



Hazard Mitigation in a Changing Climate: The Dane County Natural Hazard Mitigation Plan

PROFESSIONAL PROJECT SUBMISSION

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COVER IMAGES

Examples of natural hazard mitigation techniques.

Top Left: A rain barrel captures stormwater off of a home's roof, keeps it out of stormwater systems, and stores it for later use (Photo Credit: Sustain Dane).

Top Right: Healthy trees help keep a neighborhood cool and mitigate the effects of extreme heat in the Village of Cambridge in Dane County. (Photo Credit: Cambridge Tree Project)

Bottom Left: An official from the Federal Emergency Management Agency gives a member of the public information on steps that can be taken to limit one's personal risk to natural hazards (Photo Credit: Federal Emergency Management Agency).

Bottom Right: A rain garden in a City of Madison community. Rain gardens help control stormwater runoff volume by encouraging infiltration to groundwater (Photo Credit: City of Madison Engineering)

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Executive Summary

In April 2015 the Dane County Natural Hazard Mitigation Plan (DCNHMP) update process began. The planning process, now nearing completion, assesses the risk to Dane County of a wide range of natural hazards and creates mitigation goals and strategies to address this risk. When finished, the plan will be reviewed and approved by the Federal Emergency Management Agency and will stand as the County's hazard mitigation plan until the next update is required in five years.

The 2015 Update will be the first DCNHMP to include climate change as a factor in the risk assessment and mitigation goals and strategies of the plan. The DCNHMP process has helped County officials better understand the changing level of risk residents of Dane County face from natural hazards. Inclusion of climate change has also forced the standard natural hazard mitigation planning process to be altered in a way that considers an environment that includes changing hazards, and not simply changing societal vulnerability to those hazards.

The process, managed by Dane County Emergency Management (DCEM), has helped frame the issue of climate adaptation for County officials. This framing of the issue has led directly to conversations about how best to adapt, the role of County government in that process, and has created partnerships among County agencies and outside organizations. While natural hazard mitigation is a perpetual process, the mitigation goals and strategies resulting from this plan have the potential to spur action both on the part of government and private citizens.

As a project assistant working with DCEM, through the University of Wisconsin-Madison Department of Urban and Regional Planning, I have been involved with the project since near its start. My role has been working the day-day operations of the plan which includes assisting local communities with their plans through sit-down meetings, performing analyses for hazard analysis, drafting mitigation goals and strategies, and organizing and leading planning meetings. This document is a summary of the planning process, its outcomes, and my conclusions and recommendations for future plans. Conclusions and recommendations are my own and do not necessarily represent the views of Dane County Emergency Management or any other organizations involved with this plan.

Introduction

Natural hazards are hazards that occur through natural processes and phenomena. These hazards may be enhanced through human activity, and the danger they pose may be entirely created from societal impacts, but they originate from processes of the natural world. A natural phenomenon becomes a hazard when it presents a risk to society. Risk is a function of a community's vulnerability to natural hazards, its exposure to a given hazard, and the hazard itself. A changing climate presents a situation in which risk changes both as a result of a community's vulnerability changing, and from the hazards themselves changing in how they impact the community (IPCC, 2014). This risk cannot be entirely prevented, however, it can be lessened through natural hazard mitigation planning (FEMA, 2013). The 2015 Dane County Natural Hazard Mitigation Plan (DCNHMP) will address this changing risk for the first time.

Natural hazard mitigation planning (NHMP) is a cross-sector approach to planning. It must incorporate environmental, economic, and social systems to be successful (Pine, 2014). The goal of all natural hazard mitigation planning is to protect life and property, and save communities money. For every one dollar spent on mitigation actions, four dollars are saved from future damages (FEMA, 2013). Most NHMP is done in accordance with the Disaster Management Act of 2000 (DMA 2000). The Federal Emergency Management Agency (FEMA) offers guidance and sets requirements for the planning process. Completion of the FEMA process and plan approval makes a community eligible for mitigation funds from FEMA's Hazard Mitigation Assistance program (FEMA, 2013). Currently, FEMA does not require County governments to include climate change in NHMPs. State-level plans, however, are now required to do so (FEMA, 2015).

Climate change refers to the warming of Earth's atmosphere through the trapping of heat by greenhouse gases. Actions taken to reduce greenhouse gas concentrations in the atmosphere, are known as climate mitigation measures. That is, through these actions, society is trying to reduce the magnitude of climate change. Climate mitigation measures do not deal with the impacts of climate change, only the magnitude to which the climate changes (IPCC, 2014). It is important to distinguish between climate mitigation and natural hazard mitigation. Natural hazard mitigation in relation to climate change is not a climate mitigation action. Rather, it is a form of *climate adaptation*. Climate adaptation represents the idea that climate change is happening, it will continue to happen, and the natural world will change because of it. Society must find ways to address and live with these changing conditions, and thus adapt to a changing climate (IPCC, 2014).

The inclusion of climate change in the DCNHMP follows the creation of the Dane County Climate Action Council (CAC) and its Dane County Climate Change and Emergency Preparedness Report (Dane County, 2013). The DCNHMP process seeks to build upon the findings of the CAC and its report through creating mitigation strategies that reflect the need to adapt to changing climatic conditions.

I worked on the DCNHMP as a project assistant with Dane County Emergency Management, through the University of Wisconsin-Madison Department of Urban and Regional Planning. This document summarizes the DCNHMP planning process and outcomes, outlines anticipated climate impacts and changing risk factors as understood by the DCNHMP team, and offers my own conclusions on the first DCNHMP to include climate change as a factor in the plan. These conclusions are drawn from my experiences working with the DCNHMP's day-to-day operations and organizing and conducting many of the processes described.

Dane County Natural Hazard Mitigation Planning Process

The planning process for the DNHMP can be broken into three related, but distinct portions:

- Risk and community capability assessment
- Public participation
- Mitigation goals and strategies

These three categories of the project are interrelated. Each portion is interdependent on the others and relies on the information gathered from other portions of the plan. Climate change is considered a central theme of the plan and has been incorporated throughout the process.

The 2015 DCNHMP is a multi-jurisdictional natural hazard mitigation plan. In multi-jurisdictional plans, local municipalities participating in a larger, regional plan add a local version of the NHMP as an appendix to the base plan. The plan incorporates 40 of Dane County's 61 local municipalities, including townships, villages, and cities as seen in **APPENDIX C**. Now nearing completion, the plan represents an update to the original DCNHMP which was completed in 2010.

