive understanding of flood hazard and risk exposure for their community, watershed, or other geographic area. In addition, Ready.gov provides a Flood Safety Social Media Toolkit that contains numerous materials related to flood safety and preparedness.

The WDNR has several grant programs related to flood and stormwater control, including the municipal flood control grant program, municipal dam grant program, and urban nonpoint source stormwater construction grant. The WDNR website also contains informational and educational material and additional resources related to its floodplain management program.

Together FEMA, NWS, WEM, and WDNR produced flood inundation maps for portions of the Milwaukee River and all of Cedar Creek in Ozaukee County. The interactive web-based maps assist in communicating where flooding may occur over a range of river levels and are connected to real-time and forecasted river levels at stream gages. The interactive maps are user-friendly and provide information to local officials and property owners on the potential impacts of flooding and promote flood preparedness. The inundation prediction tool provides for improved implementation of protective measures and evacuation options prior to floods. In addition, the tool assists in identifying cost-effective mitigation measures, lowering future response, repair, and recovery costs.[205]

The U. S. Army Corps of Engineer (USACE) website also provides informational and educational resources and links related to flood risk preparedness and management. The USACE National Flood Risk Management program was established to integrate and coordinate USACE flood risk management programs and activities with FEMA and other Federal, state, regional, and local agencies. The USACE flood risk management program maintains and constructs public flood control structures such as dams, reservoirs, levees, floodwalls, and diversion channels. The USACE Disaster Preparedness program includes emergency management organization, planning, training, maintaining adequate supplies, tools and equipment, and inspection for non-Federal flood risk management projects.

USACE Cold Regions Research and Engineering Laboratory (CRREL) applies advanced science and engineering skills to study complex environments, materials, and processes such as ice jam events. The CRREL ice jam database provides informational and educational resources as well as known locations and descriptions of historical and current ice jam events.[206]

Over the years, Federal, State, and local governmental agencies have constructed numerous wetland restorations projects covering hundreds of acres on public and private land in Ozaukee County. Their efforts are ongoing, with several additional wetlands appearing on the landscape each year through incentives such as those provided by the Natural Resources Conservation Service (NRCS), United States Fish & Wildlife Service (USFWS), WDNR, and County programs. These programs encourage landowners to remove highly erodible land from agricultural use and restore natural plant communities.[207] Restoration projects such as this help reduce and prevent flooding and stormwater impacts while at the same time improving the ecological, economical, and social well-being of Ozaukee County.

The Wisconsin Department of Health Services has prepared a flooding toolkit for citizens.[208] The toolkit provides general flood information, preparedness tips, and guidelines on cleaning up after a flood has occurred. A factsheet prepared by WEM explains the different types of flood watches and warnings and

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[204] *msc.fema.gov/portal/resources/productsandtools.*

[205] *www.ci.mequon.wi.us/community/page/new-flood-inundation-prediction-tool.*

[206] *www.crrel.usace.army.mil/icejams.*

[207] *Ozaukee County,* Land and Water Resource Management Plan*, 2011-2015.*

[208] *The Wisconsin Flood Toolkit is available for download at www.dhs.wisconsin.gov/publications/p0/p00631.pdf.*

provides information on what citizens should do if a flood is likely to occur in their area.[209] The Ozaukee County's Land and Water and Emergency Management webpages contain a number of informational and educational resources related to local, State, and Federal flood protection.

Ozaukee County and the various municipalities should, as needed, collaborate to prepare and distribute various public informational and educational materials, including materials oriented toward property owners and homeowners designed to help them consider and potentially undertake actions to mitigate damages caused by stormwater flooding and sanitary sewer backups. Methods available for distributing information include, but are not limited to, print and broadcast media, cable television, pamphlet development, individual seminars, municipal and County online resources, social media, and community speaking engagements.

Public Participation Activities and Coordination with Other Agencies and Units of Government

The second subelement of this mitigation measure involves direct public participation and coordination with other agencies during detailed stormwater and floodplain management plan development. Much of this input has occurred in conjunction with floodplain map updating activities.

Discovery meetings for the Milwaukee River watershed RiskMAP program were held in 2013 and 2014. At the meetings, community members from around the watershed, WDNR, and FEMA exchanged information regarding flooding history, development plans, flood risks, floodplain management activities, and study needs. In 2019, the WDNR hosted a RiskMAP update meeting for local planning officials to discuss recent progress on the draft floodplain maps, including areas in Ozaukee County. As described above, work is nearly complete on the RiskMAP effort within the Milwaukee River watershed. Local knowledge and participation from the public through community representatives during the RiskMAP discovery meetings was an essential component for a successful program.

With a focus toward further informing the public regarding flood mitigation, stormwater and floodplain management, and related issues, this hazard mitigation plan update calls for concerned units and agencies of government, including Ozaukee County and all cities and villages within the County, to involve members of the general public and to seek public input in preparing and implementing recommendations regarding such issues.

Evaluation of Alternatives and Identification of Priority Mitigation Measures

The goal of flood mitigation activities is to reduce, in a cost effective manner, the loss of lives and property due to these events. In the initial assessment of potential mitigation measures for flooding and in examining alternative approaches to mitigate the impacts of flooding problems in Ozaukee County, the full range of nonstructural and structural approaches was considered.

An important factor in selecting priority mitigation measures is to consider incorporating recommendations from other related County and local planning efforts (i.e., Ozaukee County's park and open space plan,[210] comprehensive plan, economic plan, land and water plan, and comprehensive emergency management plan) that may help prevent flooding or act to mitigate the impacts of flooding when it occurs. Including such recommendations in the hazard mitigation plan furthers the goal of integrating the elements of the various plans that seek to provide guidance to the County for a variety of issues. Similarly, it was judged important that the set of priority mitigation measures incorporate existing programs and efforts that reduce the exposure of people and property to risks posed by flooding or that act to mitigate the impacts of flooding when it occurs. Examples of such programs include floodplain zoning, continued and expanded participation in the CRS and National Flood Insurance Program (NFIP), updating of FIRM maps, stormwater management regulation and planning, and educational and informational outreach programs.

Flooding damages can be mitigated by limiting or restricting how development occurs in high-risk areas. These measures can limit the County's and municipalities' future vulnerability to impacts from flooding and should be a principal element in any flood mitigation effort. Measures to implement this type of mitigation

[209] *The Ready Wisconsin flood informational handout is available for download at readywisconsin.wi.gov/media/pdf/Flooding.pdf.*

[210] *SEWRPC Community Assistance Planning Report No. 133,* A Park and Open Space Plan for Ozaukee County *(3nd Edition), June 2011.*

include incorporating recommendations from other related County and local planning efforts and enforcing regulations such as floodplain, wetland, and wetland-shoreland zoning regulations and management. Another important measure to implement this element is preserving open space and environmentally sensitive lands to preserve and restore the flood mitigating functions of Ozaukee County's natural resources.

Another important flood mitigation component should be to focus on existing development located within high-risk areas. Recurring economic losses and distress from flooding can be reduced by either removing structures from the floodplain, or modifying them to resist damage from flooding. This priority element includes acquisition and demolition, floodproofing, and retrofitting of structures in high-risk areas. In addition, actions to manage the potential flood-related impacts of dam failure is an important component of this hazard mitigation plan update.

Based upon the foregoing evaluation and consideration of risk, and review by the Ozaukee County Hazard Mitigation LPT, the flooding and related stormwater drainage problem mitigation plan for Ozaukee County consists of four elements: a preservation of floodplain and environmentally sensitive lands element, a floodplain management element; a stormwater management element, and a public education and information element. Each element of the plan is an important component of the overall strategy for reducing flood risk and flood damage. Some aspects of the overall plan are already being implemented in the form of existing and ongoing activities being carried out by the County and local units of government. The priority mitigation measures, along with a general cost benefit summary are presented in Table 5.5.

5.4 HAZARD MITIGATION PLAN COMPONENT FOR THUNDERSTORM WIND, NON-THUNDERSTORM HIGH-WINDS, HAIL, AND LIGHTNING HAZARDS

As described in Chapter 3, thunderstorm winds, non-thunderstorm high-winds, hail, and lightning are natural hazard events of significant concern to be considered in the Ozaukee County hazard mitigation plan. This section describes alternative and selected priority strategies to mitigate these types of hazards. As part of the updating process, these strategies were reviewed and reevaluated by the Ozaukee County Hazard Mitigation LPT in light of the updated hazard conditions and hazard mitigation goals documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

All thunderstorm related hazards and non-thunderstorm high-wind events are potentially dangerous and are common within Ozaukee County. An estimated 10 percent of the thunderstorms and related hazard events that occur each year within Southeastern Wisconsin are classified as severe. Severe thunderstorm fronts can often be tracked, which generally provides ample warning for potentially affected areas to take precautionary actions. In addition, when severe thunderstorms and related hazard events occur, they generally last for short periods of time.

While it may not be possible to accurately identify specific areas where there is significant risk from thunderstorm related hazard events or non-thunderstorm high-wind events, measures can be taken to reduce the potential damage caused wherever they may occur in the County. High-wind events associated with windstorms and thunderstorms are similar to tornadoes, except they are more common and usually less powerful.

Hailstorms tend to occur in conjunction with severe thunderstorms. A severe thunderstorm weather advisory or advance warning system may indicate that large or damaging hail is imminent. During a hailstorm personal safety is the first priority and persons should seek shelter and stop driving to avoid accidents. Advance warning systems may allow some actions to reduce hail damage to vehicles and some property, but little can be done to protect structures or crops in the field.

Personal protection is paramount for lightning safety—many people suffer injuries or are killed due to misinformation and inappropriate behavior during lightning storms. A few simple precautions can reduce many of the dangers posed by lightning. The individual is ultimately responsible for his/her personal safety and should take appropriate action when threatened by lightning. Little can be done to protect property from lightning strikes.

Table 5.5
Cost-Benefit Analysis for Measures Included in the Ozaukee County All-Hazards Mitigation Plan: Flood and Associated Stormwater Drainage Problems Hazards

Priority Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Estimated Benefits (thousands of dollars)[c]	Benefits						Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High		Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Floodland and Environmentally Sensitive Land Preservation Element													
Maintain floodplain and wetland zoning regulations	--[e]	--[e]	X			--	X	X	X	X	X	X	Ozaukee County, Cities of Cedarburg, Mequon; Villages of Fredonia, Grafton, Newburg, Saukville, Thiensville; Towns of Belgium, Cedarburg, Fredonia, Grafton, and Port Washington
Continued preservation and maintenance of environmentally sensitive lands and open space areas[d]	41,838	--[f]			X	--	X	X			X	X	Ozaukee County, and all cities, villages, and towns
Wetland Restoration to Reduce Flood-related Agricultural and Property Damage[g]	7,001	--[h]			X	--[i]	X	X			X	X	Ozaukee County, City of Mequon, Village of Saukville, and Towns of Belgium, Cedarburg, Fredonia, Port Washington, and Saukville
Floodplain Management Element													
Remove up to 27 repetitive loss structures[d,j]	12,781 (2018 dollars)	--[h]			X	910 (per year)	X	X	X	X	X	X	Cities of Mequon, Port Washington; Villages of Saukville and Thiensville; Towns of Grafton and Saukville
Surveys of up to 863 structures identified as being potentially located in flood hazard areas[d]	1,036 (2018 dollars)	--[h]			X	27,000 (per 100-year flood event)	X	X			X	X	Ozaukee County, and all cities, villages, and towns
Floodproofing 217 structures identified as potentially located in flood hazard area[d, j]	21,725 (2018 dollars)	--[h]			X	13,100 (per 100-year flood event)	X	X	X	X	X	X	Cites of Cedarburg and Mequon; Villages of Grafton, Fredonia, Saukville, Thiensville; and Towns of Fredonia and Grafton
Acquisition and removal/demolition of 624 structures identified as being potentially located in flood hazard area[d]	204,028 (2018 dollars)	--[h]			X	13,000 (per 100-year flood event)	X	X	X	X	X	X	Cities of Cedarburg, Mequon, and Port Washington; Villages of Fredonia and Thiensville; and Towns of Belgium, Cedarburg, Fredonia, Grafton, Port Washington, and Saukville

Table continued on next page.

Table 5.5 (Continued)

Priority Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Estimated Benefits (thousands of dollars)[c]	Benefits						Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High		Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Floodplain Management Element (continued)													
Continue participation in FEMA's National Flood Insurance Program and floodplain map updating[d]	--[e]	--[e]	X			--	X	X					Ozaukee County and all its cities, villages, and towns
Continue County participation in the Community Rating System program	--[k]	--[k]		X		--	X	X				X	Ozaukee County and towns
Lending institution and real estate agent policies should continue their practice of determining the floodprone status of properties before mortgage transactions are complete[d, e]	--[e]	--[e]	X			--	X	X					Ozaukee County and its all cities, villages, and towns
Enforcement of floodplain regulations	--[e]	--[e]	X			--	X	X				X	Ozaukee County and its all cities, villages, and towns
Ice Jam Mitigation Measures	--[e]	--[e]	X			--	X	X					City of Cedarburg, Villages of Fredonia, Grafton, and Saukville, and Town of Fredonia
Installation of new and maintenance of existing USGS stream gages	12 (2019 dollars)	12 (2019 dollars)	X			--	X						Milwaukee River in Ozaukee County
Documentation of extent of future floods	--[l]	--[l]	X			--	X						Ozaukee County and its all cities, villages, and towns
Stream channel maintenance	--[e]	--[e]	X			--	X	X				X	Ozaukee County and its all cities, villages, and towns
Dam Failure Subelement													
Regular inspection and maintenance of dams	--[l]	--[l]	X			--	X	X					Cities of Cedarburg, Mequon, and Port Washington; Villages of Fredonia, Grafton, Saukville, and Thiensville; and Towns of Belgium, Fredonia and Grafton
Dam emergency action plans	--[l]	--[l]	X			--	X	X					Cities of Mequon and Cedarburg; and Villages of Fredonia, Grafton, Saukville and Thiensville
Dam failure analysis	--[m]		X			--	X	X					Cities of Mequon and Cedarburg; and Villages of Fredonia, Grafton, Saukville and Thiensville

Table continued on next page.

Table 5.5 (Continued)

Priority Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Estimated Benefits (thousands of dollars)[c]	Benefits						Community/Jurisdictions Affected
	Capital (thousands of dollars)	Average Annual Operation and Maintenance (thousands of dollars)	Low	Moderate	High		Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Dam Failure Subelement (continued)													
Investigate interest in abandonment and removal of high hazard potential dam	--[l]	--[l]	X			--	X	X				X	Cities of Cedarburg, Mequon, and Port Washington; Villages of Fredonia, Grafton, Saukville, and Thiensville; and Towns of Belgium, Fredonia and Grafton
Stormwater Management Element													
Development and/or Continued Maintenance of Stormwater Management Plans/Programs[d]	--[e]	--[e]	X			--	X	X				X	Ozaukee County and all cities, villages, and towns
Continuation of Stormwater-Related Regulations[d]	--[e]	--[e]	X			--	X	X				X	Ozaukee County and all cities, villages, and towns
Implementation and integration of green infrastructure and low impact design	--[l]	--[l]	X			--	X				X	X	Ozaukee County and all cities, villages, and towns
Public Informational and Educational Element													
Continue and enhance public education activities related to flood and stormwater management	--[e]	--[e]	X			--	X						Ozaukee County and all cities, villages, and towns
Promote and distribute information related to Federal Flood Insurance Program	--[e]	--[e]	X			--	X	X					Ozaukee County and all cities, villages, and towns
Enhance public participation activities and coordination with other agencies and units of government	--[e]	--[e]	X			--	X						Ozaukee County and all cities, villages, and towns

[a] *All costs are expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low
- *Educational and informational programming*
- *Ongoing enforcement of ordinances*
- *Plan development*
- *Continued coordination/mutual aid/interagency agreements*

Moderate
- *Addition of new staff*
- *Additional staff hours budgeted*
- *Additional equipment*
- *New ordinance development*
- *New programs/task force*

High
- *Major construction*
- *New buildings (infrastructure)*
- *Capital programs*

Table continued on next page.

Table 5.5 (Continued)

[c] *The estimated benefits are based upon the reduction in flood damages during a one-percent-annual-probability flood event. The damage estimates were developed by the Commission staff based upon structure values, flood stage, and depth of flooding as described in Chapter 3. Note, not all recommendations have a quantifiable benefit for the 100-yr floodplain, hence mitigation measures not having a cost associated to that column.*

[d] *This mitigation is related to, but not essential to, compliance with the requirements of the National Flood Insurance Program.*

[e] *Costs are covered under ongoing or day-to-day activities.*

[f] *Costs were developed under the Ozaukee County Park and Open Space Plan. Unit costs used to estimate acquisition costs were $3,000 per acre of wetlands, $10,000 per acre of woodlands, and $6,000 per acre of other open lands in 2010 dollars .The costs are based on purchasing all recommended land for parks and open spaces. It should be noted that the protection of these areas could also be accomplished through conservation easements, conservation subdivisions, donations, and purchase or transfer of development rights. The acquisition of all land is unlikely to occur before the park and open space plan year 2020 since acquisitions occur only on a willing seller, willing-buyer basis, and only when funds are available. In the past, major land acquisitions by Ozaukee County have been subsidized by State and Federal grants, which are not always available.*

[g] *Wetland restoration to be carried out at discretion of property owners.*

[h] *Costs are unknown.*

[i] *It is estimated that full implementation of this recommendation would result in an average annual reduction of agricultural damages due to flooding of $225,500.*

[j] *Structure floodproofing, elevation, or removal will be evaluated on a site-by-site basis and be carried out at the discretion of property owners.*

[k] *Ozaukee County currently participates in the CRS program, covering all townships. Cost of municipality participation is to be determined.*

[l] *Costs to be determined. Partially covered under ongoing programs.*

[m] *Costs are site-specific, and additional investigation is needed for countywide estimate.*

Source: Ozaukee County Division of Emergency Management and SEWRPC

Through review by the Ozaukee County Hazard Mitigation LPT, the following measures to reduce vulnerability to thunderstorm winds, non-thunderstorm high-winds, hail, and lightning have been identified as viable for this update of the County hazard mitigation plan. In addition to the measures listed below, mitigation strategies that were found to address multiple hazard types, including thunderstorm-related and non-thunderstorm high-wind events, are discussed in the hazard mitigation plan component for multiple hazard types earlier in this Chapter.

Nonstructural

- Continue to maintain and regularly update local fire department equipment to help detect or mitigate lightning-related fires, such as thermal imaging devices. All fire departments maintain multiple thermal imaging devices. The Ozaukee County Sheriff's Office also maintains a drone program with advanced thermal imaging capabilities that is available to fire departments;

- Enforce existing local ordinances requiring adequate electrical grounding in newly constructed buildings;

- Continue to work with local fair/festival planning officials to create emergency plans in the case of severe weather;

- Pursue grant funding for installation or upgrading of adequate safe rooms in existing mobile home parks, campgrounds, and public parks and beaches based on community and landowner interest;

- Provide information and encourage the use of fire-resistant materials and surge protectors on critical electronic equipment.

Structural

- Promote planting windbreaks for farm crops;

- Work with municipalities and businesses to explore installation or upgrading of community safe rooms and hardening projects[211] for public buildings, community facilities, major industrial and manufacturing sites, large businesses, mobile home parks, campgrounds, and fairgrounds to ensure adequate shelter from thunderstorm and high-wind hazards. Priority should be considered for those facilities that are located in slab-on-grade structures and for those projects that can be completed as part of a newly planned building or building expansion;

- Routinely inspect mobile and manufactured housing to ensure they are properly and securely anchored;

- Install lightning grade surge protection devices for critical electronic components used by government, public service, and public safety facilities, such as warning systems, control systems, communications, computers, and data networks.

Public Informational and Educational Programming

- Increase public education and awareness of the potential severity of thunderstorm related hazards and non-thunderstorm high-wind hazards and continue to distribute emergency preparedness information related to thunderstorm hazards. Such educational efforts should include promoting public awareness of proven thunderstorm safety guidelines to reduce the risk of lightning hazards and the potential severity of hailstorms;

- Distribute, and make readily available, information on where to go during severe weather events for campground, public park, and beach visitors;

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[211] *FEMA defines "hardening" as project-specific specialized design and construction methods which are applied to one or more rooms within a building and/or to an entire building envelope to allow portions of and/or the entire structure to resist wind pressures and windborne debris impacts during an extreme wind event and are capable of providing life-safety protection to the occupants of the room or structure.*

Current Programs

Federal and State Programs

The NWS issues warnings, watches, and advisories when there is a threat of severe weather conditions. Several categories of warnings, watches, and advisories apply to thunderstorms and associated hazards. The NWS Storm Prediction Center in Norman, Oklahoma will issue a severe thunderstorm watch when conditions are favorable for the development of severe thunderstorms in and close to the watch area.

The NWS Milwaukee/Sullivan office will issue a severe thunderstorm warning when:

- A spotter reports a thunderstorm that is producing winds equal to or exceeding 58 miles per hour (mph)
- Hail of one inch or larger in diameter
- A severe thunderstorm is detected by Doppler radar.

The NWS Milwaukee/Sullivan office will issue a high wind warning when:

- Sustained winds of 40 mph are expected to occur for an hour or more
- Wind gusts of 58 mph or more are expected to occur.

The NWS Milwaukee/Sullivan office will issue a wind advisory when:

- Sustained winds of 30 mph are expected to occur for an hour or more
- Wind gusts of 45 mph to 57 mph are expected to occur.

Federal and State programs include awareness and education efforts. As mentioned in the multiple hazards plan, FEMA, NWS, and WEM provide many online resources and social media tool kits to assist the public on hazardous weather preparedness, safety, and recovery. The NWS has an extensive public information program to educate people about the dangers of thunderstorms and related hazards.

The Wisconsin Department of Health Services has developed a severe thunderstorm and tornado tool kit to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to severe thunderstorms and tornadoes. Similarly, WEM has produced several educational resources regarding thunderstorms and related hazards including prerecorded radio public service announcements, scripts for radio public service announcements, fliers, and educational materials for children. In addition, numerous other organizations, including the American Red Cross, provide public safety information regarding lightning.

Local Programs

As discussed in detail in the multiple hazards plan component, Ozaukee County has a variety of methods to warn residents of emergency situations, including thunderstorm and thunderstorm related events.

Ozaukee County DEM and the Washington-Ozaukee Public Health Department have a number of online resources, brochures, booklets, and pamphlets available for the public on severe weather safety, including thunderstorm and related events.

Ozaukee County Emergency Management encourages all special events that are primarily outdoors to register with the National Weather Service for special event preparedness and weather support. Ozaukee County DEM actively works with the planning board for the Ozaukee County Fair as well as municipalities and private festival organizers to develop an all hazards special event plan to keep attendees safe.

The NWS SKYWARN Storm Spotter Program trains volunteers to provide timely and accurate reports of severe weather to the NWS. Ozaukee County hosts two severe weather safety and spotter training seminars

through the SKYWARN Storm Spotter Program.[212] Severe weather safety and spotter training sessions are provided for the general public and local government and school district employees. Similarly, the City of Cedarburg's Emergency Management Department also maintains a group of organized volunteer weather spotters trained by the NWS. Ozaukee County is also an active participant in the NOAA Weather-Ready Nation Ambassador Initiative and is actively pursuing the NWS StormReady Program designation as detailed in the multiple hazards plan component.

Multi-Jurisdictional Considerations

Thunderstorms and their related hazards can potentially impact all municipalities within the County. In addition, these severe events can potentially cause multiple damages to a variety of infrastructure including, transmission lines, communication lines, and transportation routes due to flooding, as well as damage to buildings from flooding, hail, and/or high winds. Hence, Ozaukee County, municipalities, relevant businesses, and other organizations should coordinate hazard mitigation activities through a cooperative County and local government partnership in countywide disaster planning and response mechanisms.

Evaluation of Alternatives and Identification of Priority Mitigation Measures

Based upon review of the above and the risk analysis given in Chapter 3, continuation and refinement of current early warning system programs represents a major component of the planned mitigation action with respect to thunderstorm related hazards and non-thunderstorm high-wind events. The existing warning systems should continue to rely upon the use of multiple means of communication to alert people to the threat of severe weather. In addition, informing the public of the significance of thunderstorm watches and warnings so that they take thunderstorms and related hazards seriously, know where to seek shelter in emergency situations, and are prepared should such a storm cause a disaster is an important component for minimizing the risks associated with these natural hazards. Community-based informational programs should also continue to be conducted by the County in partnership with Federal, State and local authorities.

Promoting the provision of adequate safe places for people to seek shelter during severe storms constitutes an additional approach to mitigating potential impacts of severe storms. Ozaukee County DEM should continue to provide informational resources on safe rooms at public outdoor facilities such as parks, golf courses, campgrounds, and beaches. In addition to providing informational resources on safe rooms, the County should encourage and promote the construction or upgrade of community safe rooms to provide additional and adequate shelter from severe storms.

Similarly, severe storm events can cause economic losses especially to agricultural producers through damage to crops. Continuing to provide agricultural producers with information regarding Federal crop insurance programs and encouraging them to purchase crop insurance provides some protection against such losses.

Finally, other feasible mitigation actions include enforcement of building code regulations that improve the ability of structures to withstand severe wind; surge protection for sensitive electronic equipment; on-site emergency backup power generation for critical infrastructure; and other precautions that will limit possible injuries, deaths, or property damages due to severe weather events. The majority of these measures are currently in place to varying degrees, indicating an emphasis on informational programming and enforcement would take precedence.

Based upon the foregoing evaluation and consideration of risk and consideration by the Ozaukee County Hazard Mitigation LPT (see Appendix A), there are six actions determined to be priority mitigation measures for this hazard mitigation plan update that are specifically related to thunderstorm winds, non-thunderstorm high-winds, lightning and hail events.[213] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.6.

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[212] *More information on the NWS's SKYWARN Storm Spotter Program can be found at www.weather.gov.*

[213] *Priority mitigation measures that apply to multiple hazard types including thunderstorm winds, non-thunderstorm high-winds, lightning and hail events, are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section in this Chapter.*

Table 5.6
Cost-Benefit Analysis for Measures Included in the Ozaukee County Hazard Mitigation Plan: Thunderstorm, Non-Thunderstorm High-Winds, Hail, and Lightning Hazards

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Maintain and regularly update local fire department equipment to help detect or mitigate lightning-related fires, such as thermal imaging devices	18,000	1,000		X		X						Cities of Cedarburg, Mequon, and Port Washington; Villages of Belgium, Fredonia, Grafton, Newburg, Random Lake, Saukville, and Thiensville; Towns of Belgium, Cedarburg, Fredonia, Grafton, Saukville, and Trenton
Continue to work with local fair/festival organizers to create emergency plans in case of severe weather	--[c]	--[c]	X			X						Ozaukee County
Pursue grant funding for installation or upgrading of adequate safe rooms in existing mobile home parks, campgrounds, and public parks and beaches	--[c]	--[c]	X			X						Ozaukee County and all local jurisdictions[d]
Work with municipalities and businesses to explore installation or upgrading of community safe rooms and hardening projects for public buildings, community facilities, major industrial and manufacturing sites, large businesses, mobile home parks, campgrounds, and fairgrounds to ensure adequate shelter from thunderstorm and high-wind hazards.	--[c]	--[c]			X	X		X	X			Ozaukee County and all local jurisdictions[d]

Table continued on next page.

Table 5.6 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Install lightning grade surge protection devices for critical electronic components used by government, public service, and public safety facilities, such as warning systems, control systems, communications, computers, and data networks	--[e]	5,000 for County Facilities		X		X	X					Ozaukee County and all local jurisdictions[d]
Increase public education and awareness of the potential severity of thunderstorm related hazards and non-thunderstorm high-wind hazards and distribute emergency preparedness information related to thunderstorm hazards	--[c]	--[c]	X			X						Ozaukee County and all local jurisdictions[d]

[a] *All cost expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low
- *Educational and informational programming*
- *Ongoing enforcement of ordinances*
- *Plan Development*
- *Continued coordination/mutual aid/interagency agreements*

Moderate
- *Addition of new staff*
- *Additional staff hours budgeted*
- *Additional equipment*
- *New ordinance development*
- *New programs/task force*

High
- *Major construction*
- *New buildings (infrastructure)*
- *Capital programs*

[c] *Costs covered under day to day operations.*

[d] *Jurisdictions include general purpose units of government—Cities, Towns, and Villages—and special purpose units of government such as School Districts, Sanitary and Utility Districts, and Agricultural Drainage Districts.*

[e] *Costs are site-specific.*

[f] *Costs to be determined. Partially covered under ongoing programs.*

Source: Ozaukee County Division of Emergency Management and SEWRPC

5.5 HAZARD MITIGATION PLAN COMPONENT FOR TORNADOES

As described in Chapter 3, tornadoes are natural hazard events of moderate concern to be considered in this update of the Ozaukee County hazard mitigation plan. This section describes alternative and selected priority strategies to mitigate these types of hazards. As part of the updating process, these strategies were reviewed and reevaluated by the Ozaukee County Hazard Mitigation LPT in light of the updated hazard conditions and hazard mitigation goals documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

All tornadoes are potentially dangerous hazards within Ozaukee County as discussed in Chapter 3. However, tornadoes have been shown to impact Ozaukee County five times over a 54-year period and all but one of these were EF1 (or F1) magnitude or less. In addition, when tornadoes and related hazard events occur, they generally last for short periods of time and impact relatively small areas upon the landscape. However, when strong tornadoes do strike, they can cause extensive property damage, injuries, and death.

While it may not be possible to accurately identify specific areas where there is significant risk from tornado events, or the number or severity of the events, measures can be taken to reduce the potential damage caused by tornado and related hazards wherever they may occur in the County. Based upon review by the Ozaukee County Hazard Mitigation LPT, the following measures to reduce vulnerability to tornadoes have been identified as viable for this update of the Ozaukee County hazard mitigation plan. In addition to the measures listed below, mitigation strategies that were found to address multiple hazard types, including tornadoes, are discussed in the hazard mitigation plan component for multiple hazard types earlier in this Chapter.

Nonstructural

- Require construction regulations for safe rooms in new schools, daycares, and nursing homes, and encourage the establishment of safe rooms for existing structures that do not have basements

- Conduct an inventory and inspection of facilities to ensure the quality, quantity, and accessibility of adequate tornado shelters

- Continue to work with local fair/festival planning officials to create emergency plans in case of severe weather

- Pursue grant funding for installation or upgrading of adequate safe rooms in existing mobile home parks, campgrounds, public parks, and public beaches based on community and landowner interest.

Structural

- Ensure that maintenance, monitoring, and usage policies/procedures of the County's public outdoor warning systems are up-to-date and reflect the needs of fire and police personnel;

- Work to locally adopt and implement the Wisconsin Outdoor Warning Siren Best Practices for operation of the municipally-owned outdoor warning sirens in Ozaukee County;

- Routinely inspect mobile and manufactured housing to ensure that they are securely anchored (i.e., tie-downs);

- Work with municipalities and businesses to explore installation or upgrading of community safe rooms and hardening projects[214] for public buildings, community facilities, major industrial and manufacturing sites, large businesses, mobile home parks, campgrounds, and fairgrounds to ensure adequate shelter from tornadoes. Priority should be considered for those facilities that are located in slab-on-grade structures and for those projects that can be completed as part of a newly planned building or building expansion.

[214] *FEMA defines "hardening" as project-specific specialized design and construction methods which are applied to one or more rooms within a building and/or to an entire building envelope to allow portions of and/or the entire structure to resist wind pressures and windborne debris impacts during an extreme wind event and are capable of providing life-safety protection to the occupants of the room or structure.*

Public Informational and Educational Programming

- Increase public education and awareness of the potential severity of tornadoes and continue to produce and distribute emergency preparedness information related to tornado events

- Distribute, and make readily available, information on where to go during severe weather events for campground, public park, and beach visitors

- Produce and distribute information related to what steps should be taken by the public when they hear tornado sirens.

Current Programs

Federal and State Programs

The NWS issues tornado watches when conditions are favorable for the development of thunderstorms that have a strong capability of producing tornadoes and issues tornado warnings when a tornado has been spotted by a trained observer or Doppler radar has indicated a developing tornado.

Federal and State programs include awareness and education efforts. NOAA's National Severe Storms Laboratory (NSSL) website has educational material on severe weather, including tornadoes. In addition, the NWS has an extensive public information program to educate people about the dangers of tornadoes and related hazards that assist in preventing related deaths and injuries. WEM, in conjunction with the NWS and State and local government agencies, provides both preparedness information and severe weather information to the public. Similarly, WEM has produced several educational resources regarding tornadoes including prerecorded radio public service announcements, scripts for radio public service announcements, fliers, and educational materials for children.[215] The Wisconsin Department of Health Services has developed a severe thunderstorm and tornado tool kit to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to severe thunderstorms and tornadoes.[216] In addition, numerous other organizations, including the American Red Cross, provide public safety information regarding tornadoes.

Local Programs

As discussed in detail in the multiple hazards plan component, Ozaukee County has a variety of methods to warn residents of emergency situations, including tornado events.

Ozaukee County has a total of 33 outdoor tornado siren systems, plus a backup in the Village of Saukville. The number of sirens within the communities and the agencies that control each are shown in Table 3.13. The municipalities regularly test warning systems, repairing and upgrading as necessary. In addition, the City of Port Washington is interested in implementing Wisconsin Outdoor Warning Siren Best Practices to improve public safety and public warning effectiveness in Wisconsin by encouraging statewide adoption of one simple, clear, consistent and credible outdoor warning siren policy.

Ozaukee County DEM and the Washington-Ozaukee Public Health Department have a number of online resources, brochures, booklets, and pamphlets available for the public on tornado preparedness and safety and what to do if a tornado warning is issued. Ozaukee County DEM actively promotes tornado safety public information as well as other summer severe weather public awareness and educational efforts, including applicable links on the County website.

The Ozaukee County Fair provides informational brochures and resources on weather safety and mitigation. A number of local emergency management and fire departments have instituted educational programs and communications for the public related to tornado safety. Ozaukee County DEM as well as municipalities participate in Tornado Awareness Week every spring. Media information packets are distributed to reemphasize and alert the public to tornado warning procedures.

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[215] *These can be accessed at Wisconsin Emergency Management's ReadyWisconsin website located at: ready.wi.gov/Resources/Manager_Resources.asp.*

[216] *Wisconsin Department of Health Services,* Wisconsin Severe Thunderstorm and Tornadoes Toolkit, op. cit.

Ozaukee County also assists the National Weather Service with sponsoring tornado spotter training and in organizing local tornado spotter networks. Ozaukee County is also an active participant in the NOAA Weather-Ready Nation Ambassador Initiative and is actively pursuing the NWS StormReady Program designation as detailed in the multiple hazards plan component.[217] The City of Cedarburg and Village of Bayside are currently recognized as StormReady communities.

Multi-Jurisdictional Considerations

Tornadoes and their related hazards can potentially impact all municipalities within the County. In addition, these severe events can potentially cause severe damage to a variety of infrastructure including transmission lines, communication lines, and transportation routes due to high winds and debris. Public and private buildings can also be destroyed. Hence, Ozaukee County, municipalities, relevant businesses, and other organizations should coordinate hazard mitigation activities through a cooperative County and local government partnership in countywide disaster planning and response mechanisms. Such measures are already well underway through the comprehensive emergency management planning program involving the Ozaukee County DEM and coordinated local community emergency operations programs and should be continued.

Evaluation of Alternatives and Identification of Priority Mitigation Measures

The goal of tornado and high-wind mitigation activities is to reduce, in a cost-effective manner, the loss of lives and property due to these events. An effective warning system is the single most important resource for alerting the public to a tornado hazard, which is critical to the main goal of saving lives. Based upon review of the above and the risk analysis given in Chapter 3, continuation and refinement of the early warning system programs represents a major component of the planned mitigation action with respect to tornadoes. The existing warning systems should continue to rely upon the use of multiple means of communication to alert people to the threat of severe weather. In addition, informing the public of the significance of tornado watches and warnings so that they take tornado warnings seriously and know where to seek shelter in emergency situations, are important, ongoing components for minimizing the risks associated with these natural hazards. Community- and school-based informational programs should also continue to be conducted by the County in partnership with Federal, State and local authorities.

Promoting the provision of adequate safe places for people to seek shelter when tornadoes may be in the area constitutes an additional approach to mitigating potential injury or death. The best shelters are specifically designed tornado shelters or safe rooms. Lacking such shelters, taking refuge in a basement near supporting walls or pillars, and away from windows, or, if there is no basement, taking shelter in smaller interior, windowless rooms, such as hallways or closets, can offer some protection. Cars, mobile homes, garages, and outbuildings are not safe shelters from tornadoes. Ozaukee County has two small mobile home parks located in the Towns of Grafton and Port Washington. Both parks lack access to adequate tornado shelters. Encouraging and promoting the construction of community safe rooms to provide shelter from tornadoes to these vulnerable populations constitutes an important addition to this hazard mitigation plan update.

Finally, other feasible mitigation actions include enforcing building code regulations that improve the ability of structures to withstand severe wind, on-site emergency backup power generation for critical infrastructure, and other precautions that would limit potential injury, death, or property damage. The majority of these measures are currently in place to varying degrees, indicating an emphasis on informational programming and enforcement would take precedence.

Based upon the foregoing evaluation and consideration of risk and consideration by the Ozaukee County Hazard Mitigation LPT (see Appendix A), there are seven actions determined to be priority mitigation measures as part of this hazard mitigation plan update that are specifically related to tornado events. [218] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.7.

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[217] *Based on scheduling with the National Weather Service, Ozaukee County should be awarded the StormReady status in spring 2020.*

[218] *Priority mitigation measures that apply to multiple hazard types, including tornado events, are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section in this Chapter.*

Table 5.7
Cost-Benefit Analysis for Measures Included in the Ozaukee County All-Hazards Mitigation Plan: Tornado Hazards

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Continue to work with local fair/festival organizers to create emergency plans in case of severe weather	--[f]	--[f]	X			X						Ozaukee County
Pursue grant funding for installation or upgrading of adequate safe rooms in existing mobile home parks, campgrounds, and public parks and beaches	--[c]	--[c]	X			X						Ozaukee County and all local jurisdictions[d]
Ensure that maintenance, monitoring, and usage policies/procedures of the County's public outdoor warning systems are up-to-date and reflect the needs of fire and police personnel	Estimated at $25,000 per siren	--[f]	X			X						Ozaukee County and all local jurisdictions[d]
Work to locally adopt and implement the Wisconsin Outdoor Warning Siren Best Practices	--[h]	--[h]	X			X	X	X	X			Ozaukee County and all local jurisdictions[d]
Work with municipalities and businesses to explore installation or upgrading of community safe rooms and hardening projects for public buildings, community facilities, major industrial and manufacturing sites, large businesses, mobile home parks, campgrounds, and fairgrounds to ensure adequate shelter from tornadoes.	--[c]	--[c]			X	X		X	X			Ozaukee County and all local jurisdictions[d]

Table continued on next page.

Table 5.7 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Increase public education and awareness of the potential severity of tornadoes and continue to produce and distribute emergency preparedness information related to tornado events	--[h]	--[h]	X			X						Ozaukee County and all local jurisdictions[d]
Distribute, and make readily available, information on where to go during severe weather events for campground, park, and beach visitors	--[e]	--[e]	X			X						Ozaukee County

[a] *All cost expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low	*Moderate*	*High*
Educational and informational programming	*Addition of new staff*	*Major construction*
Ongoing enforcement of ordinances	*Additional staff hours budgeted*	*New buildings (infrastructure)*
Plan Development	*Additional equipment*	*Capital programs*
Continued coordination/mutual aid/interagency agreements	*New ordinance development*	
	New programs/task force	

[c] *Costs are site-specific.*

[d] *Jurisdictions include general purpose units of government—Cities, Towns, and Villages—and special purpose units of government such as School Districts, Sanitary and Utility Districts, and Agricultural Drainage Districts.*

[e] *Costs to be determined. Partially covered under ongoing programs.*

[f] *Costs are site-specific, and survey is needed for countywide estimate.*

[g] *Costs covered under ongoing activity.*

[h] *Portion of costs included in ongoing program and construction project implementation programs. Additional cost of all of the hazard mitigation and public informational and educational programs is estimated to be $21,800 per year.*

Source: Ozaukee County Division of Emergency Management and SEWRPC

5.6 HAZARD MITIGATION PLAN COMPONENT FOR EXTREME TEMPERATURES

As described in Chapter 3, extreme temperatures are natural hazard events of moderate concern to be considered in the Ozaukee County hazard mitigation plan. Extreme temperatures can cause disruption of normal activities for the population and even the loss of life, particularly among more vulnerable populations. This section describes alternative and selected priority strategies to mitigate this type of hazard. As part of the updating process, these strategies were reviewed and reevaluated by the Ozaukee County Hazard Mitigation Plan LPT in light of the updated hazard conditions and hazard mitigation goals documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

Extreme temperature events pose a serious threat to Ozaukee County and should be expected with each summer and winter season. Extreme heat is the deadliest type of severe weather in Wisconsin.[219] Extreme heat and cold events do not typically occur suddenly and are generally connected to a weather system that can be forecast days in advance, making this a hazard for which plans to mitigate injury, loss of life, and property damage can be activated with sufficient advanced warning. When extreme temperature events do occur, they commonly last for extended periods of time (several days to as much as a week) and impact areas larger than Ozaukee County.

Temperature extremes are difficult for a community to mitigate and cause risks to the health and safety of citizens, animals, and the viability of crops. While it may not be possible to accurately identify specific areas where there is significant risk from extreme temperature, extreme heat will have the greatest impact in the most urbanized areas of the County, where larger amounts of paved areas can cause an urban heat island effect, enhancing the existing hot air mass. Demographically, the elderly, debilitated, mentally ill, poor, and homeless are most vulnerable to both excessive heat and cold. Fatalities are often related to age because excessive heat is stressful to the human body and can overwhelm those who are weakened because of age or illness. Measures can be taken to reduce the potential injuries and fatalities caused by temperature extremes wherever they may occur in the County. Based upon review by the Ozaukee County Hazard Mitigation LPT as part of the updating process, the following measures to reduce the vulnerability to extreme temperature events have been identified as viable for this update of the Ozaukee County hazard mitigation plan.

Nonstructural

- Organize neighborhood outreach groups who look after vulnerable individuals and populations
- Continue to provide special arrangements for payment of heating and cooling bills for customers unable to pay due to financial restraints
- Designate sites to be used as public cooling/warming shelters during extreme temperature events. In addition:
    - Conduct an inventory and inspection of these facilities to ensure their quality, quantity, and accessibility for use as heating and/or cooling shelters
    - Extend hours at these sites during extreme temperature events
    - Promote transportation options to assist members of highly vulnerable populations to reach these sites during extreme temperature events
- Reschedule public events to avoid large outdoor gatherings during periods of extreme heat or cold
- Extend public swimming pool hours during extreme heat events

[219] *Wisconsin Department of Emergency Management and Military Affairs,* State of Wisconsin Hazard Mitigation Plan, *December 2016*.

- Establish and promote a donation program of functional window air conditioner units and fans that are no longer in use and distribute these items to vulnerable populations

- Promote and expand winter weather clothing drives (coats, hats, mittens) where people can drop off gently used winter clothing for distribution to vulnerable populations

Structural

- Take measures to reduce heat island effects in urban areas. Examples of such measures include:

    - Increase the amount of green space throughout urban areas

    - Increase tree plantings around buildings, parking lots, and along public right-of-ways to shade surfaces that contribute to heat island formation

    - Encourage the use of "cool roofing" products made of highly reflective and emissive materials

- Maintain warming and cooling public shelter sites

Public Informational and Educational Programming

- Increase public education and awareness of the potential severity and danger of extreme temperature events and distribute emergency preparedness information related to these types of events

- Promote awareness of public cooling/warming shelters that are available during extreme temperature events through municipal, County, and public health department websites, and by sharing with appropriate local media outlets

- Produce and distribute emergency preparedness information related to the safe operation of generators, space heaters, fireplaces, and wood stoves

Current Programs

Federal and State Programs

The NWS issues warnings, watches, and advisory statements to media, emergency management, and public health officials when there is a threat of severe weather conditions. Several categories of warnings, watches, and advisories apply to both extreme heat and extreme cold conditions and associated hazards. The conditions necessary for each of these categories are presented in detail in Chapter 3 of this report. Heat waves cannot be prevented; therefore, it is important to provide notice of adverse conditions so that the public can anticipate and avoid health-threatening situations. Excessive heat alert thresholds specific to major metropolitan centers are determined based on research results that link unusual amounts of heat-related deaths to city-specific meteorological conditions. The heat alert procedures are:

- Include Heat Index values in zone and city forecasts.

- Issue Special Weather Statements and/or Public Information Statements presenting a detailed discussion of 1) the extent of the hazard including Heat Index values, 2) who is most at risk, and 3) safety guidelines for reducing the risk.

- Assist State and local health officials in preparing civil emergency messages in severe heat waves. Meteorological information from Special Weather Statements will be included, as well as medical information, advice, and names and telephone numbers of health officials.

- Release to the media and over the NOAA Weather Radio all of the above information.

State programs include awareness and education efforts. WEM, in conjunction with the National Weather Service and State and local government agencies, provide both preparedness and severe weather information to the citizens of Wisconsin. Preparedness information is provided during three severe weather awareness

campaigns conducted during the year, each focusing on the prevalent weather hazard at that time. The Wisconsin Department of Health Services (WI DHS) has developed an extreme heat tool kit to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to extreme heat events.[220]

WI DHS developed a Building Resilience Against Climate Effects (BRACE) Program. The Program conducted a geo-spatial analysis of heat-related vulnerability in the State. This analysis used existing data related to population density, such as the number of people per square mile; health factors, such as the percentage of the population that visited a hospital emergency department for heat stress; demographic and socioeconomic factors, such as the percentages of young children or persons over 85 years of age and the percentage of households in poverty; and natural and built environment factors, such as surface air temperature during a heat wave, land cover, and air quality; to create a heat vulnerability index (HVI) to identify areas of greatest risk for negative health impacts due to extreme heat. The HVI was calculated for each census block in the County. Based on the HVI, each census block was placed in one of five vulnerability categories based on the level of vulnerability indicated, with each category consisting of 20 percent of the census blocks analyzed. It is important to note that the levels of vulnerability shown by the HVI indicate relative levels of risk and do not indicate absolute risks. The results of the Ozaukee County heat vulnerability index are shown in Figure 3.6.

Additionally, WI DHS has developed a winter weather tool kit to provide information about winter weather, including extreme cold.[221] WEM has produced several educational resources regarding extreme heat and winter weather, such as extreme cold, including prerecorded radio public service announcements, scripts for radio public service announcements, fliers, and educational materials for children.[222] In addition, numerous other organizations, such as the American Red Cross, provide public safety information.

Local Programs

The Ozaukee County DEM participates in the statewide public information campaigns for winter and heat awareness weeks each year and provides links to personal preparedness information on its website. Informational links and resources are available on the Washington-Ozaukee Public Health Department website regarding safety strategies for extreme heat and cold. The Health Department website also includes locations, hours of operation, and other information related to designated cooling and warming shelters within both Ozaukee and Washington Counties.

In conjunction with the County, many of the local units of government have developed emergency operations plans and/or programs which complement the County's Comprehensive Emergency Management Plan (CEMP) which sets forth procedures and actions for extreme temperature events.

Finally, a variety of methods to warn the residents of Ozaukee County of emergency situations, including extreme temperatures, are described in detail in the "multiple hazards" plan component earlier in this Chapter.

Multi-Jurisdictional Considerations

Extreme temperature events are primarily a public health concern for all communities within the County and ultimately prevention should fall to the neighborhood watch groups and local authorities. These events can affect all individuals in the County; however, they are particularly dangerous for the elderly, sick, mentally ill, poor, and homeless who cannot access shelter with adequate heat or air conditioning; or lack access to advisory and educational resources. A coordinated effort involving the Ozaukee County DEM and local community emergency operations programs will be needed to identify and protect individuals vulnerable to temperature-related hazards.

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[220] *Wisconsin Department of Health Services,* Wisconsin Extreme Heat Toolkit, *Publication P00632, March 2014.*

[221] *Wisconsin Department of Health Services,* Wisconsin Winter Weather Toolkit, *Publication P00652, April 2014.*

[222] *These can be accessed at Wisconsin Emergency Management's ReadyWisconsin website located at: ready.wi.gov/Resources/Manager_Resources.asp.*

Evaluation of Alternatives and Identification of Priority Mitigation Measures

The goal of extreme temperature mitigation activities is to reduce injury and the loss of lives due to these events. Based upon review of the above and the risk analysis given in Chapter 3, the ongoing informational and educational programs related to extreme temperatures represent a major component of the planned mitigation action. Ozaukee County should continue to promote basic strategies to reduce injuries and fatalities, hazard awareness, and community involvement. Temperature hazards are experienced by Ozaukee County residents annually and the ability to make positive decisions concerning exposure limits will depend on safety awareness. Analysis of the vulnerability of humans, infrastructure, and economic production caused by extreme temperature events demonstrates that the provision of advanced weather forecasting systems; provision of early warning systems to alert the public of extreme temperature situations; availability of adequate shelter from the heat and cold in public buildings, major industrial sites, and other large businesses or complexes; and public informational and educational programming are the most important mitigation actions to be considered. Ozaukee County supports measures presently implemented by the National Weather Service; national, State, and local health organizations; and the media preceding and during excessively hot and cold weather. It is also important to continue to encourage concern and awareness of neighbors, especially the elderly, debilitated, and mentally ill. Outreach to poor and homeless populations to inform them of the availability and location of warming and cooling shelters within the County is an important component to keeping these vulnerable populations safe. Community and school-based informational programs should continue to be conducted by the County in partnership with Federal, State and local authorities.

Based upon the foregoing evaluation and consideration of risk and consideration by the Ozaukee County Hazard Mitigation LPT (see Appendix A), there are seven actions determined to be priority mitigation measures as part of this hazard mitigation plan update that are specifically related to extreme temperature events.[223] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.8.

