



# **NAVAL POSTGRADUATE SCHOOL**

**MONTEREY, CALIFORNIA**

## **THESIS**

**INCLUSION OF DISASTER RESILIENCY IN  
CITY/NEIGHBORHOOD COMPREHENSIVE PLANS**

by

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September 2017

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**INCLUSION OF DISASTER RESILIENCY IN CITY/NEIGHBORHOOD  
COMPREHENSIVE PLANS**

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## **ABSTRACT**

Once hazard mitigation is included in a city's comprehensive plan, the region and its citizens are more prepared to respond to a potential natural disaster. The purpose of this thesis was to illuminate factors that encourage cities to include hazard mitigation within their comprehensive plans. The research used geographic information system (GIS) and census data to locate urban, suburban, and rural areas at risk of flooding and analyzed these regions' comprehensive plans. The research results suggest that previous major flooding events often lead to the inclusion of flood-related hazard mitigation into cities' comprehensive plans. This finding suggests that policy alone does not influence hazard mitigation; other methods should be practiced to ensure hazard mitigation is included within neighborhood/city comprehensive plans.

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

APA	American Planning Association
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HIFLD	Homeland Infrastructure Foundation-Level Data
NFHL	National Flood Hazard Layer
SFHA	Special Flood Hazard Area

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## **EXECUTIVE SUMMARY**

Urban planning professionals and FEMA encourage the inclusion of hazard mitigation in the urban planning process. Comprehensive plans are a tool that planners create to strategize for the future of a community and/or city and to determine how the land and its citizens will interact within the community's spaces. To better understand the relationship between comprehensive plans and hazard mitigation, I analyzed several comprehensive plans in cities susceptible to some form of flooding. I discovered that the majority of comprehensive plans that included flood-related hazard mitigation experienced a catastrophic flooding event in the past, or has recurring floods. In response to these findings, I argue that cities should automatically include hazard mitigation within their comprehensive plans rather than including it retrospectively, only after a catastrophic hazard or recurring natural disaster arises.

I used two main sources of data for this research, Geographic Information Systems (GIS) software and FEMA's designated Special Flood Hazard Area (SFHA) GIS data, to locate cities vulnerable to flooding. Using this data, I was able to locate all areas within the United States that have a high chance of flooding. To limit the large pool of regions with SFHAs, I created specific qualifiers to better analyze the cities of inquiry. For example, the pool was limited to large urban cities that contain an SFHA, wherein a large urban city was defined as a city with a population of at least 400,000 and a population density of at least 5,500 per square mile. Only ten large urban cities within the United States fit these qualifications. In addition, to guarantee the research would consider varying city types, I located suburban and rural regions near each large urban city that also contain SFHAs. Suburbs, for the purposes of this research, were considered regions directly adjacent to the aforementioned large urban city's boundaries, and rural regions were considered counties within the same state of the large urban cities with a population of 15,000 or less.

I then located the large urban cities', suburban cities', and rural counties' comprehensive plans to determine if any form of flood-related hazard mitigation was included in the document. I separated the results by large urban city, suburb, and rural

county, and recorded each mention of hazard mitigation by creating a chart with two columns labeled “yes” and “no.” Once all comprehensive plans were located and analyzed, I separated the results by state and discovered which states had the highest and lowest percentage of flood-related hazard mitigation discussion in their comprehensive plans. To narrow down common reasons for this topic’s inclusion in the plans, I separated the top three and lower two states and further analyzed their comprehensive plans.

I discovered that the strongest contributing factor for the inclusion of hazard mitigation for both states with a high percentage and low percentage of flood-related hazard mitigation discussion in comprehensive plans was past unfavorable experiences with flooding within their jurisdictions.

## **ACKNOWLEDGMENTS**

To my sapphire: Watching you blossom as an artist has been my encouragement to press on to excel through this program. Thank you for being who you are. I love you.

To my best friend and mentor: Thank you for the constant reminder that “the race is not given to the swift...but he who endures until the end.” It kept me calm and allowed me to focus on the clarity of my research.

To my parents: Your constant prayers and encouragement are what pushed me through. I could not ask for better parents.

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## **I. INTRODUCTION**

Community planners often rely on such stakeholders as local leaders, residents, and business owners to assist in creating comprehensive plans for a community. However, in many cases, resiliency from natural disasters is not included in the planning process. Godschalk, Brody, and Burby have suggested, “Many planners believe that emergency response [is] handled ... by the plans and programs of other government agencies.”<sup>1</sup>

I researched hazard mitigation planning for this thesis because both the Federal Emergency Management Agency (FEMA) and the American Planning Association (APA) have stressed the importance of converging hazard mitigation and urban planning efforts to increase public safety. Researchers have found that “when public participation is integrated into disaster management planning and community planning, the result is sustainable hazard mitigation.”<sup>2</sup>

### **A. RESEARCH QUESTIONS**

This thesis seeks to answer the following questions: Do city comprehensive plans include hazard mitigation in land areas that are at high risk for flooding and are within a FEMA-designated Special Flood Hazard Area (SFHA)? In addition, if hazard mitigation is included within the comprehensive plans, what are the possible factors that encourage planners to include hazard mitigation?

### **B. PROBLEM STATEMENT**

The word “sustainability” often applies to urban and community objectives; it relates—but is not limited—to transportation, infrastructure, or the act of “going green,” which involves making more environmentally conscious decisions. Interestingly, these

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<sup>1</sup> David R. Godschalk, Samuel Brody, and Raymond Burby, “Public Participation in Natural Hazard Mitigation Policy Formation: Challenges for Comprehensive Planning,” *Journal of Environmental Planning and Management* 46 (2003): 733–754.

<sup>2</sup> Laurie Pearce, “Disaster Management and Community Planning, and Public Participation: How to Achieve Sustainable Hazard Mitigation,” *Natural Hazards* 28, no. 2–3 (2002): 211.

objectives are all at least loosely related to natural disasters. For example, proper transportation planning should include disaster evacuation methods for community members who do not have access to cars. For infrastructure considerations, planners could monitor the type of infrastructure built in hurricane-prone communities to mitigate hurricane damage to buildings. Lastly, and the key consideration researched in this thesis, making environmentally conscious planning decisions could minimize impervious surfaces—areas of land mainly consisting of artificial structures such as roads, sidewalks, driveways, and parking lots—which are subject to flooding. It is important to note that impervious surfaces tend to diminish the rate at which soil is able to absorb rainfall, which in return accentuates the impact of flooding.

In 2012, in the course of my duties as an urban planning student, I created the graphic in Figure 1 using ArcMap in order to show neighborhoods in the District of Columbia (Washington, DC) that were susceptible to a 100-year flood.

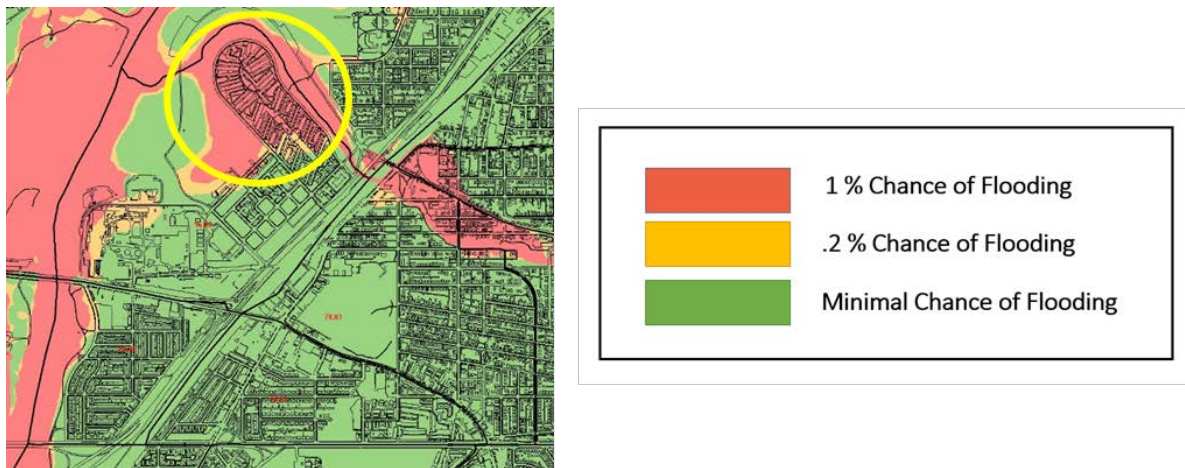


Figure 1. Washington, DC, Neighborhoods Susceptible to Flooding

In this graphic, I coupled both a floodplain map and an impervious surface layer and then placed the data over DC. This map revealed that an area directly adjacent to the Anacostia River was both heavily populated and in danger of flooding. Unfortunately,

upon evaluating DC's comprehensive plan, I discovered there were no in-place measure to increase resiliency for the communities located in the most vulnerable areas.<sup>3</sup>

This led to a pressing question: Is it common for comprehensive plans to include resiliency? If so, which communities tend to include hazard mitigation within their plans and what is the common underlying factor for including it? Through this research, the gap I intend to fill is how to strengthen the relationship between disaster planners and community planners, which will eventually trickle down to the actual community.

### **C. LITERATURE REVIEW**

To bring disaster planners and community planners together in pursuit of resiliency, we must first gather known information about urban planning, comprehensive plans, and hazard mitigation. This literature review first discusses the role of an urban planner and the importance he or she may play in building and maintaining the physical flow of a city's makeup. Later, hazard mitigation and its potential role in the urban planning process is explained. Finally, the literature review further explains comprehensive plans and common methodology urban planners use to create plans, such as using GIS and participatory planning to research and explain past, current, and future plans for a city.

According to the APA, an "urban planner is a professional who works to improve the welfare of people and their communities by creating more convenient, equitable, healthful, efficient, and attractive places for present and future generations."<sup>4</sup> An effective plan must be constructed in order to increase the probability of a thriving community, city, county, or even state. This plan among urban and community planners is most commonly called a comprehensive plan.

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<sup>3</sup> "2006 Comprehensive Plan," Washington, DC Office of Planning, accessed October 5, 2015, <http://planning.dc.gov/page/2006-comprehensive-plan>.

<sup>4</sup> "About Planning," American Planning Association (APA), accessed July 21, 2017, <https://www.planning.org/aboutplanning/>.

According to the University of Illinois, “Comprehensive plans can be a tool for planning the future growth or decline of a local community.”<sup>5</sup> Iowa State University defines a comprehensive plan as “a collection of information and materials designed to guide the future development of a city or county.”<sup>6</sup> These plans generally contain an overall look into the future for a community or city, and describe how the land will be used. FEMA’s region X—the 10th region in FEMA’s geographical breakdown focusing on Alaska, Washington, Idaho, and Oregon—asserts that comprehensive plans “establish policies that are intended to guide a community’s day-to-day land use decisions and capital facilities expenditures.”<sup>7</sup> The idea of creating a comprehensive plan for land-use purposes originated during the “City Beautiful Movement,” which was sparked during Chicago’s World’s Fair of 1893.<sup>8</sup> The common characteristics of the traditional comprehensive plan are: “(1) It is a physical plan, with a reflection on social and economic values, (2) It is a long-range plan, usually five years or more, (3) It is comprehensive, encompassing all the functions that make up a community and (4) It is a statement of policy, covering community character, geographic considerations and change features.”<sup>9</sup>

For example, the 2006 District of Columbia Comprehensive Plan covers what has traditionally been the standard requirement for a comprehensive plan. In general, a comprehensive plan is a “tool for planning the future growth or decline of a local community.”<sup>10</sup> In the plan, each region has detailed sections discussing the history, land use, demographics, housing characteristics, income and employment, projections, planning and development priorities, policies and actions, and policy focus areas.<sup>11</sup> Each section was carefully created with a common goal to improve and maximize the use of

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<sup>5</sup> “Comprehensive Planning,” University of Illinois Extension, accessed November 21, 2015, <http://extension.illinois.edu/lcr/comprehensiveplanning.cfm>.

<sup>6</sup> Story County Planning and Development, *Comprehensive Plan Audit* (Nevada, IA: Story County, 2013, <http://www.storycountyiowa.gov/AgendaCenter/ViewFile/Item/3910?fileID=3142>.

<sup>7</sup> Ibid.

<sup>8</sup> Ibid.

<sup>9</sup> Ibid.

<sup>10</sup> “Comprehensive Planning,” University of Illinois Extension.

<sup>11</sup> “2006 Comprehensive Plan,” Washington, DC Office of Planning.



the land and benefit the local community. However, there is no mention of hazard mitigation throughout the entire comprehensive plan.

One must then ask: How can a comprehensive plan truly be used for the betterment of a local jurisdiction without the inclusion of any hazard mitigation? The inclusion of hazard mitigation in addition to the continued participation of community members through a process known as participatory planning may lead to an improved comprehensive plan.

### **1. Hazard Mitigation and Planning**

Research completed by Philip Berke and Gavin Smith referred to the combining of disaster resiliency and urban planning as hazard mitigation planning. “Hazard mitigation planning,” they explain, “can be defined as a coordinated series of structural and non-structural actions and processes designed to reduce the likelihood of future damages to property, while minimizing the health and safety-related impacts associated with natural hazards and disasters.”<sup>12</sup>

The majority of this type of planning is something planners simply label mitigation planning. It turns out that both FEMA and the APA, since the Disaster Mitigation Act of 2000 amendments to the Robert T. Stafford Disaster Assistance and Relief Act, now emphasize the increasing necessity for disaster resiliency and urban planning increasingly to become one in the same. ... [This] makes planners essential to hazard mitigation planning for two important reasons.”<sup>13</sup> One concern FEMA mentions is that “few planners are formally trained to understand how hazards should influence [the planning process].”<sup>14</sup> FEMA later states, “Integrating hazard mitigation into the local comprehensive plan ... establishes resilience as an overarching value of a community and

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<sup>12</sup> Philip Berke and Gavin Smith, “Hazard Mitigation, Planning, and Disaster Resiliency: Challenges and Strategic Choices for the 21st Century,” in *Building Safer Communities: Risk Governance, Spatial Planning and Responses to Natural Hazards*, ed. Urbano Fra Paleo, 1–23 (Amsterdam: ISO Press, 2009), 1.

<sup>13</sup> James C. Schwab, *Hazard Mitigation: Integrating Best Practices into Planning* (Washington, DC: APA, 2010), [https://www.fema.gov/media-library-data/20130726-1739-25045-4373/pas\\_560\\_final.pdf](https://www.fema.gov/media-library-data/20130726-1739-25045-4373/pas_560_final.pdf).

<sup>14</sup> Ibid.

provides the opportunity to continuously manage development in a way that does not lead to increased hazard vulnerability.”<sup>15</sup>

During the 2012 Alaska Planning Conference, it was discussed that

successful integration of hazard mitigation into the comprehensive plan involves a series of key points: include an element within the comprehensive plan that clearly addresses hazards, identify in all other elements of the comprehensive plan those areas where hazard mitigation may play a role in advancing the overall goals of the plan, establish the linkages between identified hazards in the hazard element and these specific opportunities, and cross-reference them to clarify where and how mitigation needs to address these problems, and if the plan has an implementation element, be sure that it includes, specific provisions, such as financing and timing, for how mitigation solutions will actually be achieved, and by whom.<sup>16</sup>

The research clearly indicates that both FEMA and the APA acknowledge a missing link between the two agencies as it relates to comprehensive plans. Unfortunately, “state planning laws tend to focus on local land-use planning and regulation, without reference to hazards.”<sup>17</sup> Mitigation, in turn, “is often reduced to a series of disconnected projects intended to address past ‘mistakes,’ and therefore not part of a comprehensive and integrated planning approach.”<sup>18</sup> For example, according to the Institute for Business and Home and Safety, only twenty-three states “require some or all local governments to develop local comprehensive plans”; out of these twenty-three states only ten have special “requirements that local plans must in some way address natural hazards in a specific element.”<sup>19</sup>

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<sup>15</sup> “Building Community Resilience by Integrating Hazard Mitigation,” FEMA, July 26, 2013, 1, <http://www.fema.gov/media-library-data/20130726-1908-25045-9918/factsheet1.pdf>.

<sup>16</sup> Sally Russell Cox, Taunnie Boothby, and Ann Gravier, “Increasing Community Resilience by Integrating Hazard Mitigation into Local Comprehensive Planning Efforts,” Presented at the 2012 Alaska Planning Conference, Anchorage, AK, November 12, 2012, [https://www.commerce.alaska.gov/web/Portals/4/pub/AK\\_APA\\_Haz-Mit\\_Comp-Plan.pdf](https://www.commerce.alaska.gov/web/Portals/4/pub/AK_APA_Haz-Mit_Comp-Plan.pdf).

<sup>17</sup> Schwab, *Hazard Mitigation*, 24.

<sup>18</sup> Berke and Smith, “Hazard Mitigation, Planning, and Disaster Resiliency,” 7.

<sup>19</sup> Schwab, *Hazard Mitigation*, 25.

In this light, FEMA suggests that one role of a planner is to engage public participation. FEMA understands that most planners have at least some training in public engagement and the ability to gather a community's thoughts and opinions through participation planning.<sup>20</sup> The research clearly asserts the necessity of incorporating participatory planning in the hazard mitigation and planning process.

## **2. Participatory Planning**

According to the literature, participatory planning is key to not only getting a community involved, but also to clearly understanding what the community's needs are. These findings are not limited to urban planners; FEMA, a federal agency, has stated, "A community benefits from the active participation of all stakeholders."<sup>21</sup>

Participatory planning goes beyond getting individuals involved—it involves determining the detailed sociological effects of community interaction and encourages planners to study intra-psychic phenomena or, in other words, the "impact of our behaviors toward places, thus influencing whether and how we might participate in local planning efforts."<sup>22</sup> "Communities engaged in the development of a hazard mitigation plan benefit from the involvement of individuals trained in the art of public participation and dispute resolution."<sup>23</sup> Encouraging participatory planning provides opportunities for urban planners to gain a better understanding of a community's functionality. Understanding these personality traits is essential to executing effective community planning.

Manzo and Perkins add, "Place attachments and sense of community play a significant role in neighborhood revitalization efforts. More specifically, in cases where

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<sup>20</sup> Schwab, *Hazard Mitigation*, 108.

<sup>21</sup> FEMA, *Developing and Maintaining Emergency Operations Plans* (Washington, DC: Department of Homeland Security, 2010), 4-2, [https://www.fema.gov/media-library-data/20130726-1828-25045-0014/cpg\\_101\\_comprehensive\\_preparedness\\_guide\\_developing\\_and\\_maintaining\\_emergency\\_operations\\_plans\\_2010.pdf](https://www.fema.gov/media-library-data/20130726-1828-25045-0014/cpg_101_comprehensive_preparedness_guide_developing_and_maintaining_emergency_operations_plans_2010.pdf).

<sup>22</sup> Lynne C. Manzo and Douglas D. Perkins, "Finding Common Ground: The Importance of Place Attachment to Community Participation and Planning," *Journal of Planning Literature* 20 (2006): 336, 335–350.

<sup>23</sup> Berke and Smith, "Hazard Mitigation, Planning, and Disaster Resiliency," 3.

neighbors are anonymous and do not stay long enough to develop any emotional connection to the place, they tend not to be committed enough to improve.”<sup>24</sup> They argue that understanding a citizen’s connection to a specific place is important for planners; in order to be an active facilitator of participatory planning, the planner should understand that each stakeholder will play a different role, and what type of player each individual is. I do not believe the authors are insinuating that a planner should assume certain parties will not be interested in participating in the planning process, but the authors do suggest certain factors many explain why there is a lack of interest for some individuals within a community.

*a. Participatory Planning Examples*

Participatory planners must also consider that whenever there is discussion of development or change to a community, some individuals may be unreceptive to potential change to the neighborhood’s physical aesthetics. For example, research has shown that if there is a common or sacred place in the community, planners should deeply consider holding events at that sacred place, since “sense of community is linked to citizen participation.”<sup>25</sup> Finding common interest and guaranteeing that citizens do not feel marginalized is key to getting members of the community involved.

One example of successful participatory planning is the work of the Dudley Street Initiative team. Dudley Street is a community in Boston that was rife with blight, crime, arson, and poverty in the 1980s. Thankfully, two individuals took it upon themselves to invest in the community. They later decided to have a participatory meeting with the community. The first meeting was full of people desperate for change, but who unfortunately had no trust in these two strangers; they had seen planners come in the communities of other neighborhoods, only to create plans that pushed the lower-income residents out in favor of condos and retail establishments geared toward attracting higher-income residents.<sup>26</sup> As the two men had no interest in making money, however, they

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<sup>24</sup> Manzo and Perkins, “Finding Common Ground,” 337.

<sup>25</sup> Manzo and Perkins, “Finding Common Ground,” 339.

<sup>26</sup> Peter Medoff and Holly Sklar, *Streets of Hope: The Fall and Rise of an Urban Neighborhood* (Boston: South End Press, 1994).

decided it would better if they let the community do the talking. This approach to community involvement increased social resources, economic opportunity, and political interest among the residents.<sup>27</sup>

The overall makeup of a community and those invested in the community can also encourage participatory planning. For example, Manzo and Perkins stated their team involved “two community psychologist, three urban planners, an economist, and a socialist who collaborated closely across multiple disciplinary divides to work together with community leaders and organizers.”<sup>28</sup>

### ***b. Disadvantages of Participatory Planning***

Some studies suggest there are disadvantages in pursuing participatory planning. For instance, participatory planning is time consuming. Often, when a larger group of citizens is involved with the planning process, there are differing opinions and personal preferences that slow or refocus the effort. This process can only be lengthened if stakeholders have ulterior motives, which will naturally harm the participatory process. “Since workers are not paid for their time, committees may be dominated by strongly partisan participants whose livelihood or values are strongly affected.”<sup>29</sup>

## **3. Planning and GIS**

Several tools are required for effectively informing a community of possible vulnerabilities related to natural disasters. One particular tool often used by community planners and the local governments is geographic information systems (GIS). According to the Environmental Systems Research Institute, a company that owns more than 30 percent of the GIS software market worldwide, “GIS is the integrated collection of computer software and data used to view and manage information about geographic

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<sup>27</sup> Medoff and Sklar, *Streets of Hope*.

<sup>28</sup> Manzo and Perkins, “Finding Common Ground,” 346.

<sup>29</sup> Renee A. Irvin and John Stansbury, “Citizen Participation in Decision Making: Is it Worth the Effort?” *Public Administration Review* 64, no. 1 (2004): 59, 55–65.

places, analyze spatial relationships, and model spatial processes.”<sup>30</sup> More simply put, GIS is “a computing application capable of creating, storing, manipulating, visualizing and analyzing geographic information.”<sup>31</sup> It is my belief that incorporating GIS could be used to better understand a community. It has the ability to inform a community of possible natural disasters and can tell a story with the use of graphics and images presented on a geographical layout. It also has the capability to inform planners about the makeup of a community and can warn a community about natural disasters it may face.