All hazard mitigation plans for Dane County have been coordinated by Dane County Emergency Management (DCEM). The 2010 DCNHMP represented the first time the DCNHMP was completed according to DMA 2000 standards. The 2010 plan brought Dane County into compliance with DMA 2000 requirements to ensure continued eligibility for hazard mitigation grant funding. The broad mission of the 2015 DCNHMP update process is as follows:

- To complete an update of the DCNHMP as required by FEMA.
- To encourage local municipalities to undertake natural hazard mitigation planning by attaching local annexes to the main plan.
- To incorporate climate change into the risk analysis and mitigation strategies of the county-wide plan.

Risk and Community Capability Assessment

For each hazard considered in the DCNHMP, a hazard analysis was undertaken. This assessment yields a level of risk to the County from the given hazard. This includes an analysis of past occurrences of the hazard and an impact magnitude of the hazard. The impact magnitude assessment considers both direct and indirect impacts of the hazard. This is followed

by an analysis of the community’s vulnerability to the given hazard. The vulnerability of the county is largely based on development changes in hazardous areas. These analyses are both quantitative and qualitative in nature depending on the hazard and available data. The qualitative risk assessment for each hazard as perceived by County staff that sat on the DCNHMP Steering Committee and by the representatives for local jurisdictions can be found in **APPENDIX B**.

In plan updates that do not include climate changes, this is generally a process of updating community vulnerability changes due to new development, as hazard magnitudes and likelihoods are fairly static. However, with climate change inclusion in the 2015 DCNHMP hazards are more dynamic and both new vulnerabilities and changing hazard frequency and magnitude must be accounted for. More information regarding this process and its outcomes are in later sections of this document.

The hazard and vulnerability assessments were combined to create a general score for overall risk to the County from a given hazard. The community capability assessment is a simple accounting of the local government’s fiscal, technical, and personnel resources that can be leverage for natural hazard mitigation actions. These assessments are used to help guide the creation and prioritization of mitigation strategies that are proposed in the plan.

Public Participation Process

DCNHMP Public Workshops

Public workshops were held in four locations around Dane County. The locations selected were geographically spread out around the county, and were held in municipalities participating in the plan. The workshops were well advertised, the County Executive’s office issued a press release, which was picked up by multiple media outlets, and County Executive Joe Parisi conducted an in-studio interview on a prominent morning news show regarding the upcoming meetings. Despite the heavy press, attendance was lower than the planning team had hoped (**TABLE 1**).

During the public workshops, I presented on climate change impacts in Dane County and the way in which natural hazard risk was changing as a result. Participants were then given the opportunity to ask questions related to natural hazards and to offer their own input about problems they observe with natural hazards and possible solutions to these problems.

Table 1. DCNHMP Public Workshop Locations and Input Summaries

MEETING LOCATION	ATTENDANCE	MAIN ISSUES DISCUSSED
City of Madison	1*	<ul style="list-style-type: none"> • Extreme cold situations dominated the discussion
Village of Cambridge	9	<ul style="list-style-type: none"> • Tornado shelter availability and response capacity • NOAA Weather Radio distribution • Flood concerns and concerns over new Flood Insurance Rate Maps and properties now required to purchase Flood Insurance
Town of Westport	7	<ul style="list-style-type: none"> • Lake Mendota flooding and Town of Westport response to flooding • Town of Sun Prairie stormwater conveyance and road armoring as a mitigation technique
Town of Montrose	3	<ul style="list-style-type: none"> • Tornado siren placement and operation • General flood concerns • Infrastructure replacements in the Town of Montrose

**The City of Madison meeting yielded a much lower attendance than anticipated. This may be attributable to several factors occurring on the same night: a Wisconsin Badgers Men’s Basketball home game, President Obama’s State of the Union Address, and temperatures that were below 0° Fahrenheit.*

Survey

To gather broader opinions regarding the perception of natural hazard risk in Dane County, the project team partnered with the UW-Madison Water Sustainability and Climate Project on a survey being conducted to understand perceptions of climate change and ecosystem services’ role within the Yahara Watershed. The survey, headed by Dr. Adena Rissman, measured opinions across political and rural and urban divides. Results of the survey were shared with the DCNHMP team to aid in shaping mitigation goals and strategies.¹

Mitigation Goals and Strategies Process

The end goal of the planning process for the DCNHMP is to create mitigation strategies that lead to a lower risk of loss of life or property from natural hazards. These strategies were formed by the DCNHMP Steering Committee and informed by the risk analysis and input collected from local jurisdictions, the public, and Dane County agencies. This input was summarized to the steering committee and used to form problem statements, which **TABLE 3** gives examples of. These problem statements had potential mitigation strategies attached to them, which the Steering Committee could then approve or modify. Strategies from the 2010

¹ The results of the survey are the intellectual property of Dr. Rissman and her team and are therefore not included in this report.

DCNHMP were also considered for inclusion. The strategies were influenced by the mitigation goals of the DCNHMP (**APPENDIX A**), which follow the goals of the 2011 State of Wisconsin Natural Hazard Mitigation Plan and the 2010 DCNHMP.

Table 3 Example Problem Statements and Proposed Mitigation Strategy Response

Problem Statement	Related Hazard	Possible Mitigation Strategy
<p>Property owners understand hazard related issues, however, they do not know how to protect their own property or become part of a larger solution.</p>	<p>General</p>	<p>Sponsor workshops or other public outreach campaigns to educate property owners on feasible projects they can undertake to become more resilient.</p>
<p>Water volume into stormwater systems increases with development. Eventually these systems may be overwhelmed as strong storms become more frequent. A need exists to control the runoff to lessen the volume of water flowing into stormwater and surface water systems.</p>	<p>Flood</p>	<p>Explore and assess feasibility of developing a 100% of pre-development run-off control ordinance and fee in-lieu-of program.</p>
<p>Basement flooding in low-income housing is often minimally addressed leading to damp conditions that foster harmful mold.</p>	<p>Flood</p>	<p>Explore creation of a sump-pump or dry basements program for eligible housing.</p> <p>Educate landlords and residents on negative, long-term health effects that can affect their tenants from damp conditions following a flood event.</p>

Climate Change and Natural Hazard Risk in Dane County

The risk of natural hazards in Dane County is changing as the climate does. The DCNHMP planning team consulted with climate change experts to better understand the impacts of climate change and the resulting change in risk of natural hazards. We primarily relied on the expertise of the Wisconsin Initiative on Climate Change Impacts (WICCI) and the University of Wisconsin-Extension.