5.7 HAZARD MITIGATION PLAN COMPONENT FOR LAKE MICHIGAN COASTAL HAZARDS

As described in Chapter 3, Lake Michigan bluff recession, shoreline erosion, flooding, and shoreline protection structural damage are natural hazard events of high concern to be considered in the Ozaukee County hazard mitigation plan. The Great Lakes shoreline is a high energy environment with storm surge and waves. Beyond the erosive nature of waves, the shoreline is highly vulnerable to erosion largely because the landforms are made up of mixed, unconsolidated glacial till material. Additionally, there has been significant change in the duration of ice cover and rainfall intensity recently making the dynamics of Lake Michigan less predictable. Lake Michigan water levels have increased significantly from near record low levels in 2013 to near record high levels in 2019 as described in Chapters 2 and 3 of this Report. Coastal bluffs erode and fail under normal conditions, however, with human activity and intervention these natural processes often occur at faster rates than anticipated. Planning, preparing for, and adapting to coastal hazards can enhance community resilience to the dynamic coastal conditions and strengthen coastal economies. This section describes alternative and selected priority strategies to mitigate these types of hazards.

As part of the updating process, these strategies were reviewed and reevaluated by the Ozaukee County Hazard Mitigation LPT in light of the updated hazard conditions and hazard mitigation goals documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

As reported in Chapters 2 and 3, a number of studies and planning programs have been carried out related to Lake Michigan coastal erosion and related hazards. A review of those plans and materials under the State of Wisconsin Coastal Management Program (WCMP) indicates a range of alternative shoreline erosion control and flood mitigation measures. Ozaukee County's Lake Michigan shoreline is low-lying along the northern shores of the Towns of Port Washington and Belgium while the southern portion of the County has high coastal bluffs, many of which are unstable. The recent near-record water levels for Lake Michigan have

[223] *Priority mitigation measures that apply to multiple hazard types, including extreme temperature events, are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section in this Chapter.*

Table 5.8
Cost-Benefit Analysis Summary of Measures Included in the Ozaukee County All-Hazards Mitigation Plan: Extreme Temperature Hazards

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Organize neighborhood outreach groups who look after vulnerable populations and promote the availability of shelters during extreme heat and cold	--[c]	--[c]	X			X			X			Ozaukee County and all local jurisdictions[d]
Continue to provide special arrangements for payment of heating and cooling bills for customers unable to pay due to financial restraints	--[c]	--[c]	X			X		X		X		Ozaukee County and all local jurisdictions[d]
Designate sites in the County to be used as public cooling/heating shelters during extreme temperature events	--[e]	--[e]	X			X		X		X		Ozaukee County and all local jurisdictions[d]
Promote measures to reduce heat island effects in urban areas	--[c]	--[c]	X			X				X	X	Ozaukee County and all local jurisdictions[d]
Maintain and update warming and cooling public shelter sites in Ozaukee County	--[e]	--[e]	X			X		X	X	X		Ozaukee County and all local jurisdictions[d]
Increase public education and awareness of the potential severity of temperature extreme events and distribute emergency preparedness information related to extreme temperature events	--[e]	--[e]	X			X						Ozaukee County and all local jurisdictions[d]
Promote awareness of public warming and cooling shelters that are available during extreme temperature events through municipal, County, and public health department websites	--[e]	--[e]	X			X						Ozaukee County and all local jurisdictions[d]

Table continued on next page.

Table 5.8 (Continued)

[a] *All cost expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low	*Moderate*	*High*
Educational and informational programming	*Addition of new staff*	*Major construction*
Ongoing enforcement of ordinances	*Additional staff hours budgeted*	*New buildings (infrastructure)*
Plan Development	*Additional equipment*	*Capital programs*
Continued coordination/mutual aid/interagency agreements	*New ordinance development*	
	New programs/task force	

[c] *Costs to be determined. Partially covered under ongoing programs.*

[d] *Jurisdictions include general purpose units of government—Cities, Towns, and Villages—and special purpose units of government such as School Districts, Sanitary and Utility Districts, and Agricultural Drainage Districts.*

[e] *Costs covered under ongoing activity.*

Source: Ozaukee County Division of Emergency Management and SEWRPC

increased the vulnerability of all of these coastal areas in Ozaukee County. For this plan element, coastal mitigation measures are presented in four main categories:

- Regulations and policy measures
- Bluff top and bluff face mitigation measures
- Near-shore and shoreline mitigation measures
- Informational and educational programming

The following measures to reduce the vulnerability to shoreline erosion and flooding hazards were considered as viable for incorporation into this update of the Ozaukee County hazard mitigation plan.

Regulations and Policy Measures

A fundamental element for coastal communities to consider is the setback requirements from coastal bluffs and shorelines to protect development and redevelopment from potential coastal hazards. A number of States, including Wisconsin, have adopted coastal management regulations and/or policies.[224]

Wisconsin's Shoreland Management Program is a partnership between State and local government that requires the adoption of County shoreland zoning ordinances to regulate development near navigable lakes and streams, in compliance with statewide minimum standards. These minimum statewide standards are set forth in Chapter NR 115, *Wisconsin Administrative Code*.

WCMP developed a model coastal ordinance for construction setback distances above and beyond the setback required by the State's Shoreland Protection Program. Ozaukee County has adopted the WCMP model ordinance, which states all buildings must be set back a minimum of 75 feet from the top of bluff edge or the calculated stable slope angle setback, whichever is greater. The following are current recommendations to consider in regard to coastal development:

- Continue to participate in FEMA's NFIP and RiskMAP floodplain mapping program for updated Lake Michigan coastal V and VE flood hazard zones.
- Develop and enforce consistent County and municipal shoreland regulations and policies (i.e., ordinances) relating to setbacks for new development or redevelopment and structural shoreline erosion protection, bluff stabilization, and coastal erosion ravine measures.
- Continue working with Wisconsin Coastal Management Program (WCMP) and University of Wisconsin-Sea Grant Institute to review, and re-examine as necessary, the County's current zoning ordinances, regulations, and comprehensive plans to identify opportunities to better address coastal hazards.
- Ozaukee County and its coastal communities should continue to participate in the Southeast Wisconsin Coastal Resilience Project's semi-annual "Community of Practice" meetings. The Community of Practice is designed to be a network of local and state officials and coastal experts to demonstrate coastal resilience resources, discuss ongoing hazard issues, initiate inter-community collaboration, and develop consistent approaches to address coastal hazards in the Southeastern Wisconsin Region.

Bluff Top and Bluff Face Mitigation Measures

- Develop and encourage bluff top best management practices (BMPs) to be implemented along the entire bluff coastline of Ozaukee County. Implementing these practices is of particular priority in areas where significant bluff crest recession has been observed, both long-term and short-term. As

[224] *Alan R. Lulloff, P.E., CFM, Science Services Program Director - Association of State Floodplain Managers and Philip Keillor, P.E., Coastal Engineer,* Wisconsin Coastal Management Program: Managing Coastal Hazard Risks On Wisconsin's Dynamic Great Lakes Shoreline, *2015*.

discussed in Chapter 3, the largest bluff crest recession distances were observed in the Village of Bayside, City of Mequon, Town of Grafton, and the Town and City of Port Washington. Bluff top and bluff face best management practices include:

- Stormwater management – Stormwater runoff can contribute to bluff destabilization and erosion. Paved surfaces and structures on the top of the bluff can cause sheet and concentrated flows that increase the force of flowing water which causes erosion. It is recommended to have a well-designed and properly constructed drainage system to eliminate stormwater from flowing over the edge and down the face of the bluff.[225] These BMPs include:
  - Positioning stormwater ditches and roof gutters to direct flow away from the bluff
  - Use rain barrels to capture roof runoff
  - Route water into existing stormwater systems that move water away from the coastal bluff
- Groundwater management – Groundwater saturation can weaken the soil matrix, causing landslides or slumps on the bluff face. Where groundwater saturation is known to be weakening bluff soils, it is recommended to investigate the suitability of installing a well-designed, appropriately-located underground drainage system to help dewater the subsurface bluff soils. This system would help reduce groundwater saturation and increase bluff stability.
- Vegetative plantings – Vegetation on coastal bluff slopes can stop surface erosion and may prevent shallow slides. Shallow slides occur frequently along the bluffs of Ozaukee County. Combining a variety of plants and root structures increases the strength and cohesion of soil even during saturated conditions, thus implementing this technique can slow stormwater runoff, reduce erosion, and increase bluff top and face stability. Guidance on selecting suitable plant species for bluff stabilization can be found in "A Property Owner's Guide to Protecting Your Bluff."[226]

- Continue to review and implement findings of up-to-date geotechnical engineering studies that assess the variables (i.e., soil, groundwater conditions, maximum groundwater levels, vegetative cover, surface drainage, bluff height, slope angle, and previous studies) which determine the stable slope angle setback for bluff stability and shoreline recession determinations.

- Bluff slope stability analyses should be based upon the highest groundwater conditions (when the bluff is most likely to fail), and safety factors appropriate for the consequences of failure.[227]

- If determined to be necessary by a licensed engineer, maintain bluff stability by regrading and terracing the angle of the bluff face to create a less steep slope between the top and toe of the bluff. Any bluff regrading project would need to be designed and overseen by a geotechnical engineer trained in slope stabilization and a qualified contractor should be involved throughout the project.[228]

- Consider relocating buildings determined to be at high-risk for sustaining damages from bluff recession and/or failure. Detailed studies by a licensed engineer would be needed to determine if a building should be considered for relocation. This plan element is presented as an option, subject to the preference of the individual property owner.

- In circumstances where buildings cannot be relocated safely or economically, or where bluff recession has progressed to the point where the risk of catastrophic failure of the slope is

[225] *A. Mangham, D. Hart, A. Belche, G. Clark, D. Peroff, J. Noordyk, B. Stitt, and L. Stitt, University of Wisconsin Sea Grant Institute,* Adapting to a Changing Coast*,* Options and Resources for Lake Michigan Property Owners, *August 2017.*

[226] *L. Salus, A. Bechle, J. Noordyk, G. Clark, and D. Carter, University of Wisconsin Sea Grant and Southeastern Wisconsin Regional Planning Commission,* A Property Owners Guide to Protecting Your Bluff, *November 2019 (Draft version).*

[227] *Ibid.*

[228] *Ibid.*

imminent, or where there is an imminent threat of failure within five years, acquisition and demolition of the structures should be considered. This plan element is presented as an option, subject to the preference of the individual property owner.

- Develop and maintain long-term protection measures for critical community, utility, and historical facilities located within the high-risk coastal hazard zone. The critical community facilities located within this zone are presented in Table 3.22 in Chapter 3 of this Report.

- Continue to enforce County setback regulations along coastal ravines.

Near-Shore and Shoreline Protection Measures

- Conduct an updated inventory and assessment of the condition and effectiveness of all shoreline protection structures along the Lake Michigan coast in the County. Structures to include in the inventory and assessment are breakwater walls, jetties, groins, seawalls, and revetments.

- Ensure breakwater walls and piers within and around the Port Washington harbor are properly designed and constructed to withstand gale force winds, the highs and lows of storm seiche events, and intense wave events, especially with high Lake Michigan water levels.

- Construct and maintain shoreline protection structures where public infrastructure is at risk. It should be noted that effective shore protection may also require bluff stabilization measures as discussed above. The following considerations should be evaluated prior to any shore protection project:

    - Structural shore protection measures (i.e. jetties, groins, seawalls, and revetments) should be installed if other less invasive measures are inadequate in reducing shoreline erosion and if it can be shown that such measures will effectively reduce shoreline erosion while not adversely affecting adjacent sections of the Lake Michigan shoreline.

    - Fish and wildlife preservation measures to limit any adverse impacts during construction should be considered and implemented.

    - Assistance from a geotechnical engineer or geologist trained in slope stabilization, an engineer trained in shore protection design, and a qualified marine contractor should be involved throughout the stabilization project.[229]

    - It can often be more economical and effective to plan and implement shoreline protection or bluff stability projects in concert with design and implementation of such measures for neighboring properties.[230]

- The WDNR may allow the placement of temporary emergency material in public waters if the landowner makes a request in writing to protect a structure or infrastructure from an eroding shoreline or bluff. In 2019, the WDNR developed a streamlined temporary erosion control placement authorization process intended for emergency situations for coastal (Great Lakes) shorelines.[231] Once the required form is submitted, work on the project may proceed provided it is designed to meet all the requirements included on the form. With this streamlined process landowners do not need to wait to hear back from the WDNR prior to initiating emergency shoreline protection, and the WDNR will continue to allow the placement of temporary emergency material in public water to protect property during the application process.[232]

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[229] *University of Wisconsin Sea Grant and US Army Corps of Engineers,* Living on the Coast—Protecting Investments in Shore Property on the Great Lakes, *2003*.

[230] *Ibid*.

[231] *Temporary emergency material WDNR form 3500-127 can be downloaded at dnr.wi.gov/files/PDF/forms/3500/3500-127.pdf.*

[232] *Details and requirements of this program can be found at dnr.wi.gov/topic/waterways/shoreline/GreatLakesErosionControl.html.*

- The coastal one-percent-annual-probability floodplain has been mapped for all of Wisconsin's coastal counties. This information is included in FEMA's National Flood Hazard Layer (NFHL), which was used by SEWRPC to conduct the GIS parcel-based analysis for the flood risk assessment presented earlier in this Chapter. That analysis found that up to 120 structures were estimated to potentially be within the coastal one-percent-annual-probability flood hazard area. Considering the recent near record water levels for Lake Michigan, these structures may now be at an even higher risk. As indicated in the recommendations made earlier in this Chapter, these coastal flood risk structures should be considered for acquisition and demolition. This plan element is presented as an option, subject to the preference of the individual property owner. Furthermore, field surveys should be made for these structures in order to obtain a more definitive assessment of their flood hazard status. The estimated cost of implementing this recommendation of the floodplain management element related to potential Lake Michigan flooding would be nearly $73 million (2018 dollars). This cost is already included in the floodplain management element costs presented earlier in this Chapter.

- This plan encourages landowners to consider, to the degree practicable, nature-based shoreline protection measures, such as living revetments or seawalls, native plantings, dune and coastal wetland restoration, and beach replenishment. Traditional "hard" shoreline protection structures (i.e., jetties, groins, breakwaters, seawalls, and levees) intervene with the natural processes of coastal systems and can sometimes cause unintended consequences to other locations along the shore. Nature-based protection measures are intended to be less intrusive to natural coastal processes.

Public Informational and Educational Programming

- Coastal hazard information should be readily available to the public. Coastal erosion hazard assessments and associated erosion hazard maps have been developed for Lake Michigan's coast.[233] It is recommended, as a part of this plan update, to inform and encourage Ozaukee County coastal communities and landowners to use the Wisconsin Shoreline Inventory and Oblique Photo viewer mapping tool to better understand long- and short-term shoreline processes and the natural or man-made impacts on individual properties.

- Work with WCMP to develop, refine, and distribute guidance and education to local decision makers, developers, consultants, and homeowners related to coastal hazards.

- Work with WCMP to continue to conduct public outreach and to provide technical assistance to decision-makers and landowners regarding best management practices to prevent shoreline erosion and bluff recession, including shoreline protection structures, planting proper vegetation, and stormwater/groundwater drainage practices.

- Provide information on shoreland erosion related hazards to serve as a "fair warning" guide for groups such as realtor-brokers, shoreline property owners, developers, lending institutions, and prospective buyers.

- Promote the awareness of flood insurance to residents along the County's low-lying coast in the Towns of Port Washington and Belgium.

Current Programs

Federal Programs

The USACE exercises some control over lake levels through the use of water controls, such as locks and dams between the Great Lakes. However, these impacts are minimal compared to the lake level impacts due to climatic influence. The USACE provides current, past, and forecasted average daily and monthly mean water levels for the Great Lakes. On January 13, 2020, Ozaukee County's DEM hosted an informational and educational meeting with members of the USACE to discuss programs available for Wisconsin communities in regard to the recent impacts of record high Lake Michigan levels as well as high water levels for inland

[233] *Wisconsin Coastal Management Program*, Managing Coastal Hazard Risk on Wisconsin's Dynamic Great Lakes Shoreline*, Alan R. Lulloff, P.E., CFM, Science Services Program Director - Association of State Floodplain Managers and Philip Keillor, P.E., Coastal Engineer, 2011, updated in 2015.*

waterbodies. Participation was beneficial to local officials and planners for preventative measures related to high water level events including coastal flooding and ice jams. The USACE can provide technical, direct, and advanced measures assistance. In addition, the USACE Report entitled, "Living on the Coast" provides informational and educational guidance for local officials and coastal property owners.[234]

As described in Chapter 2 of this Report, FEMA's Great Lakes Coastal Flood Study (GLCFS) is a comprehensive storm and wind study of the Great Lakes basin for updating coastal flood hazard information and DFIRMs for Great Lakes coastal communities, including Ozaukee County. These flood maps and related information will be tools that can help communities identify high-risk areas and guide land use planning and capital investments to mitigate future losses. During the draft phase of this Report, the floodplain mapping of these V and VE flood hazard locations, through FEMA's RiskMAP mapping program, was near completion and should be finalized during the life cycle of this plan update.

The FEMA Community Rating System (CRS) rewards communities that are doing more than meeting the minimum requirements of the National Flood Insurance Program (NFIP) to help citizens prevent or reduce flood losses. Ozaukee County communities, including the Towns of Belgium and Port Washington that prohibit hard shoreline protection structures, can receive points under the CRS program.[235]

In cooperation with the University of Wisconsin-Madison's Sea Grant Institute, Department of Civil and Environmental Engineering, Land Information and Computer Graphics Facility, the WDNR, several private consultants and agencies from the State of Michigan, the USACE organized the Lake Michigan Potential Damages Study (LMPDS). The objective of this research project, which took place between 1996 and 2000, was to create a modeling procedure and engineering-management tool for predicting future shoreline retreat and estimating economic effects of lake level changes and related social, environmental and cultural impacts.[236]

State Programs

Wisconsin Emergency Management (WEM) provides coastal hazard mitigation education and information in the state hazard mitigation plan. In addition, WEM administers Federal programs within the State to assist coastal communities and local governments in preventing coastal hazards which include the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Hazard Mitigation (PDM) program, and the more recent Building Resilient Infrastructure and Communities ("BRIC") pre-disaster mitigation program.

The WCMP, which is part of the Wisconsin Department of Administration, Division of Intergovernmental Relations, oversees management of the State's coastal resources and strives to maintain a balance between preservation and economic needs. Established in 1978 under the Federal Coastal Zone Management Act, the WCMP works to preserve, protect, and wisely use the resources of the Lake Michigan and Lake Superior coastline for this and future generations. The WCMP provides guidance and grants to encourage the management and protection of Wisconsin's coastal resources and to increase public access to the Great Lakes. The WCMP has constituted an interagency coastal hazards work group that includes staff from the WDNR, University of Wisconsin-Madison's Sea Grant Institute, the State Cartographer's Office, and the WCMP as a forum to coordinate initiatives related to coastal management in the State. In addition, in 2015, the WCMP updated its Report entitled, "Managing Coastal Hazard Risks on Wisconsin's Dynamic Great Lakes Shoreline" to provide a number of educational and informational resources regarding Wisconsin's coastal environments, regulations, and practices throughout Wisconsin. Furthermore, the WCMP created a web-based tool that allows users to examine oblique photos from the late 1970s and compare them to corresponding photos from 2007 and 2008 to assess changes to the shoreline.[237] GIS layers for shore structures, beach protection, and bluff conditions for each time frame allow for more detailed analysis of shoreline and bluff changes. WCMP is a vital partner and resource for the County and local communities for any coastal related issues and advice related to coastal resilience projects.

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[234] *Ibid.*

[235] *Federal Emergency Management Agency, FEMA,* CRS Credit for Management of Coastal Erosion Hazards*, 2006.*

[236] *ascelibrary.org.*

[237] *The Wisconsin Shoreline Inventory and Oblique Photo Viewer can be accessed at greatlakesresilience.org/maps-tools-data/data/wisconsin-shoreline-inventory-and-oblique-photo-viewer.*

The University of Wisconsin Sea Grant is a statewide program of basic and applied research, education, outreach, and technology transfer dedicated to the stewardship and sustainable use of the Great Lakes. The Sea Grant staff has, over the years, provided substantial support to Ozaukee County in dealing with Lake Michigan shoreline management issues. As described in Chapter 3, the UW-Sea Grant Institute initiated the Integrated Assessment program. This program is a collaborative effort made up of a team of investigators representing a range of disciplines focused on the impacts of changing water levels on coastal bluffs in northern Milwaukee County and southern Ozaukee County. The Integrated Assessment identified, reviewed, and synthesized existing data and reports and developed options through the "Adapting to a Changing Coast" guidebook to help local official's and property owners.

The Southeast Wisconsin Coastal Resilience Project, as described in Chapter 2 of this Report, is a collaborative effort to enhance community capacity in southeastern Wisconsin and to build resilience to coastal hazards. The Coastal Resilience project develops educational and outreach materials for bluff best management practices, bluff slope vegetation practices that can improve bluff stability, nature-based shoreline protection specifically for Great Lakes shorelines, and resilient beach restoration practices that increase resistance to erosion. This project has an online website, which provides an excellent resource for local officials and residents living in coastal communities. The website contains informational and education programs, a blog, and social media outlets with updated news in regard to State and local coastal information.[238]

Local Programs

As stated previously in this Report, all Ozaukee County municipalities have adopted floodplain ordinances under Wisconsin Chapter NR 116 of *Wisconsin Administrative Code* to protect property from flooding hazards in flood-prone areas, including along the Lake Michigan coast. The current County shoreland regulations regarding Lake Michigan setbacks for development and shore protection, which have been incorporated into ordinances for the City of Port Washington and Towns of Belgium, Grafton, and Port Washington, are sound and represent current planning recommendations. The ordinances provide for the use of shoreline protection, bluff stabilization structural measures, and bluff setbacks for development along portions of Lake Michigan shoreline where urban shoreline development exists or is envisioned, and provides for a larger setback for development in areas where structural protection is not envisioned to be used due to limited planned urban development. County regulations also provide for specific procedures for the design and review of shore protection measures. The City of Mequon requires all permanent structures constructed since 1988 to be set back from the top of bluff a distance based on a slope ratio of two feet horizontal distance to every one-foot vertical distance measured from the toe of the bluff at the time of construction. In no case can a building in the City be set back less than 75 feet from the top edge of bluff at the time of construction.[239]

A variety of methods are used to warn people in Ozaukee County of emergency situations, including Lake Michigan coastal hazards. These warning systems are described in the section of this chapter related to multiple hazards types.

Multi-Jurisdictional Considerations

The plan elements for Lake Michigan shoreline erosion and related problems correspond to the Cities of Mequon and Port Washington, the Village of Bayside, and the Towns of Belgium, Grafton, and Port Washington.

Evaluation of Alternatives and Identification of Priority Mitigation Measures

Based upon the foregoing evaluation and consideration of risk, and review by the Ozaukee County Hazard Mitigation LPT (see Appendix A), there are 13 actions determined to be priority mitigation measures as part of this hazard mitigation plan update that are specifically related to Lake Michigan coastal hazard events.[240] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.9.

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[238] *sewicoastalresilience.org/about/project-overview/.*

[239] *Under the City of Mequon's Chapter 58, "Planning and Development Regulations" code of ordinances.*

[240] *Priority mitigation measures that apply to multiple hazard types, including Lake Michigan coastal hazard events, are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section in this Chapter.*

Table 5.9
Cost-Benefit Analysis for Priority Measures Included in the Ozaukee County All-Hazards Mitigation Plan: Lake Michigan Coastal Hazards

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Regulations and Policy Measures												
Continue to participate in FEMA's NFIP and RiskMAP floodplain mapping program for updated Lake Michigan coastal V and VE zones	--[c]	--[c]	X			X	X					Ozaukee County coastal communities
Develop and enforce consistent county and municipal shoreland regulations and policies (i.e., ordinances) relating to setbacks along bluffs and ravines	--[d]	--[d]	X			X	X	X				Ozaukee County coastal communities
Bluff Top and Face Mitigation Measures												
Develop and encourage bluff top and face best management practices	--[d]	--[d]	X			X	X				X	Cities of Mequon and Port Washington, and Towns of Grafton and Port Washington
Continue to implement engineering studies that assess the variables influencing bluff stability and shoreline recession which determine the stable slope angle setback.	--[d]	--[d]		X		X	X					Cities of Mequon and Port Washington, and Towns of Grafton and Port Washington
Consider relocating buildings within high-risk bluff failure areas.	--[c]	--[c]		X		X	X	X	X			Ozaukee County coastal communities
Continue to enforce County coastal ravine setback regulations	--[d]	--[d]	X			X	X					Cities of Mequon and Port Washington, and Towns of Grafton and Port Washington

Table continued on next page.

Table 5.9 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Near Shore/Shoreline Protection Measures												
Conduct an updated assessment of the condition and effectiveness of all shoreline protection structures in the County	--[d]	--[d]	X			X	X	X			X	Ozaukee County coastal communities
Ensure breakwater walls and piers within and around the Port Washington harbor are properly designed and constructed to withstand severe environmental conditions of Lake Michigan	--[e]	--[e]		X		X	X					City of Port Washington
Construct and maintain shoreline protection structures and bluff stabilization measures where public infrastructure is at risk	--[c]	--[c]		X		X	X	X				Ozaukee County coastal communities
Possible acquisition and demolition of up to 120 structures identified as potentially being located in the northern low-lying shores of Lake Michigan's one-percent-annual-probability floodplain[g]	$73 million (2018 dollars)	--[f]			X	X	X					Ozaukee County and the Towns of Belgium and Port Washington
Encourage the practice of non-structural or nature-based shoreline protection measures, such as living revetment or seawalls and artificial beach and beach nourishment.	--[d]	--[d]	X			X	X				X	Ozaukee County coastal communities
Public Informational and Educational Programming												
Work with WCMP to conduct public outreach and to provide technical assistance regarding BMPs to prevent shoreline erosion and bluff recession	--[d]	--[d]	X			X						Ozaukee County and all coastal communities
Promote flood insurance to residents along the County's low-lying coast located in Lake Michigan's flood hazard area	--[d]	--[d]	X			X	X					Ozaukee County and the Towns of Belgium and Port Washington

Table continued on next page.

Table 5.9 (Continued)

[a] *All cost expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low	Moderate	High
Educational and informational programming	Addition of new staff	Major construction
Ongoing enforcement of ordinances	Additional staff hours budgeted	New buildings (infrastructure)
Plan Development	Additional equipment	Capital programs
Continued coordination/mutual aid/interagency agreements	New ordinance development	
	New programs/task force	

[c] *Costs to be determined. Partially covered under ongoing programs.*

[d] *Cost covered under ongoing programs.*

[e] *Project costs*

[f] *Costs to be determined.*

[g] *Acquisition and demolition costs of these structures are included in the parcel-based-analyses conducted by Commission staff when determining potential damages caused from a 100-year probability flood as described in Chapter 3.*

Source: Ozaukee County Division of Emergency Management and SEWRPC

5.8 HAZARD MITIGATION PLAN COMPONENT FOR WINTER STORMS

As described in Chapter 3, winter storms are natural hazard events of moderate concern to be considered in the Ozaukee County hazard mitigation plan. This section describes alternative and selected priority strategies to mitigate this type of hazard. As part of the updating process, these strategies were reviewed and reevaluated by the Ozaukee County Hazard Mitigation Plan LPT in light of the updated hazard conditions and hazard mitigation goals documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

Severe winter weather can include blizzards, freezing rain, sleet, ice, and dangerous combinations of temperatures and wind. Winter storms may last a few hours or days, completely shutting down businesses and government, while isolating residents in their homes.

Impacts of heavy snow and ice accumulations include slippery roads and walkways; collapsed roofs from heavy ice and snow loads; and damaged trees, telephone poles and lines, electrical wires, and communications towers.[241] Additionally, indirect injuries and fatalities can occur frequently from activities associated with winter storms such as heart attacks while shoveling snow, carbon monoxide poisoning, hypothermia, frostbite, automobile accidents, and improper use of space heaters. Severe winter storm fronts can often be tracked, which generally provides ample warning for potentially affected areas to take preventative actions.

While it may not be possible to accurately predict the number or severity of winter storm events, measures can be taken to reduce the potential damage caused by winter storms and their related hazards whenever they may occur in the County. High-wind, freezing rain, sleet, ice, and snow may be associated with a winter storm. In review by the Ozaukee County Hazard Mitigation LPT as part of the updating process, the following measures to reduce vulnerability to these dangers have been identified as viable for the Ozaukee County hazard mitigation plan.

Nonstructural

- Review the energy efficiency and winter readiness of critical facilities and housing in the community
- Continue to work with agencies, such as the American Red Cross to establish a system for short-term sheltering
- Pursue additional funding opportunities to assist with budgeting for overtime hours and extra governmental personnel needed during extreme winter events
- Ensure that the necessary amount of snow removal, anti-icing, and deicing equipment is available and operational

Structural

- Work with utility companies to assess and improve, as needed, electric service systems dependability and/or redundancy and back up
- Maintain and update shelter sites that have back-up emergency power sources
- Promote the installation of backup power systems at homes and businesses
- Continue installing and promote the installation of additional snow fences and planting of windbreaks to protect farm crops and highways

[241] *Wisconsin Department of Emergency Management and Military Affairs,* State of Wisconsin Hazard Mitigation Plan, *December 2016*.

Public Informational and Educational Programming

- Continue to maintain and promote winter hazard awareness, including home and travel safety measures, such as avoiding travel during winter storms; having a shovel, sand, warm clothing, food, and water in the vehicle if travel cannot be avoided; and installing a back-up heating system in at least one room in the home

- Organize neighborhood outreach groups who look after vulnerable or special-needs populations, during and after winter storms

- Promote the availability of low-income energy assistance programs

- Publicize the availability of emergency shelter sites for those in need of temporary shelter during winter storms

Current Programs

Federal and State Programs

The NWS issues warnings, watches, and advisories when there is a threat of severe weather conditions. Several categories of warnings, watches, and advisories apply to winter weather conditions and associated hazards. The NWS Milwaukee/Sullivan office will issue a winter storm warning when one or more of the following weather events are expected to occur over a period of 12 or fewer hours:

- Snowfall greater than six inches

- Sleet accumulations of two or more inches

- Intermittent blowing snow that reduces visibility below one-half mile with winds of 25 to 34 mph or closed roads

- Less than one-quarter inch of freezing rain accompanied by another winter event

The NWS Milwaukee/Sullivan office will issue a winter weather advisory when one or more of the following weather events are expected to occur over 12 or fewer hours:

- Snowfall of three to six inches

- Sleet accumulations of less than two inches

- Intermittent blowing snow that reduces visibility below one-half mile with winds of less than 25 mph

- Less than one-quarter inch of freezing rain accompanied by another winter event

The NWS office will also issue an advisory or warning for blizzard, ice storm, and a lake effect snow events.

The NWS winter bulletins are distributed over a number of telecommunication channels, including the NOAA Weather Radio All Hazard radio network, the NOAA All Hazards Weather Wire, and the State law enforcement TIME system, and through an emergency e-mailing network. In addition, these bulletins are relayed to other local media via the Federal Communication Commission's Emergency Alert System (EAS) which rebroadcast the weather bulletins over public and private television and radio stations.
Federal and State winter storm programs include awareness and education activities. The Department of Homeland Security's *Ready.gov* campaign provides online resources on snowstorms and extreme cold awareness and preparedness.

In November each year, Winter Awareness Week focuses on informing and educating people concerning the hazards presented by severe winter weather and information on preparedness for extreme weather conditions during winter. The Wisconsin Department of Health Services has developed a weather took kit to provide information to local governments, health departments, and citizens in Wisconsin about preparing

for and responding to winter storm events.[242] Similarly, WEM has produced several educational resources regarding winter weather, including prerecorded radio public service announcements, scripts for radio public service announcements, fliers, and educational materials for children.[243]

The Wisconsin Building Code specifies design requirements to minimize vulnerability to winter storms by setting the load capacity of roofs by region based on likely maximum snowfall. The National Weather Service reports that 70 percent of winter storm fatalities occur in automobiles, therefore, listening to weather advisories and avoiding travel during winter storms would help prevent many fatalities.

Local Programs

Winter safety information is prepared and distributed to the media and the public by the Ozaukee County DEM during Winter Awareness Week in November. Preparedness information is also available from display racks in the County courthouse and the Ozaukee County DEM website. In addition, the DEM website contains specific information on winter road conditions in and around Ozaukee County. The Washington-Ozaukee Health Department website also provides residents with numerous links and resources pertaining to extreme temperature safety, preparedness, and education including public shelter locations throughout the two counties.

Community strategies for winter storms in Ozaukee County include snow removal, salting and sanding roads, and installing snow fences along roadways, maintaining the health of urban trees to minimize damage from ice storms, and promoting sound levels of home insulation. During a storm, the public is advised to monitor local radio, television, and NOAA weather alert radios for up-to-date forecasts. As described in Chapter 2, Ozaukee County has developed a comprehensive emergency management plan, which sets forth an all-hazards action plan. The Plan provides for coordination of public safety support agencies such as the American Red Cross and for resource acquisitions during winter emergencies. In addition, many of the local units of government have developed emergency operations plans and/or programs which complement the County plan and which also set forth procedures and actions to deal with a range of situations and events, including winter storm events.

A variety of methods are used to warn people in Ozaukee County of emergency situations, including winter storms. These warning systems are described in the section of this chapter related to multiple types of hazards.

Multi-Jurisdictional Considerations

Winter storms and their related hazards can potentially impact all municipalities within the County. In addition, these severe events can potentially cause multiple damages to a variety of infrastructure including transmission lines, communication lines, and transportation routes due to whiteout conditions, snow accumulations, and ice. Ozaukee County, the local units of government and relevant businesses need to coordinate hazard mitigation activities through local government participation in countywide disaster planning and response mechanisms.

Evaluation of Alternatives and Identification of Priority Mitigation Measures

Analysis of the vulnerability of humans, infrastructure, and economic production to winter storms and related hazard events demonstrates that providing advanced weather forecasts and warning systems, as well as public informational and educational programming, are the most important mitigation actions to be considered. In addition, informing the public of the significance of winter storm watches and warnings so that they take these events seriously and know where to seek shelter in emergency situations, are important, ongoing components to minimizing the risks associated with these natural hazards. Forming a neighborhood outreach program to locate isolated, vulnerable or special-needs populations likely to be affected by winter storms is an important element in ensuring that these vulnerable population groups are protected during these events and assistance is available to those who need help clearing away snow or ice after winter storm events. Community and school based informational programs are currently being conducted by the County in partnership with Federal, State and local authorities.

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[242] *Wisconsin Department of Health Services,* Wisconsin Winter Weather Toolkit, op. cit.

[243] *These can be accessed at Wisconsin Emergency Management's ReadyWisconsin website located at ready.wi.gov/Resources/Manager_Resources.asp.*

Based upon the foregoing evaluation and consideration of risk and consideration by the Ozaukee County Hazard Mitigation LPT (see Appendix A), there are eight actions determined by the Ozaukee County Hazard Mitigation LPT to be priority mitigation measures as part of this hazard mitigation plan update that are specifically related to winter storm events. [244] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.10.

5.9 HAZARD MITIGATION PLAN COMPONENT FOR DROUGHT

As described in Chapter 3, droughts are natural hazard events of moderate concern to be considered in the Ozaukee County hazard mitigation plan. This section describes alternative and selected priority strategies to mitigate this type of hazard. As part of the updating process, these strategies were reviewed and reevaluated by the Ozaukee County Hazard Mitigation Plan LPT in light of the updated hazard conditions and hazard mitigation goals documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

A drought is a prolonged period of unusually constant dry weather that persists long enough to cause deficiencies in water supply (surface or groundwater). When drought events do occur, they often impact a relatively large area. The effects of drought are often grouped as economic, environmental, and social. Over time droughts can severely affect crops, municipal water supplies, recreational resources, human health, and wildlife. If drought conditions extend over a number of years, the direct and indirect impacts can be significant.[245]

Ultimately, drought is about the sufficiency of water, and communities have always depended on water for their economic and physical survival. Stresses on the water resources of Ozaukee County include a growing population, increased competition for available water, loss of groundwater recharge areas due to development, and the potential effects of a changing climate. The majority of Ozaukee County has groundwater as their drinking and irrigation water supply. .

Droughts can have the greatest impact on agricultural producers. Ozaukee County has over 65,000 acres of farmland (as shown on Map 2.2), with 65 percent considered prime agricultural farmland.[246] It should be noted that even droughts of limited duration can significantly reduce crop growth and yields, adversely affecting farm income. More substantial events can decimate croplands and result in total loss, negatively impacting individual producers and the local economy.

Although nothing can prevent a drought, measures can be taken to reduce the potential loss and impacts caused by droughts wherever they may occur in the County. In a review by the Ozaukee County Hazard Mitigation Plan LPT as part of the updating process, the following measures to reduce vulnerability to drought events have been identified as viable for this update of the Ozaukee County hazard mitigation plan.

Nonstructural

- Encourage the development and maintenance of drought emergency plans for local water utilities and local communities. Such plans should include:
    - Development of criteria for triggering drought-related actions
    - Development of agreements for secondary water sources that may be used during drought conditions
    - Specification of water use regulations during drought conditions

[244] *Priority mitigation measures that apply to multiple hazard types, including winter storm events, are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section in this Chapter.*

[245] *FEMA*, Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, January 2013*.

[246] *Detailed information on what defines "prime agricultural farmland" can be found in SEWRPC Community Assistance Report No. 87, 2nd Edition*, A Farmland Preservation Plan for Ozaukee County Wisconsin*, December 2013*.

Table 5.10
Cost-Benefit Analysis for Measures Included in the Ozaukee County All-Hazards Mitigation Plan: Winter Storms

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Review the energy efficiency and winter readiness of critical facilities and housing in the community	--[c]	--[c]	X			X				X		Ozaukee County and all local jurisdictions[d]
Continue to work with American Red Cross to establish a system for short-term sheltering of vulnerable populations	--[c]	--[c]		X		X		X	X	X		Ozaukee County and all local jurisdictions[d] and NGOs
Ensure that the necessary amount of snow removal, anti-icing, and deicing equipment is available and operational	--[c]	--[c]		X		X				X		Ozaukee County and all local jurisdictions[d]
Work with utility companies to assess and improve, as needed, electric service systems dependability	--[e]	--[e]		X		X				X		Ozaukee County and all local jurisdictions[d]
Continue installing and promote the installation of additional snow fences and planting of windbreaks to protect farm crops and highways	--[c]	--[c]	X			X	X	X	X			Ozaukee County and all local jurisdictions[d]
Continue to maintain and promote winter hazard awareness, including home and travel safety measures, such as avoiding travel during winter storms; having a shovel, sand, warm clothing, food, and water, in vehicle if travel cannot be avoided; and installing a back-up heating system in at least one room in the home	--[c]	--[c]	X			X						Ozaukee County

Table continued on next page.

Table 5.10 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Organize neighborhood outreach groups who look after vulnerable, or special-needs populations, during and after winter storms	--[c]	--[c]	X			X				X		Ozaukee County and all local jurisdictions[d]
Publicize the availability of emergency shelter sites for those in need of temporary shelter during winter storms	--[e]	--[e]	X			X				X		Ozaukee County and all local jurisdictions[d]

[a] *All cost expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low	*Moderate*	*High*
Educational and informational programming	*Addition of new staff*	*Major construction*
Ongoing enforcement of ordinances	*Additional staff hours budgeted*	*New buildings (infrastructure)*
Plan Development	*Additional equipment*	*Capital programs*
Continued coordination/mutual aid/interagency agreements	*New ordinance development*	
	New programs/task force	

[c] *Costs are covered under day-to-day operations.*

[d] *Jurisdictions include general purpose units of government—Cities, Towns, and Villages—and special purpose units of government such as School Districts, Sanitary and Utility Districts, and Agricultural Drainage Districts.*

[e] *Costs to be determined. Partially covered under ongoing programs.*

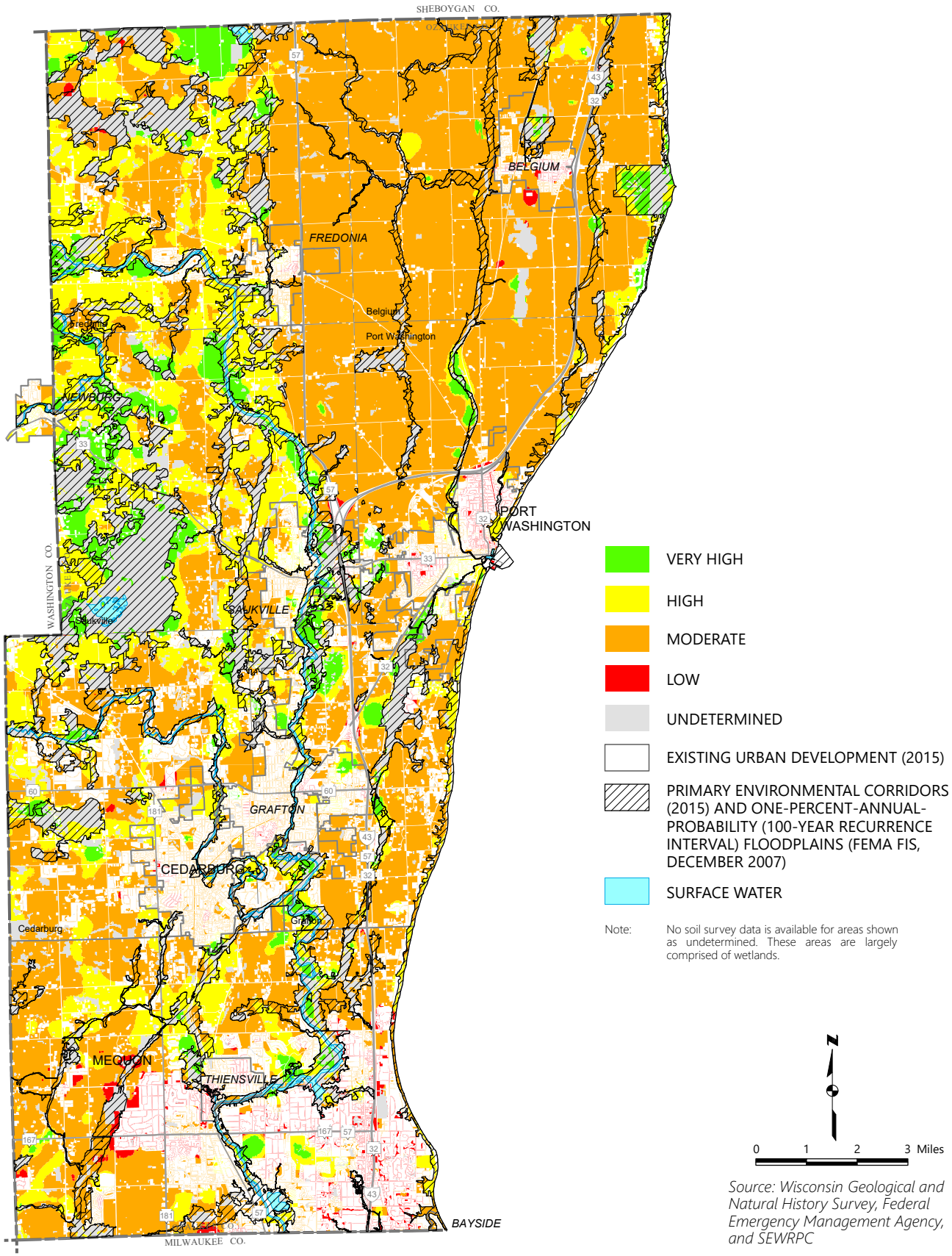
Source: Ozaukee County Division of Emergency Management and SEWRPC

- Encourage the development of local water conservation programs.[247] Such programs may include provisions such as:
    - Water supply system efficiency actions including meter testing, leak detection and repair, water main maintenance and replacement, water system audits, and water production system refinement
    - An irrigation time/scheduling program or process so that all agricultural land gets the required amount of water
    - Public information and education programming, distribution of educational materials, and presentations to schools and civic groups
    - Outdoor watering reduction measures such as the use of rain barrels/cisterns or implementation of lawn and landscape plant watering restrictions when a severe drought is occurring
    - Development and use of water conservation rate structures
    - Fixture and plumbing system retrofits
- Protect areas of high and very high groundwater recharge potential within Ozaukee County (see Map 5.9) from inappropriate development.
- Promote regional activities to protect groundwater recharge areas outside of the County boundaries (these areas were identified during the development of the regional water supply plan).[248]
- Identify areas with potential groundwater level problems and inspect wells in those areas for adequate depth and construction;
- Promote the use of agricultural methods that reduce evaporation and/or promote infiltration. Such methods may include planting windbreaks for farm crops, planting cover crops, use of no-till or reduced-till methods, and contour plowing;
- Allow and encourage the use of drought-resistant landscaping practices using native plantings;
- Promote the use of green infrastructure and other stormwater management practices that facilitate aquifer recharge, such as rain gardens, permeable pavement, and soil amendments;
- Support agricultural programs that promote soil health, monitor and preserve soil moisture, and help to minimize loss of crops and topsoil during drought conditions;
- Maintain and support the University of Wisconsin-Extension Farmer to Farmer Hay, Forage, and Corn List;
- Support ordinances to prioritize or control water use during drought conditions;
- Design and plan for water supply infrastructure systems that are not vulnerable to drought events; and
- Promote enrollment of agricultural producers into Federal crop insurance programs.

[247] *For recommended levels of conservation programs based on forecast conditions in the design year 2035, see Map 126 and Table 189 from SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin*, December 2010.*

[248] *See groundwater recharge protection areas on Map 128 from SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, *December 2010.*

Map 5.9
Groundwater Recharge Potential In Ozaukee County: 2009



Source: Wisconsin Geological and Natural History Survey, Federal Emergency Management Agency, and SEWRPC

Structural

- Consider implementing the recommendations made in the regional water supply plan for additional water supply facilities and programs to meet forecast water use demands[249]

- Where opportunities exist, consider development of interconnections between adjacent water utilities to ensure provision of water in the event of a loss of water supply due to severe drought[250]

- Continue operation and monitoring of stream gaging stations and groundwater monitoring wells by the WDNR, U.S. Geological Survey, National Weather Service, and U.S. Army Corps of Engineers.

Public Informational and Educational Programming

- Increase public education and awareness of the potential severity of drought events

- Produce and distribute emergency preparedness information related to droughts

- Encourage farmers to report crop and/or livestock losses to the appropriate officials, including the Ozaukee County DEM

Current Programs

Federal Programs

Interagency/Collaborative Efforts

The National Oceanic and Atmospheric Administration's (NOAA) National Integrated Drought Information System (NIDIS) Act was signed into law in 2006. This law is a comprehensive interagency program that coordinates and integrates drought research by building upon existing federal, tribal, State, and local partnerships in support of creating a national drought early warning information system. In addition, the NIDIS website[251] serves as the primary drought portal and clearinghouse for drought related resources. The NIDIS website provides regional drought early warning systems (DEWS)[252], links to research and resources for drought planning and preparedness, recovery, education, news about drought, regional webinars and upcoming drought-related events. In addition, the website has a number of maps, tools, social media updates, and data related to drought at both the national and regional scale.

The National Drought Resilience Partnership (NDRP)

NDRP is a federal partnership comprised of the U.S. Department of Agriculture (USDA), the U.S. Department of Energy (U.S. DOE), the U.S. Department of the Interior (U.S. DOI); and federal sub-agencies including NOAA, National Weather Service (NWS), NIDIS, U.S. Geological Survey (USGS), National Aeronautics and Space Administration (NASA), the Assistant Secretary of the Army for Civil Works, FEMA, and the U.S Environmental Protection Agency (EPA). The NDRP leverages technical and financial Federal resources, strengthens communication, and supports State, tribal, and local efforts to build, protect, and sustain long-term drought resilience capacity at regional and basin-level scales. The NDRP responsibilities include:

- Strengthening coordination of federal drought policies and programs in support of State, tribal, and community efforts

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[249] *See recommendations for Ozaukee County in Table 194 from SEWRPC Planning Report No. 52, A Regional Water Supply Plan for Southeastern Wisconsin, December 2010. These recommendations were made for water utilities to meet a "reliable capacity" based on forecast water use demands in the design year 2035.*

[250] *Any such interconnections would require the establishment of necessary agreements and approvals for activation and would need to consider and address issues related to equipment, pumping rates, and demand on water sources. In addition, some interconnections could be prohibited or subject to approvals pursuant to the Great Lakes-St. Lawrence River Basin Water Resources Compact.*

[251] *The NIDIS website can be found at www.drought.gov.*

[252] *The Drought Early Warning System (DEWS) utilizes new and existing networks of federal, tribal, State, local, and academic partners to make climate and drought science accessible and useful for decision makers. It also aims to improve the capacity of stakeholders to monitor, forecast, plan for, and cope with the impacts of drought.*

- Serving as a single federal point of contact on drought resilience

- Leveraging the work of existing federal investments such as the NIDIS, the development of a National Soil Moisture Network, and the Bureau of Reclamation-Natural Resource Conservation Service partnership to improve agricultural water use efficiencies

- Linking information such as monitoring, forecasts, outlooks, and early warnings with long-term drought resilience strategies in critical sectors such as agriculture, municipal water systems, energy, recreation, and manufacturing

University of Nebraska-Lincoln National Drought Mitigation Center

The National Drought Mitigation Center (NDMC), based at the University of Nebraska-Lincoln, helps people, organizations, and institutions build resilience to drought through monitoring and planning. The NDMC serves as the academic partner and web host of the U.S. Drought Monitor map. NDMC's capabilities include climatology, social science, and public engagement. NDMC's services are directed to State, Federal, regional, tribal, and local governments as well as individual ranchers and farmers involved in drought and water supply planning, mitigation, and policy making. NDMC's website offers abundant information on drought research, education, planning, and monitoring.

The U.S. Drought Monitor (USDM)

USDM produces a weekly map product that provides a general summary of current drought conditions. The USDM is a partnership between the NDMC, USDA, and NOAA. Multiple drought indicators are reviewed and synthesized for this weekly product including various indices, outlooks, field reports, and news accounts. In addition, numerous experts from agencies and offices across the country are consulted. The drought monitor map uses five drought classifications (D0, D1, D2, D3, and D4) that are described in Chapter 3 of this Report.[253]

U.S. Geological Survey (USGS)

The USGS monitors, assesses, researches, and presents information on a wide range of water resource conditions including streamflow, groundwater, water quality, and water use and availability. Natural interactions of the hydrologic system, both in surface and groundwater, enables resource managers and policy-makers to better prepare for and respond to drought. The USGS National Water Information System (NWIS) is a comprehensive system that supports long-term storage of water data including surface water and ground water level information. The USGS website provides water quality and water level data through a number of interactive map programs, including USGS "Drought Watch", "Water Watch", and "Groundwater Watch." In addition, the website offers a number of additional drought-related resources and links available for public information and education.