The combination of GIS and participatory planning is not without its challenges. According to Esnard, “Most community-based organizations have some computing infrastructure in place ... however, they are at various stages with little regard to GIS adoption.”<sup>32</sup> The use of advanced GIS applications, as presented in Figure 1 (shown previously in Section B of this chapter). requires specialists trained in ArcMap tools. Without prior knowledge, use of ArcMap requires extensive training, which would prevent planners from including GIS in the planning process. As Esnard mentions, within the realm of planning there are usually paid professionals, hired consultants, and volunteers. A GIS-specified staff members would be needed in order to include GIS in the planning process. Most planners would not consider having a GIS professional as a requirement and would likely not consider hiring a professional strictly for a GIS product. In addition, the cost associated with GIS software might deter some planners from using GIS for hazard mitigation plans. For example, if a planner noticed that a community was in the middle of the floodplain and wanted to use the ArcGIS system to create an image similar to the one shown in Figure 1, the planner would need to pay around \$1,500 per year for an active license. Many cities may not have the money in their budget and would reject the idea of purchasing an active ArcMap license. However, the literature supports that incorporating GIS in analysis can help build productive hazard mitigation planning.

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<sup>30</sup> “Geographic Information Systems (GIS),” Case Western Reserve University, last updated April 17, 2017, <http://researchguides.case.edu/GIS>.

<sup>31</sup> Michael F. Goodchild, “Spatial Analysts and GIS Practitioners: The Current Status of GIS and Spatial Analysis,” *Journal of Geographical Systems* 2, no. 1 (March 2000): 6.

<sup>32</sup> Ann-Margaret Esnard, “Institutional and Organizational Barriers to Effective use of GIS by Community-Based Organizations,” *URISA Journal* 19, no. 2 (July 2007): 13.

## **D. RESEARCH DESIGN**

Disaster planning should not be excluded from the participatory and community planning process. Pearce found that “when public participation is integrated into disaster management planning and community planning, the result is sustainable hazard mitigation.”<sup>33</sup> In other words, disaster management must be mitigated through community planning. Pearce believes, “If community planners and disaster managers ignore the local community, then they decrease their chance of providing reasonable solutions to disaster related problems.”<sup>34</sup> I would add to this: How could we not include disaster resiliency in the planning process when it could directly affect stakeholders in the same way that zoning laws, crime, and retail could? Pearce believes officials traditionally “have not wanted to reveal potential hazards to their representatives in fear that panic would prevail.”<sup>35</sup>

However, if people have prior knowledge about disasters that could occur in their region, there is a stronger possibility they will push the state and local politicians to provide them with basic disaster services and needs. “Without resilience, communities are not likely to recover after a disaster.”<sup>36</sup> By communicating in person, the local government members would be able to see how many community members are available to be of assistance. For example, young men and women would be able to lift sand bags due to a storm, and middle-aged stakeholders could be available to assist the elderly. This type of planning would not only allow for a community to increase its resiliency, it would, in return, encourage community team-building.

### **(1) Sample**

In addition to providing previous research, my research demonstrates why resiliency from natural disasters must be included in all comprehensive plans. To prove the importance of this theory, I used GIS to locate communities susceptible to flooding

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<sup>33</sup> Pearce, “Disaster Management and Community Planning,” 211.

<sup>34</sup> Ibid., 216.

<sup>35</sup> Ibid.

<sup>36</sup> Susan Nicholls, “The Resilient Community and Communication Practice,” *Australian Journal of Emergency Management* 27, no. 1 (2012): 46.

throughout various cities within the United States. From there, I located the comprehensive plan from the selected cities/neighborhoods to see if resiliency is included.

## (2) Selection

I examined at a total of sixteen large urban cities. To be considered a large urban city, the city must have between 400,000 and 3 million residents and a population density of at least 5,500 people per square mile. A suburban area is directly adjacent to a large urban city, and rural areas are considered counties with relatively small populations and low population density. A city, suburb, or rural county was selected only if FEMA designated an area within its boundaries as a Special Flood Hazard Area (SFHA)—an area at high risk for flooding. From there, I discovered which cities provided the most information to facilitate a conclusion.

## (3) Limitations

Data were limited to information that was readily available for the research objective. In this light, many cities (neighborhoods) located within high-risk floodplain zones, do not have comprehensive plans readily available. One may argue that this limitation minimized the effectiveness of the research.

In addition, I only researched floodplains with a high risk of flooding. It is evident that disaster resiliency is not limited to flooding. This same type research could be done with earthquakes, tornadoes, fires, terrorism, etc. However, one could argue that listing all types of disasters in a comprehensive plan is tedious, time consuming, and not worth an effort for a disaster that may never happen.

## (4) Data Sources

My data sources included a combination of literature from city comprehensive plans and the analysis of GIS data where SFHAs are overlaid with high-density, suburban, or rural areas. In the cities of interest, I researched where the floodplain high-risk area is located and then found their comprehensive plans. I then focused on comprehensive plans with flood-related hazard mitigation. From there, I discovered



common factors and theorized why flood-related hazard mitigation was included within the plan outside of just its location within a high-risk flooding region.

#### (5) Type and Mode of Analysis

I first found urban cities whose populations are between 400,000 and 3 million and have population densities of at least 5,500 residents per square mile; I only selected cities that are heavily populated and sit in the middle of a FEMA-designated SFHA. Next, I located suburban cities that are located outside of my definition of an urban city, and that sit in the middle of an SFHA. Finally, I focused on rural areas and small towns located in a floodplain. Once these cities were selected, I then used ArcGIS to determine which cities have locations that fall into FEMA's SFHA designation. From there, I used ArcGIS to locate adjacent cities with high-risk flood threats. I then located the city's comprehensive plan and determined if there is any type of hazard mitigation planning reserved for flooding.

#### (6) Output

My final product was separated by states with high rates of hazard mitigation in their comprehensive plans, and states with low rates of hazard mitigation in their comprehensive plans. From there, I analyzed the commonalities between the two groups to illuminate factors that influence the inclusion of hazard mitigation within a comprehensive plan.

It is my hope that readers working or versed in community planning will use this evidence to consider including disaster resiliency in future comprehensive plans.

### **E. CHAPTER OUTLINE**

Following this introduction and literature review, Chapter II discusses my research design in greater detail. Chapter III shows my analysis for determining the commonalities of states with a high percentage of comprehensive plans that account for flood-related resiliency. Similar to Chapter III, Chapter IV shows the analyzed commonalities of the chosen states that had a low percentage of comprehensive plans with flood-related hazard mitigation, but that still included hazard mitigation within their

plan. The final chapter, Chapter V, consists of my findings and conclusion. My findings focus on the states in Chapter III and Chapter IV that included disaster resiliency in their comprehensive plans to reveal the reasons why these particular jurisdictions included hazard mitigation. In addition, I suggest policy considerations for community planning academic programs and the federal government, and make general suggestions for cities based on my findings.

## II. BACKGROUND AND METHODOLOGY

In order to guarantee that my research would consider the varying city types, I separated cities into three categories: large urban cities, suburbs, and rural counties.

### A. DEFINITIONS

*Large urban city:* The urban cities were selected based on 2010 census data. For the purpose of this research, an urban city must have a population of at least 400,000 and a population density of at least 5,500 people per square mile. For example, according to the 2012 United States Census, Houston, Texas, is the 4th largest city in the United States; but with a city area of 627.8 square miles, Houston only has a population density of approximately 3,311 per square mile.<sup>37</sup> Much of the city could be considered suburban, or even rural to some, and the city's planning style would differ from more densely populated areas where more people could possibly be affected by one hazard event. Therefore a city like Houston was not considered for my research. In addition to population density requirements, the cities chosen had to have at least one area within their boundaries designated as a FEMA Special Flood Hazard Area (SFHA) with high risk. According to the National Flood Insurance Program, SFHA with high risk is an area where "there is at least a 1 in 4 chance of flooding during a 30-year [period]."<sup>38</sup>

*Suburb:* All suburban cities studied were directly adjacent to the urban cities chosen for this research. Neither population nor population density were considered when selecting suburban cities. The only qualification was that the suburb must have a portion of the city also designated as an SFHA with high risk.

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<sup>37</sup> "About Houston: Facts and Figures," City of Houston, accessed March 25, 2016, [www.houston.tx.gov/about/houston/houstonfacts.html](http://www.houston.tx.gov/about/houston/houstonfacts.html); "2010 Census Interactive Population Map," United States Census Bureau, accessed May 14, 2016, <http://www.census.gov/2010census/popmap/>.

<sup>38</sup> "What is a Special Flood Hazard Area (SFHA)?" FEMA, accessed March 25, 2016, [www.floodsmart.gov/floodsmart/pages/faqs/what-is-a-special-flood-hazard-area.jsp](http://www.floodsmart.gov/floodsmart/pages/faqs/what-is-a-special-flood-hazard-area.jsp).

*Rural county:* According to the U.S. Census Bureau, a rural area “encompasses all population, housing and territory not included within an urban area.”<sup>39</sup> I therefore located all the counties whose states match that of the urban cities and whose populations were less than 15,000. For example, if one of the urban cities chosen was New York City, I would choose only the counties in the state of New York whose population is less than 15,000. Also, like the suburbs and urban cities, there had to be a FEMA-designated SFHA with high risk.

## **B. METHODOLOGY**

My first method was to locate all cities that, for the sake of this research, are considered large urban cities. To do so, I created an Excel spreadsheet of all the cities within the United States, separated in columns by city, state, land area, 2010 census population, and population density. Through Excel’s sorting feature, I sorted the population column by largest to smallest city and deleted all cities that contained less than 500,000 people. The population density was then calculated by dividing the 2010 census population from the land area of the remaining cities. Once the population density was calculated, I deleted all cities that had population densities of less than 5,000 people per square mile. Through this analysis, it was discovered that sixteen cities met the qualifications. The cities, listed from highest to lowest population density, are as follows: (1) New York, New York, (2) San Francisco, California, (3) Boston, Massachusetts, (4) Chicago, Illinois, (5) Miami, Florida, (6) Philadelphia, Pennsylvania, (7) Washington, DC, (8) Long Beach, California, (9) Los Angeles, California, (10) Baltimore, Maryland, (11) Seattle, Washington, (12) Minneapolis, Minnesota, (13) Oakland, California, (14) Milwaukee, Wisconsin, (15) San Jose, California, and (16) Detroit, Michigan. Table 1 shows the final chart of cities that were used for the research.

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<sup>39</sup> “2010 Census Urban Area FAQs,” United States Census Bureau, last modified February 9, 2015, <https://www.census.gov/geo/reference/ua/uafaq.html>.

Table 1. Cities Used for Research<sup>40</sup>

Population Density Rank	City	State	2010 Census Population	Land Area	2010 Population Density
1	<i>New York</i>	New York	8,175,133	302.6 sq mi	27,012 per sq mi
2	San Francisco	California	805,235	46.9 sq mi	17,179 per sq mi
3	Boston	Massachusetts	617,594	48.3 sq mi	12,793 per sq mi
4	Chicago	Illinois	2,695,598	227.6 sq mi	11,842 per sq mi
5	Miami	Florida	399,457	35.9 sq mi	11,539 per sq mi
6	<i>Philadelphia</i>	Pennsylvania	1,526,006	134.1 sq mi	11,379 per sq mi
7	Washington	District of Columbia	601,723	61.0 sq mi	9,856 per sq mi
8	Long Beach	California	462,257	50.3 sq mi	9,191 per sq mi
9	Los Angeles	California	3,792,621	468.7 sq mi	8,092 per sq mi
10	<i>Baltimore</i>	Maryland	620,961	80.9 sq mi	7,672 per sq mi
11	Seattle	Washington	608,660	83.9 sq mi	7,251 per sq mi
12	Minneapolis	Minnesota	382,578	54.0 sq mi	7,088 per sq mi
13	Oakland	California	390,724	55.9 sq mi	7,004 per sq mi
14	Milwaukee	Wisconsin	594,833	96.1 sq mi	6,188 per sq mi
15	San Jose	California	945,942	176.6 sq mi	5,359 per sq mi
16	Detroit	Michigan	713,777	138.8 sq mi	5,144 per sq mi

Column four (2010 Census Population) was divided by column five (Land Area) to calculate the population density. The chart was then organized in descending order from highest population density to lowest population density.

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<sup>40</sup> Adapted from “American FactFinder,” United States Census Bureau, accessed July 31, 2017, <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>; “2014 U.S. Gazetteer Files,” United States Census Bureau, last revised May 26, 2015, <https://www.census.gov/geo/maps-data/data/gazetteer2014.html>.

## 1. ArcMap

In order to see which of the sixteen large urban cities contained a FEMA-designated SFHA with high risk, I used software called ArcMap. According to the Environmental Sciences Research Institute, “ArcMap represents geographic information as a collection of layers and other elements in a map. Common map elements include the data frame containing map layers for a given extent plus a scale bar, north arrow, title, descriptive text, a symbol legend, and so on.”<sup>41</sup> ArcMap is often used to tell a story or answer a question through shapefiles, “a vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.”<sup>42</sup> The question I sought to answer was: Which of these sixteen cities has a FEMA-assigned SFHA with high risk within the city boundary?

The United States Census Bureau provides several shapefiles with current statistical analysis of population and boundaries within the United States. One such shapefile, or layer, provided by the Census Bureau is city boundaries called Cartographic Boundary Shapefiles.<sup>43</sup> Each city that made it through the original analysis city boundary was inserted into ArcMap as a layer. In addition, FEMA provides the National Flood Hazard Layer (NFHL) in the form of a shapefile. The NFHL is a “digital database that contains flood hazard mapping data ... and is for community officials and members looking to view effective regulatory flood hazard information in a Geographic Information Systems (GIS) application.”<sup>44</sup> One of the NFHL’s many features is identifying SFHAs with high risk. To extract SFHA information from the NFHL shapefiles, I used a feature within ArcMap known as definition query. Definition query

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<sup>41</sup> “What is ArcMap?” ESRI, accessed June 16, 2016, <http://desktop.arcgis.com/en/arcmap/10.3/main/map/what-is-arcmap-.htm>.

<sup>42</sup> “Shapefile,” ESRI, accessed June 26, 2016, <http://support.esri.com/other-resources/gis-dictionary/term/shapefile>.

<sup>43</sup> “Cartographic Boundary Shapefiles—Counties,” United States Census Bureau, accessed June 26, 2016, [https://www.census.gov/geo/maps-data/data/cbf/cbf\\_counties.html](https://www.census.gov/geo/maps-data/data/cbf/cbf_counties.html).

<sup>44</sup> “National Flood Hazard Layer (NFHL),” FEMA, August 21, 2015, <https://www.fema.gov/national-flood-hazard-layer-nfhl>.

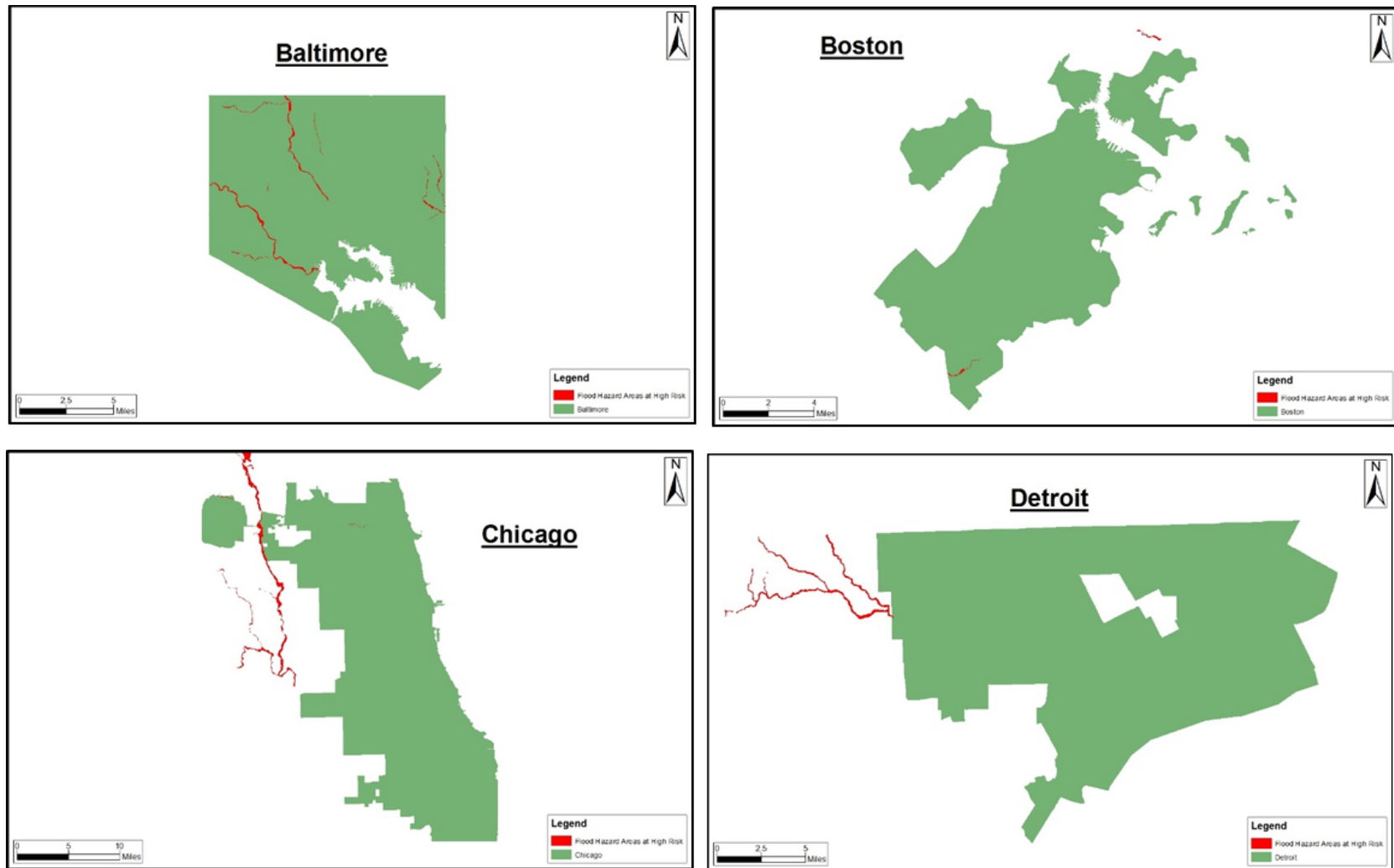
“is a request that examines feature or tabular attributes based on user-selected criteria and displays only those features or records that satisfy the criteria [in ArcMap].”<sup>45</sup> Definition query allowed me to only show the feature of “SFHA with high risk” within the NFHL layer. Once I inserted the queried NFHL layer in ArcMap, I selected all large urban cities that contained an SFHA with high risk; these were the cities selected for further analysis in this research.

After the analysis was complete I was left with a total of ten cities that have an SFHA with high risk within the city boundary. The chosen cities are as follows, shown in Figure 2: (1) Baltimore, Maryland, (2) Boston, Massachusetts, (3) Chicago, Illinois, (4) Detroit, Michigan, (5) Milwaukee, Wisconsin, (6) Minneapolis, Minnesota, (7) Oakland, California, (8) Philadelphia, Pennsylvania, (9) San Jose, California, and (10) Washington, DC. For the sake of presentation, all SFHA with high risk layers outside the city boundary were removed. The removal of the high risk layers outside of the city boundary was accomplished through an ArcMap application known as intersect. The intersect feature “computes a geometric intersection of the input features. Features or portions of features which overlap in all layers and/or feature classes will be written to the output feature class.”<sup>46</sup> All large urban cities were saved and separated in a folder labeled “large urban cities.”

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<sup>45</sup> “Definition Query,” ESRI, accessed June 26, 2016, <http://support.esri.com/other-resources/gis-dictionary/term/definition-query>.

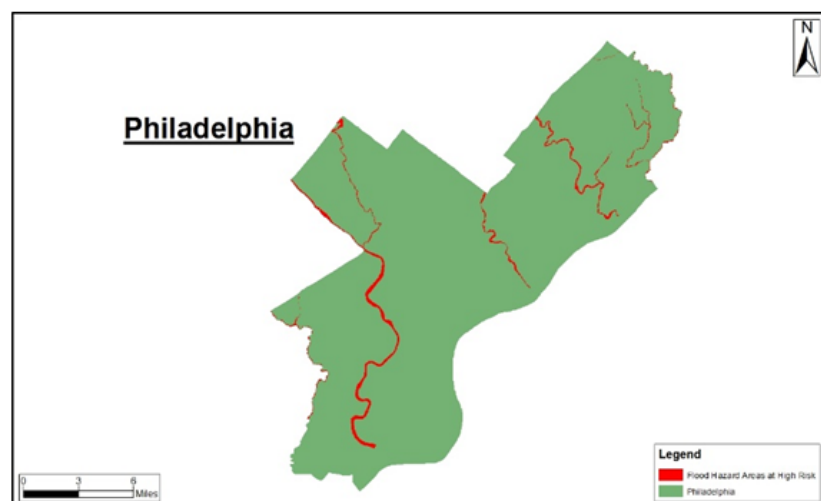
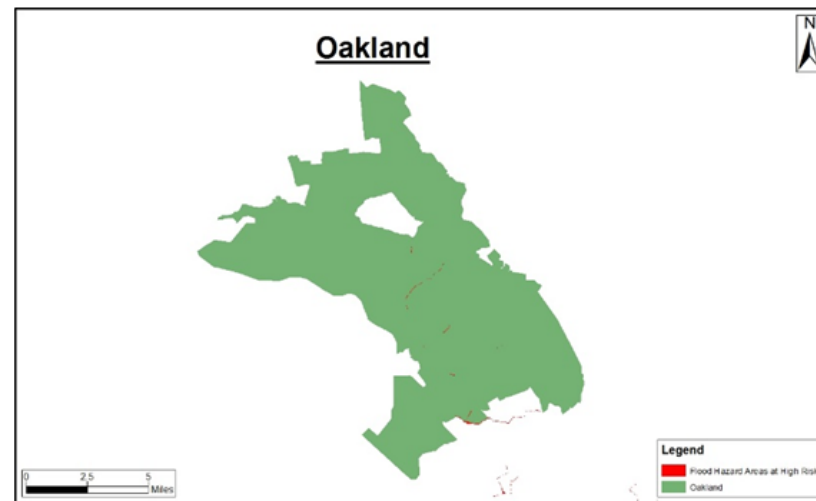
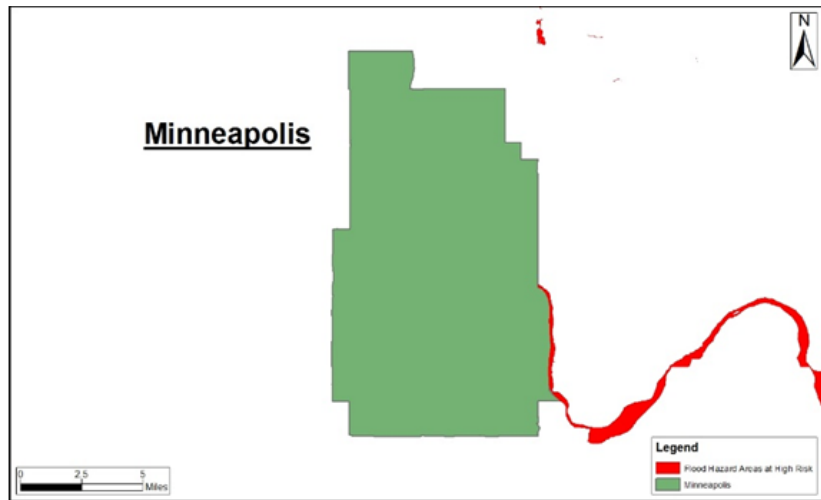
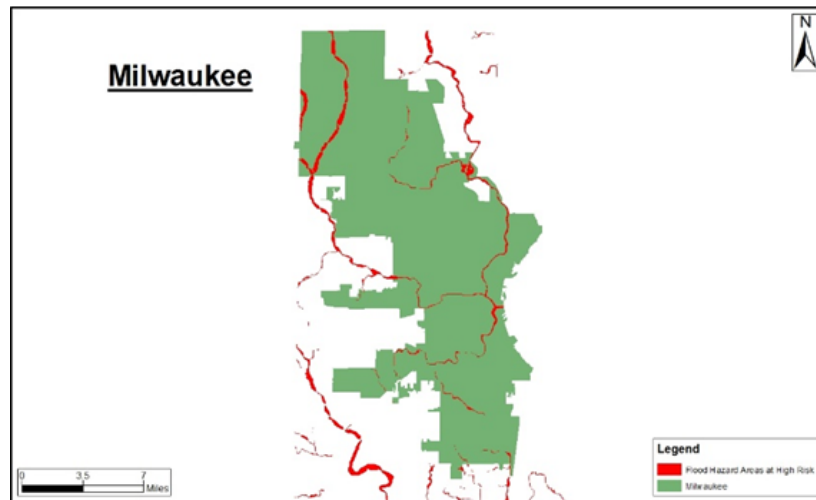
<sup>46</sup> “Intersect,” ESRI, accessed March 5, 2016, <http://pro.arcgis.com/en/pro-app/tool-reference/analysis/intersect.htm>.