Climate Impacts in Dane County

Climate change will enhance natural hazards that already occur. Storms may become stronger, and more frequent, but single events cannot be said to happen due to climate change. Rather, the probability of the hazardous event occurring changes in a changing climate. (IPCC, 2014) (Wisconsin Institute for Climate Change Impacts, 2011).

In Wisconsin, WICCI's projections do not specifically project the increase in tornadoes, severe thunderstorms, or other hazard events. Rather they give changing climactic conditions, from which changing natural hazards can be inferred. The 2011 WICCI report, uses its projections to make some of these inferences about changing hazards (WICCI, 2011).

In Dane County, the WICCI projections, to 2055, point to a warmer and wetter climate. This will be especially pronounced in the late winter and early spring seasons (WICCI, 2011). Warming conditions during these seasons will lead to more days with conditions that can cause freezing rain or ice. In the summer months, precipitation amounts will also go up, and the intensity with which this precipitation falls will increase. Storms that produce over two inches of rain in short time periods are projected to increase (WICCI, 2011). WICCI projections also suggest an increase in the amount of days above 90° Fahrenheit and a decrease in nights below 0° Fahrenheit in the winter months, suggesting a continued warming trend.

Changing Climate, Changing Risk

Changing natural hazard risk associated with climate change is an influencing theme in all areas is explicitly addressed in two areas of the plan: the risk analysis, and the mitigation goals and strategies. These two portions of the plan are highly linked. The risk analysis influences the prioritization of mitigation strategies. The inclusion of climate change in the risk analysis alters established risk estimation process. In past plans, the hazard analysis based the future likelihood of an event occurring solely on its historic occurrences. An event that occurred once in the past ten years, could be considered as having a 10% likelihood. Climate change is an additional variable to consider in analyzing future probability as the conditions in which the 10% likelihood was established are changing. In the 2015 DCNHMP, WICCI projections and expert advice were used to assign broad likelihood categories to each hazard. **TABLE 4** shows the historical likelihood of a hazard occurring in a given year and how hazard's likelihood changes when considering climate change. Hazards with a likely historical occurrence rating and an increased likelihood when climate change is considered are of the highest concern.

Table 4. DCNHMP 2015 Historical and Climate Change Adjusted Likelihood of Natural Hazards in a Given Year

Hazard	Historical Likelihood of Occurring in a Given Year	Likelihood Considering Climate Change	Climate Change Risk Change Rationale
Dam/Levee Failure	Unlikely	Slightly Increased	Expected increases of intense rainfall could result in higher dam failure risk, especially after repeated storms in short period of time.
Extreme Cold	Very Likely	Slightly Decreased	Expected increase in nights above zero in winter.
Extreme Heat	Very Likely	Increased	Warming trends will likely bring more days above 90° Fahrenheit, leading to extended heat waves that may be exasperated in urban areas.
Drought	Moderately Likely	Slightly Increased	Uncertain weather patterns and higher temperatures may lead to drought.
Flood	Moderately Likely	Increased	Projected increases in annual average precipitation amounts, and projected increases in storm intensity raise significant flooding concerns.
Fog	Likely	No Change	Little concern over fog impacts exists.
Hail Storm	Likely	No Change	No projections are known for hail storms.
Landslide	Unlikely	Slightly Increased	Intense rainfalls may increase risk in steep areas of County.
Lightning	Likely	No Change	No direct projections for lightning. Most critical facilities have lightning mitigation in place.

Hazard	Historical Likelihood of Occurring in a Given Year	Likelihood Considering Climate Change	Climate Change Risk Change Rationale
Tornado	Likely	No Change	No increase in tornadoes is projected.
Wildfire	Unlikely	Slightly Increased	Wildfire is not common in Dane County, but warmer conditions may increase risk.
Windstorm	Likely	No Change	No clear projections to warrant an increased concern.
Winter Storm	Likely	Increased	Increase in winter temperature, and increase in late-winter early spring precipitation raise risk of major ice storms.
Algal Blooms	Likely	Increased	Intense rainfalls creating nutrient runoff in area watersheds paired with warming temperatures create ideal conditions for algal blooms in Dane County lakes.
Pest Outbreak	Moderately Likely	Increased	Warming temperatures are likely to create favorable conditions for non-native species. Increased rainfalls and warming will create more opportunities for disease vectors to breed.

Extreme heat and flooding are the hazards that are considered to pose the highest risk to Dane County. These events already have either a very likely or a moderately likely historical occurrence rating and are projected to increase in a climate with warmer temperature that yields an increase intense rain storms.

Public health concerns related to climate change were of great concern to the DCNHMP Steering Committee. The Steering Committee considered extreme heat public health risks to be of great concern as urbanization increases vulnerability to urban heat island effects. Increased heavy precipitation and warmer summer projections raised concerns about continued harmful

algal blooms (HABs) in area water bodies. While Dane County has undertaken extensive efforts to combat these blooms, the DCNHMP Steering Committee felt that the public health concerns associated with these blooms warranted inclusion in this plan as a separate hazard. Pest outbreaks, including disease vectors such as mosquitoes and ticks, were also of high enough concern to be included as a standalone hazard, rather than a secondary hazard.

Mitigating Natural Hazards in a Changing Climate

The final outcome of the 2015 DCNHMP will not hinge on analyses completed or surveys rendered, but rather the actions that are taken as a result of these informative efforts. To give rise to that action, the final chapters of the DCNHMP outline the mitigation goals, objectives, and strategies of the DCNHMP. The mitigation goals of the DCNHMP are broad statements meant to shape the strategies and policies, which are proposed in the plan as concrete action items.