The continuous monitoring of hydrologic conditions is important to identify and assess drought conditions. The USGS operates one observation well in the northeast portion of the Town of Fredonia to monitor groundwater levels. In addition, USGS operates a stream gaging program with local cooperators throughout the State, including monitoring locations in Ozaukee County on Cedar Creek, the Little Menomonee River, and the Milwaukee River near Cedarburg.

USGS Groundwater and Streamflow Information Program: 2018

The USGS Groundwater and Streamflow Information Program (GWSIP) serves as the national source of impartial, timely, rigorous, and relevant data for short- and long-term water decisions by stakeholders across the United States. In 2018, the USGS began piloting the Nation's next-generation integrated water observing system that provides high-fidelity, real-time data on water quantity and quality.

The United States Department of Agriculture (USDA)

The USDA Farm Service Agency (USDA-FSA) provides information about conservation, commodity programs, crop insurance, and farm loans, along with State and county contacts. It also administers several programs which can provide emergency assistance to agricultural producers in the event of natural disasters such as

[253] *www.droughtmonitor.unl.edu.*

drought. These programs include the Emergency Conservation Program, the Emergency Forest Restoration Program, the Emergency Loan Program, the Livestock Forage Disaster Program, the Noninsured Crop Disaster Assistance Program and the Tree Assistance Program. The FSA's electronic Hay and Grazing Net Ad Service (eHayNet) is an internet-based service allowing farmers and ranchers to share "Need Hay" and "Have Hay" ads online. Recently this service expanded its website to include the option to list a need for grazing acres or to list acres available for grazing.

The Natural Resources Conservation Service (NRCS) provides financial and technical assistance to farmers, ranchers, and other private landowners through its conservation programs. Conservation programs such as the Environmental Quality Incentives Program, Conservation Stewardship Program, Regional Conservation Partnership Program, Agricultural Conservation Easement Program, the Healthy Forests Reserve Program, and the Conservation Technical Assistance Program help alleviate the effects of drought through proper soil, land, and water best management practices.[254] Additionally, the NRCS website provides a number of informational and educational resources related to drought preparedness.

The National Oceanic and Atmospheric Administration (NOAA)

The National Weather Service (NWS), a federal sub-agency under NOAA, provides a number of informational and educational online resources related to drought and drought monitoring, including the NWS Climate Prediction Center, the National Climatic Data Center Drought Monitoring, and NOAA's experimental drought monitoring and early warning guidance tool known as Evaporative Demand Drought Index.[255]

Additional Federal Programs and Mitigation Resources

FEMA provides drought mitigation assistance through its Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) planning program as well as drought-related informational and educational resources and links available on the FEMA website. NASA's Gravity Recovery and Climate Experiment (GRACE) satellite integrates groundwater and soil moisture storage observations with modeling to generate drought indicators based on cumulative distribution of wetness conditions.[256] In 2013, the American Planning Association (APA), in collaboration with NDMC and NIDIS, published a guide to help decision-makers, resource managers, public agencies, land owners, local officials, and policy-makers assist communities for drought preparedness and mitigation.[257]

State Programs

The Wisconsin Geological and Natural History Survey (WGNHS), in collaboration with USGS, and WDNR, provide interactive online maps of statewide monitoring wells that include groundwater elevation and conditions.

Farmers in the County that irrigate can also use the Wisconsin Irrigation Scheduling Program (WISP). This research-based computer program provided by the University of Wisconsin-Extension can assist growers in determining frequency and amounts of irrigation throughout the growing season. Irrigation scheduling provided by this program may be especially helpful during a drought.

The Farmer to Farmer Hay, Forage and Corn List sponsored by the University of Wisconsin-Extension puts Wisconsin farmers in touch with one another for the purpose of buying and/or selling corn and forage. The farmer to farmer list is free of charge to both buyers and sellers.

The Wisconsin Department of Health Services has developed a drought tool kit to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to

[254] *Detailed information related to NRCS financial and technical assistance programs can be found at www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/*

[255] *Evaporation Demand Drought Index (EDDI) can offer early warning of agricultural drought, hydrologic drought, and fire-weather risk by providing near-real-time information. EDDI can capture signals of water stress at weekly to monthly timescales, which makes it a strong tool for drought preparedness.*

[256] *Drought.gov.*

[257] *James C. Schwab, American Planning Association-Planning Advisory Service Report No. 574,* "Planning and Drought"*, October, 2013.*

drought events.[258] Similarly, Ready Wisconsin Drought provides drought-related information and resources to assist individuals and communities prior to and during a drought.[259]

Chapter NR 852, "Water Conservation and Water Use Efficiency," of the *Wisconsin Administrative Code* establishes mandatory water conservation and efficiency measures for withdrawals in the Great Lakes Basin and water loss approvals throughout the State. The requirements set forth in this chapter apply to all people within the Great Lakes Basin applying for a diversion or a new or increased withdrawal averaging 100,000 gallons per day (gpd) or more and all people within the State applying for withdrawals that will result in a water loss averaging more than 2,000,000 gpd. The chapter establishes three tiers of requirements based upon the size of the withdrawal and the amount of water not returned to the basin from which it is withdrawn as a result of a diversion or consumptive use. The chapter requires that people applying for a new or increased withdrawal, diversion, or water loss approval submit a water conservation plan meeting specific requirement with their application. In addition, written documentation must accompany the application showing that water conservation and efficiency measures (CEM) that do not require retrofitting have been implemented or completed. The specific CEMs required vary according to the water use sector and tier to which the application is assigned.

Local Programs

As described in Chapter 2, Ozaukee County has developed a comprehensive emergency management plan that sets forth an all-hazards action plan. In addition, many of the local units of government have developed emergency operations plans and/or programs in accordance with the County plan and with additional procedures and actions to deal with a range of situations and events, including instances of drought. Many Ozaukee County municipalities have adopted water usage regulations during drought conditions, but in general, mitigation strategies for periods of drought include preparing informational releases and plans for farmers and homeowners that can be used if needed during drought conditions. Ozaukee County farmers can contact the Ozaukee County University of Wisconsin-Extension Office and the USDA's Farm Service Agency for information and guidance related to drought.

Multi-Jurisdictional Considerations

Droughts and their related hazards can potentially impact all municipalities within the County, however, those communities that depend on groundwater as a source of water supply and agricultural areas experience the most severe impacts from drought events. Ozaukee County, the local units of government, and relevant businesses and agricultural producers need to coordinate hazard mitigation activities through local government participation in countywide disaster planning and response mechanisms.

Evaluation of Alternatives and Identification of Priority Mitigation Measures

Drought can have economic, environmental, and social impacts. These events can impact agriculture by reducing crop yields or destroying crops. Drought can also reduce local water supplies. Mitigation of the potential impacts of drought should be addressed through a multi-faceted approach. Important elements of such an approach include developing plans for responding to drought conditions for local communities and utilities; protecting local water supply sources; water conservation efforts, both in municipal and agricultural settings; and encouraging agricultural producers to take advantage of Federal crop insurance programs.

Based upon the foregoing evaluation and consideration of risk and consideration by the Ozaukee County Hazard Mitigation LPT (see Appendix A), there are 11 actions determined to be priority mitigation measures for this hazard mitigation plan update that are specifically related to drought events.[260] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.11.

[258] *Wisconsin Department of Health Services,* Wisconsin Drought Toolkit, *Publication P00884, revised May, 2019.*

[259] *Ready.gov/wisconsin.*

[260] *Priority mitigation measures that apply to multiple hazard types including drought events, are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section in this Chapter.*

Table 5.11
Cost-Benefit Analysis for Priority Measures Included in the Ozaukee County All-Hazards Mitigation Plan: Drought Hazards

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Encourage the development and maintenance of drought emergency plans for local utilities and local communities	--[c]	--[c]	X			X						Ozaukee County and all local jurisdictions[d]
Encourage the development of local water conservation programs	--[e]	--[e]	X			X						Cities of: Cedarburg, Port Washington and Mequon; Villages of: Belgium, Fredonia, Grafton, and Saukville
Protect areas of high and very high groundwater recharge potential from inappropriate development (see Map 5.9)	--[f]	--[f]	X			X	X				X	Ozaukee County and all local jurisdictions[d]
Promote regional activities to protect groundwater recharge areas outside of the County boundaries	--[g]	--[g]	X			X					X	Ozaukee County and all local jurisdictions[d]
Identify areas with potential groundwater level problems and inspect wells in those areas for adequate depth and construction	--[f]	--[f]		X		X	X				X	Ozaukee County and all local jurisdictions[d]
Support agricultural programs that promote soil health, preserve soil moisture, and help to minimize loss of crops and topsoil during drought conditions	--[c]	--[c]	X			X	X				X	Cities of: Cedarburg Mequon Port Washington; Villages of: Belgium, Fredonia, Grafton, Newburg, and Saukville; Towns of: Belgium, Cedarburg, Fredonia, Grafton, Port Washington, and Saukville

Table continued on next page.

Table 5.11 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Support ordinances to prioritize or control water use during drought conditions	--[c]	--[c]	X			X				X	X	Ozaukee County and all local jurisdictions[d]
Design and plan for water supply infrastructure systems that are not vulnerable to drought events	--[h]	--[h]		X		X	X			X		Ozaukee County and all local jurisdictions[d]
Promote enrollment of agricultural producers into Federal crop insurance programs	--[f]	--[f]	X			X	X					Ozaukee County; Cities of: Cedarburg Mequon Port Washington; Villages of: Belgium, Fredonia, Grafton, Newburg, and Saukville; Towns of: Belgium, Cedarburg, Fredonia, Grafton, Port Washington, and Saukville
Continue operation and monitoring of stream gaging stations and groundwater monitoring wells by the WDNR, USGS, National Weather Service, and U.S. Army Corps of Engineers	--[c]	--[c]	X			X					X	Ozaukee County
Increase public education and awareness of the potential severity of drought events; Produce and distribute emergency preparedness information related to droughts	--[c]	--[c]	X			X	X	X	X	X	X	Ozaukee County and all local jurisdictions[d]

Table continued on next page.

Table 5.11 (Continued)

[a] *All cost expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low	Moderate	High
Educational and informational programming	*Addition of new staff*	*Major construction*
Ongoing enforcement of ordinances	*Additional staff hours budgeted*	*New buildings (infrastructure)*
Plan Development	*Additional equipment*	*Capital programs*
Continued coordination/mutual aid/interagency agreements	*New ordinance development*	
	New programs/task force	

[c] *Costs covered under ongoing activity.*

[d] *Jurisdictions include general purpose units of government—Cities, Towns, and Villages—and special purpose units of government such as School Districts, Sanitary and Utility Districts, and Agricultural Drainage Districts.*

[f] *Costs are site-specific.*

[e] *Costs to be determined.*

[g] *Costs to be determined based on amount of funding allocated for program.*

[h] *Costs are site-specific. Partially covered under ongoing programs.*

[i] *Costs based from SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, *December 2010.*

Source: Ozaukee County Division of Emergency Management and SEWRPC

5.10 HAZARD MITIGATION PLAN COMPONENT FOR UTILITY FAILURE

As described in Chapter 3, utility failure is of moderate concern to be considered in this update of the Ozaukee County hazard mitigation plan. The vast majority of the public is dependent on public and private utility infrastructure to provide services such as electricity, fuel (i.e., natural gas), water, and wastewater services. The disruption or loss of one or more of these utility systems could have impacts ranging from inconvenience, economic disruptions, to threats to safety and human life. The goal of utility failure mitigation activities is to reduce the potential for the above impacts in a cost-effective manner.

This section describes alternative and selected priority strategies to mitigate these types of hazards. As part of the updating process, these strategies were reviewed and reevaluated by the Ozaukee County Hazard Mitigation LPT in light of the updated hazard conditions and hazard mitigation goals documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies for Contamination or Loss of Water Supply

Ozaukee County is richly supplied with surface and groundwater resources as discussed in Chapter 3. However, these sources are not unlimited, and both surface and groundwater resources are subject to contamination, as well as depletion of supply. Groundwater is a major source of water for domestic, municipal, and industrial water uses in Ozaukee County. As indicated in Table 2.15 and Map 2.15, almost 85 percent of the water served by public water utilities in Ozaukee County use groundwater as the primary source of drinking water. Like surface water, groundwater is susceptible to depletion in quantity and to deterioration in quality from both naturally occurring and man-made contaminants.

Water utility systems are among the most important infrastructure facilities in Ozaukee County. Such systems directly affect the health and welfare of the resident and transient populations of the County and are vital to the commercial and industrial activities. When contamination and/or loss of water supply events occur, they may last for extended periods of time (weeks or months), and likely would impact a specific water source, such as Lake Michigan, a particular public or private well, or malfunction of a specific water utility. In some cases, industries may be particularly vulnerable to loss of water supply due to equipment and process needs. Water supply is also a necessity for municipal and volunteer fire suppression.

Based upon review by the Ozaukee County Hazard Mitigation LPT, the following measures to reduce vulnerability to contamination or loss of water supply have been identified as viable for this update of the Ozaukee County hazard mitigation plan.

Nonstructural

- Continue to monitor water supply capacity and plan for future water supply demand for each public water utility by considering implementation of recommendations made in the regional water supply plan for additional or alternative drinking water sources (i.e., groundwater to surface water supply), and for additional water supply facilities and programs needed to meet future water use demands projected for Ozaukee County[261]

- Promote development of a thorough drinking water supply risk and threat assessment that identifies potential vulnerabilities and targets for sabotage and terrorism attack

- Maintain and/or develop an emergency operation plan for each public water supply system in order to specify procedures for mechanical failures, power outages, unsafe samples, and threats of acts of terrorism

- Promote measures to protect groundwater recharge areas including areas outside of the County boundaries and incorporate a groundwater protection element in future land use planning activities and incorporate a groundwater protection element in future land use planning activities

[261] *See groundwater recharge protection areas for the Region on Map 128 from SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, *December 2010.*

- Promote land development site design and stormwater management practices that are designed to maintain the natural hydrology and facilitate recharge of aquifers while minimizing pollutant loads that could contaminate groundwater[262]

- Utilize advanced technology and available data to identify important groundwater management areas and continue to develop and implement wellhead protection plans and establish setbacks from wellhead locations

- Reduce the potential for groundwater contamination from agricultural fertilizers, chemicals, and manure with emphasis on groundwater related water quality management areas

- Promote proper location, installation, cleaning, monitoring, and maintenance of holding tanks, septic systems and other private onsite sewage disposal systems and identify failing onsite sewage disposal systems and leaking or failed sewer laterals for remediation

- Encourage private and public utilities to identify priority water customers and develop a plan for restoring their service first

- Encourage local communities and residents to develop emergency drinking water supply plans and identify potential distribution points for emergency water supply

- Ensure that utility personal are trained to shut down and start up utility systems manually

- Encourage regular testing of private and public wells for nitrate, bacteria, viruses and other pathogens, pesticides, arsenic, lead, radionuclides, and volatile organic chemicals (VOCs)

Structural

- Where opportunities exist, develop interconnections between adjacent water utilities to ensure provision of water in the event of an emergency such as a breakdown of utility equipment, a major fire, or a terrorist attack

- Maintain municipal water and sewer infrastructure at efficient and acceptable operating standards

- Maintain and consider upgrading water disinfection capabilities, including emergency disinfection equipment

- Provide onsite-backup power for wells, treatment plants, and other vital water utility system components

- Locate and properly abandon old and improperly abandoned wells

Public Informational and Educational Programming

- Develop and implement programs to replace publicly owned water service mains, laterals, and other infrastructure that are known to contain lead and promote the replacement of privately owned portions of lead water service lines and lead plumbing fixtures within homes. Encourage local communities to apply for potential funding opportunities to help offset costs for municipalities and private homeowners. Consider programs to offer low interest loan options to homeowners or deferred payment through property taxes for such privately owned lead service line replacements.

[262] *Examples of potential site design and stormwater management practices which could be considered include the use of permeable pavement; set-aside open space; infiltration basis and trenches; landscaping with drought resistant plants; landscape mulch versus turf grass; conservation subdivision design; and the integration of rain gardens, bioswales, and other groundwater recharge features into site design. Care must be taken on a site-specific basis to avoid increased potential for groundwater contamination.*

- Promote the use of water filtration devices on drinking water sources in homes where there are known lead service lines, lead plumbing, or fixtures where replacement of the lead service line or plumbing fixtures are not currently feasible

- Continue and expand public education and outreach efforts regarding the effects of arsenic, lead, nitrate, bacteria, viruses and pathogens, radionuclides, VOCs, and other emerging contaminants of concern found in drinking water

- Expand educational and informational outreach material for private well owners to regularly test and maintain their wells

- Continue educational outreach programs related to backflow prevention

- Train operators and plant personnel in security awareness and reporting protocols

Current Programs for Contamination or Loss of Water Supply

Federal and State Programs

There are various governmental and agency programs to help address and fund surface and groundwater contamination-related issues. Some of these Federal and State programs are described below.

U.S Environmental Protection Agency (EPA)

The EPA has various programs and informational material related to drinking water supply systems for both groundwater and surface water providers.

EPA's Water Infrastructure Improvements for the Nation (WIIN) Act of 2016 addresses, supports, and improves drinking water infrastructure. Included in the WIIN Act of 2016 are three drinking water grant programs that promote public health and protect the environment:

- Assistance for Small and Disadvantaged Communities grant

- Reducing Lead in Drinking Water grant

- Lead Testing in School and Child Care Program Drinking Water grant

The EPA's Water Utility Response On-The-Go phone app, for both Android and Apple cellphone users, consolidates information and tools that water utility operators and response partners may need during an emergency. These resources can help responders increase situational awareness, facilitate coordination, and enhance overall response efforts.

In addition, EPA's Creating Resilient Water Utilities (CRWU) initiative provides drinking water, wastewater and stormwater utilities with practical tools, training and technical assistance needed to increase resilience to extreme weather events. Through a comprehensive planning process, CRWU assists water utilities by promoting a potential long-term adaptation options for decision-making related to water utility infrastructure financing. Furthermore, the EPA recently published a Community-Based Water Resiliency (CBWR) Guide designed to help water utilities and communities prepare for water service interruptions before an emergency occurs by:[263]

- Promoting a better understanding of public-private sector interdependencies

- Fostering a greater understanding of water infrastructure and the potential impacts from a loss of service

- Identifying the actions and resources needed to increase resilience by starting a conversation between water utilities and the community

[263] *www.epa.gov.*

- Assisting stakeholders in building strong response plans for water service interruptions.

In 2018, EPA's America's Water Infrastructure Act (AWIA) was signed into law as an amendment to the Safe Drinking Water Act (SDWA). The AWIA is intended to improve drinking water and water quality, enhance drinking water infrastructure, and enhance public health and quality of life. As part of the AWIA, community drinking water systems serving more than 3,300 people are to develop or update risk assessments and emergency response plans.

Additional EPA grant programs related to public drinking water supply, include:

- The Public Water System Supervision Grant program (PWSS) that helps eligible states develop and implement an adequate PWSS program to enforce the required SDWA regulations and to ensure that water systems comply with National Primary Drinking Water Regulations.

- The Drinking Water State Revolving Fund program (DWSRF) is a federal-state partnership established by the SDWA. The program awards grants to states, which in turn may provide low-cost loans and other types of assistance to eligible public water utilities to assist in infrastructure projects needed to achieve or maintain compliance with SDWA requirements. States are also authorized to set aside a portion of the grant funds for activities including source water protection, capacity development, and operator certification.

- The Water Infrastructure Finance and Innovation Act (WIFIA) provides long-term, low-cost supplemental loans for regionally and nationally significant water and wastewater infrastructure projects. This program is separate, but often coordinated with the DWSRF program.

- The Superfund program was designed to clean up sites such as landfills and warehouses that have been contaminated with hazardous waste sources. The program is intended to prevent risk to human health and/or the environment, including contamination of groundwater and surface water. As indicated in Figure 5.1 there is one Superfund site in Ozaukee County, located in the City of Cedarburg.

It should be noted that the EPA periodically issues memorandums and reports that clarify and update drinking water policies and regulations. These policies and regulations can be found on the EPA website and in the water supply guidance (WSG) manual.[264] The WSG manual is available to State and public water systems to assist with implementation of the SDWA.

Wisconsin Department of Natural Resources

The WDNR establishes surface and groundwater quality standards for the State and coordinates implementation through diverse agencies and programs. WDNR programs that protect and manage water supply sources include: [265]

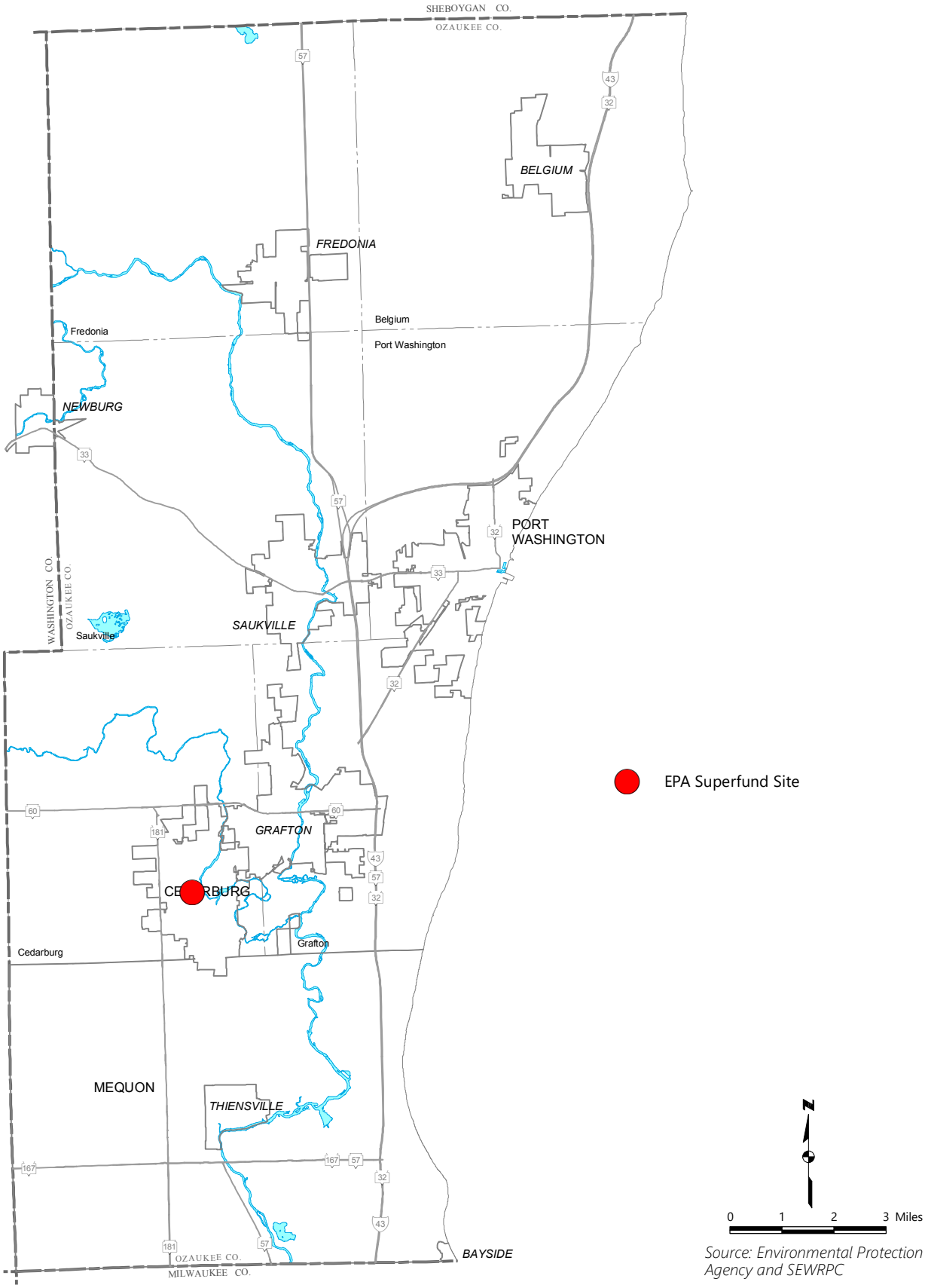
- The Bureau of Drinking Water and Groundwater Program regulates public water systems, private drinking water supply wells, well abandonment, and high capacity wells. This program is responsible for adopting and implementing groundwater quality standards contained in Chapter NR 140, *Wisconsin Administrative Code*, and works closely with other programs and agencies to implement groundwater monitoring and data management. Groundwater quantity provision[266]

[264] *The EPA's water supply guidance manual includes guidance and regulations related to chemical contaminants (i.e., EPA's Arsenic Rule, Chemical Contaminant Rule, Lead and Copper Rule, and Radionuclide Rule), microbial contaminants (i.e., EPA's Groundwater Rule, Surface Water Treatment Rules, Stage 1 and Stage 2 Disinfectants Rules, and Total Coliform Rule), right-to-know rules, and capacity development guidance.*

[265] *Wisconsin Groundwater Coordinating Council*, Report to the Legislature*, FY 2019.*

[266] *The DNR is authorized under Ch. 281, Wis. Stats., to regulate wells, except for residential wells or fire protection wells that have a capacity of more 100,000 gallons per day, also known as high capacity wells. The DNR review of high capacity wells has been evolving over the last decade, with the most recent update in 2017 under Wisconsin Act 10.*

Figure 5.1
Environmental Protection Agency Superfund Priority Site in Ozaukee County: 2020



Source: Environmental Protection Agency and SEWRPC

and the Great Lakes Compact[267] are also implemented by the Drinking Water and Groundwater program. The program also coordinates the State's wellhead protection and drinking water source water protection programs.

  - Wisconsin's Wellhead Protection (WHP) program aims to reduce the risk of groundwater contamination in areas contributing groundwater recharge to public water supply wells. A wellhead protection plan is required for new municipal wells and must be approved by the WDNR before the new well can be used. WDNR continues to report to EPA on the percent of public water systems that are protected by the implementing wellhead protection.

  - The Public Water Supply (PWS) program oversees the drinking water quality provided by public water systems. The PWS program ensures that samples are collected and analyses are completed to determine if drinking water meets federal SDWA standards. The PWS program also regulates the operation of public water systems and the general design and construction of community water systems. Additionally, the PWS program works to educate water system owners and operators on proper maintenance of water systems to ensure safe public drinking water.[268]

- The Remediation and Redevelopment (RR) program oversees response actions at spills, hazardous substance release sites, abandoned containers, drycleaners, brownfields (including the Site Assessment Grant Program), "high priority" leaking underground storage tanks, closed wastewater and solid waste facilities, hazardous waste corrective action and generator closures, and sediment cleanup actions. It has primary responsibility for implementing and aiding cleanups under the Spill Law, the Environmental Repair Law, Federal programs (Superfund, Hazardous Waste Corrective Action, Leaking Underground Storage Tanks (LUST), and Brownfields), the Land Recycling Law and State Brownfield Initiatives, the Drycleaner Environmental Response Fund, and at closed landfills. The RR program provides technical assistance, helps to clarify legal liability, provides financial assistance primarily to local governmental units, and provides technical project oversight of cleanup projects. The program's main database on the status of sites undergoing investigation and/or cleanup is the Bureau of Remediation and Redevelopment Tracking System (BRRTS).

- The Waste and Materials Management (WMM) program regulates and monitors groundwater and proposed, active, and inactive solid waste facilities and landfills. The WMM program reviews investigations of groundwater contamination and implementation of remedial actions at active solid waste facilities and landfills. WMM also maintains a Groundwater and Environmental Monitoring System (GEMS) database of groundwater quality data from over 600 facilities and landfills.

- The Bureau of Water Quality (WQ) is responsible for the statewide implementation of the WDNR groundwater standards. The Bureau regulates the discharge of municipal and industrial wastewater, by-product solids and sludge disposal from wastewater treatment systems and wastewater land treatment/disposal systems. The Bureau also issues permits for discharges associated with clean-up sites regulated for the RR program.

- The Bureau of Watershed Management primarily regulates stormwater and agricultural runoff, as well as managing waste from large animal feeding operations, also known as concentrated animal feeding operations (CAFOs).

- The Well Compensation Grant program provides funding to eligible landowners or renters to replace, reconstruct or treat contaminated private water supplies that serve a residence or provide water to livestock.

[267] *More information on the Great Lakes Compact and Implementation of 2007, Act 227 regarding groundwater quantity and quality can be found in the 2019 Wisconsin Groundwater Coordinating Council Report to the Legislature.*

[268] *Wisconsin Groundwater Coordinating Council*, Report to the Legislature*, FY 2019*.

Additionally, the WDNR periodically submits a list of substances to the Wisconsin Department of Health Services (DHS) and requests that they review available toxicological information and provide recommendations for new and/or revised groundwater standards. A table of the States groundwater standards is provided on the EPA, WDNR, and DHS websites.

Wisconsin Groundwater Coordinating Council (GCC)

The Wisconsin Groundwater Coordinating Council (GCC), directed by the Wisconsin Groundwater Protection Law (*Wisconsin Statute* 160.50)[269] is an interagency collaboration that assists State agencies in the coordinating and exchanging information related to groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities and appropriating and allocating State funds for research. The GCC is made up of State representatives from the WDNR, DHS, Wisconsin Geological and Natural History Survey (WGNHS), the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP), the University of Wisconsin Systems (UW), the Wisconsin Department of Transportation (WisDOT), and the Department of Safety and Professional Services (DSPS).[270]

Local Programs

As part of its water supply planning program, the Southeastern Wisconsin Regional Planning Commission (SEWRPC) identified groundwater recharge areas with high and very high recharge potential and has made recommendations regarding groundwater recharge area protection.[271] The regional water supply plan also identified additional water supply facilities and programs necessary for water utilities to meet a "reliable capacity" based on forecast water use demands in the design year 2035.[272]

The Villages of Belgium and Saukville municipal water supply systems have wellhead protection plans. The Village of Belgium also has a wellhead protection ordinance. While the details of wellhead protection plans differ among municipalities, they typically document some or all of the following:

- Specify minimum separation distances from wells and potential sources of contamination such as sewer mains, septic tanks, and fuel storage tanks
- Define protection zones around municipal wells
- Indicate land uses that are permitted, permitted on a conditional basis, and prohibited within these zones

Section NR 810.15 of the *Wisconsin Administrative Code* requires that the water supplier for every municipal water system develop and implement a comprehensive cross-connection control program. All water utilities within Ozaukee County have developed such programs. While the provisions of these programs differ from

[269] *Wisconsin's groundwater protection law, Chapter 160, Wisconsin Statutes, established the framework for a comprehensive approach to protect public health and welfare and the environment. The intent of this law is to minimize the concentration of polluting substances in groundwater through the use of numerical standards in all groundwater regulatory programs. The law applies to all groundwater in the State and is used by all State agencies in their regulatory programs that may impact groundwater.*

[270] *Wisconsin Groundwater Coordinating Council*, Report to the Legislature*, FY 2019*.

[271] *SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, *December 2010; SEWRPC Technical Report No. 47,* Groundwater Recharge in Southeastern Wisconsin Estimated by a GIS-Based Water _Balance Model, *July 2008*.

[272] *See recommendations for Ozaukee County in Table 194 from SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin*, December 2010. For utilities utilizing groundwater as a source of supply, reliable capacity was defined as adequate capacity to supply the needed maximum daily pumpage with the largest capacity well out of service. For utilities utilizing surface water as a source of supply, reliable capacity was defined as the capacity remaining with the most critical unit of the production process out of service. In the design of the recommended plans, facilities were then added to each water supply system to provide a reliable capacity equal to the anticipated 2035 maximum daily pumpage demand. The resulting systems then have a reliable capacity that provides significant protection for the continuity of supply in the event of loss of functionality of a portion of the utility. The potential new, expanded, or upgraded facilities and programs recommended in the regional water supply plan should be implemented based upon local needs and determinations, and any available updated water use forecasts for a particular facility.*

utility to utility, they may include such measures as initial and periodic inspections of industrial, commercial, and public authority buildings to detect actual and potential cross-connections; requirements that property owners install protective devices, such as backflow preventers, where unprotected cross-connections are detected; annual testing of backflow preventers; and public education measures.

Ozaukee County has adopted an "Animal Waste Storage" ordinance. The purpose of the ordinance is to regulate the construction, location, and use of animal waste storage facilities; regulate the application of animal wastes from the facility in order to prevent water pollution (i.e., pathogens, total coliform, *E. coli*, and/or nitrate saturation and contamination); and protect the health and safety of residents by preventing the spread of disease. These standards are intended to provide effective, practical, and environmentally safe methods of storing and utilizing animal waste.

Ozaukee County municipal water utilities and the Ozaukee-Washington Public Health Department also send out informational brochures and newsletters as well as provide online resources related to drinking water issues and regulations.

Multi-Jurisdictional Considerations for Contamination and Loss of Water Supply

The contamination or loss of water supply can potentially impact all municipalities within the County. Those communities relying on individual private wells are susceptible to certain problems, such as shallow aquifer contamination or drawdown. Communities with public systems are more susceptible problems related to security, facility malfunction, main breaks, and aging infrastructure.

Evaluation of Alternatives and Identification of Priority Mitigation Measures for Contamination and Loss of Water Supply

Based upon review of the above, current ongoing programs represent a major component of the planned water supply mitigation actions with regard to the continued provision of advanced protection and monitoring measures, as well as public informational and educational programming systems. In addition, feasible mitigation actions include development of a thorough water supply risk and threat assessment that identifies potential vulnerabilities; heightening security at water supply and treatment facilities; and development of site emergency plans, including emergency water supply source alternative plans, which may be applicable at the town, city, or village municipality levels. Other potential mitigation actions include increased monitoring measures for pathogens and chemical toxins, as well as management measures to reduce the potential for groundwater contamination from chemicals, livestock, and sewage sources in order to limit possible future injuries and deaths due to contamination or loss of water supply. Aging water supply infrastructure can pose multiple risks including contamination and loss of delivery capacity. Maintenance and updating of water supply infrastructure should continue to be a major component of the planned mitigation measure.

Consideration by the Ozaukee County Hazard Mitigation LPT has indicated there are 16 actions determined to be priority mitigation measures for this hazard mitigation plan update that are specifically related to contamination or loss of water supply.[273] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.12.

Identification of Alternative Mitigation Strategies for Electrical Disruption or Outages

Long-term power outages can occur throughout Ozaukee County. The severity of such events may range from small, relatively localized incidents to major incidents impacting a substantial portion of the County. Some outages may result in serious social and economic disruptions. The Port Washington We Energies generating facility produces most of the electricity that serves the County and beyond. In review by the Ozaukee County Hazard Mitigation LPT as part of the updating process, the following measures to reduce vulnerability to these dangers have been identified as viable for the Ozaukee County hazard mitigation plan.

[273] *Priority mitigation measures that apply to multiple hazard types including contamination and loss of water supply are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section of this Chapter.*

Nonstructural

- Continue to review and implement programs to improve the reliability of the power supply facilities. Such measures may include implementation of maintenance and operational improvements, equipment upgrading, providing redundancy in the supply facilities where appropriate, and in some instances, burying power lines.

- Coordinate activities and communication between the power suppliers and the Ozaukee County Division of Emergency Management to keep County and municipal officials informed of damage prevention practices and response activities during outages;

- Establish and maintain a database of critical facilities, such as community shelters, long-term care facilities, public utilities, and fueling sites, that have, and do not have, backup power generators;

- Encourage businesses to develop a continuity of operations plan and business resumption plan to be put into place during and after a long-term power outage;[274]

- Develop plans for evacuations and shelter operations in the case of a prolonged outage

- Create and maintain an emergency plan that includes backup provisions for special electrical medical equipment, sump pump backup systems, telephone provisions, assembly of an emergency kit, protection of electrical equipment, and installation or provision of power generators where appropriate.

Structural

- Encourage the installation of backup generators at critical facilities, shelters, and public utilities;

- Ensure critical power lines are structurally reinforced to withstand heavy wind or ice accumulation; and

- Trim and maintain the health of trees near vulnerable infrastructure, such as utility lines, essential facilities and roads, right-of-ways, and near homes and businesses. Communities should develop a funding mechanism and strategy for removal of ash trees infested by the emerald ash borer. A well planned response can minimize the impact of infestation, reduce liability, and lessen the overall cost to a community.

Public Informational and Educational Programming

- Conduct outreach to businesses and facilities to encourage them to develop plans for dealing with long-term power outages. Such outreach should also encourage them to be realistic about the amount and types of assistance that they can expect to receive from local government during an outage.

- Continue and refine public informational and educational programming to include information on safety during power outages and preparation for power outages. With regard to safety during outages, We Energies offers the following recommendations:

    - Stay at least 25 feet from downed power lines or flooded areas;

    - Use flashlights rather than candles;

    - Unplug or turn off appliances to avoid overloading when power is restored;

    - Do not use extension cords between homes or across yards or streets;

[274] *A continuity of operations plan focuses on restoring an organization's essential functions at an alternate site and preforming those functions for up to 30 days before returning to normal operations. A business resumption plan addresses the restoration of business processes after an emergency.*

- Do not use outdoor grills, kerosene heaters, or camping stoves or heaters indoors;
- People whose homes are extremely hot or cold should go to a safe shelter;
- Stay clear of electric company vehicles and equipment;
- Have a supply of safe water;
- Keep refrigerated food cold or dispose of it;
- Leave a light on in your home. When crews do neighborhood spot checks, they will know your power is back on if a light is on; and
- Create a family plan on procedures to be used if an outage occurs.

Current Programs for Electrical Disruption or Outages

State Programs

WEM has produced educational resources regarding power outages including prerecorded radio public service announcements and scripts for radio public service announcements.[275] Other informational and educational material related to power outages and mitigative measures are available from organizations such as the American Red Cross.[276]

Local Programs

As previously noted, the causes of power outages are primarily weather related and, to a lesser extent, equipment failure and other factors. The electric power supply companies —in the case of Ozaukee County, We Energies, the City of Cedarburg Light and Water Utility, and the American Transmission Company— have programs in place to improve the reliability of the electric power delivery system. Equipment and facilities where equipment failures have a history of occurrence are given priority. These companies also have operational procedures for resolving outage problems once they occur. The power company procedures are prioritized to first deal with any life-threatening situations, then larger outages, and then smaller secondary lines and neighborhood equipment. In some cases homes, utilities, hospitals, and business owners have installed, or have available, backup power generating sources to be used during power outages that temporarily provide for partial or full power. We Energies has also prepared informational and educational materials related to power outage mitigative measures.

Multi-Jurisdictional Considerations for Electrical Disruption or Outages

All municipalities within Ozaukee County could potentially be impacted by short- and long-term power outages. Ozaukee County, the local units of government, and relevant businesses need to coordinate hazard mitigation activities through local government participation in countywide disaster planning and response mechanisms.

Evaluation of Alternatives and Identification of Priority Mitigation Measures for Electrical Disruption or Outages

Based upon the risk assessment given in Chapter 3 and the discussion given above, three approaches to mitigating the impacts of power outages are considered viable for incorporating into the Ozaukee County hazard mitigation plan. First, efforts should be taken to improve the reliability of the electric power supply system. The responsibility for this lies mainly with the electric utilities. Second, facilities and business should be prepared to deal with power outages. Such preparation involves both planning activities and installing backup power generators at critical facilities. Third, since power outages can pose risks to the safety of people affected, mitigation should include educational programming related to safety during power outages.

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[275] *These can be accessed at Wisconsin Emergency Management's ReadyWisconsin website located at: readywisconsin.wi.gov/resources/media-campaign-information/.*

[276] *American Red Cross,* "Be Red Cross Ready: Power Outage Checklist," *2010.*

Consideration by the Ozaukee County Hazard Mitigation LPT has indicated there are six actions determined to be priority mitigation measures for this hazard mitigation plan update that are specifically related to power outages.[277] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.12.

Identification of Alternative Mitigation Strategies for Sanitary Sewerage System Disruption, Failure, or Loss

Sanitary sewer systems are meant to collect and transport all of the sewage that flows into them to a publicly-owned wastewater treatment plant (WWTP). Sewage conveyance and treatment systems provide important public health and environmental benefits. As discussed in Chapter 2, several Ozaukee County communities are served by sanitary sewerage systems (see Map 2.16). Disruption or failure of these systems could result in sewer overflows and basement backups. Such disruption could threaten public health and could result in damage to the environment. The following measures to reduce vulnerability to the loss of sewerage systems have been identified as viable for the Ozaukee County hazard mitigation plan update.

Nonstructural

- Ensure that utility personnel are trained to shut down and start up utility systems manually
- Promote development of a thorough sewerage system risk and threat assessment that identifies potential vulnerabilities and targets for sabotage and terrorism attack
- Develop an emergency operation plan for each sanitary sewerage system in order to specify procedures for mechanical failures, power outages, and acts of terrorism

Structural

- Maintain municipal sanitary sewer infrastructure at acceptable operating standards
- Floodproof and stormproof the wastewater treatment plant, pumping stations, and other vital system components
- Initiate facility planning for sanitary sewerage systems when average daily flow to the wastewater treatment plant approaches 80 percent of the plant's design capacity[278]
- Provide onsite-backup power for the wastewater treatment plant, pumping stations, and other vital system components
- Evaluate the ability of electrical equipment to accept generators. Repair or upgrade as necessary.

Public Informational and Educational Programming

- Continue and expand public informational and educational programming related to preventing clogging and unnecessary maintenance of sewer laterals and responding to basement backups
- Where appropriate, encourage the installation of residential sewage backflow prevention devices
- Inform the public on optional home insurance policy add-on coverage for sewer backup damages

[277] *Priority mitigation measures that apply to multiple hazard types including power outages are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section of this Chapter.*

[278] *This metric was applied as a guide for when facilities planning should be considered in SEWRPC Planning Report No. 30,* A Regional Water Quality Management Plan for Southeastern Wisconsin*, Volume One,* Inventory Findings*, Volume Two,* Alternative Plans, and *Volume Three*, Recommended Plan*, July 1979 and SEWRPC Planning Report No. 50,* A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds*, December 2007, amended May 2013.*

Current Programs for Sewerage System Disruption, Failure, or Loss

State Programs

Section NR 210.23 of the *Wisconsin Administrative Code* requires that all owners of sanitary sewage collection systems, including satellite sewage systems, develop and implement a Capacity, Management, Operation and Maintenance Program (CMOM). A CMOM Program assures that a sewage system is properly managed, operated, and maintained at all times; has adequate capacity to convey peak flows; and that all feasible steps are taken to eliminate excessive infiltration and inflow into the system. These programs are intended to significantly reduce, if not eliminate, sanitary sewer overflows (SSOs) and basement backups. A CMOM Program must also mitigate the impact of overflows on waters of the State, the environment, and public health. Public notification is required for each SSO.

Chapter NR 208, "Compliance Maintenance," of the *Wisconsin Administrative Code*, requires that owners of wastewater treatment facilities annually submit an electronic Compliance Maintenance Annual Report (eCMAR) to the WDNR. The eCMAR is a tool intended to evaluate the wastewater treatment system for problems or deficiencies. As part of completing the eCMAR, treatment plant owners describe management, operation, and maintenance activities and identify proposed actions that are intended to prevent violations of their discharge permits and degradation of water quality. The eCMAR program also encourages actions that promote the owners' awareness of, and responsibility for, wastewater collection and treatment needs; maximize the useful life of wastewater treatment systems through improved operation and maintenance; and initiate formal planning, design, and construction for system upgrades.

Local Programs

Some of the sanitary sewer utilities provide online or mailed information and conduct public information and education activities related to steps that they can take to prevent clogging of sewer laterals and what residents should do in response to basement backups.

Multi-Jurisdictional Considerations for Sanitary Sewerage System Disruption, Failure, or Loss

Only those areas within Ozaukee County that are served by sanitary sewerage systems face risks due to loss or failure of these systems. These areas are largely located within the Cities of Cedarburg, Mequon, and Port Washington; and the Villages of Bayside, Belgium, Fredonia, Grafton, Newburg, Saukville, and Thiensville. Because they are not served by municipal sanitary sewerage systems, the other areas within the County are not at risk from this hazard, but should be aware of the importance of monitoring and maintaining private onsite wastewater treatment systems.

Evaluation of Alternatives and Identification of Priority Mitigation Measures for Sewerage System Disruption, Failure, or Loss

Based upon review of the above and the risk analysis given in Chapter 3, feasible mitigation actions include development of a thorough sewerage system risk and threat assessment that identifies potential vulnerabilities, and development of response plans, including plans to continue operations in response to particular emergencies. An additional feasible measure is the provision of backup power for vital system components.

Consideration by the Ozaukee County Hazard Mitigation LPT has indicated there are six actions determined to be priority mitigation measures for this hazard mitigation plan update that are specifically related to the potential disruption, failure, or loss of sewerage systems.[279] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.12.

Identification of Alternative Mitigation Strategies for Natural Gas Utility Disruption or Loss

Natural gas is a main energy source in Ozaukee County to heat homes and to power appliances such as ovens, stoves, water heaters, and clothes dryers. In addition, natural gas is the main fuel used at the Port Washington We Energies power plant to produce electricity that serves much of the County and beyond. Because natural gas is distributed through underground pipelines (see Map 2.17), disruptions and outages are rare; however, when disruptions do occur, it can take weeks or even months to restore. Natural gas

[279] *Priority mitigation measures that apply to multiple hazard types including the disruption of sewerage systems are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section of this Chapter.*

Table 5.12
Cost-Benefit Analysis Summary of Measures Included in the Ozaukee County All-Hazards Mitigation Plan: Utility Failure Hazards

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Contamination or Loss of Water Supply												
Reduce the potential for groundwater contamination from agricultural fertilizers, chemicals, and manure with emphasis on groundwater related water quality management areas	--[f]	--[f]	X			X		X			X	Ozaukee County and all cities, villages, and towns
Promote proper location, installation, cleaning, monitoring, and maintenance of holding tanks, septic systems and other private onsite sewage disposal systems and identify failing onsite sewage disposal systems and leaking or failed sewer laterals for remediation	--[f]	--[f]		X		X	X	X			X	Ozaukee County and all cities, villages, and towns
Encourage private and public utilities to identify priority water customers and develop a plan for restoring their service first	--[e]	--[e]	X			X		X	X			Ozaukee County and all cities, villages, and towns
Encourage local communities and residents to develop emergency drinking water supply plans and identify potential distribution points for emergency water supply	--[e]	--[e]	X			X						Ozaukee County and all cities, villages, and towns
Encourage regular testing of private and public wells for nitrate, bacteria, viruses and other pathogens, pesticides, arsenic, lead, radionuclides, and volatile organic chemicals (VOCs)	--[e]	--[e]	X			X		X	X		X	Ozaukee County and all cities, villages, and towns

Table continued on next page.

Table 5.12 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Contamination or Loss of Water Supply (continued)												
Where opportunities exist, develop interconnections between adjacent water utilities	--[j]	--[j]		X		X		X		X		Cities of Cedarburg, Mequon, and Port Washington; Villages of Belgium, Fredonia, Grafton, Saukville, Thiensville, and Newburg
Provide onsite-backup power for wells, treatment plants, and other vital water utility system components	--[e,h]	--[e,h]		X		X	X	X	X		X	Cities of Cedarburg, Mequon, and Port Washington; Villages of Belgium, Fredonia, Grafton, Saukville, Thiensville, and Newburg
Develop and implement programs to replace publicly owned water service mains, laterals, and other infrastructure that are known to contain lead and promote the replacement of privately-owned portions of lead water service lines and lead plumbing fixtures within homes.	--[i,l,m]	--[i,l,m]			X	X		X		X		Ozaukee County and all cities, villages, and towns
Promote the use of drinking water filtration devices in homes where there are known lead service lines, lead plumbing, or fixtures where replacement of the lead service line or plumbing fixtures are not currently feasible	--[e]	--[e]	X			X		X		X		Ozaukee County and all cities, villages, and towns
Continue and expand public education and outreach efforts regarding the effects of arsenic, lead, nitrate, bacteria, viruses and pathogens, radionuclides, VOCs, and other emerging contaminants of concern found in drinking water	--[e]	--[e]	X			X		X		X	X	Ozaukee County and all cities, villages, and towns

Table continued on next page.

Table 5.12 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Contamination or Loss of Water Supply (continued)												
Expand educational and informational outreach material for private well owners to regularly test and maintain their wells	--[e]	--[e]	X			X		X			X	Ozaukee County and all cities, villages, and towns
Electrical Disruption or Outages:												
Continue to review and implement programs to improve the reliability of the power supply facilities	--[k]	--[k]	X			X	X			X		Ozaukee County and all cities, villages, and towns
Maintain a database of critical facilities that have, and do not have, backup power generators	--[k]	--[k]	X			X	X					Ozaukee County and all cities, villages, and towns
Create and maintain an emergency plan that includes backup provisions for special electrical medical equipment, sump pump backup systems, telephone provisions, assembly of an emergency kit, protection of electrical equipment, and installation or provision of power generators where appropriate	--[k]	--[k]	X			X	X					Ozaukee County and all cities, villages, and towns
Encourage installation of backup generators at critical facilities, shelters, and public utilities	--[e, h]	--[e, h]		X		X	X	X	X			Ozaukee County and all cities, villages, and towns
Maintain vegetation and trees in the right-of-way of power lines.	--[e]	--[e]	X			X	X					Ozaukee County and all cities, villages, and towns
Refine public informational and educational programming to include information on safety and preparation of power outages	--[k]	--[k]	X			X		X	X			Ozaukee County and all cities, villages, and towns

Table continued on next page.

Table 5.12 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Sanitary Sewer System Disruption, Failure, or Loss												
Promote development and/or update of a thorough sewerage system risk and threat assessment that identifies potential vulnerabilities	--[e]	--[e]	X			X	X	X			X	Cities of Cedarburg and Port Washington; Villages of Belgium, Fredonia, Grafton, Saukville, and Newburg
Develop and/or maintain an emergency operation plan for each sanitary sewerage system	--[e]	--[e]	X			X	X	X			X	Cities of Cedarburg and Port Washington; Villages of Belgium, Fredonia, Grafton, Saukville, and Newburg
Floodproof and stormproof the wastewater treatment plants, pumping stations, and other vital system components	--[g]	--[g]		X		X	X	X			X	Ozaukee County; Cities of Cedarburg and Port Washington; Villages of Belgium, Fredonia, Grafton, Saukville, and Newburg
Initiate facility planning for sanitary sewerage systems when average daily flow to the wastewater treatment plant approaches 80 percent of the plant's design capacity	--[e]	--[e]		X		X						Cities of Cedarburg and Port Washington; Villages of Belgium, Fredonia, Grafton, Saukville, and Newburg
Provide onsite-backup power for the wastewater treatment plants, pumping stations, and other vital system components	--[h]	--[h]		X		X	X	X			X	Cities of Cedarburg and Port Washington; Villages of Belgium, Fredonia, Grafton, Saukville, and Newburg
Continue and expand public informational and educational programming related to preventing clogging of sewer laterals and responding to basement backups	--[n]	--[n]	X			X						Ozaukee County and Cities of Cedarburg and Port Washington; Villages of Belgium, Fredonia, Grafton, Saukville, and Newburg

Table continued on next page.