The cities are colored green and the SFHA high risk is presented in red.

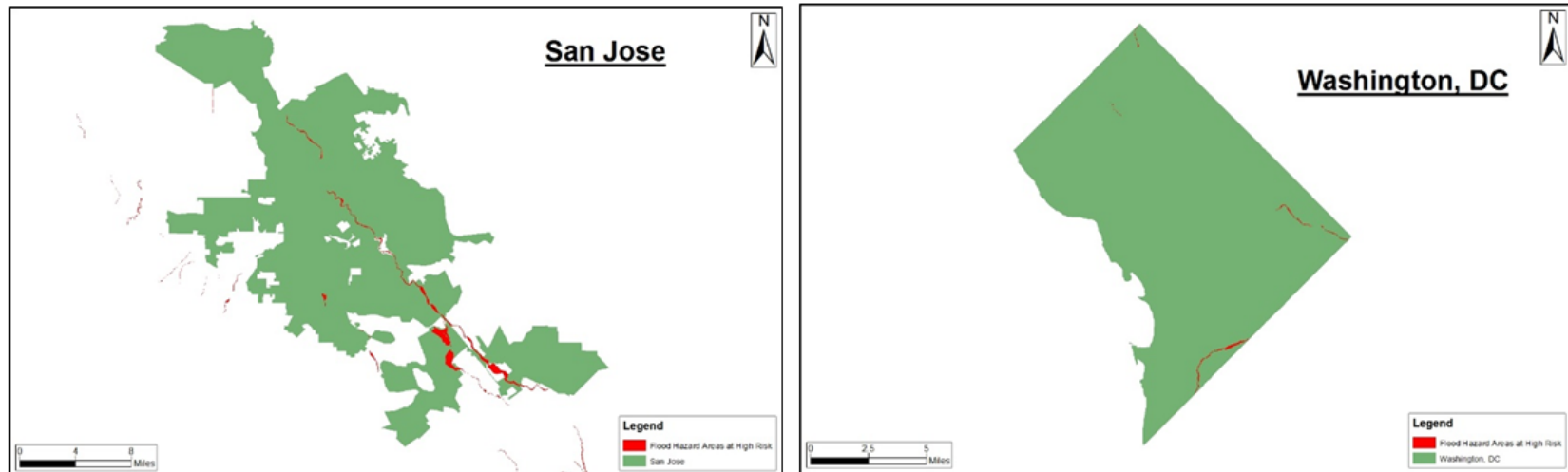
Figure 2. Selected Large Urban Cities (continued on next page)





The cities are colored green and the SFHA high risk is presented in red.

Figure 2. (cont.) Selected Large Urban Cities (continued on next page)



The cities are colored green and the SFHA high risk is presented in red.

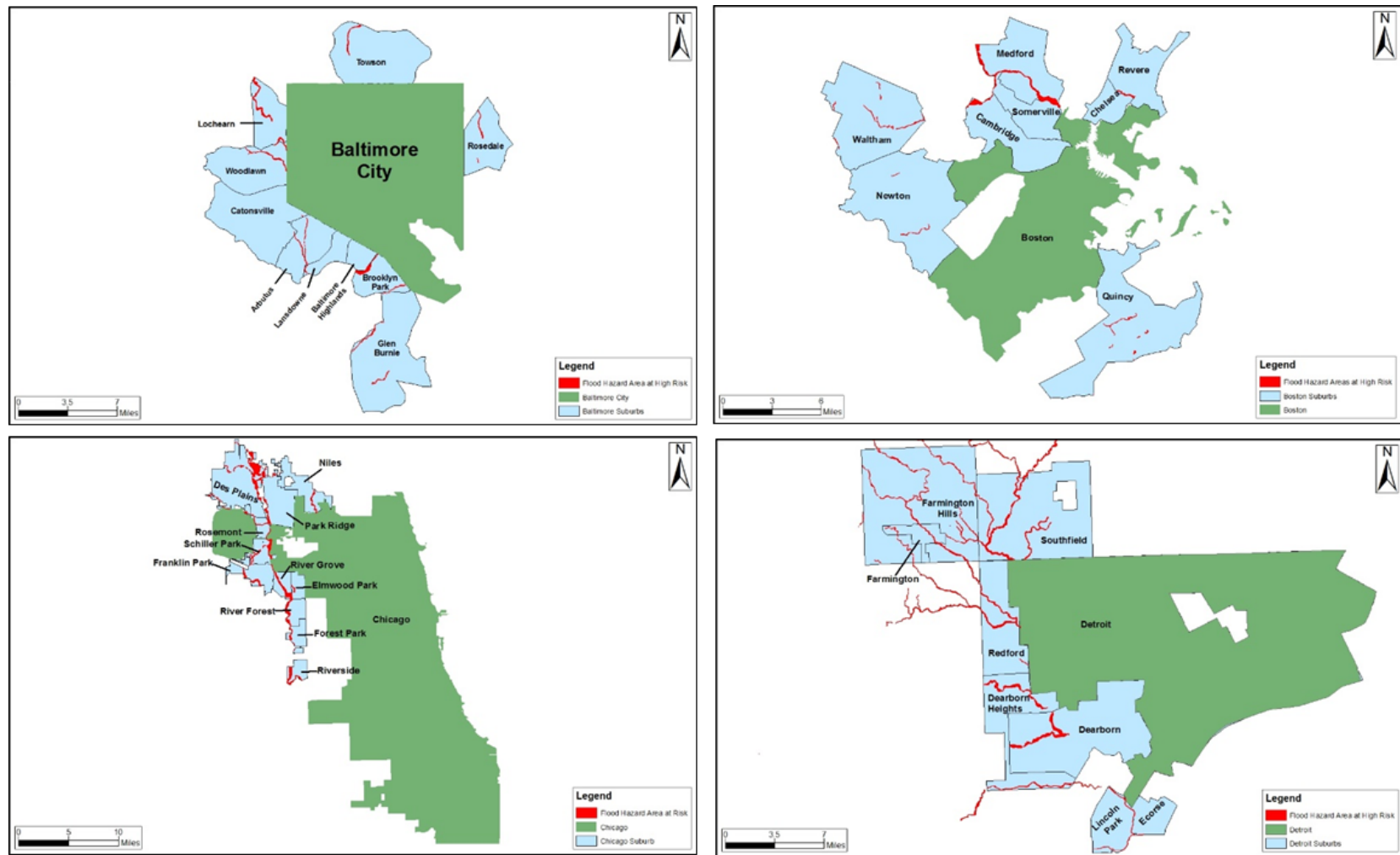
Figure 2. (cont.) Selected Large Urban Cities

Once the large urban cities were labeled I then located their suburbs. According to Webster, a suburb is “the residential area on the outskirts of a city or large town.”<sup>47</sup> I used the census’s Cartographic Boundary Shapefiles to view cities directly adjacent to these large urban cities. To make this determination, I labeled each large urban city a green color and selected all cities it immediately bordered. Once I selected and queried the adjacent cities, I inserted FEMA’s SFHA with high risk layer. I then used the intersect feature to only display SFHAs with high risk that intersect with the assigned suburbs. If the suburb did not have an SFHA with high risk within its boundary it was deleted. Once this process was completed, I used ArcMap’s “identify” tool to see the names of the suburbs. The identify tool “identifies the geographic feature or place on which you click.”<sup>48</sup> For the analysis, I then labeled each suburb with the correct name (see Figure 3).

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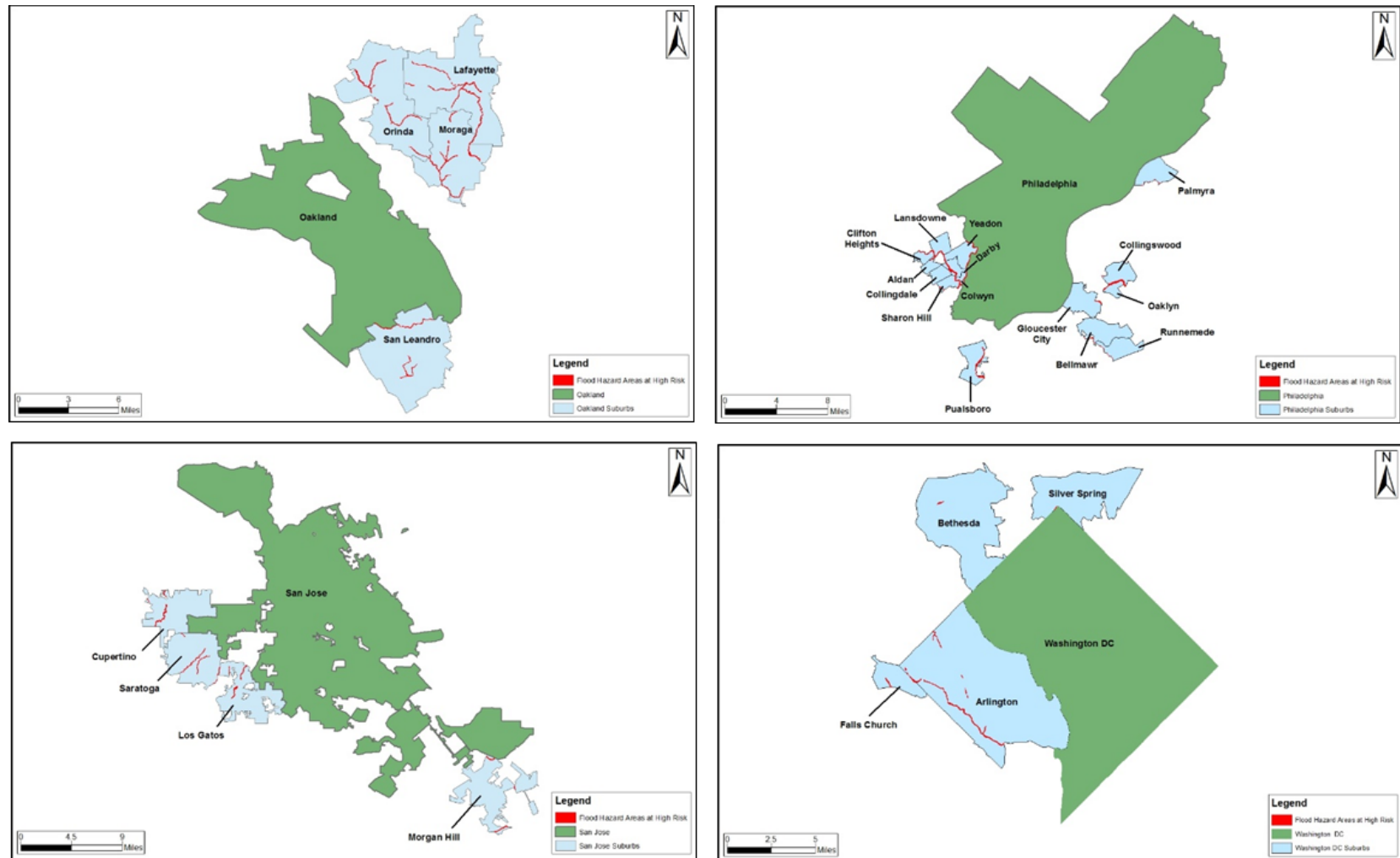
<sup>47</sup> “Suburb,” *Merriam-Webster*, accessed May 21, 2016, <http://www.merriam-webster.com/dictionary/suburb>.

<sup>48</sup> “Intersect,” ESRI.



The cities' suburbs are labeled and colored light blue and the SFHA high risks in the county are presented in red.

Figure 3. Selected Suburbs (continued on next page)



The cities' suburbs are labeled and colored light blue and the SFHA high risks in the county are presented in red.

Figure 3. (cont.) Selected Suburbs

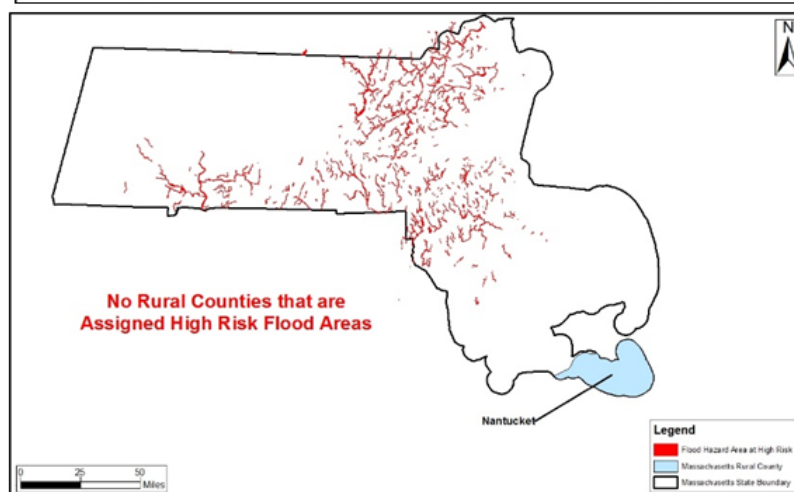
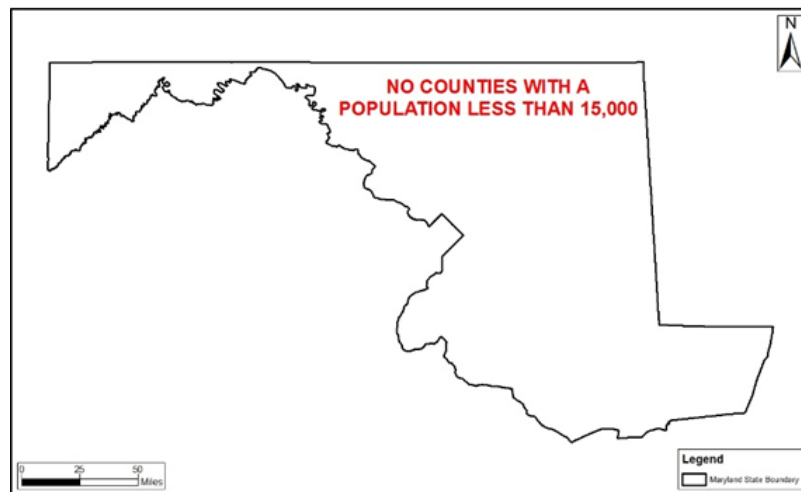
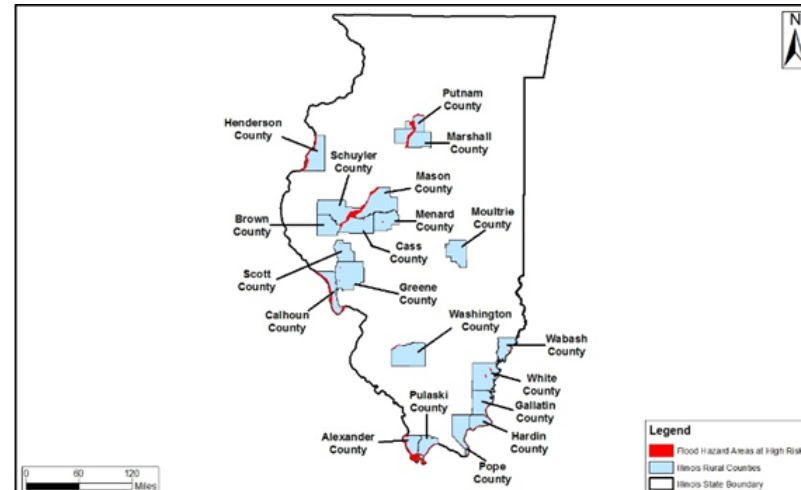
For consistency, I selected all rural counties within the same state of the large urban city. The only outlier was Washington, DC, which is a federal district rather than a city. To account for this, I used Virginia as the state of choice for Washington, DC's, rural counties. Unlike the large urban cities and suburban cities, I used a different layer to find all the counties within each state. The county layer came from the Homeland Infrastructure Foundation-Level Data (HIFLD) online subcommittee. The HIFLD was created "to address improvements in collection, processing, sharing and protection of National geospatial information across multiple levels of government in order to help provide a common foundation for data visualization and analysis."<sup>49</sup> Much of the HIFLD is for official use only (FOUO); however, this particular county dataset was open to the public. When the county layer was inserted into ArcMap, I read through the layer's attributes and noticed that there was no mentioning of the county population.

Because I was labeling all counties with a population of 15,000 or less as rural, I knew that the population should be inserted into the attributes of the layer or shapefile. I navigated to the United States Census Bureau website, which provides annual estimates of resident population for counties from April 1, 2010, to July 1, 2014, in the form of an Excel document.<sup>50</sup> Later, I went into the attributes of ArcMap's state county shapefile and sorted the state county names alphabetically for each state included in the research. I then took the Excel document for the selected state and sorted the county names from A to Z. After making sure that the Excel document county names matched the state county shapefile names in ArcMap, I pasted the Excel document's county population into ArcMap and deleted all counties that did not have a population of less than 15,000 people. Once this was completed, I once again used the intersect tool to delete all rural counties without FEMA's SFHA with high risk layer. All rural counties that met the qualifications were then labeled on ArcMap (see Figure 4).

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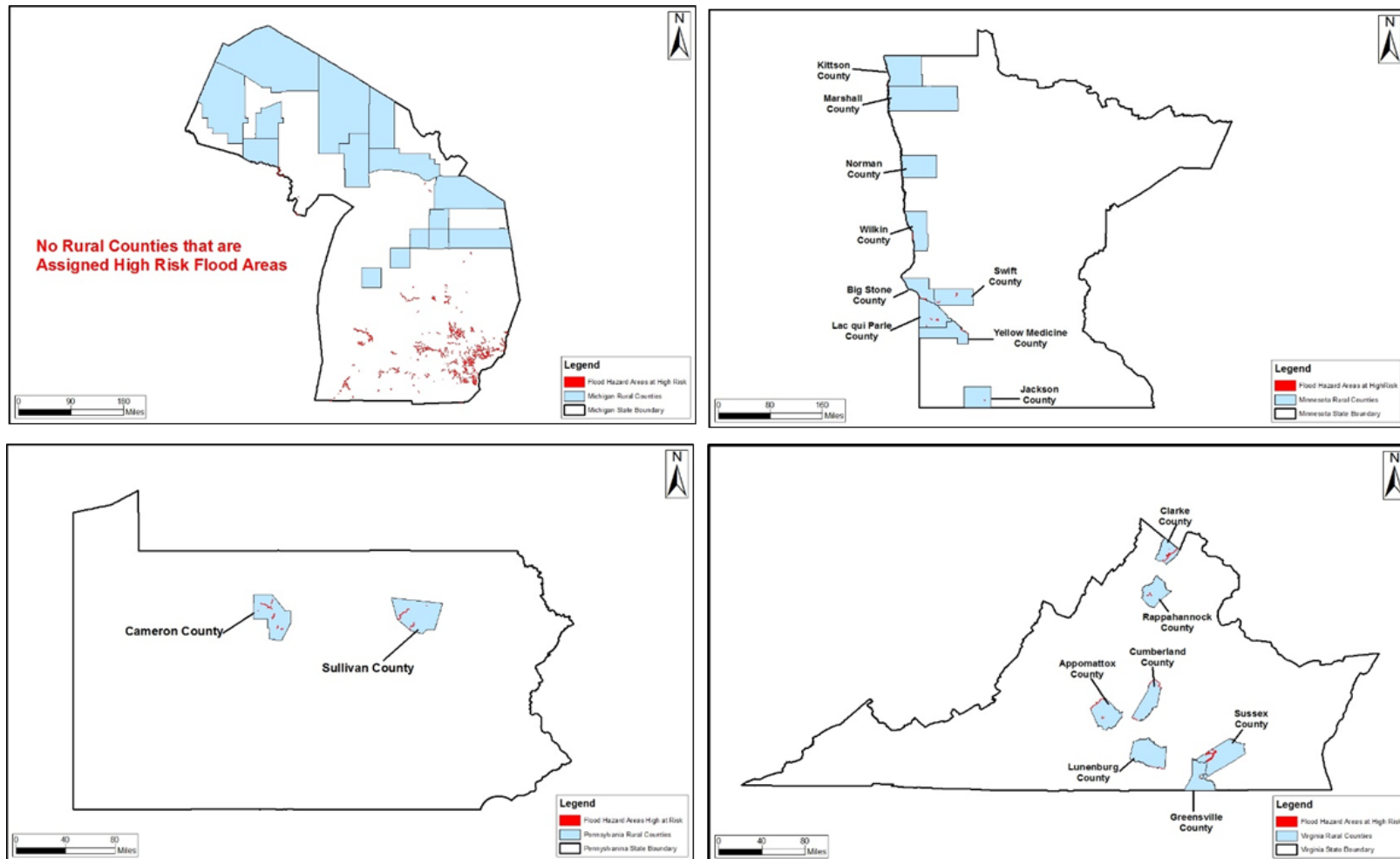
<sup>49</sup> "Homeland Infrastructure Foundation-Level Data (HIFLD)," accessed August 2, 2016, <https://hifld-dhs-gii.opendata.arcgis.com/>.