Consistency with existing plans can be a key factor in achieving the goals of a plan. The 2015 DCNHMP uses the same language as the Dane County Comprehensive Plan in proposing goals, objectives, strategies, and policies. The first five goals of the 2015 DCNHMP are consistent with the goals of the 2009 DCNHMP and with the 2011 State of Wisconsin Natural Hazard Mitigation Plan. The sixth goal is the incorporation of climate change, which does not appear in other plans. The goals of the 2015 DCNHMP are as follows:

- Minimize human, economic, and environmental disruption from natural hazards.
- Educate and encourage property owners to take action to decrease their vulnerability to the impacts of natural hazards.
- Encourage hazard mitigation planning and incorporate that planning into other related plans.
- Facilitate and coordinate solutions to multi-jurisdictional issues that involve government, citizens, stakeholders, and policy-makers at all levels.
- Improve the disaster resilience of existing buildings, structures, critical facilities, as well as infrastructure whether new construction, expansion, or renovation.
- Utilize existing science and technology to better understand and address changing risk of natural hazards in a changing climate.

The sixth goal, regarding climate change, is meant to reflect the need to consider climate change in all mitigation planning activities. The strategies proposed demonstrate this. One of the main themes of the strategies revolve around the second goal, which deals with educating the public regarding natural hazard mitigation and steps they can take to protect themselves and their property.

The list of mitigation goals, and their attached objectives, as well as the actual strategies and policies proposed can be found in **APPENDIX A**. Many of the strategies build off the recommendations of the work of the Dane County Climate Action Council and its report.

Conclusions

Dane County has demonstrated a commitment to addressing climate change and the impacts it will bring. The County's plans until now have addressed climate change through climate mitigation actions and few adaptation measures. The 2015 DCNHMP's natural hazard mitigation strategies reflect the need to adapt to the increased risk that climate change will bring.

Hazard mitigation in a changing climate is a wicked problem, there is no one set solution to it. The mitigation strategies proposed reflect this. They correctly place a heavy emphasis on education and outreach. The risk of natural hazard damages cannot be mitigated through any one action, large or small. Rather, through education and outreach, the DCNHMP may start the collective action needed. One of the challenges in future plans to ensure this happens will be to incorporate climate change into local plans. The 2015 DCNHMP only addresses climate change at the County level. For challenges such as controlling stormwater volume in increasing storms, local action is necessary. Local municipal governments have the resources and regulatory capability to better address this problem, while the County has technical expertise that can aid their efforts.

The DMA 2000 and FEMA regulated natural hazard mitigation process is well suited to ensuring progressive adaptation measures continue. The five-year renewal requirement ensures that communities are frequently considering mitigation planning. With each update, a community must account for its progress in mitigating natural hazards. This is meant to ensure that NHMPs are not simply shelved, but are instead acted on. In including climate adaptation activities within the DCNHMP, the County has created an accountability mechanism for itself to ensure that progress is made on the topic.

This planning process, and those that will follow, ensure that County staff and decision makers are having the conversations needed to ensure Dane County is addressing increased risk in a changing climate. The benefits of these conversations include:

1. Immediate needs are identified and addressed. This includes immediate information needs and needs for improvements to critical infrastructure or facilities.
2. Sources of uncertainty are understood. The changing climate is a dynamic planning environment, and even climate experts cannot say for certain exactly how the environment will change. Officials with understanding of where uncertainty exists in data, and to what extent, will aid in future decision making.
3. Disagreements regarding mitigation strategies among officials are identified. These disagreements allow for thorough discussion and exploration of options among experts and officials to decide the best way forward for lowering the risk associated with natural hazards. Disagreements that lead to ineffective passive language such as "explore and assess" in an NHMP may be resolved by the plan's next update or sooner and result in actionable language or demonstrable progress in addressing an issue.

4. Partnerships are forged or strengthened. The partnerships between County agencies and other organizations that are formed for hazard mitigation will likely remain intact for future NHMP updates and other projects.

The 2015 DCNHMP is subject to review and approval by not only FEMA, but also the Dane County Board of Supervisors. From my view, as a contracted, but not permanent employee of Dane County, this is both a positive and a negative. Earlier plans that have suggested climate adaptation measures have not been subject to this approval. This leaves them in a political limbo in which County staff may pursue the measures proposed, but a County Board that has not approved such measures may not be inclined to offer funding for them. Whereas, the DCNHMP's approval by the County Board should be another motivation to keep the plan from being shelved. However, this process also creates a situation in which topics that should be discussed as mitigation measures are less likely to be put on the table. In the case of the DCNHMP, this issue is Lake Mendota's water level. Lake Mendota is the first lake on the Yahara Chain of Lakes in and around Madison and receives much of the watershed's stormwater. It is controlled by a dam in Tenney Park. It has been proposed in the past that the lake should be maintained at a lower level to allow for more storage of stormwater in major storm events. Lakeside property owner however, are against this proposal as they prefer current levels that are closer to their homes and make the lake more appealing. The higher water levels present a greater risk for flooding, but this issue was not addressed in the plan due to its political sensitivity.

That is not to say that the 2015 DCNHMP is not ambitious. Its inclusion of climate change alone is ambitious and sets it apart from all natural hazard mitigation plans in Wisconsin but one. It also suggests aggressive public outreach efforts, new lobbying positions, and the exploration of some innovative policy alternatives such as the 100% pre-development runoff control and fee-in-lieu of program. In my opinion, the plan's strongest point is in its ambition. It is unrealistic to think that all of the mitigation strategies proposed will be implemented before the next five-year update. Those that are, however, will have actual hazard mitigation effects rather than being token efforts.

The DCNHMP incorporating climate change is another step in a process that has no set endpoint. The issues and ideas recognized through the mitigation planning process may be just as important as the plan itself. This plan rightly frames addressing climate change and its impacts as an imperative for protecting lives and property. Its passage will demonstrate that the County's leaders are dedicated to doing exactly that.

Appendices

Appendix A Dane County Natural Hazard Mitigation Goals, Objectives, and Strategies

The following six goals provide the direction for reducing future hazard-related losses within Dane County. They are listed below, with their related objective statements that support the goals.

The strategies and policies listed in the table below following these goals are the actions proposed by the DCNHMP Steering Committee for the county to carry out its natural hazard mitigation goal. The goals column refers to the mitigation goal listed above that the given strategy supports. All strategies were written with climate change as a factor, and thus goal six is not listed, but applies to all strategies. Strategies carried over for continuation from the 2010 DCNHMP are noted as such in the new/continued column.