Table 5.12 (Continued)

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Natural Gas Utility Disruption or Loss												
During a fuel shortage, encourage and promote the importance of conserving fuel	--[k]	--[k]	X			X		X		X		Ozaukee County and all cities, villages, and towns
Develop and implement a contingency plan for natural gas supply with local and emergency officials	--[k]	--[k]	X			X	X	X	X	X		Ozaukee County and all cities, villages, and towns
Ensure emergency officials and first responders are properly informed, trained, and equipped for pipeline emergencies	--[e]	--[e]	X			X		X	X			Ozaukee County and all cities, villages, and towns
Ensure pipeline operators conduct Federal and State pipeline safety inspections and maintenance	--[k]	--[k]	X			X	X	X	X	X		Ozaukee County and all cities, villages, and towns
Ensure above-ground gas utility pipeline signage is properly placed and maintained	--[k]	--[k]	X			X	X	X	X	X		Ozaukee County and all cities, villages, and towns
Promote the importance of damage prevention by requiring the use of diggers hotline	--[k]	--[k]	X			X	X		X	X		Ozaukee County and all cities, villages, and towns
Ensure pipeline operators develop and implement awareness programs with key stakeholders including the public, emergency officials, local public officials, and excavators	--[n]	--[n]	X			X	X	X	X	X		Ozaukee County
Distribute informational and educational material on recognizing and responding to natural gas pipeline leaks or emergencies	--[k]	--[k]	X			X	X	X	X			Ozaukee County

Table continued on next page.

Table 5.12 (Continued)

Note: Some of the priority mitigation measure descriptions have been reduced for the purpose of simplifying the content in this table. Complete mitigation measure descriptions are listed within this plan component.

[a] *All cost expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low	*Moderate*	*High*
Educational and informational programming	*Addition of new staff*	*Major construction*
Ongoing enforcement of ordinances	*Additional staff hours budgeted*	*New buildings (infrastructure)*
Plan Development	*Additional equipment*	*Capital programs*
Continued coordination/mutual aid/interagency agreements	*New ordinance development*	
	New programs/task force	

[c] *An injury refers to a physical injury or a severe illness caused by a hazard event.*

[d] *See recommendations for Ozaukee County in Tables 192 through 194 from SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, *December 2010. The potential new, expanded, converted, or upgraded facilities and programs recommended in the regional water supply plan should be implemented based upon local needs and determinations, and any available updated water use forecasts for a particular utility.*

[e] *Cost to be determined. Partially covered under ongoing programs.*

[f] *Portion of costs included in ongoing programs and are site-specific based on practice(s) being implemented.*

[g] *Costs are community- and/or site-specific. Costs are determined based on planning and implementation efforts.*

[h] *Costs are site-specific. Current cost for the installation of an on-site backup electrical generator at the City of Port Washington's Wastewater Treatment facility was estimated at $750,000 (2020 dollars).*

[i] *Costs to be determined.*

[j] *Costs are site-specific, and survey is needed for countywide estimate(s).*

[k] *Costs covered under ongoing activities and/or programs.*

[l] *Estimated cost for a replacement of a utility-owned water supply service line is about $6,300. Cost is dependent on length of pipe.*

[m] *Estimated cost for a replacement of privately-owned portion of water supply line is typically $3,700 to $7,350.*

[n] *Portion of costs included in ongoing programs. Additional cost of the hazard mitigation and public informational and educational programs is estimated to be $10,500 per year.*

Source: Ozaukee County Division of Emergency Management and SEWRPC

pipeline failures are characterized as low-probability, high-consequence events. The loss or disruption of this utility service can be detrimental for many Ozaukee County residences and the County's economy.

Natural gas is highly flammable and has the potential to cause an extensive amount of damage, by fire or explosion, which could also lead to a fuel shortage or disruption. Most hazardous incidents involving natural gas pipelines include a contractor or a homeowner severing a buried distribution line, weather, or outdated pipes. Land development in close proximity to gas transmission pipelines increases the likelihood of damage to the pipelines and the potential for impact to the community from a pipeline failure. Land development can also impede access needed for safe operation and maintenance of the pipeline and for emergency response. Gas facilities and transmission pipelines require a variety of preparedness and response planning strategies in the event of a gas release or explosion, particularly if it occurs in a sensitive or populated area.

Based upon review by the Ozaukee County Hazard Mitigation LPT, the following measures to reduce vulnerability to the disruption or loss of natural gas supply have been identified as viable for this update of the Ozaukee County hazard mitigation plan.

Nonstructural

- Ensure Integrity Management programs[280] are followed by the pipeline operators[281]
- Confirm excavators are informed of, and follow, the State's Damage Prevention Law prior to, and during, an excavation project[282]
- During a fuel shortage, encourage and promote the importance of conserving fuel to homeowners, critical community facility personnel, and business owners
- Promote built-in redundancies and alternatives for delivery in the natural gas system to help minimize natural gas outages
- Develop and implement contingency plans[283] with local and emergency officials if fuel shortage reaches a critical stage
- Promote the integration of natural gas pipeline (distribution and transmission lines) emergency mitigation and response into other County and community planning efforts, particularly for those communities that have a high population near a gas transmission pipeline[284]
- Ensure emergency officials and first responders are properly informed, trained, and equipped for natural gas pipeline emergencies

Structural

- Ensure pipeline operators appropriately conduct Federal and State pipeline safety inspections and maintenance to their gas transmission pipelines, valves, and other associated infrastructure

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[280] *Pipeline safety regulations include requirements for operators of hazardous liquid and natural and other gas transmission and distribution pipelines to develop and implement comprehensive integrity management programs. An integrity management program is a set of safety management, operations, maintenance, evaluation, and assessment processes that are implemented in an integrated and rigorous manner to ensure operators provide enhanced protection for High Consequence Areas (HCAs).*

[281] *Pipeline operators are responsible for the safe and reliable operation and maintenance of their pipelines and Liquified Natural Gas (LNG) facilities. Operators are subject to State and Federal pipeline safety regulations.*

[282] *State and Federally regulated pipeline companies maintain Damage Prevention Programs. The purpose of these programs is to prevent damage to pipelines and facilities from excavation activities, such as digging, trenching, blasting, boring, tunneling, backfilling, or by any other digging activity.*

[283] *A contingency plan is a plan devised for an outcome other than the usual or expected plan.*

[284] *PHMSA's High Consequence Areas for natural gas transmission pipelines focus solely on populated areas.*

- Ensure above-ground gas utility pipeline signage is properly placed and maintained for easy public notification and warning

Public Informational and Educational Programming

- Promote the importance to residents and excavators of damage prevention by requiring the use of Diggers Hotline (i.e., 8-1-1) before any excavation project begins

- Ensure pipeline operators develop and implement public awareness programs with key stakeholders including the public, emergency officials, local public officials, and excavators

- Distribute informational and educational material to County residents, officials, excavators, and contractors on recognizing and responding to natural gas pipeline leaks or emergencies

Current Programs for Natural Gas Utility Disruption or Loss

Federal and State Programs

As indicated in Chapter 2, and shown in Map 2.17, Ozaukee County has two major underground natural gas transmission pipelines. The Wisconsin Department of Transportation's (WisDOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) oversees developing and implementing regulations concerning pipeline construction, maintenance, and operation. Federal pipeline safety regulations require pipeline operators to conduct continuing public awareness programs to provide pipeline safety information to the public, emergency officials, local officials, and excavators. PHMSA provides States and communities with grant opportunities designed to improve damage prevention, develop new technologies, or otherwise improve pipeline safety. The rules governing pipeline safety are included in Title 49 of the Code of Federal Regulations (CFR), Parts 190-199. If necessary, PHMSA issues advisory bulletins to inform affected pipeline operators and Federal and State pipeline safety personnel of potential safety or environmental risks. Additionally, PHMSA has a regional "Community Liaison Service" program to provide citizens and County officials technical expertise with up-to-date technology, data, and information to reduce pipeline risks through program and policy development.[285]

In 2015, FEMA and the U.S Department of Transportation published a document entitled "Hazard Mitigation Planning: Practices for Land Use Planning and Development near Pipelines" to provide a framework for State, local, and tribal governments to use the hazard mitigation planning process to reduce the risks to their communities associated with hazardous liquid and gas transmission pipeline failures.

The National Pipeline Mapping System (NPMS), administered by PHMSA, is an interactive map designed to assist the general public by displaying information, by county, related to gas transmission and hazardous liquid pipelines, liquefied natural gas plants, and breakout tanks.[286]

The Common Ground Alliance (CGA), works to ensure public safety, environmental protection, and the integrity of underground infrastructure by promoting effective damage prevention practices for all underground facilities in North America.[287] The CGA has created "Public Awareness Toolkits" designed to address the importance of pipeline damage prevention, including the 8-1-1 campaign.

The American Gas Association (AGA) represents local energy companies throughout the United States and provides a number of informational and educational resources related to natural gas use as well as an emergency preparedness handbook for natural gas utilities.

Wisconsin's Public Service Commission (PSC) is an independent regulatory agency that is responsible for the regulation of Wisconsin public utilities. The PSC provides a variety of online resources related to Wisconsin's water and energy utility regulations, programs, publications, reports, news, and public events.

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[285] *U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration online resources.*

[286] *U.S Department of Transportation's website: www.transportation.gov/fastlane/how-locate-pipelines-national-pipeline-mapping-system transportation*

[287] *Common Ground Alliance,* Standards & Guidelines: 811 Know What's Below. Call Before You Dig*, February 2018*

The PSC website has several interactive mapping systems, such as a map of Wisconsin's natural gas service territories.[288]

We Energies is the main energy provider for Ozaukee County and offers online information regarding natural gas safety, leaks, and outages.

Local Programs

Ozaukee County's Division of Emergency Management website provides links to the County's comprehensive emergency plan (CEMP) as well as the County strategic plan. The strategic plan offers a brief description on the County's natural gas system source and distribution. The CEMP describes the County's participation, activities, and responsibilities for pre-emergency, emergency response, and emergency recovery efforts regarding utility failure or disruption, included natural gas utilities.

Multi-Jurisdictional Considerations for Natural Gas Utility Disruption or Loss

All municipalities within Ozaukee County could potentially be impacted by the disruption or loss of natural gas supply. In addition, malfunction of, or damage to natural gas transmission or distribution lines can cause very hazardous conditions anywhere in the County. Ozaukee County, the local units of government, and relevant businesses need to coordinate with natural gas utilities for hazard mitigation activities and participation in countywide disaster planning and response mechanisms.

Evaluation of Alternatives and Identification of Priority Mitigation Measures for Natural Gas Utility Disruption or Loss

Based upon review of the above and the risk analysis given in Chapter 3, the current ongoing Federal and State natural gas pipeline programs and regulations represent a main component of the planned mitigation action for natural gas disruption or loss. These include Federal and State pipeline safety inspections and maintenance of gas transmission pipelines, valves, and other infrastructure to meet regulatory standards. Additional components should include built-in and alternative delivery systems for natural gas distribution; the assurance that emergency officials and first responders are properly informed, trained, and equipped for pipeline emergencies; and, to continually promote the importance of damage prevention by requiring the use of Diggers Hotline before an excavation project begins. It is also important to continue to distribute informational and educational material to county residents and officials, excavators, and contractors on recognizing and responding to natural gas leaks or emergencies. During a fuel shortage, or disruption, conservation of fuel should be encouraged, especially for facilities that are designated to be used as emergency shelters or are considered critical for county residents and officials. Additionally, during the winter months where natural gas is used as a heat source, it is vital for emergency personnel to be familiar with locations in the County where vulnerable populations reside.

There are eight priority mitigation measures for this hazard mitigation plan update that are specifically related to the potential disruption of natural gas service,[289] along with a general cost-benefit summary, are presented in Table 5.12.

5.11 HAZARD MITIGATION PLAN COMPONENT FOR FOG

As described in Chapter 3, fog events are natural hazard events of moderate concern to be considered in the Ozaukee County hazard mitigation plan. This section describes alternate and selected priority strategies to mitigate this hazard. As part of the updating process, these strategies were reviewed and reevaluated by the Ozaukee County Hazard Mitigation LPT in light of the updated hazard conditions and hazard mitigation goals documented in Chapters 3 and 4, respectively.

Identification of Alternative Mitigation Strategies

As discussed in Chapter 3, fog events pose a moderate threat to Ozaukee County. The main impacts of fog events are upon transportation systems. Reduced visibility associated with fog events is a contributing

[288] *maps.psc.wi.gov.*

[289] *Priority mitigation measures that apply to multiple hazard types including the disruption natural gas utility service are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section of this Chapter.*

factor in transportation-related accidents, especially during wet road conditions. In addition, dense fog results in travel problems and/or delays. In review by the Ozaukee County Hazard Mitigation LPT as part of the updating process, the following measures to reduce vulnerability to fog events have been identified as viable for this update of the Ozaukee County hazard mitigation plan.

Nonstructural

- Continue training, planning, and preparedness for mass-casualty incidents involving transportation systems

Structural

- Consider expanding the use of ramp closure devices to allow for rapid closure of freeway on-ramps during major traffic incidents, inclement weather such as thick fog cover, or special events
- Ensure proper warning signs and signals (i.e., Port Washington Breakwater Lighthouse and highway signage) are maintained for both road vehicles and watercraft
- Continue and expand the use of closed-circuit television cameras (CCTV) on heavily traveled freeways, arterial streets, and highways
- Continue and expand the use of advisory information measures including variable message signs (VMS)[290] on the freeway system and appropriate arterial streets and highways to warn of potential hazards on the road ahead

Public Informational and Educational Programming

- Increase public education and awareness of the potential severity of hazardous fog events
- Produce and distribute emergency preparedness information related to fog events and identifying roadways and locations in the County known to be particularly vulnerable to fog cover
- Promote driver safety hazard awareness, especially to drivers within the 15 to 24 age group and inclusion of safety strategies for fog events in driver education classes and materials
- Continue to provide public education regarding the dangers of distracted driving such as texting and using mobile phones while driving

Current Programs

Federal and State Programs

When dense fog covers a widespread area and reduces visibility to less than one-quarter mile for a period of three hours or more, the NWS will issue a Dense Fog Advisory. The NWS will issue a Freezing Fog Advisory when fog causes the formation of ice or rain that impacts transportation. These advisories are broadcast through NOAA All Hazard Weather Radio and are relayed to other local media via the Federal Communication Commission's Emergency Alert System (EAS). The NWS recommends that drivers slow down and modify their speed, drive with low beam headlights in the day or night, and avoid turning on high beams on foggy nights as it reduces visibility. They also recommend tuning into NOAA All Hazard Weather Radio for the latest information.

The Wisconsin Department of Transportation (WisDOT) conducts several activities to inform motorists of hazards to highway safety, including fog, along the State's freeway system. WisDOT operates a network of cameras that monitor road and traffic conditions on freeways through much of the State, including six cameras along IH 41/94 in Ozaukee County. WisDOT makes information regarding road and weather conditions, travel times, road closures, and traffic incidents available to the public through the internet and a system of message signs located throughout the freeway system.[291]

[290] *VMS are over-road devices that display dynamic messages providing real-time information to motorists.*

[291] *This information is available at www.511wi.gov.*

Local Programs

Programs within the County include those conducted by the Ozaukee County Division of Emergency Management (DEM). The County DEM has a number of brochures, booklets, and pamphlets available for the public on fog and other general emergency management-related topics.

A variety of methods are used to warn people in Ozaukee County of severe weather events, including fog. These were described previously in this Chapter in the hazard mitigation plan component for multiple hazard types.

Multi-Jurisdictional Considerations

Fog and its related hazards can potentially impact all municipalities within the County, however, coastal communities and neighborhoods near Lake Michigan may have an increased vulnerability. Ozaukee County, the local units of government and relevant businesses need to coordinate hazard mitigation activities through the local government participation in countywide disaster planning and response mechanisms. Such measures are already well underway through the coordinated emergency operations planning program involving the Ozaukee County DEM and coordinated local community emergency operations programs.

Evaluation of Alternatives and Identification of Priority Mitigation Measures

The major vulnerabilities to fog result from its impacts upon the transportation system. Fog can create hazardous conditions for operating motor vehicles when it reduces visibility to one-quarter mile or less. Adjustment in motorist behavior in response to fog can substantially reduce the risks resulting from its presence. Thus, the impacts of this hazard can be mitigated largely through maintenance of warning systems and signage to inform the public of the presence of, or potential for, hazardous incidents of fog and public information and education programs which inform motorist of the attendant risks.

Based upon the foregoing evaluation and consideration of risk and consideration by the Ozaukee County Hazard Mitigation LPT (see Appendix A), there are six actions determined to be priority mitigation measures as part of this hazard mitigation plan update that are specifically related to fog events.[292] These priority mitigation measures, along with a general cost-benefit summary are presented in Table 5.13.

5.12 HAZARD RISK ANALYSIS AND PRIORITIZATION: 2017

The major hazards that have been identified as potentially affecting Ozaukee County have been ranked by risk to assist in developing a mitigation plan. Additional description of hazards as well as the vulnerability assessment of Ozaukee County to these hazards have been identified and summarized in Chapter 3 of this report. These priority rankings were based upon the number of incidences per year, number of mortalities, number of injuries, property damage, and crop damage inventories set forth in Chapter 3. Specifically, this prioritization is based upon protecting human life and health and protection from property and crop damages throughout the County. Therefore, the major indicators of hazard severity used to rank these hazards to Ozaukee County are based upon the deaths and injuries versus economic losses as summarized in Tables 5.14 and 5.15, respectively. It should be noted, however that economic losses due to utility failure (i.e., water supply contamination, electrical disruption or loss, sewerage system disruption or loss, and natural gas disruption or loss) and Lake Michigan coastal hazards were not included in this plan.

As identified in the vulnerability assessment of hazards to Ozaukee County in Chapter 3, the magnitude and consequent risk of a particular hazard is dependent upon a number of factors that include, but are not limited to, time (e.g., time of year for thunderstorm events or time in terms of how long an event may last such as drought), size or scale, frequency of occurrence, population size potentially impacted, and amount of urban growth or development potentially impacted. These factors do not indicate that rural areas are any more or less important than urban areas; however, it does indicate that the more urbanized areas have a greater chance of loss in terms of human death, injury, and property damage per hazard event. It is also important to note, as identified in Chapter 3, that many disaster events are compound in nature and not the result of a single event, such as flooding hazards during a severe thunderstorm event. Nonetheless, since the causes of disasters of the past will likely be the best predictor of future disasters, an attempt was made

[292] *Priority mitigation measures that apply to multiple hazard types, including fog events, are presented in the "Hazard Mitigation Plan Component for Multiple Hazard Types" section in this Chapter.*

Table 5.13
Cost-Benefit Analysis for Priority Measures Included in the Ozaukee County All-Hazards Mitigation Plan: Fog

Mitigation Measures	Estimated Cost[a]		Costs of Implementation[b]			Benefits						Community/ Jurisdictions Affected
	Capital	Average Annual Operation and Maintenance	Low	Moderate	High	Enhanced Preparedness/ Protection	Reduced Property Damage	Reduced Injuries	Reduced Mortalities	Enhanced quality of life/social benefits	Increased Environmental and/or Recreational Benefits/Ecosystems	
Continue training, planning, and preparedness for mass-casualty incidents involving transportation systems	--[c]	--[c]	X			X			X			Ozaukee County and all local jurisdictions[d]
Consider expanding the use of ramp closure devices on freeways	--[e]	--[e]	X			X	X	X	X			Ozaukee County and all local jurisdictions[d]
Ensure proper warning signs and signals	--[c]	--[c]	X			X	X	X	X			Ozaukee County and all local jurisdictions[d]
Continue and expand the use of closed circuit television cameras (CCTV) on heavily traveled freeways, arterial streets, and highways	--[f]	--[f]	X			X	X	X	X			Ozaukee County and all local jurisdictions[d]
Continue and expand the use of advisory information measures including variable message signs (VMS) on the freeway system and appropriate arterial streets	--[g]	--[g]		X		X	X	X	X			Ozaukee County and all local jurisdictions[d]
Increase public education and awareness	--[c]	--[c]	X			X	X	X	X			Ozaukee County and all local jurisdictions

Table continued on next page.

Table 5.13 (Continued)

[a] *All cost expressed in 2017 dollars unless otherwise noted.*

[b] *Cost of implementation is allocated among three categories of low (less than $100,000 dollars), moderate (greater than $100,000 and less than $1,000,000), and high (greater than $1,000,000) costs, which are generally defined as:*

Low	Moderate	High
Educational and informational programming	Addition of new staff	Major construction
Ongoing enforcement of ordinances	Additional staff hours budgeted	New buildings (infrastructure)
Plan Development	Additional equipment	Capital programs
Continued coordination/mutual aid/interagency agreements	New ordinance development	
	New programs/task force	

[c] *Costs covered under ongoing activity.*

[d] *Jurisdictions include general purpose units of government—Cities, Towns, and Villages—and special purpose units of government such as School Districts, Sanitary and Utility Districts, and Agricultural Drainage Districts.*

[e] *Estimated equipment and installation cost for one ramp closure gate ranges from $10,500 to $15,750. Note that this cost is per gate and one or two gates are typically installed at one freeway entrance ramp. Average annual operation and maintenance for a single ramp closure gate is estimated to be $400.*

[f] *Estimated equipment and installation cost for one closed circuit television system ranges from about $52,500 to $68,250. Average annual operation and maintenance for a single unit is approximately $1,500.*

[g] *Estimated equipment and installation cost for one variable message sign (VMS) ranges from about $36,750 to $78,750 at an arterial highway location, from $84,000 to $94,000 for a ground-mount system at a freeway location, and from $189,000 to $210,000 for an overhead system at a freeway location. Average annual operation and maintenance for a single VMS unit is approximately $2,300.*

Source: Ozaukee County Division of Emergency Management and SEWRPC

Table 5.14
Priority Ranking of Hazards Affecting Ozaukee County Based Upon Mortality and Injury

Order Based on Local Planning Team[a]	Hazards Identified in the Hazard Vulnerability Assessment Tool	Period of Record	Number of Incidents Per Year (average)	Number of Mortalities Per Year (average)[b]	Number of Injuries Per Year (average)	Sum of Average Mortality and Injury Incidences Per Year	Priority Ranking Based on Analysis
4	Tornado	1964-2017	0.1	0	0.6	0.6	1
1, 2, 3, 5	Thunderstorms, Hail, Lightning, Strong Winds	1960-2017	3.7	0	0.1	0.1	2
8	Fog	1996-2017	3.6	0	0.0	0.0	5
5, 11	Winter Storms (*Heavy Snow and Blizzard*)	1959-2017	2.9	0	0.0	0.0	4
9, 12	Temperature Extremes (*Extreme Cold and Extreme Heat*)	1995-2017	2.3	0	0.0	0.0	6
6, 10	Flood (*Stormwater Flooding and Riverine Flooding*)	1996-2017	1.1	0	0.0	0.0	3
14	Drought	1976-2017	0.7	0	0.0	0.0	7
7	Coastal Erosion[c]	--	--	--	--	--	--
19	Utility Failure[d]	--	--	--	--	--	--

[a] *These numbers indicate the ranked order of the hazards assigned by the Ozaukee County Hazard Mitigation Local Planning Team (LPT) through responses give in the Hazard and Vulnerability Assessment Tool (HVA). For more details see Hazard Identification section in Chapter 3 of this report. Similar hazardous events as listed in the HVA tool (see Table 3.1) are shown in italics—hence the multiple rankings given for hazardous events. Similar events listed in the HVA tool were combined into one hazardous event for this hazard mitigation Plan. For example, "heavy snow" and "blizzard" in the HVA tool was combined into "Winter Storms."*

[b] *Deaths that are reported in this table refer only to deaths that are directly caused by the hazard event, indirectly related deaths are not reported in this table. For example, a death caused by a car accident where fog or snow-covered roads were contributing factors are considered indirectly related deaths and are not reported in this table.*

[c] *No available data for Ozaukee County.*

[d] *Utility failure includes power outages, loss of sewerage systems, contamination of water supply, and natural gas disruptions. For this plan, utility failure was profiled as a hazardous event, however data pertaining to this table was analyzed for natural hazard events only.*

Source: National Climatic Data Center (NCDC), National Oceanic and Atmospheric Administration (NOAA), and National Environmental Satellite, and Data and Information Service (NESDIS)

Table 5.15
Priority Ranking of Hazards Affecting Ozaukee County Based Upon Crop and Property Damages

Order Based on Local Planning Team[a]	Hazards Identified in the Hazard Vulnerability Assessment Tool[b]	Period of Record	Number of Incidents Per Year (average)	Total Property Damage Per Year (dollars)[c]	Total Crop Damage Per Year (dollars)	Sum of Property and Crop Damages Per Year (dollars)	Priority Ranking Based on Analysis
6, 10	Flood (*Stormwater Flooding and Riverine Flooding*)	1996-2017	1.1	1,198,127	557,717	1,755,844	1
4	Tornado	1964-2017	0.1	381,526	6,745	388,271	2
1, 2, 3, 5	Thunderstorms, Hail, Lightning, Strong Winds	1960-2017	3.7	338,892	38,135	377,027	3
14	Drought	1976-2017	0.7	0	128,530	128,530	4
5, 11	Winter Storms (*Heavy Snow and Blizzard*)	1959-2017	2.9	59,585	6,108	65,693	5
9, 12	Temperature Extremes (*Extreme Cold and Extreme Heat*)	1995-2017	2.3	97	3,253	3,350	6
8	Fog	1996-2017	3.6	0	0	0	7
7	Coastal Erosion[d]	--	--	--	--	--	8
19	Utility Failure[e]	--	--	--	--	--	9

[a] *These numbers indicate the ranked order of the hazards assigned by the Ozaukee County Hazard Mitigation Local Planning Team (LPT) through responses give in the Hazard and Vulnerability Assessment Tool (HVA). For more details see Table 3.1 and the Hazard Identification section in Chapter 3 of this report.*

[b] *Similar hazardous events listed in the HVA tool (see Table 3.1)—as shown in italics—were combined into one category of similar nature for this hazard mitigation Plan. For example, "heavy snow" and "blizzard" in the HVA tool was combined into the "Winter Storms" for this hazard mitigation plan.*

[c] *Dollar values were adjusted to year 2017 by using the average annual Consumer Price Index (CPI) values from the U.S. Department of Labor, Bureau of Labor Statistics.*

[d] *No available data for Ozaukee County.*

[e] *Utility failure includes power outages, loss of sewerage systems, contamination of water supply, and natural gas disruptions. For this Plan, utility failure was profiled as a hazardous event, however data pertaining to this table was analyzed for natural hazard events only.*

Source: National Climatic Data Center (NCDC), National Oceanic and Atmospheric Administration (NOAA), and National Environmental Satellite, Data and Information Service (NESDIS), and the U.S. Department of Agriculture Risk Management Agency

to normalize all of the hazard incidences to an annual average in order to understand the relative potential level of risk each hazard poses to Ozaukee County on an annual basis (see Tables 5.14 and 5.15).

Ranking Severity of Hazards

Death and Injury

Using the data from the various sources summarized in the vulnerability assessment of Chapter 3, the priority hazards identified in Table 3.3 were ranked with respect to their severity in terms of the sum of the number of annual death and injuries they caused and then by frequency of occurrence of each type of hazard event as shown in Table 5.14. To note, no direct deaths have been associated or reported for any of the natural hazard events profiled in this Plan.

Two of the nine identified hazards are associated with mortality and injury as shown in Table 5.14. These hazards include tornadoes and thunderstorms, high-wind, hail, and lightning events. It is important to mention that these numbers represent an *annual average* which is low. In addition, injuries and deaths are only analyzed if directly caused by the hazard event; therefore, any indirect injury or death caused by a hazard event are not included. As detailed in Chapter 3, the tornado injury data is attributed to one tornado event that occurred in 1964 that impacted many lives and property within Ozaukee County.

As summarized in the vulnerability and community impact assessment in Chapter 3, thunderstorms, high wind, hail, and lightning, as a group, represent the second most costly hazard in terms of injuries. The vulnerability and community impact assessment indicate that the entire County is at risk from these hazards as shown on Maps 3.8 and 3.9 in Chapter 3 of this report. These events are highly unpredictable in terms of exactly where they may occur and how powerful they might be.

The remaining seven hazards have not been recorded as causing mortality and injury in Ozaukee County, based upon known data. These include the meteorological hazards of winter storms, drought, temperature extremes, and flooding, naturally occurring hazards such as coastal erosion, and human induced hazards including utility failure. It is important to note that although winter storms, flooding, extreme temperatures, and drought have not been recorded to cause mortality and injury, these hazards rank among the top six associated with significant property damage costs to Ozaukee County (see Table 5.15). This illustrates that there are significant differences in the ranking of hazards depending upon whether the ranks are derived by comparing hazards based on their impacts upon human life and injury or by comparing hazards based upon the damages to property and crops that result from hazard incidents (see Property Damage section below).

Property Damage

Another way to assess the vulnerability of Ozaukee County to hazards is to examine the resultant property damage. Again, using the data from the various sources summarized in the vulnerability assessment of Chapter 3, hazards in Ozaukee County were ranked with respect to their severity in terms of the annual sum of the property and crop damage caused and then by frequency of occurrence of each type of hazard event as shown in Table 5.15. Annual average estimates of property and/or crop damages were determined for six of the nine priority hazards. These hazards, in order of appearance based upon total annual property damages, include flooding; tornadoes; thunderstorms, high winds, hail, and lightning; drought; winter storms; and extreme temperatures. Among these hazards profiled, flooding was identified as resulting in the greatest amount of damage to property and crops in Ozaukee County.

As summarized in the vulnerability and community impact assessment in Chapter 3, it is expected that for some years the County will experience more events than other years, but the average annual number is not expected to change over the five-year planning period of this Plan. In addition, future changes in climate and land use can adversely impact crop and property damages due to flooding events. Tornadoes represent the second most damaging hazard impacting Ozaukee County. While most of the historical damages to property and crops caused by tornadoes resulted from one event, the high rank of this hazard illustrates the impacts that can result from a single catastrophic incident, even when it is restricted to a small portion of the County. Thunderstorms, high winds, hail, and lightning were identified as the third most damaging hazards (when combined) impacting Ozaukee County. As indicated in Chapter 3, these events occur frequently throughout the County and can cause considerable damage to both property and crops. Because of the unpredictability of thunderstorm wind, hail, lightning, and non-thunderstorm high wind events, all buildings, infrastructure, and critical facilities within the County are considered at risk.

PLAN ADOPTION, IMPLEMENTATION, MAINTENANCE, AND REVISION 6

The hazard mitigation plan described in this report is designed to attain, to the maximum extent practicable, the goals and objectives set forth in Chapter 4 of this report. In a practical sense, however, the plan is not complete until the steps to convert the plan into action policies and programs have been specified. This chapter presents the plan implementation strategies envisioned and includes information on plan adoption, maintenance, and revision.

6.1 PLAN REFINEMENT, REVIEW, AND ADOPTION

As described in Chapter 1, the hazard mitigation planning program was initiated by Ozaukee County in 2008. The plan set forth in this report was begun in 2018 and conducted pursuant to the mitigation planning requirements of 44 *Code of Federal Regulations*, Section 201.6(d) (44 CFR 201.6(d)), which call for local hazard mitigation plans to be reviewed; updated to reflect changes in development, progress in local mitigation efforts, and changes in priorities; and reapproved every five years for local jurisdictions to be able to receive hazard mitigation funding. During 2002, the Federal Emergency Management Agency (FEMA) published rules for hazard mitigation planning in response to the Disaster Mitigation Act of 2000. These rules address State and local mitigation planning and are important for the Ozaukee County hazard mitigation program in the following manner:

- The Wisconsin Department of Military Affairs, Division of Emergency Management (WEM), is directly involved in a partnership role for all-hazard mitigation planning. That agency is responsible for preparing and periodically updating a State all-hazard mitigation plan, provides technical assistance and guidance for local all-hazards planning, and administers planning grant programs for FEMA.

- The rules outline State and local mitigation planning guidelines for accessing hazard mitigation grant funds. For disasters declared after November 1, 2004, local units of government must have a FEMA-approved mitigation plan in order to receive project grants from the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation (PDM) program. This element is important because it requires local adoption of a hazard mitigation plan to remain eligible to receive grants from specific mitigation funds. Communities can formally adopt the County plan, or, alternatively, create and adopt their own plan.

- The rules and related guidance provide more specificity and detail on the hazard mitigation plan content than did the previous rules. The Ozaukee County hazard mitigation plan has been structured to meet the 2002 guidance.

The Ozaukee County hazard mitigation plan was prepared under the guidance of the Ozaukee County Hazard Mitigation Local Planning Team (LPT) comprised of representatives of all of the communities within the County, as well as elected and appointed officials; agency, business, and non-profit representatives; and citizens from throughout the County knowledgeable in hazard mitigation matters. The LPT met three times during the plan preparation period and held a teleconference a fourth time to provide input on the types of hazards to be considered, the appropriate mitigation strategies, and to review and refine the draft report chapters to reflect the comments and recommendations of the LPT.[293] The activities of the LPT are documented in Appendix A.

During the drafting of the plan, public informational meetings were held to review the plan with local officials, businesses and industry, and citizens, following completion of the first four chapters and after

[293] *The fourth and final Local Planning Team meeting was held via teleconference due to the 2019-2020 COVID-19 pandemic's "Safer-At-Home" protocol.*

completion of the plan in draft form.[294] In addition, as draft chapters of the updated plan were completed, copies were placed in downloadable form on the website of the Southeastern Wisconsin Regional Planning Commission (SEWRPC) and a webpage was available on the SEWRPC website on which members of the public could ask questions and submit comments on the draft plan update. Following plan finalization, the plan was presented for consideration and adoption to the Ozaukee County Board of Supervisors on August 5, 2020. A copy of the signed plan adoption resolution is included in Appendix H. Copies of the plan were also sent to each of the local units of government in the County advising them of the need for adoption by the local government in order to retain future eligibility for mitigation funding from the FEMA Hazard Mitigation Grant and the Pre-Disaster Mitigation Programs administered by WEM. Copies of the adopted local government resolutions approving the plan are included in Appendix H. In addition, County and SEWRPC staff have been made available to meet with communities on an individual basis to review the plan and consider adoption and implementation steps. A status report on plan adoption by the County and local units of government is maintained by the Ozaukee County Division of Emergency Management (DEM).

6.2 PLAN IMPLEMENTATION STRATEGIES

An important first step in implementing the updated hazard mitigation plan for Ozaukee County is its formal adoption by Ozaukee County; the Cities of Cedarburg, Mequon and Port Washington; the Villages of Belgium, Fredonia, Grafton, Newburg, Saukville, and Thiensville; and the Towns of Belgium, Cedarburg, Fredonia, Grafton, Port Washington, and Saukville.[295] Upon formal adoption, the plan becomes an important guide to hazard mitigation and related management decisions for the County and participating local units of government. Such adoption serves to signify agreement with and official support of the plan recommendations and enables government officials and staff to begin integrating the plan recommendations into the other ongoing County and municipal programs, such as land use and public works development planning and programming.

Realization of the plan will require a long-term commitment to the objectives of the plan and a high degree of coordination and cooperation among County officials and staff and various County and community departments and other bodies, including the Hazard Mitigation Local Planning Team; intergovernmental task forces or other committees that may be created in the future to help address common hazard mitigation issues; other concerned units and agencies of government and their respective officials and staffs; area developers and lending institutions; businesses, industry, and institutions; and concerned private citizens in undertaking the substantial investments and series of actions needed to implement the plan. Close cooperation with WEM and FEMA is also essential.

A summary of the plan elements and selected implementation strategy information, including current status, general priority assignments, designated management agencies, and schedules is included in Table 6.1. It is recommended that the County and local units of government incorporate the analyses performed and mitigation strategies recommended into other local planning efforts, such as those related to stormwater management, stream and river protection, land and water conservation, and comprehensive planning, where appropriate.

6.3 HAZARD MITIGATION FUNDING SOURCES

Financing of the construction, operation, and maintenance of hazard mitigation measures may be accomplished through a number of means, including: establishing a stormwater utility; tax incremental financing (TIF) districts; local property taxes; reserve funds; general obligation bonds; private-developer contributions, including fees applied to construction of regional stormwater management facilities in lieu of providing onsite facilities; State grants or loans; and certain Federal and State programs. Identifying

[294] *The second public meeting was held remotely with virtual assistance due to the 2019-2020 COVID-19 pandemic's "Safer-At-Home" protocol.*

[295] *The Villages of Bayside and Newburg lie partially within Ozaukee County. The Village of Bayside lies within Milwaukee and Ozaukee County, while the Village of Newburg lies within Ozaukee and Washington County. Because of this, both Villages had the opportunity to participate in one or both County hazard mitigation plans. The Village of Bayside participated and is covered only under the Milwaukee County hazard mitigation plan, while the Village of Newburg decided to participate in both Ozaukee and Washington County's hazard mitigation planning efforts.*

Table 6.1
Ozaukee County Hazard Mitigation Plan Summary and Implementation Plan

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Multi-Hazards					
Continue to enforce State building code regulations that aim to improve the ability of structures to withstand hazardous weather conditions	Implemented	High	Ongoing	Wisconsin Department of Safety and Professional Services, Municipal Building Inspector and/or Engineer	1, 4, 5, 7, 32, 35, 38 40, 51, 74, 75, 85
Continue the County's participation in the National Weather Service's (NWS) StormReady program	Partially Implemented	Low	County was designated a StormReady participant in 2020	NWS, OCDEM, City of Cedarburg	
Continue to promote and encourage participation in Ozaukee County Emergency Management's Weather Safety and Spotter training program	Implemented	Low	Ongoing	NWS, OCDEM	
Continue the integration of hazard mitigation planning into other local planning efforts (i.e., comprehensive and land use planning)	Implemented	High	Ongoing	FEMA, WEM, SEWRPC, OCDEM, OCLWM, OCPP	
Continue to work with public health and human services departments, volunteer groups, NGOs, and American Red Cross	Implemented	Medium	Ongoing	American Red Cross, WOPHD, OCHHS, OCDEM	
Continue coordination of emergency response and operation plans among governmental units and first responders	Implemented	High	Ongoing	American Red Cross, WOPHD, OCDEM, OCSD, Municipal EMS, Fire, and Police Departments	
Maintain, update, and upgrade public early warning systems and networks	Implemented	High	As needed	NOAA, OCDEM, OCSD	
Continue the use, maintenance, and updating of the County's interoperability communication network systems	Implemented	High	As needed	OCDEM, OCSD, Municipal Police and Fire Departments	
Bury and protect power and utility lines, where feasible and appropriate, to prevent damage from hazardous weather conditions	Partially Implemented	Medium	Ongoing	We Energies, OCDEM, Municipal Public Works and/or Utility Departments	
Promote emergency on-site back-up power generation at critical facilities, including water treatment and wastewater treatment facilities	Partially Implemented	High	Ongoing	OCDEM, Municipal Water Supply and Wastewater Utilities	
Trim and maintain the health of trees near vulnerable infrastructure. Communities should continue the monitoring of emerald ash borer (EAB) and develop a funding strategy for removal. Communities should also encourage private landowners to remove dead or infested ash trees near vulnerable infrastructure	Partially Implemented	Low	As funding and opportunities become available	WDNR, UW-Extension, OCLWM	

Table continued on next page.

Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Multi-Hazards (continued)					
Continue to promote, update, and add to Ozaukee County Division of Emergency Management's online information related to hazardous weather events, preparedness, and post-event management	Implemented	Medium	Ongoing	OCDEM	1, 4, 5, 7, 32, 35, 38 40, 51, 74, 75, 85
Encourage residents to develop a Family Emergency Preparedness Plan and Disaster Supply Kit	Implemented	Medium	Ongoing	FEMA, WEM, OCDEM, WOPHD	
Promote inclusion of safety strategies for severe weather events into driver educational classes and materials	Partially Implemented	Low	Ongoing	OCDEM, WisDOT	
Encourage and educate the public on the use of severe weather warning applications (apps) on electronic mobile devices (i.e., FEMA's *ready.gov* severe weather warning cellular phone app)	Implemented	Low	Ongoing	FEMA, NOAA, NWS, OCDEM, City and Village Boards	
Continue to distribute and promote informational and educational resources and programs on available home insurance, flood insurance (i.e., Federal Flood Insurance Program), and crop insurance for damages sustained during severe weather	Implemented	High	Ongoing	FEMA, OCDEM, OCLWM	
Flooding and Associated Stormwater Drainage Problems					
Floodplain and Environmentally Sensitive Land Preservation Element					
Maintain floodplain and wetland zoning regulations	Implemented	High	Ongoing	WDNR, OCLWM, OCPP, Municipal Engineering, Planning, and/or Zoning Departments	1, 2, 3, 4, 5, 13, 15, 16, 19, 20, 22, 23, 25, 26, 27, 28, 31, 33, 34, 35, 36, 38, 41, 44, 45, 47, 48, 53, 54, 56, 57, 58, 59,60, 61, 62, 63, 64, 66, 69, 76, 77, 78, 79, 80, 83
Continued preservation and maintenance of environmentally sensitive lands and open space areas	Partially Implemented	High	As funding and opportunities become available	WCMP, WDNR, OWLT, OCLWN, OCPP, Municipal- Council/Board; Parks, Open Space, and/or Recreational Departments; and Planning Departments	
Continue wetland restoration to reduce flood-related agricultural and property damage	Not Implemented	Medium	As funding and opportunities become available	USFWS, NRCS, WDNR, OWLT, OCLWN, OCPP, Municipal Engineering, Planning, and/or Zoning Department(s)	

Table continued on next page.

Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Flooding and Associated Stormwater Drainage Problems (continued)					
Floodplain Management Plan Element					
Remove up to 27 repetitive loss structures	Not Implemented	High	As funding and opportunities become available	FEMA, WEM, OCDEM, OCLWN, Property owners, Municipal-Council/Board; Engineering, Planning, and/or Zoning Department(s)	1, 2, 3, 5, 14, 15, 16, 17, 18, 19, 20, 28, 35, 36, 37, 38, 39
Surveys of up to 863 structures identified as being potentially located in flood hazard areas	Not Implemented	High	Implement after floodplain maps have been updated	WEM, OCLWN, Property owners, Municipal Engineering Departments	
Floodproofing 217 structures identified as potentially located in flood hazard area	Not Implemented	Medium	Implement as funds become available, after floodplain maps have been updated, and surveys of structures have been completed	WEM, OCDEM, OCLWN, Property owners, Municipal Planning, Engineering, and/or Zoning Commission(s)	
Acquisition and removal/demolition of up to 624 structures identified as being potentially located in flood hazard area	Not Implemented	Medium	Implement as funds become available, after floodplain maps have been updated and surveys of structures have been completed	FEMA, WEM, OCDEM, OCLWN, Property owners, Municipal-Council/Board; Engineering, Planning, and/or Zoning Department(s)	
Continue participation in FEMA's National Flood Insurance Program and floodplain map updating	Implemented	High	Ongoing, several map updating efforts are underway	FEMA, WDNR, SEWRPC, OCLWM	
Continue County participation in the Community Rating System program	Partially Implemented	Medium	Ongoing for County only	FEMA, OCLWM, Municipal Planning, Engineering, and/or Zoning Commission(s)	
Enforcement of floodplain regulations	Implemented	High	In place and ongoing	WDNR, OCLWM, OCPP, Municipal Engineering, Planning, and/or Zoning Departments	
Develop Ice Jam Mitigation Measures	Partially Implemented	Medium	Under consideration	USACE, OCDEM, OCLWM, Municipal River Advisory/Committee	
Installation of new and maintenance of existing USGS stream gages	Partially Implemented	High	Ongoing with existing stream gages. Installation of new gages a consideration as funding becomes available	USGS, WDNR, SEWRPC, OCLWM	
Documentation of extent of future floods	Not Implemented	High	As future flooding occurs	OCLWM	
Stream channel maintenance	Partially Implemented	Medium	Ongoing as funds and opportunities become available	WDNR, OCLWM, OCPP, Municipal Public Works Departments	

Table continued on next page.

Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Flooding and Associated Stormwater Drainage Problems (continued)					
Dam Failure Subelement					
Regular inspection and maintenance of dams	Implemented	High	When necessary as required by WDNR	WDNR, Municipal Public Works Department, OCHD, Private and Public Dam Owners	35, 36, 62, 76, 77, 82
Dam emergency action plans	Partially Implemented	High	2025	WDNR, OCDEM, Private and Public Dam Owners	
Dam failure analysis	Partially Implemented	High	2025	WDNR, OCDEM, Private and Public Dam Owners	
Investigate interest in abandonment and removal of high hazard potential dam	Not Implemented	Medium	As needed	WDNR, Private Owner	
Stormwater Management Plan Element					
Development and/or Continued Maintenance of Stormwater Management Plans/Programs	Implemented	High	In place and ongoing	OCLWM, OCPP, Municipal Public Works Departments	5, 19, 28, 41, 57, 64, 65, 68,
Continuation of Stormwater-Related Regulations	Implemented	High	In place and ongoing	OCLWM, WDNR	
Implementation and integration of green infrastructure and low impact design	Partially Implemented	Medium	As funding and opportunities become available	FEMA, WDNR, OCLWM, OCPP, Municipal-Board/Council, Planning Commission, Public Works Departments	
Public Informational and Educational Element					
Continue and enhance public education activities related to flood and stormwater management	Partially Implemented	Low	Ongoing	UW-Extension, OCLWM, OCDEM, WDNR, Municipal Public Works Departments	5, 40, 41, 57, 64, 66, 75
Promote and distribute information related to Federal Flood Insurance Program	Implemented	Medium	Ongoing	FEMA, OCDEM, OCLWN, Municipal Planning Commissions	
Enhance public participation activities and coordination with other agencies and units of government	Partially Implemented	Medium	Ongoing	UW-Extension, WDNR, OCDEM, OCLWM, OCPP	
Thunderstorm Wind, Non-Thunderstorm High-Wind, Hail, and Lightning					
Maintain and regularly update local fire department equipment to help detect or mitigate lightning-related fires, such as thermal imaging devices	Implemented	Medium	As needed	Municipal Fire Departments	1, 5, 9, 15, 32, 35, 40, 74
Continue to work with local fair/festival organizers to create emergency plans in case of severe weather	Implemented	High	Ongoing	OCDEM, OCPSC, OCSD, Municipal Festival, Emergency Management and Public Safety Commissions	
Pursue grant funding for installation or upgrading of adequate safe rooms in existing mobile home parks, campgrounds, and public parks and beaches	Not Implemented	Low	As needed and as funding and opportunities become available	WDNR, OCPP, OCDEM, Municipal Planning and/or Community Development Commissions	

Table continued on next page.

Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Thunderstorm Wind, Non-Thunderstorm High-Wind, Hail, and Lightning (continued)					
Work with municipalities and businesses to explore installation or upgrading of community safe rooms and hardening projects for public buildings, community facilities, major industrial and manufacturing sites, large businesses, mobile home parks, campgrounds, and fairgrounds to ensure adequate shelter from thunderstorm and high-wind hazards.	Partially Implemented	Medium	As needed	OCPP, OCDEM, Municipal Council/Boards, Engineering, Planning, Community Development, and/or Zoning Department(s)	1, 5, 9, 15, 32, 35, 40, 74
Install lightning grade surge protection devices for critical electronic components used by government, public service, and public safety facilities, such as warning systems, control systems, communications, computers, and data networks	Partially Implemented	High	As needed	OCDEM, Municipal Council/Boards	
Increase public education and awareness of the potential severity of thunderstorm related hazards and non-thunderstorm high-wind hazards and distribute emergency preparedness information related to thunderstorm hazards	Partially Implemented	Low	Ongoing	UW-Extension, OCDEM	
Tornadoes					
Continue to work with local fair/festival organizers to create emergency plans in case of severe weather	Implemented	High	Ongoing	OCDEM, OCPSC, OCSD, Municipal-Festival, Emergency Management and Public Safety Commissions	1, 5, 35, 40, 74, 75
Pursue grant funding for installation or upgrading of adequate safe rooms in existing mobile home parks, campgrounds, and public parks and beaches	Not Implemented	Low	As needed and as funding and opportunities become available	WDNR, OCPP, OCDEM, Municipal Planning and/or Community Development Commission(s)	
Ensure that maintenance, monitoring, and usage policies/procedures of the County's public outdoor warning systems are up-to-date and reflect the needs of fire and police personnel	Implemented	High	Ongoing	OCDEM, OCSD, City of Cedarburg and Mequon Fire and Police Departments	
Work to locally adopt and implement the Wisconsin Outdoor Warning Siren Best Practices	Not Implemented	Low	During the draft phase of this plan, implementation of outdoor warning siren BMPs was under consideration	OCDEM, OCSD	

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Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Tornadoes (continued)					
Work with municipalities and businesses to explore installation or upgrading of community safe rooms and hardening projects for public buildings, community facilities, major industrial and manufacturing sites, large businesses, mobile home parks, campgrounds, and fairgrounds to ensure adequate shelter from tornadoes	Partially Implemented	Medium	As needed	OCPP, OCDEM, Municipal Council/Boards, Engineering, Planning, Community Development, and/or Zoning Department(s)	1, 5, 35, 40, 74, 75
Increase public education and awareness of the potential severity of tornadoes and continue to produce and distribute emergency preparedness information related to tornado events	Implemented	Medium	Ongoing	UW-Extension, OCDEM	
Distribute, and make readily available, information on where to go during severe weather events for campground, park, and beach visitors	Not Implemented	Low	Ongoing	WDNR, OCDEM, OCPP	
Extreme Temperatures					
Organize neighborhood outreach groups who look after vulnerable populations and promote the availability of shelters during extreme heat and cold	Partially Implemented	High	Ongoing	OCDEM, WOPHD	35, 40, 51, 70, 75
Continue to provide special arrangements for payment of heating and cooling bills for customers unable to pay due to financial constraints	Implemented	Medium	As needed	OCHHS, WOPHD	
Designate sites in the County to be used as public cooling/heating shelters during extreme temperature events	Implemented	High	Ongoing	American Red Cross, WOPHD, OCDEM	
Promote measures to reduce heat island effects in urban areas	Not Implemented	Low	As needed and as funding and opportunities become available	OCPP, Municipal Planning Commissions, and Parks and Recreational Departments	
Maintain and update warming and cooling public shelter sites in Ozaukee County	Implemented	Medium	As needed	WOPHD	
Increase public education and awareness of the potential severity of temperature extreme events and distribute emergency preparedness information related to extreme temperature events	Implemented	Medium	Ongoing	UW-Extension, WOPHD, OCDEM	

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Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Extreme Temperatures (continued)					
Promote awareness of public warming and cooling shelters that are available during extreme temperature events through municipal, County, and public health department websites	Partially Implemented	High	Ongoing	American Red Cross, WOPHD, OCHHS, OCDEM	35, 40, 51, 70, 75
Lake Michigan Coastal Hazards					
Regulations and Policy Measures					
Continue to participate in FEMA's NFIP and RiskMAP floodplain mapping program for updated Lake Michigan coastal V and VE zones	Implemented	High	Ongoing, several map updating efforts are underway	FEMA, OCLWM, OCPP	1, 2, 3, 4, 14, 15, 19, 20, 45, 76, 78, 80, 82
Develop and enforce consistent county and municipal shoreland regulations and policies (i.e., ordinances) relating to setbacks along bluffs and ravines	Partially Implemented	High	In place and ongoing	WDNR, OCLWM, OCPP, Municipal Planning Commissions	
Bluff Top and Face Mitigation Measures					
Develop and encourage bluff top and face best management practices	Not Implemented	High	As needed and as funding and opportunities become available	WDNR, WCMP, UW-Sea Grant, OCLWM, OCPP	
Continue to implement engineering studies that assess the variables influencing bluff stability and shoreline recession which determine the stable slope angle setback	Partially Implemented	High	As needed	WDNR, WCMP, OCLWM, OCPP	
Consider relocating buildings within high-risk bluff failure areas	Not Implemented	High	Implement after surveys of structures are complete	USACE, FEMA, WEM, WDNR, OCDEM, OCLWM, OCPP. Municipal Council/Boards, Engineering and Planning Commissions	
Continue to enforce County coastal ravine setback regulations	Implemented	High	In place and ongoing	WDNR, OCLWM, OCPP	
Conduct an updated assessment of the condition and effectiveness of all shoreline protection structures in the County	Partially Implemented	Medium	Assessment to be done every 10 years	WDNR, UW-Sea Grant Institute; Municipal Council/ Boards, Public Works, and Engineering Departments, and Private Landowners	
Ensure breakwater walls and piers within and around the Port Washington harbor are properly designed and constructed to withstand the severe environmental conditions of Lake Michigan	Implemented	Medium	Repair work to the Port Washington harbor breakwater walls was ongoing during the draft phase of this report	City of Port Washington Common Council and Public Works Department	

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Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Lake Michigan Coastal Hazards (continued)					
Bluff Top and Face Mitigation Measures (continued)					
Construct and maintain shoreline protection structures and bluff stabilization measures where public infrastructure is at risk	Not Implemented	High	As needed and as funding and opportunities become available	USACE, WDNR, Municipal-Boards/Common Councils, Public Works, and Engineering Departments; Private Landowners	1, 2, 3, 4, 14, 15, 19, 20, 45, 76, 78, 80, 82
Possible acquisition and demolition of up to 120 structures identified as potentially being located in the northern low-lying shores of Lake Michigan's one-percent-annual-probability floodplain	Not Implemented	High	Implement as funds become available, after floodplain maps have been updated and surveys of structures have been completed	FEMA, USACE, WEM, OCDEM, OCLWM; Municipal Council/Boards, Engineering Commission, Planning, and/or Zoning Department(s), and Property owners	
Encourage the practice of non-structural or nature-based shoreline protection measures, such as living revetment or seawalls and artificial beach and beach nourishment.	Not Implemented	Medium	As funding and opportunities become available	WCMP, UW-Sea Grant Institute, UW-Extension, OCLWM	
Work with WCMP to conduct public outreach and to provide technical assistance regarding BMPs to prevent shoreline erosion and bluff recession	Not Implemented	Medium	Ongoing	WCMP, UW-Sea Grant, UW-Extension, OCLWM, OCPP	
Promote flood insurance to residents along the County's low-lying coast located in Lake Michigan's flood hazard area	Partially Implemented	High	Ongoing	FEMA, WEM, OCLWM, OCDEM	
Winter Storms					
Review the energy efficiency and winter readiness of critical facilities and housing in the community	Partially Implemented	High	Ongoing	OCDEM, WOPHD	1, 5, 70, 75
Continue to work with American Red Cross to establish a system for short-term sheltering of vulnerable populations	Implemented	High	Ongoing	American Red Cross, OCDEM, WOPHD	
Ensure that the necessary amount of snow removal, anti-icing, and deicing equipment is available and operational	Partially Implemented	Medium	Ongoing	OCPWD, OCHD, Municipal Public Works Departments	
Work with utility companies to assess and improve, as needed, electric service systems dependability	Partially Implemented	High	As needed	We Energies, Municipal Public Works and/or Utility Departments	
Continue installing and promote the installation of additional snow fences and planting of windbreaks to protect farm crops and highways	Partially Implemented	Low	As needed	OCHD, Property owners	

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Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Winter Storms (continued)					
Continue to maintain and promote winter hazard awareness, including home and travel safety measures, such as avoiding travel during winter storms; having a shovel, sand, warm clothing, food, and water, in vehicle if travel cannot be avoided; and installing a back-up heating system in at least one room in the home	Implemented	Medium	Ongoing	UW-Extension, WOPHD, OCDEM	1, 5, 70, 75
Organize neighborhood outreach groups who look after vulnerable, or special-needs populations, during and after winter storms	Not Implemented	High	Ongoing	WOPHD, OCHHS, OCDEM	
Publicize the availability of emergency shelter sites for those in need of temporary shelter during winter storms	Implemented	High	Ongoing	American Red Cross, WOPHD, OCHHS, OCDEM	
Drought					
Encourage the development and maintenance of drought emergency plans for local utilities and communities	Partially Implemented	High	Ongoing	Municipal Water Supply Utilities and Planning Departments	27, 31, 32, 47, 67, 68, 74,
Encourage the development of local water conservation programs	Partially Implemented	Medium		NRCS, UW-Extension, OCLWM, Municipal Water Supply Utilities and Planning Departments	
Protect areas of high and very high groundwater recharge potential from inappropriate development	Partially Implemented	High	Incorporated into the Regional Land Use Plan, Ongoing	OCLWM, OCPP, SEWRPC, Municipal Planning Commissions	
Promote regional activities to protect groundwater recharge areas outside of the County boundaries	Not Implemented	Low	As needed	OCLWM, OCPP	
Identify areas with potential groundwater level problems and inspect wells in those areas for adequate depth and construction	Partially Implemented	High	Ongoing	USGS, WDNR, OCLWM, Property owners	
Support agricultural programs that promote soil health, preserve soil moisture, and help to minimize loss of crops and topsoil during drought conditions	Implemented	Medium	Ongoing	USDA, NRCS, UW-Extension, OCLWM	
Support ordinances to prioritize or control water use during drought conditions	Implemented	High	In place and ongoing	WDNR, OCLWM	
Design and plan for water supply infrastructure systems that are not vulnerable to drought events	Not Implemented	Low	Ongoing	Municipal Water Supply Utilities and Planning Commissions	

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Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Drought (continued)					
Promote enrollment of agricultural producers into Federal crop insurance programs	Partially Implemented	Low	Ongoing	USDA-FSA, OCLWM	27, 31, 32, 47, 67, 68, 74,
Continue operation and monitoring of stream gaging stations and groundwater monitoring wells by the WDNR, USGS, National Weather Service, and U.S. Army Corps of Engineers	Partially Implemented	Low	Ongoing	USACE, USGS, WDNR, OCLWM, OCPP	
Increase public education and awareness of the potential severity of drought events and produce and distribute emergency preparedness information related to droughts	Not Implemented	High	Ongoing	USDA, NRCS, UW-Extension, OCLWM, OCDEM	
Utility Failure					
Contamination or Loss of Water Supply					
Reduce the potential for groundwater contamination from agricultural fertilizers, chemicals, and manure with emphasis on groundwater related water quality management areas	Partially Implemented	High	Ongoing	WDNR, WOPHD, OCLWM, Property Owners	21, 35, 55, 67, 74
Promote proper location, installation, cleaning, monitoring, and maintenance of holding tanks, septic systems and other private onsite sewage disposal systems and identify failing onsite sewage disposal systems and leaking or failed sewer laterals for remediation	Implemented	High	Ongoing	WDNR, WOPHD, Wisconsin Department of Safety and Professional Services, OCLWM, Property owners	
Encourage private and public utilities to identify priority water customers and develop a plan for restoring their service first	Partially Implemented	High	2025	Municipal Water Supply Utilities	
Encourage local communities and residents to develop emergency drinking water supply plans and identify potential distribution points for emergency water supply	Not Implemented	Medium	2025	OCDEM, Municipal Water Supply Utilities	
Encourage regular testing of private and public wells for nitrate, bacteria, viruses and other pathogens, pesticides, arsenic, lead, radionuclides, and volatile organic chemicals (VOCs)	Implemented	High	Ongoing	WDNR, WOPHD, UW-Extension, OCLWM, Municipal Water Supply Utilities, Property owners	
Where opportunities exist, develop interconnections between adjacent water utilities	Not Implemented	Low	To be determined	Municipal Water Supply Utilities	

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Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Utility Failure (continued)					
Contamination or Loss of Water Supply (continued)					
Provide onsite-backup power for wells, treatment plants, and other vital water utility system components	Partially Implemented	High	Ongoing	We Energies, OCDEM, Municipal Water Supply and Wastewater Utilities	21, 35, 55, 67, 74
Develop and implement programs to replace publicly owned water service mains, laterals, and other infrastructure that are known to contain lead and promote the replacement of privately-owned portions of lead water service lines and lead plumbing fixtures within homes	Not Implemented	Medium	As needed	WDNR, WOPHD, Municipal Water Supply Utilities	
Promote the use of drinking water filtration devices in homes where there are known lead service lines, lead plumbing, or fixtures where replacement of the lead service line or plumbing fixtures are not currently feasible	Not Implemented	Medium	Ongoing	UW-Extension, WDNR, WOPHD, Municipal Water Supply Utilities	
Continue and expand public education and outreach efforts regarding the effects of arsenic, lead, nitrate, bacteria, viruses and pathogens, radionuclides, VOCs, and other emerging contaminants of concern found in drinking water	Partially Implemented	High	Ongoing	UW-Extension, WDNR, WOPHD, OCDEM, OCHHS, Municipal Water Supply Utilities	
Expand educational and informational outreach material for private well owners to regularly test and maintain their wells	Partially Implemented	High	Ongoing	UW-Extension, WDNR, WOPHD, OCDEM, OCHHS	
Electrical Disruption or Outage					
Continue to review and implement programs to improve the reliability of power supply facilities	Partially Implemented	Medium	Ongoing	We Energies, ATC, WisPSC, OCPWD, OCDEM, Municipal Utility and/or Public Works Departments	1, 5, 51, 74, 75
Maintain a database of critical facilities that have, and do not have, backup power generators	Implemented	High	Ongoing	OCDEM, OCSD	
Create and maintain an emergency plan that includes backup provisions for special electrical medical equipment, sump pump backup systems, telephone provisions, assembly of an emergency kit, protection of electrical equipment, and installation or provision of power generators where appropriate	Implemented	High	2025	We Energies, WisPSC, OCDEM, Municipal Utility and/or Public Works Departments	

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Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Utility Failure (continued)					
Electrical Disruption or Outage (continued)					
Encourage installation of backup generators at critical facilities, shelters, and public utilities	Partially Implemented	High	Ongoing	ATC, We Energies, WisPSC, OCDEM	1, 5, 51, 74, 75
Maintain vegetation and trees in the right-of-way of power lines	Implemented	Medium	Ongoing	ATC, We Energies, OCPWD, Municipal Utility and/or Public Works Departments	
Refine public informational and educational programming to include information on safety and preparation for power outages	Partially Implemented	Low	Ongoing	We Energies, OCDEM, Municipal Electrical Utilities	
Sanitary Sewer System Disruption, Failure, or Loss					
Promote development and/or update of a thorough sewerage system risk and threat assessment that identifies potential vulnerabilities	Implemented	High	2025	OCDEM, Municipal Sewer/Wastewater Utility	1, 5, 21, 35, 74
Develop and/or maintain an emergency operation plan for each sanitary sewerage system	Implemented	High	2025	OCDEM, Municipal Sewer/Wastewater Utility	
Floodproof and stormproof the wastewater treatment plants, pumping stations, and other vital system components	Not Implemented	High	Implement after funds become available and surveys of structures are complete	FEMA, WEM, OCDEM, Municipal Council/Boards, Planning Commissions, Engineering Departments, Zoning Commissions, and Sewer/Wastewater Utility	
Initiate facility planning for sanitary sewerage systems when average daily flow to the wastewater treatment plant approaches 80 percent of the plant's design capacity	Implemented	Medium	As needed	Municipal Sewer/Wastewater Utility	
Provide onsite-backup power for the wastewater treatment plants, pumping stations, and other vital system components	Partially Implemented	High	Ongoing	We Energies, OCDEM, Municipal Sewer/ Wastewater Utility	
Continue and expand public informational and educational programming related to preventing clogging of sewer laterals and responding to basement backups	Implemented	Medium	Ongoing	Municipal Sewer/Wastewater Utility	
Natural Gas Utility Disruption or Loss					
During a fuel shortage, encourage and promote the importance of conserving fuel	Implemented	High	Ongoing	We Energies, OCDEM	11, 35, 38, 74
Develop and implement a contingency plan for natural gas supply with local and emergency officials	Partially Implemented	High	2025	We Energies, OCDEM	

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Table 6.1 (Continued)

Mitigation Measures	Status	Priority	Implementation Timetable	Designated Department, Management Agency, or Personnel	Potential Funding Programs (see Appendix G)
Utility Failure (continued)					
Natural Gas Utility Disruption or Loss					
Ensure emergency officials and first responders are properly informed, trained, and equipped for pipeline emergencies	Partially Implemented	Medium	2025	OCDEM, OCSD, Municipal First Responders	11, 35, 38, 74
Ensure pipeline operators conduct Federal and State pipeline safety inspections and maintenance	Implemented	High	Ongoing	WisDOT-PHMSA, WisPSC, We Energies, OCDEM	
Ensure above-ground gas utility pipeline signage is properly placed and maintained	Implemented	High	Ongoing	WisPSC, We Energies, OCDEM	
Promote the importance of damage prevention by requiring the use of Diggers Hotline	Partially Implemented	Medium	Ongoing	WisDOT-PHMSA, Common Ground Alliance, We Energies, OCDEM	
Ensure pipeline operators develop and implement awareness programs with key stakeholders including the public, emergency officials, local public officials, and excavators	Implemented	High	Ongoing	WisPSC, We Energies, OCDEM	
Distribute informational and educational material on recognizing and responding to natural gas pipeline leaks or emergencies	Partially Implemented	Medium	2025	We Energies, OCDEM	
Fog					
Continue training, planning, and preparedness for mass-casualty incidents involving transportation systems	Implemented	High	Ongoing	American Red Cross, WisDOT, WOPHD, OCDEM, OCHD, OCPWD, OCSD	43, 44, 71, 85
Consider expanding the use of ramp closure devices	Not Implemented	Low	As needed	WisDOT, OCPWD, OSCD	
Ensure proper warning signs and signals	Partially Implemented	Low	As needed	WisDOT, OCPWD, OCSD, Municipal Public Works Departments, Municipal Police, Fire, and EMS Departments	
Continue and expand the use of closed-circuit television cameras (CCTV) on heavily traveled freeways, arterial streets, and highways	Partially Implemented	Low	As needed	OCPWD, Municipal Public Works Departments	
Continue and expand the use of advisory information measures including variable message signs (VMS) on the freeway system and appropriate arterial streets	Not Implemented	Low	As needed	OCPWD, Municipal Public Works Departments	
Increase public education and awareness	Partially Implemented	Low	Ongoing	OCDEM, OCHD, OCPWD, OCSD	

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Table 6.1 (Continued)

Note: The following abbreviations are used for designated management agencies or departments:

ATC= American Transmission Company
FEMA= Federal Emergency Management Agency
NOAA= National Oceanic and Atmospheric Administration
NRCS= Natural Resources Conservation Service
NWS= National Weather Service
OCDEM= Ozaukee County Division of Emergency Management
OCHD= Ozaukee County Highway Department
OCHHS= Ozaukee County Health and Human Services
OCLWM= Ozaukee County Land and Water Management
OCPP= Ozaukee County Parks and Planning
OCPSC= Ozaukee County Public Safety Committee
OCPWD= Ozaukee County Public Works Department
OCSD= Ozaukee County Sheriff's Department
OWLT= Ozaukee-Washington Land Trust
PHMSA= Pipeline and Hazardous Materials Safety Administration
PSC= Public Service Commission
USACE= U.S. Army Corps of Engineers
USDA-FSA= U.S. Department of Agriculture - Farm Service Agency
USGS= U.S. Geological Survey
WCMP= Wisconsin Coastal Management Program
WDNR= Wisconsin Department of Natural Resources
WEM= Wisconsin Emergency Management
WisDOT= Wisconsin Department of Transportation
WOPHD= Washington-Ozaukee Public Health Department

Source: SEWRPC

potential funding sources, including sources other than solely local-level sources, is an integral part of implementing a successful mitigation plan. The following description of funding sources includes those that appear to be applicable for the County and local units of government as of 2020. However, because funding programs and opportunities are constantly changing, the involved staff of County and local units of government will need to monitor the potential funding sources and programs. Some of the programs described in this chapter may not be available under all envisioned conditions in the County or to its residents and/or property owners for a variety of reasons, including, for example, eligibility requirements or lack of funds at a given time in Federal and/or State budgets. Nonetheless, the list of sources and programs set forth in this chapter should provide a starting point for identifying possible funding for implementing the hazard mitigation plan recommended in this report (see also Appendix G).

Federal Emergency Management Agency Programs

The Federal Emergency Management Agency (FEMA) funds several programs that in the State of Wisconsin are administered through WEM. These programs include the Hazard Mitigation Grant Program, the Flood Mitigation Assistance Program, the Pre-Disaster Mitigation Program, and the Public Assistance Program. These programs are described below.[296] Examples of types of projects that can be eligible for funding under the Hazard Mitigation Grant Program, the Flood Mitigation Assistance Program, and the Pre-Disaster Mitigation Program are given in Appendix G.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) can provide up to 75 percent of the costs attendant to certain natural hazard mitigation programs. In the case of flood mitigation, projects can include floodproofing or acquiring and relocating floodprone properties, elevating structures in compliance with National Flood Insurance Program (NFIP) standards, and other flood control measures, including structural projects, where identified as cost-effective. To be eligible for mitigation activities with FEMA funding, structures must be insured under the NFIP.

Under the HMGP, the balance of the costs is shared by the State of Wisconsin (12.5 percent) and the grantee (12.5 percent). Communities in Wisconsin can apply through the State for HMGP funds only after a Presidential disaster declaration is issued. HMGP funds must be applied for within 60 days of the declaration. The State, as HMGP grantee, is responsible for identifying and prioritizing projects. Eligible projects must be included as part of the grantee's all-hazard mitigation plan and must meet cost-benefit criteria established by FEMA. Although State and local units of government are eligible applicants, HMGP funds can be used on private property for eligible projects. The HMGP gives priority to properties identified by FEMA as repetitive-loss properties.

Flood Mitigation Assistance Program

The Flood Mitigation Assistance (FMA) program can provide up to 75 percent of the costs attendant to acquiring, relocating, elevating, and floodproofing structures in compliance with NFIP standards. Properties included in a project subapplication for FMA funding must be NFIP-insured at the time of the application submittal and prior to the period of availability or application start date. Flood insurance must be maintained through completion of the mitigation activity and for the life of the structure. In addition to participating in the NFIP, eligible program applicants must meet cost-benefit criteria established by FEMA. Mitigating repetitive-loss properties is given a high priority under this program. Increased cost of compliance (ICC) coverage under the NFIP may provide a funding source for bringing noncompliant structures into compliance after a flood loss.

Pre-Disaster Mitigation Program

FEMA's Pre-Disaster Mitigation Program (PDM) can potentially provide up to 75 percent of the costs attendant to pre-disaster mitigation planning and implementing cost-effective mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. Examples of eligible projects include property acquisition, structure acquisition and demolition or relocation, structure elevation, safe room construction, dry floodproofing of nonresidential structures and historic residential structures, and minor localized flood reduction projects.

It should be noted that at the time of publication of this Report, FEMA was accepting comments on the *Building Resilient Infrastructure and Communities Policy (BRIC)*. This new policy describes a new program authorized by recent legislation that allows FEMA to set aside 6 percent of estimated disaster expenses for each major disaster to fund a mitigation grant program to assist States, territories, Tribes, and local governments. The new BRIC program would supersede the existing PDM program and is aimed to promote a national culture of preparedness through encouraging investments to protect communities and infrastructure and strengthening national mitigation capabilities to foster resilience.

Public Assistance Program

FEMA's Public Assistance Program (PA) can provide some limited assistance with respect to structure elevation and relocation. For example, if entire portions of a community were to be relocated outside of a floodplain, this program can assist in rebuilding the necessary infrastructure in the new location. Funding under this program is provided for repairing infrastructure damaged during a flood that results in a Presidential disaster declaration. In making repairs to the infrastructure, cost-effective mitigation activities may be included. If a community determines that a badly damaged facility is not to be repaired, the estimated damage amount may be used to fund an alternate project. Funding provided under the PA may pay for cost-effective hazard mitigation measures for facilities damaged by the incident. In addition, funding from the PA may be combined with funding from the HMGP, FMA, and/or PDM programs to implement mitigation measures on the same facility; however, they cannot be combined to pay for the same work.

U.S. Department of Housing and Urban Development
Community Development Block Grant Program

Community Development Block Grant (CDBG) programs, funded by the U.S. Department of Housing and Urban Development, are administered by the Wisconsin Department of Administration. The Community Development Block Grant Emergency Assistance Program is a special program that the Wisconsin Department of Administration, Division of Energy, Housing and Community Resources activates to assist local units of government that have recently experienced a natural or man-made disaster. The program provides funds to address housing needs that occur as a direct result of natural or man-made disasters, with preference given to those households with incomes at or below 80 percent of the county median household income. A local unit of government that has recently experienced a natural or man-made disaster may apply for assistance in addressing the housing problems caused by the disaster. Generally, cities, villages, and towns with populations less than 50,000 and all counties, except Milwaukee, Waukesha, and Dane, are eligible to apply. The program also makes funds available for repairing public infrastructure affected by a natural disaster. Eligible activities dependent upon the nature of the disaster may include repairing damage to the dwelling unit; acquiring and demolishing dwellings unable to be repaired; costs for new housing units to replace those lost in the disaster; and repairs to publicly owned utility systems, streets, and sidewalks.

The Community Development Block Grant for Public Facilities Program is a versatile financing tool for general purpose local units of government in need of funds to undertake needed infrastructure and public building projects. This program is designed to enhance the vitality of a community by undertaking public investment that contributes to its overall community and economic development. Eligible applicants are local units of government that are not HUD entitlement communities.[297] Projects must meet one of three national objectives for the program. These are: 1) the project principally benefits low- and moderate-income persons; 2) the project eliminates slum and blight; and 3) the proposed activity meets an urgent local need, typically a catastrophic event. Eligible activities include utilities and streets, fire stations and emergency vehicles, community/senior centers and shelters, and municipal telecommunications. Grant funds are available on a continual basis. The maximum grant for any single applicant is $500,000, and applicants can receive only one grant per 12-month period.

U.S. Small Business Administration Programs

The U.S. Small Business Administration (SBA) provides disaster loans to homeowners and businesses to repair or replace property damaged in a declared disaster. SBA loans are granted only for uninsured losses. Loans may be used to meet required building codes, such as the NFIP requirements. SBA may also provide

[297] *HUD entitlement communities include principal cities of Metropolitan Statistical Areas, other metropolitan cities with populations of at least 50,000, and urban counties with populations of at least 200,000 (excluding the population of entitlement cities). There are no entitlement communities in Ozaukee County.*

loans for relocation out of special flood hazard areas when such locations are required by local officials. While SBA's enabling legislation generally prohibits the agency from making disaster loans for voluntary relocations, there are exceptions that can be made, including relocating homeowners, renters, and business owners out of special flood hazard areas when the community is participating in a buyout program. These loans would be limited to the amount necessary to repair or replace the damage at the disaster site. SBA loans may also be used to refinance existing mortgages. Up to 20 percent of the disaster loan can be used for mitigation measures.

U.S. Army Corps of Engineers

The Army Corps of Engineers programs are potential sources of funding for implementing the floodplain management recommendations of this plan. In order to be eligible for funding, the plan components must meet specific Corps economic feasibility and other criteria. The programs that may be applicable include the following:

- Section 22—Water resources planning assistance (50 percent Federal, 50 percent local cost share)
- Section 103—Hurricane and Storm Damage Reduction Program. Maximum $5.0 million per project (65 percent Federal, 35 percent local cost share)
- Section 205—Flood damage reduction projects. Maximum Federal cost for planning, design, and construction is $10.0 million per project (65 percent Federal, 35 percent local cost share)
- Section 208—Clearing debris and sediment from channels for flood prevention. Maximum $500,000 per project (65 percent Federal, 35 percent local cost share)
- Section 14—Emergency streambank and shoreline protection. Maximum $1.5 million per project (65 percent Federal, 35 percent local cost share)

U.S. Department of Agriculture Farm Service Agency

The U.S. Department of Agricultural Farm Service Agency (USDA-FSA) oversees several voluntary conservation-related programs that provide direct and indirect hazard mitigation benefits. These programs work to address a large number of farming- and ranching-related issues including drinking water protection, reducing soil erosion, preserving wildlife habitat, preserving and restoring forest and wetlands, and aiding farmers whose farms have been damaged by natural disasters. Several of these programs are described below (also see Appendix G).

Conservation Reserve Program

The Conservation Reserve Program (CRP) is a voluntary program for agricultural landowners that provides annual rental payments and up to 50 percent cost-share assistance to establish long-term, resource-conserving covers on eligible farmland. The CRP goal is to reduce soil erosion, protect the nation's ability to produce food, reduce sedimentation in streams and lakes, improve water quality, establish wildlife habitat, and enhance forest and wetland resources. Implementing the program can also have hazard mitigation benefits, including reducing crop losses and property damages due to flooding. Through the program, farmers are encouraged to convert highly erodible cropland or other environmentally sensitive areas to vegetative cover such as prairie-compatible, noninvasive forage mix, wildlife plantings, trees, filter strips, or riparian buffers. The rental payment that the landowner receives is based on the agricultural rental value of the land.

U.S. Department of Agriculture Natural Resources Conservation Service

The U.S. Department of Agricultural Natural Resources Conservation Service (USDA-NRCS) provides farmers and ranchers with financial and technical assistance to voluntarily install conservation measures to concurrently help the environment and agricultural operations. Many of these programs may serve as potential funding sources for flood mitigation efforts by the County and local communities (see Appendix G).

Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources (WDNR) operates programs that may serve as potential funding sources for flood mitigation efforts by the County and local communities (see also Appendix G). These programs are described below.

Municipal Flood Control Grants

Under Chapter NR 199, "Municipal Flood Control Grants" of the *Wisconsin Administrative Code* municipalities including cities, towns, and villages, as well as metropolitan sewerage districts, are eligible for cost-sharing grants from the State for projects such as acquiring and removing structures; floodproofing and elevating structures; riparian restoration projects; acquiring vacant land or purchase of easements to provide additional flood storage or to facilitate natural or more efficient flood flows; constructing facilities for the collection, detention, retention, storage, and transmission of stormwater and groundwater for flood control and riparian restoration projects; and preparing flood mapping projects. Municipalities and metropolitan sewerage districts are eligible for up to 70 percent State cost-share funding for eligible projects and would have to provide at least a 30 percent local match. Applications are due on March 15 of even-numbered years.

Knowles-Nelson Stewardship Local Grant Assistance Programs

Local units of government are eligible to apply for funding through four stewardship grant programs and two related federal programs administered by the WDNR. The WDNR programs include the Aids for the Acquisition and Development of Local Parks, the Urban Green Space, the Urban Rivers, and the Acquisition of Development Rights programs. The WDNR also administers the Federal Land and Water Conservation Fund and Recreational Trails Act programs. These programs provide 50 percent matching grants to cities, villages, towns, counties, public inland lake protection and rehabilitation districts, and qualified nonprofit conservation organizations. Eligible activities include acquiring land; development and renovation projects for nature-based outdoor recreation; developing, maintaining, and restoring trails; river habitat restoration projects that serve public recreation or resource conservation purposes; and purchasing land for noncommercial gardening in urban areas. The annual application deadline is May 1.

Stormwater Management Program

The WDNR administers a Targeted Runoff Management (TRM) grant program provided for under Section 281.65(4c) of the *Wisconsin Statutes*. Local governmental units may be reimbursed up to 70 percent of eligible costs associated with installing Best Management Practices (BMPs) to limit or end nonpoint water pollution. Grant awards for small-scale agricultural and urban projects cannot exceed $150,000. Grants provided under this program may be used for projects to control nonpoint source pollution and may be available to partially support dual-purpose (water quality and water quantity) detention ponds, streambank protection projects, or other stormwater management facilities.

The WDNR also administers an Urban Nonpoint Source and Stormwater Grant Program provided for under Section 281.66 of the Wisconsin Statutes. Cities, towns, villages, and counties are eligible for grants under this program to improve urban water quality by limiting or ending sources of urban nonpoint source pollution. Funded projects are site-specific and targeted to address high priority problems in urban project areas. Two types of grants are available under this program: planning grants and construction grants. Construction grants are made for construction projects designed to control stormwater runoff rates, volumes, and discharge quality from nonpoint sources within existing urban development. Eligible project sponsors can be reimbursed up to 50 percent of project costs to construct BMPs. A project must be located in an urban area to be eligible for BMP cost sharing. Eligible activities include construction of structural urban BMPs such as detention basins, wet basins, infiltration trenches, infiltration basins, or wetland basins; engineering design and construction services for BMP installation; land acquisition and easement purchase; storm sewers; and streambank and shoreland stabilization projects. Projects are selected for funding based on a competitive process.

Municipal Dam Grant Program

The 2019-2021 biennial budget provides approximately $3.5 million to fund eligible engineering and construction costs associated with the maintenance, repair, modification, or abandonment and removal of municipally-owned dams. The program will cover 50 percent of the first $400,000 of eligible project costs and 25 percent of the next $800,000 of dam repair, reconstruction, or modification project costs. The

program will cover 100 percent of the first $400,000 for dam abandonment and removal projects. Cities, towns, villages, counties, tribes, and public inland lake protection and rehabilitation districts may apply for funds through this program.

Dam Removal Grant Program

The 2019-2021 Biennial Budget provides approximately $500,000 to fund dam removal projects for any owner who wishes to remove their dam. This program provides reimbursement for 100 percent of eligible costs up to a maximum of $50,000 to remove a dam. Counties, cities, villages, towns, tribes, public inland lake protection and rehabilitation districts, and private dam owners may apply for grant funds through this program.

Wisconsin Coastal Management Program

The Wisconsin Coastal Management Program administers an annual competitive grants program available for the 15 Wisconsin coastal counties. Under the category Coastal Resource and Community Planning, funds are available for projects that support natural hazard planning and development of ordinances.

Other Potential Funding Sources

A variety of other potential funding sources exist which may provide funds for implementation of elements of the recommended hazard mitigation plan. These are listed in Appendix G.

6.4 PLAN MONITORING AND REEVALUATION STRATEGIES

For a hazard mitigation plan to be successful it must not only be implemented; it must be monitored. Plan monitoring is best accomplished through a formal, periodic process designed to measure and assess progress in implementation, changes in outside circumstances that may affect the plan and efforts to implement it, and changes to the plan or the implementation process. The plan should also be reviewed following each hazard event to assess its continued viability and the need for revisions.

Plan Monitoring

Review

Toward ensuring successful monitoring of the hazard mitigation plan, it is recommended that the Ozaukee County All Hazards Mitigation Plan LPT meet periodically to review the plan and the status of its implementation with a view toward enhancing and improving response to natural and other hazard events. Plan review meetings will be held following any disasters that affect the County and at the discretion of the Director of the County DEM. These meetings will provide the opportunity to develop and recommend any necessary revisions of the plan to the Ozaukee County Board of Supervisors, as well as to the local units of government involved. The revisions would be proposed, considered, and adopted in the form of formal amendments to the hazard mitigation plan. This review process will be coordinated and conducted by the County DEM, with input from, coordination with, and participation by all concerned County officials and staff, all units and agencies of government involved in plan implementation, and concerned private parties. The LPT, in its review process, will periodically examine the plan and the efforts to implement it with respect to:

1. Whether any hazards affecting the County and local units of government have changed, and if so, how they have changed

2. Whether any hazard mitigation goals and objectives have changed, or need to be changed

3. The degree and extent of progress made in implementing previously identified hazard mitigation actions

4. Whether the plan elements and their priorities should remain unchanged or need modification

5. Whether any new plan elements are needed

6. Whether applicable funding programs and levels have changed.

As an integral part of its review process, it is recommended that the County DEM, with review and guidance of the LPT, will submit a written report to the Local Emergency Planning Committee and the County Board that sets forth the status of plan implementation efforts, details plan implementation actions taken over the past year, prioritizes mitigation goals and activities for the next year, and sets forth any recommended revisions to the plan. It is also recommended that the County DEM oversee the development and maintenance of a tracking and archiving system for all future detailed hazard mitigation studies undertaken by or for the County or the local units of government concerned. Such studies should be evaluated using policies established either by the LPT or the County Board.

The meetings of the LPT will continue to be publicly noticed and salient decisions recorded in County DEM files and, where appropriate, on the County website and in press releases, among others. Meetings of the LPT are considered public meetings under Wisconsin Law and are open to all interested parties. County DEM staff will also continue to organize community level events to increase public awareness, participation, and preparedness. The staff will ensure that appropriate notices, agendas, and other documentation are provided to interested persons and LPT members in a timely manner. The venue and timing of these events shall be varied to ensure the widest possible participation and geographic spread across the County. Through these community level events, staff will gain an understanding of issues of concern, encourage public involvement, and maintain hazard awareness and preparedness at a high level. County DEM will be responsible on a day-to-day basis for creating and implementing a common monitoring system. This will require close cooperation and coordination with other units of government and agencies involved. This review will form part of the agenda for the aforementioned annual meeting of the LPT.

Post-Disaster Review

The plan monitoring and refinement strategy will include a post-disaster component whereby the plan is reviewed and evaluated after any future major hazard event. Based upon this review, the hazard mitigation plan will be updated or revised as needed based upon the experiences with, circumstances, and consequences of the hazard. In this regard, the post-disaster review effort will be coordinated with the emergency operations program administered by the County DEM in partnership with the local units of government. The experiences of the emergency operations may indicate a need for refined mitigation actions that would then be incorporated into the plan. Any plan updating found to be needed will be incorporated into the annual plan update noted above.

Reevaluation Strategy

As a condition of eligibility for receiving project grant funding from its mitigation grant programs, FEMA requires that hazard mitigation plans be reviewed, revised, and resubmitted for approval every five years. The updated plan should document changes that have occurred since the development of the plan, such as implementing recommended mitigation measures, changes in development, occurrences of hazard events, and changes in local priorities. In addition, it should update the risk analysis. This should include both determining whether the risks posed by specific hazards have changed and reevaluating the identified hazards to determine whether any changes need to be made in the set of hazards addressed by the plan. Finally, the updated plan should evaluate the relevance of the plan's goals, objectives, and recommended strategies and update them as appropriate.

To meet these requirements, it is recommended that the hazard mitigation plan be updated at a minimum of five-year intervals. Updating efforts should be led by the Director of the Ozaukee County DEM in partnership with other appropriate County Departments. Reevaluation, updating, and revision of this plan should be initiated approximately 24 months prior to expiration of this plan. As part of the updating process, the Director will reconstitute the Hazard Mitigation LPT to oversee development of the updated plan. The team should include representatives of all of the municipalities that are covered under the plan. The meetings of the LPT will be publicly noticed. In addition, at appropriate times during the updating process, members of the public and adjacent communities will be provided with opportunities to review and submit questions and comment on the plan update. Plan updating will be conducted according to relevant guidance available from FEMA and WEM. Following completion of the updated plan in draft form, it will be submitted to WEM and FEMA for review and approval. Following approval by FEMA, the updated plan will need to be adopted by the Ozaukee County Board and by the governing bodies of the incorporated municipalities in the County.

Incorporating Existing Planning Mechanisms

The Hazard Mitigation LPT will meet on an annual basis to provide a mechanism for ensuring that the actions identified in the Plan are incorporated into ongoing County planning activities. Ozaukee County currently utilizes comprehensive land use planning, land use regulations, neighborhood planning, and building codes to guide and control development in the County. These existing mechanisms will have hazard mitigation strategies integrated into them where applicable. In addition, the County will require that participating local municipalities address hazards in their comprehensive plans and land use regulations. Specifically, one of the goals in the Plan promotes the spatial distribution of land uses to minimize hazards and dangers to the health, welfare, and safety of County residents from natural and manmade hazards. The County Planning and Parks Department and Land and Water Management Department will conduct periodic reviews of the County's comprehensive plan and land use policies, analyze any plan amendments, and provide technical assistance to other local municipalities in implementing these requirements.

APPENDICES

OZAUKEE COUNTY HAZARD MITIGATION PLAN UPDATE LOCAL PLANNING TEAM MEMBERS, MEETING AGENDAS, AND MEETING SUMMARY NOTES

APPENDIX A

Ozaukee County Hazard Mitigation Plan Update
Local Planning Team Members

Scott Ziegler, Chair ..... Director, Ozaukee County Division of Emergency Management
Megan Beauchaine, Secretary ..... Planner, Southeastern Wisconsin Regional Planning Commission
Daniel Birenbaum ..... Fire Chief and Department of Public Works, Village of Belgium
Tom Czaja ..... Ozaukee County Amateur Radio Emergency Service (OZARES)
Sarah DeBruijn ..... Emergency Manager, Village of Saukville
Paul Dondero ..... Staff, Concordia University
Skip Douglas ..... Ozaukee County Amateur Radio Emergency Service (OZARES)
Jason Dzwinel ..... Administrator, Ozaukee County
Rachel Fellenz ..... Executive Director of Student Services
Mequon-Thiensville School District
Thomas Frank ..... Chief, Cedarburg Police Department
Dan Gellert ..... Former Deputy Director, Ozaukee County Division of Emergency Management
Hannah Grobelny ..... Public Health Strategist
Washington Ozaukee Public Health Department
John Hanan ..... Emergency Preparedness Coordinator
Washington Ozaukee Public Health Department
Laura Herrick ..... Chief Environmental Engineer
Southeastern Wisconsin Regional Planning Commission
Andy Holschbach ..... Land and Water Management Director,
Ozaukee County
Terry Hoffman ..... Staff, WE Energies
Robert Kaslick ..... Deputy Director, Ozaukee County Division of Emergency Management
John Koster ..... Director of Public Works, Town of Cedarburg
Andy LaFond ..... Director of Public Works, Village of Thiensville
Rich Mueller ..... Emergency Manager, Town of Fredonia
Aaron Owens ..... Senior Planner
Southeastern Wisconsin Regional Planning Commission
Christina Richards ..... Land Information Coordinator, Ozaukee County
Patty Ruth ..... Emergency Preparedness Coordinator (retired)
Washington Ozaukee Public Health Department
Ben Schliesman ..... Southeast Regional Director, Wisconsin Emergency Management
Justin Schoenemann ..... Assistant City Administrator, City of Mequon
Roger Strohm ..... Director of Public Works, Village of Fredonia
Mario Valdes ..... Director of Campus Safety, Concordia University
Sarah Viera ..... Executive Director of Business
Mequon-Thiensville School District
Dawn Wagner ..... Administrator, Village of Saukville
Patrick Wester ..... Assistant Fire Chief and Department of Public Works Director
Village of Belgium
Brian Weyker ..... Fire Chief, Village of Fredonia
Tom Zajdel ..... Volunteer Emergency Manager, Village of Newburg

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05/14/2020, 5/18/20

Ozaukee County Department of Emergency Management
Southeastern Wisconsin Regional Planning Commission

Notice of Meeting and Agenda

OZAUKEE COUNTY HAZARD MITIGATION PLAN LOCAL PLANNING TEAM

DATE: February 13, 2018

TIME: 1:00 to 3:00 p.m.

PLACE: Ozaukee County Justice Center
Lower Level Sherriff's Training Room
1201 South Spring Street
Port Washington, Wisconsin 53074

AGENDA:

1. Welcome
2. Introductions
3. Overview of hazard mitigation planning: Sean Rausch, Disaster Response and Recovery Planner, WEM
4. Background to the Ozaukee County Hazard Mitigation Plan and updating process: Megan Beauchaine, Research Analyst, SEWRPC
    a. 2013 plan (first update)
    b. SEWRPC planning format
    c. Main components to be reviewed and revised (Attachment 1)
    d. Tentative schedule for the plan update (Attachment 2)
    e. Local Planning Team role
5. Review hazard mitigation goals from 2013 plan (Attachment 3): Megan Beauchaine
6. Hazard and vulnerability assessment exercise (Attachment 4): Aaron Owens
7. Adjourn

Megan A. Beauchaine
Secretary

Enclosures

Attachment 1

DETAILED PLAN COMPONENTS FOR UPDATING THE OZAUKEE COUNTY HAZARD MITIGATION PLAN

Plan Component
PLANNING PROCESS A. Public Involvement (Local Planning Team) B. Public Meetings C. Review of Status of Plan Implementation (Develop, distribute, and summarize survey of designated management agencies)
BASIC STUDY AREA INVENTORY AND ANALYSIS A. Civil Divisions B. Demographic and Economic Characteristics 1. Population 2. Households 3. Employment C. Land Use D. Surface Water System and Flood Hazard Areas E. Lake Michigan Shoreline Hazard Areas F. Transportation System (including roadway and rail systems) G. Utility Systems H. Critical Community Facilities 1. Hospitals and major clinics 2. Fire Stations 3. Local Police Stations 4. County Sheriff or State Highway Patrol Office or Substations 5. Government Administration Buildings 6. Schools 7. Nursing Homes I. Communication Systems (including dispatch centers) J. Hazard Management Regulations and Programs K. Historic Sites
RISK ASSESSMENT A. Hazard Identification and Mapping B. Historic Hazard Problems Vulnerability Analysis Methods and Procedures C. Vulnerability Assessment 1. Historical Hazard Condition 2. Recent Hazard Condition 3. Vulnerability and Community Impacts Assessment 4. Potential Future Changes in Hazard Condition (only where applicable) 5. Multi-Jurisdictional Risk Assessment Considerations (only where applicable)
MITIGATION STRATEGIES A. Identification, Analysis, and Evaluation of Alternative Mitigation Actions and Projects (by hazard, or group of hazards for flooding, tornadoes, thunderstorms, winter storms, extreme heat or cold, coastal erosion, and others, as identified under the risk assessment) B. Multi-Jurisdictional Strategy Evaluation C. Summary of Recommended Mitigation Measures (include tabular summary of plan)
PLAN MAINTENANCE PROCESS, INCLUDING IMPLEMENTATION, LOCAL ADOPTION, AND REVISION (include tabular list of measures and implementation assignments)

NOTE: Some of the above inventory items will require provision of data from local communities.

Attachment 2

PROPOSED WORK SCHEDULE FOR UPDATING THE OZAUKEE COUNTY HAZARD MITIGATION PLAN

Task	Estimated Completion Date[a]
Update Planning Team Membership	October 31, 2017
Survey Designated Management Agencies Regarding Status of Implementation of Original Plan	On Going
Kickoff Planning Team Meeting	February 2018
Public Participation	February 2018 through March 2020
Planning Team Meeting (Review Chapter 1 Introduction and Background and Chapter 2 Study Area Inventory)	Summer 2018
Planning Team Meeting (Review Chapter 3 Analysis of Hazard Conditions and Chapter 4 Hazard Mitigation Goals)	Spring 2019
First Public Meeting – Introduction to Hazard Mitigation Planning and Review of Chapters 1-4	Spring 2019
Planning Team Meeting (Review Chapter 5 Hazard Mitigation Strategies and Chapter 6 Plan Adoption, Implementation, Maintenance, and Revision)	Winter 2020
Second Public Meeting – Review Draft Report	Spring 2020
Submit Draft Plan Update to Wisconsin Division of Emergency Management for Review	April 1, 2020
Revise Plan Based on State Review	May 2020
Submit Final Plan Update to the Federal Emergency Management Agency for Approval Pending Adoption	May 31, 2020
Formal Adoption by County and Municipalities	July 31, 2020
Anticipated Period of Performance Deadline	August 30, 2020

[a] Estimated completion dates assume a one year extension approval by FEMA.

NOTE: The 2013 Hazard Mitigation Plan expires 10/18/2018 per WEM.

Attachment 3

HAZARD MITIGATION GOALS FROM THE 2013 HAZARD MITIGATION PLAN

The following goals have been established for the Ozaukee County hazard mitigation planning program:

1. To preserve life and minimize the potential for injuries or death.

2. To preserve and enhance the quality of life throughout Ozaukee County by identifying potential property damage risks and recommending appropriate mitigation strategies to minimize potential property damage.

3. To promote County-wide planning that avoids transferring the risk from one community to an adjacent community, where appropriate.

4. To identify potential funding sources for mitigation projects and form the basis for FEMA project grant applications.

Attachment 4

HAZARD AND VULNERABILITY ASSESSMENT TOOL
OZAUKEE COUNTY HAZARD MITIGATION PLAN UPDATE

EVENT	PROBABILITY	SEVERITY = (MAGNITUDE - MITIGATION)			
		HUMAN IMPACT	PROPERTY IMPACT	BUSINESS AND AGENCY IMPACT	PREPAREDNESS
	Likelihood This Will Occur	*Possibility of Death or Injury*	*Physical Losses and Damages*	*Interruption of Services*	*Pre-planning*
SCORE	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = High* *2 = Moderate* *3 = Low or none*
1. Riverine flooding					
2. Stormwater flooding					
3. Lake flooding					
4. Tornado					
5. Thunderstorm					
6. High straight-line wind					
7. Lightning					
8. Hail					
9. Heavy snow storm					
10. Blizzard					
11. Ice storm					
12. Extreme cold					
13. Extreme heat					
14. Drought					
15. Fog					
16. Dust storm					
17. Lake Michigan Erosion					
18. Earthquake					
19. Contamination or loss of water supply system					
20. Wildfire					
21. Dam failure					
22. Landslide					
23. Land subsidence					
Other Hazard Event (write in):					
Other Hazard Event (write in):					
AVERAGE SCORE	- -	- -	- -	- -	- -

RESPONDENT AFFILIATION: _____

Source: Kaiser Permanente and SEWRPC

SUMMARY NOTES OF THE FEBRUARY 13, 2018 MEETING OF THE OZAUKEE COUNTY HAZARD MITIGATION PLAN LOCAL PLANNING TEAM

INTRODUCTION

The February 13, 2018 meeting of the Ozaukee County Hazard Mitigation Plan Local Planning Team was convened at the Ozaukee County Sheriff's Office at 1:10 p.m. The meeting was called to order by Scott Ziegler, Director of Ozaukee County's Division of Emergency Management. Attendance was taken by circulating a sign-in sheet.

In attendance at the meeting were the following individuals:

Local Planning Team Members

Scott Ziegler, Chair	Emergency Management Director, Ozaukee County
Megan A. Beauchaine, Secretary	Research Analyst, Southeastern Wisconsin Regional Planning Commission
Daniel Birenbaum	Fire Chief and Department of Public Works, Village of Belgium
Tom Czaja	OZARES-Ozaukee County Amateur Radio Emergency Service, Member
Paul Dondero	Staff, Concordia University of Wisconsin
Skip Douglas	OZARES-Ozaukee County Amateur Radio Emergency Service, Member
Jason Dzwinel	Ozaukee County Administrator
Rachel Fellenz	Mequon-Thiensville School District, Executive Director of Student Services
Daniel Gellert	Emergency Management Deputy Director, Ozaukee County
Laura Herrick	Chief Environmental Engineer, Southeastern Wisconsin Regional Planning Commission
Terry Hoffman	WE Energies, Staff
John Koster	Director of Public Works, Town of Cedarburg
Andy LaFond	Director of Public Works, Village of Thiensville
Aaron Owens	Planner, Southeastern Wisconsin Regional Planning Commission
Sean Rausch	Disaster Response and Recovery Planner, Wisconsin Division of Emergency Management
Christina Richards	Land Information Coordinator, Ozaukee County
Patty Ruth	Emergency Preparedness Coordinator, Washington Ozaukee Public Health Department
Justin Schoenemann	Assistant City Administrator, City of Mequon
Ben Schliesman	Southeast Regional Director, Wisconsin Division of Emergency Management
Sarah Viera	Executive Director of Business Services, Mequon Thiensville School District
Dawn Wagner	Administrator, Village of Saukville
Patrick Wester	Assistant Fire Chief and Department of Public Works Director, Village of Belgium
Brian Weyker	Fire Chief, Village of Fredonia
Tom Zajdel	Volunteer Village Emergency Manager of Newburg, Ozaukee County

Mr. Ziegler welcomed the attendees to the meeting and thanked them for their participation. He then asked attendees to introduce themselves.

OVERVIEW OF HAZARD MITIGATION AND HAZARD MITIGATION PLANNING PROCESS

Mr. Ziegler introduced Megan Beauchaine, Research Analyst, Southeastern Wisconsin Regional Planning Commission (SEWRPC). Ms. Beauchaine briefly reviewed the meeting's agenda. She then introduced Sean Rausch, Disaster Response and Recovery Planner, Wisconsin Division of Emergency Management. At Ms. Beauchaine's request, Mr. Rausch presented an overview of hazard mitigation and the hazard mitigation planning process.