<sup>50</sup> "Population Estimates: County Totals: Annual," United States Census Bureau, March 26, 2015, <https://www.census.gov/popest/data/counties/totals/2014/CO-EST2014-01.html>.



All rural counties with a population of 15,000 or less are colored in light blue and the SFHA high risks in those counties are presented in red.

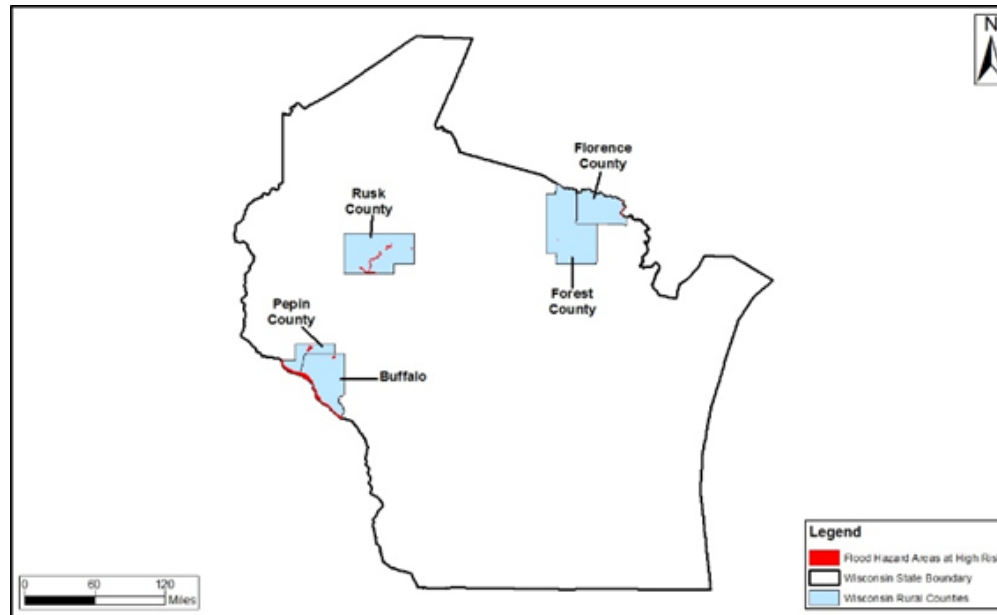
Figure 4. Selected Rural Counties (continued on next page)



Virginia was substituted for Washington, DC. All rural counties with a population of 15,000 or less are colored in light blue and the SFHA high risks in those counties are presented in red.

Figure 4. (cont.) Selected Rural Counties (continued on next page)





All rural counties with a population of 15,000 or less are colored in light blue and the SFHA high risks in those counties are presented in red.

Figure 4. (cont.) Selected Rural Counties

## 2. Comprehensive Plans

Comprehensive plans for each large urban city, suburban city, and rural county with an SFHA high risk were located through various state and local agencies' websites and other online resources and were reviewed for mention of flood mitigation. The results were separated into three sheets—for large urban cities, suburbs, or rural counties—which each contained a chart created with two columns labeled “yes” and “no.” If there was any mention of plans to help mitigate the impact of floods within the document for the large city, suburb, or rural county, a check was placed under “yes.” If there was no mention of flood mitigation strategies, a check was placed in the “no” column. Figures 5 through 20 show all researched large urban cities, suburbs, and rural counties and the checkmarks indicating mention of hazard mitigation as it relates to floods.

City Name	Yes	No
Baltimore, MD	✓	
Boston, MA		✓
Chicago, IL	✓ *Not just Chicago city plan but this is Chicago's Metro Area Plan	
Detroit, IL	✓	
Milwaukee		✓
Minneapolis		✓
Oakland		✓
Philadelphia	✓	
San Jose, CA	✓	
Washington, DC		✓

Figure 5. Large Cities with Flooding Mitigation Plans/Tools in Comprehensive Plans

Baltimore Suburbs	Yes	No
Arbutus, MD		✓
Baltimore Highlands, MD		✓
Brooklyn Park, MD	✓	
Catonsville, MD		✓
Glen Burnie, MD	✓	
Lansdowne, MD		✓
Lochearn, MD		✓
Rosedale, MD		✓
Towson, MD		✓
Woodlawn, MD		✓

Figure 6. Suburban Cities: Baltimore Area Flooding Mitigation Plans/Tools

Boston Suburbs	Yes	No
Cambridge, MA	✓	
Chelsea, MA		✓
Medford, MA	N/A	N/A
Newton, MA	✓	
Quincy, MA	✓	
Revere, MA	N/A	N/A
Somerville, MA	✓	
Waltham, MA	✓	

Figure 7. Suburban Cities: Boston Area Flooding Mitigation Plans/Tools

Chicago Suburbs	Yes	No
Des Plaines, IL	✓	
Elmwood Park, IL	✓	
Forest Park, IL	✓	
Franklin Park, IL	✓	
Niles, IL	✓	
Park Ridge, IL	✓	
River Forest, IL	✓	
River Grove, IL	N/A	N/A
Riverside, IL		✓
Rosemont, IL	✓	
Schiller Park, IL	N/A	N/A

Figure 8. Suburban Cities: Chicago Area Flooding Mitigation Plans/Tools

Detroit Suburbs	Yes	No
Dearborn , MI		✓
Dearborn, Heights MI	N/A	N/A
Ecorse, MI		✓
Farmington Hills, MI	✓	
Farmington, MI	✓	
Lincoln Park, MI		✓
Redford, MI	N/A	N/A
Southfield, MI	✓	

Figure 9. Suburban Cities: Detroit Area Flooding Mitigation Plans/Tools

Milwaukee Suburbs	Yes	No
Brookfield, WI	✓	
Brown Deer, WI	✓	
Butler, WI	N/A	N/A
Elm Grove, WI	✓	
Green Field, WI	✓	
Greendale, WI	✓	
Menomonee Falls, WI	✓	
Mequon, WI	✓	
Muskego, WI	✓	
New Berlin, WI	✓	
Oak Creek, WI	✓	
Pewaukee, WI	N/A	N/A
River Hills, WI	✓	
Shorewood, WI	N/A	N/A
South Milwaukee, WI	✓	
Sussex, WI	✓	
Waukesha, WI	✓	
Wauwatosa, WI	✓	
West Allis, WI	✓	

Figure 10. Suburban Cities: Milwaukee Area Flooding Mitigation Plans/Tools

Minneapolis Suburbs	Yes	No
Bloomington, MN	✓	
Eagan, MN	✓	
Mendota Heights, MN	✓	
Saint Paul, MN		✓

Figure 11. Suburban Cities: Minneapolis Area Flooding Mitigation Plans/Tools

Oakland Suburbs	Yes	No
Lafayette, CA	✓	
Moraga, CA	✓	
Orinda, CA	✓	
San Leandro, CA	✓	

Figure 12. Suburban Cities: Oakland Area Flooding Mitigation Plans/Tools

Philadelphia Suburbs	Yes	No
Aldan, PA	✓	
Bellmawr, NJ	N/A	N/A
Clifton Heights, PA	✓	
Collingdale, PA	✓	
Collingswood, NJ	N/A	N/A
Colwyn, PA	✓	
Darby, PA	✓	
Gloucester City, NJ		✓
Lansdowne, PA	✓	
Oaklyn, NJ	N/A	N/A
Palmyra, NJ	N/A	N/A
Paulsboro, NJ	N/A	N/A
Sharon Hill, PA	✓	
Yeadon, PA		✓

Figure 13. Suburban Cities: Philadelphia Area Flooding Mitigation Plans/Tools

Washington DC Suburbs	Yes	No
Arlington, VA	✓	
Bethesda, MD	✓	
Falls Church, VA	✓	
Silver Spring, MD		✓

Figure 14. Suburban Cities: Washington, DC, Area Flooding Mitigation Plans/Tools

Wisconsin Rural Counties	Yes	No
Buffalo County	✓	
Florence County	N/A	N/A
Forest County	✓	
Pepin County	✓	
Rusk County	✓	

Figure 15. Rural Counties: Wisconsin Flooding Mitigation Plans/Tools

California Rural Counties	Yes	No
Modoc County	✓	
Mono County	✓	
Trinity County	✓	

Figure 16. Rural Counties: California Flooding Mitigation Plans/Tools

Minnesota Rural Counties	Yes	No
Big Stone County	✓	
Jackson County	✓	
Kittson County	N/A	N/A
Lac qui Parle County	N/A	N/A
Marshall County		✓
Norman County	✓	
Swift County		✓
Wilkin County	N/A	N/A
Yellow Medicine County	N/A	N/A

Figure 17. Rural Counties: Minnesota Flooding Mitigation Plans/Tools



Pennsylvania Rural Counties	Yes	No
Cameron County		✓
Sullivan County		✓

Figure 18. Rural Counties: Pennsylvania Flooding Mitigation Plans/Tools

Virginia Rural Counties	Yes	No
Appomattox County		✓
Clarke County	✓	
Cumberland County		✓
Greensville County		✓
Lunenburg County	N/A	N/A
Rappahannock County		✓
Sussex County	N/A	N/A

Figure 19. Rural Counties: Virginia Flooding Mitigation Plans/Tools

<b>Illinois Rural Counties</b>	<b>Yes</b>	<b>No</b>
Alexander County	N/A	N/A
Brown County	N/A	N/A
Calhoun County	N/A	N/A
Cass County	N/A	N/A
Gallatin County	N/A	N/A
Greene County	N/A	N/A
Hardin County	N/A	N/A
Henderson County	N/A	N/A
Marshall County	N/A	N/A
Mason County	✓	
Menard County	✓	
Moultrie County	N/A	N/A
Pope County	N/A	N/A
Pulaski County	N/A	N/A
Putnam County	✓	
Schuyler County	N/A	N/A
Scott County	N/A	N/A
Wabash County	N/A	N/A
Washington County	✓	
White County	N/A	N/A

Figure 20. Rural Counties: Illinois Flooding Mitigation Plans/Tools

### **III. COMMONALITIES AMONG STATES WITH A HIGH PERCENTAGE OF FLOODING HAZARD MITIGATION DISCUSSION IN COMPREHENSIVE PLANS**

This chapter discusses the commonalities of those comprehensive plans that include discussion of hazard mitigation as it relates to floods. This does not, however, include detailed descriptions of how an area adjacent to a flood zone should combat a flooding disaster. For the purpose of this research, the only requirement was that the plan mentioned mitigation of floods or infrastructure near or adjacent to a floodplain or an area susceptible to flooding.

#### **A. INTRODUCTION**

As mentioned in the previous chapter, the analysis was separated into three sections: large urban cities, suburban cities, and rural counties. Each large urban city is directly related to the suburban cities and rural counties. Each urban large city, suburban city, and rural city was separated by state with the exception of Washington, DC, and Philadelphia, Pennsylvania; Washington, DC's, suburbs are located in Maryland and Virginia, and Philadelphia's suburbs are located in both Pennsylvania and New Jersey. Due to the small number of comprehensive plans in New Jersey, further analysis into the state of New Jersey was deemed unnecessary.

Figure 21 shows the percentage of comprehensive plans that include some form of hazard mitigation, separated by state.

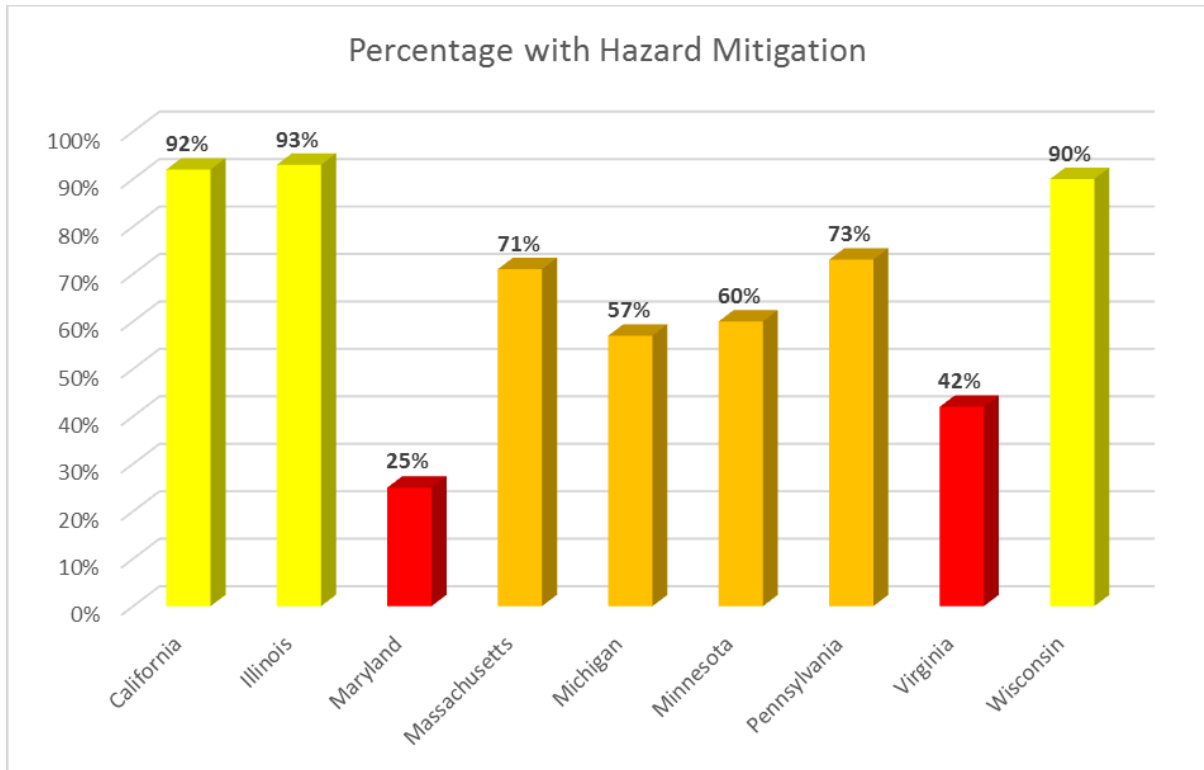


Figure 21. Comprehensive Plans Including Hazard Mitigation, by State

Illinois, California, and Wisconsin have an overwhelmingly higher percentage of urban large cities, suburban cities, and rural counties whose comprehensive plans include hazard mitigation related to floods. In contrast, Maryland and Virginia top out with only 40 percent of large urban cities, suburban cities, and rural counties that mention flood hazard mitigation in their comprehensive plans.

For the higher-percentage states (Illinois, California, and Wisconsin), I examined the plans for commonalities in verbiage.

## **B. HIGH-PERCENTAGE STATES**

### **1. Illinois**

#### ***a. Large Urban City***

##### **Chicago, Illinois**

Chicago is considered a large city with a population of approximately 2,720,546, according to recent census estimates.<sup>51</sup> Chicago's *Go to 2040 Comprehensive Regional Plan* vastly differs from other plans as it not only focuses on Chicago proper but the entire metropolitan area. However, for the sake of the research goals and topic, *Go to 2040* has been included as a large urban city comprehensive plan. To start, the plan's top priority is the "conservation of energy and water."<sup>52</sup> This, in return, has a positive effect for flood-related hazard mitigation through Chicago's building practices. The plan indicates that "conservation of energy and water and reduction of flooding can also be accomplished by using principles of conservation design, green building design, or low-impact development."<sup>53</sup> Like many of the comprehensive plans discussed in this thesis, Chicago's calls for current floodplain regions to be labeled open space; however, that is only for currently undeveloped areas. Within the comprehensive plan it is discovered that "major flooding [is] the most common type of natural disaster that threatens the Chicago region."<sup>54</sup> Chicago has many older-settled communities in flood zones, and urban planners and policy makers find it difficult to invest in these previously built neighborhoods. In this light, the comprehensive plans states that "storm water management is increasing in importance."<sup>55</sup> In addition to accounting for established areas, the comprehensive plan also calls for architects and constructors to be fully aware of their area of interest's potential to flood. The plan states, "Implementers should be aware of flood risks when planning and designing infrastructure; flooding in our region is

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<sup>51</sup> "QuickFacts: Chicago City, Illinois," United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/1714000](http://www.census.gov/quickfacts/table/PST045215/1714000).

<sup>52</sup> Chicago Metropolitan Agency for Planning (CMAP), *Go to 2040 Comprehensive Regional Plan* (Chicago: CMAP, 2010), 15, <http://www.cmap.illinois.gov/about/2040>.

<sup>53</sup> *Ibid.*, 38.

<sup>54</sup> *Ibid.*, 45.

<sup>55</sup> *Ibid.*

expected to increase in the future due to the impacts of climate change, which may require different design approaches or avoidance of floodplains altogether.”<sup>56</sup> Lastly, the comprehensive plan concludes by providing flood mitigation tactics to Chicago community stakeholders and homeowners.<sup>57</sup>

***b. Suburban Cities of Chicago, Illinois***

**Des Plaines, Illinois**

Des Plaines, Illinois, sits northeast of Chicago with a population of 58,677, according to recent census estimates.<sup>58</sup> Des Plaines’s urban planners have experience with flooding and have noticed particular problems in certain parts of town. For example, the comprehensive plan states, “Flood control is a major concern for properties on the east side of the City and, until resolved, will affect the quality of life for residents.”<sup>59</sup> Des Plaines first provides an example of flood hazard mitigation through designating “floodplain [regions] for recreational opportunities.”<sup>60</sup> Like Chicago proper, Des Plaines also has the challenge of mitigating floods whose built environment is located within a floodplain region. In order to combat this issue, “the Rand Park Flood Control and Multi-Use Trail project was proposed.”<sup>61</sup> This project includes a, “48 foot culvert under the Union Pacific Railroad, construction of a gated closure structure and pump station on Farmers Creek immediately upstream of the Union Pacific Railroad, a floodwall between the railroad and Dempster Avenue, environmental mitigation, floodwalls, levees and a multi-use trail.”<sup>62</sup>

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<sup>56</sup> CMAP, *Go to 2040*, 361.

<sup>57</sup> *Ibid.*, 402.

<sup>58</sup> “QuickFacts: Des Plaines, Illinois,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045214/1719642/embed/accessible](http://www.census.gov/quickfacts/table/PST045214/1719642/embed/accessible).

<sup>59</sup> City of Des Plaines, Illinois, *Comprehensive Plan* (Kansas City, MO: HNTB Corporation, 2007), 12, [http://www.desplaines.org/development/comm\\_plann/default.htm](http://www.desplaines.org/development/comm_plann/default.htm).

<sup>60</sup> *Ibid.*, 16.

<sup>61</sup> *Ibid.*, 62.

<sup>62</sup> *Ibid.*

### **Elmwood Park, Illinois**

Elmwood Park is west of Chicago and has a population of 24,840.<sup>63</sup> Like many plans, Elmwood Park's discusses "frequently flooded parcels that would be suitable for as open space and/or water detention areas."<sup>64</sup> Unfortunately, there have been countless examples of problematic floods in Elmwood Park. In the comprehensive plan it is mentioned that "numerous homes have been damaged by flooding, and other Village and non-Village resources and infrastructure have been damaged including roadways."<sup>65</sup> In this light, a flood mitigation study was conducted in 1997.<sup>66</sup> According to the comprehensive plan, "As a result, of [the] 1997 Flood Mitigation Study, five storage vaults were constructed between 2000 and 2005, which provided approximately 0.77 acre-feet of storage. A 2009 Flood Mitigation Study update recommended seven additional storage vaults totaling 5.24 acre-feet of storage."<sup>67</sup> This is an example of separate documents within a city's comprehensive plan focusing strictly on flood mitigation. Elmwood Park's comprehensive plan often mentions the flood mitigation study and echoes its findings with suggested implementations. Needless to say, the plan has recommendations completely dedicated to flood mitigation. Comprehensively, several GIS maps are included that detail the specific streets that would be affected as the result of a 100-year flood event.

### **Forest Park, Illinois**

Forest Park is west of Chicago and has a population of 14,123.<sup>68</sup> Within its comprehensive plan, Forest Park mentions the Village Zoning Ordinance, which contains directives for the Village of Forest Park.<sup>69</sup> Within this ordinance, "flood control is

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<sup>63</sup> "QuickFacts: Elmwood Park, Illinois," United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045216/1723724](http://www.census.gov/quickfacts/table/PST045216/1723724).

<sup>64</sup> CMAP, *Village of Elmwood Park Comprehensive Plan* (Chicago: CMAP, 2013), 49, [www.cmap.illinois.gov/programs-and-resources/ita/elmwood-park](http://www.cmap.illinois.gov/programs-and-resources/ita/elmwood-park).

<sup>65</sup> *Ibid.*, 48.

<sup>66</sup> *Ibid.*

<sup>67</sup> *Ibid.*

<sup>68</sup> "QuickFacts: Forest Park village, Illinois," United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/1726935](http://www.census.gov/quickfacts/table/PST045215/1726935).

<sup>69</sup> "Forest Park, Illinois Village Code," Village of Forest Park, March 13, 2017, [http://www.sterlingcodifiers.com/codebook/m\\_index.php?book\\_id=422](http://www.sterlingcodifiers.com/codebook/m_index.php?book_id=422).

addressed in order “to ensure the Village’s continued participation in national flood insurance programs and to minimize ... losses due to potential floods.”<sup>70</sup> Though I was not able to find this particular law within Forest Park’s zoning ordinance, the comprehensive plan mentions a law that helps diminish any future flooding by stating, “All new buildings and substantial improvements in the floodplain must be elevated two feet above the 100-year flood.”<sup>71</sup> Forest Park has also suggested participation in the “Illinois Urban and Community State Forestry Program,” which trains residents to use the natural environment to mitigate the increasing concern of urban flooding.<sup>72</sup>

### **Franklin Park, Illinois**

Franklin Park is directly south of the Chicago O’Hare airport and has a population of 18,312.<sup>73</sup> Little is mentioned within Franklin Park’s comprehensive plan concerning hazard mitigation, but the city does address the issue of flooding. One such example is the suggestion of the use of “trail systems” to help reduce the need for impervious surfaces which inadvertently contribute to possible flooding.<sup>74</sup>

### **Niles, Illinois**

Niles, Illinois, is northeast of Chicago and has a population of about 29,876.<sup>75</sup> Niles Village’s comprehensive plan has extensive data concerning hazard mitigation related to floods. This in particular has do with a major flooding event that occurred in September of 2008. This was ’Niles’s 100-year flood and cost the town over 2 million in repairs.<sup>76</sup> According to the comprehensive plan, “it had been estimated the flood impacted 10–15% of ‘ground level’ homes, [and in response] the Mayor appointed

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<sup>70</sup> Village of Forest Park, *Picture Yourself Here: Village of Forest Park Comprehensive Plan 2014* (Forest Park, IL: Village of Forest Park), 61, <http://www.forestpark.net/dfp/node/343>.