- 1. Minimize human, economic, and environmental disruption from natural hazards.**
 - a. Continue compliance with the National Flood Insurance Program.
 - b. Identify, conserve, restore, and utilize land of potential flood mitigation value. Lands of potential flood mitigation value are wetlands, floodplain corridors, upland storage, closed depressional basins, and areas of high infiltration potential.
 - c. Facilitate programs to maintain drainage channels to decrease storm flooding.
 - d. Facilitate programs that encourage stormwater volume control to reduce flow into storage areas.
 - e. Encourage local units of government within the County to employ hazard mitigation concepts when forming, reviewing, and updating local ordinances. Create local understanding of changing levels of vulnerability and risk due to climate change.
 - f. Broaden existing partnerships with community support groups and service providers to better prepare for and respond to the needs of vulnerable populations in a disaster.

- 2. Educate and encourage property owners to take action to decrease their vulnerability to the impacts of natural hazards.**
 - a. Facilitate the use of existing tools and develop new educational tools to inform local officials, developers, property owners, and other stakeholders about preventing, mitigating, and responding to floods; taking advantage of flood events as an opportunity to get the word out.
 - b. Provide an opportunity for homeowners to take advantage of state and federal flood mitigation funding to decrease their risk to flooding.
 - c. Provide information on sources of funding and technical assistance to help individuals take actions to decrease their vulnerability to all natural hazards.
 - d. Assist local businesses in planning for, mitigating against, and responding to natural hazard events.

3. Encourage hazard mitigation planning and incorporate that planning into other related plans.

- a. Engage in planning and data gathering efforts that make progress toward achieving sustainability and resiliency through increasing efforts in hazard mitigation.
- b. Address flooding as a significant component of the Dane County Comprehensive Plan.
- c. Develop a County drought plan that takes into consideration meteorological, hydrological, agricultural, and socioeconomic drought.
- d. Utilize information gathered by 2013 Dane County Climate Action Plan in planning natural hazard mitigation policies and strategies.

4. Facilitate and coordinate solutions to multi-jurisdictional issues that involve

- a. Facilitate multi-jurisdictional, high priority flood project activities involving stakeholders, and incorporated and unincorporated units of government where they are government, citizens, stakeholders, and policy-makers at all levels consistent with the goals and policies of this plan.
- b. Manage the Yahara River and Chain of Lakes as an integrated system to minimize flood risk.
- c. Improve the flood-fighting response capabilities of Dane County and local units of government.
- d. Support Adaptive Management and other multijurisdictional efforts to increase surface and groundwater quality in Dane County.

5. Improve the disaster resilience of existing buildings, structures, critical facilities, as well as infrastructure whether new construction, expansion, or renovation.

- a. Encourage local units of government to apply structural hazard mitigation and sustainability concepts when building or remodeling their facilities.
- b. Encourage critical facilities to employ hazard mitigation and sustainability concepts when building or remodeling their facilities.
- c. Employ hazard mitigation concepts and support on-going sustainability concepts when building, remodeling, or otherwise improving County facilities or infrastructure.
- d. Take steps to reduce flood damage to roadways and drainage structures and maintain emergency vehicle access to all residences.
- e. Facilitate the establishment of public/private partnerships with the local insurance industry, building industry, planners, architects, utilities, urban foresters, and their related associations to better inform and provide technical assistance to individuals about sustainable construction methods and hazard mitigation practices, and create incentives for action.

- f. Assist in establishing public/private partnerships with local power, water, and wastewater utilities to further fortify their systems and reduce power outages and related losses caused by natural hazards.
- g. Encourage local businesses to apply structural hazard mitigation and sustainability concepts when building or remodeling their facilities and when constructing residential and commercial buildings for others.

6. Utilize existing science and technology to better understand and address changing risk to natural hazards in a changing climate.

- a. Encourage all natural hazard mitigation goals, objectives, strategies, and objectives to be understood in the context of a changing climate.
- b. Facilitate working relationships with existing partners and climate experts to encourage County staff understanding of climate change and its potential impacts.
- c. Create model ordinances for use by local municipalities that address changing natural hazard risks in a changing climate.
- d. Use all available information to assess natural hazard mitigation risk. Risk analyses should utilize both historical data and, where possible, climate change impacts.

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
<p>Encourage and, where necessary, install natural barriers beside highways and other roads, and re-grade roadsides to decrease snow on roads focusing on residential developments with limited road access. Especially consider new projects and model zoning ordinance changes.</p>	Low	1, 5	Severe Winter Weather	Continuing
<p>Compile and disseminate mitigation information to help citizens decrease their vulnerability to natural hazards.</p>	High	1, 2	All	Continuing Strategy
<p>Assist eligible manufactured home owners, not within mobile home parks, by applying for federal hazard mitigation grant funds as they become available to retrofit homes with a safe room.</p>	Moderate	1,2,3	Tornado, Windstorm	Continuing Strategy
<p>Work with partners to develop and publicize an information clearinghouse on sustainable and disaster resistant construction methods and local resources and use it in a public outreach campaign to encourage property owners to consider hazard mitigation and sustainability when building or remodeling. This should be included on a resilience web-based publication.</p>	Moderate	1, 5	Drought, Flood, Hailstorm, Lightning Severe Winter Weather, Severe Cold, Tornado, Windstorm	Continuing Strategy

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
<p>Work with partners to provide technical assistance to private property owners for planting, pruning, maintaining, removing, and replacing trees. Also include information on tree care, debris clean up, recognizing and dealing with hazardous trees.</p>	Moderate	1, 2, 3	Lightning, Severe Winter Weather, Severe Heat, Tornado, Windstorm	Continuing Strategy
<p>Assess and document the extent to which critical facilities have back-up power systems in place. Work with partners to develop plans to deploy back-up power sources at critical facilities</p>	High	1, 3, 5	Flood, Lightning, Tornado, Severe Winter Storm, Windstorm	Continuing Strategy
<p>Encourage local governments to provide adequate tornado shelters for employees and public who may be present at their facilities.</p>	Moderate	1,4	Tornado	Continuing Strategy
<p>Work with partners to encourage agricultural producers, to plan for power outages and install back-up power supplies.</p>	Low	1, 2	Flood, Lightning, Tornado, Severe Winter Storm, Windstorm	Continuing Strategy