[Secretary's Note: A copy of Mr. Rausch's presentation is attached herein as Exhibit A.]

Related to discussion on elevating structures above the regulatory floodplain, Ben Schliesman asked what changes to flood insurance could a property owner expect if they choose to elevate their structure and get mapped out of the floodplain. Mr. Rausch noted that technically, the property owner would not be required to carry flood insurance if they were mapped out of the floodplain, although Wisconsin Emergency Management would still recommend they keep flood insurance. The flood insurance would be significantly less expensive than if they were still below the regulatory floodplain elevation. Mr. Rausch also noted that even if a building is raised above the regulatory floodplain, there would also need to be dry land access to the structure for emergency response purposes per Chapter NR 116 of Wisconsin Administrative Code.

BACKGROUND ON THE CURRENT EDITION OF THE OZAUKEE COUNTY HAZARD MITIGATION PLAN AND DEVELOPMENT OF THE PLAN UPDATE

Ms. Beauchaine presented a brief background on SEWRPC and its role in hazard mitigation planning. She then discussed the first update of Ozaukee County's hazard mitigation plan that was completed in 2013.

After discussion of the current edition of the County's plan, Ms. Beauchaine presented the main components that are developed as part of SEWRPC's hazard mitigation planning format. She also presented a tentative schedule for the current plan updating process. In addition, Ms. Beauchaine explained the main functions of the Local Planning Team in the plan development process.

[Secretary's Note: Ms. Beauchaine's presentation is attached herein as Exhibit B.]

HAZARD AND VULNERABILITY ASSESSMENT EXERCISE

Ms. Beauchaine introduced Aaron Owens from SEWRPC's staff and asked him to lead the hazard and vulnerability assessment exercise. Mr. Owens stated that as part of the hazard and vulnerability analysis for the plan, it will be necessary to decide which hazards will be addressed by the plan. He noted that a hazard and vulnerability assessment tool and instructions for completing the tool were included with the agenda for this meeting. He explained that the tool is a modified version of a tool developed by Kaiser Permanente for assessing the risks faced by healthcare facilities.

[Secretary's Note: A copy of the hazard and vulnerability assessment tool and the instructions for completing the tool are attached herein as Exhibit C.]

Mr. Owens asked the members of the Local Planning Team to complete the hazard and vulnerability assessment tool. He explained that the results of this exercise would be one of the factors used to determine which hazards are addressed by the hazard mitigation plan. Additionally, Mr. Owens asked the members of the Local Planning Team to note at the bottom of the exercise their community affiliation. He explained that the tool should be completed based on their experiences with the community they represent or reside in.

ADJOURNMENT

There being no further business, the meeting was adjourned at 2:40 p.m.

OZAUKEE CO. SUMMARY NOTES 02-13-2018 KICK OFF MEETING.DOC
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Exhibit C

INSTRUCTIONS FOR COMPLETING HAZARD VULNERABILITY AND ASSESSMENT TOOL

The purpose of this Hazard Vulnerability and Assessment Tool is to evaluate the potential that specific hazards may occur, the likely severity of impacts resulting from these hazards, and the extent to which these impacts may be mitigated by current levels of preparedness. The tool uses estimates of probability of occurrence, likely severity of impacts, and level of preparedness to estimate the risk posed by each hazard.

Please address all of the potential threats that are listed. Instructions for completing entries in each column are given below.

Probability
For each of the listed hazards, please indicate the likelihood that it will occur, with 1 indicating a low probability of occurrence, 2 indicating a moderate probability of occurrence, and 3 indicating a high probability of occurrence. Issues to consider for probability include, but are not limited to:

- Known risk,
- Historical data and experience, and
- Local government or agency experience.

Human Impacts
For each of the listed hazards, please indicate what you consider to be the likely level of impacts to human life if the hazard occurs, with 1 indicating a low level of impacts, 2 indicating a moderate level of impacts, and 3 indicating a high level of impacts. Issues to consider for human impacts include, but are not limited to:

- Potential of the hazard to cause death, and
- Potential of the hazard to cause injury requiring medical treatment.

Property Impacts
For each of the listed hazards, please indicate the likely level of physical losses and damages to property if the hazard occurs, with 1 indicating a low level of losses and damages, 2 indicating a moderate level of losses and damages, and 3 indicating a high level of losses and damages. Issues to consider for property impacts include, but are not limited to:

- The potential of the hazard to cause damage to property or crops,
- The cost to replace damaged property,
- The cost to set up a temporary replacement for damaged property,
- The cost to repair damaged property, and
- The time to recover from the property damage.

Business and Government Agency Impacts
For each of the listed hazards, please indicate what the likely level of impacts to the operations of businesses and government agencies is if the hazard occurs, with 1 indicating a low level of impacts, 2 indicating a moderate level of impacts, and 3 indicating a high level of impacts. Issues to consider for business impacts include, but are not limited to:

- Business or agency interruption,
- Employees unable to report to work,
- Customers or clients unable to reach facility,
- Company or agency in violation of contractual agreements,
- Imposition of fines and penalties or legal costs,
- Interruption of access to critical supplies,
- Interruption of product or service distribution,
- Financial impact or burden, and
- Interruption of critical care and emergency services.

Exhibit C

Preparedness

For each of the listed hazards, please indicate the current level of preparedness for dealing with the hazard and its impacts, with 1 indicating a high level of preparedness, 2 indicating a moderate level of preparedness, and three indicating a low level of preparedness or no preparedness. Issues to consider for preparedness include, but are not limited to:

- The status of current plans that address the hazard,
- The frequency of drills that address the hazard,
- The status of training related to the hazard and its impacts,
- Insurance,
- The availability of back-up systems, and
- The availability of community resources.

This survey will be compiled and the results will be reported during the hazard identification phase of developing or updating the hazard mitigation plan.

Exhibit C

Attachment 4

HAZARD AND VULNERABILITY ASSESSMENT TOOL
OZAUKEE COUNTY HAZARD MITIGATION PLAN UPDATE

EVENT	PROBABILITY	SEVERITY = (MAGNITUDE - MITIGATION)			
		HUMAN IMPACT	PROPERTY IMPACT	BUSINESS AND AGENCY IMPACT	PREPAREDNESS
	Likelihood This Will Occur	*Possibility of Death or Injury*	*Physical Losses and Damages*	*Interruption of Services*	*Pre-planning*
SCORE	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = High* *2 = Moderate* *3 = Low or none*
1. Riverine flooding					
2. Stormwater flooding					
3. Lake flooding					
4. Tornado					
5. Thunderstorm					
6. High straight-line wind					
7. Lightning					
8. Hail					
9. Heavy snow storm					
10. Blizzard					
11. Ice storm					
12. Extreme cold					
13. Extreme heat					
14. Drought					
15. Fog					
16. Dust storm					
17. Lake Michigan Erosion					
18. Earthquake					
19. Contamination or loss of water supply system					
20. Wildfire					
21. Dam failure					
22. Landslide					
23. Land subsidence					
Other Hazard Event (write in):					
Other Hazard Event (write in):					
AVERAGE SCORE	- -	- -	- -	- -	- -

RESPONDENT AFFILIATION: _____

Source: Kaiser Permanente and SEWRPC.

Ozaukee County Division of Emergency Management
Southeastern Wisconsin Regional Planning Commission

Notice of Meeting and Agenda

OZAUKEE COUNTY HAZARD MITIGATION PLAN LOCAL PLANNING TEAM

DATE: Tuesday August 28th, 2018

TIME: 1:00 to 4:00 p.m.

PLACE: Frank L. Weyenberg Library
Tolzman Community Room
11345 N. Cedarburg Road
Mequon, Wisconsin 53092

AGENDA:

1. Roll Call
2. Consideration of Summary Notes of February 13, 2018 Local Planning Team Meeting (a copy of the draft summary notes is available for download from the SEWRPC website at: http://www.sewrpc.org/SEWRPC/communityassistance/Hazard-Mitigation-Planning.htm
3. Consideration of Chapter 1, "Introduction and Background," of SEWRPC Community Assistance Planning Report No. 332 (3rd Edition), *Ozaukee County Hazard Mitigation Plan* (a copy of the draft chapter will be available for download from the SEWRPC website one week prior to the meeting at: http://www.sewrpc.org/SEWRPC/communityassistance/Hazard-Mitigation-Planning.htm
4. Consideration of Chapter 2, "Basic Study Area Inventory and Analysis," of SEWRPC Community Assistance Planning Report No. 332 (3rd Edition), *Ozaukee County Hazard Mitigation Plan* (a copy of the draft chapter is available for download from the SEWRPC website one week prior to the meeting at: http://www.sewrpc.org/SEWRPC/communityassistance/Hazard-Mitigation-Planning.htm
5. Review of results from hazard and vulnerability assessment exercise
6. Discussion of hazards to be addressed by the Ozaukee County Hazard Mitigation Plan Update
7. Adjourn

Megan A. Beauchaine
Secretary

SUMMARY NOTES OF THE AUGUST 28, 2018 MEETING OF THE OZAUKEE COUNTY HAZARD MITIGATION PLAN LOCAL PLANNING TEAM

INTRODUCTION

The August 28, 2018, meeting of the Ozaukee County Hazard Mitigation Plan Local Planning Team was convened at the Frank L. Weyenberg Library at 1:12 p.m. The meeting was called to order by Scott Ziegler, Director of Ozaukee County's Division of Emergency Management. Attendance was taken by circulating a sign-in sheet.

In attendance at the meeting were the following individuals:

Local Planning Team Members	
Scott Ziegler, Chair	Director, Ozaukee County Division of Emergency Management
Megan A. Beauchaine, Secretary	Planner, Southeastern Wisconsin Regional Planning Commission
Tom Czaja	Member, OZARES-Ozaukee County Amateur Radio Emergency Service
Skip Douglas	Member, OZARES-Ozaukee County Amateur Radio Emergency Service
Daniel Gellert	Deputy Director, Ozaukee County Division of Emergency Management
Andy Holschbach	Land and Water Management Director, Ozaukee County
Laura Herrick	Chief Environmental Engineer, Southeastern Wisconsin Regional Planning Commission
Andy LaFond	Director of Public Works, Village of Thiensville
Aaron Owens	Planner, Southeastern Wisconsin Regional Planning Commission
Christina Richards	Land Information (GIS) Coordinator, Ozaukee County
Patty Ruth	Emergency Preparedness Coordinator, Washington Ozaukee Public Health Department
Roger Strohm	Director of Public Works, Village of Fredonia
Sarah Viera	Executive Director of Business Services, Mequon Thiensville School District
Dawn Wagner	Administrator, Village of Saukville

Mr. Ziegler welcomed the attendees and introduced Megan Beauchaine, Planner, of the Southeastern Wisconsin Regional Planning Commission (SEWRPC). Ms. Beauchaine thanked the attendees for their participation and asked attendees to introduce themselves and state their affiliations. She briefly reviewed the meeting's agenda and the summary notes of the February 13, 2018, Local Planning Team meeting. Ms. Beauchaine noted that the slides from the presentations and the handouts from the February 13, 2018, meeting were attached to the summary notes. Ms. Ruth noted that her affiliation in the summary notes was incorrect and should be listed as the Washington Ozaukee Public Health Department.

[Secretary's Note: Ms. Ruth's affiliation was corrected to Emergency Preparedness Coordinator, Washington Ozaukee Public Health Department in the summary notes of the February 13, 2018, Local Planning Team meeting.]

CONSIDERATION OF DRAFT CHAPTER 1, "INTRODUCTION AND BACKGROUND"

Ms. Beauchaine noted that the meeting handout included the draft chapter text, followed by tables, one figure, and maps. She indicated that images of the maps from Chapters 1 and 2 would be displayed on the projection screen as they come up in the review of the chapters. Ms. Beauchaine also encouraged the Local Planning Team (LPT) members to stop her at any time during the review process for questions or comments.

Ms. Beauchaine reviewed preliminary draft Chapter 1 of the Report. She stated that Table 1.1 documents how each jurisdiction within the County has, or will have, participated in the development of the plan update. She also noted that this table will be completed at the end of the planning process after all meetings and participation have been documented. Ms. Ruth indicated that the Ozaukee Washington Public Health Department should be listed under "Other" in Table 1.1. No further questions or comments were given by the LPT for section 1.1, and none were provided for sections 1.2 through 1.4.

[Secretary's Note: Table 1.1 has been updated to include the Ozaukee Washington Public Health Department under the category of "Other".]

While reviewing Table 1.2 under section 1.5, "Plan Maintenance and Implementation Activities," Ms. Ruth noted that the MyStateUSA-Alert Sense emergency notification system for Ozaukee County should be changed to a generic name, such as "Public Alert Notification Systems". Mr. Ziegler agreed, indicating that the County no longer uses that particular service provider and that providers tend to change often. Mr. Ziegler also noted that the County uses Facebook and Twitter for outreach activities that can relate to hazard mitigation preparedness and those references should be added to Table 1.2.

In further review of Table 1.2, Mr. Holschbach indicated that the Land and Water Management Department for Ozaukee County has a flood protection link that provides river gauge levels and that should be added to the table as public outreach and education. Ms. Richardson also noted that Ozaukee County's Land Information Department's webpage contains geographic information system (GIS) mapping and could serve as another potential resource for outreach and education due to the mapped floodplains and flood hazard areas accessible for public viewing. Ms. Beauchaine replied that this information would be added to Table 1.2 for Ozaukee County outreach activities.

[Secretary's Note: Table 1.2 was revised to reflect the comments made above.]

In reference to plan implementation activities under section 1.5, Mr. Strohm commented that the two properties listed as flood control buyout projects listed in Table 1.3, under the Town of Grafton were carried out as a partnership between the Town and Ozaukee County. He suggested that the project be listed under Ozaukee County because they now own the land.

[Secretary's Note: The two flood control buyout projects that occurred in Town of Grafton have been listed under Ozaukee County in Table 1.3.]

Ms. Beauchaine asked the Local Planning Team to provide her with any other hazard mitigation projects that had been implemented since the last hazard mitigation plan update that were not included in Table 1.3.

Ms. Beauchaine discussed the planning and adoption processes of the previous two Ozaukee County hazard mitigation plans. Mr. Ziegler added that upon the completion of the plan update, the County will first adopt the plan and will then ask the cities, villages, and towns to individually adopt the plan. Mr. Ziegler stated that all but one township adopted the last edition of the County's hazard mitigation plan.

There were no further questions or comments regarding Chapter 1 "Introduction and Background."

REVIEW AND CONSIDERATION OF DRAFT CHAPTER 2, "BASIC STUDY AREA INVENTORY AND ANALYSIS"

Ms. Beauchaine reviewed preliminary draft Chapter 2 of the Report, describing the characteristics of the study area. Ms. Beauchaine explained that the description of the study area (Ozaukee County) and an inventory of the major features within the County provide the basis for sound hazard mitigation planning. There were no questions or comments from the LPT regarding the "Introduction," "Civil Divisions," and "Demographic and Economic Characteristics" sections of draft Chapter 2.

Regarding discussion of existing land uses within the County on page 3, Mr. Strohm indicated that the Village of Saukville should be listed as a community experiencing intensive urban development. Ms. Beauchaine stated that she will add the Village of Saukville to the existing list of communities. Mr. Strohm asked if the GIS files related to parcel land use would be available for review by the communities. Mr. Owens replied that GIS data is available from SEWRPC upon request and added that the data has likely been provided to the County as well. Ms. Ruth asked if the data related to critical community facilities in Appendix C and D would also be available through the County. Mr. Ziegler confirmed that similar data is available and added that the County provides much useful information on the County's land management website.

[Secretary's Note: Saukville was added to the list of communities experiencing urban development in the third sentence under the subsection "Existing Land Uses" on page 3.]

Regarding discussion related to floodplains on page 8, Ms. Herrick explained that the term "one-percent-annual-probability-floodplain" is the same as the "100-year floodplain." She explained that the one-percent-annual-probability-floodplains are those areas that have been determined to have a one percent chance of flooding in any given year. Ms. Beauchaine explained the floodplains were identified by Ozaukee County, SEWRPC, the Wisconsin Department of Natural Resources (WDNR), and FEMA. Ms. Beauchaine described the extent of the County and each of its communities that are located in the one-percent-annual-probability flood hazard area.

Ms. Beauchaine reviewed Table 2.11 and Map 2.8 regarding dams located within the County. She explained the importance of the hazard rating reported in Table 2.11 and its relation to hazard mitigation planning. She indicated the WDNR maintains a dam inventory database. Mr. Ziegler noted one dam in Port Washington may have been removed and indicated that he will check the status of that dam and provide necessary changes to Ms. Beauchaine. Mr. Ziegler added that the WDNR had inspected the one high hazard dam in the County (listed as dam number 22 in Table 2.11) that morning at the request of the dam's owner and found the dam to be in good order.

Ms. Beauchaine reviewed the section related to Lake Michigan coastal bluff erosion, noting several coastal studies and projects that have been completed, or are still ongoing, within Ozaukee County. Regarding the Southeast Wisconsin Coastal Resilience Project, discussed on page 14 of Chapter 2, Mr. Owens explained that, as a part of the project, grant money was being offered by NOAA to coastal communities for non-construction related projects that enhance coastal resilience. Mr. Owens indicated that if there were any questions regarding the grant applications, he could discuss that after the meeting. He added that he had copies of the request for proposal and grant application forms for anyone that was interested.

Regarding the Great Lakes Coastal Flood Study, Ms. Herrick stated that new coastal digital flood elevation maps (DFIRMs) for the Ozaukee County area are expected to be released by FEMA in late 2019 or 2020. Mr. Ziegler added that there is only a very small coastal flooding area within Ozaukee County due to the bluffs along Lake Michigan.

Mr. Holschbach mentioned that Ozaukee County participates in the Community Rating System (CRS) program offered through FEMA. He asked if their CRS participation should be discussed in Chapter 2. Mr. Owens noted that the County's participation in the program will be detailed in a later chapter. Mr. Owens noted that FEMA required discussion of participation in the CRS program for approval of the hazard mitigation plan.

Ms. Beauchaine briefly discussed the transportation systems within the County, which included railways, airports, arterial streets and highways, and public transit. There were no comments from the LPT on this section.

Ms. Beauchaine reviewed the section of Chapter 2 regarding utility systems in the County. Regarding discussion of public water utilities, Mr. LaFond indicated the City of Mequon and Village of Thiensville purchased and now operate the former We Energies water utility.

[Secretary's Note: Ms. Beauchaine revised the text on page 19 and in Table 2.14 to reflect that the Mequon Water Utility now owns and operates the former We Energies water utility.]

Ms. Beauchaine reviewed the section of the Chapter related to solid waste disposal. She requested that the LPT carefully review the text within that section. Mr. Ziegler remarked it is hard to keep track of solid waste disposal providers within the County because communities change providers frequently. Mr. Holschbach added that agricultural disposal is offered by the County once per year for agricultural hazardous waste and suggested that be added to the section.

[Secretary's Note: Ms. Beauchaine revised the text on page 21 within the solid waste disposal section to indicate that Ozaukee County provides proper disposal of agricultural hazardous waste once per year.]

Ms. Beauchaine reviewed the sections of Chapter 2 related to fire protection, emergency medical services, and law enforcement services in Ozaukee County. Ms. Ruth and Mr. Ziegler indicated that Table 2.17 needed some updates. Ms. Beauchaine collected the LPT comments related to staffing and stated that the changes would be made to the Table.

[Secretary's Note: Ms. Beauchaine updated the text within Table 2.17 to reflect several Team members' comments regarding the working status of fire departments and law enforcement departments serving Ozaukee County.]

In reference to emergency service dispatch locations, Mr. Czaja asked Mr. Ziegler if the Village of Grafton had switched their dispatch services to the County Sheriff's Office as planned. Mr. Ziegler responded that the County staff was currently in the process of switching the services to the Sheriff's Office. Mr. Ziegler added that Map 2.23 and the Appendix C-4 table indicate that these changes are occurring. Mr. Ziegler further explained that the Village of Grafton's Fire and EMS dispatch service has already been transferred

to the Ozaukee County Sheriff's Office, while the Grafton Police Department dispatch is planned to be transferred by December 2018.

Regarding dispatch centers, Mr. Czaja stated there have been several 9-1-1 outages in northern Wisconsin counties within the past few months. He indicated most outages were caused by utility contractors unknowingly digging up 9-1-1 underground telecommunication lines. He suggested separate and redundant 9-1-1 lines be installed to prevent an outage from occurring within Ozaukee County. Ms. Beauchaine responded that redundant and separate 9-1-1 dispatch lines could be added as a mitigation strategy in a later chapter of the Report.

Furthermore, Mr. Czaja questioned whether cyber security should be added as a potential hazard mitigation effort to be presented in the plan update. He stated cyber-attacks have happened in other communities at 9-1-1 dispatch locations as well as on emergency radio systems. Ms. Herrick acknowledged Mr. Czaja's concern, however she stated that FEMA intended for these hazard mitigation plans to be focused on natural hazard events. Ms. Herrick and Mr. Owens noted that cyber security and 9-1-1 outages could be discussed in the plan as they relate to mitigating damages from other hazards, but suggested that cyber security not be included as a separate hazard to be addressed in this planning effort. Mr. Ziegler agreed, adding that cyber security is better addressed in the Continuity of Operations Plan.

Ms. Ruth suggested that the plan address climate change and its effects on human health and its potential relationship to hazard mitigation planning. She said climate change has an effect on human health and due to this, an increase in medical services (also known as a medical surge) may be needed to help prevent medical issues among citizens, such as heat strokes that may adversely impact the elderly. Ms. Beauchaine and Mr. Owens responded that climate change and its effects on the environment and human health will be discussed later in the plan. Mr. Owens added that the vulnerability assessment that will be developed for each hazard in the next Chapter that will include discussion of potential how climate change might affect each vulnerability.

During discussion of critical community facilities, specifically hospitals and special medical centers on Map 2.26, Mr. Ziegler suggested that reference number 12 showing the Aurora Medical Center in Grafton should be changed to a hospital rather than a special medical center. Mr. LaFond noted that Appendix D-3 should include Ascension Columbia St. Mary's Ozaukee at Grafton Urgent Care Center, Froedtert Mequon Health Center, and Mequon Clinic-Children's Hospital of Wisconsin.

> [Secretary's Note: Map 2.26 and Appendix D-3 were updated to reflect the changes discussed above. Reference numbers on Map 2.26 and Appendix D-3 were also updated to provide proper sequential order.]

In further discussion of critical community facilities, Mr. LaFond noted that in Appendix D-2 (listing schools within the County) Lumen Christi Catholic School should be removed as it no longer exists. Ms. Viera also specified that school reference numbers 11, 14, and 17 should be listed as grades 4K-5 rather than grades K-5. Ms. Viera also stated that Range Line Early Childhood Education should be changed to Range Line School. Mr. Ziegler added that Port Washington's alternative high school and middle school should also be added to Appendix D-2 table. Ms. Beauchaine thanked the Local Planning Team for their input and said that the updates will be made to both Appendix D-2 and Map 2.25.

> [Secretary's Note: Map 2.25 and Appendix D-2 were updated to reflect the changes discussed above. Reference numbers on Map 2.25 and Appendix D-2 were also updated to provide proper sequential order.]

In reference to Table 2.18 which lists off-site planning facilities with extremely hazardous substances, Ms. Wagner stated that Saukville Well No.6 of Saukville should be added. Ms. Richards asked if a map should be included to show the listed locations in Tables 2.18 and 2.19. Mr. Ziegler responded that these lists of facilities are dynamic and change often and therefore did not think a map was necessary for this plan.

[Secretary's Note: Table 2.18 was updated to include Saukville Well No.6 of Saukville.]

Ms. Beauchaine explained that a requirement of an approved FEMA hazard mitigation plan is that there is discussion of the location of, and potential impacts of hazards to, historical sites and districts. She noted that National and State Historic Sites in the County are shown on Map 2.29 and listed in Appendix E. Mr. Ziegler indicated Port Washington's lighthouse is in the process of being listed as a historic site on the National Register of Historic Places. Ms. Beauchaine noted that if this site becomes listed by the National Register, it will be added to both the map and the table in Appendix E.

In reference to regulations and programs related to hazard mitigation, Mr. Holschbach indicated the Shoreland and Shoreland-Wetland Zoning section should refer to the County Administrator as the County Zoning Administrator.

[Secretary's Note: The last sentence in the second full paragraph on page 29 was revised to reflect the comment above.]

Mr. Beauchaine asked the Local Planning Team if there were any additional comments or edits to Chapter 2. None were offered. Ms. Beauchaine reminded the LPT members that they could submit additional comments to her via the project website or electronic mail.

REVIEW OF RESULTS FROM HAZARD AND VULNERABILITY EXERCISE

Ms. Beauchaine noted that FEMA requires the plan to address natural hazards. She stated that under FEMA regulations for hazard mitigation planning, human-induced or technological hazards are not required to be addressed. Ms. Beauchaine then reviewed the results of the hazard and vulnerability assessment tool (HVA) which the Local Planning Team completed at its February 13, 2018, meeting and briefly explained how the data were analyzed. She noted the six highest-ranked hazards identified by the tool along with other notable hazards ranked highly by the Local Planning Team. She said that further discussion of the HVA tool results will be included in Chapter 3 of the Report.

DISCUSSION OF HAZARDS TO BE ADDRESSED BY THE OZAUKEE COUNTY HAZARD MITIGATION PLAN UPDATE

Ms. Beauchaine explained that as part of the updating process for the hazard mitigation plan, the Local Planning Team needs to review the set of hazards that the current plan addresses and determine whether the list of hazards is still appropriate to profile for this plan update. Ms. Beauchaine noted that the HVA tool is one factor to consider in addition to the County's historical experience with hazards. To examine the County's past hazard experience, Ms. Beauchaine explained that past natural hazard events were inventoried using the National Climatic Data Center's (NCDC) Storm Events Database. Using that database data were compiled showing the number of events that have occurred for a particular hazard, the number of injuries and deaths that were caused by those events, and the reported property and crop damages. She noted that the USDA Risk Management Agency Database is an additional tool that reports the amount of crop insurance indemnities that have been paid out due to certain hazard events. Ms. Beauchaine explained that the results from the USDA Risk Management Agency inventory would not be presented during this

meeting because that data is still being analyzed. She indicated the USDA data will be incorporated into the text of the next chapter of the plan along with the HVA tool and the NCDC database results.

Ms. Beauchaine presented property and crop damage estimates from the NCDC database of natural hazard events within Ozaukee County to the Local Planning Team, noting that all reported damage amounts were converted into 2017 dollars. She highlighted the natural hazard events that resulted in the highest property and crop damage in the County included flooding, tornadoes, and hail. Ms. Richards commented that the 1964 tornado that caused extreme damage in Ozaukee County is presented on the County's Land Information website as a story map.

Ms. Beauchaine explained that the property and crop damages presented in the NCDC database are likely underestimates due to the fact that many damages go unreported. Next, Ms. Beauchaine presented the NCDC results compiled on an annual basis. She presented the top three events that resulted in the greatest property and crop damage, which again included flooding, tornadoes, and hail.

After reviewing the NCDC database results for Ozaukee County Ms. Beauchaine presented the hazards that are profiled in the current Ozaukee County hazard mitigation plan. She proposed that the plan update address the same set of hazards with the exception of earthquakes and forest fires, which she proposed removing from the plan update. Ms. Beauchaine noted that while earthquakes can occur within the County, the magnitude of earthquake that the County could expect would be slight and the likelihood of property damage or injuries would be very small. Similarly she said that while small brush fires can occur in the County, there are no past experiences of large forest fires occurring in the County and no damages have been reported. She added that the amount of concentrated forest habitat in the County that would be conducive to forest fires is lacking. The Local Planning Team was in agreement in removing earthquakes and forest fires from the plan update. Ms. Beauchaine asked the Local Planning Team if there were other hazards they would like to consider or if there were hazards that could be removed from the plan for this update and none were offered.

NEXT MEETING OF THE LOCAL PLANNING TEAM

Ms. Beauchaine reminded the Team that they can submit any additional questions or comments that they may have regarding Chapters 1 and 2 to her either through the project website or email. She indicated that at the next Local Planning Team meeting the chapters on analysis of hazard conditions and hazard mitigation goals will be reviewed. She added that the updated Chapters and other meeting materials would be posted on the project website.

ADJOURNMENT

There being no further business, Mr. Ziegler thanked everyone for attending and the meeting was adjourned at 3:30 p.m.

MGH/LKH/AWO/MAB
#244376
09/05/2018, 9/21/2018, 9/26/2018, 9/27/2018

Ozaukee County Division of Emergency Management
Southeastern Wisconsin Regional Planning Commission

Notice of Meeting and Agenda

OZAUKEE COUNTY HAZARD MITIGATION PLAN LOCAL PLANNING TEAM

DATE: Thursday May 16th, 2019

TIME: 1:00 to 3:00 p.m.

PLACE: Ozaukee County Justice Center
Lobby Conference Room
1201 S. Spring Street
Port Washington, Wisconsin 53074

AGENDA:

1. Roll Call
2. Consideration of Summary Notes of August 28, 2018 Local Planning Team Meeting (a copy of the draft summary notes is available for download from the SEWRPC website at: http://www.sewrpc.org/SEWRPC/communityassistance/Hazard-Mitigation-Planning.htm)
3. Consideration of Chapter 3, "Analysis of Hazard Conditions," of SEWRPC Community Assistance Planning Report No. 332 (3rd Edition), *Ozaukee County Hazard Mitigation Plan* (a copy of the draft chapter will be available for download from the SEWRPC website one week prior to the meeting at: http://www.sewrpc.org/SEWRPC/communityassistance/Hazard-Mitigation-Planning.htm)
4. Consideration of Chapter 4, "Hazard Mitigation Goals," of SEWRPC Community Assistance Planning Report No. 332 (3rd Edition), *Ozaukee County Hazard Mitigation Plan* (a copy of the draft chapter is available for download from the SEWRPC website one week prior to the meeting at: http://www.sewrpc.org/SEWRPC/communityassistance/Hazard-Mitigation-Planning.htm)
5. Discussion of upcoming public meeting
6. Adjourn

Megan A. Beauchaine
Secretary

CAPR-332 3rd ED MEETING AGENDA MAY 16, 2019 (248303)
500-1128
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05/07/2019

SUMMARY NOTES OF THE MAY 16TH, 2019 MEETING OF THE OZAUKEE COUNTY HAZARD MITIGATION PLAN LOCAL PLANNING TEAM

INTRODUCTION

The May 16, 2019, meeting of the Ozaukee County Hazard Mitigation Plan Local Planning Team was convened at the Ozaukee County Justice Center at 1:12 p.m. The meeting was called to order by Scott Ziegler, Director of Ozaukee County's Division of Emergency Management. Attendance was taken by circulating a sign-in sheet.

In attendance at the meeting were the following individuals:

Local Planning Team Members	
Scott Ziegler, Chair	Director, Ozaukee County Division of Emergency Management
Megan Beauchaine, Secretary	Planner, Southeastern Wisconsin Regional Planning Commission
Tom Czaja	Member, OZARES-Ozaukee County Amateur Radio Emergency Service
Sarah DeBruijn	Emergency Management, Village of Saukville
Laura Herrick	Chief Environmental Engineer, Southeastern Wisconsin Regional Planning Commission
Aaron Owens	Planner, Southeastern Wisconsin Regional Planning Commission
Patty Ruth	Emergency Preparedness Coordinator, Washington Ozaukee Public Health Department

Mr. Ziegler welcomed the attendees, thanked them for their participation. Mr. Ziegler asked attendees to introduce themselves, their affiliations, and passed it onto Ms. Beauchaine from there. Ms. Beauchaine introduced herself, affiliation, and her role in the Hazard Mitigation Plan updating process for Ozaukee County. Ms. Beauchaine briefly reviewed the meeting's agenda and the summary notes of the August 28, 2018, Local Planning Team (LPT) meeting. Ms. Beauchaine noted that the August 28, 2018 summary notes were posted on the Southeastern Wisconsin Regional Planning Commission's (SEWRPC) website shortly after the meeting and document the meeting as well as the edits made to Chapters 1 and 2 of this plan update. She explained the August 28, 2018 summary notes and Chapter 1 and 2 edits will be considered final unless the LPT provide any additional changes to her by Thursday, May 23, 2019.

Related to discussion in Chapter 2 of the Report, Mr. Ziegler explained that there are on-going changes among staff and officers within City and Village police and fire stations and dispatch centers in the County. He indicated that he will email SEWRPC staff with the updated information. Mr. Ziegler also noted that several members of the Local Planning Team may have either retired or their affiliations may have changed. He said he would email SEWRPC staff with any changes to the LPT.

> [Secretary's Note: Sarah DeBruijn, Emergency Manager, Village of Saukville was added to the Local Planning Team.]

CONSIDERATION OF DRAFT CHAPTER 3, "ANALYSIS OF HAZARDS"

Before Ms. Beauchaine started the review of preliminary draft Chapter 3, Mr. Owens explained to the LPT that the handouts consisted of draft Chapters 3 and 4 and that the tables, figures, and maps are attached at the end of the text for each chapter. He also noted that each packet is numbered in chronological order, and the page numbers will be referenced throughout the meeting.

Ms. Beauchaine next reviewed preliminary draft Chapter 3 "Analysis of Hazards". She began by summarizing the four main topics Chapter 3 provides. In addition, she explained the procedures for identifying the hazards that were specifically chosen for this plan update, which included local input; past county hazard mitigation plans; related plans, maps, and assessments; as well as the 2018 Hazard Vulnerability Assessment Tool which was completed by the LPT at the kickoff meeting. Ms. Beauchaine presented Table 3.3 "Weather Hazard Events Recorded in Ozaukee County, Wisconsin from 1950 through 2017 (Sorted by Number of Events)" which documents the number of weather related hazard events and the number of deaths, injuries, property damages, and crop damages that have occurred within Ozaukee County. Ms. Beauchaine also briefly discussed the additional hazards that were considered, but not fully profiled for this plan update. Related to Table 3.3, Ms. Ruth asked if the recent fog-related crash that caused a fatality was in Ozaukee County. Mr. Ziegler informed her that the accident occurred in Sheboygan County but the fatality was an Ozaukee County resident. Mr. Czaja asked how crop damages that are presented in the table were estimated. Mr. Owens responded that crop damage information was gathered by individual events from either the National Weather Service's (NWS) storm event database (NCDC) or from the USDA Risk Management Agency database, which reports data from crop insurance payouts. Regarding hazards that were considered, but not fully profiled in this plan update, Mr. Ziegler said that he had looked into landslides and mudslides that may have occurred in Ozaukee County and explained that everything he could find have been related to coastal bluff erosion, which is a fully profiled hazard in the plan.

Ms. Beauchaine presented Table 3.5, "Summary of Hazards to be Considered in the Ozaukee County Hazard Mitigation Plan" to the LPT. She informed the planning team members that the table was ranked qualitatively, as either "high," "medium," or, "low" based on event data (occurrences and damages), past plans, Wisconsin Emergency Management's (WEM) 2016 Hazard Mitigation Plan, and local input. Ms. Beauchaine explained the importance of having the LPT review the suggested rankings before the table is finalized.

Ms. Beauchaine outlined how each hazard vulnerability assessment is structured for this plan update in Chapter 3. Ms. Beauchaine then reviewed the hazard vulnerability assessments for each profiled hazard, beginning with flooding and stormwater drainage problems.

While reviewing flooding hazards, the topic of ice jams was discussed. Ms. Beauchaine noted that ice jams can cause significant damage and are a known issue in Ozaukee County. Ms. Herrick pointed out that mapped floodplains were used to determine flood damage estimates and that ice jams are not accounted for in the floodplain, and thus the damages that these events may cause will not be included in the updated plan. Mr. Ziegler stated that ice jams are not so much of an issue at bridge or culvert crossings (i.e., blocking the opening of the crossing), rather ice jams tend to divert the river channel at natural locations between crossings. Mr. Ziegler explained that islands in the Milwaukee River, in particular, tend to become blocked by ice jams on one side, diverting all flow to the un-blocked side of the river and pushing the flow out of it bank.

Ms. Beauchaine explained the sources of the floodplains within the County. She noted that updates to the floodplains and floodplain mapping within Ozaukee County are currently being worked on by others and should be available within the five year life cycle of this plan update. Mr. Ziegler stated that floodplain updates in downtown Port Washington, at the mouths of Sauk and Sucker Creeks, are also being updated

and should be completed soon. Mr. Czaja asked about the dates of the current floodplain data used for this plan update. Ms. Herrick replied that modeling and updating of floodplains are routinely done and the dates are often different for each stream, however the majority of the data that was used for this plan update came from the County's flood insurance study, which was current as of 2015.

Ms. Beauchaine explained that the main estimation for flood damages for this plan update was from a parcel based analysis using FEMA and SEWRPC floodplains to determine specific floodprone structures. First floor elevations were compared to flood elevations in the event of a one-percent-annual-probability flood to estimate damages that would occur. Ms. DeBruijn commented that there are several structures in the Village of Saukville that continue to experience flood damage, including from the last major flood event in the spring of 2019. She said the Village is exploring the feasibility of an acquisition and demolition project for these affected areas, citing the WDNR's Municipal Flood Control Grant Program. Mr. Ziegler replied that unless the buildings are considered repetitive loss structures by FEMA, the Village may face eligibility issues for that specific program. Mr. Owens informed the LPT that there is discussion later in this section regarding repetitive loss structures and added that FEMA currently lists one repetitive loss structure for the Village of Saukville, however that number may change due to the last major flood event. He also noted that other grant money is available for projects related to mitigating flood damages for structures that are not considered repetitive loss. Mr. Czaja asked if the repetitive loss structures listed for the City of Mequon were located along the Milwaukee River. Mr. Ziegler answered that most were along the Milwaukee River, and described the roads and locations of concentrated repetitive loss structures in Mequon.

While discussing critical facilities estimated to be located within the one-percent-annual-probability-floodplain, Ms. DeBruijn questioned whether the Saukville Post Office is within the floodplain, as stated in the text and Table 3.9. "Communities in Ozaukee County with Special Flood and Related Stormwater Drainage Considerations: 2018." Ms. DeBruijn mentioned that it was recently built and was away from any major rivers.

> [Secretary's Note: Subsequent to the LPT meeting, SEWRPC staff determined that the Village of Saukville Post Office was outside of the one-percent-annual-probability floodplain. References of this building being within the floodplain were removed from the text of Chapter as well as Map 3.6 and Table 3.9.]

During discussion of the thunderstorm related hazard impacts on Ozaukee County, Ms. Ruth asked if boater safety should be considered as a topic of concern. Mr. Ziegler commented that issues related to that topic are mostly covered under maritime/coastal weather alerts broadcasted out to boats on Lake Michigan during severe weather. He also stated that there are frequent strong wind events that occur on Lake Michigan that are not experienced over land.

Ms. Beauchaine had asked Mr. Ziegler to review a paragraph on page 52 of draft Chapter 3 related to the County's severe weather watch and warning procedures. Mr. Ziegler reviewed the paragraph and acknowledged that it was correct.

In relation to the review of the vulnerability and community impact assessment for extreme temperatures in the County, both Ms. Ruth and Mr. Ziegler highlighted that power outages and propane shortages are the major concerns during this type of hazard event.

> [Secretary's Note: Discussion regarding the concern and risks of propane shortages and power outages during extreme temperature events was added to the "Vulnerability Assessment for Extreme Temperatures" section for this hazard.]

Ms. Ruth asked how property damages related to extreme temperature events occur. Mr. Owens and Mr. Ziegler replied that pipes bursting, water main breaks, and irrigation system damages are the most common damages to property related to extreme cold temperature events.

Mr. Owens presented and reviewed the vulnerability assessment for Lake Michigan coastal hazards. Mr. Czaja asked if there are any regulations in regards to bluff slope grading. Mr. Ziegler mentioned that the City of Mequon and Ozaukee County have adopted bluff setback ordinances. Ms. Ruth asked if Lake levels affect beach loss. Mr. Owens explained that higher Lake levels can result in more severe beach recession, as is being experienced now in several areas in the northern part of the County.

During discussion regarding coastal flooding, Mr. Owens asked Mr. Ziegler if illustrating parcel boundaries on Map 3.19, "Location of Structures Along the lake Michigan Coast that are within the One-Percent-Annual-Probability Flood Hazard Area: 2015" which shows properties along the Lake Michigan coast that contain structures within the one-percent-annual-probability flood hazard area, was acceptable to the County. Mr. Owens indicated that points could be used in place of parcel boundaries to be more discrete, if desired. Mr. Ziegler and Ms. DeBruijn both thought that showing the parcel boundaries was acceptable as that information is available to anyone as public record. Mr. Owens agreed and said that the parcel boundaries would remain on Map 3.19.

While discussing the Wisconsin Shoreline and Oblique Photo Viewer website and tool, Mr. Owens stated that in addition to the 1976 and 2007 shoreline data, an analysis of 2018 conditions has recently been completed. Mr. Owens added that the new data has not yet been added to the tool on the website but that he is attempting to acquire the data from Wisconsin Coastal Management. He said that there was a possibility a brief summary of the 2018 analysis could be added to this section in Chapter 3 if the data can be obtained soon.

During discussion of Table 3.22, "Communities in Ozaukee County with Special Coastal Hazard Concerns" which describes special coastal hazard conditions in communities in Ozaukee County, Ms. Ruth noted that St. John XXIII Elementary School was listed as being a critical community facility that is within the high risk coastal hazard area. She indicated that the school building had been sold and is planned to be converted to an apartment or condominium complex.

[Secretary's Note: A footnote was added to St. John XXIII Elementary School in Table 3.22 stating that the building is no longer a school and is planned to be converted to an apartment complex.]

Regarding discussion on the assessment for utility failure in Chapter 3, Mr. Ziegler stated that the Washington Ozaukee Public Health Department had indicated to him that the loss and/or contamination of water supply was a concern that they would like addressed in this plan update. Mr. Ziegler also cited an incident that occurred during a flood event in which flood waters overtopped several wells in the unincorporated Village of Waubeka. He stated that some of those wells tested positive for sources of contamination.

While discussing the pipeline that ruptured in 2012 in Washington County, Mr. Ziegler mentioned that the pipeline associated that event has been completely abandoned and that the event caused a ripple effect associated with an increase in oil transport to the affected area.

Regarding the vulnerability assessment for fog in Chapter 3, Mr. Ziegler indicated that he had additional fog information related to maritime events that could be added to the plan update, and that he would email the information to SEWRPC staff.

[Secretary's Note: Ms. Beauchaine added text that describes historical maritime fog events in the "Vulnerability Assessment for Fog" section of Chapter 3.]

There were no further questions or comments regarding Chapter 3, "Analysis of Hazards."

REVIEW AND CONSIDERATION OF DRAFT CHAPTER 4, "HAZARD MITIGATION GOALS"

Ms. Beauchaine reviewed preliminary draft Chapter 4 of the Report, explaining that the hazard mitigation goals within this chapter are intended to complement goals that were previously established in other past planning efforts that have occurred within the County. Ms. Beauchaine presented the six goals formulated for this plan update and explained that each goal had several objectives. She further explained that the goals were general guidelines that explained what a community desires to achieve, while the objectives are specific standards needed to achieve these goals. Ms. Beauchaine asked the LPT if they had any additions or objections to the goals and objectives presented in Chapter 4, none were given.

NEXT STEPS

Ms. Beauchaine indicated that Chapter 5 will present strategies to achieve the goals and objectives that are presented in Chapter 4. She further indicated that this process may require a considerable amount of input and feedback from the LPT, County officials, and municipal representatives in regards to the hazard mitigation strategies that will be recommended. Mr. Owens suggested that draft strategies for each hazard are provided—as they are completed—to Ozaukee County Emergency Management for their review and comments prior to being presented at the next LPT meeting and Mr. Ziegler agreed.

FIRST PUBLIC MEETING

Ms. Beauchaine indicated that the next step in the plan updating process is to hold the first of two required public meetings. She suggested the public meeting be held in June 2019. Mr. Ziegler agreed and stated that he will look into a date, time, and location. He also mentioned that he will review the LPT list members and send an updated list with recent changes. Ms. Beauchaine added that the updated Chapters and other meeting materials would be posted on the project website.

ADJOURNMENT

There being no further business, Mr. Beauchaine thanked everyone for attending and the meeting was adjourned at 3:35 p.m.

COMMENTS RECEIVED FROM THE WISCONSIN COASTAL MANAGEMENT PROGRAM MAY 28, 2019

At Mr. Owens' request, Mr. Adam Bechle, of the Wisconsin Coastal Management Program, reviewed and provided additional comments via email regarding the "Vulnerability Assessment for Lake Michigan Coastal Hazards" section in draft Chapter 3.

Mr. Bechle provided comments on the effects shoreline protection structures can have on coastal environments, such as redirecting wave energy to adjacent shorelines.

[Secretary's Note: The following sentence was added to the end of the first full paragraph on page 69:

"Some shoreline protection structures may redirect wave energy to adjacent shorelines, which can increase the potential for erosion at neighboring sites."]

With regards to the discussion on long-term bluff toe and crest recession and accretion, Mr. Bechle indicated that the construction of shoreline protection structures can advance the bluff *toe* lakeward causing accretion. Because bluff *crest* accretion does not occur naturally, Mr. Bechle suggested that bluff fill added to the top of the bluff as part of slope stabilization projects is the likely reason for the areas where the data show bluff crest accretion has taken place.

In regards to the discussion of "Potential Future Changes in Coastal Hazard Conditions," Mr. Bechle noted that since the 2011 WICCI Report, science of lake level projections for the Great Lakes has improved, and projections have changed for Lake Michigan. Mr. Bechle stated that the general consensus is now there may be a small drop or even a small rise in lake levels around the historic mean. Mr. Bechle commented that the significant drop in average lake levels of 0.8 to 1.4 feet, as stated in the draft Chapter 3, is no longer the scientific agreement. Mr. Bechle also provided a recent report on the impacts of climate change on the Great Lakes which supplements the current data on projected water levels.

[Secretary's Note: The text in Chapter 3 under the section, "Potential Future Changes in Coastal Hazard Conditions" was modified to reflect recent modeling projections for water levels in the Great Lakes.]

Mr. Bechle suggested to incorporate a discussion on the effects of reduced ice cover over the Great Lakes due to climate change. He noted that ice cover reduces the amount of open water which a storm needs to produce waves (i.e., lake fetch) and can protect the shoreline from strong wave action. However, with less ice cover in fall and winter, wave action on the coastline may increase.

[Secretary's Note: Discussion was added in Chapter 3 under the section, "Potential Future Changes in Coastal Hazard Conditions" regarding the effects climate change can have on ice cover on the Great Lakes, and the effects that reduced ice cover can have on wave action.]

MAB/AWO
#248444
05/21/2019, 05/29/2019, 05/30/2019, 6/04/2019

PUBLIC INFORMATION MEETING SCHEDULED ON THE HAZARD MITIGATION PLAN UPDATE FOR OZAUKEE COUNTY

Citizens are invited to a public information meeting related to the mitigation of impacts from natural hazards in Ozaukee County, Wisconsin. This session will provide an opportunity to learn more about, and to comment on, the findings and recommendations documented in the preliminary draft of the first four chapters of Southeastern Wisconsin Regional Planning Commission (SEWRPC) Community Assistance Planning Report No. 332 of the *Ozaukee County Hazard Mitigation Plan Update*. The plan includes recommendations related to the mitigation of impacts from hazards such as flooding and related stormwater drainage problems; weather-related hazards such as tornadoes, winter storms, Lake Michigan coastal erosion, and severe thunderstorms; and utility failure or loss in Ozaukee County. This plan constitutes an update of the initial hazard mitigation plan which was adopted by the County in 2008 and is being completed in order for the County to maintain eligibility for hazard mitigation funding through the Federal Emergency Management Agency. This meeting will discuss the purpose of the plan and review the work completed to date.

Copies of the first four report chapters, including the risk and vulnerability analysis chapter, are now available for review on the SEWRPC web site at:

http://www.sewrpc.org/HMP

The plan is being prepared by SEWRPC, in cooperation with the County's Division of Emergency Management. Preparation of the plan was guided by a Hazard Mitigation Local Planning Team consisting of local official representatives, including representatives of City and Village departments, such as the fire, police, city development, and public works departments; County departments and agencies, including the County emergency management office and; interested nongovernmental organizations; and the health care community.

The meeting will be held from 5:30-7:30 p.m. on Thursday, June 27, 2019 at the Frank L. Weyenberg Library, Tolzman Community Room, 11345 N. Cedarburg Road, Mequon, Wisconsin, 53092.

The sessions will begin with a meeting in "open house" format for the first hour and, which will provide an opportunity to meet one-on-one or in small groups with the Commission and County staff to receive information, ask questions, and provide written comment. A presentation will be made by the Commission staff starting at 6:30 p.m.

Persons with special needs are asked to contact _____ at _____ a minimum of 72 hours in advance of the public session date so that appropriate arrangements can be made. Affected may be site access and/or mobility, materials review or interpretation, or active participation, including the submission of comments.

In addition to providing comments at the public meeting, written comments may also be submitted by U.S. mail or through a comment screen on the Commission's website. This comment screen may be found at:

http://www.sewrpc.org/SEWRPC/HMP

To ask questions or to submit written comments on the Hazard Mitigation Plan Update, please contact:

Southeastern Wisconsin Regional Planning Commission
Megan A. Beauchaine, Planner or
Aaron W. Owens, Planner
W239 N1812 Rockwood Drive
P.O. Box 1607
Waukesha, Wisconsin 53187-1607
Phone: 262-547-6721 Fax: 262-547-1103
e-mail: mbeauchaine@sewrpc.org

Ozaukee County Division of Emergency Management
Southeastern Wisconsin Regional Planning Commission

Notice of Meeting and Agenda

OZAUKEE COUNTY HAZARD MITIGATION PLAN LOCAL PLANNING TEAM

DATE: Tuesday May 5th, 2020

TIME: 1:00 to 2:30 p.m.

PLACE: Virtual Meeting on GoToMeeting online application. Refer to email invitation for GoToMeeting instructions.