<sup>71</sup> Ibid., 62.

<sup>72</sup> Ibid., 111.

<sup>73</sup> “QuickFacts: Franklin Park, Illinois,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/1727702](http://www.census.gov/quickfacts/table/PST045215/1727702).

<sup>74</sup> Village of Franklin Park, *Village of Franklin Park Comprehensive Plan* (Franklin Park, IL: Village of Franklin Park, 2005), 38, [http://www.villageoffranklinpark.com/assets/1/19/Comprehensive\\_Plan.pdf](http://www.villageoffranklinpark.com/assets/1/19/Comprehensive_Plan.pdf).

<sup>75</sup> “QuickFacts: Niles, Illinois,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/1753000](http://www.census.gov/quickfacts/table/PST045215/1753000).

<sup>76</sup> Village of Niles, *NILES 2030 Comprehensive Plan* (Chicago: Houseal Lavigne Associates, 2011), 50, <http://www.vniles.com/DocumentCenter/View/2464>.



[a flood] Commission shortly after the flood disaster recovery operations began.”<sup>77</sup> Not only did this event encourage flood-related hazard mitigation within the comprehensive plan, participatory planning encouraged focusing on floods; many of the residents of Niles “revealed concerns about storm water infrastructure and flooding in the village.”<sup>78</sup> In fact, the residents proclaimed that “flooding was the [single] item liked least about [Niles].”<sup>79</sup> In response, the comprehensive plan speaks of a “Village-wide Storm water Master Plan, addressing flooding issues with a share cost program, amending the zoning ordinance and zoning map to restrict development in areas prone to flooding, and ensuring zoning regulations protect and support floodplains.”<sup>80</sup> This comprehensive plan is a perfect example of how participatory planning can effect emphasis on hazard mitigation.

### **Park Ridge, Illinois**

The City of Park Ridge has a population of approximately 37,757, according to the United States Census Bureau.<sup>81</sup> Very little is mentioned concerning flood-related hazard mitigation in the city’s comprehensive plan with the exception of one statement, in which the plan calls for “the encouragement and support for local and regional flood control project and measures.”<sup>82</sup>

### **River Forest, Illinois**

River Forest is a suburb west of Chicago and has a population of 11,199.<sup>83</sup> Not much concerning flood-related hazard mitigation is mentioned within River Forest’s comprehensive plan. The main methodology for flooding mitigation is controlling the sewage system. The current sewage system combines city-owned sewers, interceptors,

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<sup>77</sup> Village of Niles, *NILES 2030 Comprehensive Plan*, 50.

<sup>78</sup> *Ibid.*, 9.

<sup>79</sup> *Ibid.*, 15.

<sup>80</sup> *Ibid.*, 9, 12, 25.

<sup>81</sup> “QuickFacts: Park Ridge, Illinois,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045216/1757875](http://www.census.gov/quickfacts/table/PST045216/1757875).

<sup>82</sup> City of Park Ridge, Illinois, *Comprehensive Plan for the City of Park Ridge* (Evanston, IL: Teska Associates, 1996), 13, [http://www.parkridge.us/community\\_preservation\\_and\\_development/default1.aspx](http://www.parkridge.us/community_preservation_and_development/default1.aspx).

<sup>83</sup> “QuickFacts River Forest, Illinois,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045216/1764304](http://www.census.gov/quickfacts/table/PST045216/1764304).

lift stations, and treatment plants.<sup>84</sup> These combined systems “encourage ... effective flood control measures where overhead sewers are not responsible.”<sup>85</sup> In addition, this system controls the flows of water to reduce basement flooding.<sup>86</sup> The plan does not call for innovative measures to limit flooding; however, since flood mitigation was included within its plan, River Forest was included in the research.

### **Rosemont, Illinois**

Rosemont’s population is quite small compared to the aforementioned Chicago suburbs, with a population of just 4,202.<sup>87</sup> The City of Rosemont has extensive approaches for combating flooding. This may be due to a large amount of the city’s property sitting on a 100-year floodplain, where “Willow Creek and Des Plaines River cover several commercial properties [where] flooding remains a recurring issue.”<sup>88</sup> Unfortunately, as extrapolated from the hazard mitigation review within their plan, construction was approved within a floodplain which only accentuated flooding issues within the region. The document explains how “several new large-scale developments ... have increased impervious surfaces communitywide, [where] storm water management is a priority issue for the Village.”<sup>89</sup> Also, like other cities, Rosemont residents have “identified flooding as a major concern.”<sup>90</sup> In fact, flooding was ranked number three out of the top six items planners were going to address.<sup>91</sup> Rosemont also encourages involvement by asking citizens to join the Center for Neighborhood Technology’s RainReady program. This program “provides resources and assistance for individuals and communities to become more resilient to flooding,” and “can serve as a resource or

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<sup>84</sup> Village of River Forest, *Comprehensive Plan Village of River Forest* (Chicago: Trkla, Pettigrew, Allen & Payne, Inc., 2003), 31.

<sup>85</sup> *Ibid.*, 13.

<sup>86</sup> *Ibid.*, 31.

<sup>87</sup> “2010 Census Population of Rosemont, IL,” Census Viewer, accessed August 1, 2017, <http://censusviewer.com/city/IL/Rosemont/2010>.

<sup>88</sup> CMAP, *Rosemont Comprehensive Plan* (Chicago: CMAP, 2015), 12, <http://www.cmap.illinois.gov/programs-and-resources/ita/rosemont>.

<sup>89</sup> *Ibid.*

<sup>90</sup> *Ibid.*, 82.

<sup>91</sup> *Ibid.*, 71.

model for engagement.”<sup>92</sup> Though the RainReady program’s target audience is homeowners, Rosemont plans to get businesses involved as well.

Due to residents’ and urban planners’ concern for flooding, many procedures have been and will be enacted to resolve flooding issues within the city. In the past, Rosemont created a “5,000 foot flood wall, storm water pumping stations, and a reservoir at Chicago O’Hare Airport, all to no avail.”<sup>93</sup> More recently, Rosemont has incorporated green infrastructure practices.<sup>94</sup> According to the Environmental Protection Agency, “Green infrastructure is a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits ... it is designed to move urban storm water away from the built environment.”<sup>95</sup> It is Rosemont’s belief that green infrastructure will help lessen runoff and create better resistance to help mitigate flooding. In addition, new regulatory statements will be introduced to minimize the amount of impervious surfaces near waterways.<sup>96</sup>

### ***c. Illinois Rural Counties***

#### **Mason County, Illinois**

Mason County has been designated as a rural county for the sake of this research. The county of Mason has a population 13,701 and is located in central Illinois.<sup>97</sup> Its comprehensive plan consists of zoning orders that deal with hazard mitigation processes. One regulation in particular controls the amount of development that is allowed within a floodplain. This regulation is known as the “Ordinance Regulating Development in Flood Plain Areas,” and was adopted in February of 2005.<sup>98</sup> Within the zone ordinance plan

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<sup>92</sup> CMAP, *Rosemont Comprehensive Plan*, 45.

<sup>93</sup> *Ibid.*, 12.

<sup>94</sup> *Ibid.*

<sup>95</sup> “What Is Green Infrastructure?” Environmental Protection Agency, accessed August 1, 2017, <https://www.epa.gov/green-infrastructure/what-green-infrastructure>.

<sup>96</sup> CMAP, *Rosemont Comprehensive Plan*, 12.

<sup>97</sup> “QuickFacts: Mason County, Illinois,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/17125](http://www.census.gov/quickfacts/table/PST045215/17125).

<sup>98</sup> “Zoning Ordinance Mason County, Illinois,” Mason County, accessed August 1, 2017, 33, [http://www.masoncountyil.org/Zoning\\_Ordinance.pdf](http://www.masoncountyil.org/Zoning_Ordinance.pdf).

there is a list of methods to limit flooding.<sup>99</sup> In addition, the planning department is aware of the housing makeup of a jurisdiction. Mason County has mobile home parks within its boundary, therefore focuses on making sure that “all land proposed for mobile home parks are adequately protected against flooding.”<sup>100</sup> This is clear planning in which zoning laws greatly influence the protection of those who live in mobile homes.

### **Menard County, Illinois**

Menard County, Illinois, is directly north of Springfield, Illinois, has a population of 12,516, and for this research has been classified as a rural county.<sup>101</sup> Menard County’s comprehensive plan has a dedicated section explaining in detail what FEMA’s floodplain is and its purpose. FEMA’s designated floodplain zone has assisted Menard County in determining where to allow housing.<sup>102</sup> According to the comprehensive plan, the county’s goal is to “keep housing out of the 100-year floodplain [to] protect people and their property and preserve rich soil for agricultural use while enhancing a habitat for plants and animals.”<sup>103</sup> The planning department’s goal is to not only focus on where a floodplain is, but also the “frequency of inundation [to know] appropriate activities and development,” which will allow Menard County to be an even more prepared county.<sup>104</sup>

### **Putnam County, Illinois**

Putnam County has been classified as a rural county in Illinois with a population of only 5,611 citizens.<sup>105</sup> The county has few, but important, methods of hazard mitigation related to floods. For example, the county encourages community involvement by “promoting [stakeholders] and private investors to convert floodplains to

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<sup>99</sup> “Zoning Ordinance Mason County, Illinois,” Mason County, 33.

<sup>100</sup> Ibid., 75.

<sup>101</sup> “QuickFacts: Menard County, Illinois,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/17129](http://www.census.gov/quickfacts/table/PST045215/17129).

<sup>102</sup> Menard County Illinois, *Comprehensive Plan of Menard County: A Center of Lincoln’s Illinois* (Petersburg, IL: Menard County Illinois, 1997), 13–14, [http://menardcountyil.org/files/1614/3534/0616/Comprehensive\\_Plan\\_Of\\_Menard\\_County.pdf](http://menardcountyil.org/files/1614/3534/0616/Comprehensive_Plan_Of_Menard_County.pdf).

<sup>103</sup> Ibid., 7.

<sup>104</sup> Ibid., 13.

<sup>105</sup> “QuickFacts: Putnam County, Illinois,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/17155](http://www.census.gov/quickfacts/table/PST045215/17155).

wetlands.”<sup>106</sup> This community involvement should naturally encourage citizens to work toward a less flood-prone environment. In addition, local policy has been enacted to “restrict or prohibit development in high quality natural areas and the 100 year flood plain.”<sup>107</sup> Putnam also mentions the possibility of using federal funds to assist citizens whose properties experience constant flooding by “applying for Pre Disaster Mitigation (PDM).”<sup>108</sup> The plan also suggests “retrofitting buildings with safe rooms and/or tie-downs.”<sup>109</sup> These suggestions do not simply provide information to the county’s residents; they give residents the opportunity to research additional alternatives if flooding is a constant issue on their property.

### **Washington County, Illinois**

According to the United States Census Bureau, Washington County, Illinois, has a population of 14,716.<sup>110</sup> Washington County mentions the commonly practiced method for flood-prone areas to be designated open space and discourages development in floodplains.<sup>111</sup>

## **2. California**

### **a. Large Urban City**

#### **San Jose, California**

San Jose has had flooding issues in the past. In response, a general plan known as “General Plan ‘75” was created in 1975.<sup>112</sup> The history of flooding in San Jose’s Santa

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<sup>106</sup> Putnam County, *Putnam County Comprehensive Plan 2010* (Ottawa, IL: North Central Council of Governments, 2010), 4:14, [http://www.pcschools535.org/pages/uploaded\\_files/Putnam-county-comp-plan2010.pdf](http://www.pcschools535.org/pages/uploaded_files/Putnam-county-comp-plan2010.pdf).

<sup>107</sup> Ibid.

<sup>108</sup> Ibid., 11:10.

<sup>109</sup> Ibid.

<sup>110</sup> “QuickFacts: Washington County, Illinois,” United States Census Bureau, April 1, 2010, [www.census.gov/quickfacts/table/PST045216/17189](http://www.census.gov/quickfacts/table/PST045216/17189).

<sup>111</sup> Washington County, Illinois, *Comprehensive Plan* (Collinsville, IL: Southwestern Illinois Planning Commission, 2016), 29, 40, <http://washingtonco.illinois.gov/wp-content/uploads/2016/07/WashCoDraftComprehensivePlan.pdf>.

<sup>112</sup> City of San Jose, *Envision San José 2040: General Plan* (San Jose, CA: City of San Jose, 2011), 38, <http://www.sanjoseca.gov/DocumentCenter/Home/View/474>.

Clara Valley has continually resulted in loss of life and property.<sup>113</sup> The city initiated hazard mitigation declarations by refusing to increase development in designated areas; this is a common theme among several plans discussed in this thesis. For example, San Jose's plan states, "The city shall require evaluation of flood hazards prior to approval of development projects within a Federal Emergency Management Agency (FEMA) designated floodplain."<sup>114</sup> The plan also call for planners to "review new development and substantial improvements to existing structures to ensure it is designed to provide protection from flooding with a one percent annual chance of occurrence, commonly referred to as the '100-year' flood or whatever designated benchmark FEMA may adopt in the future."<sup>115</sup> San Jose's methodology includes describing different design proposals, such as "projects to minimize potential damage due to storm waters and flooding to the site and other properties."<sup>116</sup> Additional procedures of hazard mitigation for San Jose include the preservation of "designated floodway areas for non-urban uses."<sup>117</sup> Since floodways are commonly used to sidetrack flood routes, the city of San Jose is using proactive techniques in the building processes.

San Jose's office of planning works with other agencies within the city to help mitigate possible flooding issues. One such example is the planning agency's relationship with the Santa Clara Valley Water District, where the two "develop flood control facilities ... to protect areas from the occurrence of the 1% or 100-year flood or less frequent flood events when required by the State."<sup>118</sup> This shows that state and local governments can effectively encourage cities to include hazard mitigation in their plans. The federal government is also a motivational factor. This is evident in San Jose's proposal, which advocates following FEMA guidelines for construction in SFHAs, and

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<sup>113</sup> City of San Jose, *Envision San José 2040*, 46

<sup>114</sup> Ibid.

<sup>115</sup> Ibid.

<sup>116</sup> Ibid., 56.

<sup>117</sup> Ibid., 47.

<sup>118</sup> Ibid.

regularly updating of the city's flood hazard regulations according to FEMA guidance.”<sup>119</sup>

The *Envision San José 2040: General Plan* mentions two equal halves of the hazard mitigation process: general flooding mitigation plans and practices, and the protection and involvement of San Jose's citizens. For example, the plan states that the city should “prepare and periodically update appropriate emergency plans for the safe evacuation of occupants of areas subject to possible inundation from dam and levee failure and natural flooding,” to include providing “maps with pre-established evacuation routes in dam failure plans.”<sup>120</sup> The plan also mentions educating the general public on best practices for personal protection from flooding. According to the plan, the city should “promote awareness and caution among San José residents regarding possible natural hazards, including soil conditions, earthquakes, flooding, and fire hazards.”<sup>121</sup>

***b. Suburban Cities of San Jose, California***

**Cupertino, California (San Jose)**

Cupertino, California, is a suburb west of San Jose with a population of 60,572.<sup>122</sup> Cupertino's comprehensive plan is separated by chapters with focal subjects. This plan first began to briefly discuss flooding and mitigation, which is now contained in the “Chapter 6: Environmental Resources” section. In this chapter, Cupertino discusses its relationship with the Santa Clara Valley Water District and summarizes its work with other unnamed agencies to control flooding. In this plan, Cupertino proclaims that it will “work with the Santa Clara Valley Water District and other relevant regional agencies to enhance riparian corridors and provide adequate flood control by use of flow increase mitigation measures.”<sup>123</sup> Chapter 7 is designated as the “Health and Safety” section of

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<sup>119</sup> City of San Jose, *Envision San José 2040*, 48.

<sup>120</sup> *Ibid.*, 47.

<sup>121</sup> *Ibid.*, 41.

<sup>122</sup> “QuickFacts: Cupertino City, California,” United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045216/0617610>.

<sup>123</sup> City of Cupertino, *Cupertino General Plan Community Vision 2015–2040* (Cupertino, CA: City of Cupertino, 2014), ES-27, <http://www.cupertino.org/our-city/departments/community-development/planning/general-plan/general-plan>.

the comprehensive plan. Throughout the chapter there are several designated hazards associated with the city's health and safety. According to the plan, the most common form of flooding in Cupertino is flooding due to rain; however, the plan provides two graphics showing the potential state of the city if its reservoir—known as the Stevens Creek Reservoir—were to fail, as well as the FEMA-designated 100-year flood plain. That maps show which people and businesses will be directly affected by the events. Figure 22 shows the impact on the city if the Stevens Creek Reservoir were to fail based on its maximum 3,700-acre storage capacity. Figure 23 shows the impact of flooding based on the city's 100-year flood plain.

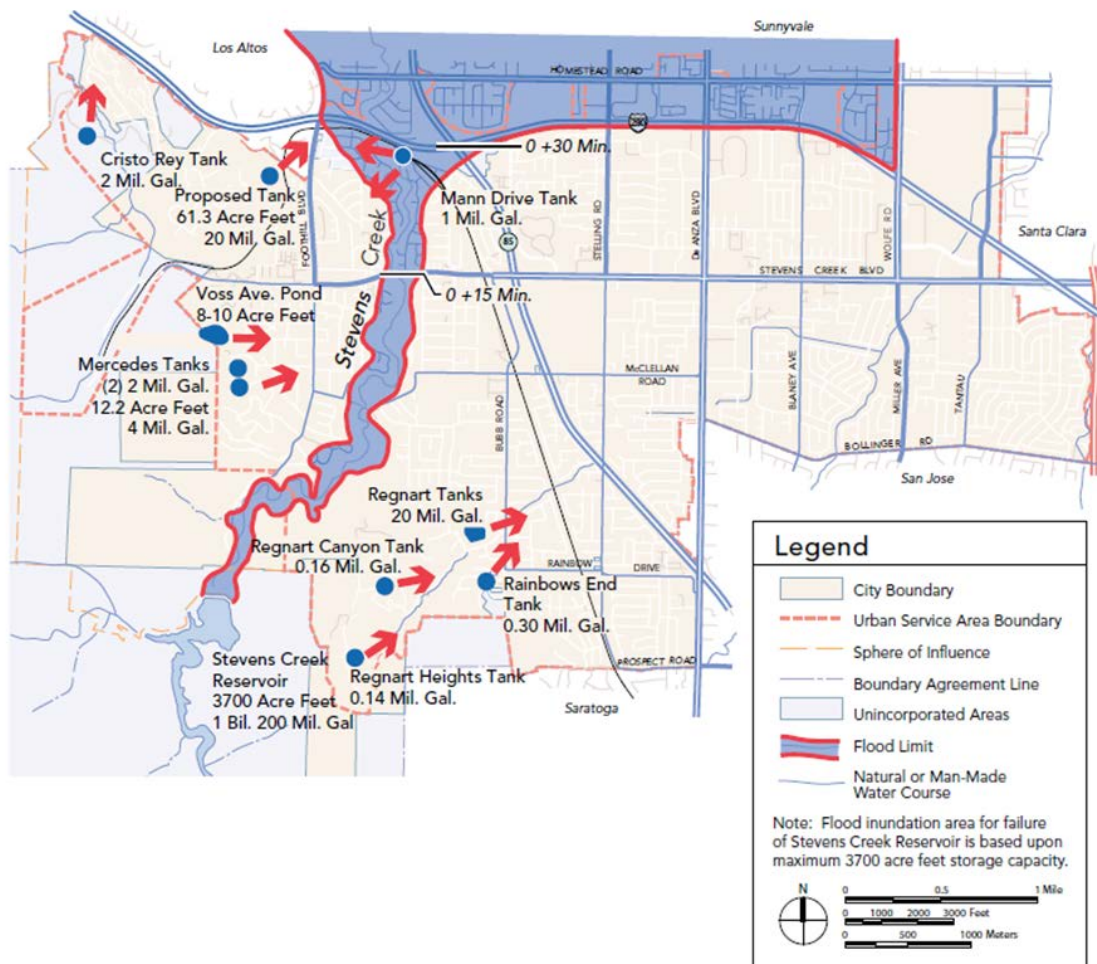


Figure 22. Impact of Stevens Creek Reservoir Failure in Cupertino<sup>124</sup>

<sup>124</sup> Source: City of Cupertino, *Cupertino General Plan*, HS-20.



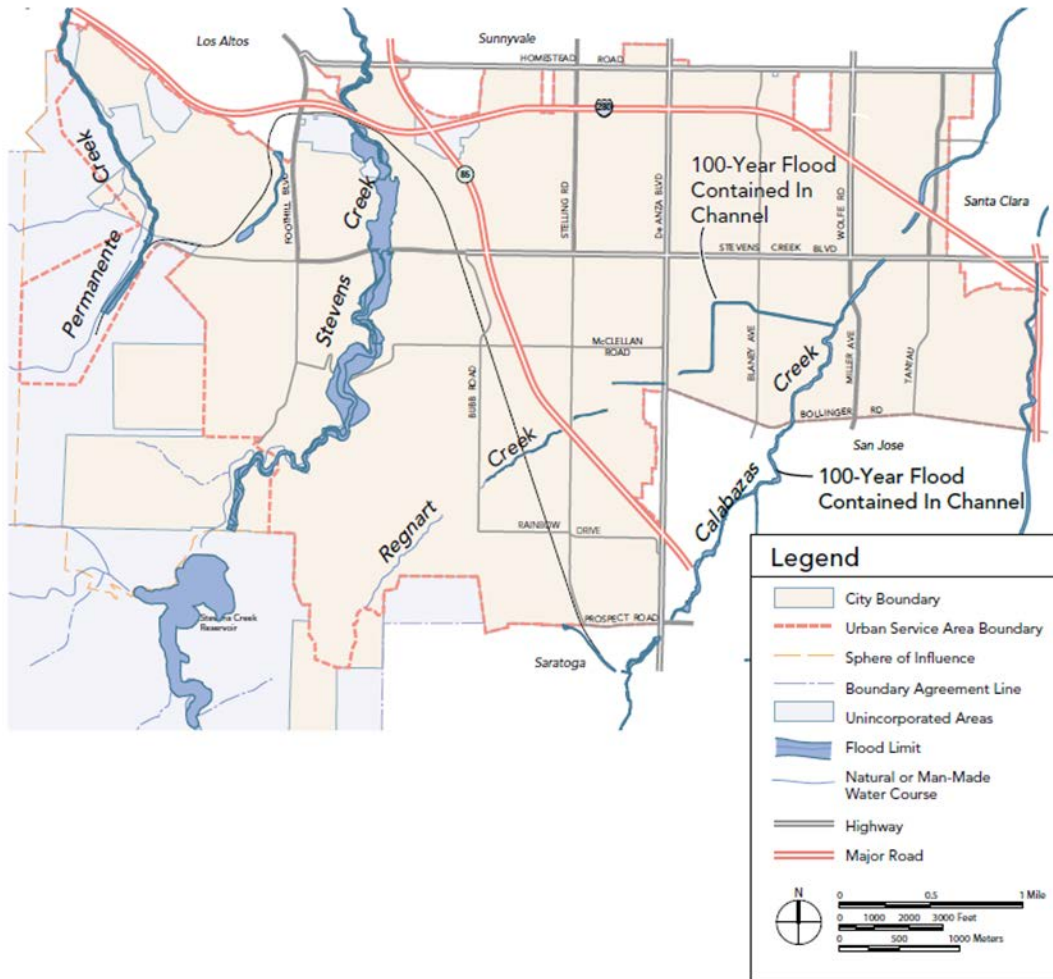


Figure 23. Impact of Flooding in Cupertino based on 100-Year Flood Plain<sup>125</sup>

In Cupertino's description of Figure 23, it states that "structural improvements, while not preferred, may be necessary, to protect properties from a 100-year flood."<sup>126</sup> Cupertino, like many other cities, limits any construction on built environment that has already been categorized as a 100-year flood limit. This has proven to be a common form of hazard mitigation. Cupertino claims the city will achieve this by "discouraging new residential development in natural floodplains" and regulation "all types of redevelopment in natural floodplains. This includes prohibiting fill materials and obstructions that may increase flood potential or modify the natural riparian

<sup>125</sup> Source: City of Cupertino, *Cupertino General Plan*, HS-21.