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
<p>Support the bulk purchase of weather alert radios for at-cost redistribution to local residents.</p>	Moderate	1	Flood, Hailstorm, Lightning Severe Winter Weather, Severe Cold, Tornado, Windstorm	Continuing Strategy
<p>Assist local governments in developing hazard mitigation plans that will meet the DMA2000 requirements, address specific local needs, and are consistent with County goals.</p>	High	3	All	Continuing Strategy
<p>Assist local units of government in developing plans and model ordinances for managing trees or other vegetation, before, during, and after natural hazard events including flooding, tornadoes, drought, wildfires, and ice storms. Plans should reflect changing risk to flooding, ice storms, and excessive heat.</p>	Low	3, 4	Flood, Hailstorm, Lightning Severe Winter Weather, Severe Cold, Tornado, Windstorm.	Continuing Strategy

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
<p>Encourage local governments to review local building codes to determine if revisions are needed to improve the ability of structures to withstand greater wind velocities, snow weight, wildfire, and hail impact and establish the means to enforce the requirements.</p>	Low	4,5	Hailstorm, Lightning Severe Winter Weather, Wildfire, Severe Cold, Tornado, Windstorm.	Continuing Strategy
<p>If not already in place, encourage local governments to require that mobile home parks have storm shelters with enough capacity to adequately protect all residents of the development.</p>	High	1,4	Severe Cold, Severe Heat, Severe Winter Storm, Tornado	Continuing Strategy
<p>Decrease the vulnerability of County park users to natural hazards through education and better shelter design. Assist local governments in applying for pre-disaster mitigation funds to construct storm shelters in vulnerable public facilities, such as parks and fairgrounds, and in mobile home parks.</p>	High	1,4	Severe Cold, Severe Heat, Severe Winter Storm, Tornado	Continuing Strategy

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
Review the County's Green Building Policy and consider revisions to include hazard mitigation and sustainability features of new County building and remodeling projects.	Low	5	Flood, Hailstorm, Lightning Severe Winter Weather, Severe Cold, Tornado, Windstorm	Continuing Strategy
Where feasible, retrofit existing or install new structures in County-owned buildings to ensure adequate shelter from tornadoes.	Low	1, 5	Tornado	Continuing Strategy
Identify and map areas in the County that have potential flood mitigation value.	High	3	Flood	Continuing Strategy
Establish flood mitigation as a criterion for land acquisition and environmental restoration where it would aid in the achievement of flood-reduction goals and conserve and restore land that meets the criteria.	High	3	Flood	Continuing Strategy
Ensure that the Department of Natural Resources affords flood risk as high priority when evaluating the public interest in the lake level orders for the Yahara chain of lakes.	Moderate	4	Flood	Continuing Strategy
Maintain the levels of the Yahara lakes at the lower limit of the DNR's set operating range as part of a comprehensive strategy that addresses flood risk and the needs of fisheries, recreational interests, agricultural interests, and lakeshore property owners.	Moderate	4	Flood	Continuing Strategy

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
Develop a coordinated management strategy and a unified plan of operation and maintenance for all control structures on the Yahara River from Tenney Dam to the Stebbinsville Dam. Assure that the responsible agency has the technical expertise and resources to operate and maintain the control structures within the parameters of the plan.	Moderate	4	Flood	Continuing Strategy
Improve monitoring and modeling of the Yahara River and chain of lakes to develop a better understanding of how the system can be more effectively managed.	Moderate	4	Flood	Continuing Strategy
Evaluate methods such as modification of bridge constrictions, aquatic plant removal, dredging, and channel modifications to increase flow conveyance, while respecting in-stream natural and cultural resources.	Low	3	Flood	Continuing Strategy
Identify hot spots or high priority projects involving multiple jurisdictions where watershed level solutions could be applied.	High	4	Flood	Continuing Strategy
Coordinate funding opportunities to carry out the objectives of the natural hazard mitigation plan including, but not limited to, mitigation, land acquisition, regional projects, and flood response activities.	High	4	Flood	Continuing Strategy
Launch and update when necessary an educational program to provide local units of government with important flood-fighting information.	Moderate	4	Flood	Continuing Strategy
Improve citizen and local elected officials understanding of floodplain maps, floodplain regulations, floodproofing options, development and stormwater management considerations, and other information to assist in good decision-making.	Moderate	2	Flood	Continuing Strategy

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
Develop and use a flood risk map based on hydric soils, wetlands, and areas of past damage. Consider incorporating a buffer area of 1 foot in elevation above the mapped 100-year floodplain on FIRM maps as an advisory tool. Use the map as an educational tool, and also share with real estate agents and local units of government.	Moderate	3	Flood	Continuing Strategy
Pursue Storm Ready Certification from the National Weather Service.	Moderate	1	Flood, Fog, Hail Storm, Lightning, Tornado, Severe Cold, Severe Heat, Severe Winter Storm, Windstorm	Continuing Strategy
Continue to implement sound floodplain management practices through continued compliance with the National Flood Insurance Program, to include floodplain ordinance enforcement and periodic review, promoting the benefits of flood insurance, and continued staff training and development in floodplain management.	High	1	Flood	Continuing Strategy
Further refine the County’s flood risk assessment to include an analysis of cost savings from implementation of floodplain management.	Moderate	1	Flood	Continuing Strategy
Support the WDNR hazard classification of dams in the County.	Moderate	1	Dam Failure	Continuing Strategy
Sponsor public education workshop demonstrating mitigation actions people can take on their own property to become more resilient.	Moderate	1, 2	All	Continuing Strategy

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
Assess and document the current state of tornado shelters at businesses. Facilitate the provision of technical assistance and incentives, when available, for business owners to provide adequate tornado shelter for employees, customers, and members of the public present at their facilities.	Moderate	1	Tornado	Continuing Strategy with New Aspect
Create a web-based resiliency guide for citizens to better understand their vulnerabilities and what can be done to lessen risk. Include flood zone maps, climate change information, and mitigation strategies by hazard.	High	1, 2	All	New
Publish and distribute a continuing operations guide to critical facilities and businesses. Guide should outline potential natural hazard impacts and associated mitigation strategies that can aid in minimizing or preventing downtime during a natural disaster.	High	1, 2, 5	All	New
Continue to enhance anti-icing practices for roads within Dane County.	Moderate	1, 5	Severe Winter Weather	New
Encourage communities to use best urban and rural forestry management practices. Supply information regarding benefits of urban forestry on urban heat island effects. Develop model policy for addressing invasive species and pest outbreaks as they relate to trees.	Moderate		Severe Winter Weather, Wind Storm, Tornado, Severe Heat, Pest Outbreaks	New
Support and expand the Municipal, County and Citizen Water Quality Monitoring System.	High	1, 2, 4	Flood, Algal Blooms	New