AGENDA:
It is requested that Local Planning Team members review the material below before attending this meeting. Please bring any questions, comments, and/or edits to the meeting. Due to the circumstances, this will be an abbreviated meeting designed to take any suggested edits and to answer any questions; material will not be reviewed in detail. Local Planning Team Members are also encouraged to provide any comments or edits by email to Megan Beauchaine at mbeauchaine@sewrpc.org or through the comments screen provided on the project website at:
https://www.sewrpc.org/SEWRPC/communityassistance/Hazard-Mitigation-Planning/Ozaukee-County-Comment-Form.htm

1. Roll Call
2. Consideration of Summary Notes of May 16, 2019 Local Planning Team Meeting (a copy of the draft summary notes is available for download from the SEWRPC website at: http://www.sewrpc.org/SEWRPC/communityassistance/Hazard-Mitigation-Planning.htm)
3. Consideration of Chapter 5, "Hazard Mitigation Strategies," of SEWRPC Community Assistance Planning Report No. 332 *Ozaukee County Hazard Mitigation Plan* (a copy of the draft chapter is available for download from the SEWRPC website at: https://www.sewrpc.org/SEWRPCFiles/CommunityAssistance/Ozaukee-Hazard-Mitigation/capr-332-chapter-5-preliminary-draft.pdf)
4. Consideration of Chapter 6, "Plan Adoption, Implementation, Maintenance, and Revision," of SEWRPC Community Assistance Planning Report No. 332 *Ozaukee County Hazard Mitigation Plan* (a copy of the draft chapter is available for download from the SEWRPC website at: https://www.sewrpc.org/SEWRPCFiles/CommunityAssistance/Ozaukee-Hazard-Mitigation/capr-332-chapter-6-preliminary-draft.pdf)
5. Discussion of upcoming public meeting
6. Adjourn

Megan A. Beauchaine
Secretary

CAPR-332 MEETING AGENDA MAY, 2020 (253557)
500-1128
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SUMMARY NOTES OF THE MAY 5TH, 2020 MEETING OF THE OZAUKEE COUNTY HAZARD MITIGATION PLAN LOCAL PLANNING TEAM

INTRODUCTION

The May 5, 2020, meeting of the Ozaukee County Hazard Mitigation Plan Local Planning Team was convened via GoToMeeting at 1:07 p.m. The meeting was called to order by Ms. Herrick, Chief Environmental Engineer, SEWRPC. Attendance was taken by voice roll call.

In attendance at the meeting were the following individuals:

Local Planning Team Members	
Scott Ziegler, Chair	Director, Ozaukee County Division of Emergency Management
Megan Beauchaine, Secretary	Planner, Southeastern Wisconsin Regional Planning Commission
Sarah DeBruijn	Emergency Management, Village of Saukville
Hannah Grobelny	Public Health Strategist, Washington Ozaukee Public Health Department
Laura Herrick	Chief Environmental Engineer, Southeastern Wisconsin Regional Planning Commission
Terry Hoffman	WE Energies, Staff
Andy Holschbach	Land and Water Management Director, Ozaukee County
Aaron Owens	Planner, Southeastern Wisconsin Regional Planning Commission
Justin Schoenemann	Assistant City Administrator, City of Mequon
Roger Strohm	Director of Public Works, Village of Fredonia
Dawn Wagner	Administrator, Village of Saukville

Ms. Herrick welcomed the attendees and thanked them for their participation. Ms. Herrick briefly reviewed the online format for this meeting and then introduced Ms. Beauchaine to lead the next part of the meeting. Ms. Beauchaine briefly reviewed the meeting agenda and the summary notes of the May 16, 2019, Local Planning Team (LPT) meeting. Ms. Beauchaine noted that the May 16, 2019 summary notes were posted on the Southeastern Wisconsin Regional Planning Commission's (SEWRPC) website shortly after the meeting and document the meeting as well as the edits made to Chapters 3 and 4 of this plan update. With changes to staff, officers, and affiliations as well as retirements, Mr. Ziegler requested a copy of the LPT members list to update for the final version of the plan. There were no further LPT comments on the May 16, 2019 summary notes.

[Secretary's Note: Sarah DeBruijn, Emergency Manager, Village of Saukville was added to the Local Planning Team.]

CONSIDERATION OF DRAFT CHAPTER 5, "HAZARD MITIGATION STRATEGIES"

Before Ms. Beauchaine started the review of preliminary draft Chapter 5, Mr. Owens explained the format for the hazard strategies in Chapter 5. Structural, nonstructural, and public educational and informational strategies are listed for each hazard, and then priority mitigation measures are developed in greater detail. No comments on the chapter format were provided by the LPT.

Ms. Beauchaine next reviewed preliminary draft Chapter 5 "Hazard Mitigation Strategies". She began by reviewing the section for multiple hazard types (Section 5.2). This would include strategies that could be

incorporated to mitigate multiple hazards, such as early warning systems. No comments were provided by the LPT for this section.

Ms. Beauchaine then discussed Section 5.3 for flooding and stormwater drainage problems. The main priority mitigation strategy for the 863 potentially flooded structures in Ozaukee County (County) was voluntary acquisition or floodproofing. Mr. Holschbach asked if the flooded structures identified in the floodplain parcel analysis could be shared. Ms. Herrick indicated that SEWRPC staff will share this information with the County, noting that it is confidential and for internal use only. Another priority strategy for flooding was to maintain and add continuous USGS streamflow gages in the County. Ms. DeBruijn asked if these gages are different than weather service water depth gages. Ms. Herrick responded that they were different, and there are only three USGS gages in the entire county, all in the southern half.

Ms. Beauchaine reviewed Section 5.4 for thunderstorm wind, non-thunderstorm high-winds, hail, and lightening hazards. No comments were provided by the LPT for this section.

Section 5.5 for tornado hazards and Section 5.6 for extreme temperature hazards was discussed next by Ms. Beauchaine. No comments were provided by the LPT for these sections.

Ms. Beauchaine reviewed Section 5.7 for Lake Michigan coastal hazards and Section 5.8 for winter storm hazards. No comments were provided by the LPT for these sections.

Section 5.9 for drought hazards and Section 5.10 for utility failure hazards was discussed next by Ms. Beauchaine. Mr. Strohm asked if there was any way to get private power utilities to implement hazard mitigation for elevated power lines. Mr. Ziegler responded that the industry is regulated by the Public Service Commission and local communities do not have any regulatory authority for this topic.

Finally, Ms. Beauchaine reviewed Section 5.11 for fog hazards. No comments were provided by the LPT for this section.

There were no further questions or comments regarding Chapter 5, "Hazard Mitigation Strategies."

REVIEW AND CONSIDERATION OF DRAFT CHAPTER 6, "PLAN ADOPTION, IMPLEMENTATION, MAINTENANCE, AND REVISION"

Ms. Beauchaine reviewed preliminary draft Chapter 6 of the Report, noting that the final plan will need to be adopted by the County and all cities and villages in the County to be eligible for FEMA funds related to mitigation. The towns are welcome to adopt the final plan as well, but can be covered under the County adoption. Ms. Beauchaine discussed Appendix H, which included potential funding programs for implementation of the mitigation measures in the plan. Mr. Ziegler noted that the matching fund percentages listed in Appendix H may change based on the details of the particular project.

There were no further questions or comments regarding Chapter 6 "Plan Adoption, Implementation, Maintenance, and Revision."

SECOND PUBLIC REVIEW

Mr. Owens indicated that the second public review for the complete draft plan will be completed by providing the entire draft document on SEWRPC's website on the hazard mitigation page. A summary presentation PDF for the plan document has also been posted online as of May 4, 2020. Promotion for public comment has been made via SEWRPC's Facebook page and the County webpage. Mr. Ziegler indicated that he would share the summary presentation with the local communities so they could share it

through their public outreach avenues. Public comments can be provided through the comment screen on the SEWRPC project page, by email to Ms. Beauchaine, or by phone call to Mr. Ziegler. Public comments are due by May 12, 2020.

NEXT STEPS

Mr. Owens indicated that the next steps for the plan will be to incorporate comments from the LPT and the public, and then submit the draft plan to Wisconsin Emergency Management (WEM) for their review. He noted that any additional comments from the LPT are due by May 8, 2020. Once the WEM review comments are addressed, and the plan is approved by WEM, the plan will be finalized for adoption by the County. Adoption by the County needs to be completed before the grant end date of August 30, 2020. Mr. Ziegler indicated he has already coordinated with WEM to receive their approval in a timely manner so he can get plan adoption on the required County board agendas.

ADJOURNMENT

There being no further business, Ms. Herrick thanked everyone for attending and the online meeting was adjourned at 2:25 p.m.

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05/06/2020

Plan Documentation

- The plan update will be documented in a Southeastern Wisconsin Regional Planning Commission (SEWRPC) Community Assistance Planning Report (CAPR)
- SEWRPC CAPR No. 332, *Ozaukee County All Hazard Mitigation Plan Update*
- When completed the finalized full report will be available for download on the SEWRPC website at http://www.sewrpc.org/HMP

Draft Chapters Currently Available for Review

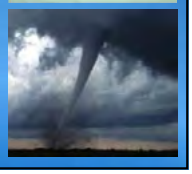
- Preliminary draft chapters of the Report are currently available on the SEWRPC website (http://www.sewrpc.org/HMP) or download via links below:
  - Preliminary Draft Chapter 1 "Introduction and Background"
  - Preliminary Draft Chapter 2 "Basic Study Area and Analysis"
  - Preliminary Draft Chapter 3 "Analysis of Hazard Conditions"
  - Preliminary Draft Chapter 4 "Hazard Mitigation Goals"
  - Preliminary Draft Chapter 5 "Hazard Mitigation Strategies"
  - Preliminary Draft Chapter 6 "Plan Adoption, Implementation, Maintenance and Revision

What is Hazard Mitigation?

- "Mitigation is any sustained action taken to eliminate or reduce the long-term risk to human life and property from natural and technological hazards"—FEMA
- Actions to reduce the damages that result when disasters occur

What is Hazard Mitigation?

- Mitigation is not:
  - Emergency response
  - Crisis management
  - Disaster preparation and recovery
- Mitigation focuses on reducing the impacts from hazard events when they occur



Why Do We Mitigate Hazards?

- Disasters are costly
- State and Federal assistance are insufficient
- We can prevent future damages
- Lesser impacts mean a quicker response and recovery process
- Can do this locally

Ozaukee County Hazard Mitigation Plan

- Includes the municipalities that make up the County

  (Straddling communities of Newburg and Bayside are covered under the Washington County and Milwaukee County Hazard Mitigation Plans, respectively)

- Sets forth strategies for mitigating impacts of natural hazards (as well as loss of utility service)
- Maintains eligibility for hazard mitigation funding from the Federal Emergency Management Agency (FEMA)
  - FEMA requires that local hazard mitigation plans be updated and revised every five years

Ozaukee County Hazard Mitigation-- Previous Planning Efforts

- 1995- Flood Hazard Mitigation Plan
  - 2001 Flood Hazard Mitigation Update
- 2008- First Pre-Disaster Hazard Mitigation Plan
  - EPTEC, Inc.
  - Referenced from Flood Hazard Mitigation Plan
- 2013- Hazard Mitigation Plan first Update
  - EPTEC, Inc.
- Current- Hazard Mitigation Plan 2nd Update (3rd Edition)
  - SEWRPC CAPR No. 332

Ozaukee County Hazard Mitigation Plan

- Plan development and updating is overseen by a Local Planning Team
  - Team includes County officials, City/Village officials, department and agency representatives, and knowledgeable citizens
  - Law enforcement, fire, and EMS departments; public works and engineering departments, planning departments, conservation departments, and educational institutions
- Staff include Ozaukee County Emergency Management Division, the Wisconsin Division of Emergency Management, and SEWRPC

Plan Components

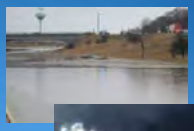
- Reviewed hazard mitigation implementation activities
- Updated inventories of natural and built features
- Reviewed and reevaluated identification of hazards
- Updated and reevaluated risk analysis
- Reviewed and revised mitigation goals
- Reviewed and revised mitigation strategies
- Updated plan adoption, implementation, and maintenance strategies
  - Developed an inventory of potential funding sources

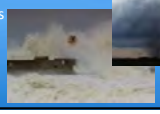
Inventory Data

- Demographic characteristics
- Existing and planned land use
- Surface water
  - One-percent-annual-probability floodplains
- Transportation and utility systems
- Critical community facilities
- Existing programs and regulations

Hazard Identification

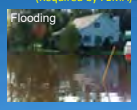
- Local Planning Team input
  - Hazard and Vulnerability Assessment tool
- Past hazard experience
  - Frequency of occurrence
  - Property and crop damages
  - Fatalities and injuries

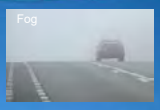


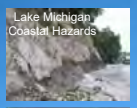


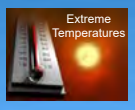
Natural Hazards Profiled in the Plan

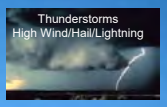
(Required by FEMA)

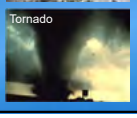


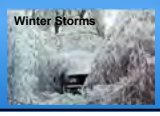








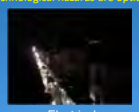




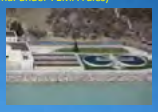
Utility Failure Also Profiled in the Plan

(Man-made or technological hazards are optional under FEMA rules)

Contamination/Loss of Water Supply



Electrical Disruption/Outages



Sewerage System

Natural Gas Disruption

Risk Analysis—Hazard Profiles

- Most profiles follow a similar format
  - Definition and description of the hazard
  - Description of notable historical events that affected the County
  - Description of some notable recent events that affected the County
    - Mapped events such as thunderstorms, tornadoes, number of structures in the floodplain, etc.
  - Assessment of vulnerabilities to the hazard and community impacts from the hazard
  - Description of potential future changes in impacts

Some Examples of the Types of Hazard Data Presented in this Plan Update…

Average Annual Damages

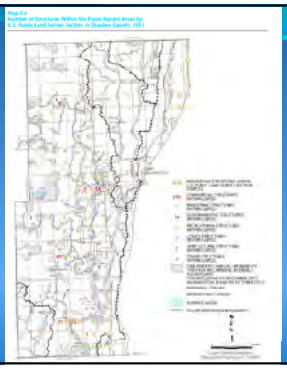


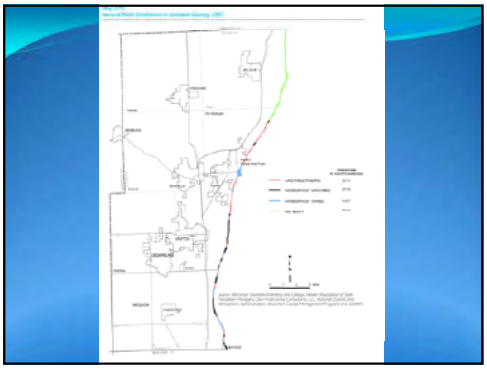
Table 3.8
Estimated Flood Damages for a One-Percent Annual Probability Flood in Ozaukee County

Municipality	Number of Structures in Floodplain	Flood Damages* Direct ($)	Indirect ($)	Total ($)
Cities				
Cedarburg	84	5,671,900	2,068,570	7,739,870
Mequon	228	5,249,600	858,470	6,208,070
Port Washington	25	640,370	143,150	783,520
Villages				
Bayside*	0	0	0	0
Belgium	1	4,610	690	5,300
Fredonia	15	73,090	17,670	91,560
Grafton	25	188,910	46,150	235,060
Newburg*	0	0	0	0
Saukville	164	4,450,360	1,160,550	5,610,910
Thiensville	65	1,953,330	549,540	2,502,870
Towns				
Belgium	116	1,477,650	221,660	1,699,310
Cedarburg	39	720,210	114,120	834,330
Fredonia	39	376,640	74,540	451,180
Grafton	32	450,980	78,310	529,290
Port Washington	4	42,260	6,580	48,840
Saukville	26	326,520	49,050	375,570
Total	863	21,722,630	5,389,050	27,111,680

Note: Estimated damages are based on assessed improvement values in 2018.

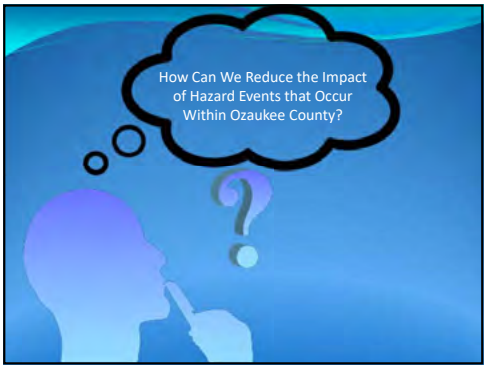
*Only the portion of the community within Ozaukee County was analyzed for this assessment.

Source: Wisconsin Department of Natural Resources and SEWRPC.



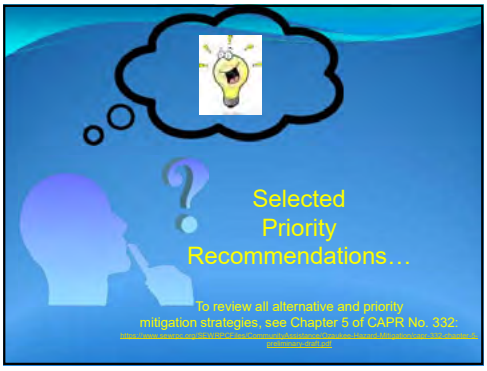
Ozaukee County Hazard Mitigation Plan Goals

1. Preserve life and minimize the potential for injuries
2. Preserve and enhance the quality of life throughout Ozaukee County by identifying potential property and crop damage risks and recommending appropriate mitigation strategies to minimize potential damages
3. Promote Countywide coordination, planning, and training that avoids transferring the risk of hazards from one community to an adjacent community
4. Maintain various land uses that preserve and protect the natural resources of the County, including soils, inland lakes and streams, groundwater, wetlands, woodlands, wildlife, floodplains, and natural areas and critical species habitats
5. Increase public awareness to hazards that threaten life and property
6. Identify potential funding sources that can assist in the implementation of mitigation projects and programs



Development of Hazard Mitigation Strategies

- Review existing alternative hazard mitigation strategies
- Identify additional alternative strategies
  - Structural—*e.g.* safe rooms, flood proofing
  - Nonstructural—*e.g.* ordinances, floodplain preservation
  - Public Informational and Educational
- Reviewed current programs
  - Federal, State, and local
- Evaluated existing and newly identified alternatives
- Examined multi-jurisdictional considerations
- Selected a revised set of priority mitigation measures



Examples Priority Recommended that Apply to Multiple Hazard Types

- Maintain, update, and upgrade public early warning systems and networks
- Continue the use, maintenance, and updating of the County's interoperability communication network systems
- Promote emergency on-site back-up power generation at critical facilities
- Continue to promote, update, and add to Ozaukee County Division of Emergency Management's online resources related to hazardous weather events, preparedness, and post-event management
- Encourage residents to develop a Family Emergency Preparedness Plan and a Disaster Supply Kit
- Promote inclusion of safety strategies for severe weather events into driver educational classes and materials
- Encourage and educate the public on the use of severe weather warning applications (apps) and NOAA Weather Radios

Examples Priority Recommended Flood Mitigation Strategies

- Maintain floodplain and wetland zoning regulations AND enforcement of floodplain regulations
- Continue preservation and maintenance of environmentally sensitive lands and open space areas
- Pursue wetland restoration opportunities to reduce flood related agricultural and property damage (implemented at the discretion of the property owners)
- Acquisition and removal of up to 27 "repetitive loss" structures (implemented at the discretion of the property owner)
- Acquisition and removal of up to 624 single-family residential structures identified as being located in flood hazard areas (implemented at the discretion of the property owner)
- Floodproofing of up to 217 commercial, industrial, and other structures identified as being located in flood hazard areas (implemented at the discretion of the property owner)
- Installation of new and maintenance of existing USGS stream gages within the County to improve floodplain mapping

Examples of Priority Recommended Mitigation Strategies for Lake Michigan Coastal Hazards

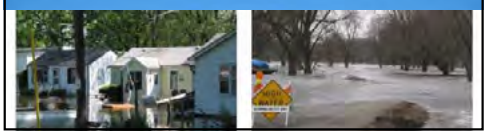
- Develop and enforce consistent County and municipal shoreland regulations and policies (i.e., ordinances) relating to setbacks along bluffs and ravines
- Develop and encourage bluff top best management practices for property owners
- Continue to implement engineering studies that assess the variables influencing bluff stability and shoreline recession which determine the stable slope angle setback
- Consider relocating buildings within high-risk bluff failure areas
- Conduct an updated assessment of the condition and effectiveness of all shoreline protection structures in the County
- Construct and maintain shoreline protection structures and bluff stabilization measures where public infrastructure is at risk
- Encourage the practice of nature-based shoreline protection measures, such as coastal wetlands or dune restoration, suitable vegetation plantings that can stabilize bluff soils, and beach nourishment
- Continue to work with Wisconsin Coastal Management Program to conduct public outreach and to provide technical assistance regarding BMPs to prevent shoreline erosion and bluff recession

Example of Priority Recommended Mitigation Strategies for Weather-related Hazards

- Provide public Information and Education via handouts, municipal webpages, or online links to additional resources
- Coordinate cooling and warming shelters and inform the public, especially vulnerable populations
- Continue to work with local fair/festival organizers to create emergency plans in case of severe weather
- Pursue grant funding for constructing and/or upgrading additional storm shelters and community safe rooms within the County
- Maintain and regularly test early warning systems (i.e., tornado sirens and public alert notification systems)
- Review and enforce building code requirements
- Continued coordination of local government emergency operations and response plans
- Work with utility companies to assess and improve, as needed, system dependability and redundancy

Implementation Strategies (see CAPR 332 Ch. 6)

- Estimation of mitigation measure costs
- Summarized benefits of implementing mitigation measures
- Designated lead management agencies
- Updated current implementation status
- Identified potential sources of funding and technical assistance



Plan Approval and Adoption

- Review and approval by Wisconsin Division of Emergency Management (WEM)
- The plan will then need to be adopted by:
  - Ozaukee County Board
  - Governing bodies of the Cities and Villages in the County
- Approved and adopted Plan will be effective from 2020-2025

Project Web Site Resources

- http://www.sewrpc.org/SEWRPC/communityassistance/Hazard-Mitigation-Planning.htm
  - Agendas and other Local Planning Team meeting materials
  - Summary notes from Local Planning Team meetings
  - Presentations
  - Draft chapters
  - Comment screen

Public Comment Period Open Through May 12, 2020

Provide Comments Related to this Plan Update….

- By Comment screen on the SEWRPC website: CLICK HERE TO COMMENT!
- By Email to Megan Beauchaine, Planner, SEWRPC: mbeauchaine@sewrpc.org
- By Phone to Scott Ziegler, Director, Ozaukee County Emergency Management:

  (262)-238-8398

THANK YOU FOR YOUR INTEREST IN REDUCING THE IMPACT OF HAZARD EVENTS IN YOUR COMMUNITY!

APPENDIX B

PLAN PARTICIPATION AND PREPARATION FROM THE 2013 OZAUKEE COUNTY ALL-HAZARDS MITIGATION PLAN

The Ozaukee County Emergency Management Director contracted with Emergency Planning, Training and Exercise Consulting (EPTEC, Inc.) to draft the 2013 Hazard Mitigation Plan Update. A Hazard Mitigation Committee was organized to oversee the completion of that plan. The committee members included:

- Mark Owen, Ozaukee County Emergency Management
- Mary Fitzgerald, Ozaukee County Emergency Management
- Paul Riegel, Ozaukee County Emergency Management
- Kirsten Johnson, Ozaukee County Public Health Department
- Carolee Jacque, Ozaukee County Public Health Department
- Diana Noack, Ozaukee County Public Health Department
- Patty Ruth, Ozaukee County Public Health Department
- Andy Holschbach, Ozaukee County Planning, Resources and Land Management
- Christina Richards, Ozaukee County Land Information Office
- Beth Vargo, Ozaukee County Sheriff's Office
- Mike Yuhas, Ozaukee County Amateur Radio Emergency Services
- George King, Local Emergency Planning Committee, American Red Cross Volunteer, Ozaukee County
- Kevin Runkel, City of Cedarburg Emergency Management
- Randy LeRoy, City of Mequon, Columbia St. Mary's
- Scott Tyler, City of Mequon Police Department
- Mark Mitchell, City of Port Washington Fire Department
- Richard Howells, Village of Belgium President
- Roger Strohm, Village of Fredonia Public Works Department
- Dan Murphy, Village of Grafton, Aurora Medical Center
- Steven Zils, Village of Grafton, Aurora Medical Center
- Bob Sehmer, Village of Grafton
- Matt Bernarski, Village of Newburg
- Mike Heili, Village of Newburg
- Jack Morrison, Village of Saukville
- Dianne Robertson, Village of Thiensville
- Danny Birenbaum, Town of Belgium
- Brian Schommer, Town of Fredonia Fire Department
- Ben Schliesman, SE Region WI Emergency Management
- Kurt Worden, WI Red Cross
- Lenora Borchardt, EPTEC, Inc. (Contractor)

Table B.1
Plan Preparation for the 2013 Ozaukee County Hazard Mitigation Plan Update

Date	Summary of Opportunity
October 2011	Letter requesting that municipalities and applicable county departments send a representative to the hazard mitigation workgroup meetings
October 17, 2011	Memo to the City, Village, and Town leaders informing the public of the hazard mitigation plan update process and requesting that they complete and submit a hazard mitigation survey to the County Emergency Management (EM) office
November 14, 2011	Initial press release informing the public of the hazard mitigation plan update process
December 15, 2011	Article in the newspaper informing the public of the hazard mitigation plan update process
February 17, 2012	Hazard Vulnerability Analysis/PDM Assessment meeting
February 28, 2012	Hazard mitigation workgroup planning meeting
March 29, 2012	Hazard mitigation workgroup planning meeting
May 7, 2013	Ozaukee County EM director met with Roger Strohm (Village of Fredonia) to complete the hazard mitigation survey and to select the hazard mitigation strategies for the plan
June 6, 2013	Legal public notice printed in the Ozaukee Press newspaper

Source:

An informational brochure was created and copies were distributed throughout the community at local community gathering points such as municipal halls, libraries, etc. Meetings were held with officials from the municipalities to explain and gather input regarding the program (e.g., previous occurrences, mitigation strategies.) The FEMA Region V survey was sent to the clerk and chief elected official of every municipality (town, village and city) as well as key county departments (e.g., planning, highway) for completion; surveys were received back from county offices and the incorporated municipalities as well as many of the unincorporated towns.

The committee met several times, first to evaluate and incorporate input from local officials and then to review and provide input on the progress of the plan. A public notice was placed in the newspaper to invite members of the public, local officials, academia and business and industry leaders to review the plan. A working draft of the plan was distributed to the County Emergency Management Directors from Milwaukee, Sheboygan and Washington Counties. Comments received were reviewed and incorporated into the plan as appropriate. A copy of the mitigation brochure and a list of meeting dates.

Table B.1 includes workgroup meetings, meetings with public officials, and media opportunities for the all-hazards pre-disaster mitigation plan of 2013.

PUBLIC SAFETY FACILITIES AND SERVICES WITHIN THE OZAUKEE COUNTY PLANNING AREA

APPENDIX C

Table C.1
Fire Departments and Stations Within the Ozaukee County Planning Area: 2018

Map Number (See Map 2.19)	Service Zone Area (acres)	Facility Name	Communities Served	Address	Telephone Number	Fax Number
1	23,516	Belgium Fire Department	Village and Town of Belgium	195 Commerce Street	(262) 285-3257	(262) 285-3251
2	18,938	Cedarburg Fire Department Station 1	City and Town of Cedarburg	W61 N631 Mequon Avenue	(262) 375-7630	(262) 375-9203
3	1,618	Cedarburg Fire Department Station 2	Town of Cedarburg	1350 Covered Bridge Road	(262) 375-7630	--
4	7,922	Fredonia Fire Department	Village and Town of Fredonia and Saukville	201 S. Milwaukee Street	(262) 692-9973	(262) 375-9203
5	15,632	Grafton Fire Department	Village and Town of Grafton, City of Port Washington	1431 13th Street	(262) 375-5314	(262) 375-5334
6	30,073	Mequon Fire Department Station 1 (Safety Station)	City of Mequon	11300 N. Buntrock Avenue	(262) 242-2530	(262) 242-5042
7	--	Mequon Fire Department Station 2	City of Mequon	Port Washington Road	--	--
8	13,936	Newburg Fire Department	Village of Newburg, Town of Trenton, and Town of Saukville	508 Main Street	(262) 675-6262	(262) 675-9390
9	14,435	Port Washington Fire Department	City and Town of Port Washington	104 W. Washington Street	(262) 284-2891	(262) 284-3962
10	3,272	Random Lake Fire Department	Village of Random Lake and Towns of Belgium and Fredonia	718 N. Spring Street	(920) 946-1848	--
11	11,147	Saukville Fire Department	Village and Town of Saukville	520 W. Dekora Street	(262) 284-5800	(262) 284-0775
12	693	Thiensville Fire Department	Village of Thiensville	250 Elm Street	(262) 242-3393	(262) 238-4448
13	17,516	Waubeka Fire Department	Towns of Fredonia and Saukville	W4114 River Road	(262) 692-2656	--

Source: Ozaukee County Department of Land Information and SEWRPC

Table C.2
Emergency Medical Service-Rescue Departments Within the Ozaukee County Planning Area: 2018

Zone Number (See Map 2.20)	Service Zone Area (acres)	Emergency Medical Service-Rescue Department Facility Name	Communities Served	Address	Telephone Number	Fax Number
1	23,516	Belgium Emergency Medical Service	Village and Town of Belgium	195 Commerce Street	(262) 285-3257	(262) 285-3251
2	18,938	Cedarburg Ambulance and Emergency Medical Service	City and Town of Cedarburg	W61 N631 Mequon Avenue	(262) 375-7630	(262) 375-9203
3	7,922	Fredonia Emergency Medical Service (Northern Ozaukee Ambulance)	Village and Town of Fredonia, Town of Saukville	201 S. Milwaukee Street	(262) 692-9973	(262) 692-6844
4	15,632	Grafton Ambulance and Emergency Medical Service	Village and Town of Grafton, City of Port Washington	1431 13th Street	(262) 375-5314	(262) 375-5334
5	30,073	Mequon Ambulance and Emergency Medical Service	City of Mequon	11300 N. Buntrock Avenue	(262) 242-2530	(262) 242-5042
6	13,936	Newburg Ambulance And Emergency Medical Service	Village of Newburg, Town of Trenton, Town of Saukville, Town of Farmington	508 Main Street	(262) 675-6262	(262) 675-9390
7	17,516	Waubeka Emergency Medical Service	Town of Fredonia, Town of Saukville	W4114 River Street	(262) 692-2656	--
8	14,435	Port Washington Ambulance and Emergency Medical Service	City and Town of Port Washington	104 W. Washington Street	(262) 284-2891	(262) 284-3962
9	3,272	Random Lake Ambulance and Emergency Medical Service	Northern portions of the Towns of Fredonia and Belgium	718 N. Spring Street	(920) 994-4326	--
10	11,147	Saukville Ambulance and Emergency Medical Service	Village and Town of Saukville	520 W. Dekora Street	(262) 284-5800	(262) 284-0775
11	693	Thiensville Ambulance	Village of Thiensville	250 Elm Street	(262) 242-3393	(262) 238-4448

Source: Ozaukee County Department of Land Information and SEWRPC

Table C.3
Police and Sheriff's Departments Within the Ozaukee County Planning Area: 2018

Map Number (See Map 2.22)	Facility Name	Community	Address	Telephone Number	Fax Number
1	Cedarburg Police Department	Village of Cedarburg	W75 N444 Wauwatosa Road	(262) 375-7620	(262) 375-7906
2	Grafton Police Department	Village of Grafton	1981 Washington Street	(262) 375-5320	(262) 375-5338
3	Mequon Police Department	City of Mequon	11300 N. Buntrock Avenue	(262) 242-3500	(262) 242-7655
4	Newburg Police Department	Village of Newburg	614 Main Street	(262) 675-2160	(262) 675-2287
5	Ozaukee County Sheriff's Office	Port Washington	1201 S. Spring Street	(262) 284-7172	(262) 284-8490
6	Port Washington Police Department	City of Port Washington	365 N. Wisconsin Street	(262) 284-5575	--
7	Saukville Police Department	Village of Saukville	649 E. Green Bay Avenue	(262) 284-0444	(262) 284-5404
8	Thiensville Police Department	Village of Thiensville	250 Elm Street	(262) 242-2100	(262) 238-4442

Source: Ozaukee County Department of Land Information and SEWRPC

Table C.4
Dispatch Centers in Ozaukee County: 2018

Map Number (See Map 2.23)	Facility Name	Address	Dispatch For:
1	Ozaukee County Sheriff's Office	1201 S. Spring Street, Port Washington	Ozaukee County Sheriff, Ozaukee County Emergency Management Hazmat Team and Rescue Boat, Port Washington Police and Fire/EMS, Saukville Police and Fire/EMS, Thiensville Police and Fire/EMS, Grafton Fire/EMS, Waubeka Fire/EMS, Fredonia Marshals and Fire/EMS, and Belgium Fire/EMS
2	Cedarburg	W75 N444 N. Wauwatosa Road, Cedarburg	Cedarburg Police and Fire/EMS, Cedarburg Emergency Management, and MABAS (Mutual Aid Box Alarm System) Division 119 Primary Dispatch for Fire/EMS
3	Mequon	11300 N. Buntrock Avenue, Mequon	Mequon Police and Fire/EMS and MABAS (Mutual Aid Box Alarm System) Division 119 Secondary Dispatch for Fire/EMS

Source: Ozaukee County Division of Emergency Management and SEWRPC

CRITICAL COMMUNITY FACILITIES AND SERVICES WITHIN THE OZAUKEE COUNTY PLANNING AREA

APPENDIX D

Table D.1
Selected Government Administration Buildings Within the Ozaukee County Planning Area: 2015

Map Number (See Map 2.24)	Name	Community	Address	Telephone Number	Fax Number
			County Offices		
1	Ozaukee County Administration Center	Port Washington	121 W. Main Street	(262) 284-9411	--
2	Ozaukee County Justice Center	Port Washington	1201 S. Spring Street	(262) 284-8491	--
			City, Town, and Village Halls		
3	Belgium Town Hall	Belgium	5698 Lake Church Road or 171 Main Street	(262) 285-3326	--
4	Belgium Village Hall	Belgium	195 Commerce Street	(262) 285-7931	(262) 285-3479
5	Cedarburg City Hall	Cedarburg	W63 N645 Washington Avenue	(262) 375-7600	(262) 375-7906
6	Cedarburg Town Hall	Cedarburg	1293 Washington Avenue	(262) 377-4509	--
7	Fredonia Town Hall	Fredonia	W4114 River Road	(262) 692-9673	--
8	Fredonia Village Hall	Fredonia	242 Fredonia Avenue	(262) 692-9125	--
9	Grafton Town Hall	Grafton	1230 11th Avenue	(262) 377-8500	--
10	Grafton Village Hall	Grafton	860 Badger Circle	(262) 375-5300	--
11	Mequon City Hall	Mequon	11333 N. Cedarburg Road	(262) 242-3100	--
12	Newburg Village Hall	Newburg	614 Main Street	(262) 675-2130	(262) 675-2287
13	Port Washington City Hall	Port Washington	100 W. Grand Avenue	(262) 284-5585	(262) 284-7224
14	Port Washington Town Hall	Port Washington	3715 Highland Drive	(262) 284-5235	--
15	Saukville Town Hall	Saukville	3762 Lakeland Road	--	--
16	Saukville Village Hall	Saukville	639 E. Green Bay Avenue	(262) 284-9423	--
17	Thiensville Village Hall	Thiensville	250 Elm Street	(262) 242-3720	--
			Libraries		
18	Cedarburg Public Library	Cedarburg	W63 N589 Hanover Avenue	(262) 375-7640	--
19	Frank L. Weyenberg Library of Mequon-Thiensville	Mequon	11345 N. Cedarburg Road	(262) 242-2593	--
20	W. J. Neiderkorn Public Library	Port Washington	316 W. Grand Avenue	(262) 284-5031	--
21	Oscar Grady Public Library	Saukville	151 S. Main Street	(262) 284-6022	--
22	U.S.S. Liberty Memorial Public Library	Grafton	1620 11th Avenue	(262) 375-5315	--
			United States Postal Service		
23	Belgium Post Office	Belgium	543 Main Street	(262) 285-3791	--
24	Cedarburg Post Office	Cedarburg	W63 N605 Hanover Avenue	(262) 377-0388	(262) 377-5438
25	Fredonia Post Office	Fredonia	207 Regal Drive	(262) 692-2341	--
26	Grafton Post Office	Grafton	1817 Highland Drive	(262) 377-4250	--
27	Mequon-Thiensville Post Office	Thiensville	124 W. Freistadt Road	(262) 242-0955	(414) 242-7858
28	Newburg Post Office	Newburg	440 Main Street	(262) 675-6661	--
29	Port Washington Post Office	Port Washington	104 E. Main Street	(262) 284-5526	(262) 284-2104
30	Saukville Post Office	Saukville	600 W. Dekora Street	(262) 284-5523	--

Source: SEWRPC

Table D.2
Public, Private, and Higher Educational Schools Within the Ozaukee County Planning Area: 2018

Map Number (See Map 2.25)	Facility Name	School District	Grades	Address	Telephone Number	Fax Number
			Public Schools			
1	Cedarburg High School	Cedarburg	9-12	W68 N611 Evergreen Boulevard	(262) 376-6201	(262) 376-6210
2	4K Early Learning Center	Cedarburg	4k	W52 N932 Keup Road	(262) 376-6142	(262) 376-6110
3	Parkview Elementary School	Cedarburg	K-5	W72 N853 Harrison Avenue	(262) 376-6801	(262) 376-6810
4	Thorson Elementary School	Cedarburg	K-5	W51 N932 Keup Road	(262) 376-6701	(262) 376-6710
5	Webster Middle School	Cedarburg	6-8	W75 N624 Wauwatosa Road	(262) 376-6501	(262) 376-6510
6	Westlawn Elementary School	Cedarburg	K-5	W64 N319 Madison Avenue	(262) 376-6901	(262) 376-6910
7	Grafton High School	Grafton	9-12	1950 Washington Street	(262) 376-5500	(262) 376-5510
8	John Long Middle School	Grafton	6-8	700 Hickory Street	(262) 376-5801	(262) 376-5810
9	Kennedy Elementary School	Grafton	K-5	1629 11th Avenue	(262) 376-5651	(262) 376-5660
10	Woodview Elementary School	Grafton	K-5	600 5th Avenue	(262) 376-5751	(262) 376-5760
11	Donges Bay Elementary School	Mequon-Thiensville	4K-5	2401 W. Donges Bay Road	(262) 238-7925	(262) 238-7970
12	Homestead High School	Mequon-Thiensville	9-12	5000 W. Mequon Road	(262) 238-5646	(262) 238-5633
13	Lake Shore Middle School	Mequon-Thiensville	6-8	11036 N. Range Line Road	(262) 238-7613	(262) 238-7650
14	Oriole Lane Elementary School	Mequon-Thiensville	4K-5	12850 N. Oriole Lane	(262) 238-4220	(262) 238-4250
15	Range Line School	Mequon-Thiensville	Infants to 4K	11040 N. Range Line Road	(262) 238-8501	(262) 238-8520
16	Steffen Middle School	Mequon-Thiensville	6-8	6633 W. Steffen Drive	(262) 238-4706	(262) 238-4740
17	Wilson Elementary School	Mequon-Thiensville	4K-5	11001 N. Buntrock Avenue	(262) 238-4601	(262) 238-4662
18	Ozaukee Elementary School	Northern Ozaukee	K-5	401 Highland Drive	(262) 692-2401	(262) 692-2441
19	Ozaukee High School	Northern Ozaukee	9-12	401 Highland Drive	(262) 692-2453	(262) 692-6257
20	Ozaukee Middle School	Northern Ozaukee	6-8	401 Highland Drive	(262) 692-2463	(262) 692-2313
21	Wisconsin Virtual Learning Elementary and Middle School	Northern Ozaukee	K-8	401 Highland Drive	(262) 692-3988	(262) 692-3952
22	Dun Widdie Elementary School	Port Washington-Saukville	K-4	1243 W. Lincoln Avenue	(262) 268-5705	(262) 268-5720
23	Lincoln Elementary School	Port Washington-Saukville	K-4	1325 N. Theis Lane	(262) 268-5805	(262) 268-5820
24	Port Washington High School	Port Washington-Saukville	9-12	427 W. Jackson Street	(262) 268-5505	(262) 268-5520
25	Breakwater Academy (Alternative High School and Middle School)	Port Washington-Saukville	6-12	1317 W. Grand Avenue	--	--
26	Port Washington-Saukville School District Preschool (PWSSD)	Port Washington-Saukville		1243 W. Lincoln Avenue	(262) 268-5700	(262) 268-5720
27	Saukville Elementary School	Port Washington-Saukville	K-4	333 Mill Street	(262) 268-5905	(262) 268-5920
28	Thomas Jefferson Middle School	Port Washington-Saukville	5-8	1403 N. Holden Street	(262) 268-6105	(262) 268-6120

Table continued on next page.

Table D.2 (Continued)

Map Number (See Map 2.25)	Facility Name	School District	Grades	Address	Telephone Number	Fax Number
			Private Schools			
29	Covered Bridge Christian School	Cedarburg		774 Keup Road	--	--
30	First Emmanuel Lutheran School	Cedarburg	K-8	W67 N622 Evergreen Boulevard	(262) 377-6610	(262) 377-9606
31	Saint Francis Borgia School	Cedarburg	K-8	N43 W6005 Hamilton Road	--	--
32	Saint Francis Borgia School	Cedarburg	K-8	1425 Covered Bridge Road	(262) 377-2050	(262) 377-4099
33	Morningstar Preschool and Childcare Montessori School	Cedarburg		W63 N131 Washington Avenue	(262) 573-3200	--
34	Divine Savior Catholic School	Northern Ozaukee	K3-7	305 Fredonia Avenue	(262) 692-2141	(262) 692-3085
35	Saint Joseph Parish School	Grafton	K-8	1619 Washington Avenue	(262) 375-6505	(262) 375-6509
36	Saint Paul Lutheran School	Grafton	K-8	701 Washington Street	(262)-377-4659	(262) 377-7808
37	Our Savior Lutheran School	Grafton	K-8	1332 Arrowhead Road	(262) 377-7780	(262) 377-9045
38	Lumen Christi Catholic School	Mequon-Thiensville	4-8	11300 N. Saint James Lane	(262) 242-7960	(262) 512-8986
39	Trinity Lutheran Grade School	Mequon-Thiensville	K-8	10729 W. Freistadt Road	(262) 242-2045	(262) 242-4407
40	Mequon Montessori School	Mequon-Thiensville	4K-K	2505 W. Mequon Road	(262) 242-6782	(262) 242-5724
41	Christ Alone Lutheran School	Mequon-Thiensville	K-8	110 Division Street	(262) 242-3870	--
42	Saint John's XXIII Catholic Middle School Campus (Upper Campus)	Port Washington-Saukville	5-8	1802 N. Wisconsin Street	(262) 284-2682	(262) 284-4168
43	Saint John's Lutheran Academy	Port Washington-Saukville	K-8	217 N. Freeman Drive	(262) 284-2131	--
44	Ozaukee Christian School	Port Washington-Saukville	K-8	341 S. Dries Street	(262) 284-6980	--
			Private Colleges and Universities			
45	Concordia University	--	--	12800 N. Lake Shore Drive	(262) 243-5700	--
46	Wisconsin Lutheran Seminary	--	--	11831 N. Seminary Drive	(262) 242-8100	(262) 242-8110
47	Milwaukee Area Technical College, Mequon Campus	--	--	5555 W. Highland Road	(262) 238-2200	--

Source: Ozaukee County Department of Land Information, Wisconsin Department of Public Instruction, and SEWRPC

Table D.3
Hospitals and Special Medical Centers in Ozaukee County: 2015

Map Number (See Map 2.26)	Medical Center	Community	Address
	Community Medical Centers[a]		
1	Columbia-St. Mary's Hospital- Ozaukee Campus	Mequon	13111 N. Port Washington Road
2	Aurora Medical Center-Grafton	Grafton	975 Port Washington Road
	Special Medical Centers[b]		
3	Cedar Mills Medical Group	Cedarburg	N143 W6515 Pioneer Road
4	Aurora Advanced Health Care	Mequon	6425 W. Mequon Road
5	Aurora Health Care Clinic	Port Washington	1475 W. Grand Avenue
6	Aurora Health Care Quick Care	Mequon	10928 N. Port Washington Road
7	Advanced Health Care- Cedar Creek Clinic	Grafton	215 W. Washington Street
8	Advanced Heath Care- Port Washington Clinic	Port Washington	1777 W. Grand Avenue
9	Homestead Family Health Center	Cedarburg	4922 Columbia Road
10	Advanced Healthcare- East Mequon Clinic and Surgery Center	Mequon	12203 N. Corporate Parkway
11	Aurora Health Care Rehabilitation Center and Clinic	Mequon	1249 W. Liebau Road
12	Aurora Health Care Clinic	Belgium	309 Lakeview Drive
13	Ascension Columbia St. Mary's Ozaukee at Grafton Urgent Care	Grafton	2061 Cheyenne Court
14	Froedtert Mequon Health Center	Mequon	11430 N. Port Washington Road
15	Mequon Clinic-Children's Hospital of Wisconsin (Also an Urgent Care Facility)	Mequon	1655 W. Mequon Road

[a] *Community medical centers are defined as a hospital having at least 100 beds with inpatient and outpatient facilities as well as laboratory and clinical services.*

[b] *Special medical centers are defined to include all other types of medical centers and special clinics offering multi-specialty medical facilities and services.*

Source: SEWRPC

Table D.4
Elderly Facility Centers in Ozaukee County: 2018

Map Number (See Map 2.27)	Facility Name	Address	Facility Type	Phone Number
		Belgium		
1	Belgium Gardens	432 S. Heritage Street	CBRF	(262) 285-3660
		Cedarburg		
2	McKinley Place	W56 N225 McKinley Boulevard	CBRF	(262) 376-7700
3	Harrison Home	W72 N675 Harrison Avenue	CBRF	(262) 375-0661
4	Will-Starr/Cedarburg House	N50 W7050 Western Avenue	CBRF	(414) 550-8926
5	Cedar Springs Health & Rehabilitation Center	N27 W5707 Lincoln Boulevard	Nursing Home	(262) 376-7676
6	Lasata Care Center	W76 N677 Wauwatosa Road	RCAC and Nursing Home	(262) 377-5060
		Fredonia		
7	Hilltop View	130 Meyer Avenue	CBRF	(262) 692-2828
8	Woodland View of Fredonia	248 S. Milwaukee Street	CBRF	(262) 692-3760
		Grafton		
9	Anita's Gardens	1777 Highland Drive	CBRF	(262) 377-6828
10	Hamburg Home	1951 First Avenue	CBRF	(262) 375-0661
11	Serenity Homes of Grafton	1706 W. Washington Avenue	CBRF	(262) 377-2250
		Mequon		
12	Highlands At New Castle Place	12600 N. Port Washington Road	CBRF, CCRC, RCAC, and Nursing Home	(262) 387-8883 or (262) 387-8800
13	Lighthouse of Mequon	3111 W. Mequon Road	CBRF	(262) 613-2918
14	Luther Manor at River Oaks	11340 N. Cedarburg Road	CBRF	(262) 242-6660
15	Sarah Chudnow Campus	10995 N. Market Street	CBRF, RCAC and Nursing Home	(262) 478-1500
16	Silver Springs of Mequon	11840 Silver Avenue	CBRF	(262) 643-4223
17	Meadowmere - North Shore	10803 N Port Washington Road	RCAC	(262) 478-2200
		Port Washington		
18	Abundance of Life, Inc.	4870 Upper Forest Beach Road	CBRF	(262) 285-3533
19	Anita's Gardens	117 E. Van Buren Street	CBRF	(262) 268-9780 or (262) 268-9781
20	Ellen's Home	1800 Granite Lane	CBRF	(262) 268-9555
21	Evelyn's Adult Family Home	336 Michael Court	CBRF	(262) 692-2874 or (262) 284-6768
22	Harbor Club Harbor Cove	333 W Walters Street	CBRF	(262) 268-1800
23	Port Haven	334 S. Garfield	CBRF	(262) 284-3908
24	Port of Hope	226 N. Spring Street	CBRF	(262) 268-0301

Table continued on next page.

Table D.4 (Continued)

Map Number (See Map 2.27)	Facility Name	Address	Facility Type	Phone Number
		Port Washington (continued)		
25	Heritage Nursing and Rehabilitation Center	1119 N. Wisconsin Street	Nursing Home	(262) 284-5892
26	Harbor Club Harbor Cove	425 W. Walters Street	CBRF	(262) 268-1800
27	Heritage Lincoln Village	1330 W. Lincoln Avenue	CBRF	(414) 964-7678
		Saukville		
28	Dekora Springs	214 W. Dekora Street	CBRF	(262) 268-8234
29	Milan Estates	715 Milan Drive	CBRF	(262) 284-1601
		Thiensville		
30	Willowbrook Place Senior Apartments	205 Green Bay Road	RCAC	(262) 242-8045

Note: **Nursing Homes** are facilities for individuals who require skilled nursing care and are no longer able to function in a less restrictive setting. Nurses and aides are available 24 hours a day. **Continual Care Retirement Communities (CCRC)** offer a continuum of residential care settings with a single campus site. Independent living is offered with a combination of leisure, social, and supportive services. If additional care is needed, personal care services are available. **Community Based Residential Facilities (CBRF)** or group homes, provide an alternative living environment for individuals who need assistance but do not need the level of care given in nursing homes. CBRF's offer meals, laundry, housekeeping, medication monitoring, assistance with dressing and bathing, 24-hour staff, and organized activities. **Residential Care Apartment Complex's (RCAC)** do not include nursing home care or community based residential care, but may be physically part of a structure that is a nursing home or community based residential facility.