<sup>126</sup> City of Cupertino, *Cupertino General Plan*, HS-22.

corridors.”<sup>127</sup> Additionally, to monitor which areas are designated for construction, Cupertino also considers the effects of global warming and sea-level rise on the coastal city. The city’s hazard mitigation policies and plans are enacted through discussion of San Francisco Bay sea levels and coordination between state, local, and federal agencies.<sup>128</sup>

Within Cupertino’s comprehensive plan there are also a fair number of policies that require community involvement and communication—a pivotal component of the hazard mitigation process. As a method to shelter residents and infrastructure from flood-related dangers, the city claims it will “prepare and periodically update an evacuation map for the flood hazard areas and distribute it to the general public.”<sup>129</sup> The plan also mentions communicating with neighboring cities and within counties. This interagency process consists of “continuing to coordinate dam-related evacuation plans and alert/notification systems with the City of Sunnyvale and the County to ensure that traffic management between the agencies facilitates life safety” and “working with other neighboring cities to enhance communication and coordination during a dam-related emergency.”<sup>130</sup> By working with neighboring communities, Cupertino can educate its own residents, and also those of neighboring districts and community boundaries.

### **Los Gatos, California (San Jose)**

The town of Los Gatos is a suburb of San Jose with a population of 30,705.<sup>131</sup> Though there is limited information concerning hazard mitigation as it relates to floods in Los Gatos, the town’s general plan does mention flood mitigation. The small amount of flood-related mitigation plans may have to do with Los Gatos having a limited history of trouble with flooding. According to its general plan, “Due to [the town’s] topography and local reservoirs, [Los Gatos] has not been as severely impacted by flooding as nearby

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<sup>127</sup> City of Cupertino, *Cupertino General Plan*, HS-39.

<sup>128</sup> *Ibid.*, HS-28.

<sup>129</sup> *Ibid.*, HS-38.

<sup>130</sup> *Ibid.*

<sup>131</sup> “QuickFacts: Los Gatos, California,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/0644112](http://www.census.gov/quickfacts/table/PST045215/0644112).

communities.”<sup>132</sup> However, a section toward the end of the plan is dedicated to FEMA’s floodplain map and shows a map depicting the areas that sit in 100- and 500-year floodplains. The map clarifies that little of the built environment would be affected.<sup>133</sup> It is Los Gatos’s goal to “reduce the potential for injuries, damage to property economic and social displacement, and loss of life resulting from flood hazards.”<sup>134</sup> To ensure that the city remains a minimal flood area, the city proposes to “limit the intensity of land use in floodplain areas.”<sup>135</sup>

### **Saratoga, California (San Jose)**

Saratoga is located southwest of San Jose and has a population of 30,968.<sup>136</sup> What makes Saratoga different from other cities in this research is that its comprehensive plan is on a continuum from 1983 until November of 2014, covering more than a thirty-year period. Inside the document there is a section entitled “Safety Element,” in which Saratoga includes its local hazard mitigation plan. The safety element section focuses on earthquakes, but earthquakes present a hazard known as seismically induced flooding through dam failure. For example, “Should a dam fail during an earthquake, the released water could cause flooding downstream.”<sup>137</sup> In addition to earthquake-induced flooding, the plan has a section dedicated to natural flood hazards, which is a major concern to Saratoga as “several significant flooding events have occurred in Saratoga, dating back as far as 1914.”<sup>138</sup>

Through Saratoga’s comprehensive plan it is clear that the city has a strong understanding of what accentuates flooding and what the city can do to mitigate the impact of flooding. For example, as mentioned throughout my research, impervious

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<sup>132</sup> Town of Los Gatos, *Los Gatos 2020 General Plan* (Los Gatos, CA: Town of Los Gatos, 2011), SAF-15, <https://www.losgatosca.gov/27/General-Plan>.

<sup>133</sup> Ibid., SAF-13.

<sup>134</sup> Ibid., SAF-15.

<sup>135</sup> Ibid.

<sup>136</sup> “QuickFacts: Saratoga City, California,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/0670280](http://www.census.gov/quickfacts/table/PST045215/0670280).

<sup>137</sup> City of Saratoga, *General Plan and Environmental Impact Report: City of Saratoga* (Saratoga, CA: City of Saratoga, 2004), 19, [http://www.saratoga.ca.us/cityhall/cd/general\\_plan.asp](http://www.saratoga.ca.us/cityhall/cd/general_plan.asp).

<sup>138</sup> Ibid., 25.

surfaces and increased built environment cause more people to be affected by flooding and disrupt the natural runoff process. Saratoga's plan states, "As urban development has increased, damage became a more important consideration as population growth and the completion of water retention facilities in the area combined to alter the pattern of potential flooding."<sup>139</sup> So, as a steward of responsible hazard mitigation planners, the comprehensive plan calls for "anchoring, building with flood resistant materials and elevating and flood proofing, are required within an area of special flood hazard. The plan requires new and replacement water and sanitary sewage systems shall be designed to minimize flood water infiltration and discharge into flood waters. Standards are also inclusion for subdivisions and manufactured homes."<sup>140</sup>

*c. Suburban Cities of Oakland, California*

**Lafayette, California (Oakland)**

The city of Lafayette is located in Contra Costa County and is northeast of Oakland, California. Lafayette's general plan contains an entire chapter dedicated to the city's safety. According to the plan, "the Contra Costa County Flood Control and Water Conservation District's responsibility under State law to develop a coordinated flood control program for the County and to review development projects in Lafayette for their impact on flood risk."<sup>141</sup> In addition, there is a policy directly dedicated to reducing the risk of floods. Flood risk should be reduced, the plan states, by "maintaining effective flood drainage systems and regulating construction."<sup>142</sup> This further shows the importance of state and local policies, which can influence inclusion of hazard mitigation in comprehensive plans. This particular plan not only relies on the guidance of the state and local government, but from the federal government as well. Lafayette utilizes "FEMA's Flood Insurance Rate Map (FIRM) "to reduce risk of flooding, to identify 100

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<sup>139</sup> City of Saratoga, *General Plan and Environmental Impact Report*, 25.

<sup>140</sup> *Ibid.*, 29.

<sup>141</sup> "General Plan," City of Lafayette, October 28, 2002, VI-6, <http://www.lovelafayette.org/city-hall/city-departments/planning-building/general-master-specific-plans/general-plan>.

<sup>142</sup> *Ibid.*

Year Flood Events, to calculate flow rates within identified stream channels, and to review development proposals.”<sup>143</sup>

### **Moraga, California (Oakland)**

According to the United States Census Bureau, Moraga is small town of roughly 17,000 people and sits northeast of Oakland.<sup>144</sup> The town’s initial method of flood hazard mitigation is through information sharing with its citizens. Moraga’s plan calls for educating “streamside property owners regarding potential flooding and streambank erosion hazards, their responsibilities for streambank maintenance and repair, and mitigation measures that may be used to address potential hazards.”<sup>145</sup> In addition, the plan states that “existing structures in flood hazard areas. “require the rehabilitation or removal of structures that are subject to flooding or streambank erosion hazards.”<sup>146</sup> This suggests property along the streamside of the city has either had past problems with flooding or that, through the city’s research, it is evident that flooding is probable. Moraga has also “restricted new development in floodways in accordance with FEMA requirements.”<sup>147</sup> Again, the federal government has a direct influence on the inclusion of hazard mitigation in the comprehensive plan.

### **Orinda, California (Oakland)**

The city of Orinda, California, is northeast of Oakland and has a population of approximately 19,279.<sup>148</sup> According to Orinda’s general plan, it is evident why flooding may be a concern; “three dams regulated by the State of California are located in the Orinda area: San Pablo Dam, a hydraulic fill dam, owned by the East Bay Municipal Utility District (EBMUD); Briones Reservoir, an earthen dam, owned by EBMUD; and

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<sup>143</sup> “General Plan,” City of Lafayette, VI-7.

<sup>144</sup> “QuickFacts: Moraga Town, CA,” United States Census Bureau, April 1, 2010, [www.census.gov/quickfacts/table/PST045215/0649187](http://www.census.gov/quickfacts/table/PST045215/0649187).

<sup>145</sup> Town of Moraga, California, *Moraga 2002 General Plan* (Moraga, CA: Town of Moraga, 2002), 8:11, [http://www.moraga.ca.us/dept/planning/docs/GenPlan/GeneralPlan\\_Complete.pdf](http://www.moraga.ca.us/dept/planning/docs/GenPlan/GeneralPlan_Complete.pdf).

<sup>146</sup> Ibid.

<sup>147</sup> Ibid.

<sup>148</sup> “QuickFacts: Orinda City, CA,” United States Census Bureau, April 1, 2010, [www.census.gov/quickfacts/table/PST045215/0649187](http://www.census.gov/quickfacts/table/PST045215/0649187).

Lake Cascade Dam, an earthen dam, owned by the Orinda Country Club.”<sup>149</sup> The Division of Safety of Dams within the California Department of Water Resources ensures that these organizations maintain the dams through “periodic inspection.”<sup>150</sup> If improvements are needed, the owners are held responsible for correcting all issues. The general plan goes on to explain the importance of the Lake Cascade Dam. If this particular dam were to fail, “flooding would affect additional land, extending almost to downtown Orinda.”<sup>151</sup> This suggests that Orinda included hazard mitigation into its comprehensive plan due to general widespread threat to the city. However, to counter that argument, the document clearly states, “Flooding does not present a significant risk to Orinda, although the potential for local flood damage caused by overtopping creeks during storms does exist.”<sup>152</sup> The most prominent hazard mitigation planning related to flooding, outside of the monitoring of city dams, is the limiting of development in flood-prone areas; the plan states, “Development shall be located away from flood prone areas unless floods risks can be mitigated ... and restricting residential development near creeks, and by requiring drainage studies as part of project approval.”<sup>153</sup> Lastly, the document mentions federal influence, with a plan to begin “[appropriating] floodplain management ordinances and related measures consistent with official HUD flood-hazard boundary maps.”<sup>154</sup>

### **San Leandro, California (Oakland)**

San Leandro is directly south of Oakland and, as of July 2015 estimates, has a population of approximately 90,000 residents.<sup>155</sup> San Leandro has had its fair share of floods, though they were eventually mitigated through planning; “these hazards were greatly reduced during the 1960s and 1970s when the Alameda County Flood Control

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<sup>149</sup> City of Orinda, *City of Orinda General Plan* (Orinda, CA: City of Orinda, 1987), 45, <http://cityoforinda.org/DocumentCenter/Index/139>.

<sup>150</sup> Ibid.

<sup>151</sup> Ibid.

<sup>152</sup> Ibid., 48.

<sup>153</sup> Ibid.

<sup>154</sup> Ibid., 49.

<sup>155</sup> “QuickFacts: San Leandro City, California,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/0668084](http://www.census.gov/quickfacts/table/PST045215/0668084).

and Water Conservation District (ACFCWCD) channelized the lower portions of San Leandro Creek and constructed flood control ditches in the southern part of the city.”<sup>156</sup> However, the threat of flooding did not completely subside. In San Leandro, floods are generally associated with “overbank flooding of creeks and drainage canals, dam, failure, tsunamis and rising sea level.”<sup>157</sup> The flood control channels built in the 1960s and 1970s were initially somewhat beneficial; however, as time has progressed, “urbanization in the watersheds has increased impervious surface area, which has resulted in faster rates of runoff and higher volumes of storm water in the channels.”<sup>158</sup> San Leandro responded by creating a flood plain management ordinance which required that “new construction, additions, and major home improvement projects be raised at least one foot above the base flood elevation—this can be a significant expense for homeowners making alterations to existing structures.”<sup>159</sup>

Not only are the state and local governments heavily invested in mitigating the risk of floods in San Leandro, but the federal government plays a part in the mitigation planning process for the city as well. For example, San Leandro uses FEMA’s flood zone maps, which, according to the comprehensive plan, charge the city to “implement federal requirements relating to new construction in flood plain areas to ensure that future flood risks to life and property are minimized.”<sup>160</sup> The plan also points out policy and actions that require code revisions. These code revisions consist of “revising and updating construction codes and regulations to incorporate the latest available information and technology related to ... flood hazards.”<sup>161</sup>

There is also a great deal of collaboration between agencies for both immediate concerns with flooding and potential future flooding. The General Plan San Leandro’s general states that that city shall “work collaboratively with County, State and federal

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<sup>156</sup> “San Leandro 2035 General Plan,” City of San Leandro, September 19, 2016, 7–10, <http://www.sanleandro.org/civicax/filebank/blobdload.aspx?blobid=26493>.

<sup>157</sup> Ibid.

<sup>158</sup> Ibid., 7-12.

<sup>159</sup> Ibid.

<sup>160</sup> Ibid., 7-45.

<sup>161</sup> Ibid.

agencies to develop short and long term programs that reduce flood hazards in the city. At the local level, the City will regularly maintain its storm drainage system and ensure that those portions of San Leandro Creek under its jurisdiction remain clear of obstructions.”<sup>162</sup> Lastly, a section at the end of the general plan addresses the costs necessary to achieve the plan’s goals, and flood control improvements are placed on the higher end for costs. This again shows the city’s high priority for hazard mitigation related to flooding.

***d. California Rural Counties***

**Modoc County, California**

Older than most observed comprehensive plans, the *Modoc County General Plan* was adopted in September of 1988. With a population of 8,965 citizens, the self-designated rural county is located in the northeast corner of California and borders the state of Oregon.<sup>163</sup> There is not much mentioned in Modoc County’s comprehensive plan concerning flooding and hazard mitigation; however, even though the county has a FEMA-designated SFHA with high risk within its boundaries, “there are no significant flood hazards in Modoc County. Most areas subject to inundation are currently water bodies, uninhabited, or on publicly owned lands.”<sup>164</sup> With this knowledge, Modoc County’s flood-related hazard mitigation plan only mentions that “special consideration should be given to development within floodways and within 200 feet of year-round and ephemeral stream channels.”<sup>165</sup>

**Mono County, California**

Mono County is southeast of Sacramento and borders the state of Nevada. This rural county has a population of 13,909.<sup>166</sup> The county’s general plan is also very

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<sup>162</sup> “San Leandro 2035 General Plan,” City of San Leandro, 7-46.

<sup>163</sup> “QuickFacts Modoc County, California,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/06049](http://www.census.gov/quickfacts/table/PST045215/06049).

<sup>164</sup> County of Modoc, *Modoc County General Plan* (Sacramento, CA: Mintier Harnish & Associates, 1988), 39, <http://www.co.modoc.ca.us/departments/planning/general-plan>.

<sup>165</sup> *Ibid.*, 68.

<sup>166</sup> “QuickFacts: Mono County, California,” United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045215/06051>.



technical, focusing on Mono County’s overall land use. Instead of a document that simply explains what the city needs and how the land should be guided—as in previous comprehensive plans—Mono County’s general plan is written as a list of methods by which the city will attain its planning goals. Though there is an extensive list of county improvement statements, there is little mention of hazard mitigation related to floods. Yet, since hazard mitigation is briefly discussed, it is included in my analysis. Within the plan, the county lists five ways to minimize the impact of flooding:

(1) Restricting or prohibiting uses that are dangerous to health, safety, and property due to water or erosion hazards, or that result in damaging increases in erosion or in flood heights or velocities, (2) Requiring that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction, (3) Controlling the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel flood waters, (4) Controlling, filling, grading, dredging, and other development that may increase flood damage and (5) Preventing or regulating the construction of flood barriers that will unnaturally divert flood waters or that may increase flood hazards in other areas.<sup>167</sup>

### **Trinity County, California**

Trinity County was classified as rural due to its current population of only 13,069.<sup>168</sup> It sits northeast of Sacramento and northwest of San Francisco. The county’s comprehensive plan is in some sense outdated but should remain relevant due to the small population. Within the plan there is section mandating how land is to be used; this section describes how to organize areas that have a higher chance of flooding. In this light, Trinity County’s land use plan calls for “flood prone areas [to] be used for recreation, agricultural, and other resource production activities. Community development should be kept out of flood prone areas. No use should adversely affect the capacity of the stream, river, channel, tributary, or floodway.”<sup>169</sup> Additionally, this small rural county focuses on

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<sup>167</sup> “Mono County General Plan,” Mono County, accessed August 1, 2017, II-291, [www.monocounty.ca.gov/planning/page/general-plan](http://www.monocounty.ca.gov/planning/page/general-plan).

<sup>168</sup> “QuickFacts: Trinity County, California,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/06105](http://www.census.gov/quickfacts/table/PST045215/06105).

<sup>169</sup> The County of Trinity, *Trinity County General Plan Circulation Element* (Tahoe City, CA: LSC Transportation Consultants, 2002), 27, <http://docs.trinitycounty.org/Departments/Planning/Circulation%20Element.pdf>.

the importance of flooding mitigation in its land use process by stating that “ground water resources, water quality, and flood control are the most important land use determinants within the County.”<sup>170</sup>

### **3. Wisconsin**

#### **a. Suburban Cities of Milwaukee, Wisconsin**

##### **Brookfield, Wisconsin**

Brookfield is a suburb of Milwaukee, Wisconsin; according to the United States Census Bureau, it has a population of about 38,025.<sup>171</sup> The suburb’s comprehensive plan does not mention much concerning the mitigation of floods. However, it is important to note that Brookfield does, indeed, mention land use plans where there is consideration of possible floods in the planning process—a related ordinance “discourage(s) new development in mapped Floodplain and Upland Woodland areas.”<sup>172</sup>

##### **Brown Deer, Wisconsin**

Brown Deer is a suburb of Milwaukee, Wisconsin, and has a population of 12,102.<sup>173</sup> The village’s hazard mitigation process exemplifies a suburban city that has a working relationship with other agencies to achieve their mitigation goals. For example, Brown Deer works with the neighboring city of Milwaukee’s Department of Natural Resources and the Metropolitan Sewerage District on “flood control and water quality improvement products.”<sup>174</sup> This relationship may have developed due to Brown Deer’s history of “overland flooding.”<sup>175</sup> The overland flooding in the 1990s caused Brown

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<sup>170</sup> The County of Trinity, *Trinity County General Plan*, 26.

<sup>171</sup> “QuickFacts: Brookfield, Wisconsin,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/5510025](http://www.census.gov/quickfacts/table/PST045215/5510025).

<sup>172</sup> “City of Brookfield 2035 Comprehensive Plan,” December 1, 2009, Figure 7, [www.ci.brookfield.wi.us/629/2035-Comprehensive-Plan](http://www.ci.brookfield.wi.us/629/2035-Comprehensive-Plan).

<sup>173</sup> “QuickFacts: Brown Deer Village, Wisconsin,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/5510375](http://www.census.gov/quickfacts/table/PST045215/5510375).

<sup>174</sup> Village of Brown Deer, *The Village of Brown Deer Comprehensive Plan 2030* (Brown Deer, WI: Village of Brown Deer, 2009), 24, <http://www.browndeerwi.org/departments/community-services/comprehensive-plan/>.

<sup>175</sup> *Ibid.*, 25.

Deer to acquire and demolish several homes along Southbranch Creek.<sup>176</sup> In addition, Brown Deer has a working relationship with FEMA as the village “seeks to limit and prevent development within the floodplain in order to protect life, health, and property as well as to reduce public expenditures for relief efforts.”<sup>177</sup>

### **Elm Grove, Wisconsin**

Elm Grove is a suburb of Milwaukee and has a population of approximately 6,712.<sup>178</sup> Not much is mentioned about hazard mitigation as it relates to floods within the village’s plan. This is surprising considering that the village experienced “significant flooding events that occurred” in t 1997 and 1998.”<sup>179</sup> Nevertheless, a hazard mitigation statement was included within Elm Grove’s comprehensive plan, which says, “Development is strongly discouraged and generally prohibited in floodplains, so as to avoid both on-site and property damage both up and downstream.”<sup>180</sup>

### **Greendale, Wisconsin**

According to the United States Census Bureau, Greendale has a population of 14,333.<sup>181</sup> The city “discourage(s) incompatible development and alteration of floodplains.”<sup>182</sup> Within its comprehensive plan, the city of Greendale looked to Madison, Wisconsin, for guidance on how rain gardens could be used to help prevent flooding. According to Greendale’s comprehensive plan, it was discovered that Madison built nine rain gardens in a residential neighborhood in order to collect street runoff and help minimize flooding. Greendale planners realized they could mimic this process. The city implemented a time period during which rain gardens could constructed, stating,

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<sup>176</sup> Village of Brown Deer, *The Village of Brown Deer Comprehensive Plan 2030*, 30.

<sup>177</sup> Ibid.

<sup>178</sup> “QuickFacts: Elm Grove Village, Wisconsin,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/5523575](http://www.census.gov/quickfacts/table/PST045215/5523575).

<sup>179</sup> Village of Elm Grove, *Comprehensive Plan: Village of Elm Grove, Wisconsin* (Elm Grove, WI: Village of Elm Grove, 2007), 45, <http://elmgrovelibrary.org/index.aspx?NID=287>.

<sup>180</sup> Ibid.

<sup>181</sup> “QuickFacts: Greendale Village, Wisconsin,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045216/5531125](http://www.census.gov/quickfacts/table/PST045216/5531125).