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
Inventory public and private wells in the floodplain.	High	1, 2, 5	Flood	New
Monitor mosquito and tick populations and develop vector breeding habitat control model ordinance. Develop public education materials regarding mosquito control techniques.	High	1, 2, 4	Pest Outbreak	New
Support and maintain heat and cold shelter network throughout County.	Moderate	1	Extreme Heat, Extreme Cold	New
Ensure local communities have extreme heat and cold contingency plans for vulnerable populations.	High	1, 3	Extreme Heat, Extreme Cold	New
Encourage the use of road materials and designs that are more resilient to temperature and precipitation extremes.	Moderate	1, 5	Flood, Extreme Heat, Extreme Cold	New
Develop an inventory and monitoring system for invasive vegetation control. Consider a citizen monitoring system utilizing digital technologies, such as a mobile application, for identifying and reporting invasive species patches.	Moderate	1, 2,	Pest Outbreaks	New
Research development of digital citizen monitoring and reporting system, such as a mobile application, for potentially hazardous circumstances that can be targeted for mitigation projects with proper locational data.	Moderate	1, 2	All	New
Explore existing invasive species targeting and best management practices and develop a public outreach campaign around these techniques.	Moderate	1	Pest Outbreak	New

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
Use modeling techniques from the Wisconsin Department of Natural Resources to predict and identify invasive species hotspots with a high probability of successful control.	Moderate	1	Pest Outbreak	New
Evaluate stormwater volume control policies, such as a 100% pre-development run-off control ordinance and fee-in-lieu-of program and assess for feasibility both County-wide and in closed watersheds only.	Moderate	1, 2, 5	Flood, Pest Outbreak, Algal Blooms	New
Work with stormwater utilities to create public outreach campaign to educate public on benefits of stormwater volume control techniques and water conservation. Highlight property owner opportunities to contribute to increased volume control such as rain gardens and rain barrels or cisterns.	High	1,2, 5	Flood, Algal Blooms, Pest Outbreak	New
Educate building professionals on the importance of wind-mitigation techniques.	Low	1, 2	Wind Storm, Tornado	New
Create and distribute educational materials for landlords and residents regarding negative long-term health effects that can affect tenants from damp conditions following a flood event.	Moderate	1, 2	Flood, Pest Outbreak	New
Distribute educational materials to residents and landlords regarding their options for addressing hazardous damp and moldy conditions in their homes.	Moderate	1, 2	Flood, Pest Outbreak	New
Create a dry basements program for eligible housing to mitigate the risk of harmful mold outbreaks.	High	1, 2, 5	Flood, Pest Outbreak	New
Develop an education program for highway and town workers to identify and encourage native plants and to identify and eradicate noxious, invasive species.	High	1, 2	Pest Outbreak, Flood	New
Install a grounding and surge protection system to protect the electrical circuits that are critical to the methane blower system at the Verona Landfill.	High	1, 5	Lightning	New

Mitigation Strategy	Priority	Goals	Hazards	Status (New or Continuing)
Support the watershed adaptive management program Yahara WINs to reduce nutrient loading in the Yahara watershed from non-point source pollution sources.	High	1, 3	Algal Blooms	New
Develop procedures to establish communication channels and mechanisms for identifying and providing services to vulnerable populations during hazard events. Generate and utilize existing vulnerability maps and link surveillance data to risk factors	Moderate	1, 2	Extreme Heat, Extreme Cold, Flood	New
Continue and strengthen collaboration with non-County organizations and agencies that have natural hazard mitigation functions. Collaborate with University of Wisconsin to improve prediction capability for extreme weather events and health outcomes. Work with climate experts at partner organizations to improve County staff and resident understanding of climate change impacts.	Moderate	1, 4	All	New
Increase amount of public information about actions taken on Clean Air action days.	Moderate	1, 2		New
Consider tree coverage requirements for new subdivisions, parking lots, and other developments.	Moderate	1, 2, 5, 6	Extreme Heat, Flood	New
Adopt a lobbying position for increased ability to modify building codes to protect lives and property from changing risk of natural hazards. This includes ability to exceed state uniform building codes in areas of elevated risk.	Moderate	1, 4, 5		New – Created from merging several 2010 objectives

Appendix B: County Hazard Vulnerability Matrix- Qualitative Assessment

Hazard	Hazard Attributes Rating			Impact Attributes Rating						Total
	Area of impact	Past history, probability of future occurrence	Short term Readiness Factors (1= Less time to prepare)	Primary Impact (Short Term – Life and Property)			Secondary Impact (Long Term – Community Impacts)			
				Impact on General Structures	Impact on Critical Facilities	Impact on At-Risk Populations	Social Impact	Economic Impact	Severity of other associated secondary hazards	
(1-5)	(1-5)	(1-5)	(0-5)	(0-5)	(0-5)	(0-5)	(0-5)	(0-5)	(0-5)	
Dam/Levee Failure	2.14	1.21	3.43	2.57	2.29	1.79	1.64	3.00	2.07	20.14
Extreme Cold	4.25	3.69	2.50	1.56	1.75	3.94	3.13	2.69	2.88	26.38
Extreme Heat	4.25	3.69	2.50	1.06	1.44	4.19	3.19	2.56	2.56	25.44
Drought	3.63	3.06	1.81	0.63	0.81	1.25	2.63	3.63	2.38	19.81
Flood	3.16	3.81	3.56	3.88	3.13	3.06	3.19	3.94	3.69	31.41
Fog	2.69	3.13	2.94	0.63	1.00	0.88	0.94	1.00	1.44	14.63
Hail Storm	2.69	3.25	2.81	3.00	2.00	1.50	1.56	2.69	1.88	21.38
Landslide	1.25	1.06	2.75	1.81	1.00	0.88	1.06	1.25	1.19	12.25
Lightning	2.44	3.38	3.44	2.50	2.25	2.06	1.75	1.81	2.50	22.13
Tornado	3.06	3.94	3.88	4.19	4.00	3.50	3.75	4.38	4.00	34.69
Wildfire	1.75	1.38	2.56	2.63	1.81	1.75	1.94	2.13	2.13	18.06
Windstorm	3.25	3.31	3.44	3.31	2.50	2.69	2.38	2.88	2.56	26.31
Winter Storm	4.56	4.56	3.31	2.63	3.25	4.00	3.31	3.31	3.31	32.25