Source: Ozaukee County Department of Land Information, Wisconsin Department of Children and Families, and SEWRPC

Table D.5
Early Learning Facilities and Childcare Centers in Ozaukee County: 2018

Map Number (See Map 2.28)	Facility Name	Address	Application Type	Capacity	Ages Served
		Belgium			
1	Stepping Stones Children's Center, LLC.	420 Park Street	Licensed Group	75	4 Weeks-13 Years
		Cedarburg			
2	KinderCare Learning Center	W62 N218 Washington Avenue	Licensed Group	100	6 Weeks-12 Years
3	Morningstar Montessori	W63 N131 Washington Avenue	Licensed Group	50	8 Weeks-7 Years
4	Cornerstone Christian Learning Center, LLC.	7955 State Road	Licensed Group	47	6 Weeks-12 Years
5	YMCA SACC at Parkview Elementary	W72 N853 Harrison Avenue	Licensed Group	47	4 Weeks-13 Years
6	YMCA SACC at Thorson	W151 N932 Keup Road	Licensed Group	50	4 Weeks-13 Years
7	YMCA SACC at Westlawn School	W64 N309 Madison	Licensed Group	32	4 Weeks-13 Years
		Fredonia			
8	YMCA SACC at Northern Ozaukee Elementary	401 Highland Drive	Licensed Group	49	4 Years-13 Years
9	St. John's Preschool	824 Fredonia Avenue	Licensed Group	100	6 Weeks-13 Years
		Grafton			
10	Grafton Preschool and Childcare, LLC.	890 Badger Circle	Licensed Group	106	4 Weeks-12 Years
11	Little Friends Learning Center, LLC.	1214 10th Avenue	Licensed Group	60	3 Weeks-12 Years
12	Little Red Schoolhouse, CCC.	7025 Pleasant Valley Road	Licensed Group	60	1 Weeks-14 Years
13	Ozaukee Child Care and Preschool	1195 County Hwy C	Licensed Group	78	6 Weeks-13 Years
14	Kettle Moraine SACC YMCA Inc. at Grafton Elementary	1800 Washington Street	Licensed Group	34	4 Years-13 Years
15	Kettle Moraine SACC YMCA Inc. at Kennedy Elementary	1629 11th Avenue	Licensed Group	23	4 Years-13 Years
16	Kettle Moraine SACC YMCA Inc. at Woodview Elementary	600 5th Avenue	Licensed Group	40	4 Years-13 Years
17	Maple Leaf Academy	1621 2nd Avenue	Licensed Group	16	2 Yearss-5 Years
18	New Frontiers Early Learn Center Preschool, LLC.	350 Double Tree Lane	Licensed Group	54	1 Years-7 Years
		Mequon			
19	Milwaukee Area Technical College Children's Center	5555 W. Highland Road	Licensed Group	36	6 Weeks-12 Years
20	JCC Gan Ami Preschool	10813 N. Port Washington Road	Licensed Group	55	6 Weeks-12 Years
21	North Shore Preschool and Child Care, LLC.	10406 N. Cedarburg Road	Licensed Group	40	6 Weeks-13 Years
22	Kids Rule Academy, LLC.	2909 W. Mequon Road	Licensed Group	85	6 Weeks-12 Years
23	Ozaukee Child Care and Preschool	1115 W. Liebau Road	Licensed Group	100	6 Weeks-12 Years
24	Range Line Preschool and Child Care	11040 N. Range Line Road	Licensed Group	95	4 Weeks-12 Years
25	Dezigned 4 Kidz Child Care Center, Inc.	9950 N. Port Washington Road	Licensed Group	67	6 Weeks-14 Years
26	Kids Creative Corner Child Care, Inc.	10333 N. Enterprise Drive	Licensed Group	50	4 Weeks-12 Years
27	Mequon Jewish Preschool, Inc.	11112 N. Crown Court	Licensed Group	50	6 Weeks-12 Years
28	Sonlight Child Development Center at Mequon United Methodist Church	11011 N. Oriole Lane	Licensed Group	50	6 Weeks-10 Years

Table continued on next page.

Table D.5 (Continued)

Map Number (See Map 2.28)	Facility Name	Address	Application Type	Capacity	Ages Served
Mequon (continued)					
29	Building Blocks Christian Learning Center at St. John's Lutheran Church	1616 W. Mequon Road	Licensed Group	23	3 Years-13 Years
30	Crossroads Christian Preschool at Crossroads Presbyterian Church	6031 W. Chapel Hill Road	Licensed Group	31	2 Years-6 Years
31	Lumen Christi Milestones Programs for Children	11300 N. Saint James Lane	Licensed Group	24	3 Years-13 Years
32	Mequon-Thiensville Recreation Department	12850 N. Oriole Lane	Licensed Group	34	4 Weeks-13 Years
33	Mequon-Thiensville Recreation Department	11001 N. Buntrock Avenue	Licensed Group	34	4 Weeks-13 Years
34	Mequon-Thiensville Recreation Department	2401 W. Donges Bay Road	Licensed Group	34	4 Weeks-13 Years
35	Mequon Montessori School, Inc.	2505 W. Mequon Road	Licensed Group	50	18 Months-8 Years
36	Epic Minds Childcare, Inc.	1415 W. Donges Bay Road	Licensed Group	50	6 Weeks-12 Years
Port Washington					
37	Community Learning Center	1234 Lincoln Avenue	Licensed Group	216	6 Weeks-12 Years
38	Kettle Moraine YMCA Inc. Feith Family Ozaukee Child Care	465 Northwoods Road	Licensed Group	100	2 Years-13 Years
39	Stepping Stones Children's Center, LLC.	425 W. Walters	Licensed Group	65	4 Weeks-13 Years
40	Kids Port Child Care, Ltd.	1505 Sunset Road	Licensed Group	55	4 Weeks-13 Years
41	Kettle Moraine SACC YMCA Inc. at Lincoln Elementary	1325 N. Theis Lane	Licensed Group	60	4 Weeks-13 Years
42	Port Preschool, Inc.	131 N. Webster Street	Licensed Group	34	3 Years-6 Years
Saukville					
43	Living Hope Lutheran Church- Here We Grown Preschool and Child Care	851 W. Dekora Street	Licensed Group	85	6 Weeks-13 Years
44	Saukville Preschool, LLC.	341 S. Dries Street	Licensed Group	35	2 Years-13 Years
45	Kettle Moraine SACC YMCA Inc. at St. Peter's Church	166 W. Dekora Street	Licensed Group	49	4 Years-13 Years

Source: Ozaukee County Department of Land Information, Wisconsin Department of Children and Families, and SEWRPC

HISTORICAL AND STATE HISTORIC SITES AND DISTRICTS WITHIN THE OZAUKEE COUNTY PLANNING AREA

APPENDIX E

Table E.1
National and State Historic Sites and Districts in Ozaukee County: 2017

Map Number (See Map 2.29)	Site Name	Location By Address	Civil Division	National Year Listed
1	Covered Bridge	1 mile North of Five Corners over Cedar Creek	Town of Cedarburg	1973
2	Concordia Mill	252 Green Bay Road	City of Cedarburg	1974
3	Cedarburg Mill	N 58 W6181 Columbia Road	City of Cedarburg	1974
4	Edward Dodge House	126 E. Grand Avenue.	City of Port Washington	1975
5	Hamilton Historic District	Hamilton and Green Bay Roads	Town of Cedarburg	1976
6	Stony Hill School	South of Intersection of STH 84 and CTH I	Town of Fredonia	1976
7	Old Ozaukee County Courthouse	109 W. Main Street	City of Port Washington	1976
8	St. Mary's Roman Catholic Church	430 N. Johnson Street	City of Port Washington	1977
9	Hilgen and Wittenberg Woolen Mill	N70 W6340 Bridge Road	City of Cedarburg	1978
10	Jonathan Clark House	13615 N Cedarburg Road	City of Mequon	1982
11	John Reichert Farmhouse	1403 N. Wauwatosa Road	City of Mequon	1982
12	Harry W. Bolens House	842 W. Grand Avenue	City of Port Washington	1983
13	Grafton Flour Mill	1300 14th Avenue	Village of Grafton	1983
14	Cedarburg Woolen Co. Worsted Mill	W62 N580 Washington Avenue	City of Cedarburg	1983
15	Hoffman House Hotel	200 W. Grand Avenue	City of Port Washington	1984
16	Wayside House	W61 N439 Washington Avenue	City of Cedarburg	1986
17	Washington Ave. Historic District	--	City of Cedarburg	1986
18	Payne Hotel	310 E. Green Bay Road	Village of Saukville	1991
19	Colombia Historic District		City of Cedarburg	1992
20	Friedrich and Louisa Hilgen House	N47 W6033 Spring Street	City of Cedarburg	1992
21	Edwin Nieman J. Sr. House	13030 N. Cedarburg Road	Village of Thiensville	1996
22	Niagara Steamer	Lake Michigan	Town of Belgium	1996
23	Port Washington Light Station	311 E. Johnston Street	City of Port Washington	1999
24	Mequon Town Hall and Fire Station Complex	11333 North Cedarburg Road	City of Mequon	2000
25	Bigelow School	4228 W. Bonniwell Road	City of Mequon	2000
26	William Jahn Farmstead	12112-12116 N. Wauwatosa Road	City of Mequon	2000
27	Port Washington Downtown District	--	City of Port Washington	2000
28	Jacob Voight House	11550 N. Wauwatosa Road	City of Mequon	2000
29	O'Brien-Peuschel Farmstead	12510 N. Wauwatosa Road	City of Mequon	2000
30	Isham Day House	11312 N. Cedarburg Road	City of Mequon	2000
31	Green Bay Road Historic District	145-195 (odd) Green Bay Road	Village of Thiensville	2004
32	Main Street Historic District	101 N. Main Street, 105-130 S Main Street, 101 Green Bay Road, and 107 W. Buntrock Avenue	Village of Thiensville	2004
33	Port Washington Fire Engine House	102 E. Pier Street	City of Port Washington	2009
34	Northerner Shipwreck	Lake Michigan	--	2010

Table continued on next page.

Table E.1 (Continued)

Map Number (See Map 2.29)	Site Name	Location By Address	Civil Division	National Year Listed
35	Island City Shipwreck	Lake Michigan	--	2011
36	Milwaukee Falls Lime Company	2020 Green Bay Road	Village of Grafton	2012
37	Kendall Cabinet Shop	W4128 Mill Street	Town of Fredonia	2016
38	Senator Shipwreck	Lake Michigan	--	2016
39	Frank Vocke Octagonal Barn	1901 W. Pioneer Road	City of Mequon	2016
40	Port Washington North Breakwater Light	550 E. Jackson Street	City of Port Washington	2018

Source: Wisconsin Historical Society and SEWRPC

HAZARD MITIGATION MATERIAL AND RELATED RESOURCES

APPENDIX F

Additional Items to Consider Adding to an Emergency Supply Kit:

- ❑ **Prescription medications and glasses**
- ❑ **Infant formula and diapers**
- ❑ **Pet food and extra water for your pet**
- ❑ **Important family documents such as copies of insurance policies, identification and bank account records in a waterproof, portable container**
- ❑ **Cash or traveler's checks and change**
- ❑ **Emergency reference material such as a first aid book or information from www.ready.gov**
- ❑ **Sleeping bag or warm blanket for each person. Consider additional bedding if you live in a cold-weather climate.**
- ❑ **Complete change of clothing including a long sleeved shirt, long pants and sturdy shoes. Consider additional clothing if you live in a cold-weather climate.**
- ❑ **Household chlorine bleach and medicine dropper** – When diluted nine parts water to one part bleach, bleach can be used as a disinfectant. Or in an emergency, you can use it to treat water by using 16 drops of regular household liquid bleach per gallon of water. Do not use scented, color safe or bleaches with added cleaners.
- ❑ **Fire Extinguisher**
- ❑ **Matches in a waterproof container**
- ❑ **Feminine supplies and personal hygiene items**
- ❑ **Mess kits, paper cups, plates and plastic utensils, paper towels**
- ❑ **Paper and pencil**
- ❑ **Books, games, puzzles or other activities for children**

Ready

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Emergency Supply List

FEMA

www.ready.gov

Recommended Items to Include in a Basic Emergency Supply Kit:

- **Water, one gallon of water per person per day for at least three days, for drinking and sanitation**
- **Food, at least a three-day supply of non-perishable food**
- **Battery-powered or hand crank radio and a NOAA Weather Radio with tone alert and extra batteries for both**
- **Flashlight and extra batteries**
- **First aid kit**
- **Whistle to signal for help**
- **Dust mask, to help filter contaminated air and plastic sheeting and duct tape to shelter-in-place**
- **Moist towelettes, garbage bags and plastic ties for personal sanitation**
- **Wrench or pliers to turn off utilities**
- **Can opener for food (if kit contains canned food)**
- **Local maps**

Through its *Ready* Campaign, the Federal Emergency Management Agency educates and empowers Americans to take some simple steps to prepare for and respond to potential emergencies, including natural disasters and terrorist attacks. *Ready* asks individuals to do three key things: get an emergency supply kit, make a family emergency plan, and be informed about the different types of emergencies that could occur and their appropriate responses.

All Americans should have some basic supplies on hand in order to survive for at least three days if an emergency occurs. Following is a listing of some basic items that every emergency supply kit should include. However, it is important that individuals review this list and consider where they live and the unique needs of their family in order to create an emergency supply kit that will meet these needs. Individuals should also consider having at least two emergency supply kits, one full kit at home and smaller portable kits in their workplace, vehicle or other places they spend time.

Ready FEMA

Federal Emergency Management Agency
Washington, DC 20472

POTENTIAL FUNDING PROGRAMS TO IMPLEMENT PLAN RECOMMENDATIONS WITHIN OZAUKEE COUNTY

APPENDIX G

Table G.1
Potential Funding Programs to Implement Plan Recommendations

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
1	U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA)	Hazard Mitigation Grant Program	State agencies and participating National Flood Insurance Program (NFIP) communities; federally-recognized tribes, tribal agencies, private nonprofits, and local government/communities	1. Floodproofing 2. Relocation of structures 3. Elevation of structures 4. Property acquisition 5. Conformity with approved state and local mitigation plan 6. Plan preparation 7. Safe room construction 8. Construction or modification of dikes, levees, floodwalls, seawalls, groins, jetties, breakwaters, and stabilized sand dunes	75 percent Federal cost-share assistance; 12.5 percent State match and 12.5 percent local match required[a]	Following a Presidential disaster declaration; letter of intent must be submitted within 30 days of declaration
2	FEMA	Flood Mitigation Assistance Grant Program	State agencies and participating NFIP communities; federally-recognized tribes, tribal agencies, local governments/communities	1. Elevation, relocation, or demolition of insured structures 2. Acquisition 3. Dry floodproofing 4. Minor structural projects 5. Beach nourishment activities 6. Projects must be consistent with the goals and objectives identified in the State, tribal, or local mitigation plans	Funding is appropriated by Congress;[b] 75 percent Federal cost-share assistance; 25 percent local match required; two types of grants: Planning grant and project grant[c]	See program guidance
3	FEMA	Public Assistance Grant Program	State, tribal, territorial, and local governments; certain types of private nonprofit organizations	1. Rebuilding infrastructure damaged during a flood 2. Building infrastructure for portions of a community that are to be relocated outside of floodplains 3. Limited assistance with structural elevation and relocation	75 percent Federal cost-share assistance; the State determines the local match	Within 30 days of a Presidential disaster declaration
4	FEMA	National Training and Education Division	State and local first responders; private sector and tribal entities	1. Provides preparedness training and exercise support to first responders in the event of a manmade or natural catastrophic event 2. Provides educational services in 18 professional disciplines	Provides over 150 training courses for first responders	See program guidance
5	FEMA	Pre-Disaster Mitigation Grant Program	State agencies and participating National Flood Insurance Program (NFIP) communities; local governments, U.S. Territories, and Federally-recognized tribes	1. Acquisition and relocation or demolition of structures in flood hazard areas 2. Floodproofing 3. Minor structural projects 4. Flood control projects for critical facilities 5. Plan preparation 6. Technical assistance 7. Safe room construction 8. Applicants must have a FEMA-approved Mitigation Plan in order to qualify for project grants	Funding is appropriated by Congress;[b] 75 percent Federal cost-share assistance provided (small, impoverished communities may be eligible for up to 90 percent federal cost-share); 25 percent State or local match is required	Varies

Table continued on next page.

Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
6	FEMA	Homeland Security Preparedness Technical Assistance Program	State, local, and tribal governments	1. Activities that help achieve the National Preparedness Goal 2. Education and training on emerging homeland security issues	No statutory matching requirements; Amounts awarded vary based on the scope of the project	Contact headquarters or regional location
7	FEMA	Assistance to Firefighters Grant Program	City, County, Village, Tribal, and Township Fire Departments; nonaffiliated emergency medical services (EMS) organizations, State Fire Training Academies (SFTA)	1. Firefighter and EMT training 2. Firefighting and EMS equipment 3. Firefighter personal protective equipment	Cost-share matching fund requirements dependent upon size of population served by Fire Department	See program guidance
8	FEMA	Staffing for Adequate Fire and Emergency Response Grants (SAFER)	City, County, Village, Tribal, and Township Fire Departments (volunteer, combination, and career fire departments)	1. Hiring of new, additional firefighters to improve staffing levels 2. Recruitment and retention of volunteer firefighters involved with or trained in the operations of firefighting and emergency response	Salary and associated benefits for new firefighters and volunteer firefighters; Recipients of SAFER Recruitment and Retention of Volunteer Firefighters Activity grants are not required to contribute matching funds; Firefighters Activity grant recipients are required to contribute non-federal funds subject to a Position Cost Limit and a Cost Share (see program guidance)	See program guidance
9	FEMA	Fire Prevention and Safety Grants (FP&S)	City, County, Village, Tribal, and Township Fire Departments; non-profit organizations, educational and public health institutions	1. Community risk reduction 2. Fire and arson investigation 3. Clinical Studies 4. Technology and product development 5. Code enforcement/awareness	Non-federal match equal to or greater than five percent of the grant awarded is required	See program guidance
10	FEMA	Fire Management Assistance Grants	States, Indian tribal governments, and local governments	Provides assistance for the mitigation, management, and control of any fire burning on publicly or privately-owned forest or grassland that threatens such destruction as would constitute a major disaster	75 percent Federal cost-share assistance; 25 percent State and local match[d]	Rolling
11	U.S. Fire Administration	National Fire Academy	People with substantial involvement in fire prevention and control, emergency medical services, fire-related emergency management activities, or allied professions	Provides tuition-free training in firefighting, prevention, emergency medical services, and related areas	Provides tuition-free training in firefighting, prevention, emergency medical services, and related areas	June 15 for fall semester, December 15 for spring semester
12	U.S. Fire Administration	National Fire Academy Training Assistance Student Stipend Reimbursement Program	People who represent a career or volunteer fire department, rescue squad, or State or local government	Provides travel stipends for students attending National Fire Academy courses	Travel reimbursement	Rolling
13	U.S. Army Corps of Engineers (USACE)	Continuing Authorities Program—Snagging and Clearing for Flood Risk Management Program	State and local units of government	1. Removal of obstructions that restrict floodflows of navigable waters 2. Projects must be designed and constructed by the Corps	Federal share cannot exceed $500,000 for a given project; cost-share program with local match of 35 percent for design and preparation; construction cost varies between 30 percent and 65 percent federal share	None

Table continued on next page.

Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
14	USACE	Continuing Authorities Program—Emergency Streambank and Shore Protection Program	Local governments	1. Bank protection of highways, highway bridges, essential public works, churches, hospitals, schools, and other nonprofit public services from flood induced erosion	Federal share cannot exceed $5,000,000 for a given project; cost-share program with local match of 35 percent for design and construction required	None
15	USACE	Small Hurricane and Storm Damage Reduction Program	State agencies and local units of government	1. Beach nourishment 2. Floodproofing 3. Other structural and nonstructural storm damage reduction projects	Federal share cannot exceed $5,000,000 for a given project; cost-share program with local contribution of 35 percent for design and construction required	None
16	USACE	Water Resources Development and Flood Control Acts	Local governments	1. Water resources planning assistance 2. Emergency streambank and shoreline protection	50 percent for studies and 65 percent for project implementation of Federal cost-share assistance; 35 to 50 percent local match is required	None
17	USACE	Continuing Authorities Program—Flood Risk Management Program	Local governments and special authorities	Assistance for planning, design, and construction of structural and non-structural flood control projects. Projects are not limited to any particular type of improvement.	Feasibility study is 100 percent federally funded up to $100,000; 50 percent local match required for any costs exceeding $100,000; 65 percent federal cost share for project implementation with 35 percent local match required	Ongoing
18	USACE	Flood Plain Management Services Program	State, regional, and local governments; federally recognized Native American Tribes; other non-federal public agencies	1. Floodplain delineation 2. Flood hazard evaluation 3. Dam break analysis 4. Stormwater management 5. Flood risk reduction	100 percent federal cost-share assistance provided; entities may provide voluntary contributions	Ongoing
19	USACE	Flood Damage Reduction Program	State and local units of government	1. Projects designed to reduce the impact of flood events 2. Projects must be designed and constructed by the Corps	50 to 65 percent Federal cost-share assistance above $100,000 and cannot exceed $10 million; 35 to 50 percent local match is required	None
20	National Oceanic and Atmospheric Administration (NOAA)	Coastal Estuarine Land Conservation Program	Public agencies	1. Protect, restore, and enhance Great Lakes coastal wetlands 2. Protect restore, and enhance coastal and riparian habitats in the Great Lakes basin	50 percent Federal cost-share not to exceed $1.5 million; requires 50 percent non-federal match	See program guidance
21	U.S. Department of Agriculture (USDA)	Water and Waste Disposal Loan & Grant Program	Local units of government, nonprofit organizations; Meant for rural areas and towns of less than 10,000 people	Funds may be used to finance the acquisition, construction, or improvement of: 1. Drinking water sourcing, treatment, storage, and distribution 2. Sewage collection, transmission, treatment, and disposal 3. Stormwater collection, transmission and disposal	Long-term, low interest loans. If funds are available, grants may be combined with a loan if necessary to keep user costs reasonable	Determined by State USDA office
22	U.S. Department of Agriculture, Farm Services Agency (FSA)	Conservation Reserve Program	Individual landowners in a 10- or 15-year contract	1. Riparian buffers 2. Trees 3. Windbreaks 4. Grassed waterways 5. Farmer must have owned or operated the land for at least 12 months prior to the previous program sign-up period	50 percent Federal cost-share assistance; 50 percent local match from individual; an annual rental payment for the length of the contract is also provided	Annually or ongoing

Table continued on next page.

Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
23	FSA	Conservation Reserve Enhancement Program	Individual landowners who have owned or operated land for at least 12 months prior to submitting an offer	1. Filter strips 2. Riparian buffers 3. Grassed waterways 4. Permanent grasses (only in specially designated grassland project areas) 5. Wetland development and restoration	50 percent Federal cost-share assistance; one-time signing incentive payment of $100 per acre for installing grass waterways, filter strips, and riparian buffers; one-time practice incentive payment equal to 40 percent of the eligible reimbursable cost to install grass waterways, filter strips, and riparian buffers; an annual rental payment; State of Wisconsin provides an incentive payment (equal to 20 percent of the eligible reimbursable cost of installing the approved practice), a one-time payment for land enrolled in the State's perpetual easement, and a one-time payment for land enrolled in the State's agreement program	Ongoing
24	FSA	Emergency Conservation Program	Individual landowners	1. Grading and shaping farmland 2. Restoring conservation structures 3. Redistribution of eroded soil 4. Debris removal 5. Projects must be in response to a natural disaster	Up to 75 percent Federal cost-share assistance, the remaining is determined by the committee reviewing the application	After a designated State or presidential disaster declaration; sign-up periods vary by local FSA County Committee
25	FSA	Farmable Wetland Program	Individual agricultural landowners in 10- or 15- year contracts	1. Restore currently farmed wetland	One-time $100 per acre Federal signing incentive; up to 50 percent Federal cost share assistance for installation of practices plus one-time incentive payment of 40 percent of practice installation cost; annual rental payments based on the weighted average dryland cash rate	Variable
26	U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)	Agricultural Conservation Easement Program-Wetlands Reserve Easements	Local government and individual landowners	1. Purchase agricultural land easements that protect the conservation values of eligible land 2. Wetland protection, restoration, and enhancement	Permanent easement: NRCS pays 100 percent of easement value and 75 to 100 percent of restoration cost 30-year easement: NRCS pays 50 to 75 percent of easement value and 50 to 75 percent of restoration cost	Variable
27	NRCS	Conservation Stewardship Program	Individual landowners in a five-year contract	1. Filter strips 2. Riparian Buffers 3. Wildlife corridors 4. Stream habitat improvement	Payments for maintaining and/or enhancing natural resources not to exceed $40,000 per year or $200,000 over a five-year period	Annually
28	NRCS	Watershed Protection and Flood Prevention Program	State and local units of government; tribal governments	1. Watershed protection 2. Flood prevention measures 3. Benefits that are directly related to agriculture must be at least 20 percent of the total project benefits 4. Watersheds can be no larger than 250,000 acres	Cost-share rates vary depending on the type of measure and the purpose to which the cost is allocated; total average annual monetary benefits equal $2.2 billion	Ongoing

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Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
29	NRCS	Emergency Watershed Protection Program – Floodplain Easement Option	Individual landowners provided they have a local sponsor such as a local unit of government	1. Sale of agricultural floodprone lands to NRCS for floodplain easements 2. Land must have a history of repeated flooding (at least twice in the past 10 years) 3. Landowner retains most of the rights as before the sale 4. NRCS has authority to restore the floodplain function and value	The USDA pays the landowner the lowest of three options: a geographic rate, the fair market value of the land, or an offer made by the landowner; 75 percent Federal cost-share assistance; 25 percent local match is required[e]	Variable
30	NRCS	Emergency Watershed Protection Program - Recovery Assistance	Individual landowners provided they have a local sponsor such as a local unit of government	1. Debris removal 2. Reshaping and protection of eroded streambanks 3. Repair levees and structures 4. Repair damaged drainage facilities	Up to 75 percent Federal cost-share assistance; 25 percent local match is required	Variable
31	NRCS	Environmental Quality Incentives Program	Agricultural producers, owners of non-industrial private forestland, Indian Tribes, and those with an interest in the agricultural or forestry operations	1. Animal waste management practices 2. Soil erosion and sediment control practices 3. Nutrient management 4. Groundwater protection 5. Habitat improvement	Up to 75 percent Federal cost-share assistance; 25 percent local match is required	Variable
32	USDA Risk Management Agency	Federal Crop Insurance	Agricultural producers	1. Insurance of selected crops against losses due to natural hazards 2. USDA Risk Management Agency administers this program, however producers purchase Federal crop insurance through private insurance agents	Insurance of selected crops against losses due to natural hazards	Deadlines announced annually, vary depending on the type of crop
33	U.S. Fish and Wildlife Service (FWS)	North American Wetlands Conservation Grants Program	Private or public organizations	1. Land acquisition 2. Restoration, management, and enhancement of wetland ecosystems and other habitat for migratory birds and other fish and wildlife	Applicants must match their grant request at no less than a 1-to-1 ratio; requests for small grants may not exceed $100,000	Standard grants due in February and July Small grants due in October
34	FWS	Partners for Fish and Wildlife Habitat Restoration Program	Private landowners for a 10-year-minimum contract	1. Restoration of degraded wetlands, native grasslands, stream and riparian corridors, and other habitat areas	Full cost-share and technical assistance; individual projects cannot exceed $25,000	Continuous
35	U.S. Department of Housing and Urban Development (HUD)	Community Development Block Grant Program	Local governments	1. Public Facilities Grants to fund tornado shelters and safe houses 2. Housing Grants to fund the rehabilitation of housing to meet current building codes 3. Funds continuous training course for the building code authority	No matching requirements; Amounts awarded vary based on assessed community needs	See program guidance
36	HUD and Wisconsin Department of Administration, Division of Energy, Housing, and Community Resources	Community Development Block Grant Program-Emergency Assistance Program	Local governments	1. Repair of public infrastructure 2. Housing rehabilitation to low-and moderate-income homeowners 3. Business assistance	75 percent Federal cost-share assistance; 25 percent local match required; maximum grant award equals $500,000	Application must be submitted within 90 days of a Presidential disaster declaration
37	HUD	Healthy Homes Technical Studies Grant Program	State, tribal, and local governments; non-profit organizations, for-profit firms, educational institutions	1. Improve methods for detecting and controlling key housing-related health and safety hazards and improve environmental sampling protocols 2. Evaluate efficacy and cost-effectiveness of interventions to address high-priority residential health and safety hazards	Approximately $6 million available nationally;[b] awards range from $300,000 to a maximum grant award of $1,000,000; No match is required, applicant leveraging contributions are encouraged	See program guidance

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Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
38	U.S. Small Business Administration	Disaster Loan Program	Homeowners, renters, and businesses	1. Property repair 2. Property replacement 3. Meeting building code requirements 4. Involuntary relocations out of a special flood hazard area	Low interest loans	After a Presidential or U.S. Secretary of Agriculture disaster declaration
39	U.S. Environmental Protection Agency (USEPA)	Pesticide Environmental Stewardship Grants	Companies and organizations that use pesticides, represent pesticide users, or implement or influence pest management practices of pesticide users (pesticide manufacturers and producers are not eligible)	1. Implementation of pollution control measures 2. Plan development that includes strategies to reduce pesticide risk	Approximately $500,000 available nationally;[b] locally grants are provided up to a maximum of $50,000	Ongoing
40	USEPA	Environmental Education Grants Program	Local or State education agencies, colleges, and nonprofit organizations; State environmental agencies, tribal education agencies, and noncommercial educational broadcasting agencies	1. Improving environmental education teaching skills 2. Educating teachers, students, or the public about human health problems 3. Building capacity for environmental education programs 4. Education communities 5. Educating the public through print, broadcast, or other media	$3 million available nationally,[b] grants range from $50,000 to $100,000; up to 75 percent federal cost share assistance, 25 percent local match is required	Check regional Request for Proposals (RFP) for deadline
41	USEPA	Targeted Watershed Grants	Watershed organizations nominated by State Governors or Tribal leaders	1. Watershed-based projects to protect water resources (i.e. wetland restoration) 2. Training and technical assistance to local partnerships	75 percent maximum Federal cost-share assistance; Minimum 25 percent non-Federal match	See program guidance
42	U.S. Department of Health and Human Resources, National Institutes of Health	National Institute of Environmental Health Sciences (NIEHS) Hazardous Waste Worker Health and Safety Training	Public and private nonprofit organizations involved in hazardous waste removal, containment, or chemical emergency response	1. Assists organizations in the development of institutional competency to provide appropriate training and education to hazardous waste workers 2. Assists in development of model worker health and safety training programs consisting of classroom and practical health and safety training of workers in the treatment, storage, disposal, removal, containment, transportation or hazardous materials 3. Aids with training and education, emergency response in regard to a hazardous waste incident	No statutory matching requirements; Grants generally range from $26,960 to $2.7 million; Average grant awarded is $833,895 (2018)	See program guidance
43	U.S. Department of Transportation (USDOT), Federal Highway Administration (FHWA)	Surface Transportation Block Grant Program	State and local units of government	Provides funding assistance for smaller-scale transportation projects and activities such as improvements to pedestrian and bicycle facilities and recreational trails; provides assistance for community improvements such as historic preservation and vegetation management, and environmental mitigation related to stormwater and habitat connectivity	80 percent Federal cost-share assistance; 20 percent local match is required	Contact State Transportation Enhancement Manager

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Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
44	USDOT	Transportation Enhancement Program	State and local units of government	1. Wetland preservation and restoration 2. Stormwater treatment systems to address runoff from roads and highways 3. Land acquisition for scenic easements, pedestrian and bike trails, and abandoned railway corridors	80 percent Federal cost-share assistance; 20 percent local match is required For land acquisition: 50 percent Federal cost-share assistance; 50 percent local match is required	See program guidance
45	Wisconsin Department of Administration	Wisconsin Coastal Management Grant Program	State and local units of government, nonprofit organizations, and tribal agencies	Enhancement and restoration of coastal resources within the state's coastal zone; eligible activities include wetland protection, nonpoint source pollution control, and historic preservation projects	Approximately $1.5 million is available biennially to all counties adjacent to Lakes Superior and Michigan	See program guidance
46	WDHS	Chemical Contamination Technical Assistance	Local government	Technical assistance can determine if an actual or potential public health threat is present and if hazard mitigation is warranted or desirable	Provide technical assistance and support	None
47	Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP)	Farmland Preservation Program	Individual landowners for a period of 10 years	Best management practices that will lower the soil erosion rate to the tolerable soil loss rate or below and improve water quality	Tax incentives on an annual basis	None
48	DATCP	Land and Water Resource Management Program	Individual landowners	1. Grassed waterways 2. Manure storage systems 3. Grade stabilization structures 4. Well abandonment 5. Conservation tillage	50 to 70 percent State cost-share assistance; 30 to 50 percent individual cost-share is required; in the case of financial hardship, up to 90 percent cost-share assistance can be obtained from State	December 31
49	DATCP	Soil and Water Resource Management Program	Individual landowners	1. Wetland restoration 2. Filter strip, riparian buffers 3. Subsurface drainage 4. Well abandonment	Program funds 70 percent of the cost of conservation project	Variable
50	WDHS, Division of Public Health, Bureau of Communicable Diseases	Communicable or Infectious Diseases Technical Assistance	Local governments	Technical assistance to determine if an actual or potential human threat is present	Provide technical assistance and support	None
51	WDHS	Special Needs Technical Assistance	Local governments	Technical assistance to determine if an actual or potential human service and/or population threat is present	Provide technical assistance and support	None
53	Wisconsin Department of Natural Resources (WDNR)	Municipal Flood Control Grants Chapter NR 199 of the *Wisconsin Administrative Code*	Cities, villages, towns, metropolitan sewerage districts	1. Acquisition and removal of structures 2. Flood proofing and elevation of structures 3. Riparian restoration projects 4. Acquisition of vacant land or purchase of easements 5. Construction of stormwater and groundwater facilities related to flood control and riparian restoration projects 6. Flood mapping	50 percent State cost-share assistance; 50 percent local match	March 15 of even-numbered years

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Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
54	WDNR	Urban Green Space Program	Local units of government, tribal governments, lake protection and rehabilitation districts, and nonprofit conservation organizations	Land acquisition for greenway space in urban areas, protection of scenic or ecological features, and wildlife habitat improvement; local governments must have a WDNR accepted comprehensive outdoor recreation plan or master plan that has been approved by resolution by the local governing unit	50 percent State cost-sharing assistance; 50 percent local match is required	May 1
55	WDNR	Remediation and Redevelopment Program	Responsible Party	Oversees the investigation and cleanup of environmental contamination and the redevelopment of contaminated properties; consolidates state and federal cleanups into one program	Provide technical assistance and support	Department will take emergency action to remove or contain a spill at the expense of the responsible party
56	WDNR	Lake Classification and Local Ordinance Development Grants, Section NR 191.30 of the *Wisconsin Administrative Code*	Local units of government, lake districts	Development or improvement of ordinances related to conservancy, wetland, shoreland, floodplain, construction erosion control, stormwater control or other ordinances with water quality or lake protection benefit	75 percent State cost-share, not to exceed $50,000	December 10
57	WDNR	Lake Management Planning Grant Program, Chapter NR 190 of the *Wisconsin Administrative Code*	Local units of government, lake districts, town sanitary districts, qualified school districts, and nonprofit conservation organizations	1. Gathering and analyzing water quality information 2. Land use planning within lake watersheds 3. Gathering and compiling demographic information pertinent to individual lakes 4. Developing lake management plans	Up to 67 percent State cost-share assistance for small-scale lake planning grants, not to exceed $3,000; 33 percent local match is required; up to 67 percent State cost-share assistance for large-scale lake planning grants, not to exceed $25,000; 33 percent local match is required; lakes are eligible for more than one grant, however, the total amount of State dollars cannot exceed $100,000; maximum grant award of $50,000 in any one year for each lake	December
58	WDNR	Lake Protection and Classification Grant Program, Chapter NR 191 of the *Wisconsin Administrative Code*	Local units of government, lake districts, and nonprofit conservation organizations	1. Land acquisition for easement establishment 2. Wetland restoration 3. Lake restoration projects 4. Other projects involving lake improvement	75 percent State cost-share which cannot exceed $200,000 for land/easement acquisition projects; cannot exceed $100,000 for wetland and shoreline habitat restoration projects; 25 percent local match is required	February 1 for Lake Protections grants; December 10 for Lake Classification grants
59	WDNR	Land and Water Conservation Fund Program	Counties, cities, villages, towns, school districts	1. Land acquisition or development that will provide opportunities for outdoor recreation 2. Property with frontage on rivers, streams, lakes, estuaries, and reservoirs that will provide water-based outdoor recreation 3. Property that provides special recreation opportunities, such as floodplains, wetland, and areas adjacent to scenic highways	50 percent State cost-share assistance; 50 percent local match is required	May 1

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Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
60	WDNR	Land/Easement Acquisition for River Management Section NR 195.13 of the *Wisconsin Administrative Code*	Local units of government, lake districts, town sanitary districts, qualified river management associations, and qualified nonprofit conservation organizations	Land acquisition and easements for river protection	75 percent State cost-share assistance; 25 percent local match is required; Grant not to exceed $50,000	February 1
61	WDNR	Knowles-Nelson Stewardship Grant Program, Chapter NR 51 of the *Wisconsin Administrative Code*	Local government and nonprofit conservation organizations	1. Streambank protection projects 2. Land acquisition of stream corridors for water quality improvement	50 percent State cost-share assistance; 50 percent local match is required	May 1
62	WDNR	Municipal Dam Grant Program	Counties, cities, villages, tribes, inland lake protection and rehabilitation districts	1. Dam repair, reconstruction, or modification to improve safety 2. Dam abandonment and removal	For repair, reconstruction, or modification projects grant awards cover 50 percent of the first $400,000 and 25 percent of the next $800,000 of eligible project costs For abandonment and removal projects, grant awards will cover 100 percent of the first $400,000 of eligible project costs	See program guidance
63	WDNR	Urban Rivers Grant Program. Funding is through Chapter NR 51 of the *Wisconsin Administrative Code*	Local governments, tribal governments, and nonprofit conservation organizations	Land acquisition to preserve open areas in urban environments adjacent to streams and rivers	50 percent State cost-share assistance; 50 percent local match is required	May 1
64	WDNR	Urban Nonpoint Source and Stormwater Grants Program. Funding is through Chapter NR 155 of the *Wisconsin Administrative Code*	Local units of government, tribal governments, regional planning commissions, and special purpose lake, sewerage and sanitary districts	1. Planning 2. Educational and information activities 3. Ordinance development and enforcement 4. Land acquisition and easement purchase 5. Storm water detention ponds 6. Streambank and shoreline stabilization	70 percent State cost-share assistance for projects not involving construction, requiring a 30 percent local match; 50 percent State cost-share assistance for projects involving construction, requiring a 50 percent local match	April 15
65	WDNR	Targeted Runoff Management Grants, Chapter NR 153 of the *Wisconsin Administrative Code*	Local units of government, tribal governments, regional planning commissions, and special purpose lake, sewerage and sanitary districts	1. Complying with nonpoint source performance standards 2. Improving 303(d) waters 3. Protecting outstanding water resources 4. Compliance with a notice of discharge for an animal feeding operation 5. Addressing a water quality concern of national or statewide importance, such as the Upper Mississippi River concerns	70 percent State cost-share assistance; 30 percent local match is required. Grant awards not to exceed $150,000 for small-scale TMDL and non-TDML projects	April 15
66	WDNR	River Protection Grant Program, Chapter NR 195 of the *Wisconsin Administrative Code*	Local units of government and nonprofit conservation organizations, qualified river management organizations	1. Activities designed to develop partnerships that protect river ecosystems 2. Educational projects 3. Activities associated with river management plan development 4. Land acquisition 5. Ordinance development 6. Installation of practices to control nonpoint source pollution	75 percent State cost-share assistance; 25 percent local match is required; Planning grants not to exceed $10,000, and Management grants not to exceed $50,000	Planning grants December 10; Management grants February 1

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Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
67	WDNR	Safe Drinking Water Loan Program	Local units of government, sanitary and utility districts, and federally recognized tribes	Drinking water infrastructure projects	Loans at 55 percent of market share	June 30
68	WDNR	Clean Water Fund Program	Local units of government, sanitary and utility districts, and federally recognized tribes	1. Compliance with nonpoint source performance standards 2. Stormwater management projects 3. Projects seeking water conservation, efficiency, and reuse 4. Construction or maintenance of water treatment facilities	Loans at 55 percent of market rate	Accepted year round for projects not seeking principal forgiveness or Hardship Program
69	WDNR	Wisconsin Forest Landowner Grant Program	Individual landowners with a Forest Stewardship Plan prepared by a forester	1. Stream buffer establishment 2. Streambank stabilization 3. Wetland restoration	Up to 50 percent cost-share assistance; 50 percent local match is required	Applications may be submitted at any time; Award dates are August 1, November 1, February 1, and May 1
70	Wisconsin Department of Transportation (WisDOT)	Transportation Alternatives Program	Local governments, regional transportation authorities, transit agencies, natural resources or public land agencies, school districts, tribal governments	1. Infrastructure-related projects and systems that will provide safe routes for non-drivers 2. Community improvement projects 3. Environmental mitigation activities	80 percent State match; Minimum of $300,000 for infrastructure projects, minimum of $50,000 for non-infrastructure projects; No maximum, but grants exceeding $1 million are unlikely	See program guidance
71	WisDOT	Highway Safety Improvement Program	Local governments	1. Intersection safety improvements 2. Installing guardrails, signs, pavement markings 3. Corridor signal upgrades 4. Warning devices	90 percent Federal reimbursement; 10 percent match required; State pays match on projects on State trunk highways, local government pays match on local streets and highways	August 15 and February 15
72	Wisconsin Emergency Management	Hazard Mitigation Grant Program	State and local units of government, tribal governments, and eligible private, non-profit organizations	1. Mitigation Planning 2. Technical Assistance 3. Mitigation Projects	75 percent Federal cost-share assistance; 25 percent local match	Contact State Hazard Mitigation Officer
73	Wisconsin Emergency Management	Wisconsin Homeland Security Grant Program	State and local government units that must comply with HSPD-5	1. NIMS and ICS training courses 2. Funds purchase of equipment	Statewide $3,980,000 will be available	See Notice of Funding Opportunity for each grant for specific grant deadlines
74	Wisconsin Public Service Commission	Telecommunications, Water, Energy Divisions	Local governments	Incorporate disaster resilience into regulation development, land use practices and environmental impacts of public utilities	General Utility Assistance	--
75	University of Wisconsin Cooperative Extension	Extension Disaster Education Network	Local governments	Provides community education and public information programs promoting hazard awareness and mitigation concepts	Education and Information provided through the University of Wisconsin System	Continuous
76	Great Lakes Protection Fund	Great Lakes Protection Fund Grants Program	State and local units of government, nonprofit organizations, for-profit businesses, educational institutions, and individuals	1. Protect and restore the health of the Great Lakes 2. Promote the interdependence of healthy ecological and economic systems 3. Support innovative, creative, and venturesome ideas	Matching funds not required; past awards have ranged from $20,000 to $1.6 million; average award $460,000	Continuous applications process
77	Great Lakes Restoration Initiative	Multiple funding programs available	Varies by program	Clean toxins, combat invasive species, protect water quality, restore wetlands and other habitats	Varies by program	Varies by program

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Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
78	Joyce Foundation	Joyce Foundation Grant Program	State and local units of government, nonprofit organizations and individuals, educational institutions	1. To protect and restore the health of the Great Lakes 2. To promote the interdependence of healthy ecological and economic systems 3. To support innovative, creative, and venturesome ideas 4. Developing improved regulatory approaches 5. Better understanding of the supply of and demand for Great Lakes 6. Creating transportation alternatives to reduce over reliance on automobiles	Finance the total cost of accepted projects	Grant proposals are considered at meetings of the Foundation's Board of Directors in April, July, and December
79	National Fish and Wildlife Foundation (NFWF)	Wal-Mart Stores, Inc. Acres for America Program	State and local units of government, nonprofit organizations, Indian Tribes, educational institutions	Acquisition of permanent easement for conservation of habitat	$3.5 million available nationally annually; minimum 1:1 match ratio required, higher local match preferred	Preproposals due April; Full proposals due June; See program guidance for exact dates
80	NFWF	Five-star and Urban Waters Restoration Grant Program	Nonprofit organizations, local governments, municipal governments, Indian tribes, educational institutions	1. Wetland restoration projects 2. Riparian restoration projects 3. Coastal and forest restoration projects 4. Projects must be part of a larger watershed project 5. Projects must have at least five contributing parties	$2,000,000 available nationally annually; project awards range from $20,000 to $50,000, average award $30,000; 1:1, non-federal match ratio required, higher local match preferred	January 31
81	NFWF	Resilient Communities Grant Program	Local governments 501(c) nonprofit organizations	1. Green infrastructure 2. Stream buffer enhancements	Awards range between $200,000 and $500,000	See program guidance
82	NFWF	Sustain Our Great Lakes Community Grant Program	State and local units of government, tribal governments, nonprofit organizations, educational institutions	1. Wetland restoration, enhancement, and protection projects 2. Tributary restoration, enhancement, and protection projects 3. Shoreline restoration, enhancement, and protection projects 4. Projects must be in the Great Lakes basin (current and historic)	Grant awards range from $25,000 to $1,500,000; No match is required, however, the ratio of matching funds offered is considered during review	See program guidance
83	Ozaukee/Washington Land Trust	Stewardship Grant Program, Urban Green Space Program	Land trusts, local units of government, and nonprofit organizations	1. Land acquisition for greenway space in urban areas 2. Protection of scenic or ecological features 3. Wildlife habitat improvement	Funding depends on specific projects	None
84	Southeastern Wisconsin Watersheds Trust (Sweet Water)	Sweet Water Mini-Grant Program	Non-profit organizations and community groups Projects must be located in the Greater Milwaukee watersheds (in Ozaukee County this includes the Menomonee River and Milwaukee River watersheds)	Supports local grassroots efforts that employ green infrastructure practices and other water quality-related activities	Annual grants of $1,000 to $5,000	See program guidance

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Table G.1 (Continued)

Reference Number	Administrator of Grant Program	Name of Funding Program	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Application Deadline
85	State Farm Companies Foundation	State Farm Good Neighbor Citizenship Company Grants	Government entities, educational institutions, 501(c)(3) nonprofit organizations, 501(c)(4) volunteer fire companies, 501(c)(6) chambers of commerce	1. Auto and road safety 2. Teen driver education 3. Home safety and fire prevention 4. Disaster preparedness and recovery	Grants of $5,000 or more	See program guidance

Note: Cost-share and local match requirements reported in this table can vary depending on specific details for individual projects.

[a] *The non-Federal share is 25 percent. In Wisconsin, the State Division of Emergency Management pays 12.5 percent and the local community pays 12.5 percent.*

[b] *Funding available on an annual basis.*

[c] *Municipalities must have a flood mitigation plan to be eligible for a project grant.*

[d] *The individual fire cost threshold for a State is the greater of $100,000 or 5 percent x $1.07 x State population. The cumulative fire cost threshold for a State is the greater of $500,000 or three times the 5 percent x $1.07 x State population. Both formulas are adjusted annually for inflation using the Consumer Price Index for All Urban Consumers published annually by the Department of Labor.*

[e] *In kind services are allowed as a part of the local cost-share assistance.*

Source: FEMA, Department of Homeland Security, U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, U.S. Department of Justice, Wisconsin Emergency Management, the State of Wisconsin and SEWRPC

OZAUKEE COUNTY BOARD OF SUPERVISORS RESOLUTION TO ADOPT THE OZAUKEE COUNTY HAZARD MITIGATION PLAN UPDATE

APPENDIX H

RESOLUTION NO. 20-25

OZAUKEE COUNTY ALL HAZARDS MITIGATION PLAN UPDATE

WHEREAS, Ozaukee County recognizes the threat that natural hazards pose to people and property; and

WHEREAS, undertaking hazard mitigation actions before disasters occur will reduce the potential for harm to people and property and save tax payer dollars; and

WHEREAS, an adopted all hazards mitigation plan is required by FEMA as a condition of future grant funding for mitigation projects; and

WHEREAS, Ozaukee County participated jointly in the planning process with the other local units of government within the County to update the All Hazards Mitigation Plan, which was made available for review via a Legal Notice and a copy of which will reside permanently in the Ozaukee County Emergency Management Office.

NOW, THEREFORE, BE IT RESOLVED, that the Ozaukee County Board of Supervisors hereby adopts the updated Ozaukee County All Hazards Mitigation Plan as an official plan; and

BE IT FURTHER RESOLVED, that the Ozaukee County Emergency Management Department will submit, on behalf of the participating municipalities, upon its adoption by all such municipalities, the adopted All Hazards Mitigation Plan to Wisconsin Emergency Management and Federal Emergency Management Agency officials for final review and approval. Minor changes made upon advice from Wisconsin Emergency Management and Federal Emergency Management Agency will not require re-adopting this resolution.

Dated at Port Washington, Wisconsin, this 5th day of August 2020.

SUMMARY: Ozaukee County All Hazards Mitigation Plan

VOTE REQUIRED: Majority

LEE SCHLENVOGT
COUNTY BOARD CHAIRPERSON

TO WHOM IT MAY CONCERN:

I, Julianne B. Winkelhorst, County Clerk for Ozaukee County, Wisconsin, hereby certify that the foregoing is a true and correct copy of Resolution No. 20-25, adopted by a majority of members present of the Ozaukee County Board of Supervisors on August 5, 2020.

(S E A L) Julianne B. Winkelhorst

Julianne B. Winkelhorst
Ozaukee County Clerk

Adopted Vote: Ayes – 26
Nays – 0
Absent - 0

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION STAFF

Kevin J. Muhs, PE, AICP ..... Executive Director
Benjamin R. McKay, AICP ..... Deputy Director
Joel Dietl, AICP ..... Chief Land Use Planner
Laura L. Herrick, PE, CFM ..... Chief Environmental Engineer
Christopher T. Hiebert, PE ..... Chief Transportation Engineer
Elizabeth A. Larsen, SPHR, SHRM-SCP ..... Director of Administration
Eric D. Lynde ..... Chief Special Projects Planner
Rob W. Merry, PLS ..... Chief Surveyor
Nakeisha N. Payne ..... Public Involvement and Outreach Manager
Dr. Thomas M. Slawski ..... Chief Biologist

Special Acknowledgments is due to Megan A. Beauchaine, Planner, Dr. Joseph E. Boxhorn, Principal Planner, Megan I. Deau, Senior Graphic Designer, Timothy R. Gorsegner, GIS Specialist, Zijia Li, Stormwater and Floodland Management Engineer, Julia C. Orlowski, Engineer, Aaron W. Owens, Senior Planner, and Scott Ziegler, Director of Ozaukee County Division of Emergency Management for their contributions in the preparation of this report.