<sup>182</sup> Village of Greendale, *Village of Greendale Comprehensive Plan: 2010–2035: Revisiting a Greenbelt Community* (Milwaukee, WI: GRAEF, 2009), 3-15, [http://www.greendale.org/government/comprehensive\\_plan/index.php](http://www.greendale.org/government/comprehensive_plan/index.php).

“As streets and utility infrastructure is scheduled for repair, Greendale should consider potential opportunities for rain garden programs.”<sup>183</sup> Like many other comprehensive plans, Greendale’s also includes a floodplain map and takes the time to explain that the areas that fall into FEMA’s 100-year floodplain are designated open space.<sup>184</sup>

### **Greenfield, Wisconsin**

Greenfield is a suburb of Milwaukee, Wisconsin, with a population of 37,349.<sup>185</sup> Not much is mentioned in the town’s comprehensive plan concerning hazard mitigation outside a typical statement “recommending “that development continue to be prohibited in wetland/flood plain areas.”<sup>186</sup> In addition, like other plans, Greenfield’s plan contains a map showing areas that are susceptible to flooding.<sup>187</sup> According to their plan, “The Town of Greenfield normally has minimal interaction with federal agencies. However, after the flooding event of 2008, the Town received \$73,000 in FEMA funding to fix roadways that were damaged by floodwaters.”<sup>188</sup> With a flooding incident and FEMA interaction occurring in Greenfield in 2008, it is surprising that there is little mention of hazard mitigation a year later, when Greenfield’s comprehensive plan was published.

### **Menomonee Falls, Wisconsin**

Menomonee Falls Village is suburb of Milwaukee with a population of 36,119.<sup>189</sup> Not much is mentioned about flood related hazard mitigation in Menomonee Falls’s comprehensive plan. Like many of the Wisconsin plans, Menomonee’s mentions that

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<sup>183</sup> Village of Greendale, *Village of Greendale Comprehensive Plan*, 6-16.

<sup>184</sup> *Ibid.*, 3-4.

<sup>185</sup> “QuickFacts: Greenfield City, Wisconsin,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045216/5531175](http://www.census.gov/quickfacts/table/PST045216/5531175).

<sup>186</sup> Mississippi River Regional Planning Commission, *Town of Greenfield Comprehensive Plan 2009–2030* (La Crosse, WI: MRRPC, 2009), 2-1, [http://www.mrrpc.com/Misc\\_pdfs/TOWNOFGREENFIELDPLAN.pdf](http://www.mrrpc.com/Misc_pdfs/TOWNOFGREENFIELDPLAN.pdf).

<sup>187</sup> *Ibid.*, 2-8.

<sup>188</sup> *Ibid.*, 7.1.

<sup>189</sup> “QuickFacts: Menomonee Falls Village, Wisconsin,” United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045215/5551000>.

flood-prone areas are not “suited to urban development because of flood hazards.”<sup>190</sup> In addition, there is a map showing flood-prone areas within the Menomonee Falls region.<sup>191</sup>

### **Mequon, Wisconsin**

Mequon is a suburb of Milwaukee and has a population of 23,946.<sup>192</sup> Mequon’s comprehensive plan extensively focuses on methods to mitigate flooding. This could be because the county in which it falls, Ozaukee County, has “floodplain zoning ordinances [that] restrict uses in wetlands located in the shore lands and limit the uses allowed in the 100-year floodplain to prevent damage to structures and property and to property.”<sup>193</sup> In addition, Mequon has a goal to restore its wetlands. According to the comprehensive plan, “Over the past 20 years, Federal, State and local governments have constructed 326 wetland restorations encompassing about 365 acres on private land in Ozaukee County,” “where Mequon intends to implement restoration plans to “provide storm water storage to reduce flooding.”<sup>194</sup> These may be additional examples of how the state and local governments could directly influence a city’s comprehensive plan goals. Mequon also believes in preserving the natural environment to help mitigate flooding. For example, according to the Mequon plan, “The preservation of environmental corridors and isolated natural resource areas in essentially natural, open uses can assist in flood-flow attenuation.”<sup>195</sup>

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<sup>190</sup> Menomonee Falls Department of Community Development, *Village of Menomonee Falls 2015 Comprehensive Plan Update* (Menomonee Falls, WI: Village of Menomonee Falls, 2015), 84, <http://www.menomonee-falls.org/961/2015-Comprehensive-Plan-Update>.

<sup>191</sup> *Ibid.*, 85.

<sup>192</sup> “QuickFacts: Mequon City, Wisconsin,” United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045215/5551150>.

<sup>193</sup> “A 2035 Comprehensive Plan for the City of Mequon,” City of Mequon, April 14, 2009, 13, <http://www.ci.mequon.wi.us/vertical/Sites/%7BEC6048ED-C06B-457B-A49D-CC38EE9D051C%7D/uploads/%7B5AE92E65-D859-4504-8FC5-43356E08A209%7D.PDF>.

<sup>194</sup> *Ibid.*, 14.

<sup>195</sup> *Ibid.*, 20.

### **Muskego, Wisconsin**

Muskego is a suburb of Milwaukee and has a population of roughly 24,755 people.<sup>196</sup> Much of its hazard mitigation plans are left to the Milwaukee Metropolitan Sewerage District, which “provide[s] wastewater treatment and flood management services ... in Southeastern Wisconsin.”<sup>197</sup> The city has also created a law that regulates “the disturbance and building in and around the floodplain and associated flood zones (i.e., floodway and flood fringe). As development takes place within the City, a land owner must demonstrate that the proposed development meets ... appropriate engineering around the floodplain.”<sup>198</sup> A map in the plan shows the reader areas where the floodplain resides within Muskego boundaries.

### **New Berlin, Wisconsin**

New Berlin is a suburb of Milwaukee with a population of 39,825.<sup>199</sup> New Berlin is yet another illustration of how past tragedies can lead to future flood-related hazard mitigation planning. For example, “In June 1997, flooding threatened the dam and the Wisconsin Department of Natural Resources dug a trench around it to avoid flooding downstream in Muskego. Since no owner could be found, the homeowners formed the Linnie Lac Management District and took ownership of the dam to work out a taxing system to repair the dam.”<sup>200</sup> Though flooding has historically been an issue, the city came together to fix any possible future threats, a perfect example of the participatory discussed in previous chapters. The community has also worked together to provide alternative development practices to combat urban development problems. Once such

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<sup>196</sup> “QuickFacts: Muskego City, Wisconsin,” United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/5555275](https://www.census.gov/quickfacts/table/PST045215/5555275).

<sup>197</sup> City of Muskego, *City of Muskego 2020 Comprehensive Plan* (Muskego, WI: City of Muskego, 2009), 68, <http://www.cityofmuskego.org/DocumentCenter/View/348>.

<sup>198</sup> *Ibid.*, 120.

<sup>199</sup> “QuickFacts: New Berlin City, Wisconsin,” United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045215/5556375>.

<sup>200</sup> City of New Berlin, *New Berlin 2020 Comprehensive Plan* (New Berlin, WI: City of New Berlin, 2015), 4:16, <http://www.newberlin.org/index.aspx?nid=218>.

example is the suggestion to install stream corridors as storm water and flood management, but that also provide scenic bike trails“”<sup>201</sup>

New Berlin’s comprehensive plans also notes that high impervious cover could result in high rain flow, river runoff, and increased floodplain zones. The planners understand that “higher floodplain elevations usually result in more flood problem areas.”<sup>202</sup> New Berlin has done extensive research into what has caused flooding and how it must be mitigated. However, more extensive research may be necessary. New Berlin stated, “Increased occurrence of the 100-year storm with high intensities has caused more regional flooding problems over the last ten years. Although New Berlin has completed, with great success, several projects to alleviate flooding, more work needs to be done.”<sup>203</sup> New Berlin has mentioned several deliberate attempts to find possible working solutions to eliminate and alleviate flooding. New Berlin’s problems with flooding are clearly not isolated to that past.

### **Oak Creek, Wisconsin**

Oak Creek is a suburb of Milwaukee with a population of 35,243.<sup>204</sup> The hazard mitigation statements within Oak Creek’s comprehensive plan can mostly be attributed to laws and ordinances. For example, the city uses “zoning, subdivision, and official mapping powers to protect waterways, shorelines, wetlands, water supply, and floodplain areas.”<sup>205</sup> It is not only the local government that affects how Oak Creek handles the possibility of flooding; the plan mentions that state and federal laws could influence Oak Creek’s “growing concern” for flood hazards to private property. “Under the authority granted by the 1987 Federal Clean Water Act, the Wisconsin Department of Natural Resources adopted State rules (NR 216) in 1994.”<sup>206</sup> This will eventually force Oak

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<sup>201</sup> City of New Berlin, *New Berlin 2020 Comprehensive Plan*, 5:29.

<sup>202</sup> *Ibid.*, 5:48.

<sup>203</sup> *Ibid.*

<sup>204</sup> “QuickFacts: Oak Creek City, Wisconsin,” United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045215/5558800>.

<sup>205</sup> City of Oak Creek, *2020 Vision: A Comprehensive Plan for the City of Oak Creek* (Oak Creek, WI: City of Oak Creek, 2002), 39.

<sup>206</sup> *Ibid.*, 88.

Creek to “adopt and enforce modern erosion control and storm water management ordinances, and implement other strategies to manage storm water quality and quantity.”<sup>207</sup>

### **River Hills, Wisconsin**

The village of River Hills is a suburb of Milwaukee and has a population of 1,597.<sup>208</sup> Unlike many of the suburbs reviewed in this thesis, River Hills is aware of areas within the city where flooding is a threat, but the local government has made it clear that “any work performed to address the issue is the responsibility of the property owner.”<sup>209</sup> However, River Hills holds some responsibility in flood hazard mitigation; the village’s comprehensive plans states that “protecting floodplains from inappropriate development is critical for preventing future flooding problems.”<sup>210</sup>

### **South Milwaukee, Wisconsin**

The city of South Milwaukee has a population of 21,233.<sup>211</sup> South Milwaukee’s landscape is unique to the previous cities studies, so its response to floodplains is different as well. “The majority of the floodplain in South Milwaukee is confined to the Oak Creek Parkway’s open-space areas, making it relatively easy for the city to manage development within the floodplain.”<sup>212</sup> This shows that hazard mitigation planning can be heavily dependent upon a city’s geography. However, South Milwaukee’s plan later states, “Of course, future development should be guided away from flood-prone areas.”<sup>213</sup> Not much additional flooding mitigation is discussed. This may be because flooding is a limited and isolated threat in the city.

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<sup>207</sup> City of Oak Creek, *2020 Vision*, 88.

<sup>208</sup> “American FactFinder: River Hills Village, Wisconsin,” United States Census Bureau, accessed July 31, 2017, [https://factfinder.census.gov/faces/nav/jsf/pages/community\\_facts.xhtml#](https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml#).

<sup>209</sup> “Village of River Hills Comprehensive Plan,” September 18, 2009, 32, [http://riverhillswi.com/government/plan\\_commission/2009/plcomagoct132009.htm](http://riverhillswi.com/government/plan_commission/2009/plcomagoct132009.htm).

<sup>210</sup> *Ibid.*, 45.

<sup>211</sup> “American FactFinder: South Milwaukee City, Wisconsin,” United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045216/5575125>.

<sup>212</sup> City of South Milwaukee, *City of South Milwaukee Comprehensive + Downtown Plan Update 2035* (Milwaukee, WI: Graef, 2016), 140, <http://smwi.org/comprehensive-plan/>.

<sup>213</sup> *Ibid.*



### **Sussex, Wisconsin**

Sussex is a suburb that sits northwest of Milwaukee and has a population of 10,753.<sup>214</sup> Little is mentioned in Sussex's comprehensive plan concerning flood-related hazard mitigation. However, like other cities, Sussex has "regulate[d] development to reduce the risk of flood damage in known flood plain areas."<sup>215</sup>

### **Waukesha City, Wisconsin**

Waukesha sits west of Milwaukee and has a population of 71,970.<sup>216</sup> Like many of the other plans discussed herein, Waukesha has designated that areas susceptible to flooding should "not be allocated to any development, which would cause or be subject to flood damage; and no unauthorized structure should be allowed to encroach upon and obstruct the flow of water in perennial stream channels and floodways."<sup>217</sup> Though this methodology is common, its inclusion shows that cities are taking the time to understand the regional landscape and decide where it is appropriate to build or not to build. One way Waukesha recommends making use of designated flood land is to allow it to function as "park and open space reservation."<sup>218</sup>

### **West Allis, Wisconsin**

West Allis is a city west of Milwaukee with an approximate population of 60,620.<sup>219</sup> West Allis's hazard mitigation practices are influenced by both past flooding experiences and the inaction of policies. According to 'the city's comprehensive plan, the federal, state, and local government "actively enforce regulations limiting development within the designated floodplain area. Such areas are those potentially subject to the 100-

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<sup>214</sup> "American Fact Finder: Sussex Village, Wisconsin," United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045216/5578750>.

<sup>215</sup> Village of Sussex, *Village of Sussex Comprehensive Plan 2020* (Sussex, WI: Village of Sussex, 2003), 2-7, [http://www.villagesussex.org/index.asp?SEC=D14FD559-1B48-43E5-B786-BC134429961B&DE=EC8B45C1-1F65-4A86-AF39-BE54A08AAFBF&Type=B\\_BASIC](http://www.villagesussex.org/index.asp?SEC=D14FD559-1B48-43E5-B786-BC134429961B&DE=EC8B45C1-1F65-4A86-AF39-BE54A08AAFBF&Type=B_BASIC).

<sup>216</sup> "American FactFinder: Waukesha City, Wisconsin," United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045216/5584250>.

<sup>217</sup> "Comprehensive Plan," City of Waukesha, September 11, 2009, 2-27, <http://www.waukesha-wi.gov/618/Comprehensive-Plan>.

<sup>218</sup> *Ibid.*, 2-32.

<sup>219</sup> "American FactFinder: West Allis City, Wisconsin," United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045216/5585300>.

year flood event.”<sup>220</sup> However, due to past experience, the city understands that floodplain areas should not be the sole focus for flood mitigating plans. The plan states, “Floodplain areas are not necessarily immune from flooding, as was evidenced in the significant flooding events that occurred in the City during 2008 and 2009.”<sup>221</sup> The somewhat recent floods in West Allis have encouraged planners to build and update construction differently. West Allis also has a relationship with the Wisconsin Department of Homeland Security, with whom they work to “streamline response for floods, storms and disaster declarations as well as routine mutual aid programs.”<sup>222</sup> The city’s flood mitigation practices are therefore not solely localized; the city can draw upon assistance from other agencies if necessary.

***b. Wisconsin Rural Counties***

**Buffalo County, Wisconsin**

Buffalo County is a rural county in Wisconsin with a population off 13,192.<sup>223</sup> Buffalo has incorporated several methods into its comprehensive plan to minimize the threat of flooding. The plan recalls flooding issues in the past, stating that “the floods of 2008 and 2010 exceeded the anticipated base flood.”<sup>224</sup> To start, Buffalo County created designated areas for city officials to store disaster response equipment; “satellite shops [were created] in efforts to maximize emergency response times and optimize county resources, flood control equipment ... [so that] emergency planners can quickly deploy them as need even in the most severe conditions.”<sup>225</sup> In addition, like other jurisdictions, Buffalo County mentions constrained developmental practices near floodplain zones. The county has also authorized a process known as “floodplain management,” which,

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<sup>220</sup> “West Allis: 2030 Comprehensive Plan,” February 5, 2011, 7-7, <http://www.westalliswi.gov/index.aspx?NID=297>.

<sup>221</sup> Ibid.

<sup>222</sup> Ibid., 8-7.

<sup>223</sup> “American FactFinder: Buffalo County, Wisconsin,” United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045215/55011>.

<sup>224</sup> “Buffalo County Comprehensive Land Use Plan,” accessed August 8 2016, 117, [www.buffalocounty.com/205/Comprehensive-Land-Use-Plan](http://www.buffalocounty.com/205/Comprehensive-Land-Use-Plan).

<sup>225</sup> Ibid., 64.

according to 'the comprehensive plan, is the "operation of community program of corrective and preventative measures for reducing flood damage. A community's agreement to adopt and enforce floodplain management ordinances, particularly with respect to new construction, is an important element in making flood insurance available to home and business owners."<sup>226</sup> This sentence is impressive as it discusses community involvement for flooding preventative methods.

### **Forest County, Wisconsin**

Forest County, Wisconsin, is considered a rural county due to its total population of only 9,057.<sup>227</sup> Forest County's description of flooding mitigation efforts has an interesting start; according to the county's comprehensive plan, "Floods are one of Wisconsin's ... most common type of natural disaster."<sup>228</sup> Since areas within Forest County are susceptible to flooding, like most counties and cities they have decided to "discourage development in floodplains."<sup>229</sup> However, what makes Forest County different is their admittance that "development does occur in these areas and in turn affects the ability of [the] system to function properly."<sup>230</sup> They are willing to mention that development still does occur in flood-prone areas, which simply shows the need for further efforts toward flood mitigation practices.

### **Pepin County, Wisconsin**

Pepin County is a rural county that sits in the western section of the state; the population is estimated at 7,290.<sup>231</sup> Unlike many of the other cities and counties discussed in this research, Pepin has had "no history of flash flooding ... [and] there is usually ample time to prepare for a flood event and to minimize flood damage by moving

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<sup>226</sup> "Buffalo County Comprehensive Land Use Plan," 117.

<sup>227</sup> "American FactFinder: Forest County, Wisconsin," United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045215/5504>.

<sup>228</sup> Forest County Intergovernmental Relations Committee, *Forest County Comprehensive Plan* (Wausau, WI: North Central Wisconsin Regional Planning Commission, 2011), 14, [www.ncwrpc.org/forest/forestcp.html](http://www.ncwrpc.org/forest/forestcp.html).

<sup>229</sup> Ibid.

<sup>230</sup> Ibid.

<sup>231</sup> "American FactFinder: Pepin County, Wisconsin," United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045215/55091>.

property out of lower elevations.”<sup>232</sup> While flooding may not be a major concern for county officials, Pepin still manages the city landscape with ethical boundaries such as to “continue to prohibit development in wetland/floodplain areas.”<sup>233</sup>

### **Rusk County, Wisconsin**

Rusk County is a rural county in Wisconsin with a population of 14,124.<sup>234</sup> Very little is discussed regarding flood-related hazard mitigation in Rusk County’s comprehensive plan, with the exception of the following typical sentence, “Development is discouraged in floodplains to avoid both downstream and on-site property damage.”<sup>235</sup>

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<sup>232</sup> Mississippi Regional Planning Commission, *Pepin County Comprehensive Plan* (La Crosse, WI: MRPC, 2013), 2-2, [http://www.co.pepin.wi.us/index.asp?SEC=26D33AEC-326E-4150-AC44-0EC523FD4F9B&Type=B\\_BASIC](http://www.co.pepin.wi.us/index.asp?SEC=26D33AEC-326E-4150-AC44-0EC523FD4F9B&Type=B_BASIC).

<sup>233</sup> *Ibid.*, 2-7.

<sup>234</sup> “American FactFinder: Rusk County, Wisconsin,” United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/AGE115210/55107>.

<sup>235</sup> “Rusk County Comprehensive Plan,” December 15, 2009, 5-5, <http://www.ruskcounty.org/comprehensive-planning/>.

## **IV. COMMONALITIES AMONG STATES WITH A LOW PERCENTAGE OF FLOODING HAZARD MITIGATION DISCUSSION IN COMPREHENSIVE PLANS**

### **A. INTRODUCTION**

The previous chapter presented commonalities of comprehensive plans from states that had a high percentage of flood-related hazard mitigation discussion for their large urban cities, suburban cities, and rural counties. This chapter now analyzes the studied states with fewer comprehensive plans discussing flood-related hazard mitigation: Maryland and Virginia.

### **B. LOW-PERCENTAGE STATES**

#### **1. Maryland**

##### ***a. Large Urban City***

##### **Baltimore, Maryland**

As the largest city in Maryland, Baltimore has a population of 621,849.<sup>236</sup> It is evident that Baltimore City and its planning department have invested time and funding toward mitigating all forms of hazards that could affect the city. To start, the comprehensive plan mentions the importance of implementing the Floodplain Management Regulation.<sup>237</sup> According to Baltimore's sustainability website, the goal of floodplain regulations is to "protect life, health, and property while minimizing need for rescue and relief, economic interruption, and damage to infrastructure."<sup>238</sup> It is also important to note that, though the state and federal government may be influencers for

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<sup>236</sup> "QuickFacts: Baltimore City, Maryland," United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/2404000](http://www.census.gov/quickfacts/table/PST045215/2404000).

<sup>237</sup> City of Baltimore Department of Planning, *City of Baltimore Comprehensive Master Plan 2007–2012: A Business Plan for a World-Class City* (Baltimore: City of Baltimore, 2008), 9, <http://planning.baltimorecity.gov/planning-master-plan/plan>.

<sup>238</sup> "Floodplain," Baltimore Office of Sustainability, accessed March 21, 2017. <http://www.baltimore.sustainability.org/floodplain/>.

their regulations, Baltimore City’s floodplain regulations “supersede both State and Federal floodplain regulations.”<sup>239</sup>

Baltimore’s comprehensive plan, like other cities’, mentions the importance of using the natural environment to limit the amount of flooding with city boundaries. For example, one plan suggested “appropriate development of recreational trails and greenways in stream buffers and floodplains.”<sup>240</sup> In addition, the city has allotted funding to the planning department to initiate “new flood studies and re-delineate areas that will not undergo new studies.”<sup>241</sup> It is possible that areas in Baltimore that had flooding problems in the past no longer experience flooding issues with the same frequency or damage, perhaps due to the past implementation of flood mitigation strategies.

***b. Suburban Cities of Baltimore, Maryland***

**Brooklyn Park, Maryland**

Brooklyn Park, Maryland, sits directly south of Baltimore. According to the United States Census Bureau, Brooklyn Park has a population of 14,373.<sup>242</sup> Like many cities that include flood-related hazard mitigation in their plans, Brooklyn Park has imposed limitations on development within a floodplain. However, unlike all previous plans studied, Brooklyn Park does not combine all floodplains into one category. According to Brooklyn Park’s comprehensive plan, there are separate ordinances for development within tidal and non-tidal floodplains. To start, Brooklyn Park generally prohibits development in a non-tidal floodplain; however, if a developer is interested in development near or on a floodplain, there are provisions.<sup>243</sup> These provisions were launched through Maryland’s Floodplain Management Ordinance (Article 21 of the

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<sup>239</sup> “Floodplain,” Baltimore Office of Sustainability. More information concerning Baltimore’s floodplain regulations, can be further researched on Baltimore’s Office of Sustainability Floodplain Management’s website. See <http://www.baltimore.sustainability.org/floodplain/>.