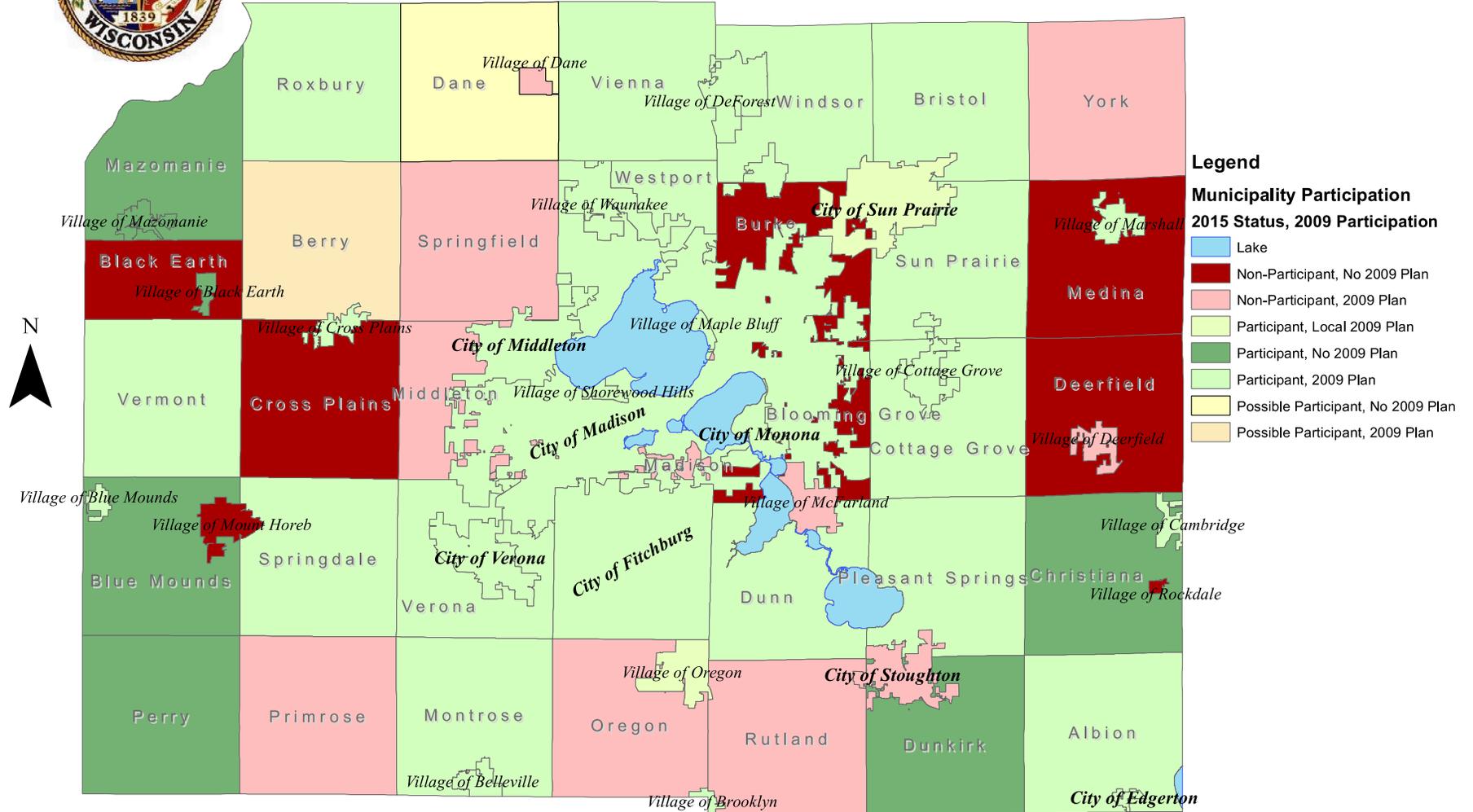
Mean scores of each hazard and associated hazard attributes as scored by local jurisdiction representatives and DCNHMP Steering Committee members. Individuals scored hazards based on their perception of the hazard and the risk it presents to the County. Area of impact refers to the proportion of the County that would be impacted by the hazard event. A score of five indicates that the entire County would be impacted, a lower score denotes that it is a more isolated occurrence. Short-term readiness factors refers to the amount of time that is available to prepare before a hazard impacts. The less time there is to prepare, the higher the risk, and thus, a higher score. Scores were used as a qualitative measure of risk to the County. This table was completed at the beginning of the planning process, before algal blooms and pest outbreaks were added as hazards.

Appendix C: Participating Municipalities

Dane County Natural Hazard Mitigation Plan

2015 Plan Update Municipality Participation Status and 2009 Participation

As of June 8, 2015



Legend

Municipality Participation
2015 Status, 2009 Participation

- Lake
- Non-Participant, No 2009 Plan
- Non-Participant, 2009 Plan
- Participant, Local 2009 Plan
- Participant, No 2009 Plan
- Participant, 2009 Plan
- Possible Participant, No 2009 Plan
- Possible Participant, 2009 Plan

This map was prepared by the Dane County Emergency Management from records and data located in various public offices. Map information is believed to be accurate but is not guaranteed to be without error. Source data used to compile this map is dynamic and in a constant state of maintenance, correction and update. This map does not represent a field survey and should be used for general cartographic and reference purposes only.

Appendix D: Dane County Natural Hazard Mitigation Plan Steering Committee

Name	Organization
David Janda	Dane County Emergency Management
Phil Rynish	Dane County Emergency Management/UW-Madison
Mindy Habecker	Dane County UW-Extension
Brian Standing	Dane County Planning and Development
Doug Voegli	Madison-Dane County Public Health
David Liebl	UW-Extension, Wisconsin Institute on Climate Change Impacts
Pamela Dunphy	Dane County Highways/Public Works
Fred Iausly	Dane County Land Information Office
Dave Merrit	Dane County Department of Administration
Jeremy Balousek	Dane County Land and Water Conservation Department
John Reimer	Dane County Land and Water Conservation Department
Mike Kakuska	Capital Area Regional Planning Commission
Jeff Halter	Henry Vilas Zoo
Katie Sommers	Wisconsin Emergency Management – Advisory Member Only

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