<sup>240</sup> City of Baltimore Department of Planning, *City of Baltimore Comprehensive Master Plan*, 231.

<sup>241</sup> *Ibid.*

<sup>242</sup> “QuickFacts: Brooklyn Park CDP, Maryland,” United States Census Bureau, April 1, 2010, <https://www.census.gov/quickfacts/table/PST045215/2404000>.

<sup>243</sup> Brooklyn Park Small Area Plan, County Council Bill No.51-04 (2004), 61.

County Code) and provisions of Article 26 (Subdivision) of Anne Arundel County [Maryland] Code.<sup>244</sup> The provisions require a developer to “delineate the 100 year floodplain and the County prohibits lots from being platted in that floodplain ... the floodplain [must then] be retained or restored to its natural states.”<sup>245</sup> In addition, if a developer wishes to build within a floodplain, there must be community involvement. A developer must “reserve easement to the community or [the] homeowners association for the right to use the area.”<sup>246</sup> Interestingly, Brooklyn Park’s plan mandates for tidal floodplains compared to those for non-tidal floodplains starkly differ: “In tidal floodplain areas, development is permitted provided buildings and structures are designed to minimize flood damage.”<sup>247</sup>

### **Glen Burnie, Maryland**

Glen Burnie is south of Baltimore and has a population of 67,639.<sup>248</sup> The city’s comprehensive plan discusses an action-based form of planning toward foreseeable flooding. One such example, is their mentioning of a, “floodplain management project ... [that will] replace concrete channels with a natural stream channel.”<sup>249</sup> Moreover, like many cities who mention flood mitigation practices, Glen Burnie limits human and infrastructure related impact from flooding through designating open space and park lands to floodplain areas.

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<sup>244</sup> Brooklyn Park Small Area Plan, County Council Bill No.51-04 (2004), 61.

<sup>245</sup> Ibid.

<sup>246</sup> Ibid.

<sup>247</sup> Ibid.

<sup>248</sup> “QuickFacts: Glen Burnie CDP, Maryland,” United States Census Bureau, April 1, 2010, [www.census.gov/quickfacts/table/PST045215/2432650](http://www.census.gov/quickfacts/table/PST045215/2432650).

<sup>249</sup> Anne Arundel County, *Glen Burnie Small Area Plan* (Annapolis, MD: Anne Arundel County, 2004), 46, [www.aacounty.org/departments/planning-and-zoning/long-range-planning/small-area-planning/forms-and-publications/GlenBurnieSAP\\_Final.pdf](http://www.aacounty.org/departments/planning-and-zoning/long-range-planning/small-area-planning/forms-and-publications/GlenBurnieSAP_Final.pdf).

*c. Suburban City of Washington, DC (Maryland)*

**Bethesda, Maryland**

Bethesda is a suburb of Washington, DC, and has a population of 60,858.<sup>250</sup> Though the content in Bethesda's comprehensive plan dates back to April of 1990, it does mention mitigation practices for floods. One reason for inclusion of flood mitigation within the comprehensive plan could be the region's past experience with flooding. According to 'the plan, "There are isolated flooding problems in each of the three major drainage areas of the planning area ... such flooding problems are further aggravated by undersized culverts and houses located too close to streams."<sup>251</sup> If flooding is occurring next to housing, one would imagine that the city's planning office would focus on the safety of the communities potentially affected. One suggestion within the comprehensive plan to counteract the flooding issues is to upgrade the storm drainages and culvert sizes, and to provide regional storm water management facilities.<sup>252</sup>

It is also clear that Bethesda's urban planning department follows the amendments of the state (Maryland) and county (Montgomery County). These regulations call for areas within a floodplain to be considered "unbuildable areas."<sup>253</sup> The plan also dedicates two pages to listing all streets located within a floodplain.<sup>254</sup> In this light, a great deal of the hazard mitigation efforts in Bethesda's comprehensive plan focus on protecting floodplains from development.

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<sup>250</sup> "QuickFacts: Bethesda CDP, Maryland," United States Census Bureau, April 1, 2010, [www.census.gov/quickfacts/table/PST045215/2407125](http://www.census.gov/quickfacts/table/PST045215/2407125).

<sup>251</sup> "Bethesda-Chevy Chase," Montgomery Planning, April 1990, 139, <http://montgomeryplanning.org/planning/communities/area-1/bethesda-chevy-chase/>.

<sup>252</sup> *Ibid.*, 5.

<sup>253</sup> *Ibid.*, 37.

<sup>254</sup> *Ibid.*, 42–44.



## **2. Virginia**

### ***a. Suburban Cities of Washington, DC (Virginia)***

#### **Arlington, Virginia**

Arlington County's comprehensive plan dates back to August 27, 1960, and has been updated and amended since then. Arlington is a suburb of Washington, DC, with a population of 230,050.<sup>255</sup> Encouragement for inclusion of flood-related hazard mitigation in Arlington's comprehensive plan is the effect climate change could have within the county's boundary. Arlington pressingly suggests that the county must prepare for more server hurricanes, and for "sea level rise, coupled with potential storm surges from hurricanes, [which] may cause significant flooding in low-lying areas, and could affect critical infrastructure."<sup>256</sup> In order to prepare for these various forms of flood-related natural disasters, the city has proposed to work alongside several "state, regional and federal agencies."<sup>257</sup>

Extensive research has been done to help mitigate the risk of flooding in Arlington County. For example, Arlington's comprehensive plan calls for the continual exploration of "both potential flood control projects and small-area drainage issues to reduce the risk of flooding, including acquisition of property as necessary."<sup>258</sup> Arlington has acquired property located within a potential flood-prone areas, which shows the level of importance the city places on the protection of life and property. Lastly, the comprehensive plan makes sure to place responsibility on the residents of Arlington by suggesting that stakeholders "regrade the property, flood-proof the structure, or [provide] an alternate means of operating the sump pump."<sup>259</sup>

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<sup>255</sup> "QuickFacts: Arlington County, Virginia," United States Census Bureau, June 1, 2016, [www.census.gov/quickfacts/table/PST045216/51013](http://www.census.gov/quickfacts/table/PST045216/51013).

<sup>256</sup> "Comprehensive Plan Elements," Arlington Virginia, accessed August 2, 2017, vii, <https://projects.arlingtonva.us/plans-studies/comprehensive-plan/>.

<sup>257</sup> Ibid.

<sup>258</sup> Ibid., 5.

<sup>259</sup> Ibid., 23.

### **Falls Church, Virginia**

Falls Church, Virginia, has a total population of 13,892.<sup>260</sup> From the city's comprehensive plan it is evident that urban planners have completed much research concerning the physical makeup of Fall Church. One important physical feature the plan mentions frequently is the importance of understanding ground sediment and how it can impact flooding. For example, the plan educates its readers by stating, "Soils found in the stream valleys of the City consist of mixed alluvium and are highly subject to frequent flooding. Soils associated with floodplains within the City tend to have high water table and variable shrink-swell potential. These soils are subject to flooding and are generally unsuitable for development."<sup>261</sup> Planners also understood the importance of limiting impervious surfaces in certain areas and provide examples on how impervious surfaces may cause problems with Falls Church watersheds.<sup>262</sup>

The main methodology Falls Church uses in its plan is to explain what causes floods, where floods occur within Falls Church, and what the county is doing to mitigate their impact. The extreme detail toward flooding hazard mitigation could be attributed to the city's Floodplain Ordinance, written in 1982.<sup>263</sup> This floodplain ordinance was encouraged on the federal level through a 1981 FEMA investigation that called out the "existence and severity of flood hazards in the City of Falls Church."<sup>264</sup>

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<sup>260</sup> "QuickFacts: Falls Church City, Virginia," United States Census Bureau, July 1, 2015, <https://www.census.gov/quickfacts/table/PST045215/2407125>.

<sup>261</sup> City of Falls Church, *City of Falls Church, Virginia Comprehensive Plan* (Falls Church, VA: City of Falls Church: 2005), 92.

<sup>262</sup> *Ibid.*, 98.

<sup>263</sup> *Ibid.*, 106.

<sup>264</sup> *Ibid.*

*b. Virginia Rural County*

**Clarke County, Virginia**

With a population of 14,374, Clarke County is located in northeastern Virginia.<sup>265</sup> Clarke County is the sole rural Virginian county that has an SFHA within its boundaries, and whose comprehensive plan includes some form of flood-related hazard mitigation discussion. Clarke County's inclusion of flooding mitigation in its comprehensive plan, despite other rural Virginia plans' lack of discussion, may be due to flooding that occurred near the Shenandoah River in 1960.<sup>266</sup> The plan calls for managing floodplains through overseeing the amount of development near floodplains, enforcing floodplain management regulations, and prohibiting drain fields near 100-year floodplains.<sup>267</sup>

In addition, Clarke County's comprehensive plan dedicates a section strictly to the Shenandoah River. This section calls for "cooperating with state agencies ... limiting development within the River's 100-year floodplain, and promoting initiatives to reduce bank erosion."<sup>268</sup> The plan later mentions an additional area known as "Chagrin-Udipsamments-Lobdell."<sup>269</sup> The amount of community and residential development has been extremely limited, and Chargin-Udipsamments-Lobdell has been designated "as an area strictly for cultivating crops or pasture."<sup>270</sup>

Clarke County's plan supports the theory that hazard mitigation inclusion in comprehensive plans is due to areas with flooding issues in the past.

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<sup>265</sup> "QuickFacts: Clarke County, Virginia," United States Census Bureau, July 1, 2015, [www.census.gov/quickfacts/table/PST045215/51043](http://www.census.gov/quickfacts/table/PST045215/51043).

<sup>266</sup> The County of Clarke, 2013 Clarke County Comprehensive Plan (Berryville, VA: Clarke County, 2014), I-6, <http://clarkecounty.gov/government/county-documents/planning-department/comprehensive-plan/1888-2013-clarke-county-comprehensive-plan-adopted/file.html>.

<sup>267</sup> *Ibid.*, II-6.

<sup>268</sup> *Ibid.*

<sup>269</sup> *Ibid.*, A-7.

<sup>270</sup> *Ibid.*

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## V. CONCLUSION

By analyzing only comprehensive plans that contain flood-related hazard mitigation discussion, I was able to discern commonalities among the plans and group the reviewed states into two categories: states with an overall high percentage of flood-related hazard mitigation discussion in plans, and states with an overall low percentage of related discussion. The goal was to gain a clearer understanding of the impetus behind including hazard mitigation within a comprehensive plan.

Figures 24 and 25 illustrate the reasons why cities and counties included flood-related hazard mitigation in their comprehensive plans. Figure 24 shows these commonalities among states with a high percentage of related discussion in their plans, and Figure 25 shows commonalities among states with a low percentage. The common factors shown in these figures describe why hazard mitigation is typically included within a comprehensive plan.

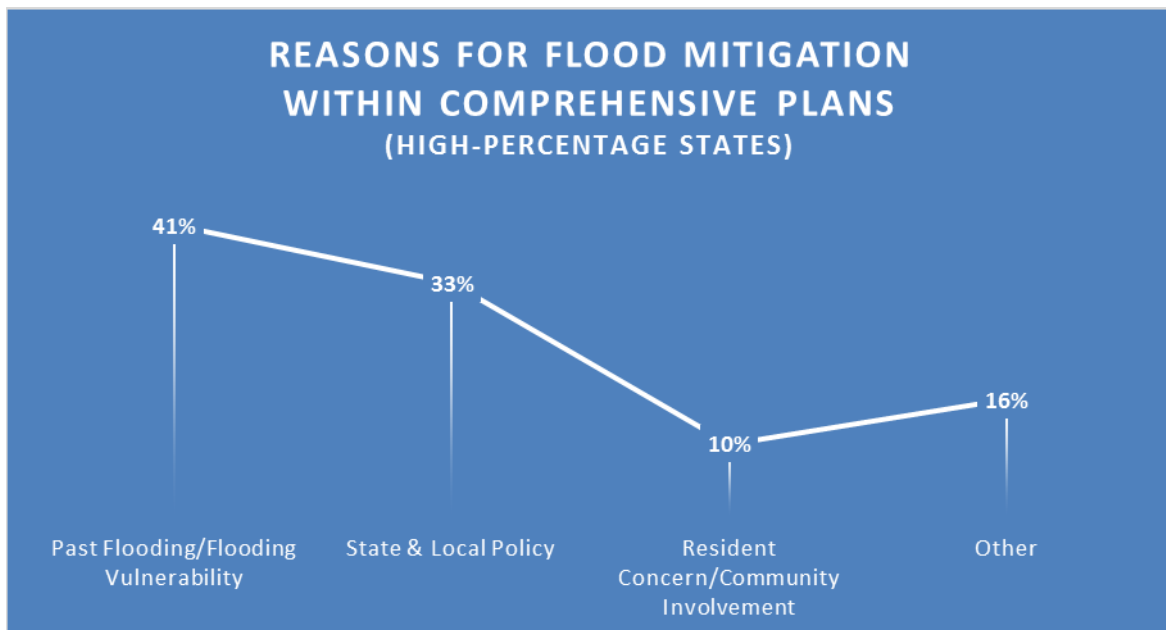


Figure 24. Reasons for Including Flood Mitigation in Comprehensive Plans: High-Percentage States

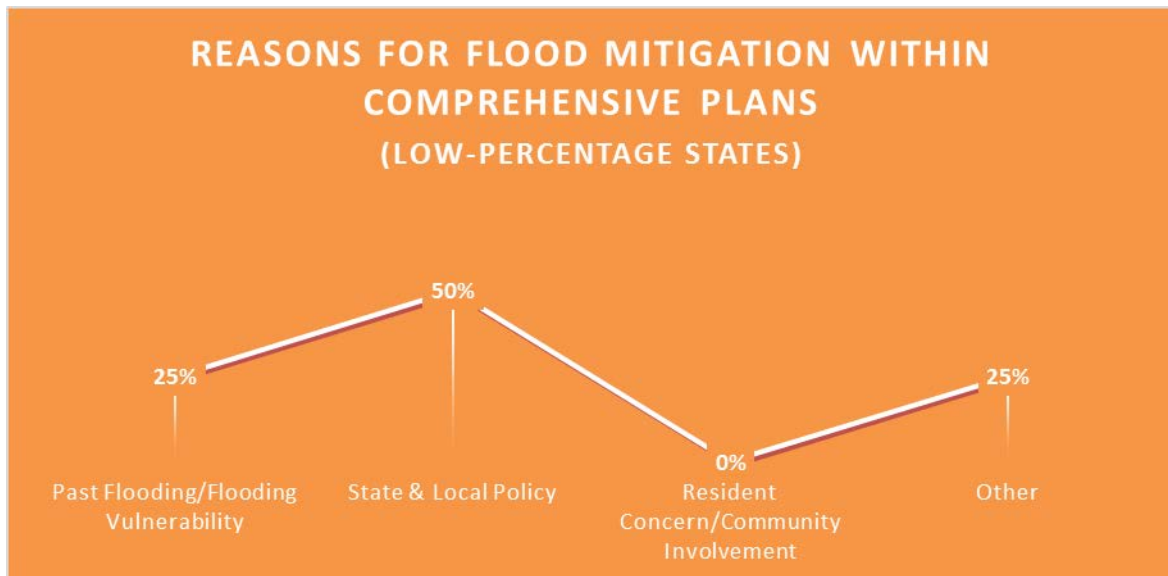


Figure 25. Reasons for Including Flood Mitigation in Comprehensive Plans:  
Low-Percentage States

#### A. ORDINANCES, PAST FLOODING, AND FLOODING VULNERABILITY

When beginning my research, I assumed the sole, or strongest, common reasoning among states would be strictly policy driven. However, the analysis showed that there was a more common trend: outside of policy, I believe the single most common factor for the inclusion of hazard mitigation is horrific past experiences with flooding or current continual concerns with flooding. In fact, on the state and local level, it can be assumed that most policy created to combat flooding was suggested due to past unfavorable experiences with flooding within the jurisdiction.

The bar graph in Figure 26 shows a comparison between comprehensive plans that mention flood-related hazard mitigation due to state and local ordinances but do not mention any past flood incidences or flood concerns, and those that do mention past flooding and flooding vulnerabilities. This comparison shows a roughly 45-percent decrease in the total amount of plans with policy-driven ordinances.

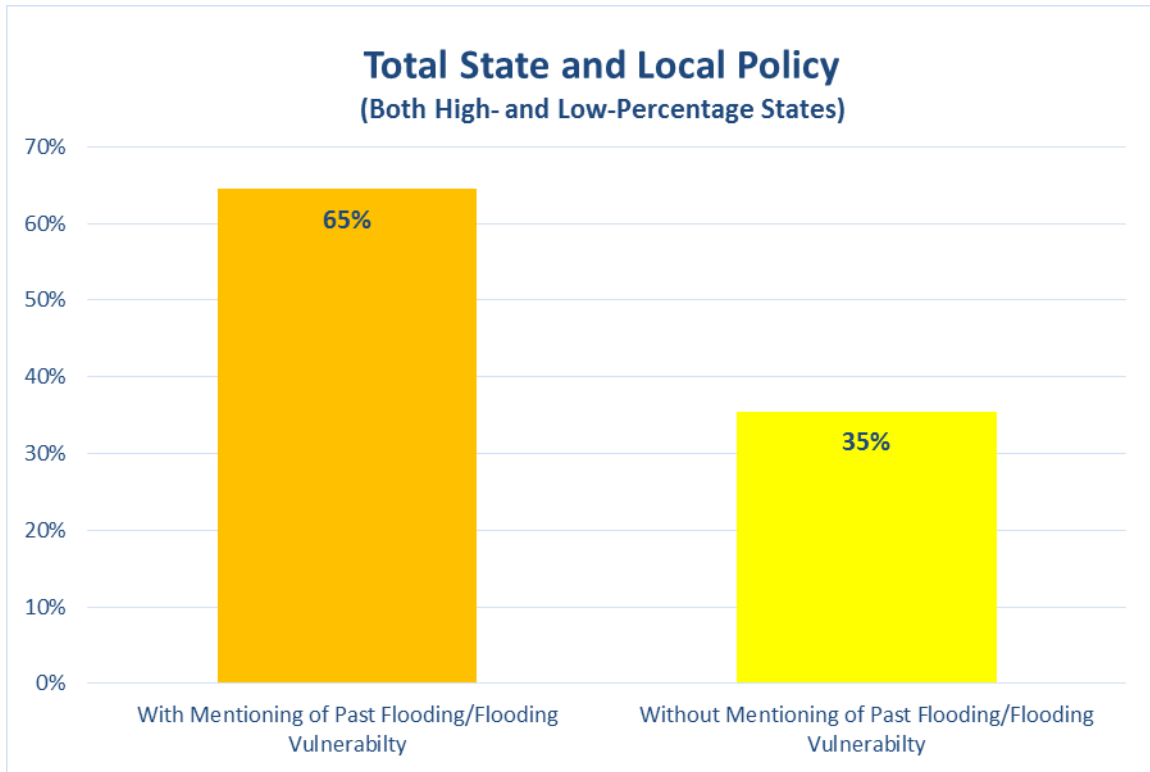


Figure 26. Comprehensive Plans Mentioning Ordinances, with and without Discussion of Past Flooding or Flooding Vulnerability

According to Forest County, Wisconsin's, comprehensive plan, "Floods are one of Wisconsin's most common type of natural disasters ... [where] each year Wisconsin communities suffer millions of dollars in flood damages."<sup>271</sup> My research further supported these numbers; the majority of Wisconsin's comprehensive plans briefly mention disastrous flooding events in the past and ongoing flooding concerns. As early as 1986, the Wisconsin state legislature has required state ordinances for the treatment of the state's floodplains.<sup>272</sup> This is not to say that policies, rules, and legislation do not influence hazard mitigation inclusion; many of the comprehensive plans in the state of Wisconsin, and elsewhere, include floodplain regulation. But, through comparing states with both high and low rates of hazard mitigation inclusion in plans, past flood

<sup>271</sup> Forest County Intergovernmental Relations Committee, *Forest County Comprehensive Plan*, 14.

<sup>272</sup> "Chapter NR 116 Wisconsin's Floodplain Management Program," Wisconsin Legislature: NR 116.14. S (35.93, Wis. Stats., 2012).

occurrences have more influence than state and federal ordinances. In fact, in some cases, the local government would supersede the state and federal law.

In few cases, citizen involvement helped encourage hazard mitigation as well. The participatory planning process often forces planners and legislators to include information in plans that will effect wellness and functionality within the community. To ensure more public involvement, I would propose voting options for those individuals who may not be able to attend the meetings. Another factor that should be considered when organizing participatory planning, however, is whether the citizens' lack of professional experience will bring about poor policy decisions; in some cases, the citizens may prefer alternatives that are not truly best for the community. If planners allowed the citizens to be the sole decision makers, their solutions could lead to ineffective participatory planning. Cost is an additional concern of those who object to participatory planning. According to Irvin and Stansbury, "On the low end [participatory planning] is more expensive than a one person decision."<sup>273</sup>

It is important to note that ordinances alone cannot support guaranteed inclusion of hazard mitigation within comprehensive plans. For example, as the research showed, only 25 percent of Maryland cities with SFHAs had comprehensive plans that included flood-related hazard mitigation discussion. However, there are Maryland state ordinances that prohibit building in floodplain zones.<sup>274</sup> This shows that the non-inclusion of hazard mitigation within comprehensive plans does not suggest that no plan was created to combat the issues of flooding for a city with SFHA. Future research should seek to determine why these cities and counties did not include flood related hazard mitigation in their comprehensive plans, especially considering that both Maryland and Virginia have several hazardous flood areas within their state boundaries.

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<sup>273</sup> Irvin and Stansbury, "Citizen Participation in Decision Making," 58.

<sup>274</sup> "Regulations for Floodplain Development," Maryland Department of the Environment, accessed April 24, 2017, <http://mde.maryland.gov/programs/water/FloodHazardMitigation/Pages/floodplainregs.aspx>.



## **B. THE FEDERAL GOVERNMENT’S ROLE**

It is clear through FEMA’s floodplain management ordinances that, “once FEMA provides a community with a the flood hazard information upon which floodplain management regulations are based, the community is required to adopt a floodplain management ordinance.”<sup>275</sup> In addition, FEMA has signed contract #HSFEHQ-07-C-007 with the American Planning Association (APA) to focus on hazard mitigation practices.<sup>276</sup> In this light, FEMA should work with the APA to guarantee that local planning agencies focus on hazard mitigation, especially as it relates to flooding. The federal government should encourage the APA to explain to city planners and urban planning professors that we must not only plan for possible hazards—we must also include mitigation strategies within that comprehensive plans that provide overall guidance for a particular community both presently and in the future.

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<sup>275</sup> “Floodplain Management Ordinances,” FEMA, last updated March 7, 2017, <https://www.fema.gov/floodplain-management-ordinances>.

<sup>276</sup> Schwab, *Hazard Mitigation*.

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